THE FIRST CLASS LOGISTICS HUB
WG2 - KEY MILESTONES

• **2020** – Hub and network integration
• **2030** – Innovative supply chain design and synchromodal service integration
• **2040** – Synchromodal services door to door
• **2050** – Physical Internet
WORKSHOP 10.1 – PI HUBS AND NETWORKS

• **Optimal Ordering and Transporting of Inventory in Small PI-Network**
  Gerlach Van der Heide (University of Groeningen)

• **Simulation-Based Assessment of Hyperconnected Distribution Center Capacity Requirements and Service Capabilities**
  Nayeon Kim (Georgia University of Technology)

• **A Simulation-Based Study of the Effect of Competition on the Operations of Hyperconnected Crossdocking Hubs**
  Shannon Buckley (Georgia University of Technology)

• **Towards Hyperconnected PI-Hubs — Linking Supply Chain Operations**
  Tomasz Dowgielewicz (MARLO Poland)
Optimal ordering and transporting of inventory in small PI-networks

Gerlach van der Heide
I.F.A. Vis, K.J. Roodbergen, P. Buijs

IPIC 2017
Towards Virtual Ports in a Physical Internet
Introduction

- Physical Internet + Internet of Things
- Track items during transportation
- Up-to-date inventory information
- Dynamic routing of items in transit
Situation:

- **One company**
- A given network of warehouses
- Dynamic routing allowed
- Storage possible at all warehouses
Introduction

Situation:
- One company
- A given network of warehouses
- Dynamic routing allowed
- Storage possible at all warehouses

Research goals:
- Optimize decisions for orders and shipments
- Analyze network flows
- Compare with static routing
- Study impact of missing edges
Orders arrive at node 0
Random demand at nodes 1, 2, and 3
When and how much to order? How much to ship over each edge?
Periodic decisions

Order of events:

1. Incoming orders and shipments arrive
2. New order and shipment decisions are taken
3. Random demand arrives
4. Inventory costs are incurred

Assumptions:
- Shipments and orders take one period
- Always transport available
- No batching/capacities
- Time-homogeneous costs and demand distributions
Model

- Periodic decisions
- Order of events:
  1. Incoming orders and shipments arrive
  2. New order and shipment decisions are taken
  3. Random demand arrives
  4. Inventory costs are incurred

- Assumptions:
  - Shipments and orders take one period
  - Always transport available
  - No batching/capacities
  - Time-homogeneous costs and demand distributions
Costs

- Identical cost parameters at each node.
- Customer behavior: backorders or lost sales
- Parameters:
  - **Holding** cost $h$ per unit per period (also for stock in transit)
  - **Shipment** cost $c$ per unit
  - **Order** cost $K$ per order
  - **Backorder** cost $b$ per unit per period
  - **Lost sales** cost $\ell$ per unit

Determine order and shipment decisions with minimal long-run average costs per period

Solve Markov Decision process
Identical cost parameters at each node.

Customer behavior: backorders or lost sales

Parameters:

- **Holding** cost $h$ per unit per period (also for stock in transit)
- **Shipment** cost $c$ per unit
- **Order** cost $K$ per order
- **Backorder** cost $b$ per unit per period
- **Lost sales** cost $\ell$ per unit

Determine order and shipment decisions with **minimal long-run average costs** per period

Solve Markov Decision process
Experiments

We vary:
- Shipment costs: $c = 0$ or $c = 5$
- Demand variability: low or high
- Customer behavior: lost sales or backorders

Other parameters: $h = 1$, $K = 50$, $b = 20$, $\ell = 60$

Average demand at nodes 1, 2, and 3: 0.1
Network flows with dynamic routing

- Situation: lost sales and low demand variability
Network flows with dynamic routing

- Situation: lost sales and low demand variability

Positive shipment costs \((c = 5)\)
Network flows with dynamic routing

- Situation: lost sales and low demand variability

Positive shipment costs \((c = 5)\)

No shipment costs \((c = 0)\)

Total flow for \(c = 0\) is 13% higher

Indirect edges are used 106% more
Network flows with dynamic routing

- Situation: lost sales and low demand variability

Positive shipment costs ($c = 5$) vs. No shipment costs ($c = 0$)

Total flow for $c = 0$ is 13% higher
- Indirect edges are used 106% more
Static vs dynamic routing

- Static routing: select end-nodes when placing order
- How much better is dynamic routing?

<table>
<thead>
<tr>
<th>Lost sales</th>
<th>$c = 0$</th>
<th>$c = 5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low variability</td>
<td>14.69%</td>
<td>10.27%</td>
</tr>
<tr>
<td>High variability</td>
<td>8.57%</td>
<td>4.71%</td>
</tr>
</tbody>
</table>

Table: Cost reduction of dynamic routing

Significant cost savings from dynamic routing!

Remark: dynamic routing has larger flows
Static vs dynamic routing

- Static routing: select end-nodes when placing order
- How much better is dynamic routing?

<table>
<thead>
<tr>
<th>Backorders</th>
<th>$c = 0$</th>
<th>$c = 5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low variability</td>
<td>17.31%</td>
<td>12.47%</td>
</tr>
<tr>
<td>High variability</td>
<td>15.91%</td>
<td>10.06%</td>
</tr>
</tbody>
</table>

Table: Cost reduction of dynamic routing
Static vs dynamic routing

- Static routing: select end-nodes when placing order
- How much better is dynamic routing?

**Table:** Cost reduction of dynamic routing

<table>
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</tbody>
</table>

- Significant cost savings from dynamic routing!
- Remark: dynamic routing has larger flows
What is the cost of missing edges?

Compare with other graphs:

- Complete graph
- A1
- A2
- B1
- B2
- C
- D
Network comparisons

Lost sales

<table>
<thead>
<tr>
<th>c = 0</th>
<th>c = 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Network

Cost increase in % compared to complete graph

Low variability

High variability

Inventory decisions in PI networks

Gerlach van der Heide
Network comparisons

<table>
<thead>
<tr>
<th>Network</th>
<th>Cost increase in % compared to complete graph</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 A2</td>
<td>c = 0</td>
</tr>
<tr>
<td>B1 B2</td>
<td>c = 5</td>
</tr>
<tr>
<td>C D</td>
<td></td>
</tr>
<tr>
<td>A1 A2</td>
<td></td>
</tr>
<tr>
<td>B1 B2</td>
<td></td>
</tr>
<tr>
<td>C D</td>
<td></td>
</tr>
</tbody>
</table>

**Low variability**

- 0
- 5
- 10
- 15

**High variability**

- 0
- 5
- 10
- 15

Lost sales

<table>
<thead>
<tr>
<th>c = 0</th>
<th>c = 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**Network**

- A1 A2 B1 B2 C D A1 A2 B1 B2 C D
- 0
- 5
- 10
- 15

**Gerlach van der Heide**

Inventory decisions in PI networks

**IPIC 2017**

12 / 14
Network comparisons

![Graph showing network comparisons with backorders](image)

**Network Cost increase in % compared to complete graph**

- **Low variability**
  - $c = 0$
  - Cost increases for networks 3 and 7

- **High variability**
  - $c = 5$
  - Cost increases for networks 4 and 8

**Backorders**

- Network 3: Low variability, $c = 0$
- Network 4: High variability, $c = 5$
- Network 7: Low variability, $c = 0$
- Network 8: High variability, $c = 5$

**Inventory decisions in PI networks**

Gerlach van der Heide
Network comparisons

Backorders

<table>
<thead>
<tr>
<th>c = 0</th>
<th>c = 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Cost increase in % compared to complete graph

Low variability

High variability

Networks

A1 A2 B1 B2 C D A1 A2 B1 B2 C D

Backorders

Low variability

High variability

Gerlach van der Heide
Inventory decisions in PI networks

IPIC 2017 12 / 14
Network comparisons

- Mostly distance first, then flexibility (more edges)
- With backorders:
  - Consideribly different ranking with low shipment costs and high demand variability
  - Flexibility much more important than distance
  - Two-echelon-like network can be worst of all!
Conclusions

- Dynamic routing leads to significant costs savings over static routing
- Low shipment costs increase usage of indirect edges
- Customer behavior has substantial impact on effectiveness of networks with missing edges
- Optimal behavior must be accounted for in network design, pricing mechanisms, etc.
Simulation-based Assessment of Hyperconnected Mixing Center Capacity Requirements and Service Capabilities

4th International Physical Internet Conference
6/Jul/2017

Nayeon Kim$^{1,2}$ & Benoit Montreuil$^{1,2,3,4}$

1. H. Milton Stewart School of Industrial & Systems Engineering, Georgia Institute of Technology
2. Physical Internet Center
3. Supply Chain & Logistics Institute
4. Coca-Cola Chair in Material Handling and Distribution

*Corresponding author: nkim97@gatech.edu*
Openly Shared Distribution

- ES3 in York, PA
- Fulfillment by Amazon
  - 100+ fulfillment centers in North America
- Flexe.com
  - Hyperconnected on-demand warehousing platform
Hyperconnected Mixing Center (HMC)

- Definition of mixing center by comparison to warehouses and distribution centers:

<table>
<thead>
<tr>
<th></th>
<th>Warehouse</th>
<th>Mixing Center</th>
<th>Distribution Center</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Storage Type</strong></td>
<td>Deep extended storage</td>
<td><strong>Short term flow storage</strong></td>
<td>Short term flow storage</td>
</tr>
<tr>
<td><strong>User Type</strong></td>
<td>Manufacturers, Retailers</td>
<td><strong>Manufacturers</strong></td>
<td>Retailers, Distributors</td>
</tr>
</tbody>
</table>

- Comparison of three types of mixing centers (MCs)

<table>
<thead>
<tr>
<th></th>
<th>Dedicated MC</th>
<th>Collaborative MC</th>
<th>Hyperconnected MC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Users</strong></td>
<td>Single Manufacturer</td>
<td>Exclusive group of partnered manufacturers</td>
<td>Open on demand to any manufacturer</td>
</tr>
</tbody>
</table>

- Extreme variants of hyperconnected mixing center (HMC)
  - Spot HMC and Steady HMC
Key Players

- Key Players:
  - Manufacturers
  - Retailers
  - Carriers
  - Logistics service provider (LSP)

- Hyperconnected MC can be operated by manufacturer(s) or LSP
Alternative Operation Scenarios and KPIs

- Alternative operation scenarios

  - No MC (Plant Warehouses)
    - No capital investment
    - Long lead time
    - Low consolidation

  - Dedicated MC
    - Large capital investment
    - Short lead time
    - Better consolidation

  - Hyperconnected MC
    - Low/no capital investment
    - Short lead time
    - Travel miles reduction
    - High consolidation

- Key performance indices (KPIs)
  - E.g. Induced travel miles, inventory requirements (average, variability, peak), service level (delivery frequency)
Case Description

- Implementing a new steady hyperconnected MC serving U.S. western states operated by a logistics service provider.
- Potential clients of the HMC are consumer goods manufacturers.
Operation and Experimental Scenarios

- **Operation Scenarios:**
  - No MC, Dedicated MC, and Hyperconnected MC

- **Experimental Scenarios:**

<table>
<thead>
<tr>
<th>Scenario ID</th>
<th># of Clients at MC (# Manufacturers)</th>
<th>Average Annual Throughput (M pallets/year)</th>
<th># of distinct outbound destinations (Customer DCs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>~2.8</td>
<td>139</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>~2.8</td>
<td>173</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>~2.8</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>~5.8</td>
<td>194</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>~3.4</td>
<td>195</td>
</tr>
<tr>
<td>6</td>
<td>13</td>
<td>~1.0</td>
<td>172</td>
</tr>
</tbody>
</table>
Capacity Requirements

- Hyperconnected MC can reduce required storage capacity of manufacturers compared to No MC or Dedicated MC operation mode
  - Compare capacity requirements of dedicated facilities to responsible capacity in HMC
- The size of reduction can differ by client configuration of HMC

<table>
<thead>
<tr>
<th>Scenario ID</th>
<th>Annual Throughput / # Clients (M pallets)</th>
<th>Capacity Requirement (K Pallets)</th>
<th>Average Capacity Requirement Reduction</th>
<th>0.99 percentile of OHI (K Pallets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>~2.8 / 2</td>
<td>200</td>
<td>0%</td>
<td>185</td>
</tr>
<tr>
<td>2</td>
<td>~2.8 / 5</td>
<td>232</td>
<td>0%</td>
<td>217</td>
</tr>
<tr>
<td>3</td>
<td>~2.8 / 8</td>
<td>241</td>
<td>5%</td>
<td>222</td>
</tr>
<tr>
<td>4</td>
<td>~5.8 / 12</td>
<td>440</td>
<td>6%</td>
<td>408</td>
</tr>
<tr>
<td>5</td>
<td>~3.4 / 8</td>
<td>281</td>
<td>13%</td>
<td>259</td>
</tr>
<tr>
<td>6</td>
<td>~1.0 / 13</td>
<td>103</td>
<td>16%</td>
<td>94</td>
</tr>
</tbody>
</table>
Average Inter-delivery Time

• HMC can significantly reduce average inter-delivery time to retail DCs by consolidating multi-retailer shipments to same destination without increasing outbound travel distances

<table>
<thead>
<tr>
<th>Scenario ID</th>
<th>Consolidation Index</th>
<th>Average Inter-Delivery Time in Days and Marginal Reduction</th>
<th>Average Marginal Reduction in Outbound Travel Distances</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No MC</td>
<td>Dedicated MC</td>
<td>Hyper MC</td>
</tr>
<tr>
<td>1</td>
<td>1.4</td>
<td>8.8</td>
<td>2.6</td>
</tr>
<tr>
<td>2</td>
<td>1.8</td>
<td>6.4</td>
<td>6.4</td>
</tr>
<tr>
<td>3</td>
<td>2.6</td>
<td>13.7</td>
<td>11.4</td>
</tr>
<tr>
<td>4</td>
<td>3.8</td>
<td>11.1</td>
<td>9.1</td>
</tr>
<tr>
<td>5</td>
<td>3.1</td>
<td>12.6</td>
<td>11.4</td>
</tr>
<tr>
<td>6</td>
<td>2.2</td>
<td>16.1</td>
<td>14.9</td>
</tr>
</tbody>
</table>
Average Inter-delivery Time

• Large manufacturers can also improve their service level
Inventory Operation at Customer(Retail) DCs

- Inventory operation at customer DCs can be improved by increased delivery frequency with HMC
- Capacity requirements and inventory variation are reduced

<table>
<thead>
<tr>
<th>Scenario ID</th>
<th>Reduction in 0.99 Percentile OHI at Customer DC</th>
<th>Reduction in Inventory Variation (COV*) at Customer DC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No MC to Hyper MC</td>
<td>Dedicated MC to Hyper MC</td>
</tr>
<tr>
<td>1</td>
<td>16%</td>
<td>0%</td>
</tr>
<tr>
<td>2</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>3</td>
<td>10%</td>
<td>3%</td>
</tr>
<tr>
<td>4</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>5</td>
<td>9%</td>
<td>6%</td>
</tr>
<tr>
<td>6</td>
<td>6%</td>
<td>3%</td>
</tr>
</tbody>
</table>

*COV: Coefficient of Variation (Standard Deviation / Mean)
Summary

• Simulation-based methodology to understand and assess the impact of hyperconnected storage and distribution through a hyperconnected MC is proposed

• Potential advantages of a steady HMC are shown
  • Storage capacity requirements can be reduced
  • Delivery frequency can be increased, even for large manufacturers
  • Outbound travel miles can be reduced
  • Inventory operation at customer DCs can be improved

• Potential disadvantages of a steady HMC are shown
  • Loss of autonomy and self-control
  • Issue with fair multi-client coordination, prioritization, and pricing
  • Margins shared with logistics service provider
Limitations and Future Research

• To be addressed:
  • Coordination cost to handle the complexity and dynamics of HMC
  • Pricing mechanisms for HMC services
  • Long term, multi-year evolution of the clientele of HMCs
  • Multi-HMCs case
  • Competition between HMCs
  • Operation of spot HMCs
  • Integration of HMC and HDC
Thank you

Q&A
Appendix: Key Players-Manufacturers and Retailers

- 150 manufacturers and 200 retailer DCs in the scope
The Effect of Competition on the Operations of Hyperconnected Crossdocking Hubs

By Shannon Buckley, Benoit Montreuil, Zachary Montreuil
Outline

- Background Information
- Our Objective
- The Main Players
- Peri-Urban Hyperconnected Hub Topologies
- Simulation Design
- Results
- Further Avenues for Research
Modular Containers

Modular Containers

Hyperconnected Crossdocking Hub

Hyperconnected Crossdocking Hub

- **Arrival**: Trucks arrive at the hub, are checked and then dispatched to a dock.
- **Departure**: Ready trucks are checked then allowed departure from the hub.
- **Unloading**: $\pi$-containers to be transhipped are unloaded in the receiving zone of the hub.
- **Loading**: Composed $\pi$-containers are loaded on their dispatched truck.
- **Reconfiguration**: $\pi$-containers remaining on the trucks are slid to create group by to-be-unloaded destination.
- **Preparation**: $\pi$-containers in the hub are recomposed by next truck and unloading destination, then directed near their dispatched truck.

Hyperconnected Crossdocking Hub

Our Objective

- Examine the ways in which multiple hubs within the same region will interact with each other and the other main players in the Physical Internet.
Main Players

Shippers     Truckers     Hub Operators
Shippers

- Large source of demand for PI Hubs
- Send PI containers

Objectives:
- Make sure shipment is delivered
- Make sure shipment is delivered on time
Truckers

- The transport providers
- Operate independently
- PI certified
- Objectives:
  - Make money
  - Maintain quality of life
Hub Operators

- Control the flow of goods through PI Hubs
- PI certified
- Manage hub like managing a business
- Objective:
  - Make money
Peri-Urban Hub Topologies

**Disconnected**
(No inter-hub connection)

**Interconnected**
(Open inter-hub connection)

Single Hub

Multi-Hub

Hub Zones

Available truck/shipment delivery route for truck arriving from the North

PI Hub
Conclusion

- **Key Learnings:**
  - In “low-flow” scenario, operate under single-hub topology
  - In “high-flow” scenario, single-hub topology had shorter truck and shipment waiting times
  - In “high-flow” scenario, interconnected hubs made for longer waiting times

- **Key Limitations:**
  - No hub capacity limits
  - No shipment expedition if waiting time was too long
Future Research Avenues

- Add capacity limits to hubs
- Analyze the effect of pricing on shipper’s decisions
- Examine scenario with collaborative hubs
Results

Driver Distance Travelled

Average Truck Time In Hubs
Results

Average Shipment Time in Hubs

Percentage in Non-Preferred Direction
Results
From business need to hyperconnectivity
iCargo project

• Delivery
  • Customer Deliveries need to be created at original shipping location (because the Supply Chain lacks the information to do this later on).

• Handling
  • All added handling is BAD as it only adds cost.

• Standardisation and collaboration
  • Standardisation and Collaboration is not in the best interest of Logistics Service Providers.
Mix Move Match – Effects in practice over one operation

Freight costs evolution during the use of MixMoveMatch.com (index 100%=2012)

Load factor with and without use of MixMoveMatch.com during 9 months in 2015
what clients say

3M Saved 35% in logistics costs

“3M reduced transport costs by 35% and CO2 emissions by 50% since the MixMoveMatch.com system was launched”

DHL become far more flexible and saved a lot of costs

“Warehousing costs are generally about half of the Transport costs in terms of cost of sales. This is why it doesn’t get as much attention as it should. But having warehouses doing various kinds of things that you might not immediately think of as warehousing services allows you to be far more flexible with your supply chain and thus save a lot of costs.”

Jaco Voorspuij
DHL IT lead EMEA region
MixMoveMatch.com is a pioneer in supporting supply chain collaboration. We are able to manage logistic networks that comprise several shippers and carriers to pool and bundle shipments together, generating significant cost reductions.
MixMoveMatch.com in a nutshell

MixMoveMatch.com is an innovative Software as a Service (SaaS) solution for supply chain collaboration. Appointed by the European Commission as best innovation in Europe in the category of Information and Communication Technologies for Society.

NEWS OF THE DAY: MIXMOVEMATCH.COM AWARDED WITH THE PHYSICAL INTERNET VENTURE AWARD PRIZE
MixMoveMatch.com provides capabilities for:

**Shippers**
- Horizontal collaboration
- Visibility
- Dashboard
- Rule based fulfillment
- ...

**Hubs**
- x-dock/reconstruction
- Decide next segment
- Optimize use of resources
- Rule based
- ...

**Carriers**
- Optimise movements
- Provide status/POD
- ...

- MixMoveMatch.com provides capabilities for:
Supply Chain Integration

Shipping orders

Tracking and tracing

Inventory orders and status
Load Unit Optimisation
The objectives

- the optimization of the load factor in the distribution
- to obtain full transparency of the increasingly fragmented supply chain for all stakeholders while
- keeping the flexibility and scalability on parcel level
- solution available for every player
The consignments of various shippers on several trucks are consolidated in the hub according to destinations on mixed, high loaded pallets (MIX) and transported furtherone (MOVE). At the hub close to the destination area, the consignments will be sorted (MATCH), where also a higher bundling on the last mile can be achieved.
Load Unit Optimisation
How does it work?

Combines consignments from different suppliers and carriers

…by stripping down and creating next leg optimized consignments

…on therefore much higher loaded loading units
Load Unit Optimisation
The Process

Get data of inb. consignments on inb. trailers

Unload

Scan cartons or pallet

Scan pallet placard & accompanying cartons

Get packing lists, print recon pallet/recon carton labels

Outbound consignments
   Reconstructed parcels by ship-to for final delivery
   Reconstructed Pallets by ship-to for final delivery
   Reconstructed Pallets by region/country for reship
   Forward pallets by region/country for reship

Plan inbound wave

Release wave, transfer data to PDA/RDT

Inbound

Strip down pallet

Sort & consolidation confirm pallets & cartons

Add label

directly to reship (full pallet/loose cartons)

Inbound consignments

Scan pallet placard & accompanying cartons

Scan to trailer
preparation
Preparation of the work area:
pre-sorting area, reconstruction area
placards for instant visualization

pre-sorting
Dismantling of inbound pallets,
pre-sorting to reconstruction
or parcel services

reconstruction
Reconstruction to new consignment,
consisting of packages from several
inbound consignment
Load Unit Optimisation
The principle: unique identification
Load Unit Optimisation Hub setup

Link to conveyor systems

MixMoveMatch Web Application in the Cloud

PDT / PDA (use existing terminals)

MixMoveMatch RDT/PDA SW App locally on RDT/PDA

MixMoveMatch Print Agent locally on Print-Server

Print-Server (use existing Server)

Network LAN A4 Printer

Network LAN Barcode Printer

Shipper’s ERP

RDT = Radio Data Terminal
PDA = Personal Digital Assistant
Hub Application

- Intermediate Storage
- Add New Label
- Loose Cartons
- Overpack
- Directly to Reship
Introduced without changes to existing infrastructure
Shipper and Carrier Application
Visibility Application

Supply Chain Manager
Dashboard
30 terminals
20+ city hubs

2,000,000 +
Items shipped per month

60,000 +
More than 60,000 distinct products are handled with MixMoveMatch.com

19
Implemented in 19 countries
MixMoveMatch.com implementation

- **17 countries**
  MixMoveMatch.com is now operating in 17 countries

- **1.5 million / month**
  Over 1.5 million packages are processed monthly

- **60.000 +**
  More than 60.000 products handled
reference shippers and logistic providers are using it

... and many others
The 3M case study

- Before the distribution took place on customer specific pallets right from the 50 factories or distribution centres causing a load factor of about 31% in average only.
- By applying the principle of MixMoveMatch.com the load factor increased to more than 70% in average.
- During the period of the ongoing operation of the rule based optimisation of MixMoveMatch a steadily increasing load factor, obviously being a learning curve, could be observed.
- In the first year of operation alone MixMoveMatch.com 3M saved about 5 million truck-kilometer or rather 10% of their transport related CO2 emissions
- According to 3M, MixMoveMatch.com now originates approx. 35% savings in total logistics costs
MixMoveMatch.com
Physical Internet Provider

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