A NEW CONCEPT FOR LOGISTICS: A PHYSICAL INTERNET

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Procter & Gamble
"In the main, organizations become large because they are good organizations and well-managed ones. They grow large because they steadily succeed in bringing new and better services and products to the public. And what are the basic elements behind new and better services and products? They are ideas, imagination, innovation, initiative, and a healthy dissatisfaction with things as they are."

Current Supply Chain Challenges

- Efficiency, trends and innovations
  - Trends...
    - Flow exponential growth (even if they will not reach the sky)
  - Shipments fragmentation
    - Shipment median weight divided by 4.5 from 160 kg in 1988 to 30 kg in 2004
      Source: IFSTTAR 2013
  - A no cost illusion for the consumers
  - Expectations: better services and economic support to growth
    How to take advantage of economy of scale when each shipment are going smaller?
    How to mitigate the environmental effects? Decoupling / economic activity?
    How to cope with the demand and without a new physical infrastructure?
Current Supply Chain Challenges

Transport inefficiency is a €160 Billions loss and 1.3% of EU27 CO2 footprint!!!

10 YEARS: ZERO IMPROVEMENT ON LOAD FACTORS

- Cost of inefficiency
- %Load Factor
- %Road efficiency
- %empty truck (km)

This is bad for both profitability and environment
Whilst logistics is the backbone sustaining our life, global logistics are inefficient and unsustainable

- **Economically, environmentally & socially**

**Current Status** – *inefficient & unsustainable supply chains*

- Non standard load size & dimensions
- Full, but only 25% of weight limit
- 60% empty, but at weight limit
- 24% of trucks run empty
- Network congestion & emissions
- Inefficient networks

This is bad for both profitability and environment
Current Supply Chain Challenges

In addition .............

- Poorly used storage facilities
- 25% wastage of retail produce
- Fast & reliable multimodal transport remains an aspiration
- Networks are neither secure nor robust
- Innovation is constrained

This is bad for both profitability and environment
Current Supply Chain Challenges
Logistic is a growing component of Product Costs

<table>
<thead>
<tr>
<th>Logistics costs in Germany(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Administrative/Management costs</strong></td>
</tr>
<tr>
<td>Costs of value-added services</td>
</tr>
<tr>
<td>Packaging</td>
</tr>
<tr>
<td>Transportation costs</td>
</tr>
<tr>
<td>Warehousing costs</td>
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<tr>
<td>Inventory costs</td>
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</tbody>
</table>

Source: \(^1\)Preliminary results of the study „Trends und Strategien in Logistik/ SCM (2012)“.
In the average supermarket, 8.2% of all goods are not available (6.5% of sales volume).

Current Supply Chain Challenges

If preferred products are not available permanently, consumers are drifting to competitive products for a long-lasting period.

- Decreasing sales and market shares
- Despite all efforts made in the supply chains still a major subject

Current Supply Chain Challenges

Ahold
Argos
Boots
Condis
Coop Denmark
Coop Norway
Debenhams
Delhaize
dm
Edeka (5 DC’s)
Eroski (2 DC’s)
Hema
Kruidvat (AS Watson)
Leclerc (2 DC’s)
Lidl
Mercadona (3 DC’s)
Migros
Müller
netto
Rewe
Rossmann
S Group (Inex DC)
Sainsbury (3 DC’s)
SOK (Inex DC)
SPAR
Teva
TJ Morris
Woolworths

European Automated DC Landscape (2013)
The Physical Internet definition

An open global logistics system based on the physical, digital and operational interconnectivity enabled by smart modular containers, interfaces and protocols for increased efficiency and sustainability

B. Montreuil, R. D. Meller & E. Ballot

In other words: a universal interconnection of logistics services
Physical expected impact

- A generalization of containerization

Physical expected impact

- The benefit of standard: the maritime container example
Build interconnection with full collaboration

THE COLLABORATION CHALLENGE
Build interconnection with new IT systems

- **Enterprise Resources Planning**
- **EDI**
- **Passive objects**
- **Software As A Service**
- **IoT**
- **Smart objects**
Build interconnection with new hubs

- Containers’ routing.
- A call for more efficient transshipments.
To enable more efficient flows of fast-moving consumer goods (FMCG)

- operate with developed iso-modular logistics units of adequate size
- provide a basis for a fully interconnected logistics system by 2030.
- identify and address the necessary changes to the logistics system
- exploit progress in digital, physical and operational interconnectivity
- build on current assets & infrastructure.
Build interconnection with modular boxes

MODULUSHCA New Modular Concept

- Modular dimensions from cargo containers down to tiny sizes
- Easy to handle, store, transport, interlock, load, unload, construct, dismantle, compose and decompose
- Smart tag enabled, with sensors
Executive Summary

Reusable transport items (RTI), crates, pallets and roll cages, represent the “nuts and bolts” of the European Fast Moving Consumer Goods (FMCG) Supply Chain. This recommendation may apply to other industries or other regions.

At the end of the precious lifetime we use an increasing variety of equipment, managed in a variety of different ways, being used to handle an expanding range of products, all with the aim of reducing Supply Chain costs for individual elements within the total Supply Chain.

But different incompatible management systems for RTI can be standardised to organise their distribution and returning.

In fact RTI are considered to be assets which need to be tracked and traced through the supply chain to enable their efficient use for all involved parties. RTI may have commercial implications if they are subject to deposits or fees related to their use. For reusing purpose RTI have to be accounted separately.

To do this, a unique identification of RTI and standardised communication of the required information is required. In the following it is explained how the EAN.UCC system should be used for this purpose.

This application guideline is designed to provide more precise guidelines on the use of the EAN.UCC system for RTI management.

Note

Under no circumstances should this application guide be considered as an end-alone document or a replacement for the full EAN.UCC manual as well as for the general EAN.UCC specifications. To implement the EAN.UCC system effectively these recommendations of IC-RTI must always be used in conjunction with the mentioned guidelines.

The recommendation reflects the current state of the art regarding communication and identification technologies, it should be considered that technological developments may cause changes or amendments of the contents of this recommendation.

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Table of contents:
1. INTERNATIONAL COUNCIL FOR REUSABLE TRANSPORT ITEMS (IC-RTI) 2
2. RECOMMENDATIONS 4
3. ORGANISATIONAL COMPLIANCE 6
4. 1. Objective and scope 7
4. 2. Types of RTI 7
4. 3. Criteria for assessing the impact of RTI 7
5. ADVANTAGES OF ASSET MANAGEMENT 8
6. PROCESS MODELING 9
7. 1. Functions in IRTI 9
7. 2. Process Description “Physical Flow” 10
7. 3. Process Descriptions “Informational Flow” 11
7. 4. Key Performance Indicators 12
8. IDENTIFICATION STANDARDS FOR RTI BASED ON EAN.UCC SYSTEM 12
8. 1. Global Reusable Asset Identifier and Global Trade Item Number 13
8. 2. Barcoding According to EAN 128 Standard 14
8. 3. Issuing of Basic Number 14
8. 4. Issuing of Basic Number 14
8. 5. Directly Exchanged RTI 15
8. 6. 2. Reused Operator Controlled RTI 16
8. 7. Serial Number 16
8. 8. Communication Standards for RTI Management 16
9. TRACKING & TRACING IN RTI APPLICATIONS 17
10. FUTURE DEVELOPMENT - THE CHALLENGE OF THE EU

Index of figures:
Figure 1: process description “Physical Flow” 13
Figure 2: process description “Informational Flow” 14
Figure 3: Reusing of the UCC

Recommendations For The Compatible Stacking Of Crates

International Council For Reusable Transport Items (IC-RTI)

Modular Logistics Units in Shared Co-modal Networks
### Basic requirements for a new R(P)C standard

<table>
<thead>
<tr>
<th>HARD</th>
<th>SOFT</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RPCs have to be ISO-MODULAR.</strong></td>
<td><strong>RPCs can be foldable.</strong></td>
<td><strong>RPCs must not be nestable.</strong></td>
</tr>
<tr>
<td><img src="image" alt="EURO pallet type" /></td>
<td><img src="image" alt="UK pallet type" /></td>
<td><img src="image" alt="RPCs" /></td>
</tr>
<tr>
<td><strong>RPCs have to have straight walls.</strong></td>
<td><strong>RPCs Lid &quot;ability&quot;</strong> We don’t need to have every RPC with lid BUT RPCs must have the ability to install a lid in case of specific requirements [e.g. Dangerous Goods].</td>
<td></td>
</tr>
<tr>
<td><strong>RPCs have to be Stackable up to 2.40 meters.</strong> when they stack, the top of one RPC connects with the bottom of another to prevent the stack from slipping.</td>
<td><strong>Protection can be realized through one RPC on top at the other and at the top either we put an empty RPC (if we store them in column) or we put a layer lid that will seal the top layer of the pallet (when we created a pallet of RPCs).</strong></td>
<td></td>
</tr>
<tr>
<td><strong>RPCs have to have flat inside surfaces.</strong></td>
<td><strong>RPCs wall thickness reduction</strong> is highly desirable in order to increase the inner dimensions.</td>
<td></td>
</tr>
<tr>
<td><strong>RPCs must have the capability to have a lid</strong></td>
<td><strong>RPCs should preferably be hermetic.</strong> However, in certain applications could have holes in the walls allowing manual handling <strong>RPCs should preferably be fully interlockable.</strong> Interlockability in all dimensions would be desirable.</td>
<td></td>
</tr>
<tr>
<td><strong>RPCs should be suitable for direct use as a retail merchandising unit.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Where is the opportunity?

Industry benchmarking - Fruit & Vegetable:

- Significant reduction of damage to goods in storage and transportation (4.2% to 0.1%)
- Reduction of staff costs through improved handling
- Reduced costs for warehousing
- No costs for waste disposal
- Total cost savings up to 23% compared with cardboard (Fraunhofer study)

RPC logistics:

- RPC can be used up to 100 trips
- 100% recyclable
- Damaged RPCs will be granulated and new RPCs will be manufactured

Ecologically superior compared to one way packaging:

- 53% lower greenhouse emission potential
- 38% lower ozone depletion potential
- 51% lower summer smog potential
Where is the opportunity?

Reusable Plastic Containers (RPC)

Key Cost Drivers:

Positive:  - Eliminate cost of corrugated shippers.
    - Eliminate manual handling at DC.
    - RPC 25x more expensive vs. corrugated box, but can be used 100 times.

Neg.:

    - Pallet utilization perfect due to modular box design, however box utilization is critical for overall T&W cost (15-50% less efficient)
    - Low cost EOL RPC filling is needed
    - Reverse logistic is a key cost part (need to define inspection/clean criteria)
    - RPC turnover/inventory significantly impact cost structure
Data to Manage Physical movements in the Physical Internet of RPCs

Acknowledgement to: Giancarlo Tretola, Meware S.r.l.
Interoperability

• Sharing the delivering goods with a collaborative approach that needs interoperability between information systems
• Interoperability needs a supporting ICT approach for information exchange, which defines data organization, access roles and covers security issues;
• It is important to consider all the objects and various assets in the logistics processes (location, warehouse, trucks, trailers, etc.) it is not only a matter of goods to be shipped
Supporting Standards

- GS1 standards, for identify assets (GRAI), shipment (GSIN), consignment (GINC), location (GLN) and so on, for enabling exchange of information
- EPCglobal initiative for allowing interoperability and information exchange
- UPU Standards (a postal standard) is interesting as an example of handling information interchange and forwarding between “abroad” partners, tracking and borders crossing
- Tracking of group of M-Boxes (dynamic aggregation) in order to simplify the tracking and tracing approach
GS1 Standards

• Identifiers are important and helpful:
  – GLN - Global location number
  – GIAI - Global Individual Asset Identifier
  – GRAI – Global Returnable Asset Identifier
  – GTIN and SGTIN - Global Trade Item and Serial Global Trade Item
  – GSIN - Global shipment identification number
  – SSCC (Single Shipment Container Code)

Image source: ILIM own study
M-Boxes UUID

- The M-Boxes may be identified using a UUID (Unique Universal ID): GRAI (Global Returnable Asset Identifier) is used to identify Reusable Assets.
- GRAI is a GS1 ID that stay with an asset throughout all lifetime of the asset. Is particularly indicated for assets that have to be re-used in several processes.
Modulushca Common Data Model

MBox Data
- GRAI (UUID)
- Size
- Weight
- Fragility
- Perishibility
- Special environment(s)

Network flow
- Public routing info:
  - GINC
  - destination address

Shipment flow
- Protected business related info:
  - GSIN
  - sender identity
  - receiver identity
  - source address
  - description of goods
  - value
  - time-window

Business flow
- Reserved information to be exchanged only between sender and receiver:
  - ID_order
  - invoice
  - acknowledge
  - missing items
  - ETA

GPS Positioning: Track the Truck (Russian Dolls approach)

Cloud Services

Distributed DB

Image source: Modulushca
Colours

• Modulushca Common Data Model is identified also as the coloured model and is organized on four subsets of information (color coded):
  • MBox info (Green): data directly available on the modular unit (stored in the RFID or QR Code)
  • Network flow (Yellow): boxes are identified with UUID that allows retrieving of selective information from the IT Systems
  • Shipment flow (Orange): boxes are aggregated/unified in the IT system(s), where “restricted” information may be retrieved by authorised interests (e.g. customs, police, agencies, etc.) in using a defined set of user-specific rules
  • Business flow (Red): commercial and reserved data are private and held by the main actors (customer and manufacturer)
Roles of the Model

- Manufacturer, Retailer
- Shipper (4PL), Custom authorities
- MBox handlers, Warehouse
- LSPs, Carriers (3PL)

Image source: Modulushca
Roles description

- All the actors involved in the logistic processes may be tagged with a role, which allows for accessing to the data, which may be color tagged. In our conception the role may be the follows:
  - green role: access granted only to the green data (i.e. systems and operators not involved in the logistic process but only in the handling, storing, stocking);
  - yellow role: access granted only to green and yellow data (i.e. logistic service provider involved in the transport);
  - orange role: access granted to all but red data (i.e. the shipper managing the shipment, the authorities);
  - red role: access granted to all data (i.e. original sender and original receiver, involved in the business processes).
The proposed High Level Architecture
Business Process Management approach: business goals to be achieved is the delivery of goods to the retail point and/or to the final customer, encapsulating them in modular units.

Who, where, what and when: driving the movement of goods, from original sender to intended receiver, using an end-to-end approach for planning and routing the modular units flow.

Deals with movement of goods considering the available means to be used, the modality, in order to move the modular units from one hub to another, following a point-to-point approach.

Regards the physical “objects” in the systems, the modular boxes, the transport means, the location, the links, T&T, loading and unloading, cross-docking and storaging, supporting the handling operations.
## OSI vs OLI

<table>
<thead>
<tr>
<th>OSI reference Model</th>
<th>Internet protocols</th>
<th>OLI reference Model</th>
<th>Architectural Layers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>Application (HTTP, FTP, SMTP, IMAP, …)</td>
<td>Logistic Web</td>
<td>Business Application (JIT Planning, Booking, …)</td>
</tr>
<tr>
<td>Presentation</td>
<td>TCP/UDP</td>
<td>Encapsulation</td>
<td>Logistic</td>
</tr>
<tr>
<td>Session</td>
<td>IP</td>
<td>Shipping</td>
<td>Transport</td>
</tr>
<tr>
<td>Transport</td>
<td>Physical</td>
<td>Routing</td>
<td></td>
</tr>
<tr>
<td>Network</td>
<td></td>
<td>Network</td>
<td></td>
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<tr>
<td>Data Link</td>
<td></td>
<td>Link</td>
<td></td>
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<tr>
<td>Physical</td>
<td></td>
<td>Physical</td>
<td>Physical</td>
</tr>
</tbody>
</table>

**Image source:** Modulushca
Architectural roles

1) Purchase Order
2) Shipment Mng
3) Collaborative Shipment

Manufacturers
Retailers

4PL (Shipper)
4PL (Shipper)

3PL
3PL
3PL
Carrier

ISP (Saas) ISP (Saas) ISP (Saas)

TIP (PaaS)

Cloud (IaaS)

4PL
3PL
3PL
Carrier

Modular Logistic Platform

Image source: Modulushca
Issues and future evolutions

• Further evolution of the model will be needed in order to address completely the needs of the modular logistics.

• Some issues emerges when evaluating the model:
  – **Security problems** have been only analyzed at high level, from ICT supporting tech point of view
  – M-Boxes can be obtained **assembling standards panels**. In such case there is an issue to solve, regarding how to generate the UUID for the assembled M-Box
  – Refining the model, could be done the introduction of **semantic description** of the data and operations, allowing a high level of interoperability and integration between the systems, enabling the machine understandable description of services, and the automatic service composition
THANK YOU!

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