Big Data Analytics in Logistics

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Content

- Big data analytics in logistics: lessons from literature
- Big data at Wageningen University
- Examples
  - Collaborative Supply Chain Analysis @ Royal Flora Holland
  - Sustainable Supply Chain Analysis @ Reefer containers Harbor of Rotterdam
  - Internet of things @ Retail & Consumers
- Discussion
Big Data Business Analytics (BDBA)

- Process data with velocity, variety, volume, value and veracity (5V)
- Gain insight by applying simulation & optimization to help business organisations make better decisions
Three categories of analytics

- **Descriptive analytics**: OLAP, online analytical processing: multidimensional analysis of business data, complex calculations, trend analysis

- **Predictive analytics**: use of mathematical algorithms and programming to discover explanatory and predictive patterns in data

- **Prescriptive analytics**: use of data and mathematical algorithms to assess alternative decisions that involve objectives and requirements with high volume and complexity (multi-criteria decision making, opt. & sim.)
Opportunities for Big Data Analytics in Logistics

- **Strategic sourcing**: building supplier relationship by analyzing organizational spend costs and acquiring commodities; supplier selection using supply market trends, benchmarks, prediction supply disruptions, etc.

- **Supply chain network design**: amount of data is massive, often uncertain demand (demand patterns)

- **Demand planning** (predictive): time-series approach

- **Procurement**: External operational and macro-economic data to manage supply risks and suppliers performance

- **Routing**: sequence of operations, routing of goods, vehicles and crew.
Big Data Analytics @ Wageningen University

At Wageningen UR, Big Data research contributes to provide innovations in areas such as

- Food production, security, safety and integrity
- Food-related public health issues
- Biobased and Circular economy
- Green cities and planet earth management
- Embedded Systems
I. Big data to improve the performance in a floricultural supply chain

- Data about, for example:
  - History of data of Supply/Demand
  - Transactions among buyers and growers
- Big data analytics for Buyer/Grower clustering to:
  - Understand the preferences of Buyers/Growers
  - Give recommendation for expected match of demand/supply
I-Flow project

Main hypothesis
Effective use of information in logistics and auction decision-making can improve the overall performance of floricultural supply chains.
Big data to improve the performance in a floricultural supply chain: operational

- Big data analytics to design customized services and processes
  - Finding Logistics Requirement Patterns
  - Design of customized logistics services/processes for each cluster
Big data for to improve the performance in a floricultural supply chain: strategic

Dutch floricultural supply chain network (De Keizer et al., 2015)
II. Complex sustainability issues in logistics networks

- **EURECA**: Effective Use of Reefer Containers for Conditioned Products Through the Port of Rotterdam

- Reefer flows and cool chains have distinctive features which make managing logistics processes challenging:
  - Importance of product quality and safety
  - Need for specific transport fleets
  - High value of reefer containers
  - Importance of container fleet management
Big data for supply chains: Quality, Sustainability, Profitability issues

- Quality controlled logistics
- Sensor data of rolling stock
  - long distance transport
  - Dynamic control of conditions (temp./humidity/etc.)
  - right quality upon delivery
Technical issues in the operation of cool chains

- Energy requirements for storage, handling and transport of reefers
- Availability of energy sources
- High investments in refrigeration equipment
- Maintenance of reefers
Trade-off of quality and energy usage

Typical pattern with reefer in continuous mode.

Typical pattern with reefer in cycle or fuel saver mode.
## Transport temperature requirements of food products

<table>
<thead>
<tr>
<th>Chilled products</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh fish (in ice), crustaceans and shellfish (excluding live ones)</td>
<td>+2</td>
</tr>
<tr>
<td>Cooked dishes and prepared foods, pastry creams, fresh pastries, sweet dishes and egg products</td>
<td>+3</td>
</tr>
<tr>
<td>Meat and cooked meats pre-packaged for consumer use</td>
<td>+3</td>
</tr>
<tr>
<td>Offal</td>
<td>+3</td>
</tr>
<tr>
<td>Poultry, rabbit and game</td>
<td>+4</td>
</tr>
<tr>
<td>Non-sterilized, untreated, unpasteurised or fermented milk, fresh cream, cottage cheese and curd</td>
<td>+3</td>
</tr>
<tr>
<td>Milk for industrial processing</td>
<td>+6</td>
</tr>
<tr>
<td>Cooked meats other than those which have been salted, smoked, dried or sterilized</td>
<td>+6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frozen Products</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice and ice cream</td>
<td>-25</td>
</tr>
<tr>
<td>Deep frozen foods</td>
<td>-18</td>
</tr>
<tr>
<td>Fishery products</td>
<td>-18</td>
</tr>
<tr>
<td>Butter and edible fats, including cream to be used for butter making</td>
<td>-14</td>
</tr>
<tr>
<td>Egg products, offal, rabbit, poultry and game</td>
<td>-12</td>
</tr>
<tr>
<td>Meat</td>
<td>-10</td>
</tr>
</tbody>
</table>
III. Big data - fresh produce @ retailers

- Big data for demand forecasting
  - Classically: for demand forecasting
  - To estimate missed demand due to stock-outs

- Big data to understand consumer behaviour
  - Substitution effect
    - Within product: quality-classes
    - Within category: product-substitutes
  - Response to discounting and promotions
    - demand volumes promoted/discounted product
    - Cannibalization: demand drops when substitute is promoted
Automated Store Order system (ASO)

- Traditionally designed for non-perishables
- How to use for perishables?
- Fast amount of data available @ retailers

Advantage for retailers:

- Improved replenishments, modelling consumer behaviour
- Optimal pricing strategies for promotions and discounts
- Dynamic expiration dates
Big data - Smart shopping

- **Smart fridges @ home indicate**
  - products @ home
  - product about to expire

- **Smart phone**
  - Propose list of recipes
  - Prepare shopping list of additional ingredients

- **Retailers**
  - dynamic promotions of ingredients/recipes
  - support online shopping basket
  - shopping route
Questions?

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Wageningen University: Big Data