LE SYSTÈME D’INFORMATION DE LA SUPPLY CHAIN ALIMENTAIRE

FSS HORIZONS

useR! 2009

July 8-10
1. A Partnership between firm and university
2. The company STEF-TFE
3. Frozen goods supply chain
4. Forecasting goals
5. Forecasting is not reality
6. Forecasting model
7. FSS Horizons
University of South Brittany
  - Lab-STICC research laboratory

STEF-TFE and Agrostar

OGGAM

L’ANRT
Transport

Logistics

Information Systems

Shipping

13 400 employees

TFE 8 142

Tradimar 1 078

STEF 3 360

Agrostar 168

Fonctions support et autres activités 471

2 400 trucks

216 frozen warehouses and frozen hubs
Frozen Transport

Product temperature between -20°C et +15°C

Some figures (2006):
- 57 hubs
- 150km between 2 hubs
- 8142 employees
- 15,000 delivery/day
- 100,000 regular destination
- Present in Italy, Spain, Benelux, UK
Frozen goods supply chain

Factory

Industry warehouses

Distributor Hubs

Retailer

Order

Sending Confirmation

Reception Confirmation

Physical flow

Central purchasing office

Manufacturer
Frozen goods supply chain

Transit Hub

Pick up
Forward Hub
Forwarding
Delivery Hub
Delivery

Direct delivery

Vocabulary
- Waybill
- Pick up
- Forwarding
- Delivery
### Why?
Planning workforce and equipment

### What?
- Forecasting goods flows to handle at hub
- Forecasting their origin and their destinations
- Horizon 28 days

### Problems to resolve
- Obtain one forecast model for more than 360 TS
- Collaborative forecasting process
- Daily update
- A unique group application easy to use
- High degree of accuracy

### Constraints
- Poor information about demand
- Poor information about sales promotions or events
- Different hub activity function regional installation
- All open source

### Solutions
- Sales history
- Combination forecasting methods
- Collaborative forecasting
By definition forecasts are wrong:

- The market evolves (consumer habits, environment, oil prices, traceability, competition, …)
- Seasonality evolves (product’s length of life, new purchasing habits, school and legal holidays, …)
- Unexpected exceptional event (competitor disappearance or appearance)

Prerequisite of an forecasting system

- What needs to be forecasted, what for, and for what horizon?
- What is the company’s ability to react?
- What is the repercussion in the case of an error?
- Who confirms the definitive forecasts?
- How can the best reports be made?
67 Hubs

6 time series per hub

- Daily weight and waybill of goods leaving out of the hub in delivery, forwarding and total

History since 2000
Extract data from operational DB, data mart and data warehouse

Transform Data into a regular TS

Forecast future data true R engineering

Load TS and forecast into data warehouse
Atypical values correction
Mathematic model

- 3 time series

\[(X_t, Y_t, Z_t) \in \mathbb{R}^3\]

avec \(X_t + Y_t = Z_t\)

- Estimation

\[U_{k,t}^1 = T_i S_i^1 (\beta^1 F)_t V_i^1 \epsilon_i^1\] deseasonalize method MM

\[U_{k,t}^2 = T_i S_i^2 (\beta^2 F)_t V_i^2 \epsilon_i^2\] deseasonalize method BB

\[U_{k,t} = \lambda U_{1,t}^1 + (1 - \lambda) U_{1,t}^2\] combining MM and BB

avec \(k \in \{X, Y, Z\}\)

et \(\omega_1, \omega_2\) tq \(U_{Z,t} = \omega_2 U_{Y,t} + \omega_1 U_{X,t}\)

- Component separation

\[
\ln(U_t) = \lambda \left[ \ln(T_t) + \ln(S_i^1) + \ln((\beta^1 F)_t) + \ln(V_i^1) + \ln(\epsilon_i^1) \right] + \ln\left[ (1 - \lambda) \left[ \ln(T_t) + \ln(S_i^2) + \ln((\beta^2 F)_t) + \ln(V_i^2) + \ln(\epsilon_i^2) \right] \right]
\]
Time series pattern and forecasting

Time Serie $U_{X,t}$

**Trend estimation**

$$T_t = \theta t + An(t) + cste$$

$$y_t = U_{X,t} - T_t$$

**Seasonal swing correction**

$$MM_t = \frac{1}{S} \sum_{i=(t-(S/2))}^{t+(S/2)} y_i ; e_t = y_t - MM_t ;$$

$$\bar{e}_j = \frac{1}{n} \sum_{i=1}^{n} e_{i,j} \text{ avec } j \in \{1, ..., S\} ; s_j = \bar{e}_j - \frac{1}{S} \sum_{i=1}^{n} \bar{e}_i$$

$$y''_{MM,t} = y_t - s_{j,t} - s_{i,t} \quad \text{j : day, i : week}$$

**Calendar event impact estimation**

$$y''_{MM,t} = y''_t - (\Phi X)_t$$

$$y''_{BB,t} = y''_{BB,t} - (\Phi X)_t$$

**Forecasting by exponential smoothing**

$$y'''_{p,T+1} = (1 - \alpha) \sum_{j=T-6}^{T-1} \alpha^j y''_{T-j}, \ p \in \{MM, BB\}$$

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Forecast combining

\[
y''_{T+1} = \lambda y''_{MM,T+1} + (1 - \lambda) y''_{BB,T+1}
\]

\[
\lambda = \frac{V(EPU_{BB}) - COV(EPU_{MM}, EPU_{BB})}{V(EPU_{MM}) + V(EPU_{BB}) - 2COV(EPU_{MM}, EPU_{BB})}
\]
A web interface for report

- The goods weights and the waybill number pass through the hub divided into two segments: “forwarding” and “delivery”