LE SYSTEME D'INFORMATION DE LA SUPPLY CHAIN ALIMENTAIRE

FSS HORIZONS

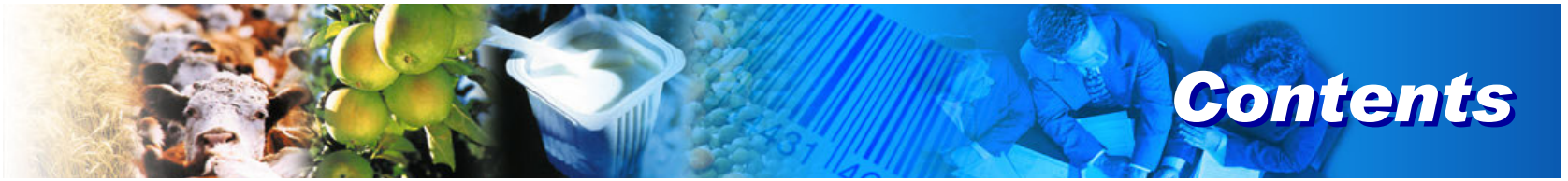
useR! 2009

July 8-10

UBS

Agrostar

TFE



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

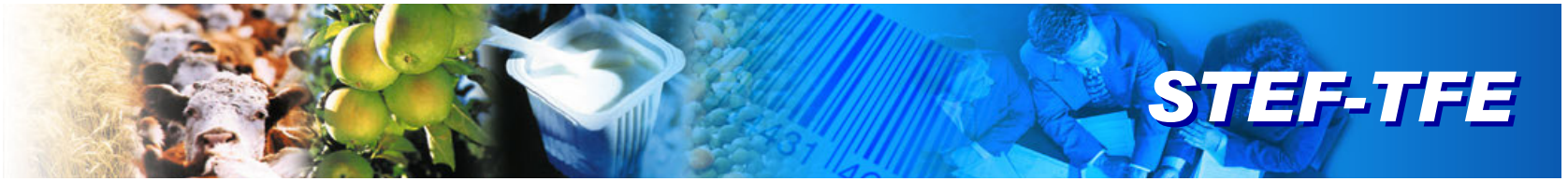
Partnership firm - university

- **University of South Brittany**
  - Lab-STICC research laboratory

- **STEF-TFE and Agrostar**

- **OGGAM**

- **L'ANRT**



Transport | Logistics | Information Systems | Shipping

TFE | Tradimar | STEF | Agrostar | CMN

13 400 employees

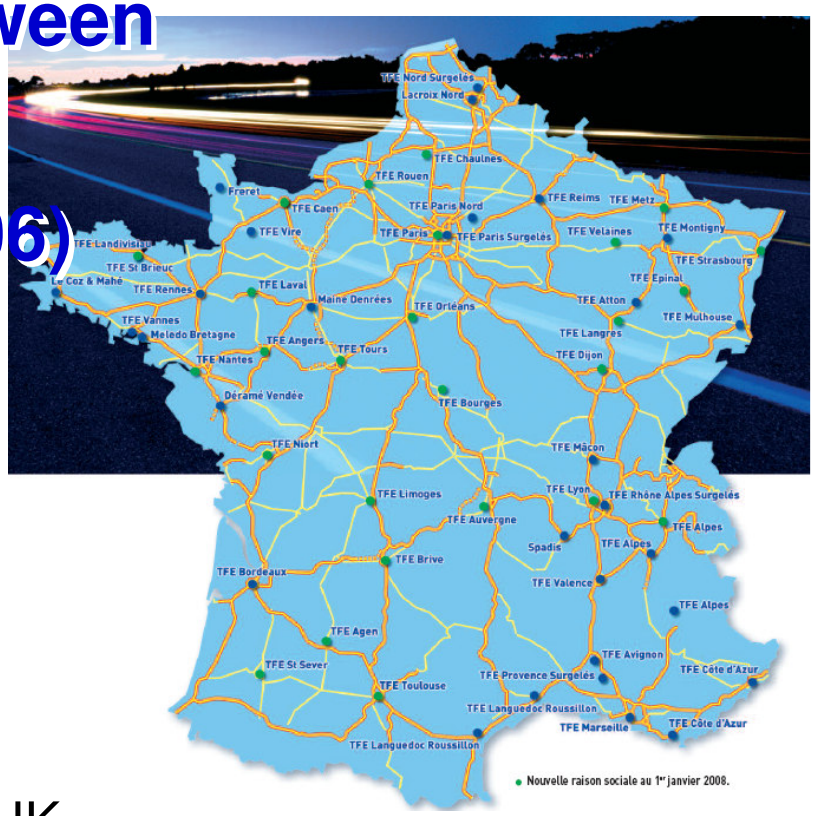
TFE	8 142
Tradimar	1 078
STEF	3 360
Agrostar	168
CMN	471
Fonctions support et autres activités	181

216 frozen warehouses and frozen hubs

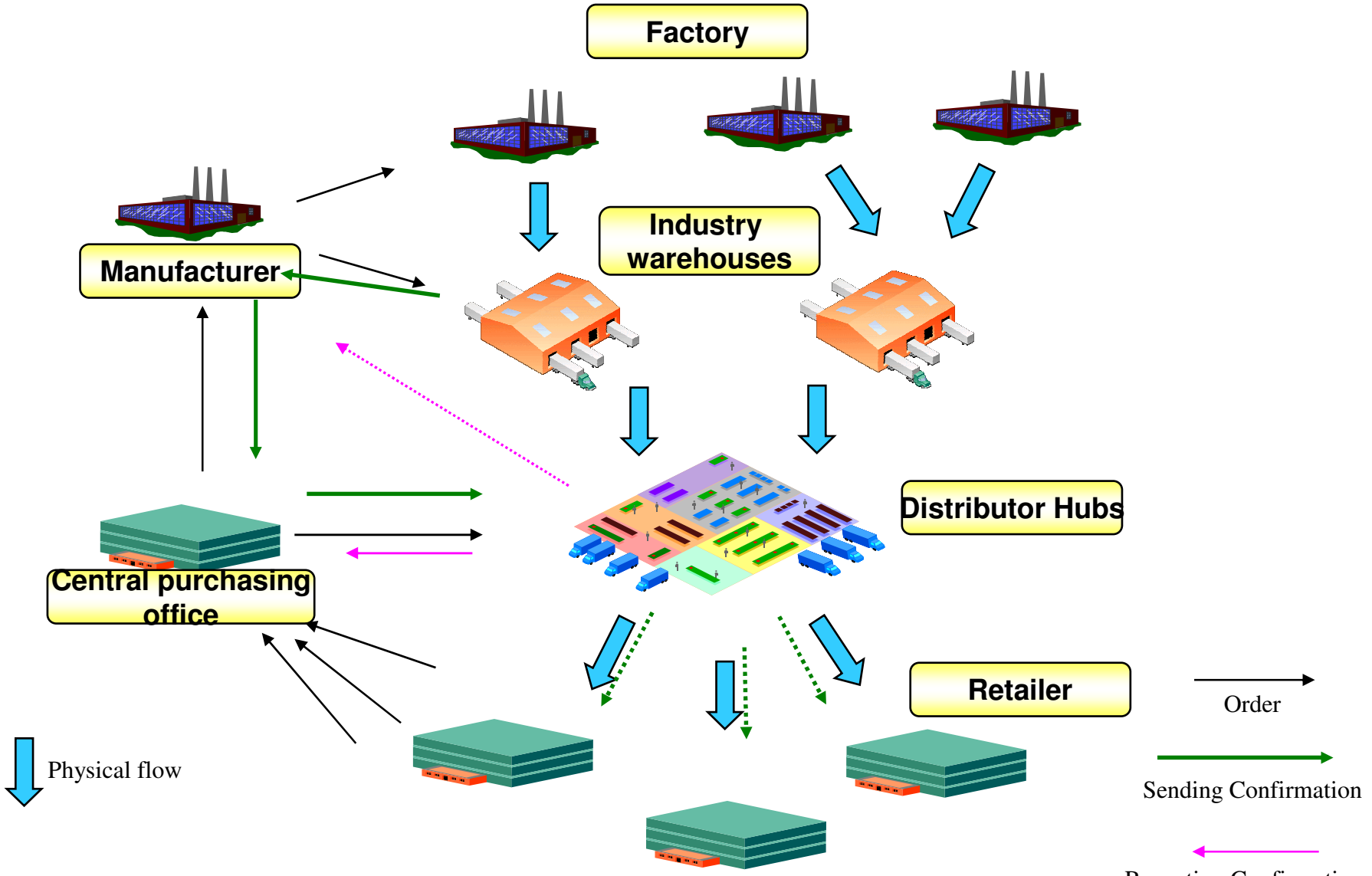
2 400 trucks

TFE: Frozen Transport in Europe

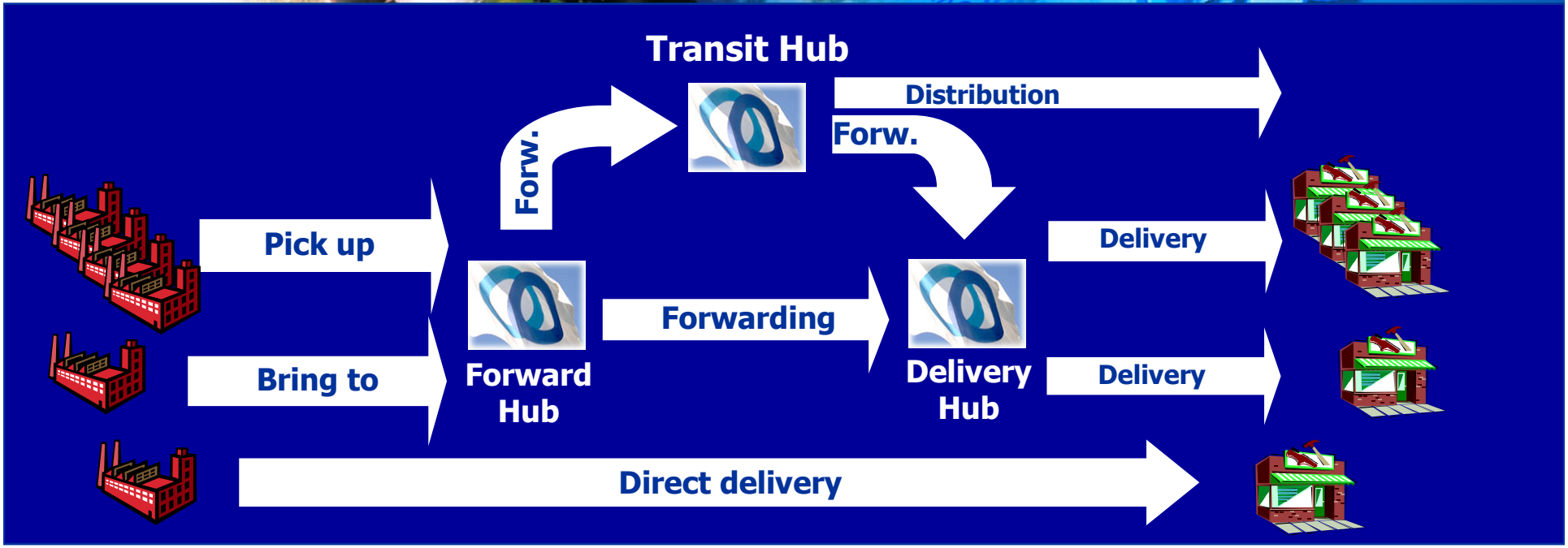
- **Frozen Transport**
- **Product temperature between -20° et +15°C**
- **TFE some figures (2006)**
  - 57 hubs
  - 150km between 2 hubs
  - 8142 employees
  - 15 000 delivery/day
  - 100 000 regular destination
  - Present in Italy, Spain, Benelux, UK

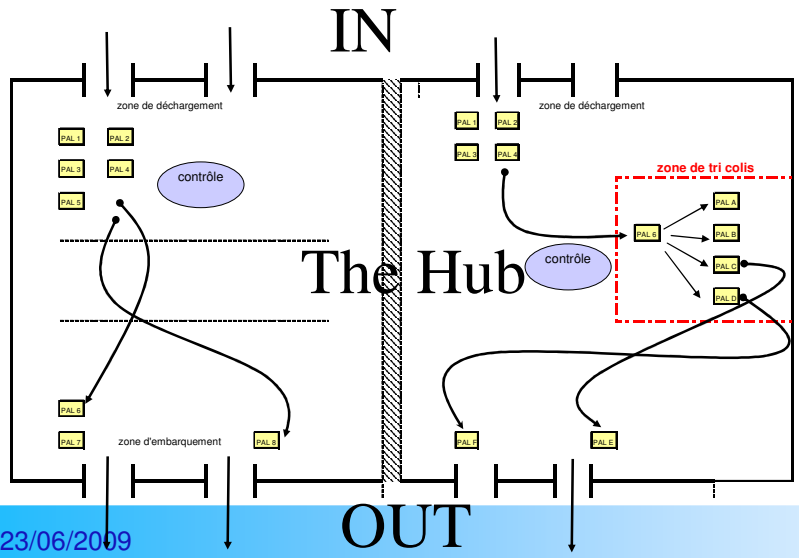


Frozen goods supply chain



Frozen goods supply chain





➲ Vocabulary

- Waybill
- Pick up
- Forwarding
- Delivery

Forecasting goals

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

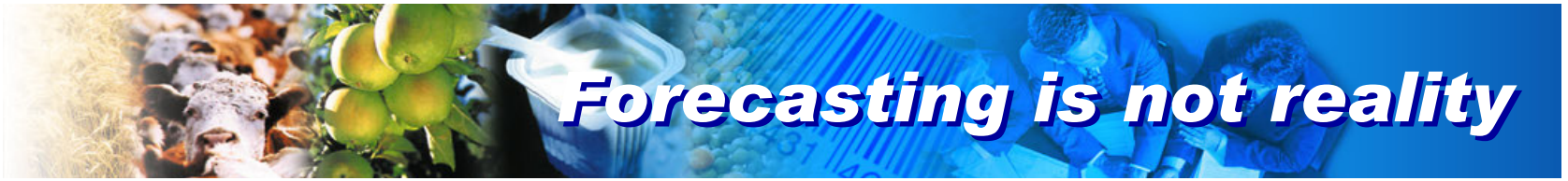
Obtain one forecast model for more than 360 TS
Collaborative forecasting process
Daily update
A unique group application easy to use
High degree of accuracy

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

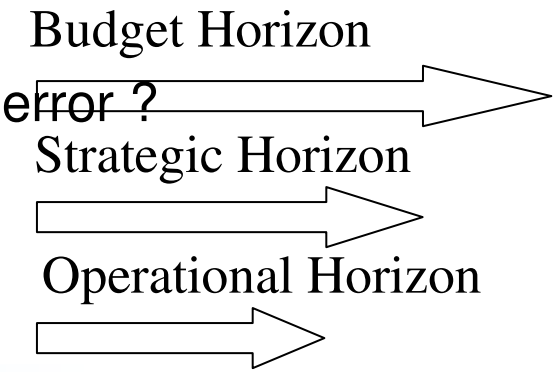


➲ By definition forecasts are wrong:

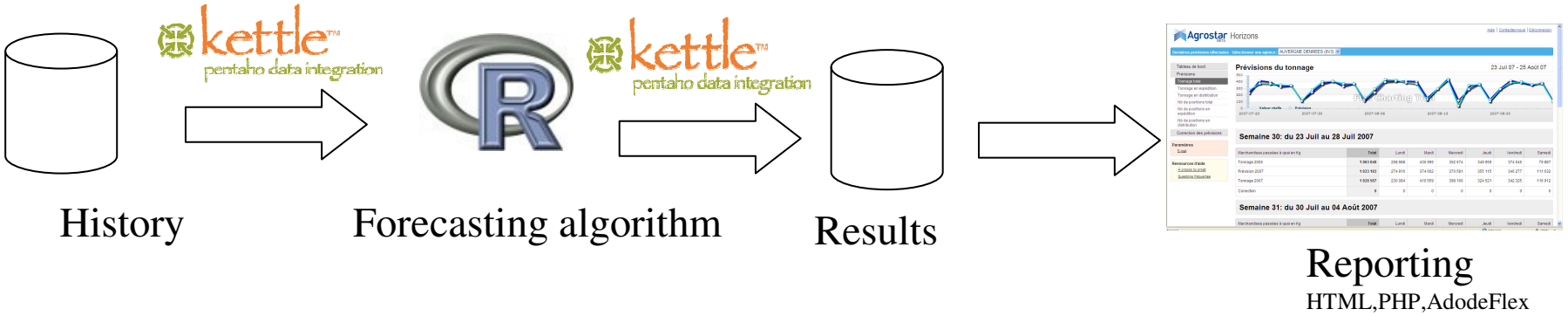
- The market evolves (consumer habits, environment, oil prices, traceability, competition, …)
- Seasonality evolves (product's length of life, new purchasing habits, school an legal holidays, …)
- Unexpected exceptional event (competitor disappearance or appearance)

➲ 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 ?



FSS Horizons: work flow

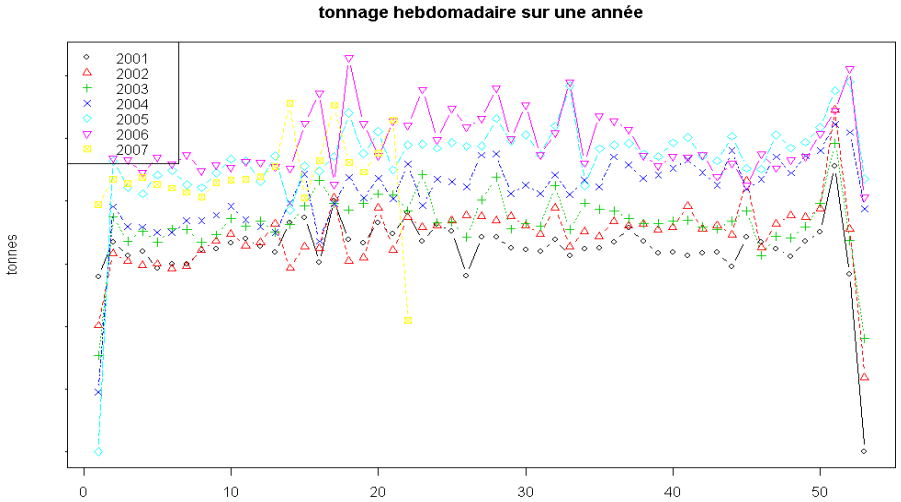


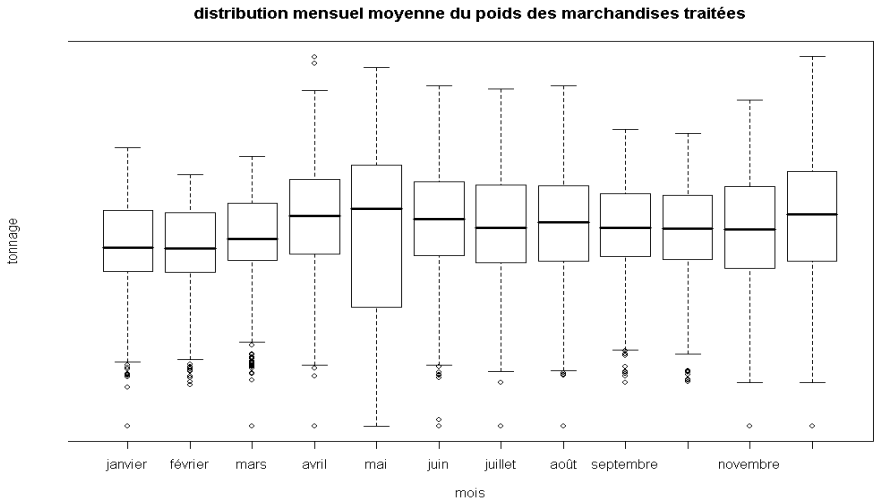
- **67 Hubs**
- **6 time series per hub**
  - Daily weight and waybill of goods leaving out of the hub in delivery, forwarding and total
- **History since 2000**

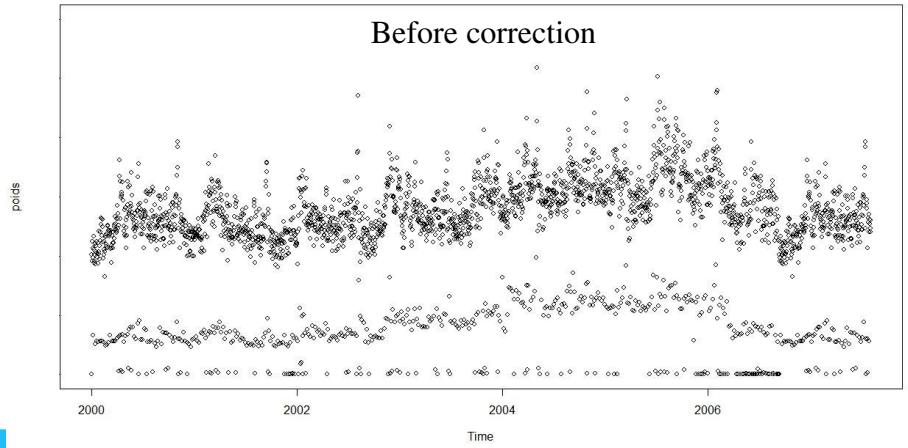
FSS Horizons : ETL Kettle

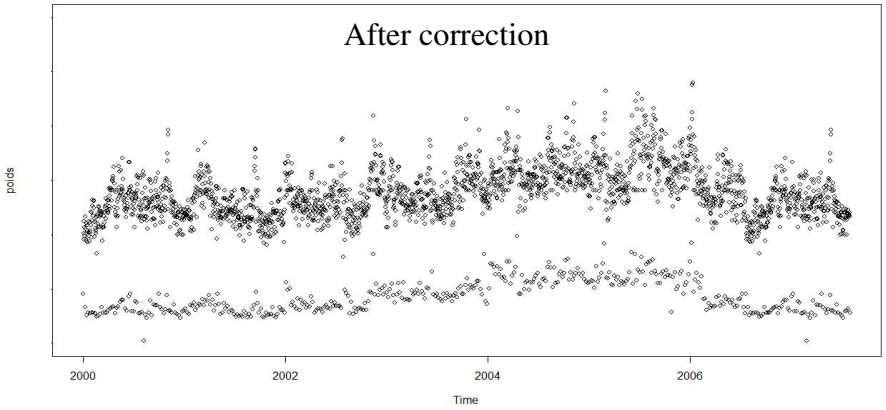
- Extract data from operational DB, data mart and data warehouse
- Transform Data into a regular TS
- Forecast future data true R engineering
- Load TS and forecast into data warehouse

➲ Atypical values correction









➲Mathematic model

- 3 time series

$$(X_t, Y_t, Z_t) \in R^3$$

$$\text{avec } X_t + Y_t = Z_t$$

- Estimation

$$U^1_{\kappa,t} = T_t S^1_t (\beta^1 F)_t V^1_t \varepsilon^1_t \text{ deseasonalize method MM}$$

$$U^2_{\kappa,t} = T_t S^2_t (\beta^2 F)_t V^2_t \varepsilon^2_t \text{ deseasonalize method BB}$$

$$U_{\kappa,t} = \lambda U^1_t + (1-\lambda) U^2_t \text{ combining MM and BB}$$

$$\text{avec } \kappa \in \{X, Y, Z\}$$

$$\text{et } \omega_1, \omega_2 \text{ tq } U_{Z,t} = \omega_2 U_{Y,t} + \omega_1 U_{X,t}$$

- Component separation

$$\ln(U_t) = \lambda\left[\ln(T_t) + \ln(S^1_t) + \ln((\beta^1 F)_t) + \ln(V^1_t) + \ln(\varepsilon^1_t)\right] +$$
$$(1-\lambda)\left[\ln(T_t) + \ln(S^2_t) + \ln((\beta^2 F)_t) + \ln(V^2_t) + \ln(\varepsilon^2_t)\right]$$

Time series pattern and forecasting

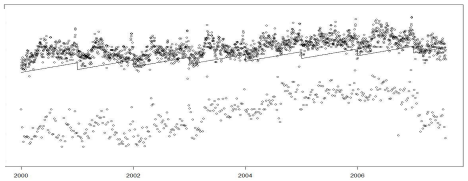
Time Serie $U_{X,t}$

Trend estimation

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

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

Tend



Seasonal swing correction

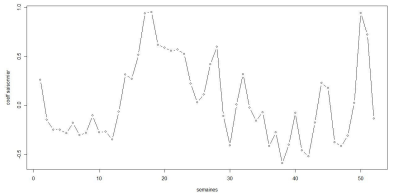
$$MM_t = \frac{1}{S}\sum_{i=(t-(s/2))}^{t+(S/2)} y_i \quad ; \; e_t = y_t - MM_t \; ;$$

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

$$y'_{MM,t} = y_t - s_{j,t} - s_{i,t}$$

j : day, i: week

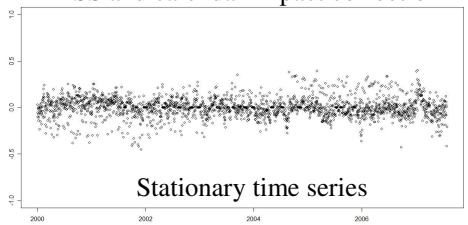
Week seasonality



$$\begin{cases} \min_{\gamma,\phi} \sum_{t=1}^{T}\left[y_t - \sum_{j=1}^{6} S_t^j \gamma_j - \sum_{i=1}^{53} S_t^i \phi_i \right]^2 \\ under \quad restriction \quad \sum_{j=1}^{6}\gamma_j + \sum_{j=1}^{53}\phi_j = 0 \end{cases}$$

$$y'_{BB,t} = y_t - \gamma_{j,t} S_t^j - \phi_{i,t} S_t^i$$

SS and calendar impact correction



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

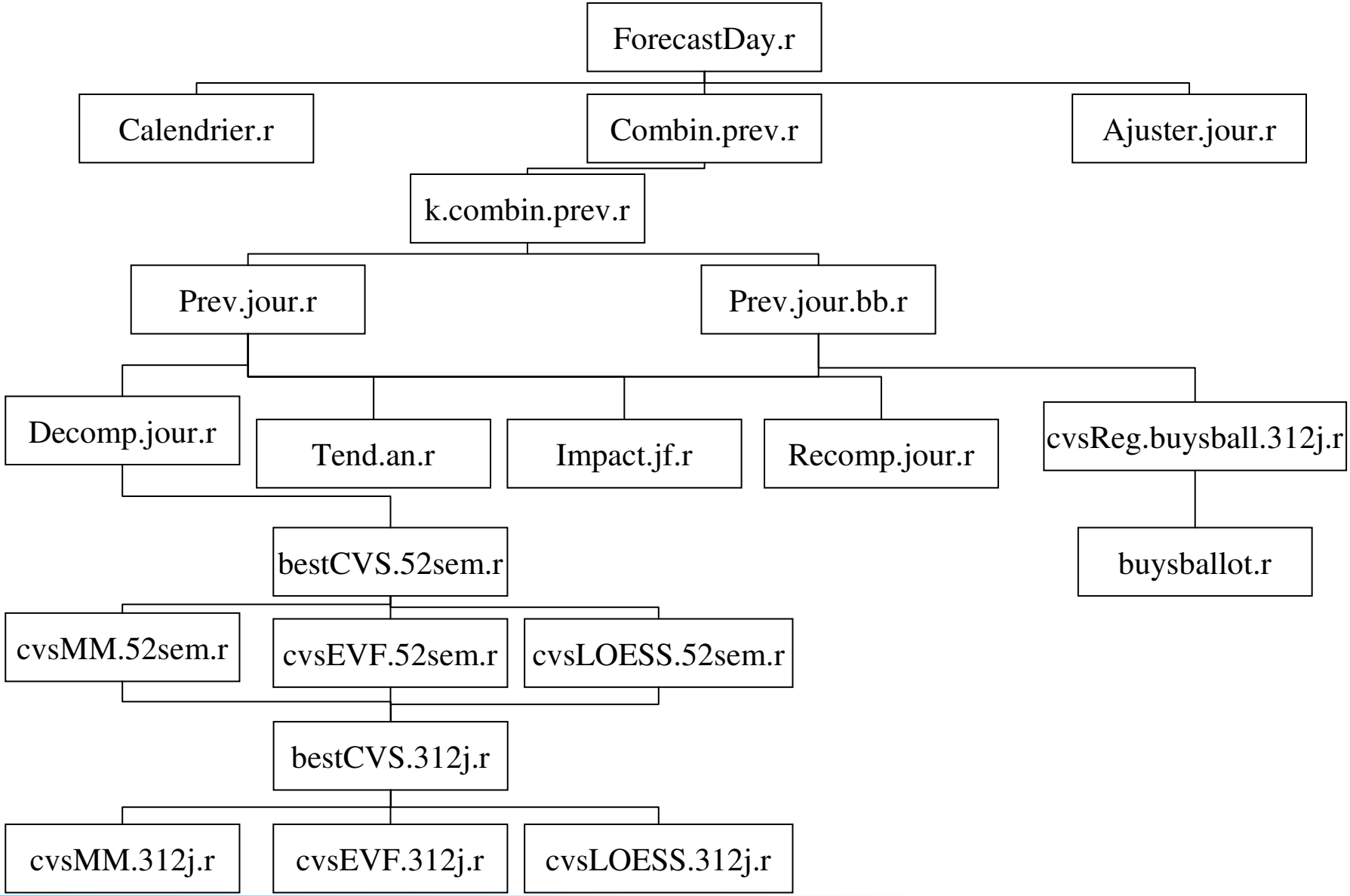
$$y''_{p,T+1} = (1-\alpha)\sum_{j=T-6}^{T-1} \alpha^j y''_{T-j} \; , \; p \in \{MM, BB\}$$

Forecast combining

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

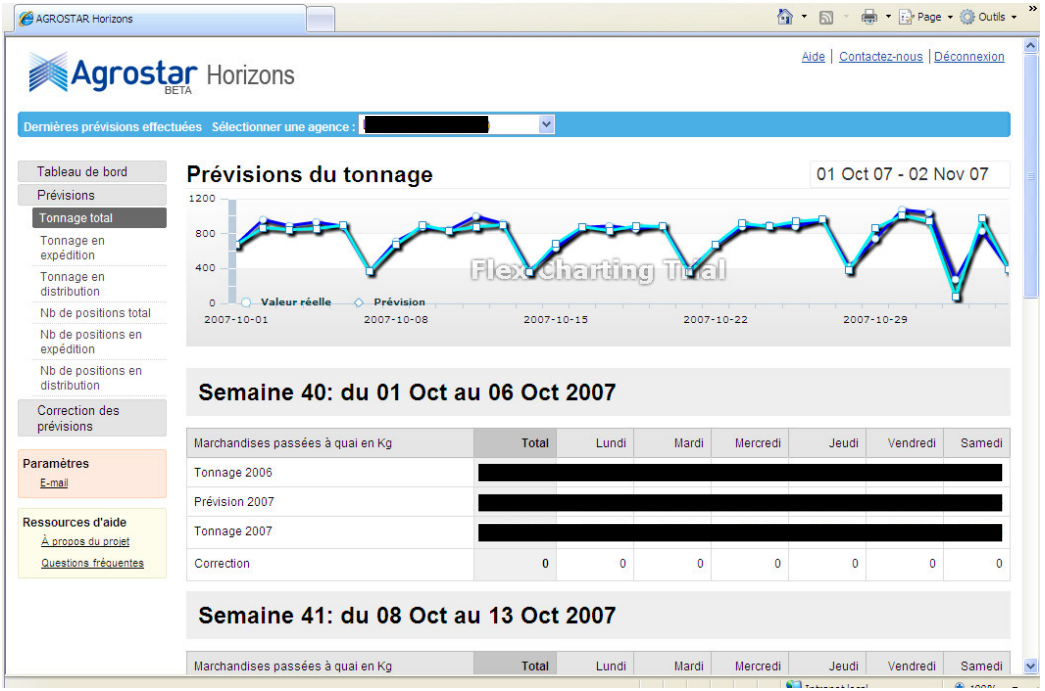
$$\lambda = \frac{V(EPU_{BB}) - COV(EPU_{MM}, EPU_{BB})}{V(EPU_{MM}) + V(EPU_{BB}) - 2COV(EPU_{MM}, EPU_{BB})}$$

FSS Horizons : R package



➲ A web interface for report

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



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