

# TRUCK AND CONTAINER LOADING FOR LOGISTICS PLATFORMS : 2 CONTRASTED EXPERIENCES

ALAIN NGUYEN / IT DEPARTMENT / OPTIMIZATION TEAM



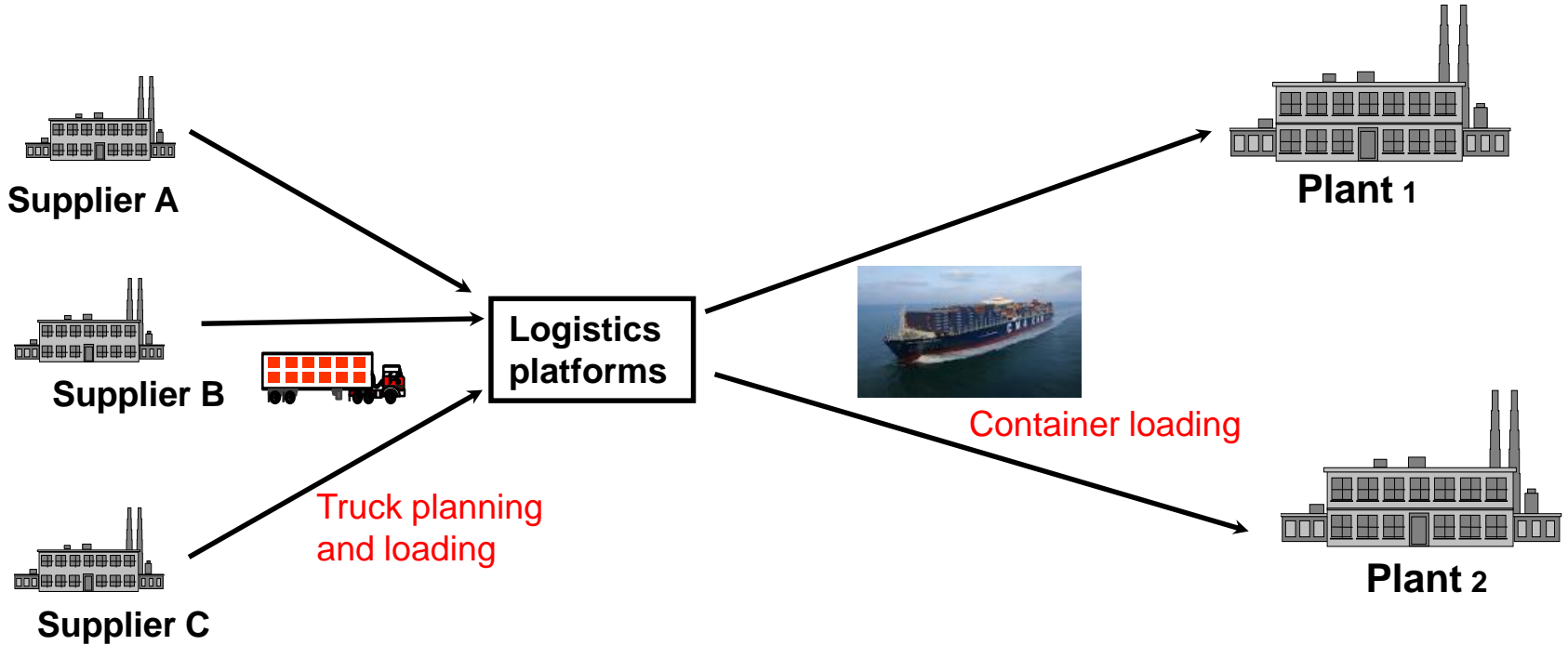
IT DEPARTMENT  
OPTIMIZATION TEAM

DATE 15/02/2018

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**GROUPE RENAULT**

# Business scope





planned daily routes  
weekly parts pickups at suppliers



## Trucks planning and loading



Assignment of parts pickups to planned daily routes  
Loading plan of the trucks



# Container loading : 3D bin packing with lots of business constraints

- (C1) One or two possible orientations
- (C2) Maximum total weight in the bin
- (C3) Stacks non overlap
- (C4) Stacks lie entirely into the bins
- (C5) Each item is packed.
- (C6) Maximum number of items that can be packed in the last bin.
- (C7) Bin 0 is the one with the smallest volume
- (C8) The height of a stack is the sum of the heights of its layer
- (C9) Maximum total height.
- (C10) Layers of almost equal dimensions in a stack.
- (C11) The envelope of a stack is the envelop of the orthogonal projection of the layers it contains
- (C12) Metal packages are packed together in stacks.
- (C13) Maximum density for each stack.
- (C14) The layers in a stack are sorted by decreasing weight.
- (C15) Layers are composed of contiguous rows
- (C16) Maximum number of rows in a layer.
- (C17) Same sizes of rows in a layer.
- (C18) All items in a layer have the same height.
- (C19) Rows are justified in a layer
- (C20) The dimension of a layer is the envelope of its rows.
- (C21) Rows are composed of contiguous items
- (C22) Maximum number of items in a row.
- (C23) Same horizontal size of items in a row.
- (C24) Items are justified in a row.
- (C25) The dimension of a row is the envelope of its items.
- (C26) Consecutive layers are contiguous in the vertical dimension
- (C27) The top of a stack is the top of its highest layer
- (C28) layers composed of metal packages can only contain one item
- (C29) maximum weight on the base layer items



# In-house tool

# Heuristics and local search

Challenge ESICUP Display V1.3 06/10/2014

Bin content

Bin type	Bin dimensions	xMax (mm)	xMax Ratio	weight (kg)	weight Ratio	volume (m3)	volume Ratio
CT40H	12090(L)x2350(l)x2680(H)	11970	99.01 %	8279.82	31.36 %	59.16	77.69 %

SOM\_BUR\_STK\_container

1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m
2.50 T	0.74 T	0.54 T	0.53 T	0.41 T	0.59 T	0.58 T	0.46 T	0.47 T	0.50 T	0.51 T	0.46 T

SOM\_BUR\_STK\_container\_5

SOM\_BUR\_STK\_container\_1  
SOM\_BUR\_STK\_container\_2  
SOM\_BUR\_STK\_container\_3  
SOM\_BUR\_STK\_container\_4  
SOM\_BUR\_STK\_container\_5

Display help

Zoom+ Zoom-  
 Resize  
3D Display  
Display type  
 Codes display

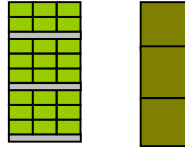
3D Display

X  
Y  
Z  
draw+  
draw-  
clean draw  
fill draw  
Zoom+ Zoom-  
 Resize  
back to center  
reset angles  
Display type

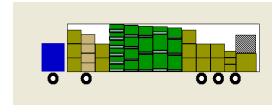
**Palettization**



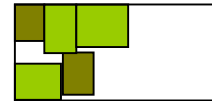
**Stacks building**



**Truck/container assignment**



**2D placement**



# FEEDBACK on Truck Optimization

- ❑ On the paper : « easy » optimization and reduction by 20% of the number of trucks thanks to the optimization
- ❑ On the field : reduction by only 10% 😞
- ❑ Gap caused by low service level on deliveries by suppliers
  - Trucks were not well filled because of delivery tardiness by suppliers
- ❑ Eventually satisfaction of the platforms managers
  - The tool enables them to challenge their suppliers on their service level

# FEEDBACK on Container Optimization

- ❑ Very strong human experts and high container filling rate
- ❑ Low expectation from the business due to negative tests with editors' tool
- ❑ First version of the in-house tool not good enough 😞
- ❑ ESICUP challenge with academic competitors
  - Re-implementation of the winner algorithm, which proves to match the human experts 😊



# ESICUP Challenge : a very exciting experience and a surprising winner 😊



Denis Naddef – Olivier Briant (University of Grenoble)



Belgium/Brazil team  
from Louvain University



University of Nagoya



University of Valencia



# FEEDBACK on Container Optimization

- ❑ Real benefit of the tool
  - Anticipation of the filling problem of the « last » container
  - Improvement of the filling rate of containers of week  $W$ , thanks to deliveries anticipation, from weeks  $W+1$  to  $W$
  - Enables negotiation with the customer plant about the deliveries the platform wishes to anticipate



# Thank you

