Consortium GARR

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Ottimizzazione della produzione e della logistica per il riuso di componenti obsolete nell'industria degli accessori moda

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A case study in the sunglasses market

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16.3 parts per BOM (on average)

Some numbers

- ~ 93 M pz/year (sun + presc. glasses)
- more than 40 brands
- 12 manufacturing facilities
- 18 distribution center worldwide
- ~ 80% of market share

Supply chain network & Data

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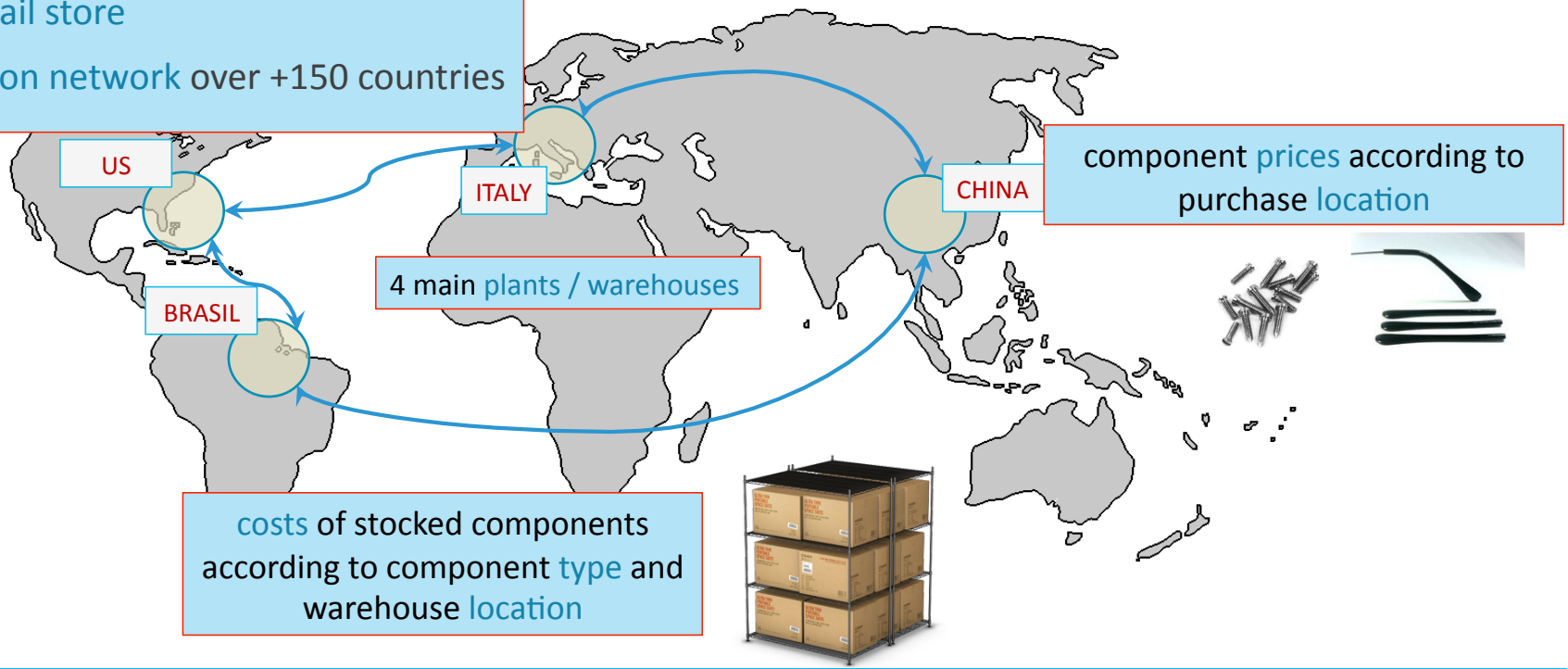
Distribution coverage:

- +7200 retail store
- distribution network over +150 countries



Challenges in fashion markets

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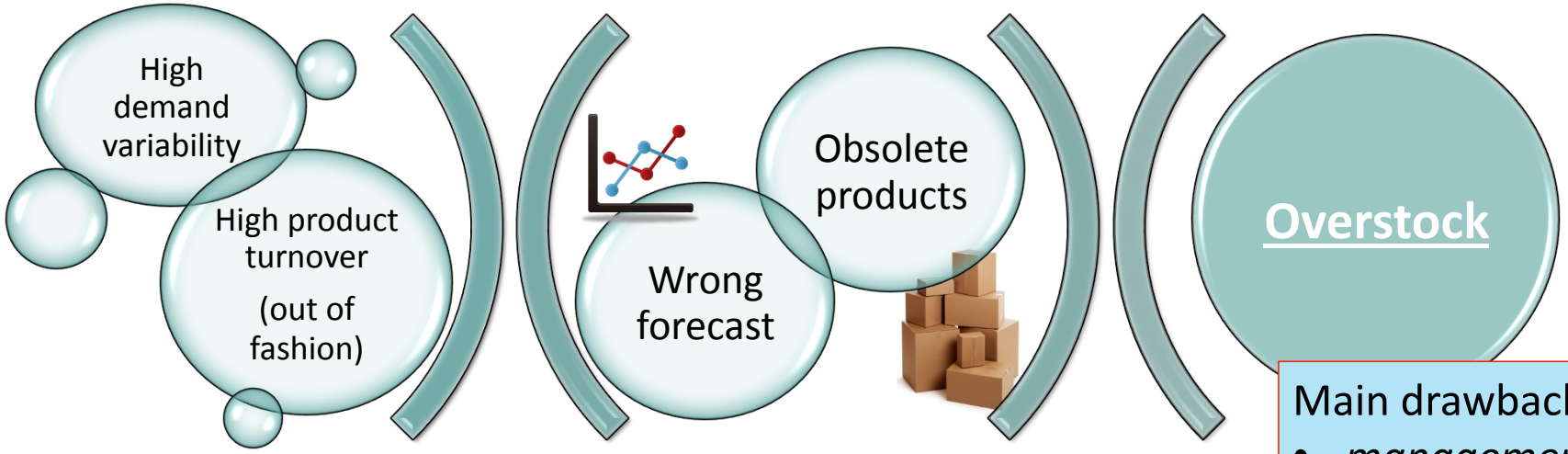

Fashion markets

Procurement planning & warehouse management

Main drawbacks:

- *management costs*
- *potential losses*

Out of fashion products & obsolescences

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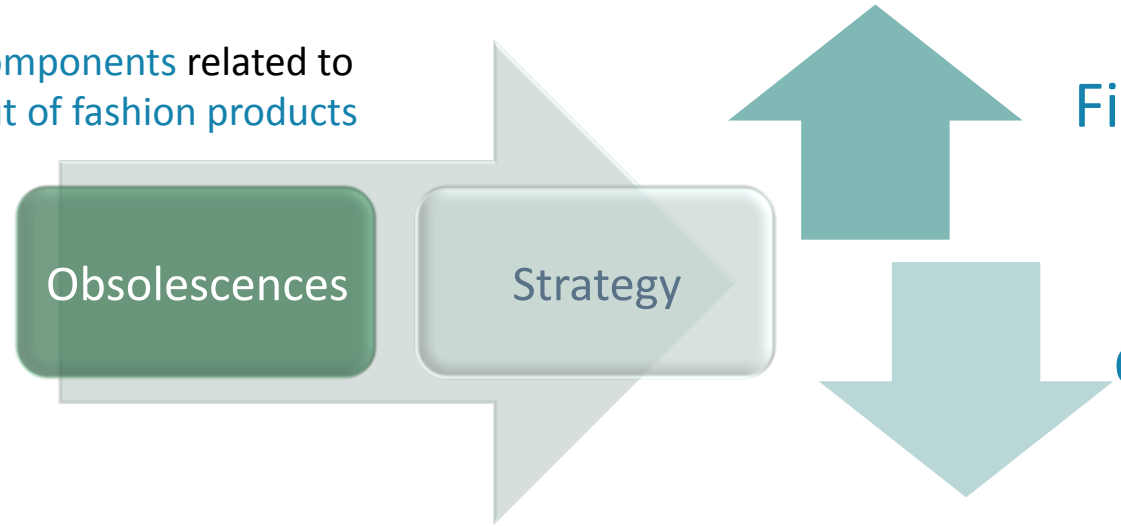
components related to out of fashion products



First market

Outlets / 2nd markets

~ 1000 different models
~ 3500 different components

reuse obsolescences in discounted products for outlets

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The Problem

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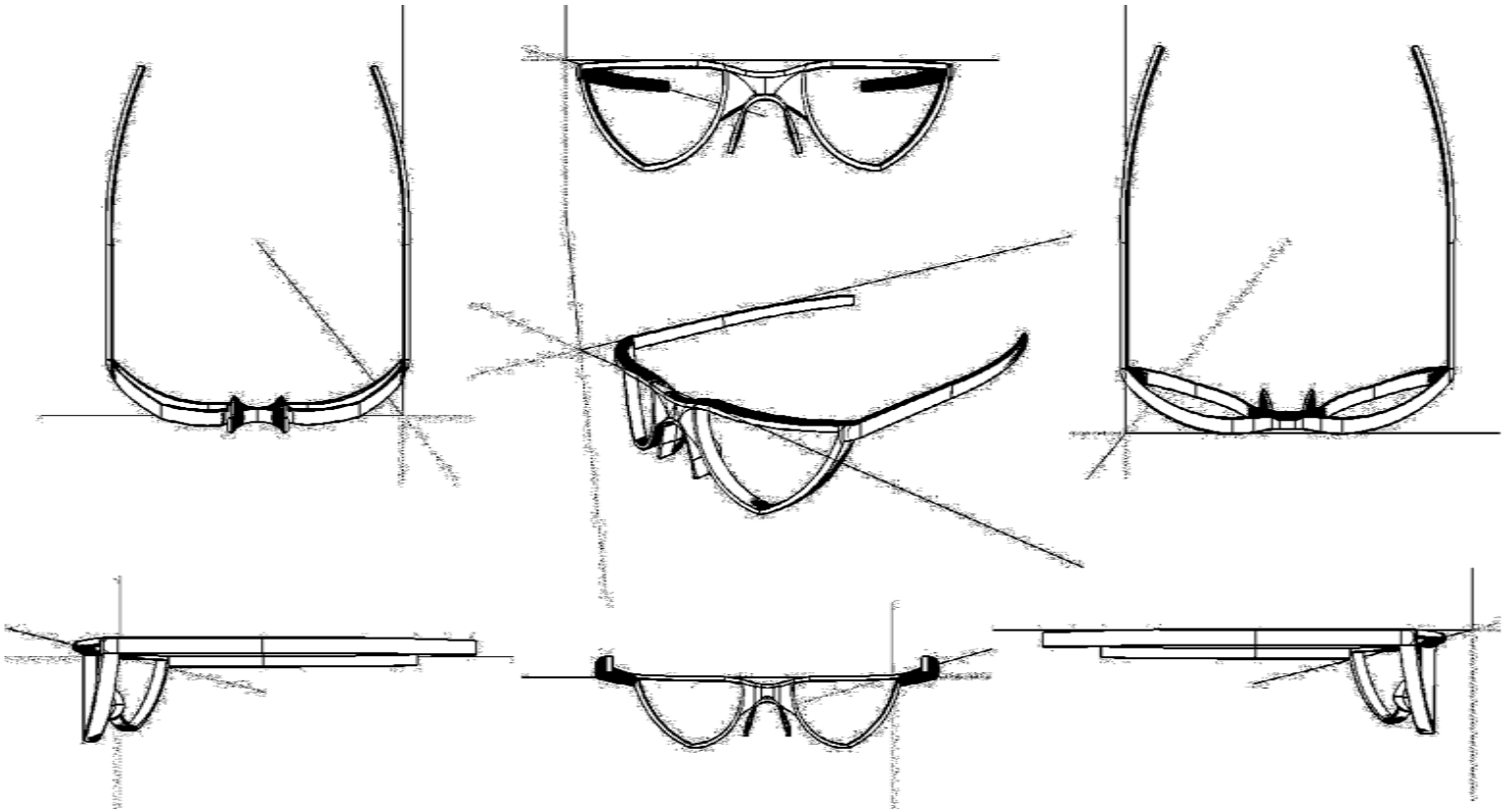
- Obsolete components overstocks are useless for the first market.
- They can be used for 2nd market products provided that new components are bought.

1. Find a production plan that maximize the *leverage* of obsolete components reusing
2. Learn to “buid” a “Frankenstein” glasses via AI/ML

- The problem is NP-hard
- The problem is not plant-wise decomposable
- Can we use ML & DL ?

DL Learning 3D models compatibility



Big Data Infrastructure

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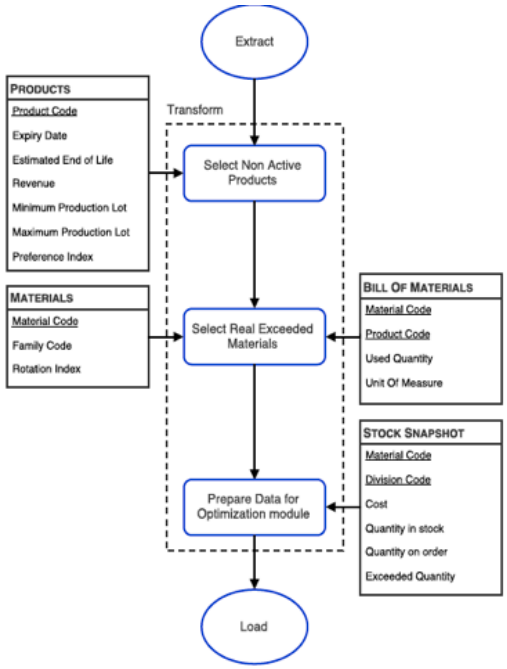

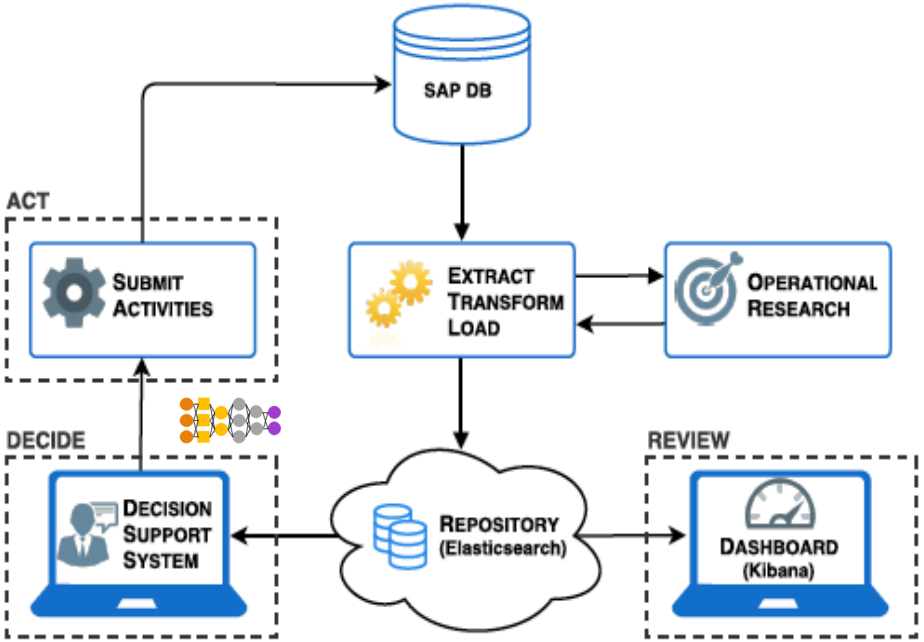

Mirco Sturari, Roberto Rosetti, Marina Paolanti, Fabrizio Marinelli, Emanuele Frontonia, Luca Di Camillo, **Big-data analysis for a DSS to optimize warehouse management**, Big Data Research, Elsevier, 2016

Optimal Component Reuse and Design Support System … LP & DL

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Input
- Bills of Material (BOM)
- Obsolete components
- budget for new orders
- orders & production lot sizes
- Design info & 3D models

Production Data

3D model

Component reusing LP Model

Transfer Learning

CNN

output
quantity and location of reused obsolete comps
quantity and type of purchasing orders

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Results (viable leverage of obsolete comp. reuse)

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Instance: a "snapshot" from the company: ~ 1000 obsolete products, ~ 3500 comp., 4 warehouses.

Setting:

- No budget and production bounds (Q, $H = \infty$)
- No order min lot sizes ($b_{ik} = 0$)
- No production lot sizes ($q_j = 0$ and $Q_j = \infty$)
- $\mu \in \{1, 0.9, 0.8, 0.7, 0.6, 0.5, 0.4, 0.3, 0.2, 0.1\}$

Problem size: ~ 6000 vars, ~ 2000 const, ~ 20000 nonzeros

CPU/GPU times: 1.42 secs on average (max 10 secs)

Absolute gap: 31 € on average (max 59 €)

R = tot revenue
P = tot cost of bought comp.
C = tot cost of used comp.

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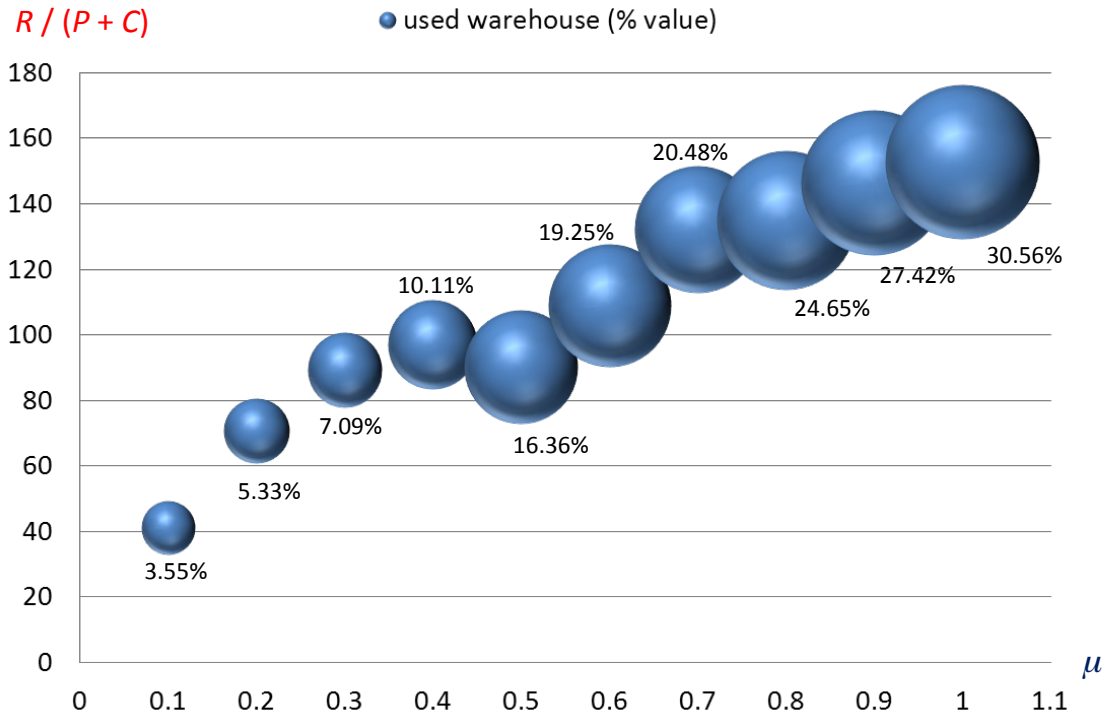
leverage of obsolete comp. reuse

μ	$R - P - C$ (M€)
0.1	4.9
0.2	13.8
0.3	25.2
0.4	42.1
0.5	67.8
0.6	103.0
0.7	141.5
0.8	184.2
0.9	233.1
1	287.1



R / P is always > 270

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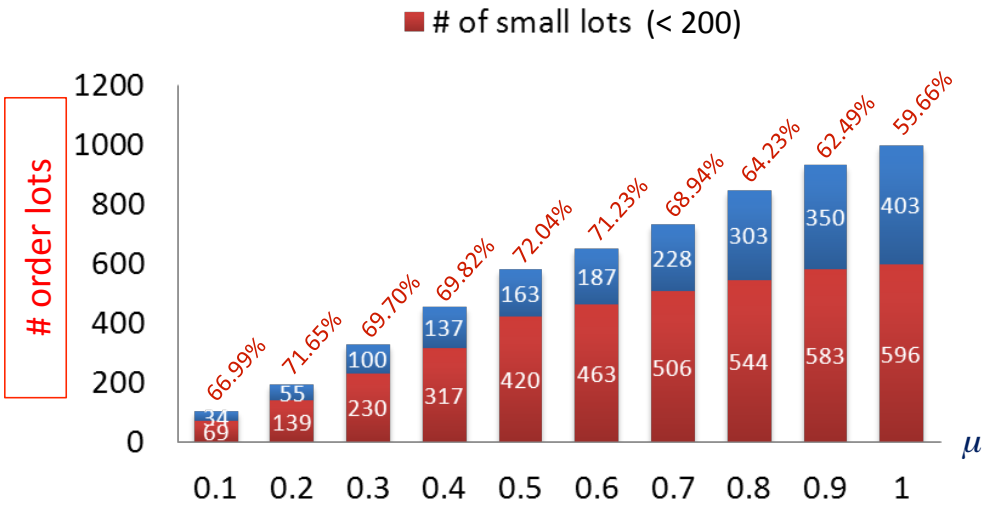
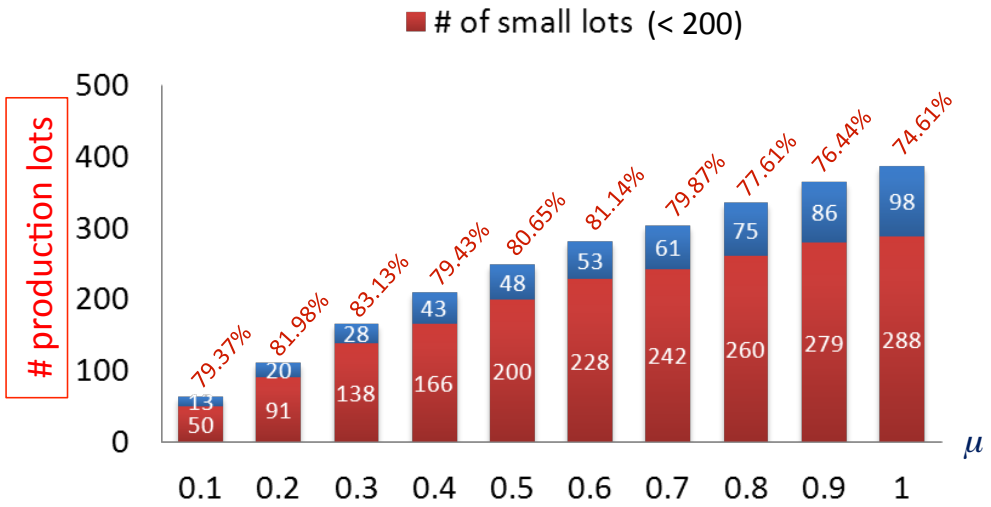
Assortment & production volumes





Too large assortment and too much small lots!

Results (viable leverage of obsolete comp. reuse)

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Instance: a "snapshot" from the company: ~ 1000 obsolete products, ~ 3500 comp., 4 warehouses.

Setting:

- Production bounds (Q = **100,000**)
- Order min lot sizes (b_{ik} = **200**)
- Production min lot sizes (q_j = **200** and $Q_j = \infty$)
- $\mu \in \{1, 0.9, 0.8, 0.7, 0.6, 0.5, 0.4, 0.3, 0.2, 0.1\}$

Problem size: ~ 31000 vars, ~ 33000 const, ~ 107000 nonzeros

CPU times: 18.2 secs on average (max 96 secs)

Absolute gap: 1.56 € on average (max 6.26 €)

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