

Solution Strategies for Dynamic Warehouse Location under Discrete Transportation Costs

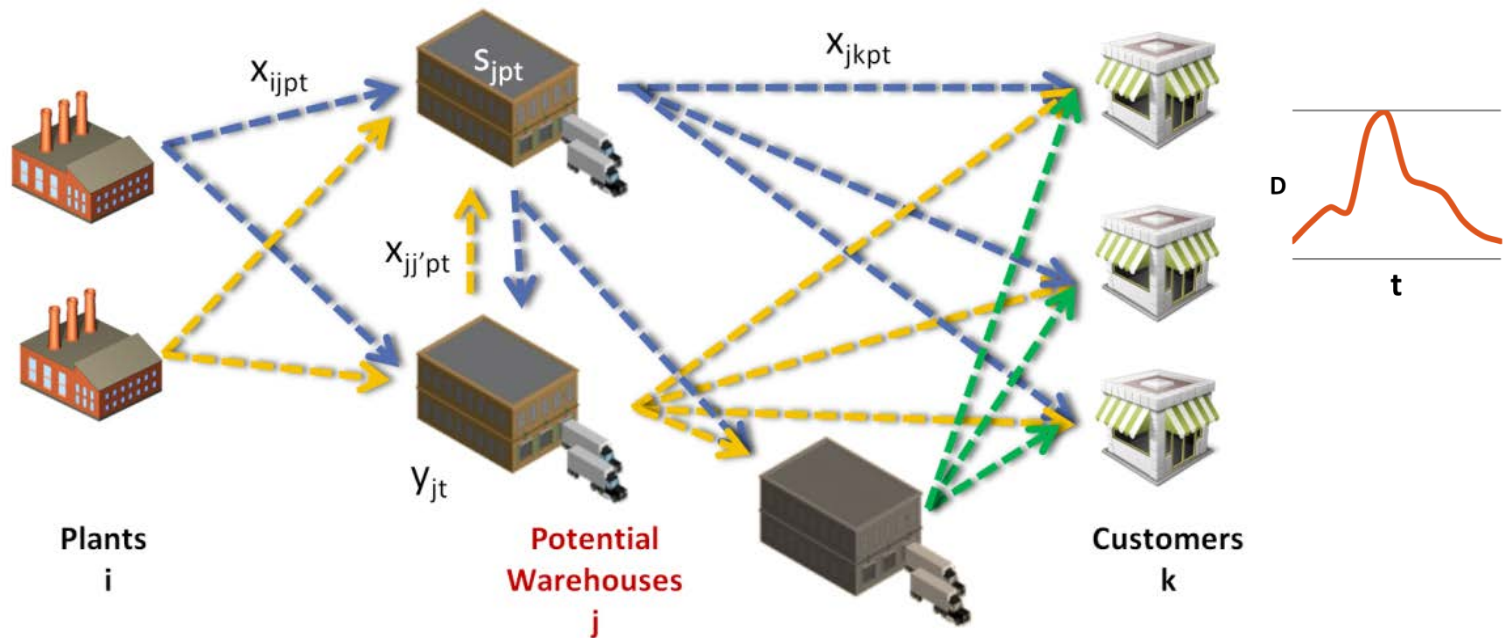
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Problem Description



t: time periods (months)

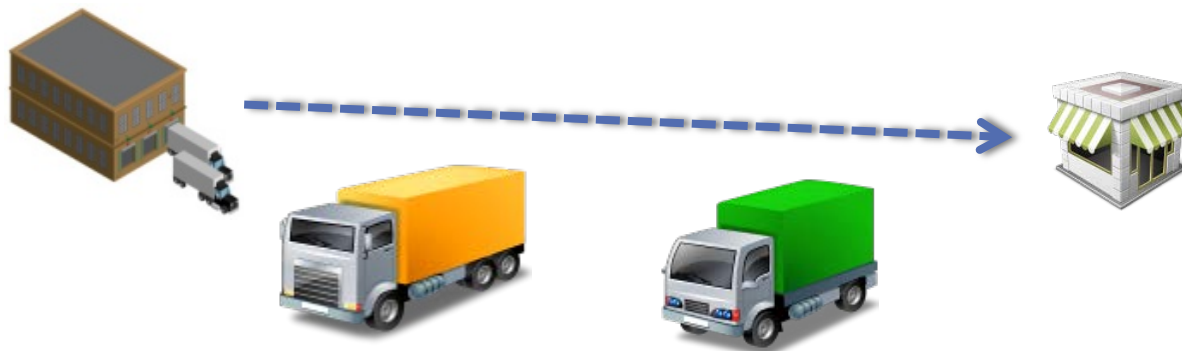
p: products

m: transportation modes

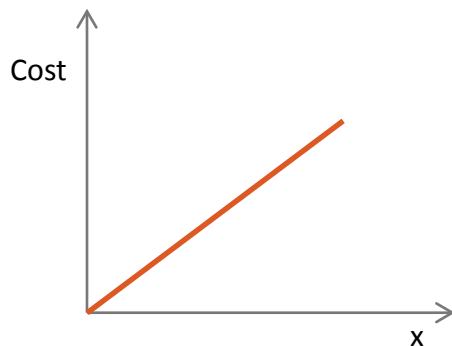
- Decide the number, size, location and contracting length for warehouses
- Dynamic decision of opening/closing warehouses at every period
- Plan the inventory allocation
- Multiple transportation modes, with discrete costs
- Seasonal Demand
- **Objective: Minimize total cost**

Discrete Transportation Costs

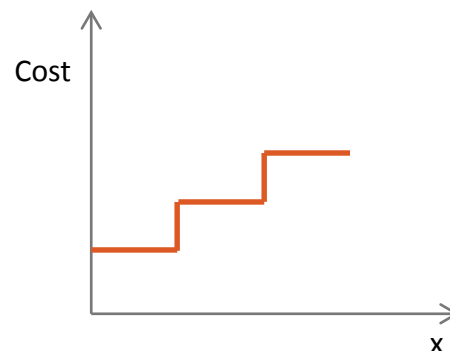
- For a defined transportation link we need to calculate how many **units** of each size (MOT) we need to use



Continuous

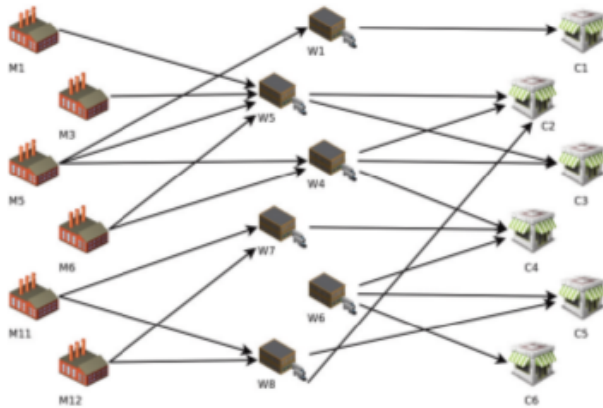


Discrete

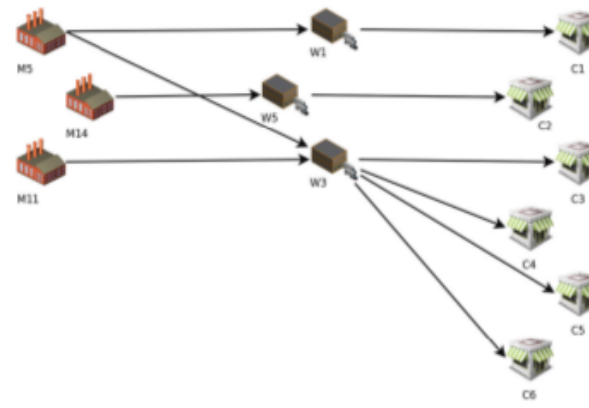


Effect of Transportation Costs

Continous Costs



Discrete Costs



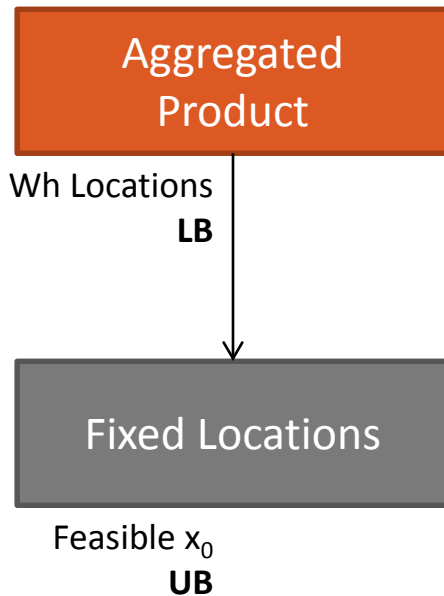
\$83 k	↓	Cost	↑	\$262 k
90 s	↓	Solution Time	↑	5 h
193 ton	↓	Inventory	↑	607 ton
807	↑	Shipments	↓	417
1.07 ton/shipment	↓	Shipment Size	↑	2.07 ton/shipment

It is important to consider discrete transportation costs

ADVANCED SOLUTION STRATEGIES

Hierarchical Decomposition

2 stage alternatives



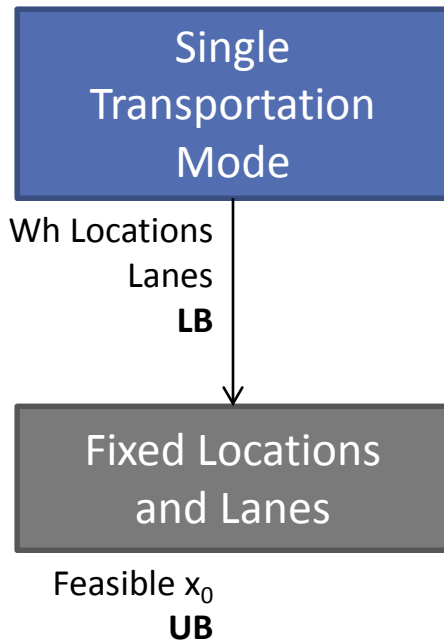
Idea:

1. Group products to solve a simpler problem and provide a LB
2. Fix warehouses to obtain UB

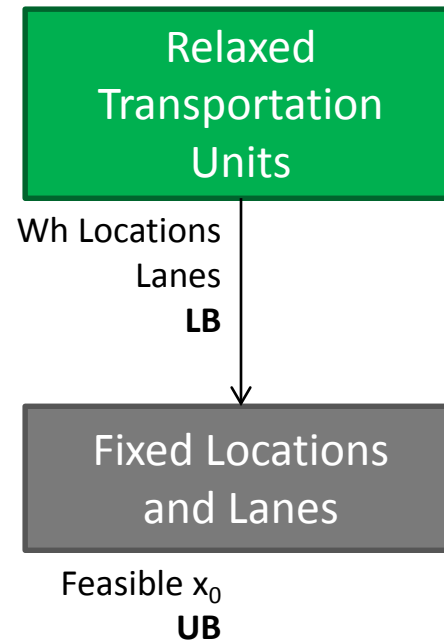
FSP

Hierarchical Decomposition

2 stage alternatives



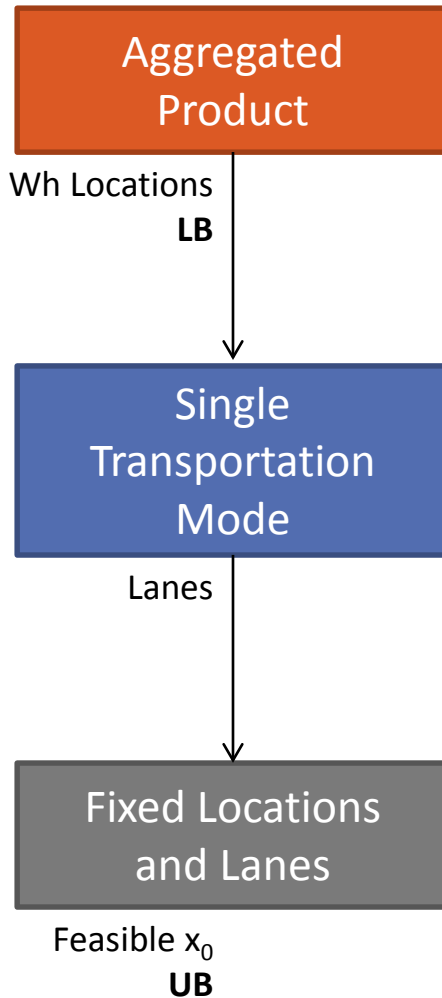
FSM



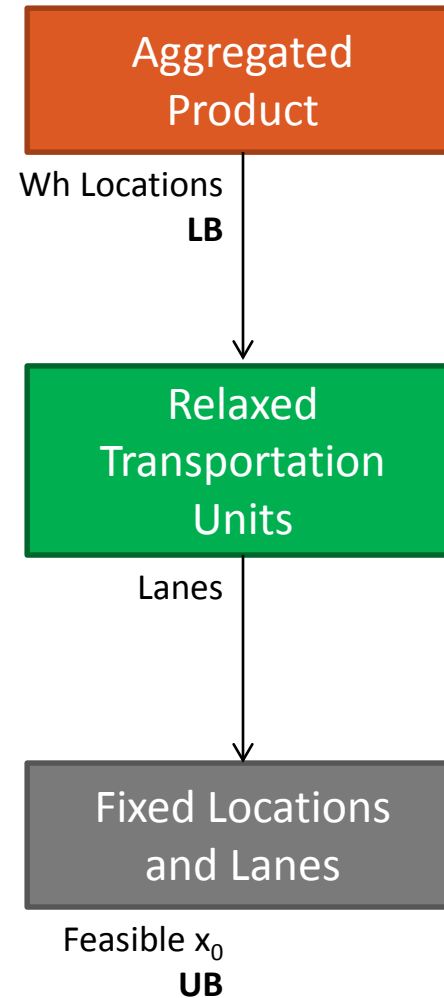
FRM

Hierarchical Decomposition

3 stage alternatives



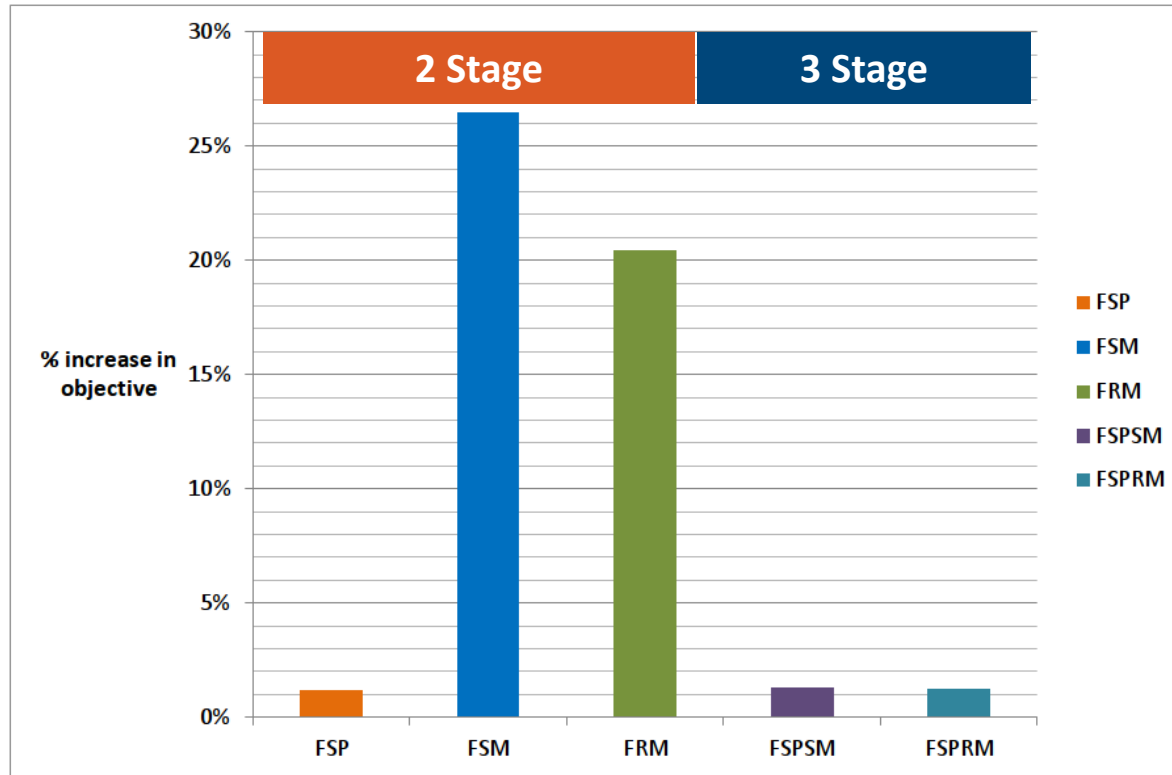
FPSM



FSPRM

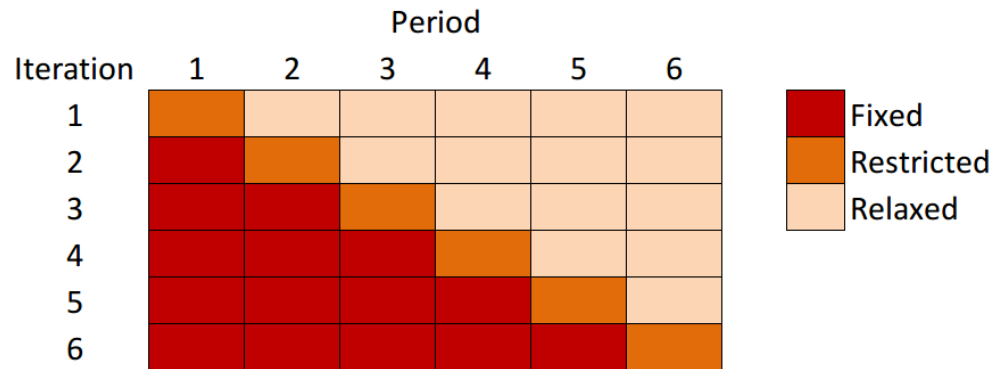
Results – Hierarchical Decomposition

582 small instances (12 months, 5/10/20 customers and products)

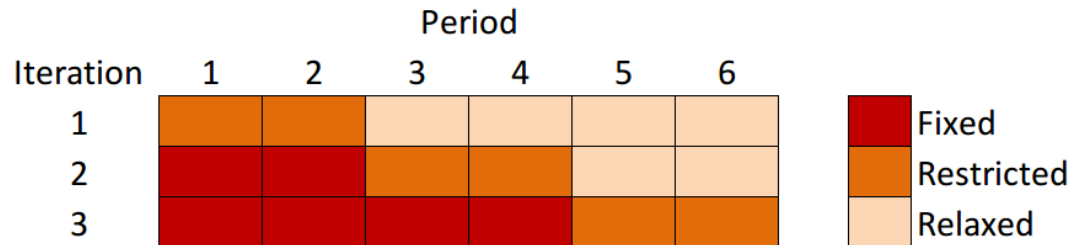


Rolling Horizon

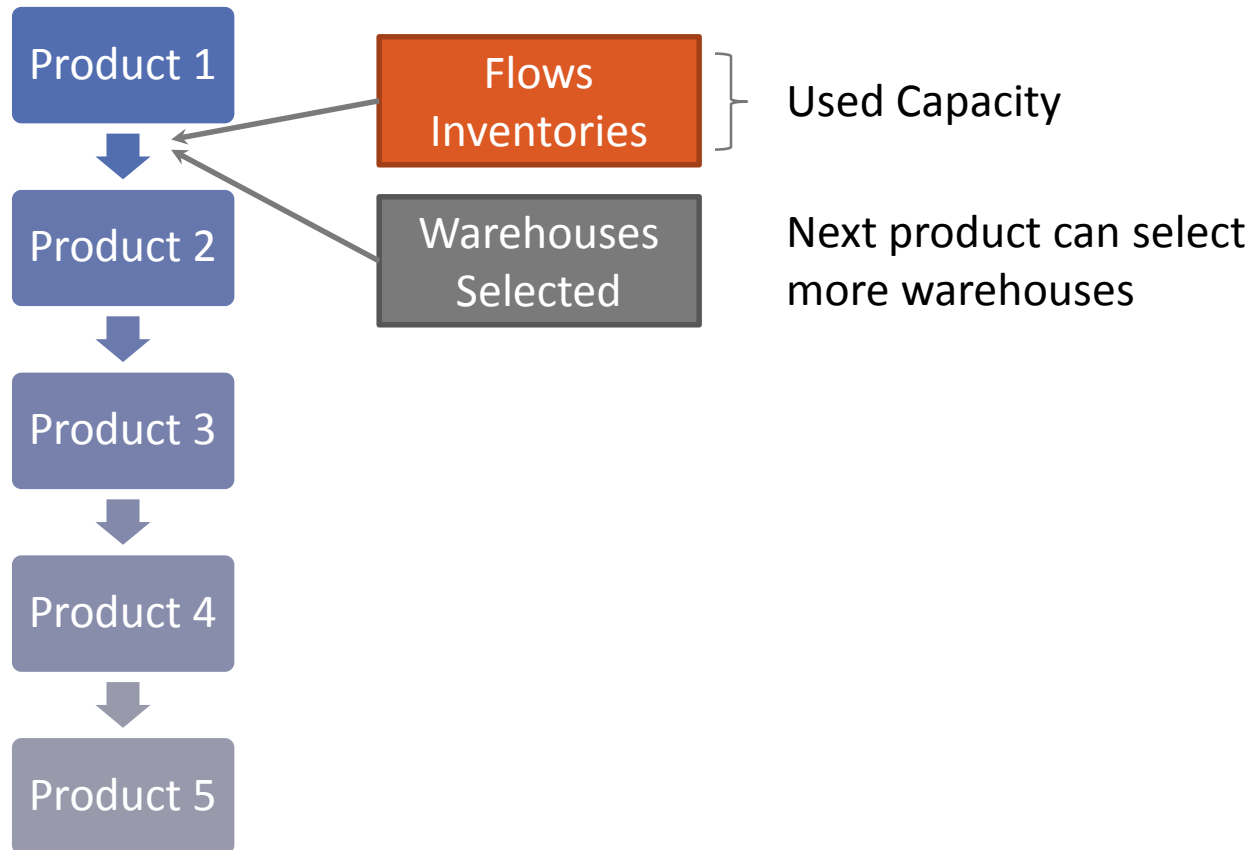
Single Period Shrinking Horizon



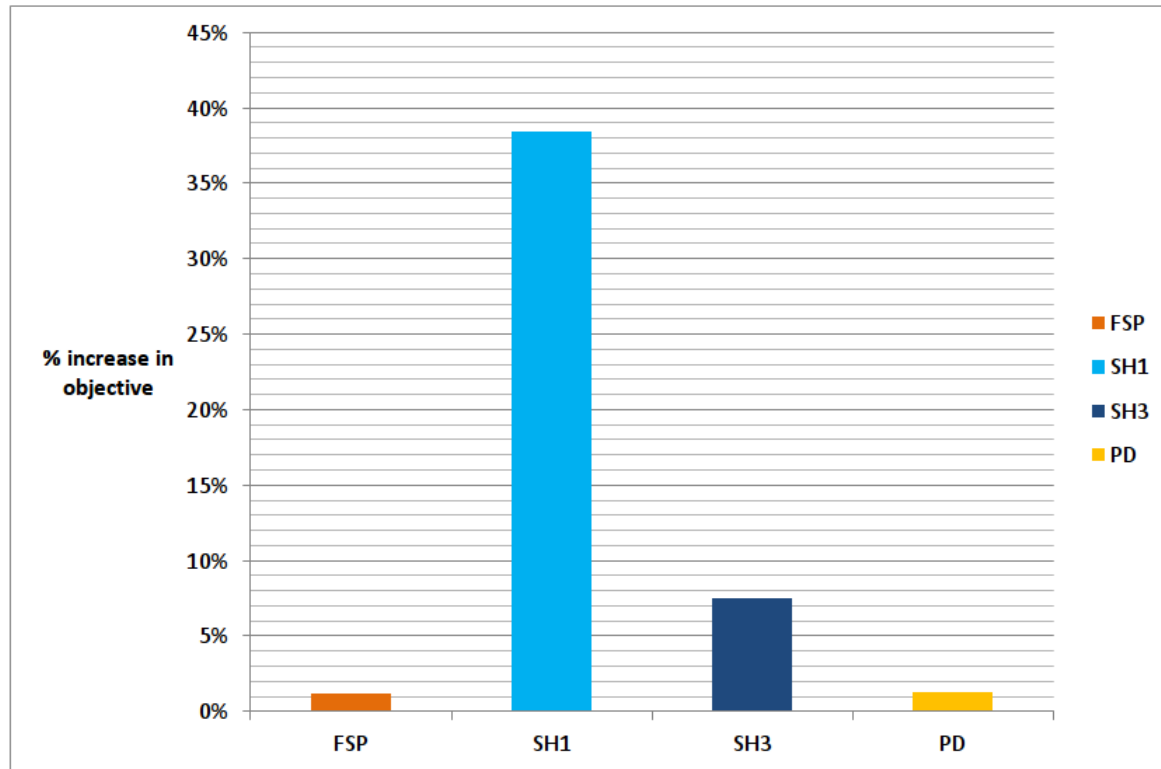
Multiperiod Shrinking Horizon



Product Decomposition



Results – Rolling Horizon and Product Decomposition

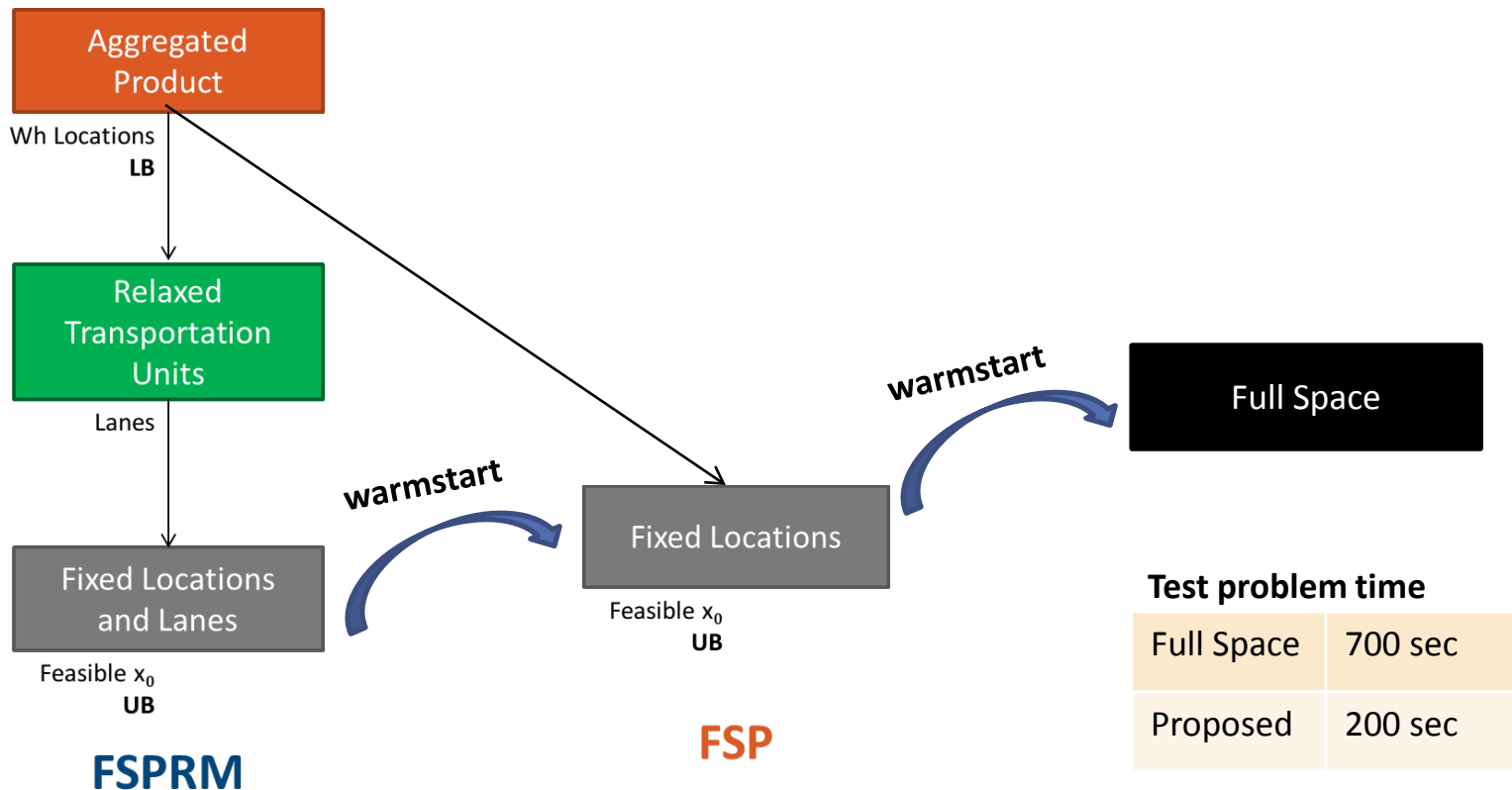


Time/Full Space Time	44 %	127 %	124 %	57 %

SH1: Single period shrinking horizon
SH3: 3-Period period shrinking horizon
PD : Product decomposition

Recommended Algorithm

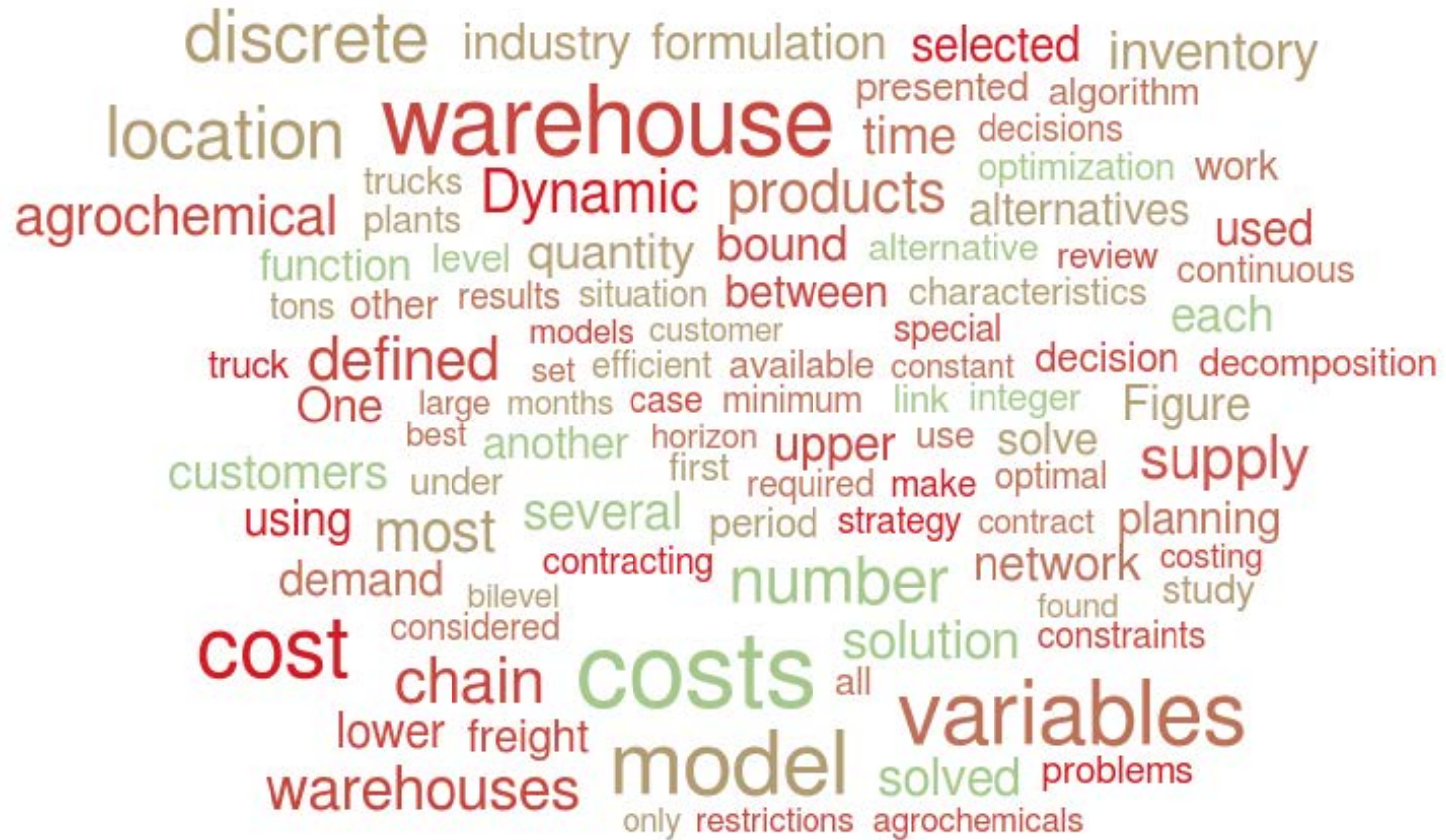
- To refine the solution or to rigorously evaluate a solution use the following scheme



Conclusions

Several algorithms were proposed to obtain good feasible solutions

1. Hierarchical decomposition with product aggregation (FSP) has an excellent performance
2. Product decomposition has better performance than shrinking horizon and it is very promising
3. Sequential warmstarting can be effective when good methods to obtain feasible solutions are available



Acknowledgments:

