
Workforce management in periodic routing

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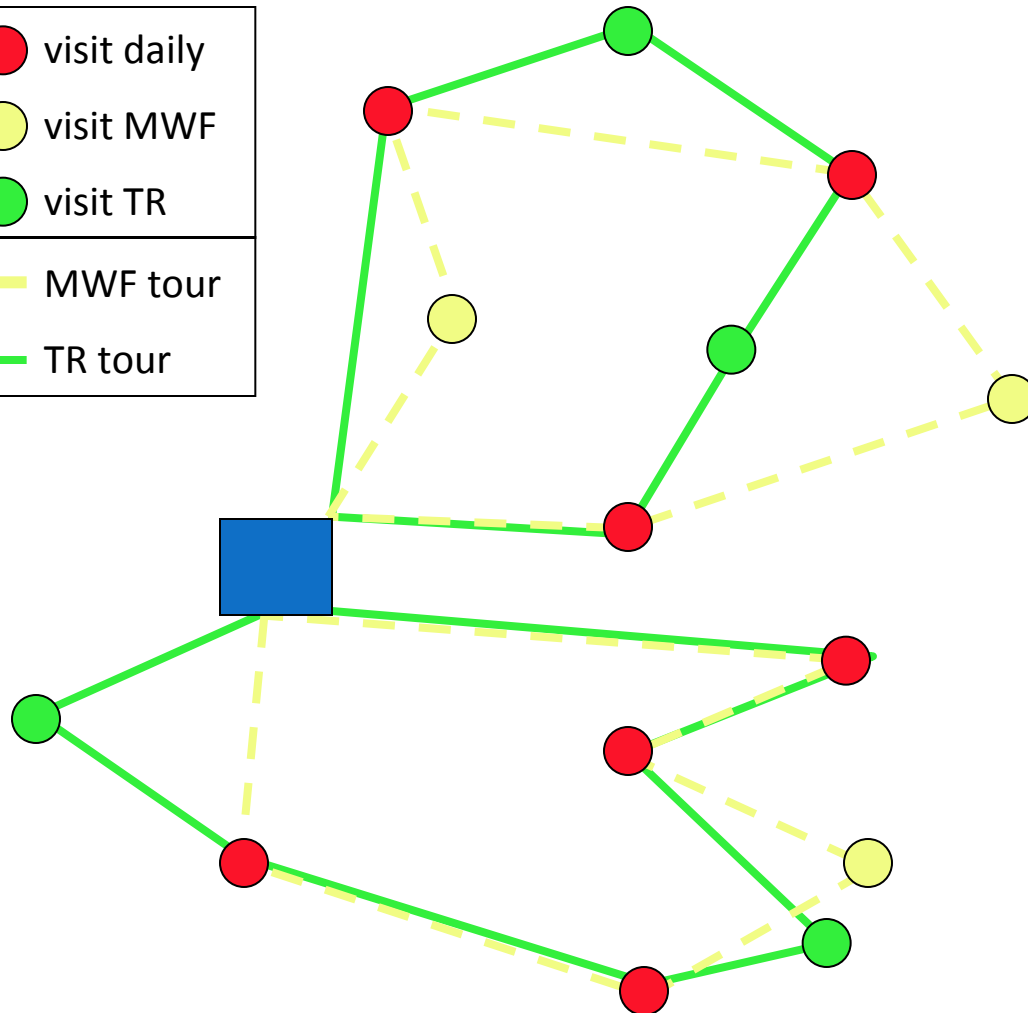
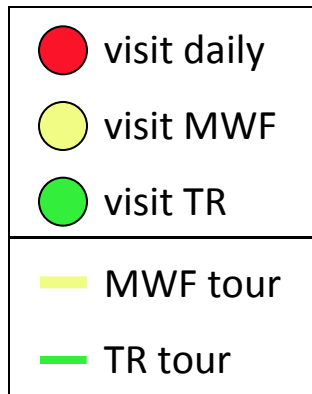
Maciek Nowak

Loyola University Chicago

Can library operations help UPS?



Period Vehicle Routing Problem (PVRP)



Serve customers over a period of time (days in week)

Given

- customer locations
- a depot location
- customer demands
- vehicle capacities
- service requirements

Find a set of tours that visits all customers with minimum length over a period of time and observes capacity restrictions

Commercial applications: grocery delivery; waste collection of waste, etc.

Operational complexity

Difficulty of solution implementation from the perspective of the service provider and its customers

Customer Familiarity

Reduce the cost per visit to a customer as the frequency of visits to that customer increases

Region Familiarity

Reduce the cost per visit to a region as the frequency of visits to that region increases

Why does operational complexity matter?

Zhong, Hall, and Dessouky (2004)

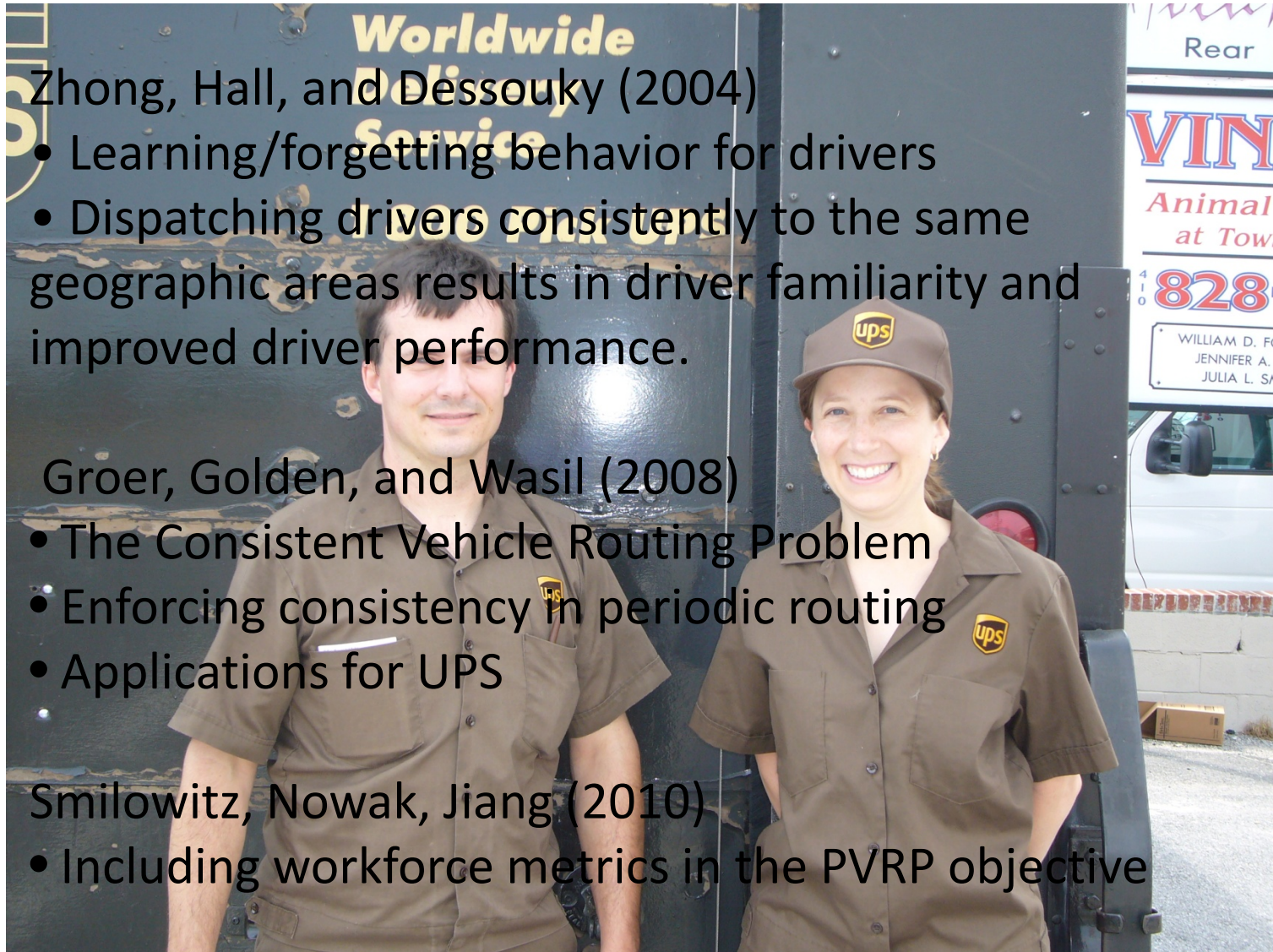
- Learning/forgetting behavior for drivers
- Dispatching drivers consistently to the same geographic areas results in driver familiarity and improved driver performance.

Groer, Golden, and Wasil (2008)

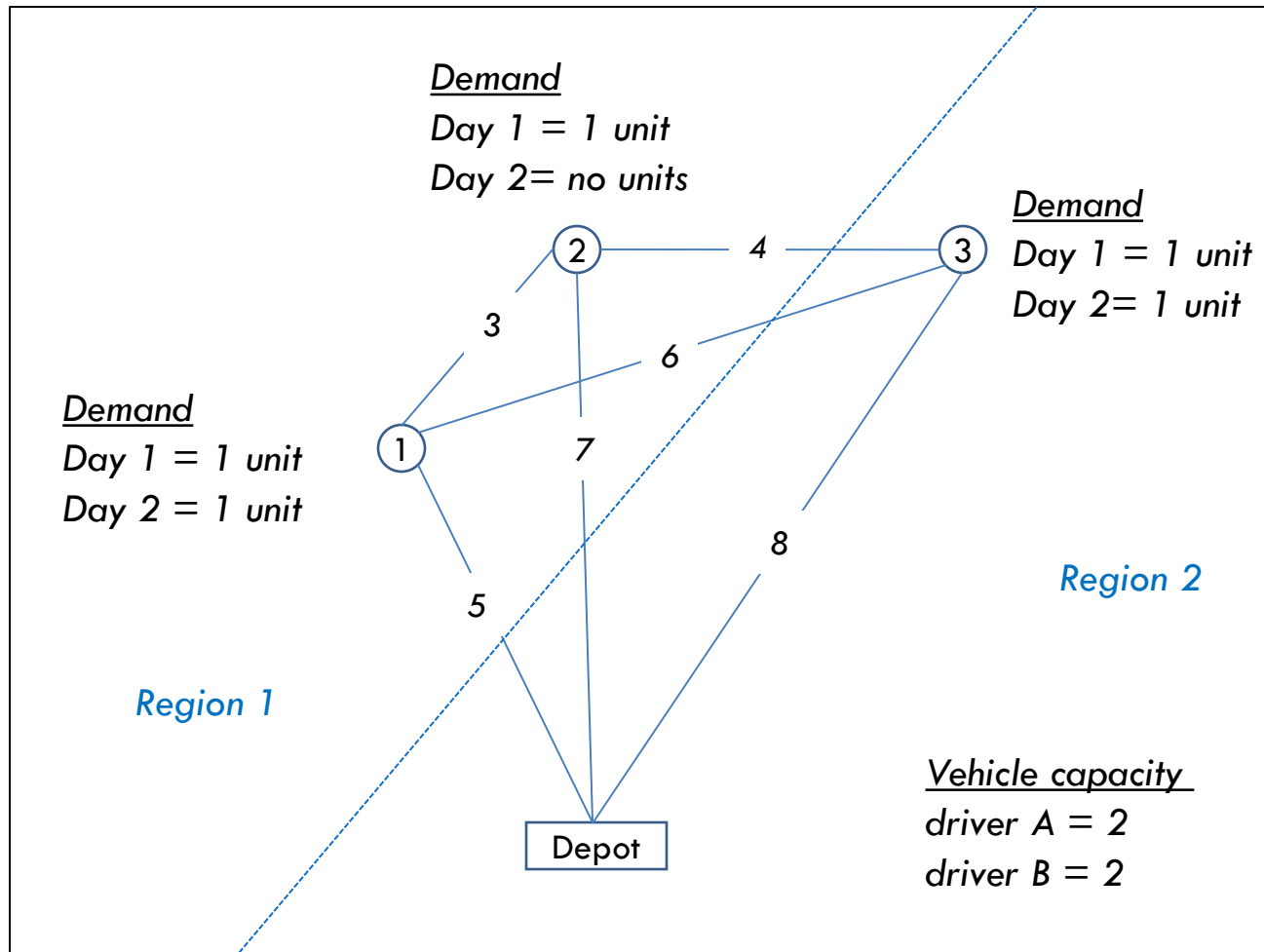
- The Consistent Vehicle Routing Problem
- Enforcing consistency in periodic routing
- Applications for UPS

Smilowitz, Nowak, Jiang (2010)

- Including workforce metrics in the PVRP objective

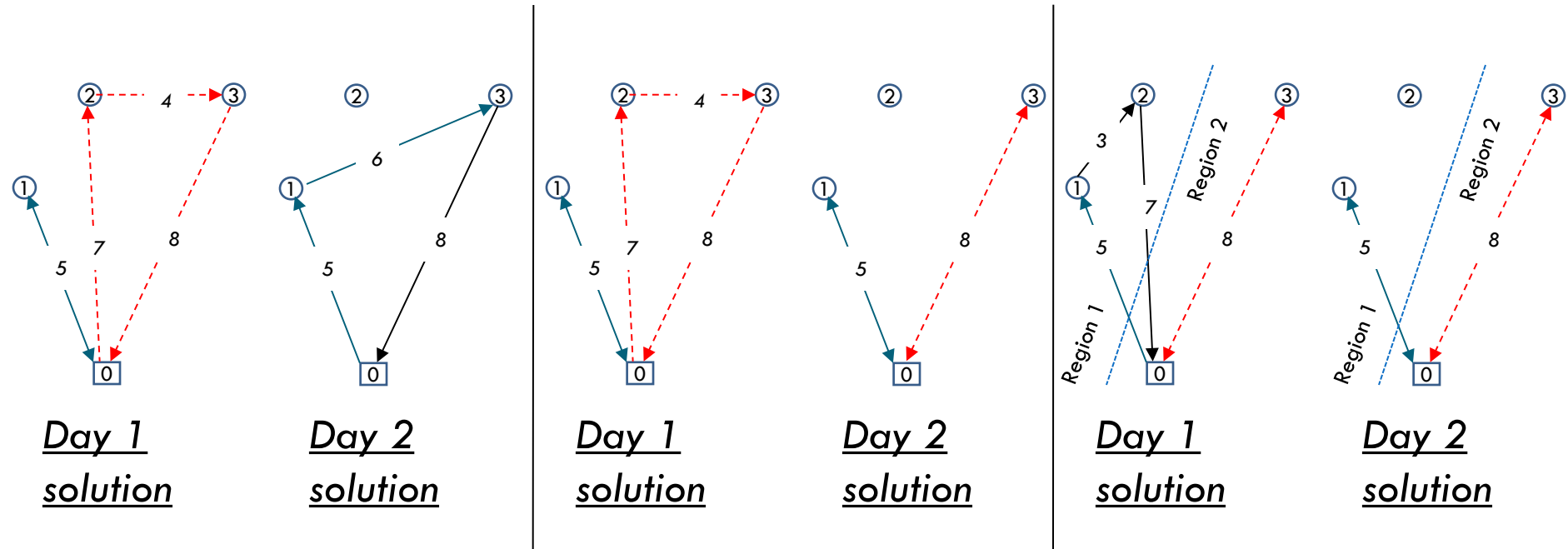


Example: how objectives change solutions



Comparison of sample solutions

— Driver A
- - - Driver B



Day 1
solution

Day 2
solution

Day 1
solution

Day 2
solution

Day 1
solution

Day 2
solution

(a) Minimize distance

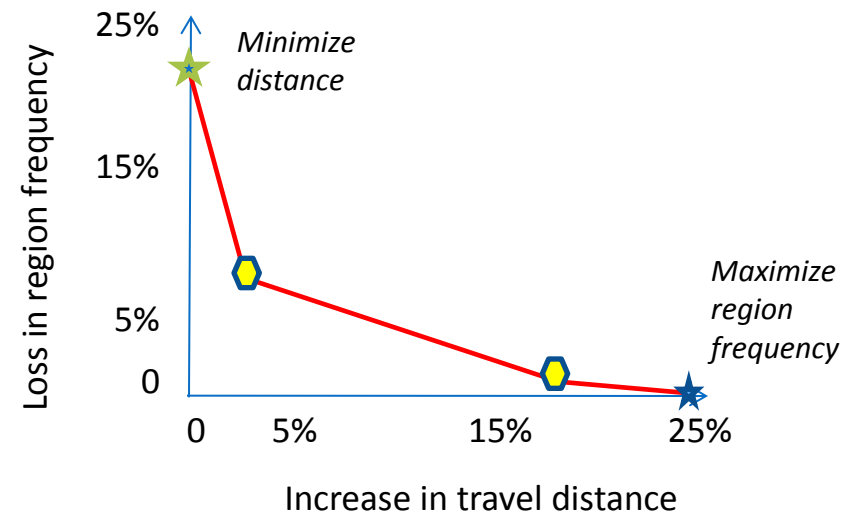
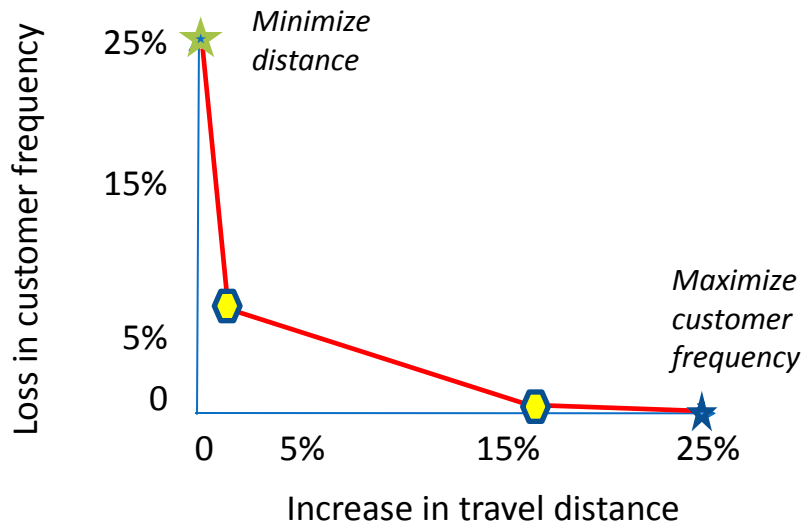
(b) Maximize customer familiarity

(c) Maximize region familiarity

Partition drivers by
 customers; increases
 number of drivers used

Partition drivers by
 regions; also increases
 number of drivers used

Observations



- Focusing solely on travel distance will not achieve satisfactory levels of workforce metrics.
- Using multi-objective models, one can obtain a satisfactory balance between workforce metrics and travel distance.

Next steps

- Analysis with UPS data
 - Should operational complexity be a constraint or an objective in the problem?