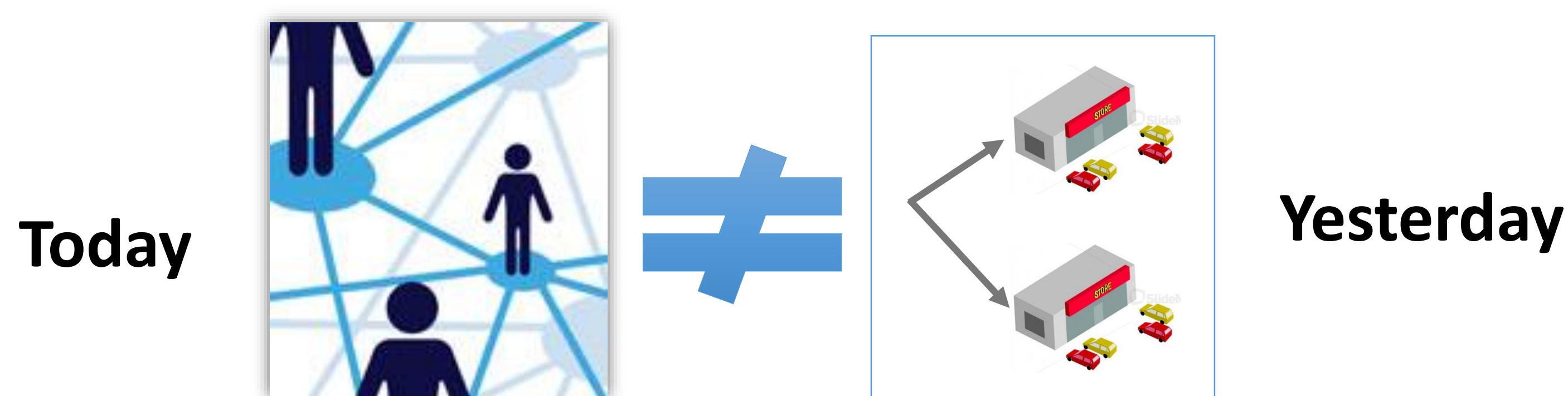


On the Unique Features and Benefits of On-Demand Distribution Models

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Today's Distribution Networks are Optimized for Yesterday's Customers



A wide variety of requests are made with little warning and are expected to be fulfilled quickly in small units to many dispersed locations, affordably.

Distribution fulfilled requests for **Known**, **Fixed**, & **Aggregated** Demand Points.

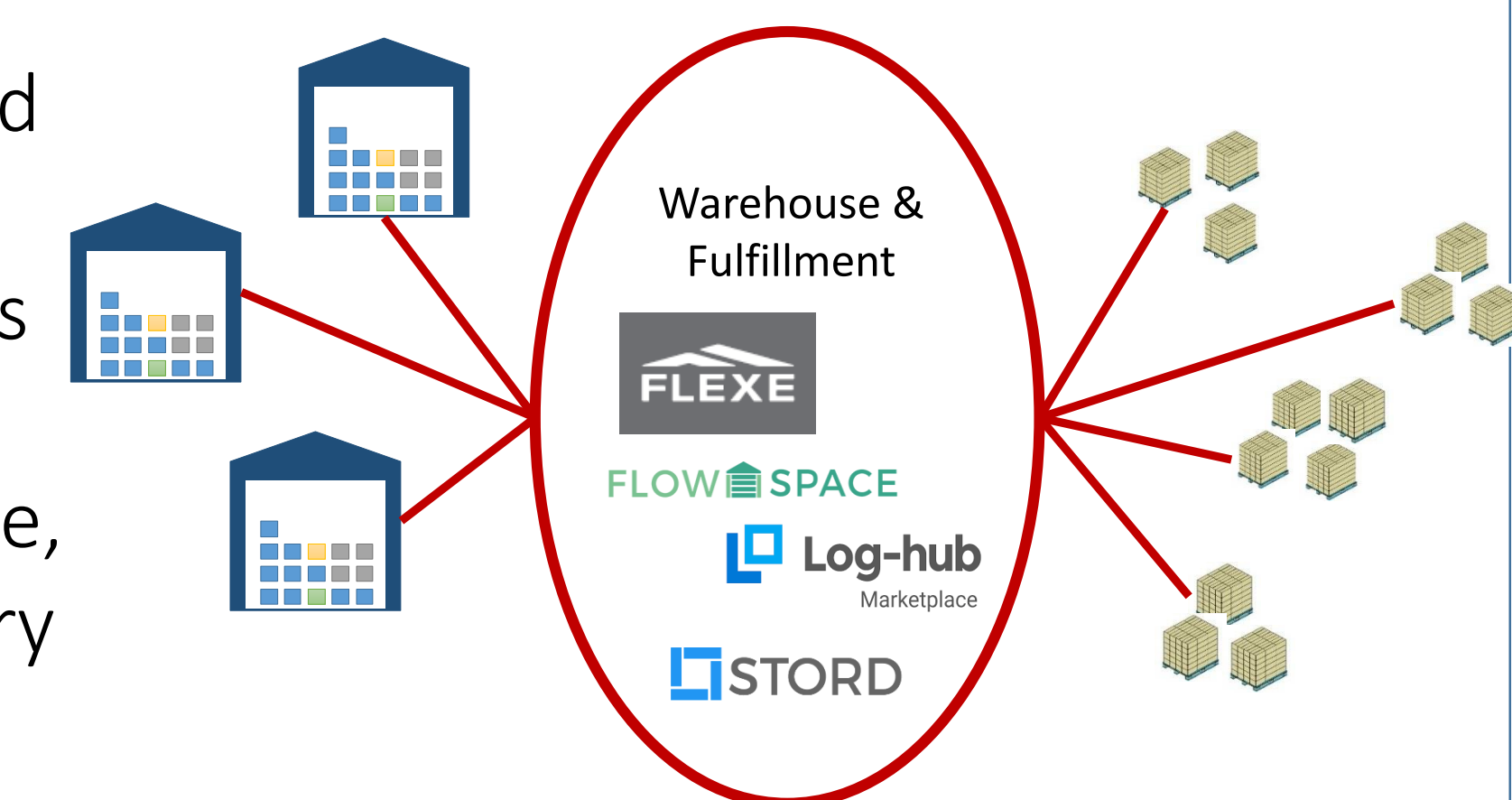
A 2017 JDA survey found only 10% of global brick-and-mortar retailers are profitably fulfilling e-commerce orders.

Source: <http://now.jda.com/CEO2017.html>

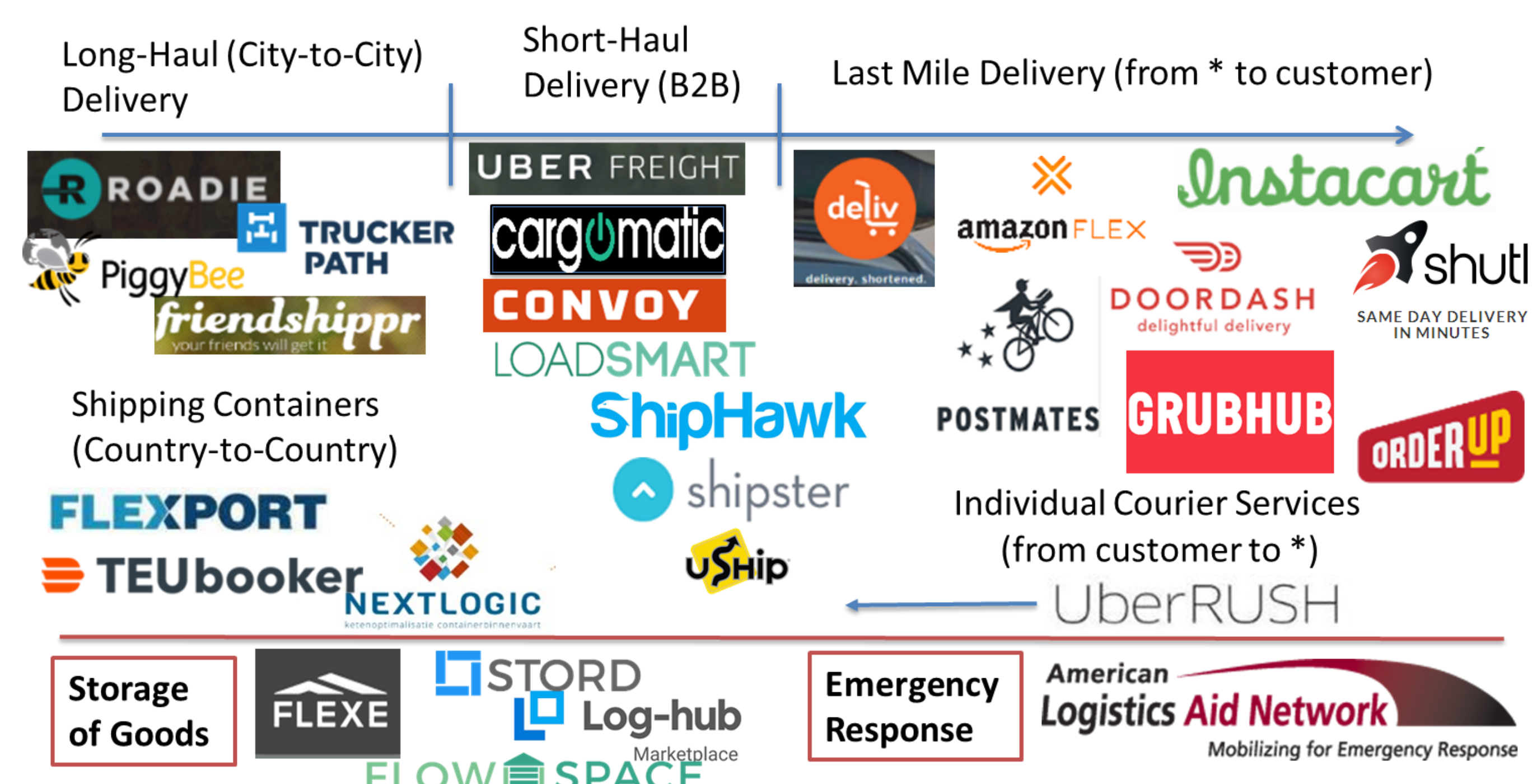
∴ We need to think differently about how resources are acquired, managed and allocated to fulfill today's customer requests.

On-Demand Distribution Platforms

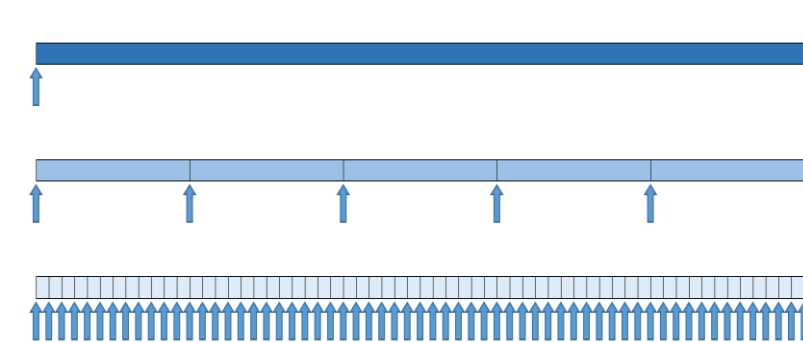
Operate marketplaces, in which a crowd of independent entities rent access to their resources. The platform facilitates on-demand matching of demand requests to resources (warehouse space, fulfillment services, truck space, delivery services).



Movement of Goods: "Crowdshipping"



Users' Benefits of On-Demand Warehousing Models



1. Access to Scale

2. Reduced Capacity Granularity

3. Reduced Commitment Granularity

These benefits need to be traded off with different cost structures.

Type	Capacity (K_{jp}^a) (in pallets)	Pallet storage cost per pallet per month with $\beta = 100\%$ utilization	Pallet storage cost per pallet per month with $\beta = 80\%$ utilization
Construct	30,000	\$2.02	\$2.53
Construct	70,000	\$1.89	\$2.36
Construct	160,000	\$1.73	\$2.16
Lease	10,000	\$2.27	\$2.84
Lease	20,000	\$2.25	\$2.81
Lease	30,000	\$2.23	\$2.79
Lease	70,000	\$2.15	\$2.69
Lease	160,000	\$1.97	\$2.46
On-demand	---	\$7.96 - \$15.63	\$7.96 - \$15.63

Optimization Models to Evaluate On-Demand Warehousing Strategies

- Developed a mixed integer linear programming model to determine facility location and type, as well as demand allocation over multiple periods.
- Novelty: multi-period capacitated facility location-allocation model with different commitment and capacity granularities that simultaneously considers three warehouse alternatives.

The model is used to answer the following open research questions:

- Given user benefits, but also differences in cost structures, is there a business case for a company to use on-demand warehousing?
- How should a company's distribution network be designed given the genesis of on-demand options (as well as existing build and lease options)?
- What influences these decisions?

Preliminary Results

Test scenarios:

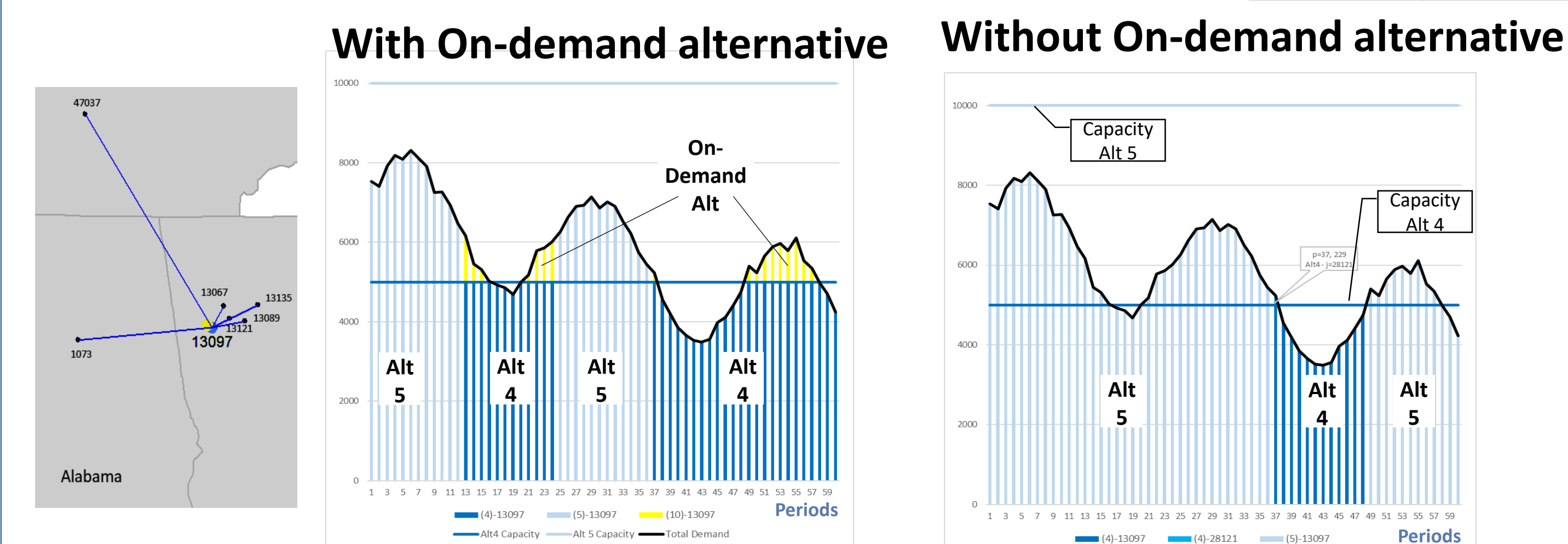
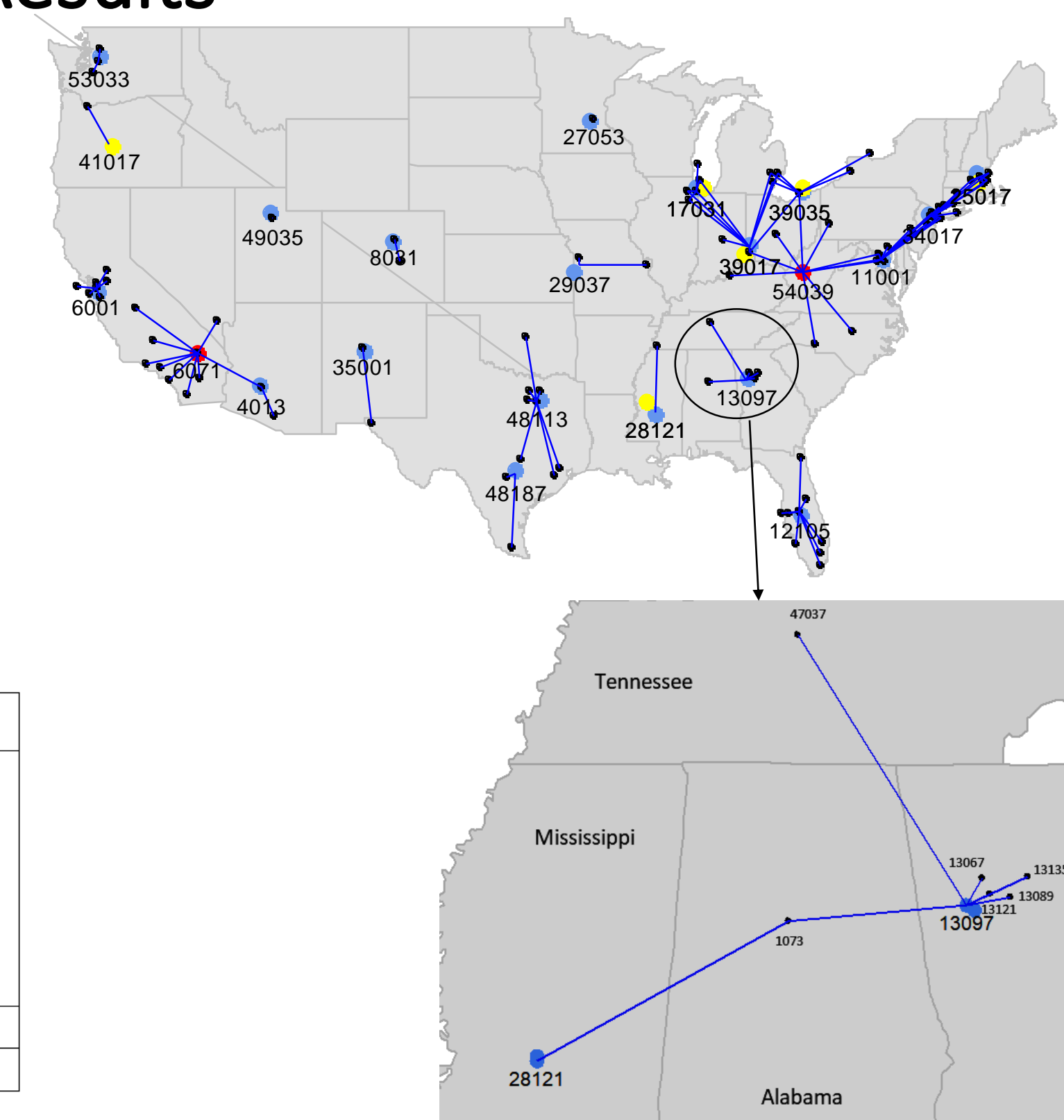
- Most populated 100 counties (~43% of the US population)
- 25 candidate locations
- 60 monthly periods (5 years)

US Network Preliminary Results:

Average **5.54%** reduction in distribution center costs with on demand alternative

Distribution Center Cost Comparison for the Selected Region

Region-1		With On-Demand Alt			Without On-Demand Alt		
Alt	Type	# of openings	Initial Cost	Fixed Cost	# of openings	Initial Cost	Fixed Cost
4	Lease	3	\$50,145	\$391,511	2	\$33,430	\$141,379
5	Lease	2	\$65,586	\$519,907	4	\$131,173	\$1,039,815
10	On-demand	Total Pallets	Holding Cost	Handling Cost			
		10939	\$42,880	\$85,324			
Total			\$1,155,356			\$1,345,798	
% Diff			16.48%				



On-Going Studies & Future Research

- Developing solution approaches (column generation based) to solve large problem instances, needed to measure access to scale.
- Design of Experiments to quantify the value of on-demand warehousing in a wide variety of scenarios.
- Stochastic supply capacity and stochastic demand considerations.
- Facility logistics operational and design for an on-demand renter of space.

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