IPIC 2019 | 6th International Physical Internet Conference | London

PHYSICAL INTERNET ENABLED HYPERCONNECTED FULFILLMENT OF TIME SENSITIVE E-COMMERCE ORDERS DELIVERY

-SERVICE-DRIVEN FULFILLMENT-

SERVICE-DRIVEN FULFILLMENT

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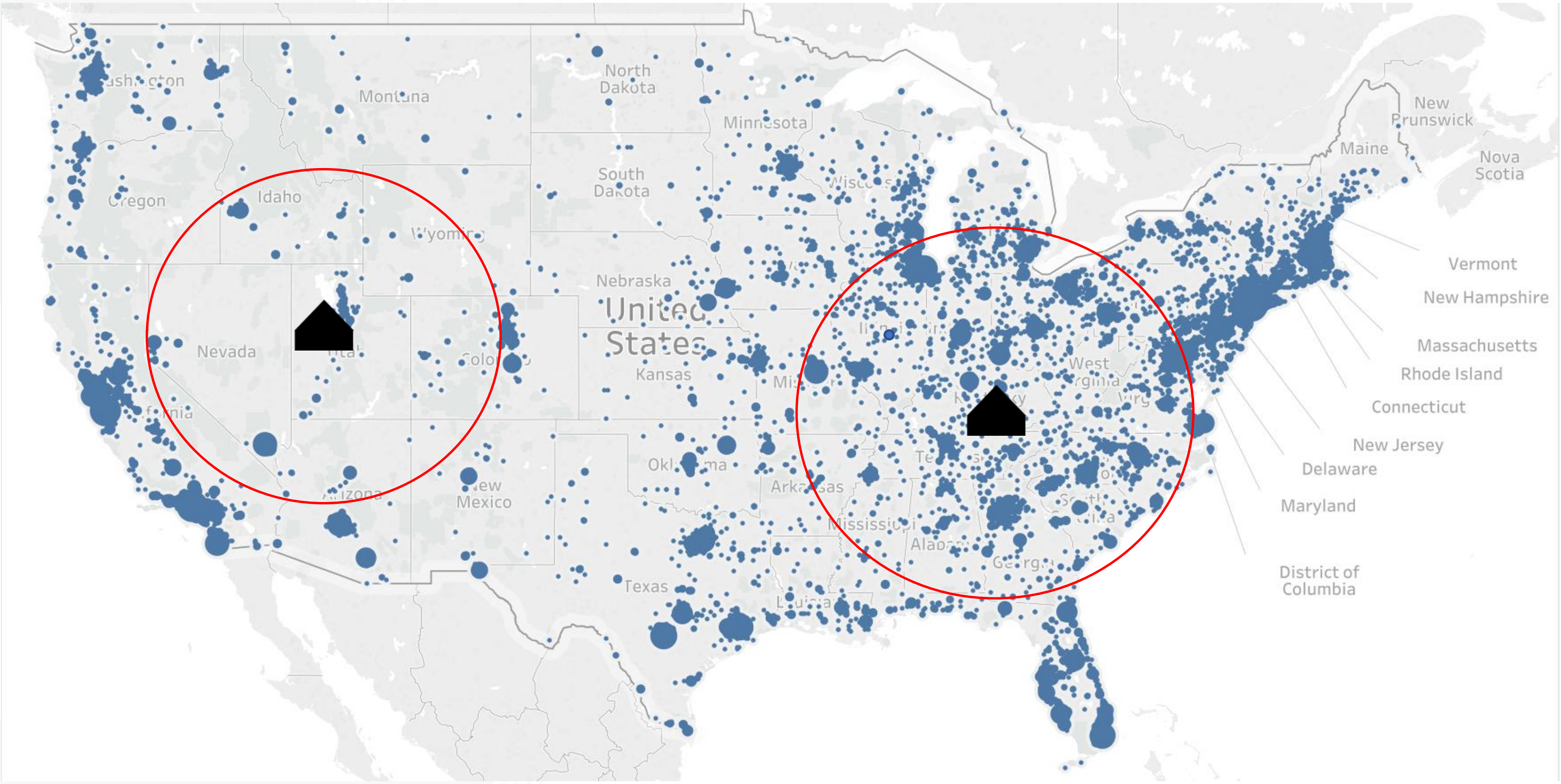
Online Order Fulfillment – Changing Business Environment [1]-[3]



Market Size ↑

Customer Required Delivery Leadtime ↓

Competition ↑

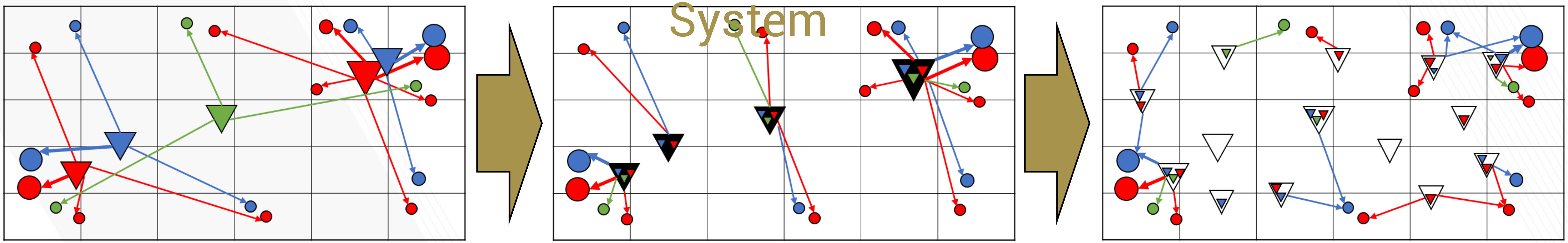
Service incapability causes customer dissatisfaction → customer loss

Can hyperconnected fulfillment system be a solution to meet customer needs without tremendous capital investment?

[1] Agatz et al., 2008; [2] Lang & Bressolles, 2013; [3] Jie et al., 2015

Hyperconnected Distribution/Fulfillment System (HDS/HFS)

Transformation of Distribution/Fulfillment System



Dedicate

Collaborative

Hyperconnected

Three dimensions of transformation to hyperconnected distribution

Resource[4] [5], Operation[6] -[8], Players

FLEXE

Open
On-demand
Broader

Sourcing/Inventory/Transportation

Dynamic, Flexible
Integrated/Standardized
& Encapsulated

Unrestricted Multi-player
New Business Model
Service Provider/User

ES3
Supply Unchained.

[4] Sohrabi et al., 2012; [5] Sohrabi et al., 2016; [6] Yang et al., 2017a; [7] Yang et al., 2017b, [8] Pan et al., 2015

Hyperconnected Fulfillment System (HFS)

- Resource
  - Dedicated vs. Open FC network
- Operation (Sourcing)
  - Demand zone allocation vs. Flexible fulfillment

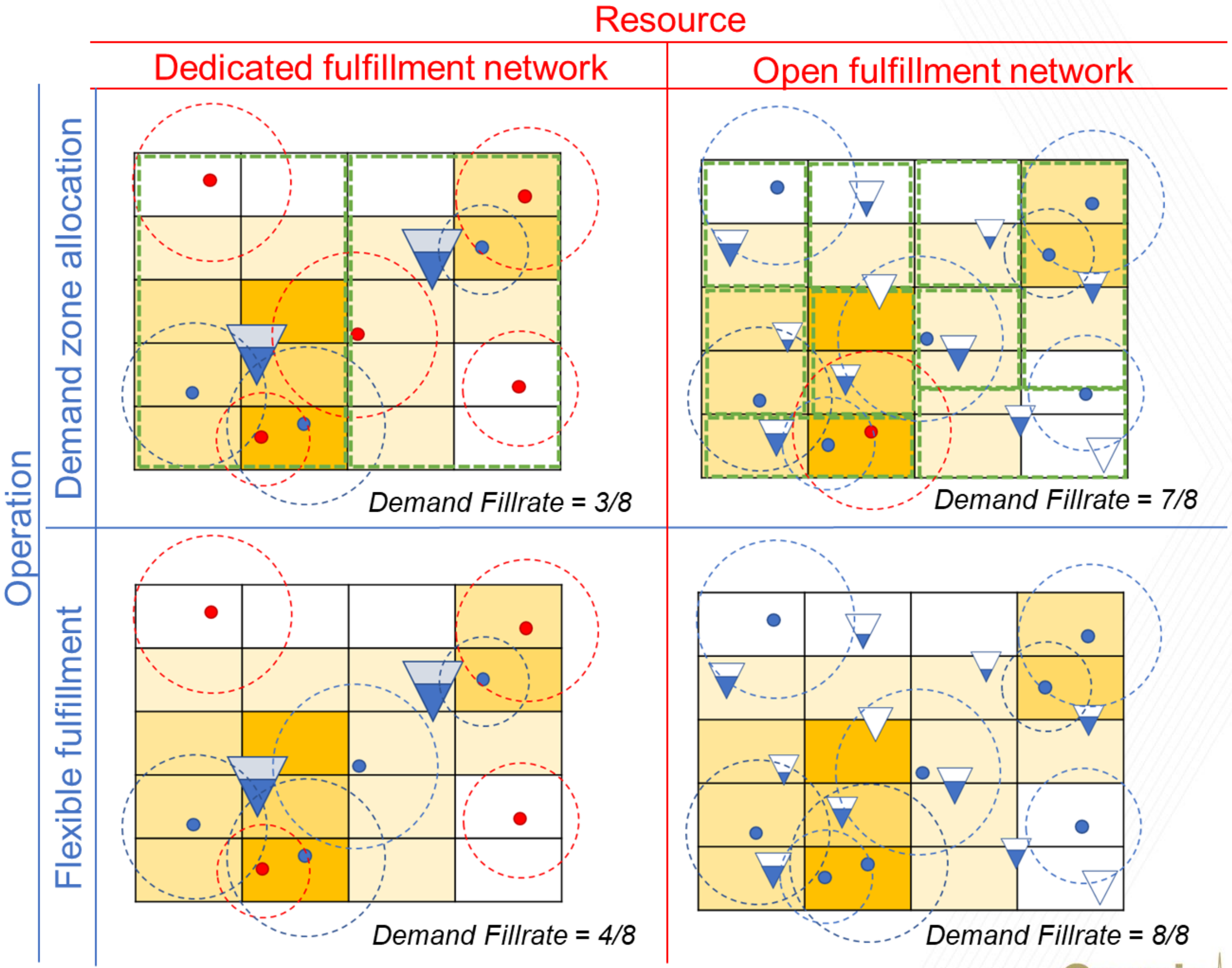
Demand fillrate can potentially improved by increased customer proximity and flexible fulfillment from pooled inventory

▼ ▽ Dedicated/Open fulfillment facility

● Customer orders (red if lost)

◌ Area within the maximum distance w.r.t. required response time

🟩 Area allocated to be served by a facility



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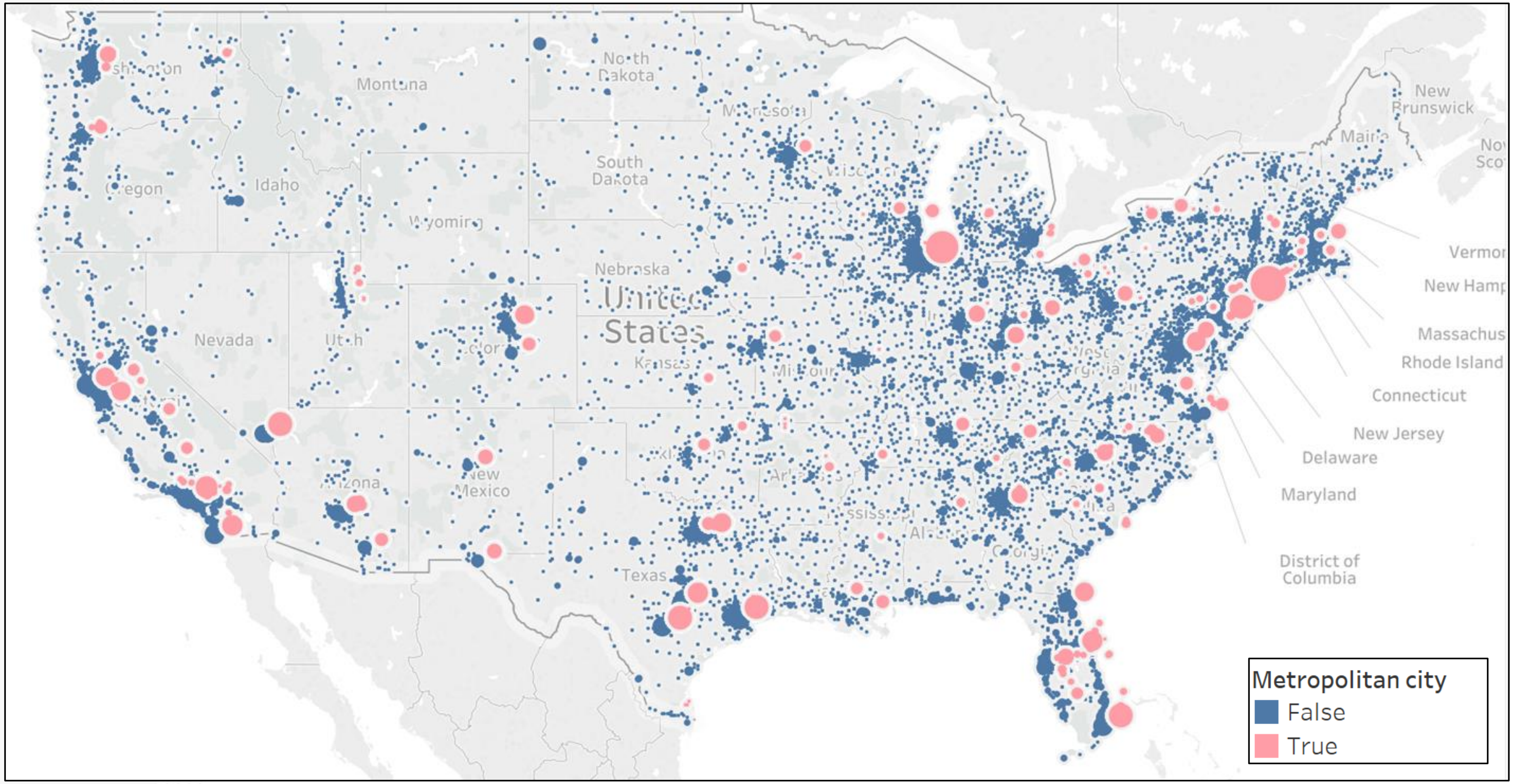
Case Study: E-Commerce Manufacturer in USA Market



Assume customer require certain delivery lead time sensitive to area.
Demand will be lost if the lead time cannot be met.

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Case Study: Scenario Design

Market Environment
Customer requested
delivery leadtime
Fast vs. Slow

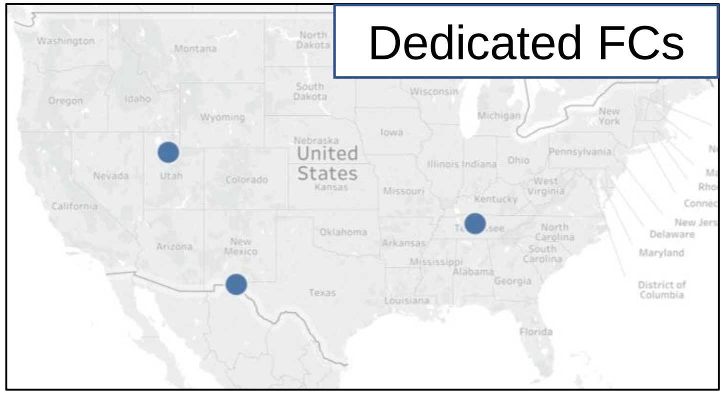
✖

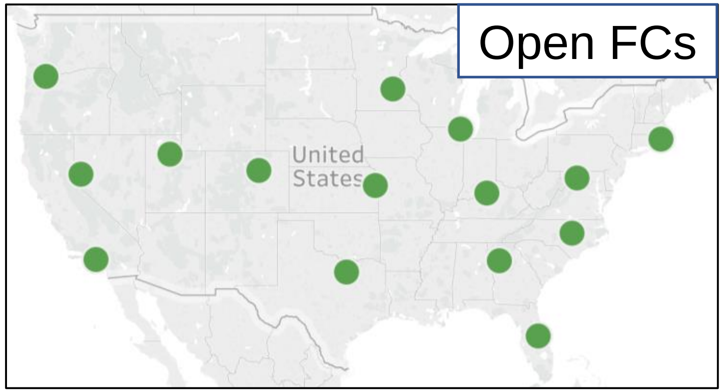
Resource
Fulfillment center network
Dedicated FCs vs. Open FCs

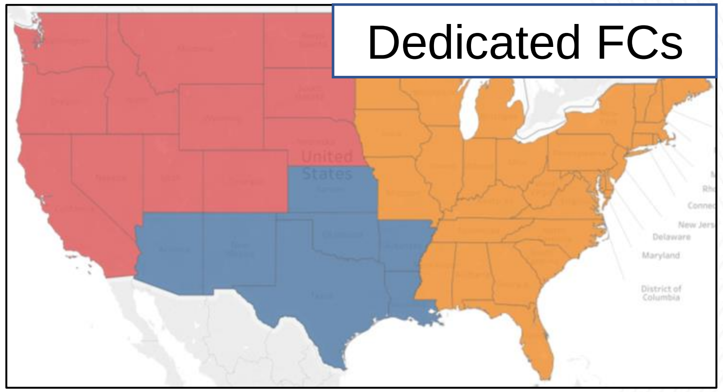
✖

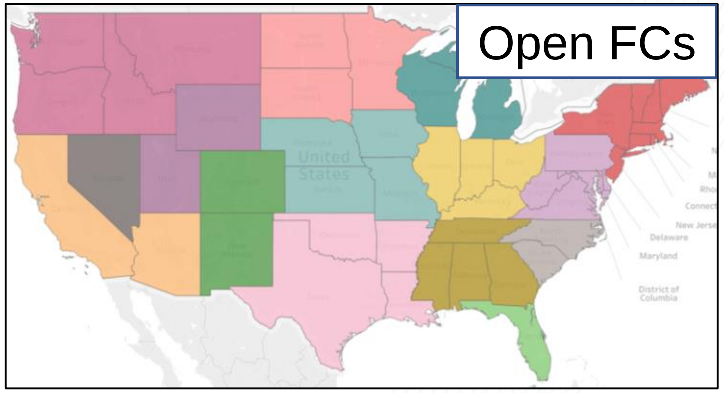
Operation
Sourcing (Zone allocation)
Single vs. Flexible sourcing
Inventory policy (level)
Low vs. Lean vs. High

Order-To-Delivery	**Average % of Customers**			
	Scenario a: Slow Delivery		**Scenario b: Fast Delivery**	
Expected Time (day)	Metro Areas	Other Areas	Metro Areas	Other Areas
0	0%	0%	40%	0%
+1	0%	0%	25%	45%
+2	0%	0%	5%	25%
+3	25%	20%	5%	5%
+4	25%	25%	5%	5%
+5	20%	25%	5%	5%
+6	15%	15%	5%	5%
+7	10%	10%	5%	5%
Longer	5%	5%	5%	5%
Total	*100%*	*100%*	*100%*	*100%*









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Case Study Result: Lost Demand – Slow Delivery

Low Inventory

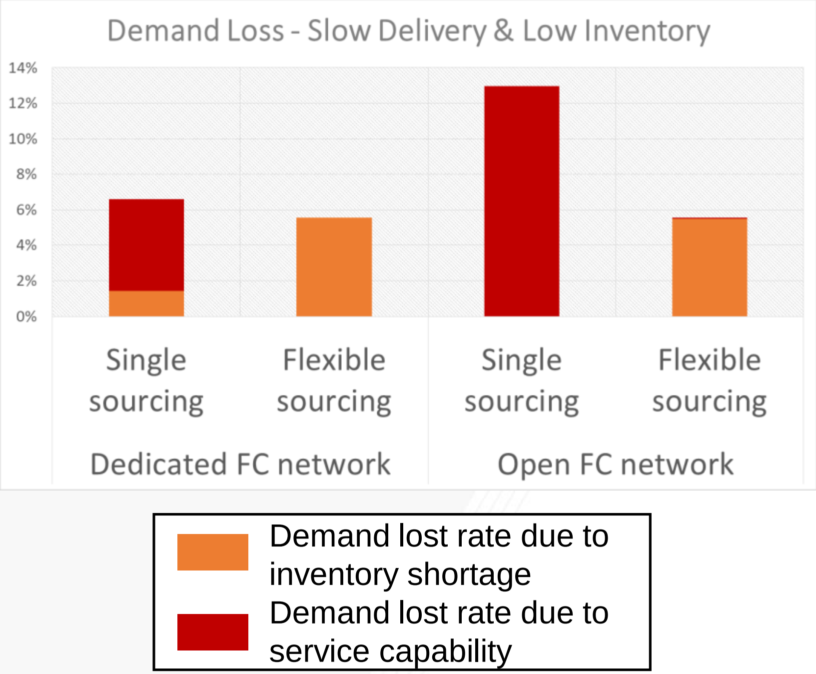
		Resource		
		Dedicated FC network	Open FC network	*Market Gain (%)*
Operation	Single sourcing	6.6%	13.0%	*-6.4%*
	Flexible sourcing	5.5%	5.5%	*0.0%*
	Market Gain (%)	-	*7.4%*	*1.1%*

Lean Inventory

		Resource		
		Dedicated FC network	Open FC network	*Market Gain (%)*
Operation	Single sourcing	0.0%	0.1%	-
	Flexible sourcing	0.0%	0.0%	-
	Market Gain (%)	-	*0.1%*	-

High Inventory

		Resource		
		Dedicated FC network	Open FC network	*Market Gain (%)*
Operation	Single sourcing	0.0%	0.0%	-
	Flexible sourcing	0.0%	0.0%	-
	Market Gain (%)	-	-	-



- When inventory is low, open FC network with single sourcing (zone allocation) performs worse than dedicated FC network with single sourcing;
  Smarter inventory allocation strategy is needed
- With flexible sourcing, only inventory shortage itself becomes bottleneck
- With slow delivery, the advantage of hyperconnected fulfillment for basic service capability is not seen

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Case Study Result: Lost Demand – Fast Delivery

Low Inventory

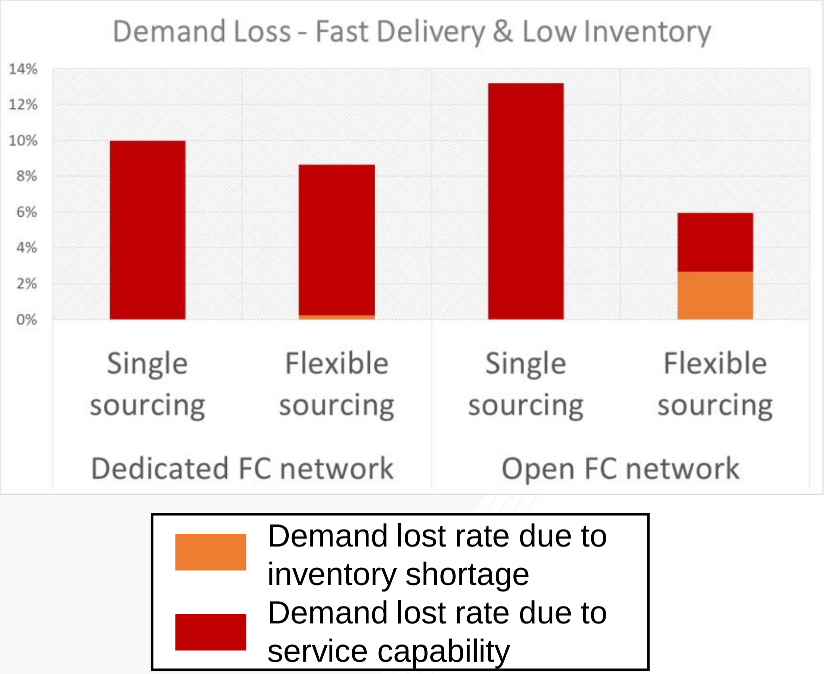
		Resource		
		Dedicated FC network	Open FC network	*Market Gain (%)*
Operation	Single sourcing	10.0%	13.2%	*-3.2%*
	Flexible sourcing	8.6%	6.0%	*2.7%*
	Market Gain (%)	-	*7.2%*	*4.0%*

Lean Inventory

		Resource		
		Dedicated FC network	Open FC network	*Market Gain (%)*
Operation	Single sourcing	7.0%	1.2%	*5.8%*
	Flexible sourcing	6.4%	0.8%	*5.6%*
	Market Gain (%)	-	*0.4%*	*6.2%*

High Inventory

		Resource		
		Dedicated FC network	Open FC network	*Market Gain (%)*
Operation	Single sourcing	7.0%	1.1%	*5.9%*
	Flexible sourcing	6.4%	0.8%	*5.7%*
	Market Gain (%)	-	*0.3%*	*6.2%*



- Service capability becomes critical factor of demand loss
- With lean/high inventory, all demand loss is caused by service incapability and from metropolitan area
- 0.8% demand loss under open FC network and flexible sourcing with lean/high inventory can only be captured with additional FCs located closer to metro area

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Case Study Result: Average Travel Miles Per Order

			Low Inventory			Lean Inventory			High Inventory		
			Resource			**Resource**			**Resource**		
			Dedicated FC network	Open FC network	*Reduction Rate (%)*	Dedicated FC network	Open FC network	*Reduction Rate (%)*	Dedicated FC network	Open FC network	*Reduction Rate (%)*
Slow Delivery	**Operation**	Single sourcing	565	177	*-69%*	567	173	*-69%*	567	173	*-70%*
		Flexible sourcing	604	247	*-59%*	556	157	*-72%*	556	149	*-73%*
		Reduction Rate (%)	-	*39%*	*-56%*	-	*-9%*	*-72%*	-	*-14%*	*-74%*
Fast Delivery	**Operation**	Single sourcing	552	174	*-68%*	553	171	*-69%*	553	170	*-69%*
		Flexible sourcing	564	223	*-60%*	545	155	*-72%*	545	147	*-73%*
		Reduction Rate (%)	-	*28%*	*-60%*	-	*-9%*	*-72%*	-	*-14%*	*-73%*

- In most cases, average travel miles per order is reduced by about 70% by utilizing open FC network and flexible sourcing
- With single stop shipping, the travel miles directly represents proximity to customers

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Conclusion and Future Research

Overall, ~6% of market gain and 73% delivery mile reduction potentials are shown with open FC network and flexible sourcing under tight delivery time constraints

- Measure the impact of hyperconnected fulfillment on cost, profit, and service considering deployment, distribution, and production
- Examine impact of transportation e.g. routing
- Optimal network selection:
  select which open FC to use and how much and when to store or redeploy
- Extend to multi-product and/or multi-player operation

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Thank you

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