

Modeling the Logistics of FedEx International Express


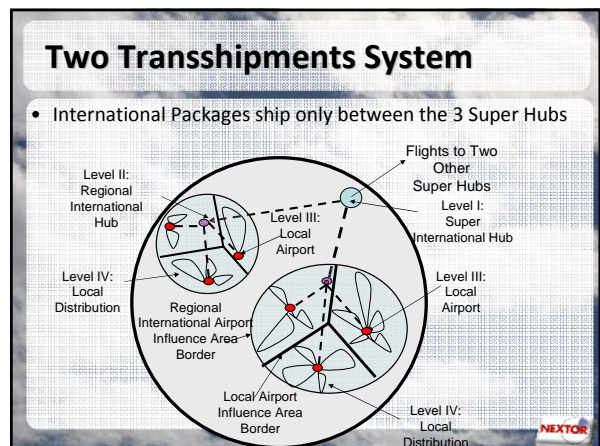
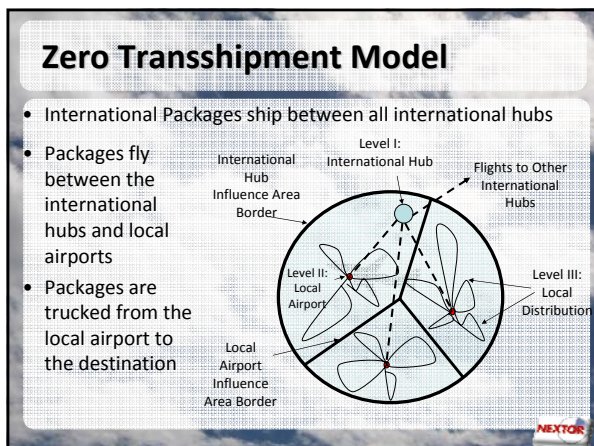
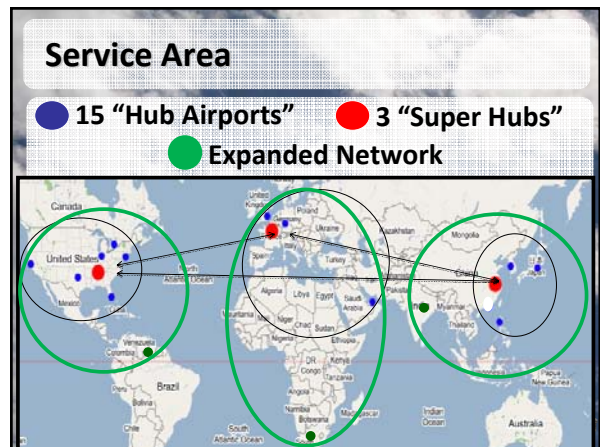
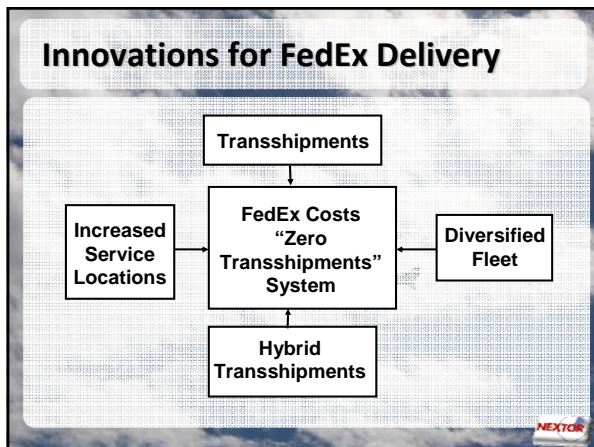
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Motivation

- Illustrate how aggregate estimation modeling can be used to investigate the impact of system innovations
- Propose innovations for a highly optimized parcel delivery service and determine cost savings

Baseline Logistics Cost Function

- Z_{terminal}
- $Z_{\text{transportation}}$



NEXTOR

Terminal Costs

- Sorting
- Facility Charges & Storage Fees



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Terminal Cost Estimation

Sorting Cost at hub i :

$$Z_{\text{sorting}_i} = \text{Volume} * \log(\text{Complexity}) * \text{Efficiency} * \text{Labor Cost}$$

daily volume of packages that pass at hub i (lbs)

number of packages that one worker can sort in an hour (man-hour / lbs)

wage rate (\$ / man-hour)

unitless value that scales the sorting cost to reflect the number of routes, N , to which the packages are directed.

Facility Charges estimated from FedEx Annual report

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Transportation Costs

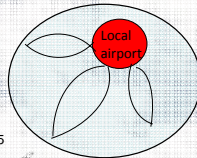
- Local Distribution
- Line-Haul Transportation
- Long-Haul Transportation



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Local Distribution: Vehicle Routing Problem Model

Truck Trips between Local Airport and Destination of Parcel



$$Z_{\text{localdistribution}} = 2 * C_{tr} * TU * 2 * A * (\delta/6)^.5$$

C_{tr} \$1/mile, Cost of Truck Operation

TU Number of Tours

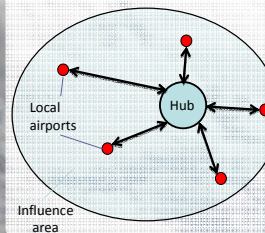
δ Density of a Region

A Area of a Region ($\pi * \text{radius}^2$)

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Line-Haul Transportation

- Air transportation between international hubs and local airports



	Capacity (lbs)	Fixed costs (\$/flight)
B-727	40 000	25 000
A310	70 000	45 000
MD-11	150 000	85 000

Influence area

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Line-Haul Transportation

$$Z_{\text{linehauldistribution}} = \underbrace{2 * C_f * C_p * r_{\text{bar}} * N * V}_{\text{Variable Cost}} + \underbrace{FC_B * A_B + FC_A * A_A + FC_M * A_M}_{\text{Fixed Cost}}$$

Constants

C_p = fixed cost of fuel consumption for line haul flights
 4.10^{-5} gallons / pound

C_f = cost of fuel
 2 \$ / gallon

Variables

V = Total weight handled (lbs) at each local airport

r_{bar} = average distance from hub to local airport

N = number of local airports for each hub

$A_{B,A,M}$ = number of aircraft type B-727 (B), A310 (A), MD-11 (M)

$FC_{B,A,M}$ = fixed cost of aircraft type B, A, and M

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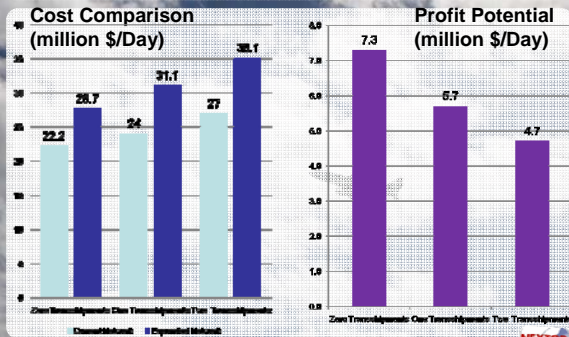
Long-Haul Transportation Costs

- Transportation between international hubs (only aircraft)
- Same equation as line haul but altered constants for long haul and not doubled

$$Z_{\text{longhauldistribution}} = C_f * C_{p1} * R_{ij} * N * V + FC_B * A_B + FC_A * A_A + FC_M * A_M$$

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Zero Transshipments: Least Cost and Maximum Profit



Introduction of A380



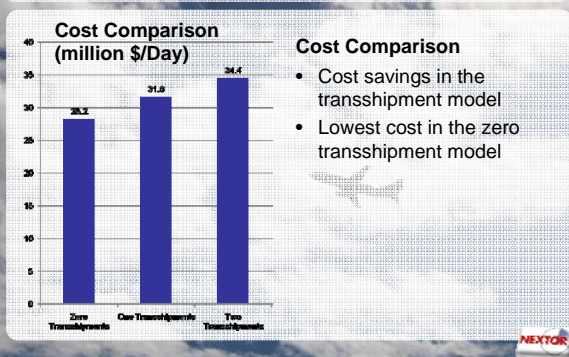
Capacity: 300,000 lbs

Estimated fixed costs: 130,000 \$/flight

➔ Potential Economies of Scale

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All Transshipment Amounts Produce Profit



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Hybrid Transshipment Model

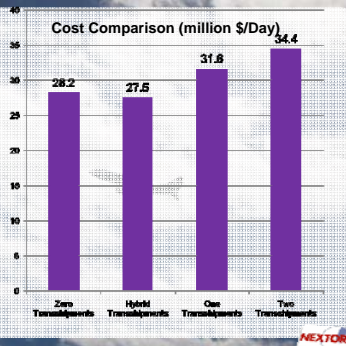
- Lowest costs result from the models with zero or one transshipments
 - ➔ Investigate hybrid transshipment structure
- If demand is high enough on one link between two international hubs, the packages will fly directly; otherwise they will be shipped with one transshipment.
- The minimum cost was determined to be when the cutoff point for shipment volume is 20,000 lbs.

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Hybrid Transshipments with A380 Decrease Cost

- Lowest costs result from the models with hybrid transshipments
- Decreased to 27.5 million \$/day from 31.8 million \$/day

1.2 million \$/day improvement



Key Take-Aways

- Aggregate freight modeling methods can allow one to examine the impacts of system innovations without exact data
- Altering the network structure due to a change in fleet could assist FedEx in reducing costs

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