Impact of Autonomous Delivery on Last-Mile Logistics

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Objective: Explore impact of autonomous/driverless vehicles on home delivery

Hypothesis: High labor cost of driver-based home delivery major reason for customer pickup at stores

Methodology: Propose design for public logistics network that would allow consolidated-load delivery to the home

Results: At scale, cost of on-demand driverless-based home delivery same as current driver-based delivery

Conclusion: Driverless-based home delivery can eliminate need for all non-recreational shopping, which is especially important for the disabled and elderly

Dirt-to-Dirt Logistics Costs

Home Delivery Alternatives

Unloading at Home Point-to-Point On-Demand Delivery Multi-Stop Delivery Window

Customer Supervised

• Time-sensitive driver-based (plate)
• Driverless vehicle (manual unloading)

Unattended (package/container)

• Aerial drone
• Time-intensive driver-based (UPS, USPS, FedEx)
• Driverless vehicle (autonomous unloading)

Load Bid = $12

Load 1: 4 x 4
Load 2: 6 x 6

Dirt‐to‐Dirt Logistics Costs

Loads in a lane ordered by decreasing bid

Load bid is sum of container bids in load

Network Coordination: Develop mechanism to coordinate operation of each container, vehicle, and DC in the network

Example: 2-D Load Formation

1. Select Containers: Sorted based on decreasing per-unit bid value; selected until cumulative area ≥ 50 (capacity of module array)

2. Order Containers: Sequence based on length, width, bid; may not be feasible to fit (pack) all containers into array (bin)

Example: 1-D Load Bidding

• Load bid is sum of container bids in load
• Loads in a lane ordered by decreasing bid

DC Storage Control:

• Module ≤ Container ≤ Shipment ≤ Load
• Each container assigned a unique priority that determines its planning sequence

Example: Unloading and Loading Operations at DC

Unloading at DC

Loading at DC

Discrepancies of Scale: Yellow containers spend/bid less on a per-unit basis to join a load leaving earlier due to their smaller size

Amazon Drone 

$1.00/delivery

Starship Delivery Robot 

$1.99/delivery

Nuro Delivery Vehicle 

5/delivery NA

Delivery Vehicle with Auto Unloading 

$3.50/delivery

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