

Assessing the use of Automated Ground Vehicles for Last-Mile Parcel Delivery

Presented by Daniel Olejarz

Supervised by Prof. Matthew Roorda

iCity-CATTS Symposium

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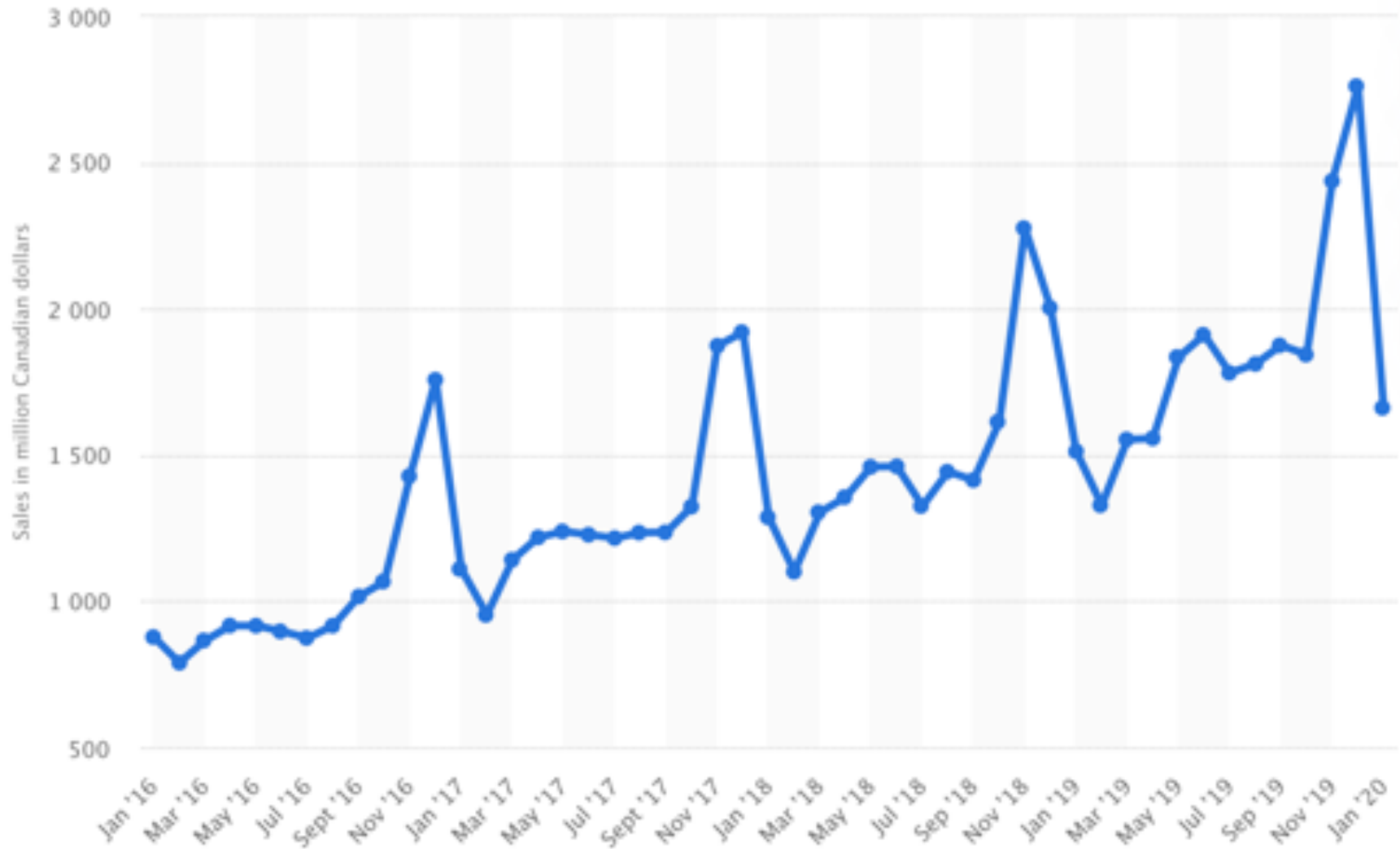
Presentation Overview

1. Challenges in Last Mile Parcel Delivery
2. Automation in Freight Transport
3. Case Study: Automating Parcel Delivery in Square One Mall
4. Discussion and Recommendations

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Canadian E-Commerce Sales 2016-2020



Characteristic	B2B Shipments	B2C Shipments
Frequency	More Regular	More Sporadic
Size	Large	Small
Variance (spatial & temporal)	Lower	Higher
Growth	Lower	Higher
Profits	Higher	Lower

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Why Automation is Inevitable in Freight

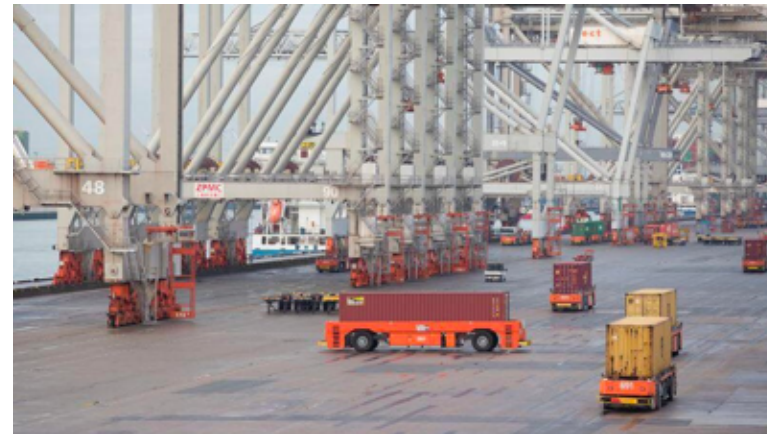
1. Firms are profit seeking



2. Major firms control large fleets



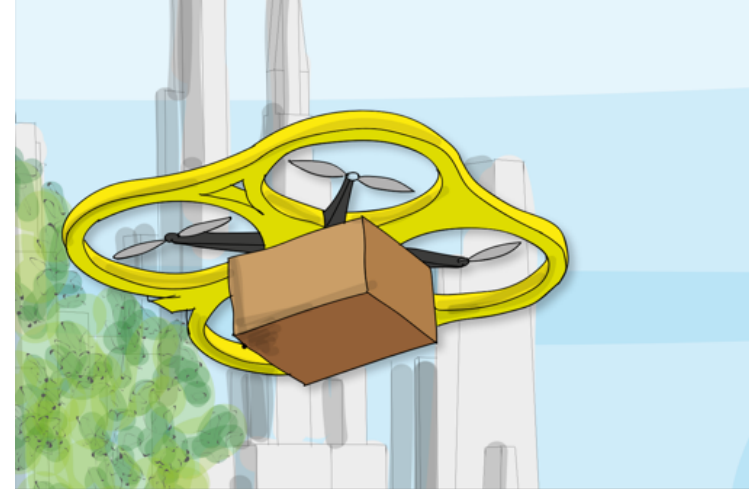
3. It has already existed for years!



Automating Last-Mile Parcel Delivery



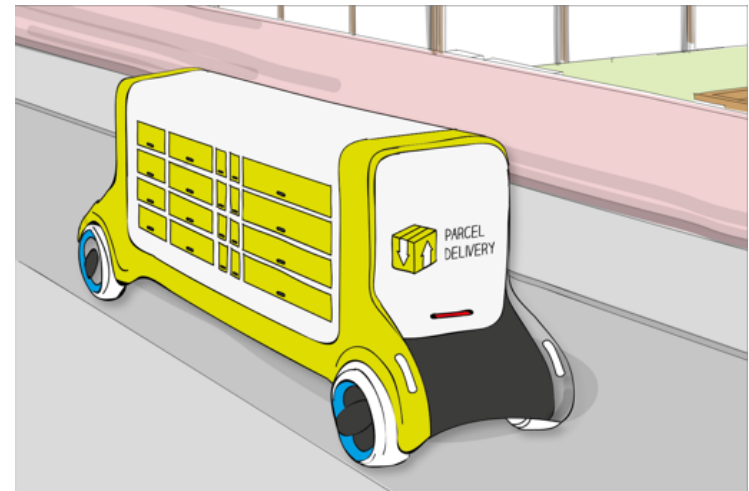
1. Semi-Autonomous Trucks



2. Drones



3. Droids



4. Autonomous Ground Vehicles (AGV)

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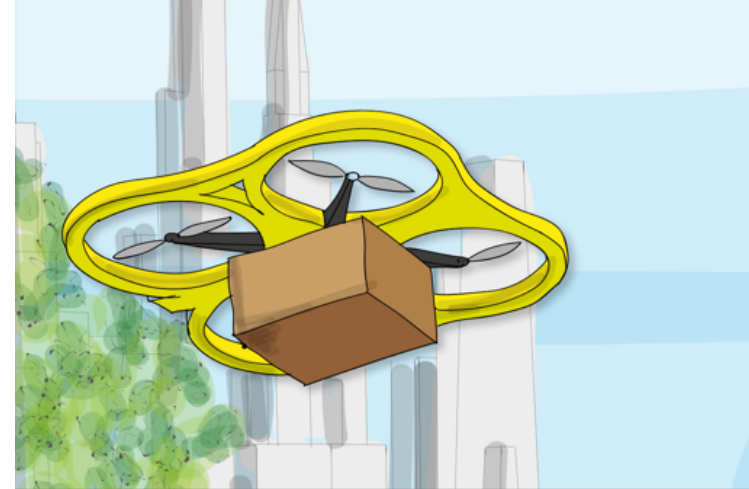
Project Context



Automating Last-Mile Parcel Delivery



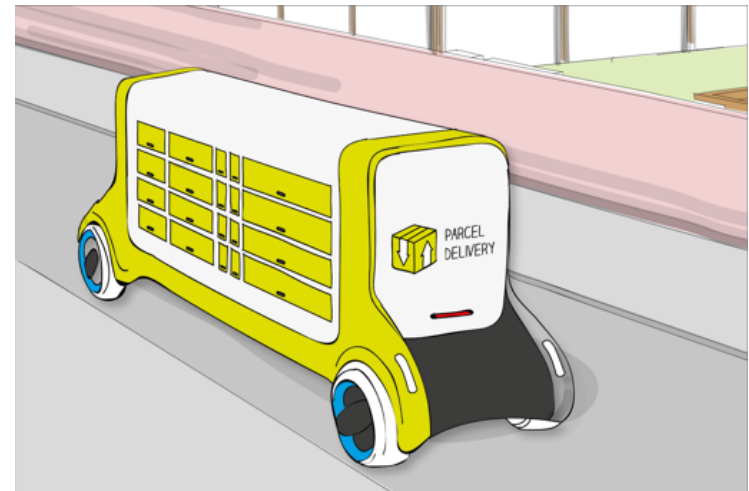
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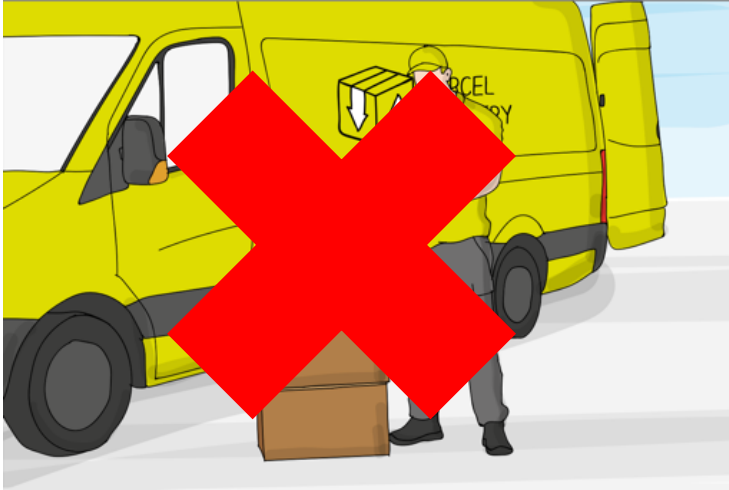


3. Droids

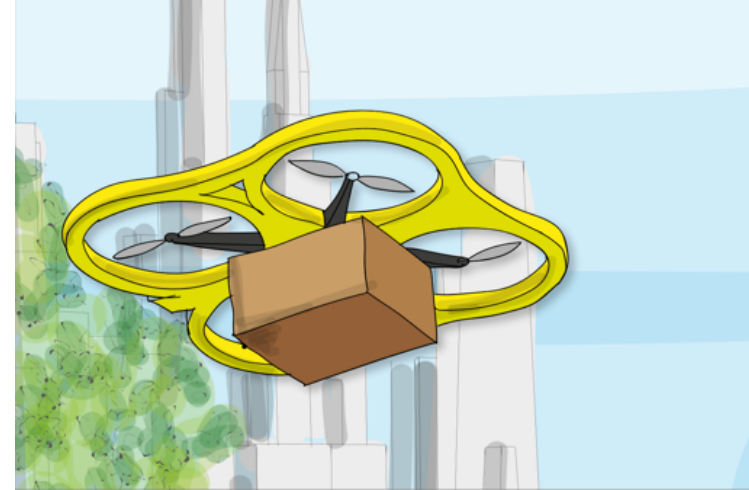


4. Autonomous Ground Vehicles (AGV)

Automating Last-Mile Parcel Delivery



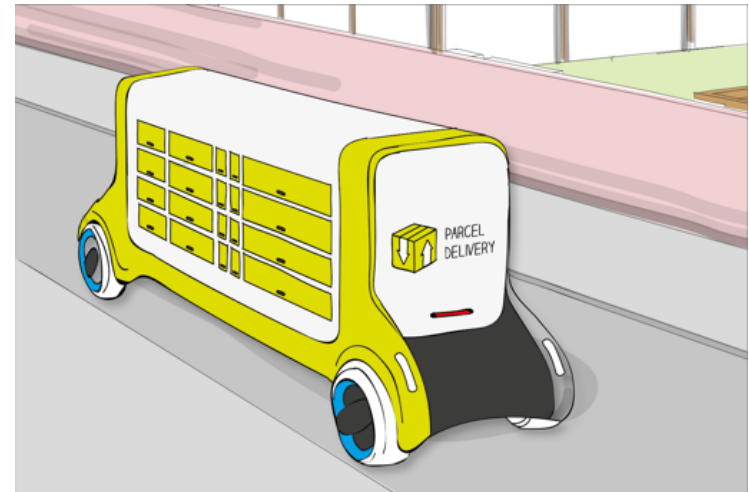
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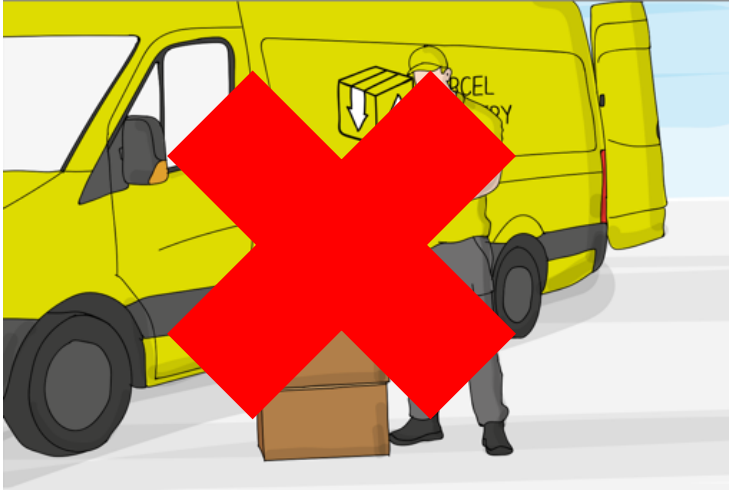


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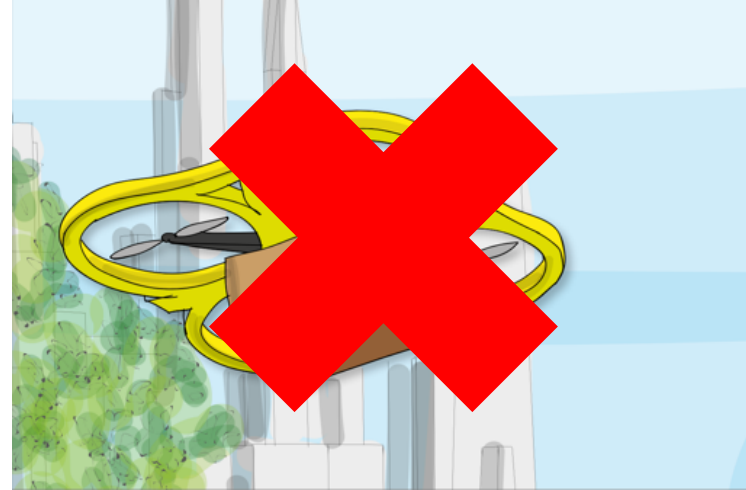


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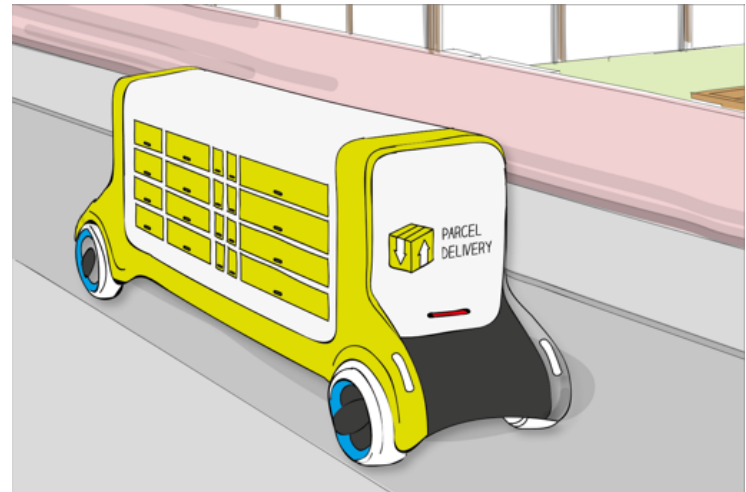
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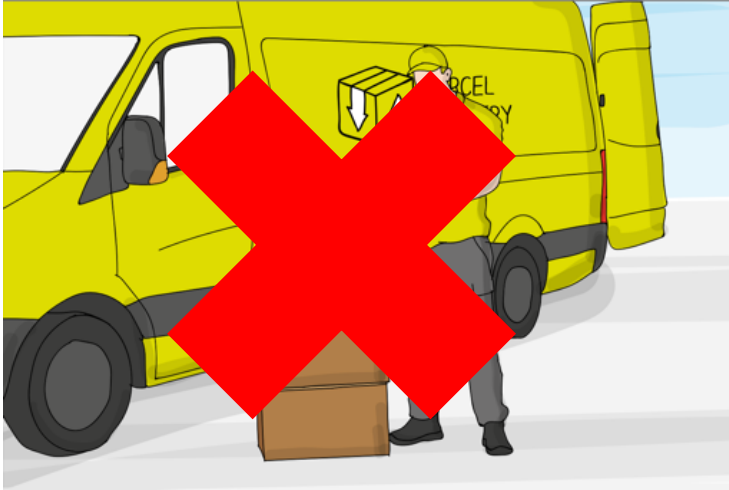


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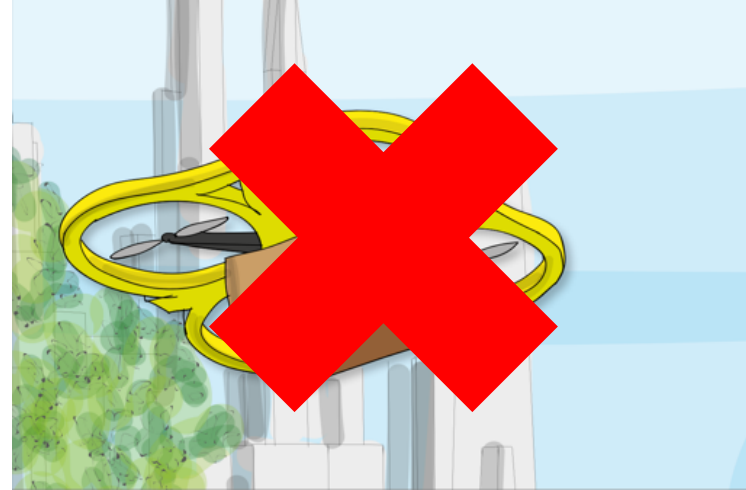


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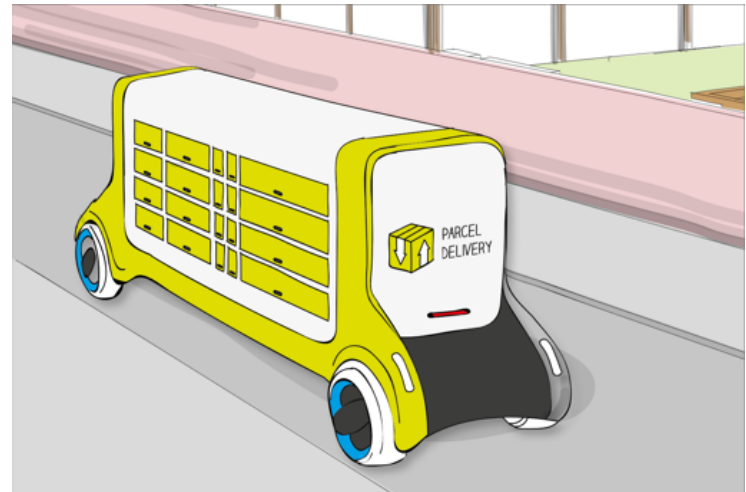
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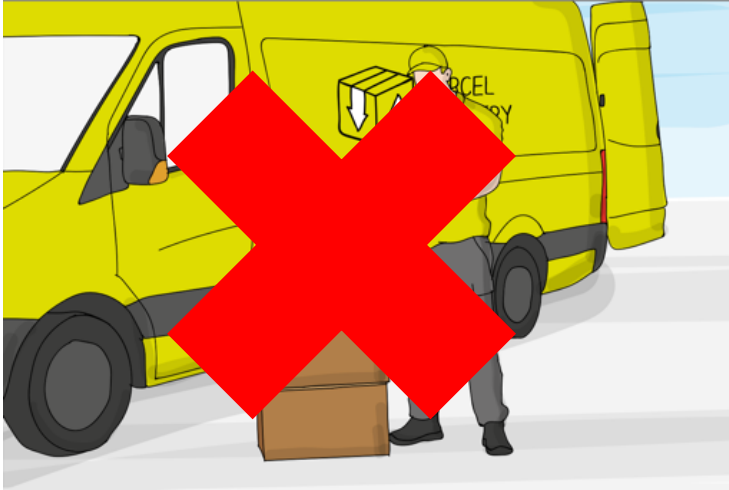


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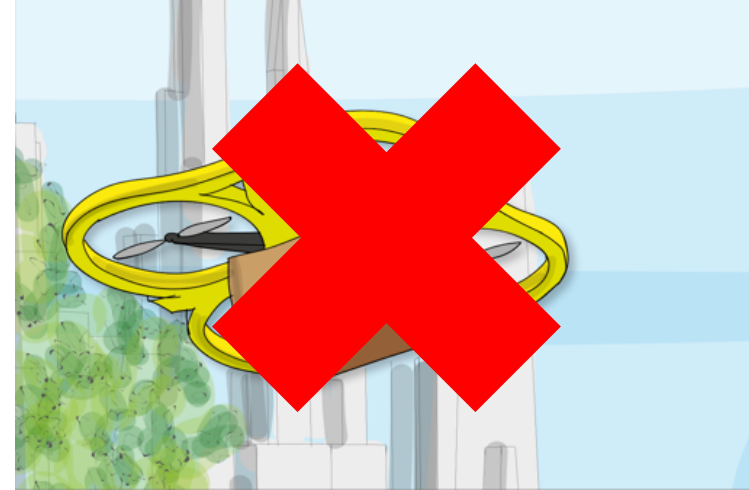


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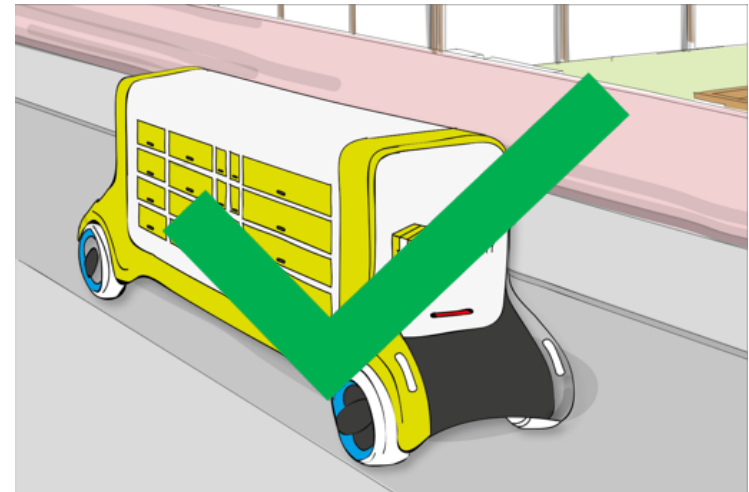
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4. Autonomous Ground Vehicles (AGV)

Overview of Current Operations



Arrive at loading dock



Take elevator if necessary



Enter shopping mall

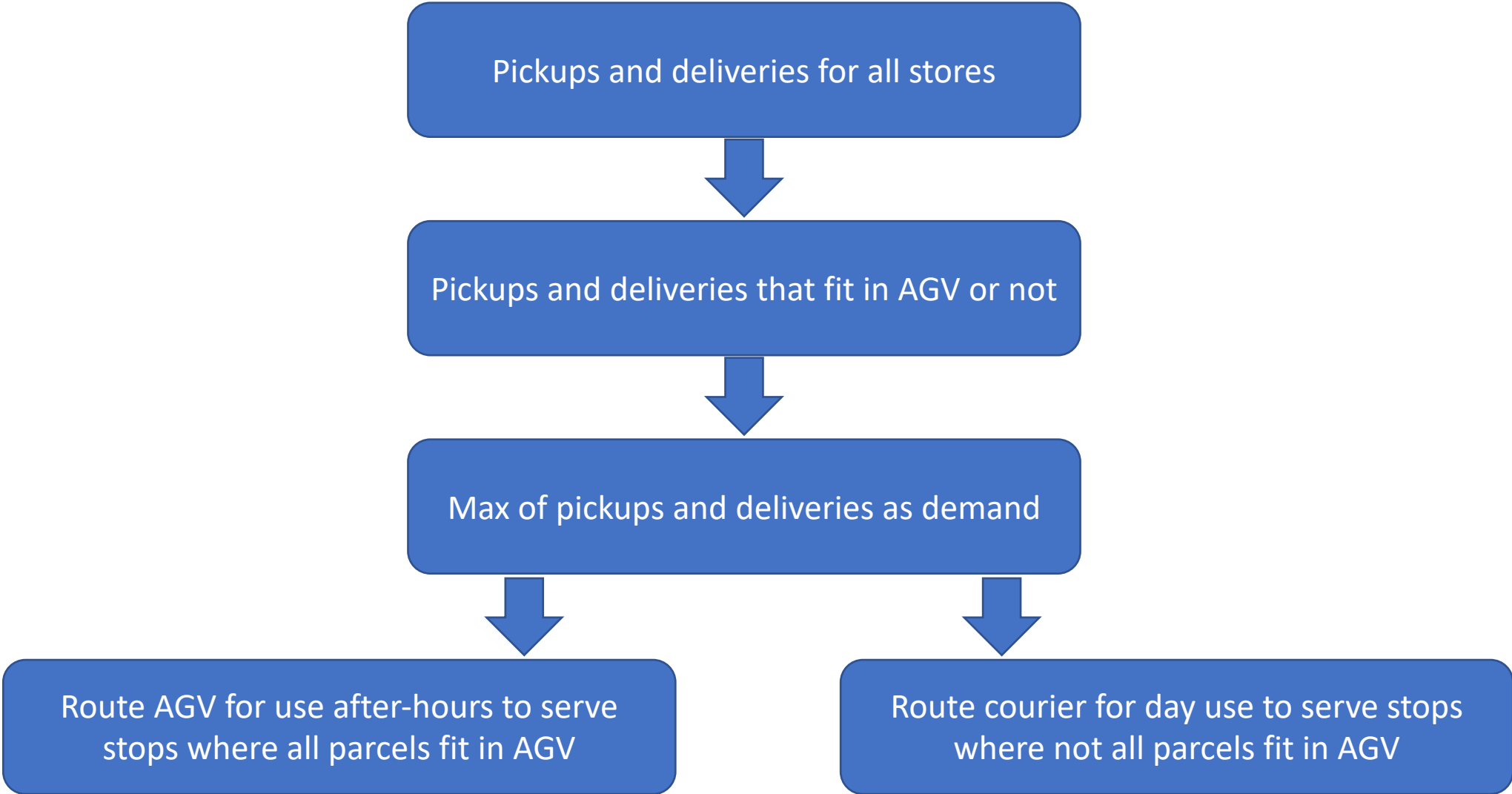
Two types of deliveries



Inventory Shipments



E-Commerce Fulfillment and Returns



Comparing Courier to AGV

Characteristic	Courier with cart	AGV
Capacity (Parcel-units)	120	6
Cost (\$/hr)	\$50	\$5
Speed (m/s)	1.2	1
Service time (minutes)	4	4

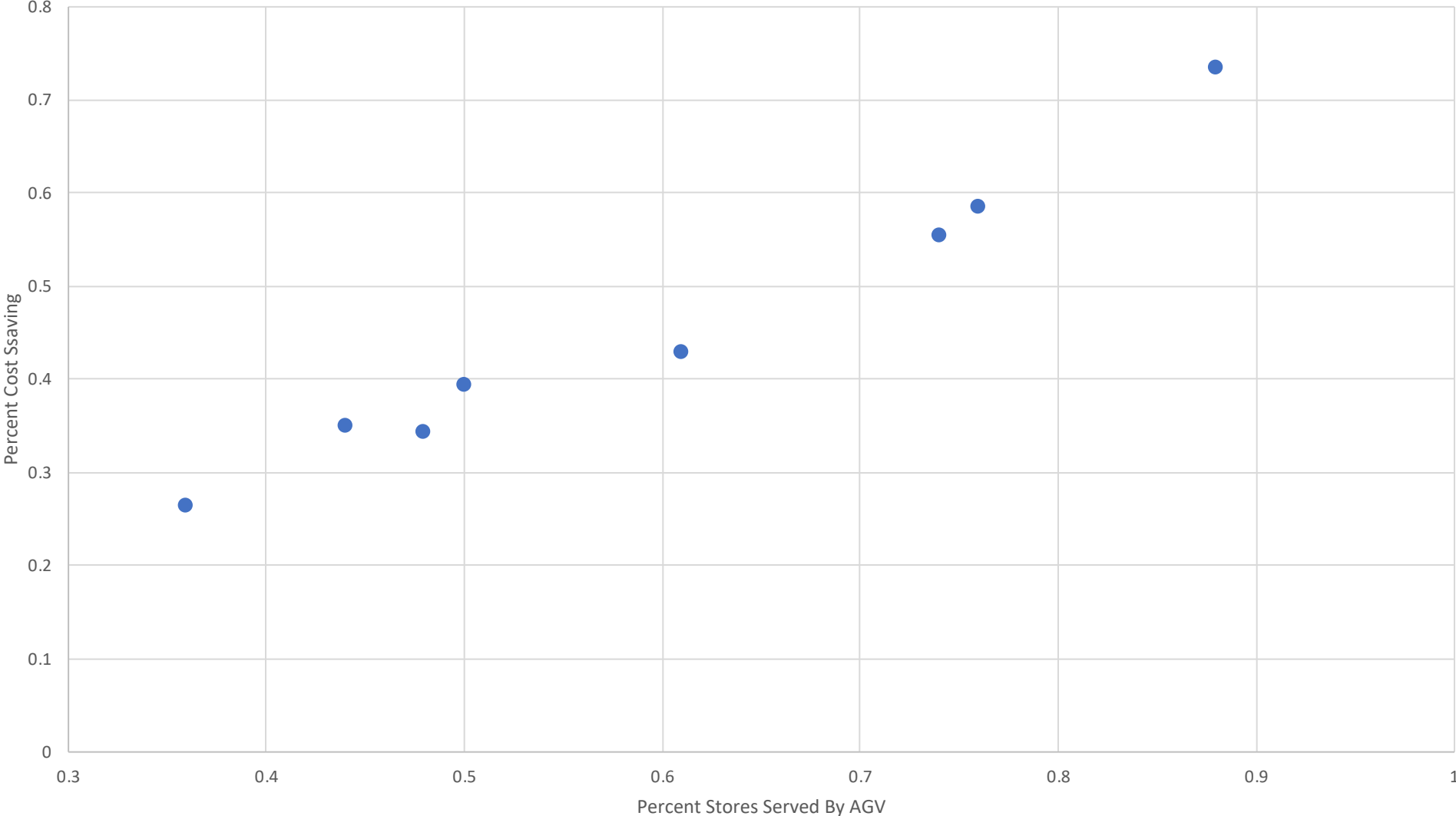
Comparing Courier to AGV – First Floor

Day	Courier Alone	AGV + Courier	Cost Reduction	% Stores AGV
March 5	\$98.59	\$26.35	73%	88%
March 14	\$98.05	\$40.72	58%	76%
April 15	\$106.84	\$61.16	42%	61%
April 17	\$92.15	\$41.04	55%	74%

Comparing Courier to AGV – Second Floor

Day	Courier Alone	AGV + Courier	Cost Reduction	% Stores AGV
March 5	\$109.57	\$72.15	34%	48%
March 14	\$107.60	\$79.15	26%	36%
April 15	\$114.46	\$74.46	35%	44%
April 17	\$146.48	\$88.87	39%	50%

Cost Reduction vs. AGV Penetration



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Some Comments

- Maximum theoretical savings
- Clear linear trend for cost savings
- Requires seamless implementation
- Stores must be willing to receive from AGVs

Recommendations on Implementation

- Use AGVs for small-volume deliveries
- Pilot the technology with a direct supervisor
- Avoid use on busy days to start



Thank you!

Questions?

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