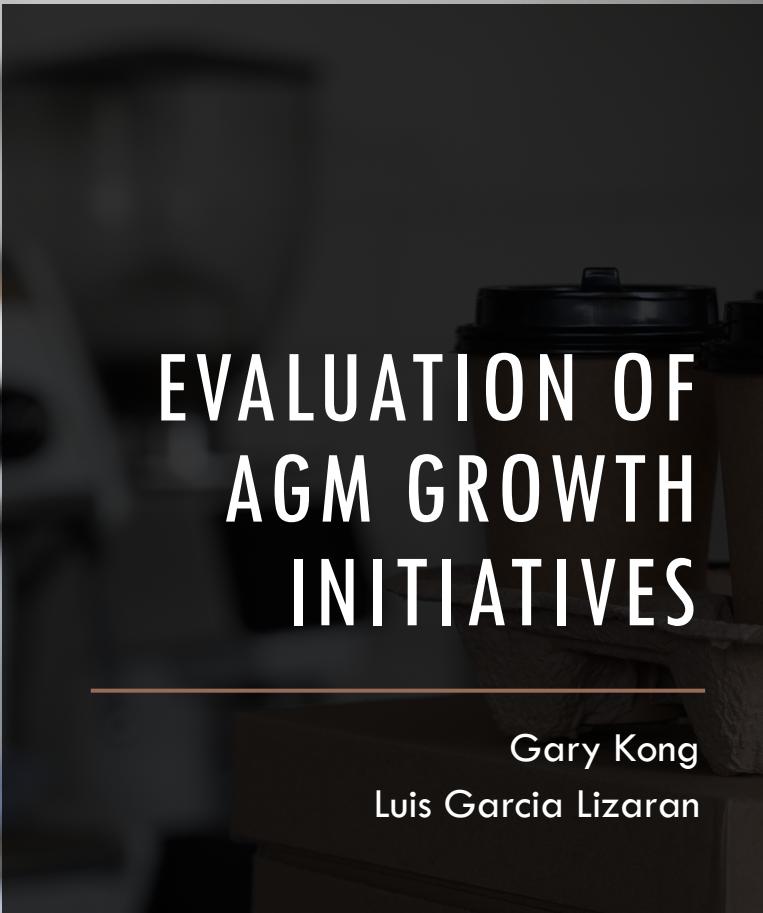


EVALUATION OF AGM GROWTH INITIATIVES

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INTRODUCTION

- Acme Gourmet Meals (AGM) provides healthy, pre-packaged gourmet quality meals which are currently marketed to high-income, young professionals in the Bay Area
- The company has a deal with a grocery store and has a small counter there for customers to pickup their food
- AGM charges a flat rate of \$12 per meal with no minimum
- Customers must order by 10am one day in order to pick up the meals the next day
- The company also conducted a delivery trial run using one delivery service at the Berkeley store
 - Deliveries were conducted by Peak Deliveries
 - Peak Deliveries charges an 18% cut per meal
 - Peak delivers to zip codes within a 5 mile radius of the store
- AGM executives are considering several initiatives for the company
 - Adding more pickup locations
 - Using public transportation to transport deliveries
 - Using delivery drones or robots

WE EVALUATED POTENTIAL SOURCES OF GROWTH FOR AGM BY CONSIDERING THE FOLLOWING QUESTIONS

- 1 Should AGM expand its footprint of pickup locations?**
- 2 What mode of transport (BART, drones, robots, and/or delivery vans) should AGM use for its delivery services?**
 - Which mode to use for long-range transport?
 - Which mode to use for last-mile transport?
- 3 Based on the above, what would be the optimal model for AGM's new business?**
 - Where should AGM locate its pickup locations?
 - How should AGM transport meals from its kitchen to pickup locations? From pickup locations to customers?
 - What are the implications of this model e.g., how many potential new customers would be reached)?
- 4 How can technology (Neo4j, MongoDB, and Redis) play a role in implementing AGM's growth strategy?**

WE HAVE MADE THE FOLLOWING ASSUMPTIONS TO CONDUCT OUR EVALUATION



The primary objective of the business is to increase its customer base



The kitchen is located at the Berkeley store



All pickup locations are assumed to be both:

- Direct point of sale (customers can pick-up food themselves)
- Base for delivery (delivery vehicle can pick-up food at the location to deliver to customers)



AGM targets customers with higher incomes



Delivery drones and robots have a limited delivery range of 1 mile



Each pickup location can only service customers within a 5-mile range



SHOULD AGM EXPAND ITS FOOTPRINT OF
PICKUP LOCATIONS?

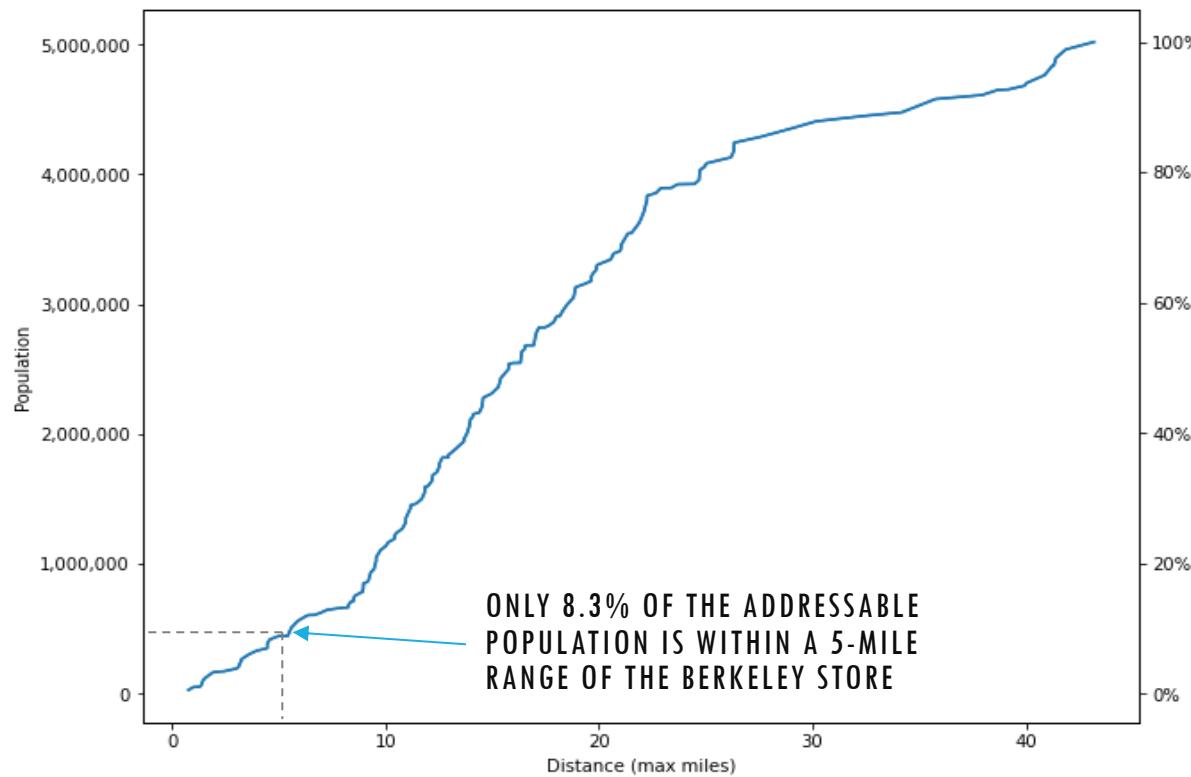
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AGM WILL NEED TO EXPAND ITS PICKUP LOCATIONS IF IT IS TO REACH A LARGER PROPORTION OF THE ADDRESSABLE POPULATION

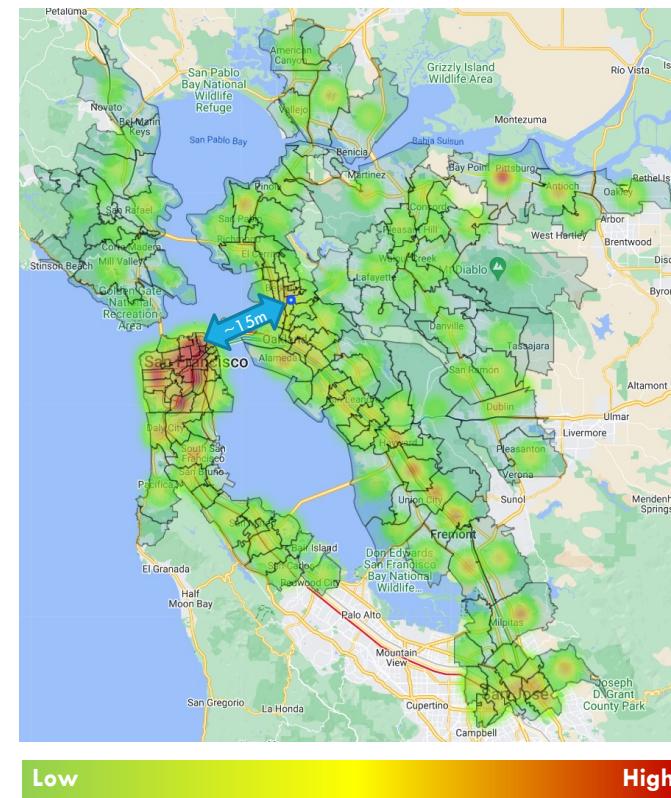
Addressable Population

Population living in zip codes that are within 5 miles of any station within the stations.csv dataset +
Population in zip codes with current AGM customers

Addressable Population by Distance from Berkeley Store



Addressable Population by Zip Code





WHAT TRANSPORT OPTIONS SHOULD AGM
USE FOR ITS DELIVERY SERVICES?

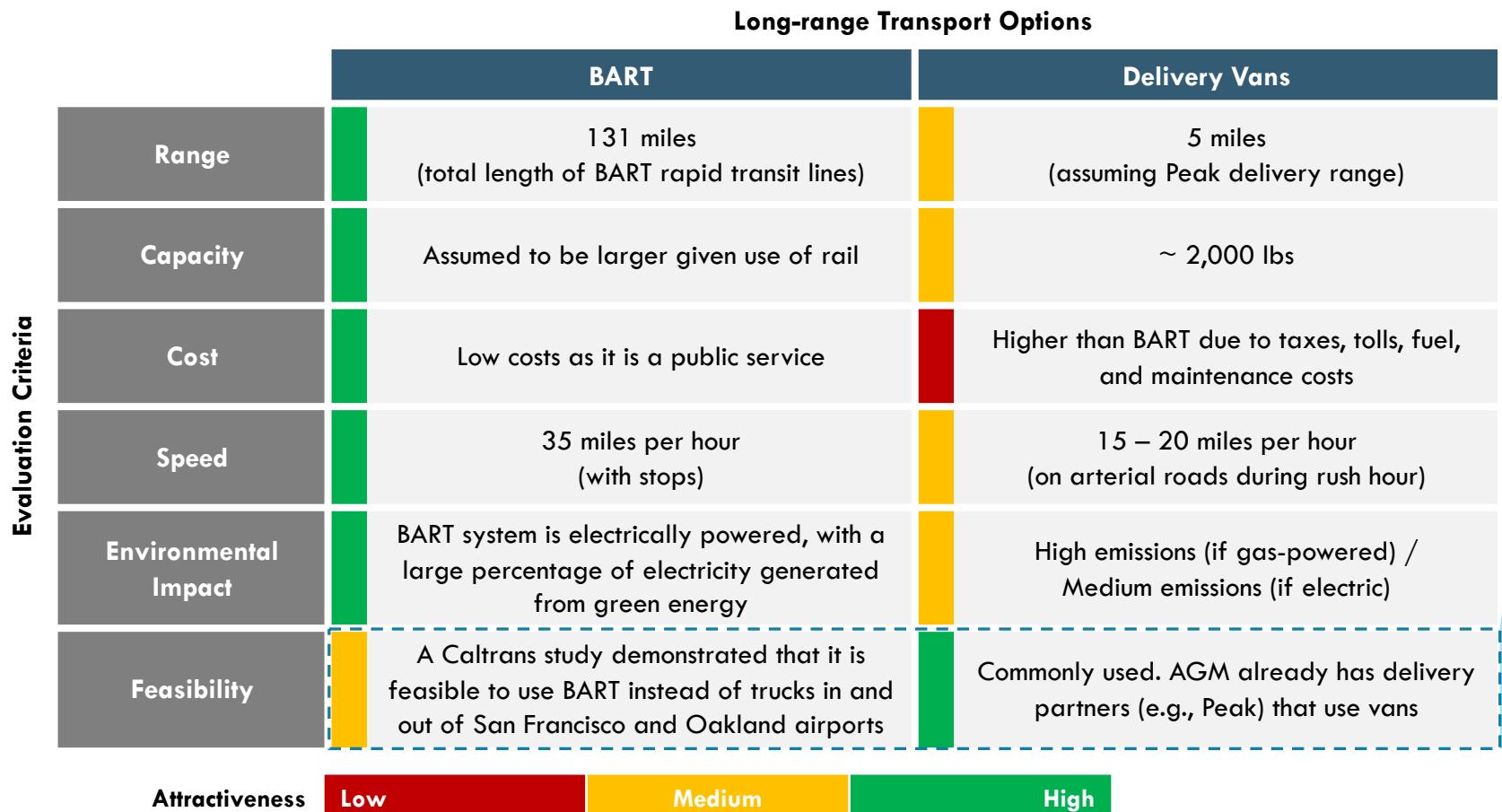
AGM WILL NEED A COMBINATION OF LONG-RANGE AND LAST-MILE TRANSPORT FOR ITS DELIVERY SERVICES

AGM Delivery Model Options

		Long-range Transport Options	
		BART	Delivery Vans
Last-mile Transport Options	Delivery Vans	BART + delivery trucks	Delivery vans only
	Delivery Drones	BART + delivery drones	Delivery vans + drones
	Delivery Robots	BART + delivery robots	Delivery vans + robots

- Delivery drones and robots are considered unfeasible long-range transport options due to limited range (1 mile)
- If BART is used as a long-range transport option, last-mile transport options will be required for both:
 - Delivery from kitchens to nearest BART station
 - Delivery from BART stations to customer
- We have not considered other options such as delivery bikes based on the prompt of the project

BART IS THE MOST SUITABLE LONG-RANGE TRANSPORT OPTION GIVEN SUPERIOR RANGE, COST SPEED AND ENVIRONMENTAL IMPACT

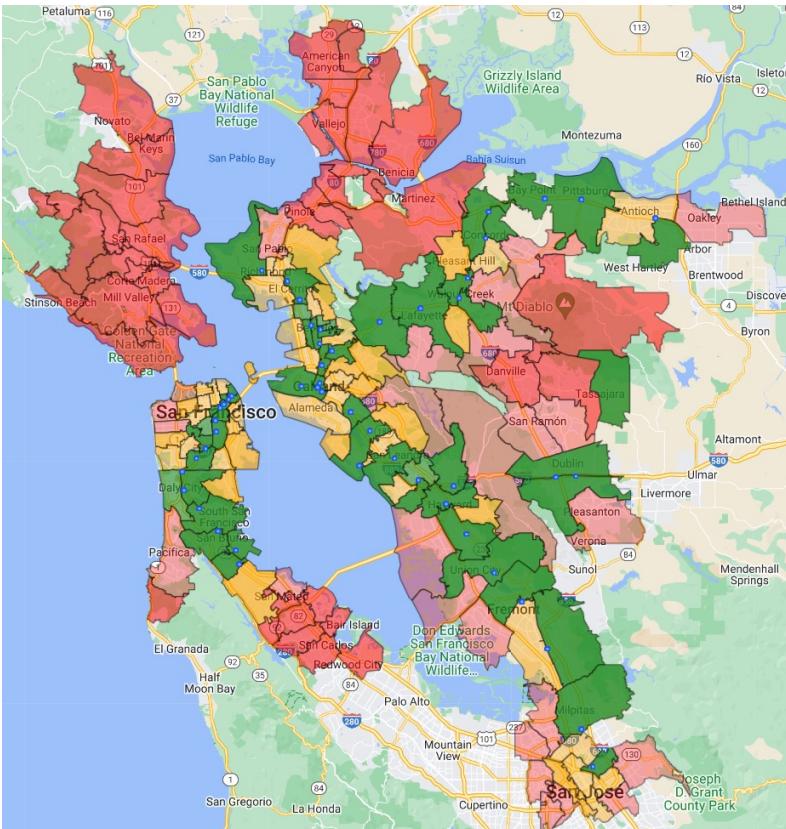


A 2014 CalTrans study found that there is scope to introduce freight services to BART:

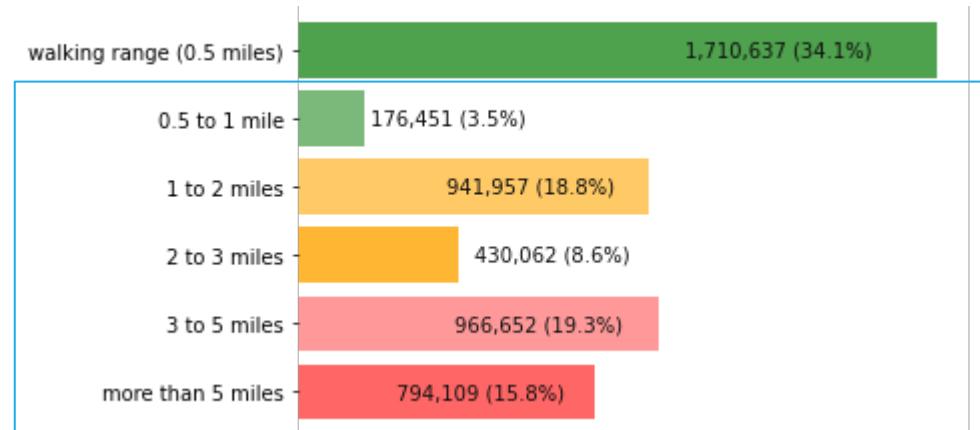
- For non-peak periods, slots for dedicated freight train insertions are available
- For peak hours in non-commute directions, some trains could be used consisting of mixed freight cars and empty passenger cars
- For peak periods in commute directions, the current schedule would need to be adjusted to accommodate freight trains
- Adopting modern train control systems could increase capacity of BART and open up more slots

LAST-MILE TRANSPORT IS NEEDED AS ~65% OF THE ADDRESSABLE POPULATION LIVE BEYOND WALKING DISTANCE OF BART STATIONS

ZIP codes by distance to nearest BART station

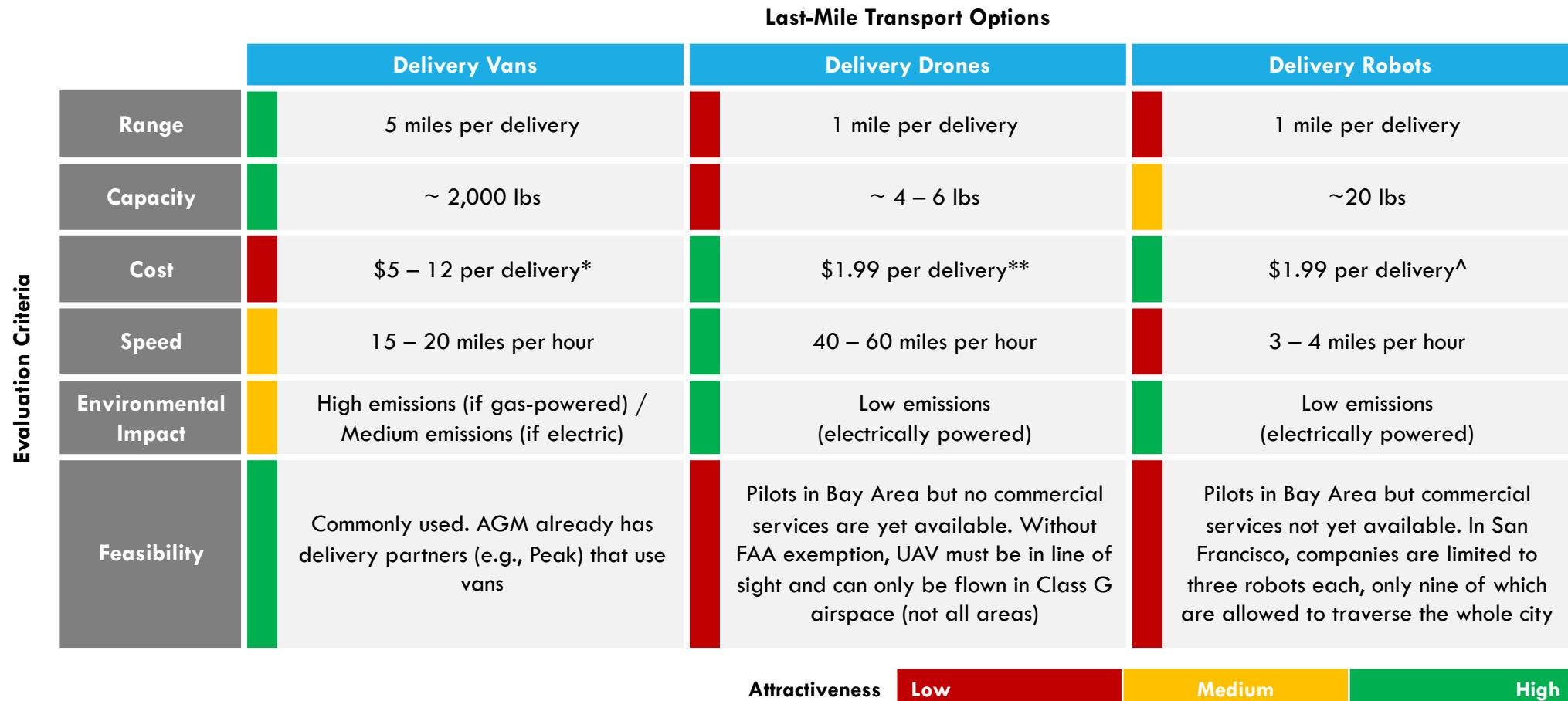


Addressable population by distance to a nearest BART station



~65% of the addressable population live beyond walking distance of BART stations

WE RECOMMEND USING DELIVERY VANS FOR LAST-MILE TRANSPORT MAINLY DUE TO RANGE AND FEASIBILITY CONCERNS



Note: * \$5 per delivery based on \$2.5 average van cost per mile, and assuming average delivery distance of 2 miles. \$12 per delivery based on Peak Delivery 18% cut and average sale value of \$67;

* Based on Ark Invest estimates for Amazon Prime Air of \$1 cost per delivery + assumed margin)

[^] As quoted by Starship Technologies

Sources: futurism.com; Technology Review; FAA; practicalecommerce.com; makeuseof.com; techcrunch.com; Ark Invest; Method.me

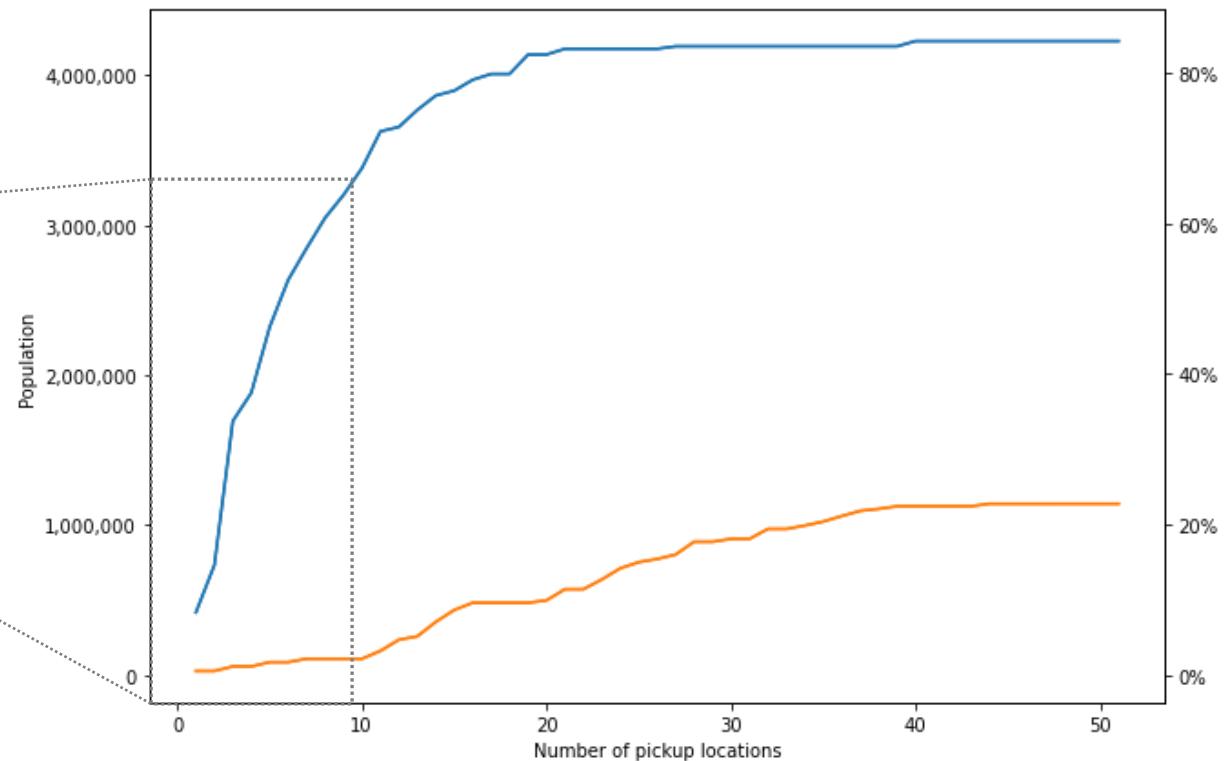
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HIGHER RUNNING COSTS OF VANS VS. TO DRONES/ ROBOTS IS OFFSET BY NEED FOR FEWER PICKUP LOCATIONS USING VANS

**Estimated Population Served with
9 Pickup Locations, by Last Mile Delivery Method***

	#	%
Delivery Vans (5 Mile Radius)	~3,200k	~64%
Delivery Robots/Drones (1 Mile Radius)	~110k	~2%

**Addressable Population Served by No. of Pickup Locations
and Last Mile Delivery Method**



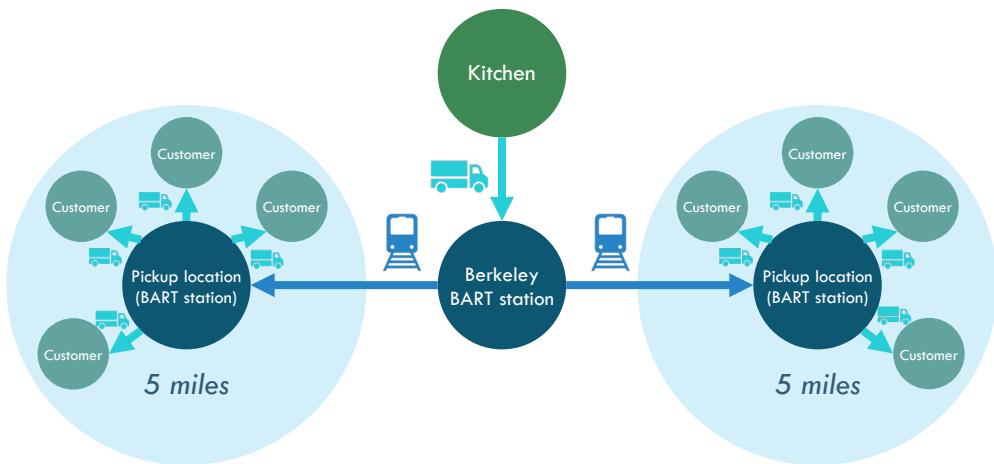
Note: *Assumes BART stations are used as pickup locations and station selection is made by a simulation choosing the set of stations which minimizes average distances from stations to population.
Takes the average of top 9 stations and population served by each depending on 1- or 5-mile radius used



WHAT WOULD BE THE OPTIMAL MODEL FOR
AGM'S FUTURE BUSINESS?

NEW PICKUP LOCATIONS SHOULD BE IN BART STATIONS DUE TO EASE OF ACCESS, CUSTOMER FOOTFALL AND CONVENIENCE

AGM delivery model



- Meals are delivered from AGM's kitchens to selected BART stations or existing stores (pickup locations) each day using a combination of vans and BART
- Customers can either pick up food from pickup locations (selected BART stations/existing stores) or arrange for delivery at any time
- For customers within a 5-mile radius of a pickup location, deliveries are serviced from the nearest pickup location using traditional food delivery trucks

Benefits of placing pickup locations in BART stations

Ease of Access

Locating pickup locations in BART stations enables immediate access to BART infrastructure for transporting food from kitchens and in between BART stations



Customer Footfall

BART stations are typically located in areas with high customer footfall, with associated benefits for sales



Convenience

Customers regularly pass by BART stations during daily commute times, so picking up meals can be done regularly with minimal disruption to customers' routines



WE RANKED THE ATTRACTIVENESS OF BART STATIONS BASED ON CENTRALITY, POPULATION AND HOUSEHOLD INCOME

Criteria	Description / Rationale	Weight
Betweenness centrality	In graph theory, betweenness centrality is a way of detecting the amount of influence a node has over the flow of information in a graph. Stations with high betweenness centrality within the BART network are more likely to be suitable 'hubs'.	25%
Number of lines passing through station	Stations with a higher number of lines passing through are more likely to have higher foot traffic. They are also likely to be transit points for customers changing between lines (i.e., convenient locations to pick-up food)	15%
Population within a 5-mile radius (Distance-weighted)	Stations which reach larger populations are more likely to have higher demand	30%
Average household income for zip-codes within a 5-mile radius (Distance + Population-weighted)	AGM's business model is targeted towards more affluent customers, so areas with higher average median income are likely to have a larger number of target customers	30%

- BART stations have been represented as a graph using Neo4j, and betweenness centrality for each station has been calculated using in-built Neo4j centrality algorithms
- When choosing pickup locations, we optimized to make all stations at least 5 miles apart from each other to avoid redundancy and overlaps in catchment areas
- Population and household incomes were weighted according to distance of zip codes to each station:
 - Greater weight assigned to zip codes located closer to each station vs. those located further away
 - Accounts for higher importance of nearby populations
- For distance-weighted population scores, a log transformation was applied to account for skew driven by outliers
- All metrics were then normalized to a 0-100 scale using Max-Min normalization

BASED ON OUR CRITERIA, WE IDENTIFIED NINE MOST ATTRACTIVE STATIONS AND RECOMMEND A PHASED ROLL-OUT OF THESE

Target pickup locations for AGM expansion, actual and normalized values (0-100 scale)**

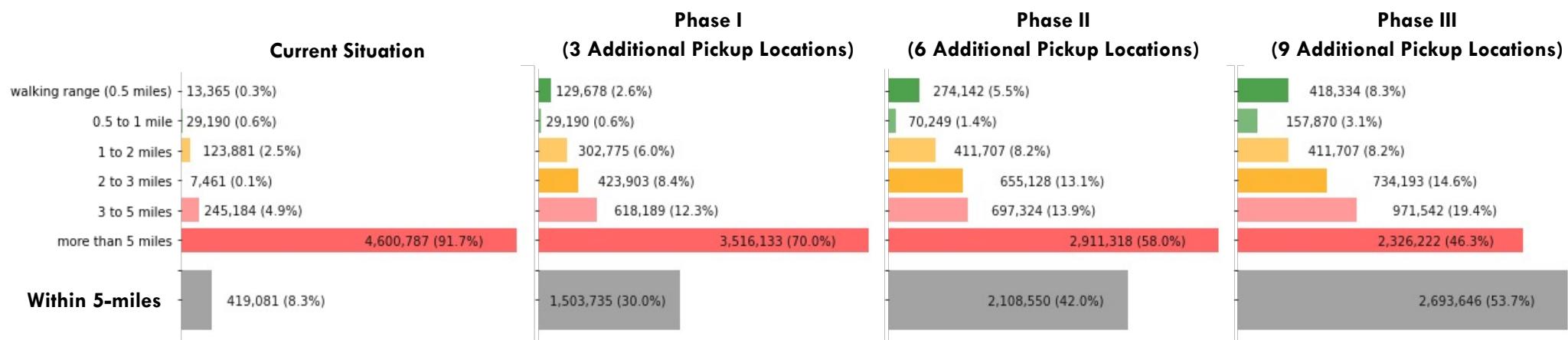
	Station	Betweenness Centrality	Number of Lines Passing Through	Population Within 5 Miles*	Average Household Income Within 5 Miles (Distance-weighted)	Total Score
		Weights	25%	15%	30%	
Phase I (Tier 1 Locations)	Orinda	4,997 (82)	1 (0)	191,812 (38)	\$212,903 (100)	62
	24th Street Mission	2,829 (45)	4 (100)	921,187 (67)	\$129,453 (41)	59
	MacArthur	5,999 (100)	3 (66)	504,427 (37)	\$92,237 (15)	50
Phase II (Tier 2 Locations)	South Hayward	2,432 (38)	2 (33)	266,634 (100)	\$90,035 (14)	49
	Coliseum	4,306 (70)	4 (100)	416,742 (27)	\$72,117 (2)	41
	Bay Fair	3,348 (54)	3 (66)	329,162 (29)	\$81,764 (8)	35
Phase III (Tier 3 Locations)	Colma	1,873 (29)	2 (33)	488,088 (37)	\$105,157 (25)	31
	Fremont	1,592 (24)	2 (33)	315,645 (21)	\$133,465 (44)	31
	Walnut Creek	3,925 (64)	1 (0)	199,253 (8)	\$121,050 (36)	29

Notes: * Populations between stations may overlap. Figures shown are actual population values. Normalized scores are based on distance-weighted populations; ** 0-100 scale based on Max-Min normalized values for all BART stations

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THE NINE TARGET STATIONS, WHEN COMBINED WITH DELIVERY SERVICES WOULD ENABLE AGM TO REACH ~55% OF THE ADDRESSABLE POPULATION

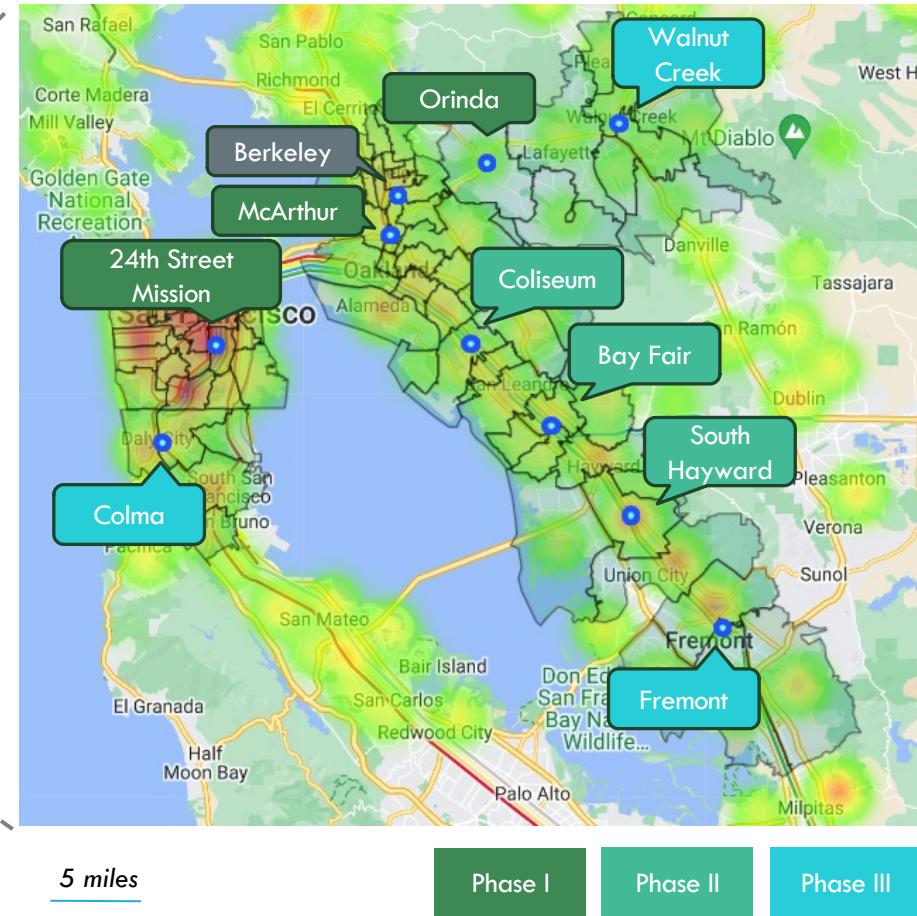
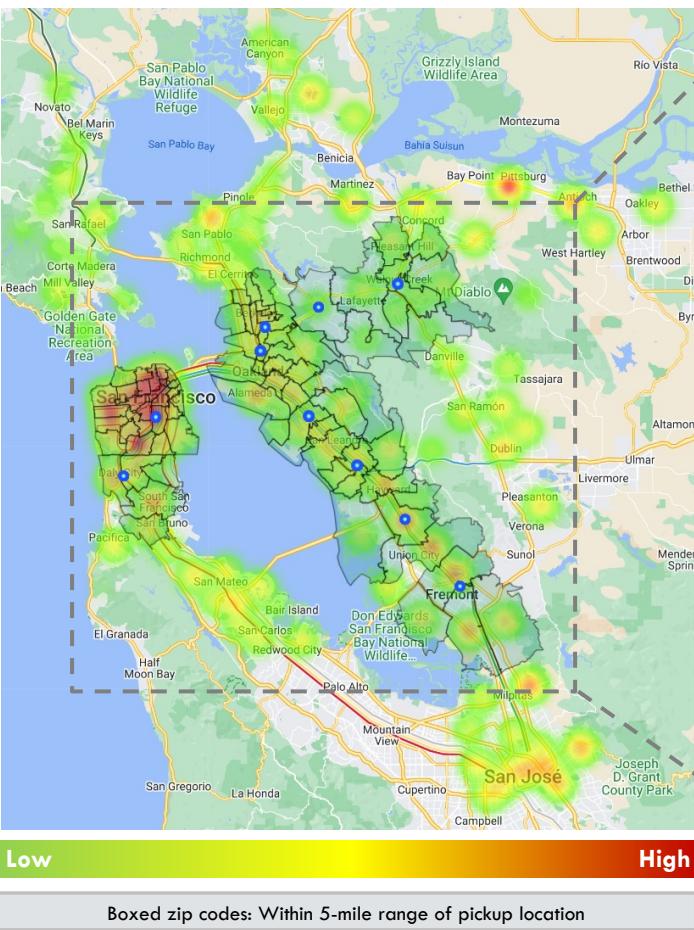
Distribution of addressable population, by distance from nearest AGM pickup location



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LOCATIONS OF THE NINE TARGET STATIONS ARE SPREAD OUT WELL ACROSS THE BAY AREA

Addressable Population by Zip Code



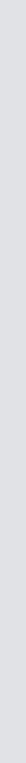


WHAT IS THE ROLE OF TECHNOLOGY IN
IMPLEMENTING AGM'S GROWTH STRATEGY?

NEO4J, MONGODB AND REDIS EACH HAS A ROLE IN REALIZING AGM'S GROWTH PLANS



Type of database	Graph database	NoSQL document-oriented database	NoSQL in-memory key-value database
Business case	<p>Determining optimal routes to transport goods (shortest path):</p> <ul style="list-style-type: none"> • Shortest BART route from kitchen to pickup locations • Shortest road route from pickup locations to delivery customers 	<p>Business intelligence and analytics:</p> <ul style="list-style-type: none"> • Predetermined views with different hierarchies of analysis (e.g., by store, customer, station) accounting for business reporting needs • Storage of additional ad hoc documents for later investigation 	<p>Real-time order management systems:</p> <ul style="list-style-type: none"> • Listing queue of customer orders that need to be fulfilled • Real-time analytics in order fulfillment to monitor metrics such as time from order to delivery
Benefits vs. Traditional Relational Database	<ul style="list-style-type: none"> • Directly represents data in a graph data structure • Built-in graph algorithms • Faster queries (for graph-based problems) 	<ul style="list-style-type: none"> • All data can be captured in a single JSON-like file (vs. multiple tables) • Flexibility • Faster queries 	<ul style="list-style-type: none"> • Extremely fast Read and Write operations: data stored in primary memory
Flexibility (Schema-Less) + Supports Horizontal Scaling + Accessibility and Reliability			



THANK YOU