

ITE GREAT LAKES DISTRICT
ANNUAL MEETING 2019

**ASSESSMENT OF THE
SOCIO-ECONOMIC
IMPLICATIONS RELATED TO
THE EMERGENCE OF SHARED
AUTONOMOUS VEHICLES:
THE TALE OF TWO
MIDWESTERN CITIES**

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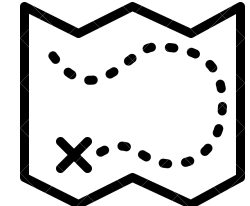


CENTER FOR CONNECTED
AND AUTOMATED
TRANSPORTATION




CURRENT AND EMERGING TRENDS

 270 million registered vehicles in the US (US EPA, 2017).

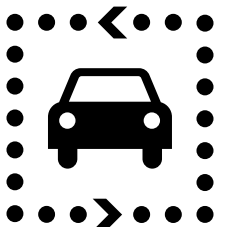
 40 miles traveled per respondent (FHWA, 2015).

Slight downward trend since 2006 on annual vehicle miles.



Approximately 73 million Millennials (18-34 years old).



 Millennials drove 20% fewer miles than last decade.

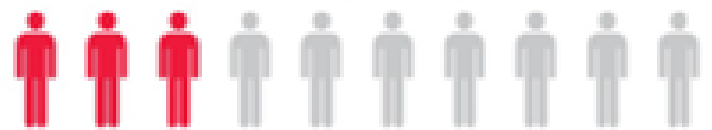


By 2045, increase by 77% of people older 65 years old and increase of income inequality

Pooled SAVs provide mobility for disadvantaged group of people and complement public transit.

Older Americans — Redefining Longevity

By 2045, the number of Americans over age 65 will increase by **77%**




About **one-third** of people over 65 have a disability that limits mobility. Their access to critical services will be more important than ever.

Millennials — Shaped by Technology

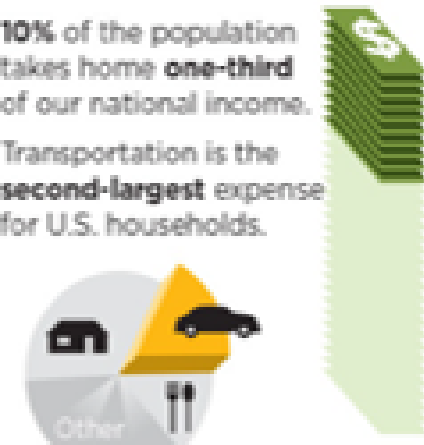
There are **73 million Millennials** aged 18 to 34. They are the first to have access to the internet during their formative years and will be an important engine of our future economy.

Millennials are driving less. By the end of the 2000s, they drove over **20% fewer miles** than at the start of the decade.



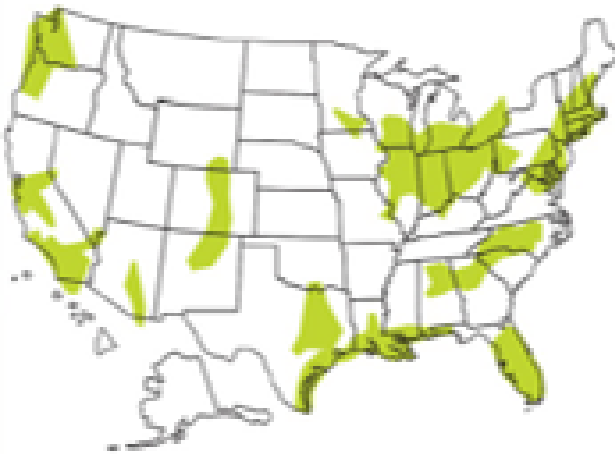
Income Inequality

10% of the population takes home **one-third** of our national income. Transportation is the **second-largest** expense for U.S. households.



Megaregions and Shifts in Population Centers

11 megaregions are linked by transportation, economics, and other factors. They represent over **75%** of our population and employment. In 2014, **365,000** people moved to the South—up **25%** from 2013—and moves to the West doubled.

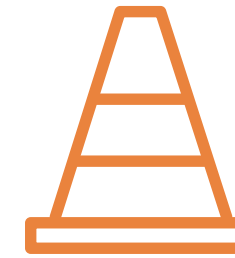


RESEARCH MOTIVATION



**SAVs emerging
transportation
mode in urban
areas.**

**Widespread
emergence of AVs
could impact:**



**Widespread
emergence of AVs
could impact:**



**Understanding characteristics
of distinct market segments can
lead to smoother transition**



RESEARCH OBJECTIVES



Assess the socio-economic implications related to SAVs:

- Identify market segments with different characteristics and different levels of adoption
- Identify transportation disadvantaged areas
- Provide best strategies and suggestions to these areas to ensure smooth transition



SURVEY DESIGN

Metropolitan Areas

Online Distribution

400 Responses

5% of margin of error and 95% confidence level

Respondents over 18 years old

March 2018

IRB Protocol # 1701018708



Indianapolis

November 2017

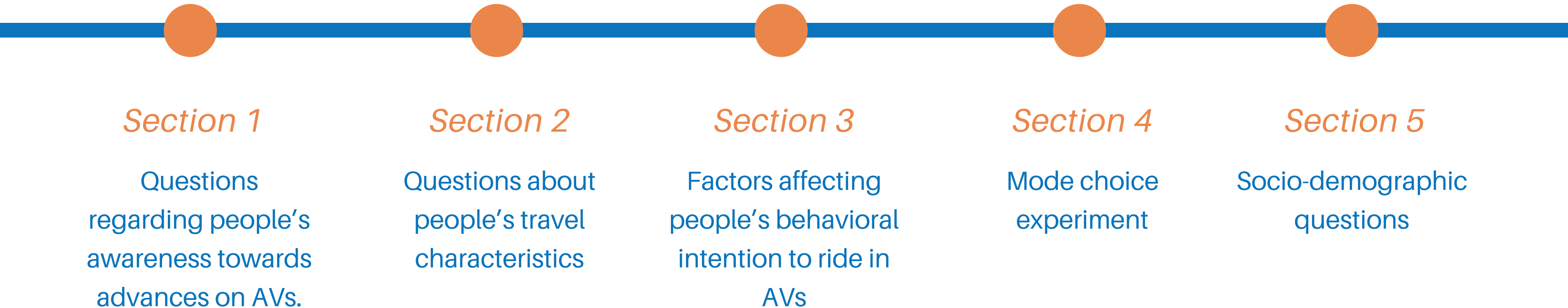
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Chicago




SURVEY QUESTIONS



SURVEY - SAMPLE

	CHICAGO	INDIANAPOLIS
Gender		
	47%	45%
	53%	55%
Modal Split		
	12%	8%
	3%	2%
	65%	81%
	2%	-
	15%	3%
	2%	6%

MARKET SEGMENTATION ANALYSIS (MSA)



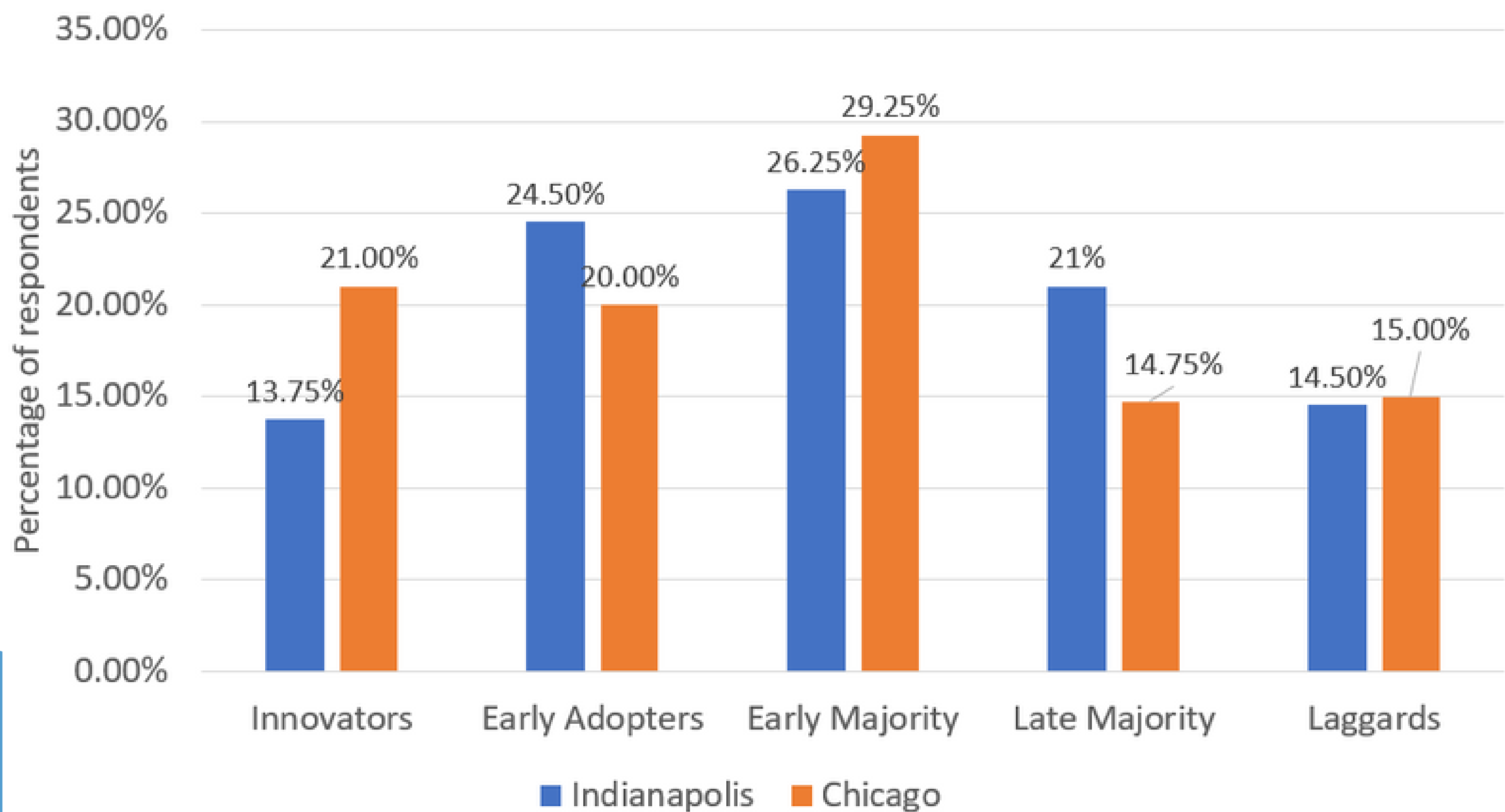
Cluster Analysis – group cases similar to each other and address heterogeneity in data set.

Classify respondents into distinct market segments.




































Partitioning method – k-means algorithm (minimize variation within clusters).

Five clusters: a) innovators, b) early adopters, c) early majority, d) late majority, e) laggards.































MARKET SEGMENTATION ANALYSIS



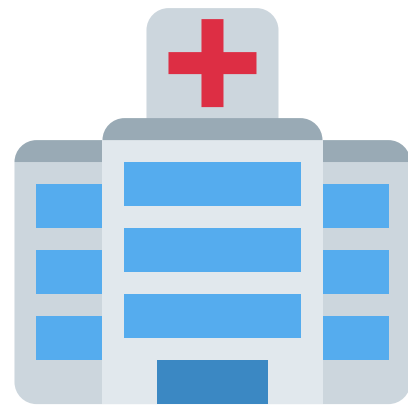
MSA - INDIANAPOLIS

	13.75%	24.50%	26.25%	21.00%	14.50%
	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
Gender		 			 
Commute Trips	 	 			
Age	<34 years old	<44 years old	35-54 years old	>45 years old	>55 years old
Income	\$\$\$\$\$	\$\$\$\$\$	\$	\$\$\$	\$\$
Vehicle Ownership	 	 	 		
Household Size	   	 	  	 	 

MSA - CHICAGO

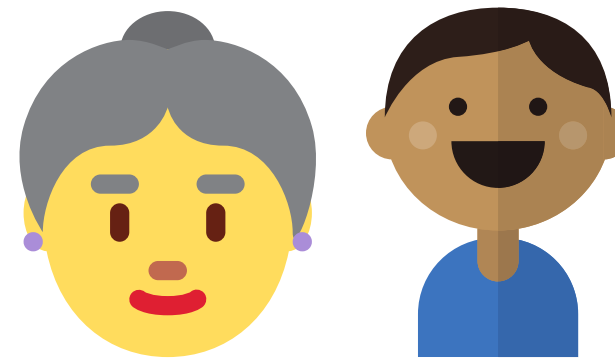
	21.00%	20.00%	29.25%	14.75%	15.00%
	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
Gender		 			
Commute Trips					
Age	< 34 years old	25-34 years old	35-44 years old	45-54 years old	>55 years old
Income	\$\$\$	\$\$\$\$	\$	\$\$\$\$\$\$	\$\$
Vehicle Ownership		 			
Household Size	   	 	   	 	No 

MULTI-SPATIAL PERSPECTIVE APPROACH



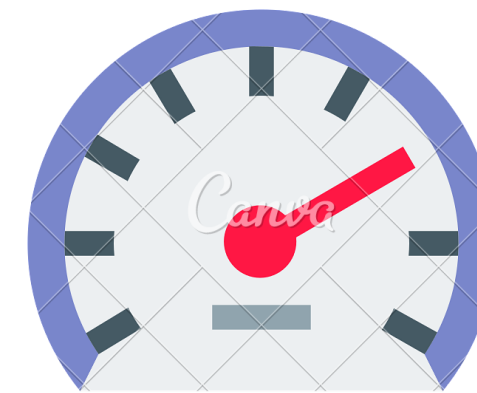
Accessibility

What opportunities are close to the area?



Mobility

What are the demographics of the area?

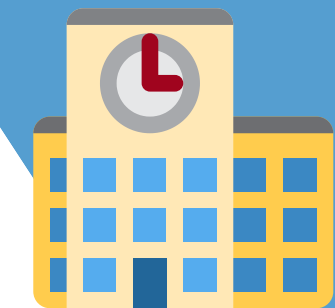


Outcome

How much does a person in an certain area drive daily?

ACCESSIBILITY-BASED APPROACH

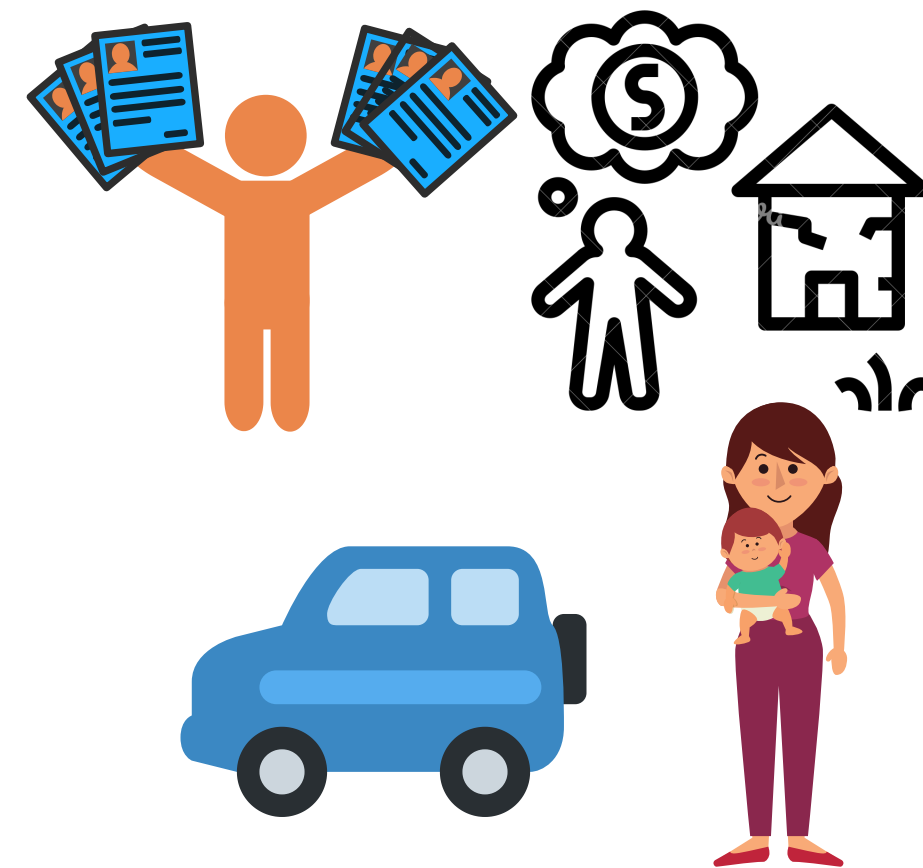
	Distance (miles)	Travel time (min)			Accessibility levels		
		Walking	Transit	Driving	Low	Medium	High
Large hospital	1.19	24	8	3		✓	✓
Schools	0.09	2	1				✓
Recreational facilities	0.11	2	1				✓
Museums	2.05	41	14	5		✓	✓
Public libraries	1.56	31	10	4		✓	✓
Transportation Stations							
Bus Stop	0.03	1					✓
Rail Stop	1.03	21	7	3			
Airports	7.55			19			



MOBILITY-BASED APPROACH

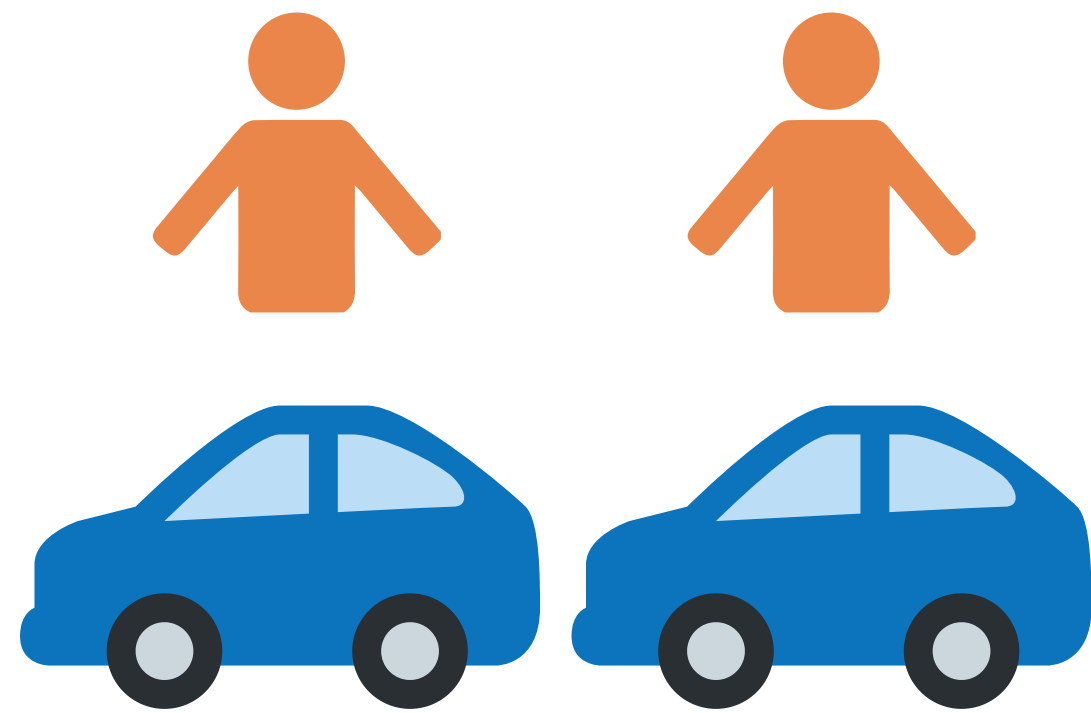


Age or physical factors



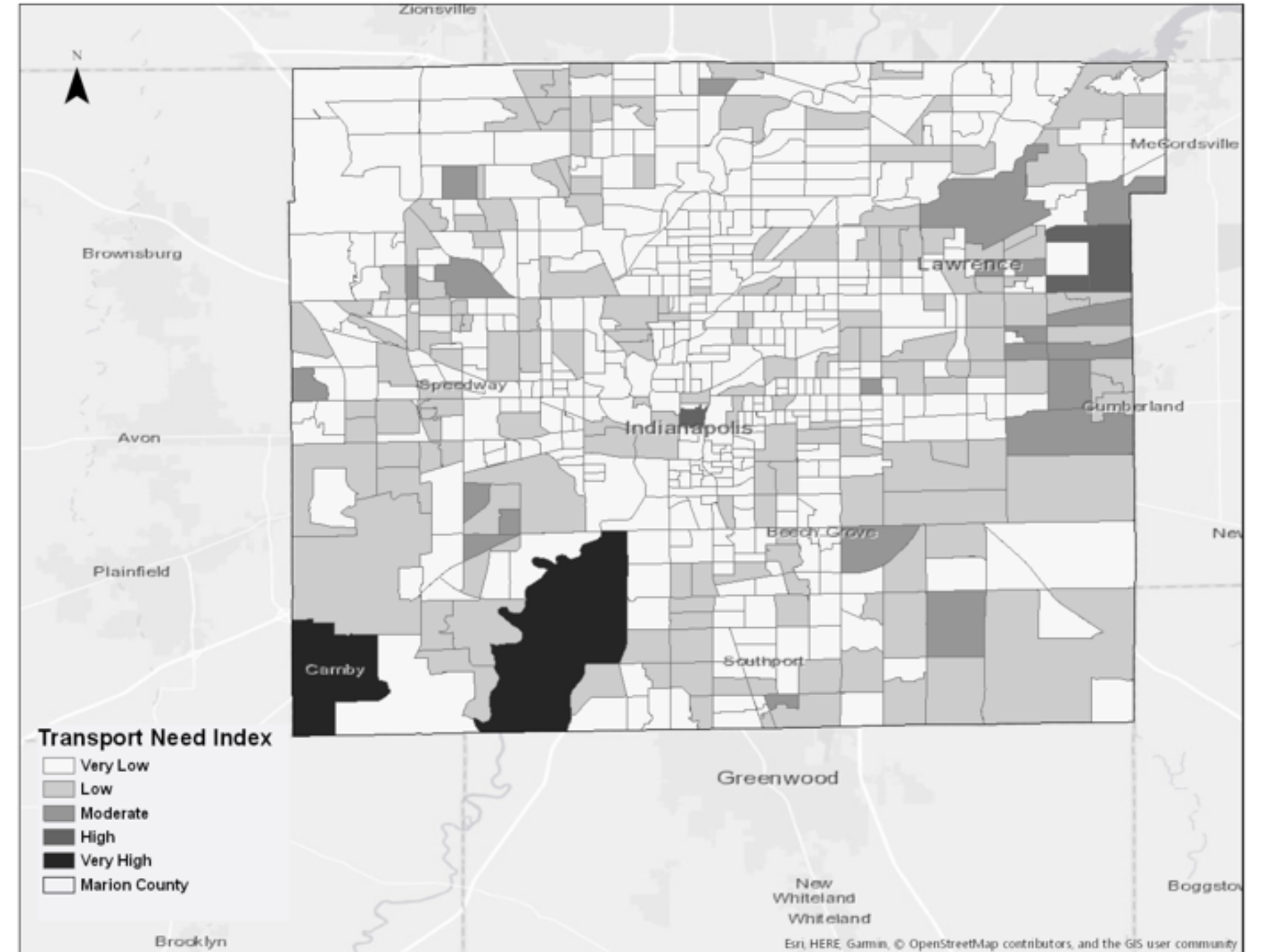
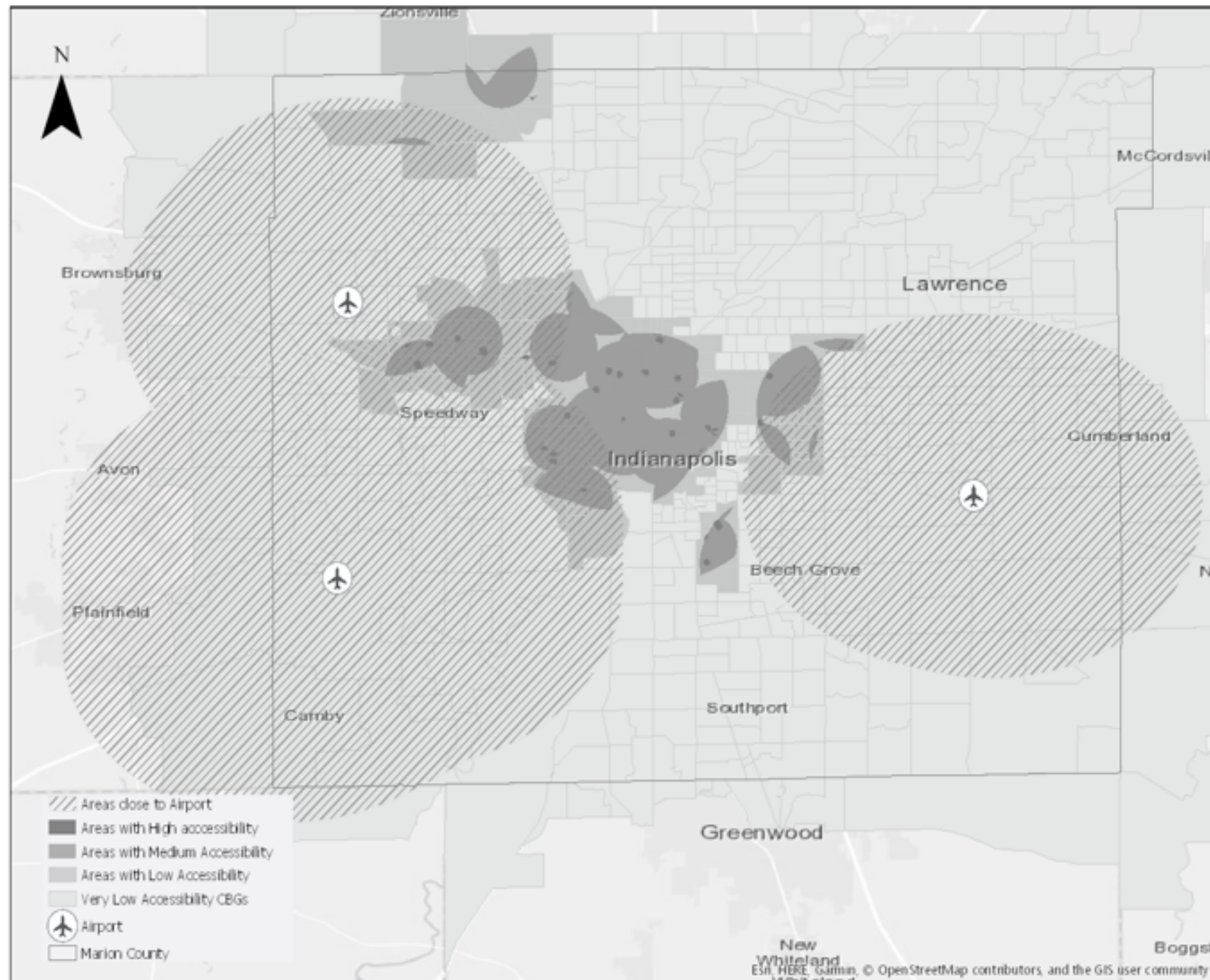
High probability of lack of mobility choices

OUTCOME-BASED APPROACH



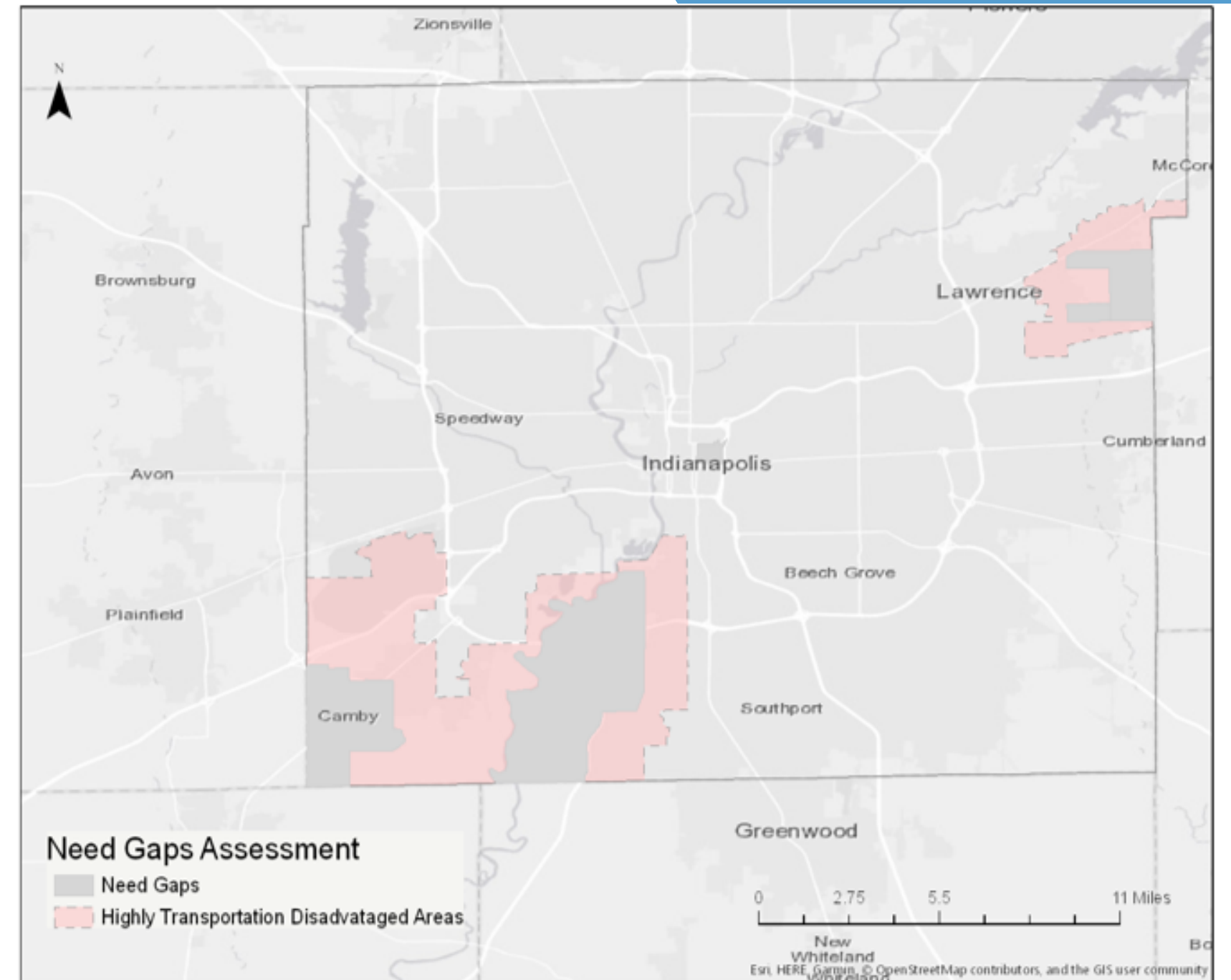
MULTI-SPATIAL PERSPECTIVE APPROACH

Indianapolis



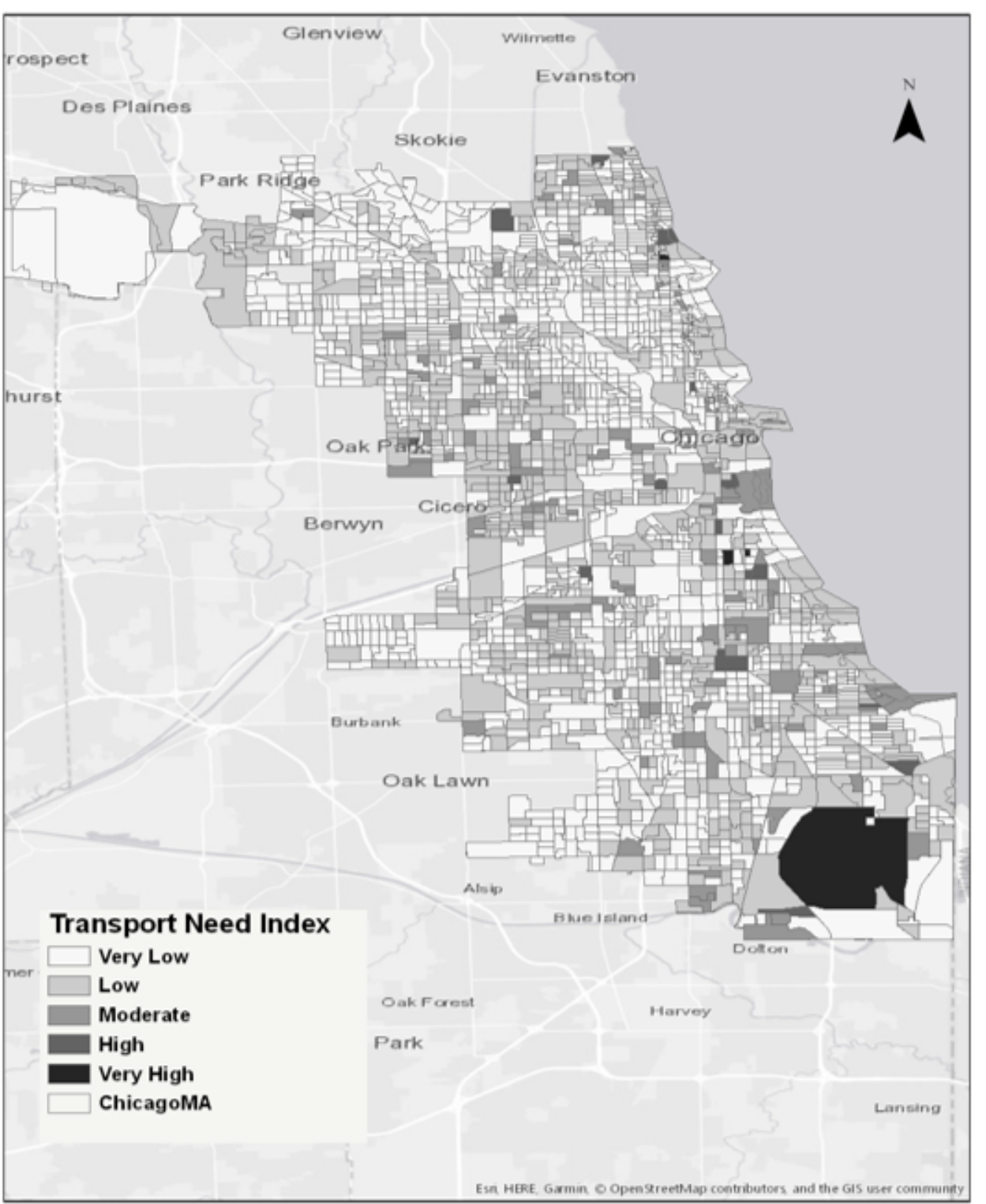
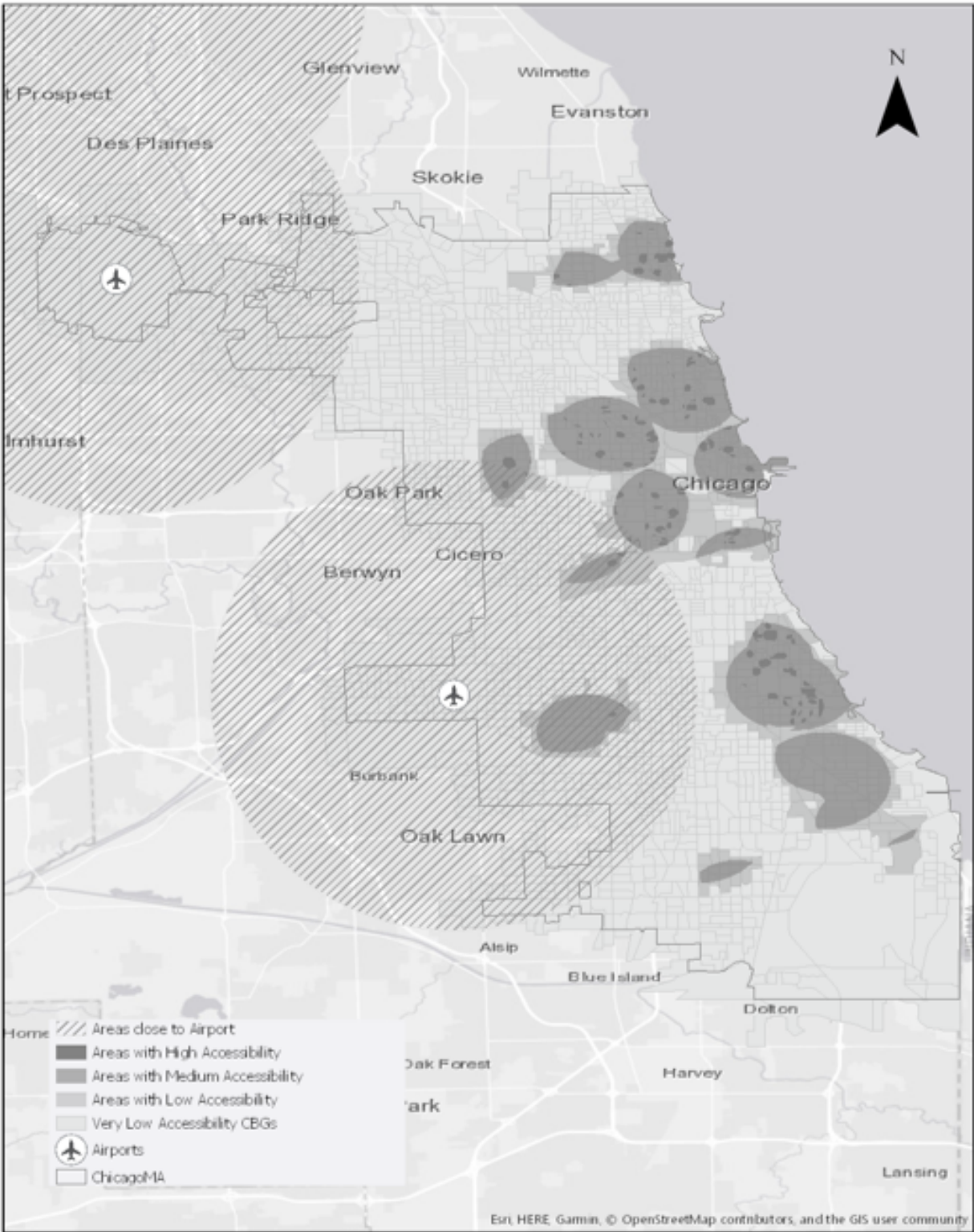
MULTI-SPATIAL PERSPECTIVE APPROACH

Indianapolis



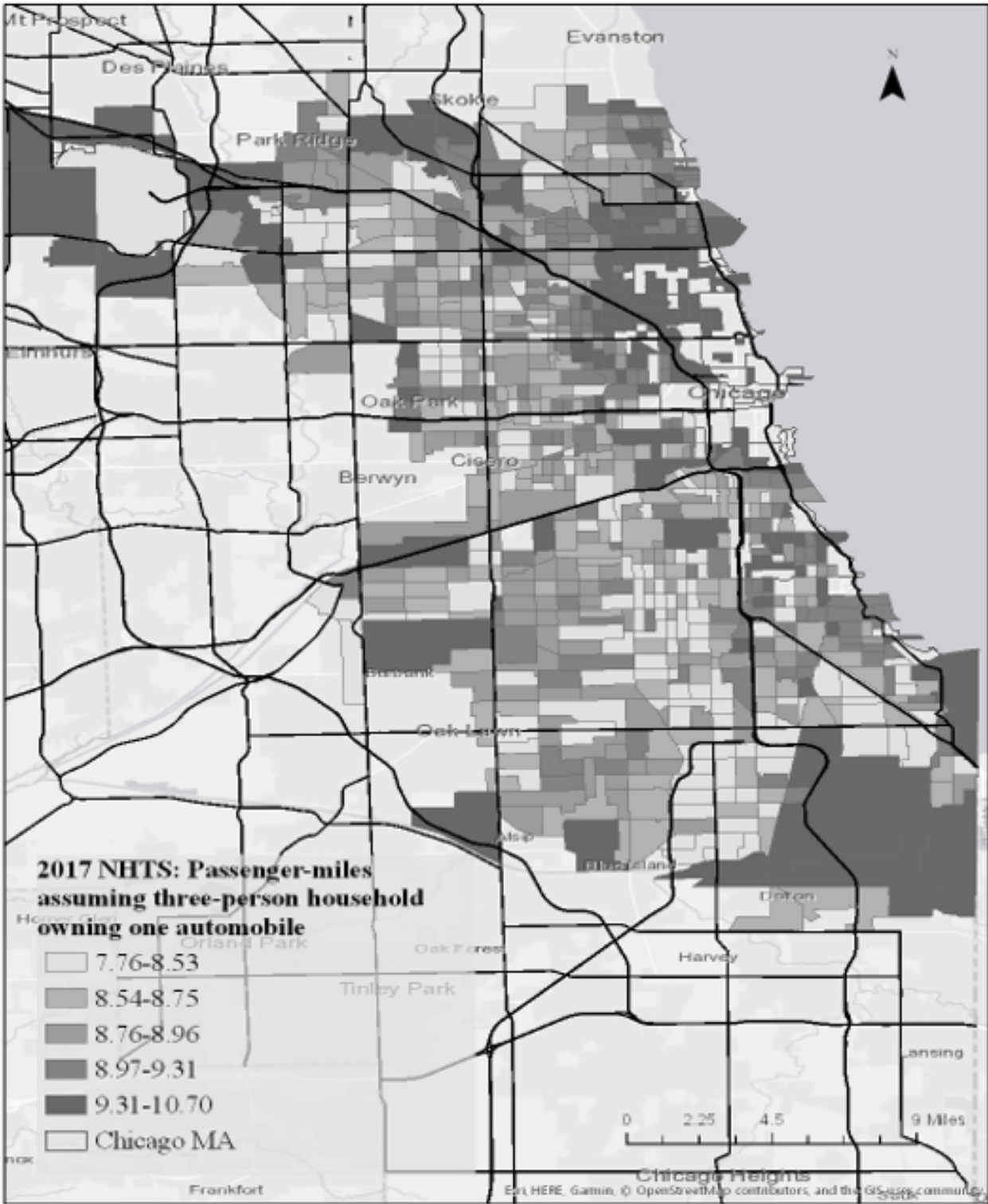
MULTI-SPATIAL PERSPECTIVE APPROACH

Chicago




MULTI-SPATIAL PERSPECTIVE APPROACH

Chicago



KEY TAKEAWAYS



Chicago seems to be more innovative than Indianapolis about the adoption of AVs.

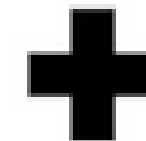
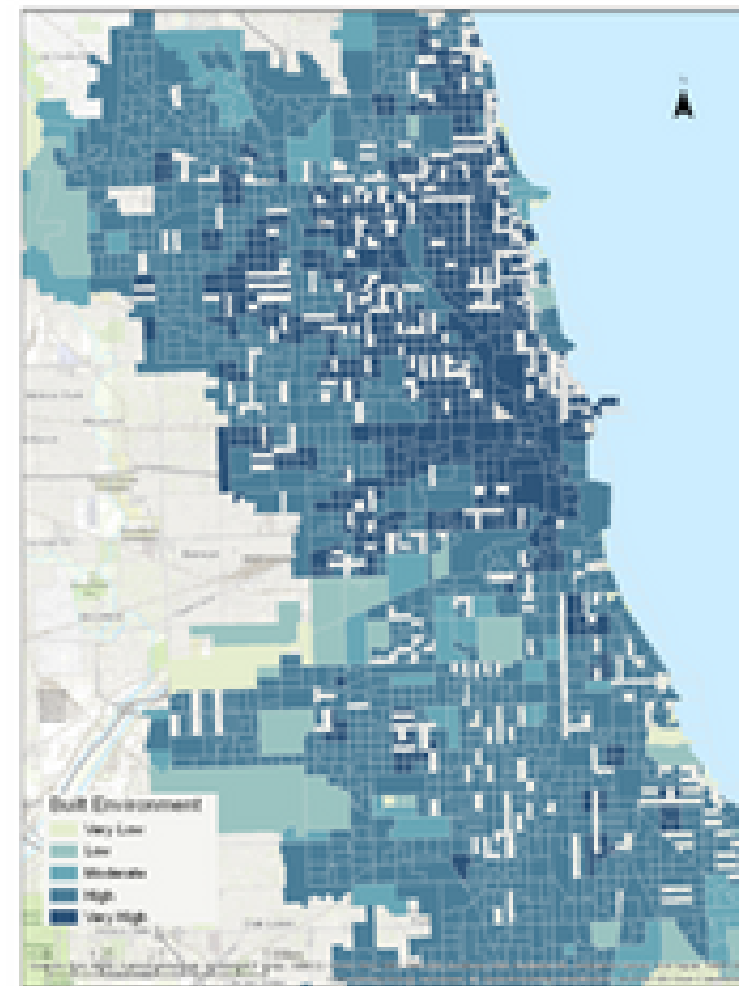
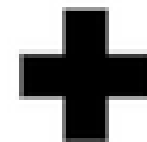
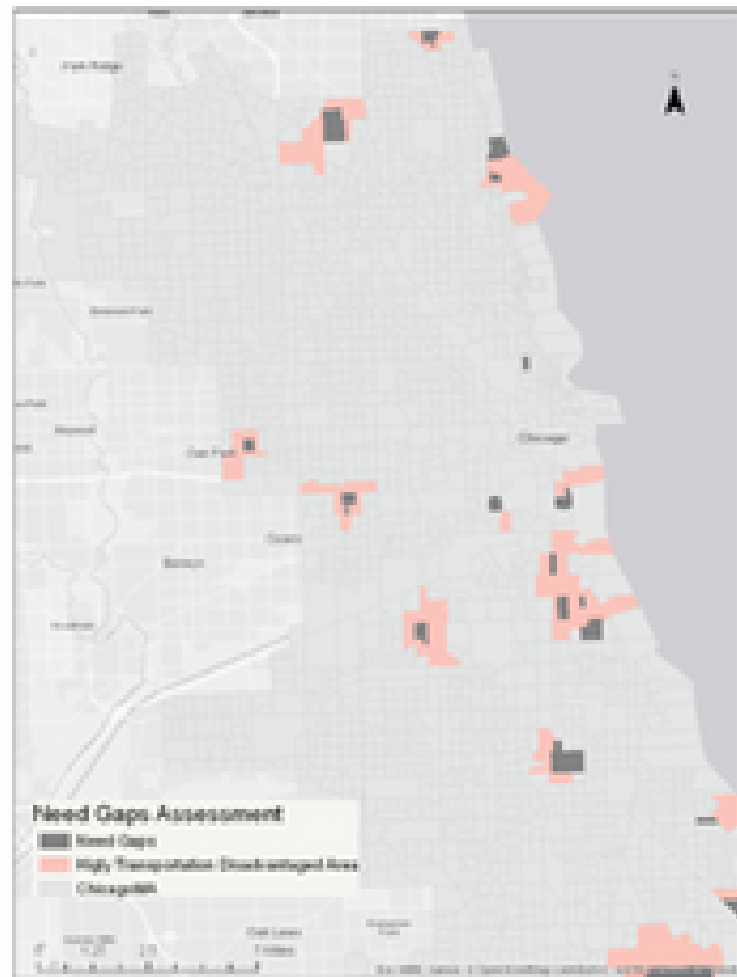
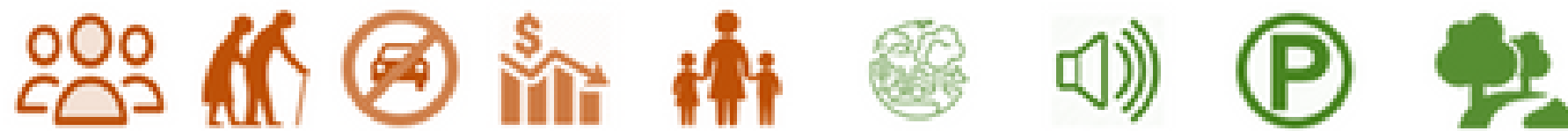
Characteristics of late adopters are similar in both cities.

Disadvantaged areas in Indianapolis are located in the south and east part of Marion County.

Disadvantaged areas in Chicago are scattered throughout Cook county.

Non-transportation disadvantage areas have higher access to transit stops and interstates. among other factors.

NEXT STEPS - SPATIAL MARKET SEGMENTATION



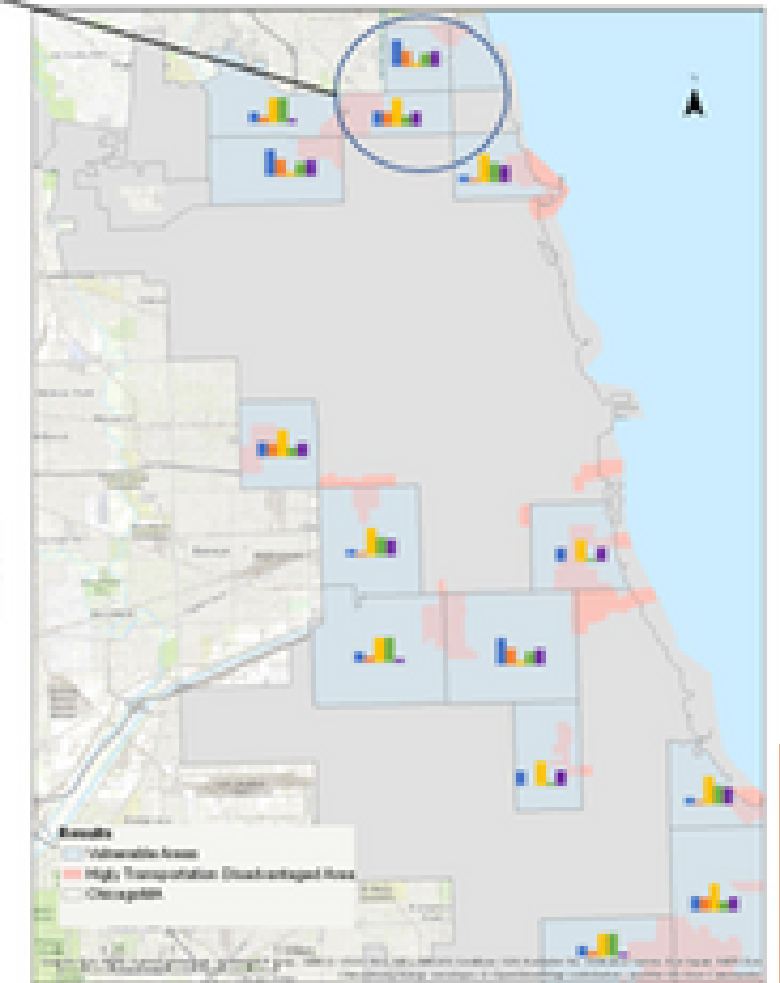
INNOVATORS

EARLY ADOPTERS

EARLY MAJORITY

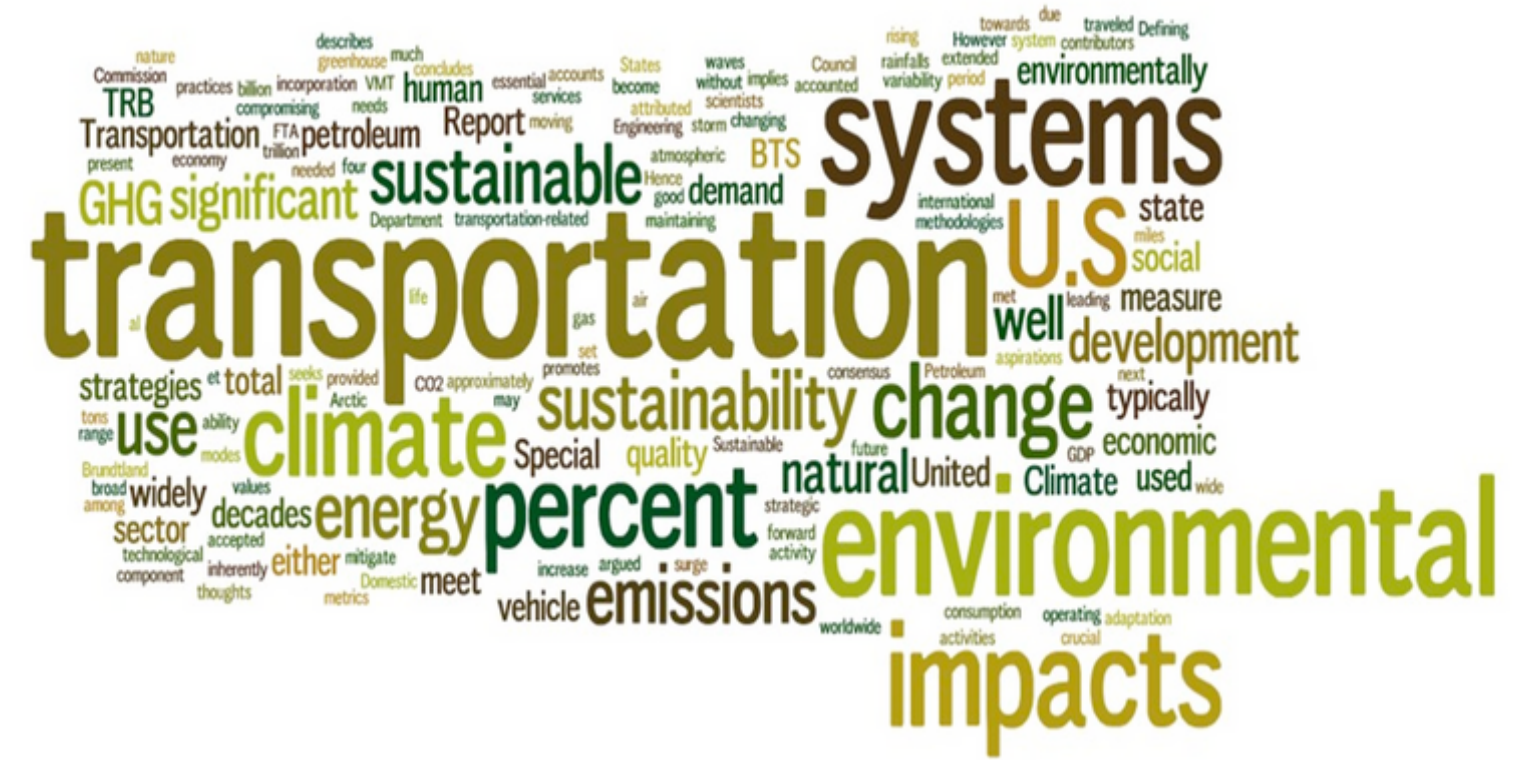
LATE MAJORITY

LAGGARDS



ACKNOWLEDGMENTS

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<https://engineering.purdue.edu/STSRG>

INNOVATORS	EARLY ADOPTERS	EARLY MAJORITY	LATE MAJORITY	LAGGARDS
Highest level of awareness on AVs	Higher than average level of awareness on AVs	Lower than average level of awareness on AVs	Higher than average level of awareness on AVs	Lowest level of awareness on AVs
25% use public transportation or walk to their commute trips as primary modes, 4% bike commute	15% use public transportation or walk to their commute trips as primary modes	80% use their personal vehicles for their commute trips	90% use their personal vehicles for trips regardless the trip purpose	90% use their personal vehicles for trips regardless the trip purpose, only 3% walk
10% do not own a vehicle. They drive about 12,000 mi/year (highest of any group)	10% do not own a vehicle. They drive about 10,000 mi/year on average	10% do not own a personal vehicle	2% do not own a personal vehicle	5% do not own a personal vehicle, though this group drives the least on (avg 9000 mi/year)
65% use ride-hailing services, 20% have a car-sharing service account	40% use ride-hailing services, 5% have a car-sharing service account	40% use ride-hailing services	20% use ride-hailing services and none of them use car-sharing services	10% use ride- hailing services, 0 respondents had a car sharing account.
64% are male	54% are female	58% are female	64% are female	52% are female
55% are Millennials (<34 y.o.)	Avg. age 29 y.o.	32% are Millennials (<34 y.o.)	35% are Millennials (<34 y.o.)	55% are people over 55 years old and 23% over 65 years old
60% work full time, 13% are students	38% work full time, 8% unemployed	44% work full time, 15% part time	24% have retired	22% have retired, 10% unemployed
Higher than average income – 52,000 on average	Higher than average income – around 50,000	Lowest average income – around 45,000	Average income around 48,000	Average income around 48,000
40% finished college degree, 10% did not graduate high school	32% finished undergraduate degree	21% are not high school graduates	17% are not high school graduates, 35% college graduates	41% finished college degree

INNOVATORS	EARLY ADOPTERS	EARLY MAJORITY	LATE MAJORITY	LAGGARDS
Highest level of awareness on AVs	Higher than average level of awareness on AVs	Lower than average level of awareness on AVs	Higher than average level of awareness on AVs	Lowest level of awareness on AVs
40% use public transportation and walk to their commute trips as primary modes	20% use public transportation to their commute trips as primary modes	60% use their personal vehicles for their commute trips	80% use their personal vehicles for trips regardless the trip purpose	70% use their personal vehicles for trips regardless the trip purpose
Half of them do not own a vehicle. 33% drove more than 15,000 miles last year (US average)	20% of them do not own a vehicle. 40% have 1 vehicle in their household	45% do not own a vehicle. 33% drove between 5k-10k miles last year	55% have at least one vehicle in their household	35% do not own a personal vehicle
60% use ride-hailing services for their trips (10% use ride-hailing services for social/recreational trips)	50% use ride-hailing services	40% use ride-hailing services	20% use ride-hailing services and none of them use car-sharing services	20% use ride-hailing services and 5% car-sharing services
60% are male	Equally split between male and female	60% are female	66% are male	75% are female
60% are Millennials (<34 y.o.)	Most dominant category people 25-34 years old	Most dominant category people 35-44 years old	Most dominant category people 45-54 years old	50% are people over 55 years old and 25% over 65 years old
82% work full time	60% work full time	10% are currently unemployed	25% have retired	33% have retired
Higher than average income – 40% earn below \$50k	Higher than average income - most dominant categories are \$25k-\$50k and \$100-\$150k	Lower than average income – 25% earn under \$25k	Highest average income – most dominant categories are \$75k-\$100k and \$100k-\$150k	Lowest average income – 50% earn \$25k-\$50k
75% college graduates or finished grad school	45% finished grad school	33% high school graduates	75% college graduates or finished grad school	45% college graduates
25% live in a household with 4 or more people	45% live in a household with 2 people	30% live in a household with 4 or more people. 40% have at least one child (under 18 y.o.) in their households	85% live in household with 2 or more people	66% do not have any children (under 18 y.o.) in their households