

# Analysis of Socioeconomic and Demographics Methodologies and Forecasting Solutions

Julia Amaral

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# Acknowledgements

- Larisa Morozovskaya
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- Joomee Lee
- Patel Munnes



IN MEMORY OF  
**IGNATIUS ADANGA**  
**CHARLES LESPERANCE**  
**SEE WONG SHUM**

# Objectives



Evaluate new methods to update NYMTC's socioeconomic and demographic forecasts



Recommend enhancement or alternatives to the existing forecasting models

# Why are forecasts important?



Shape the interaction between transportation investment and development patterns



Provide information for policy development



Help plan for infrastructure investments

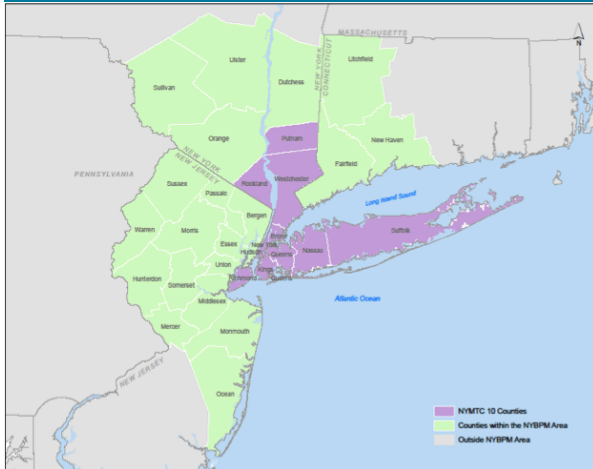


Support planning for air quality maintenance

# First Step: Understand the Current Models

## Forecasting Process

Forecasts at county level:  
population, employment,  
and households for 31 counties

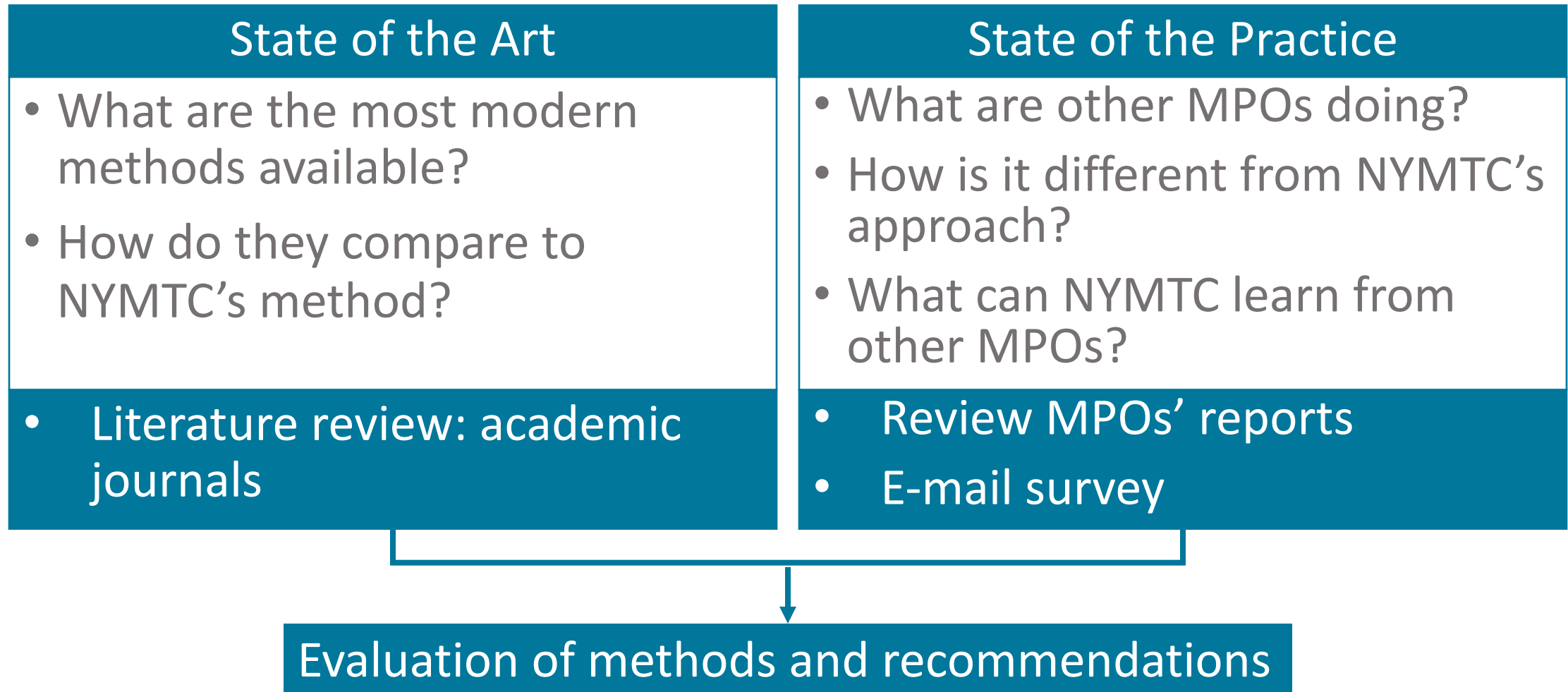


Zonal Allocation Process:  
allocation to 5,418  
Transportation Analysis  
Zones (TAZs)

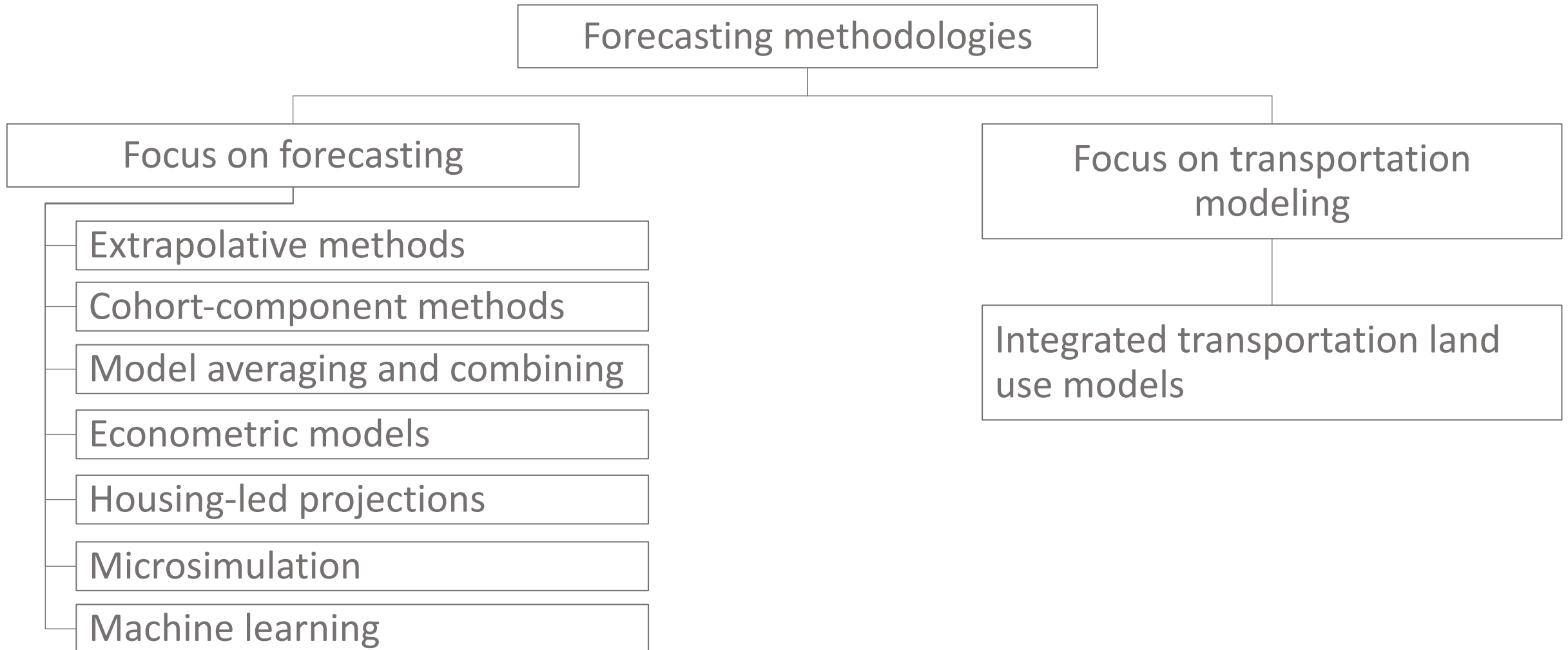
Housing units, new  
developments, location  
of businesses, schools...

New York Best Practice Model (NYBPM):  
transportation modeling

# Approach



# Literature Review

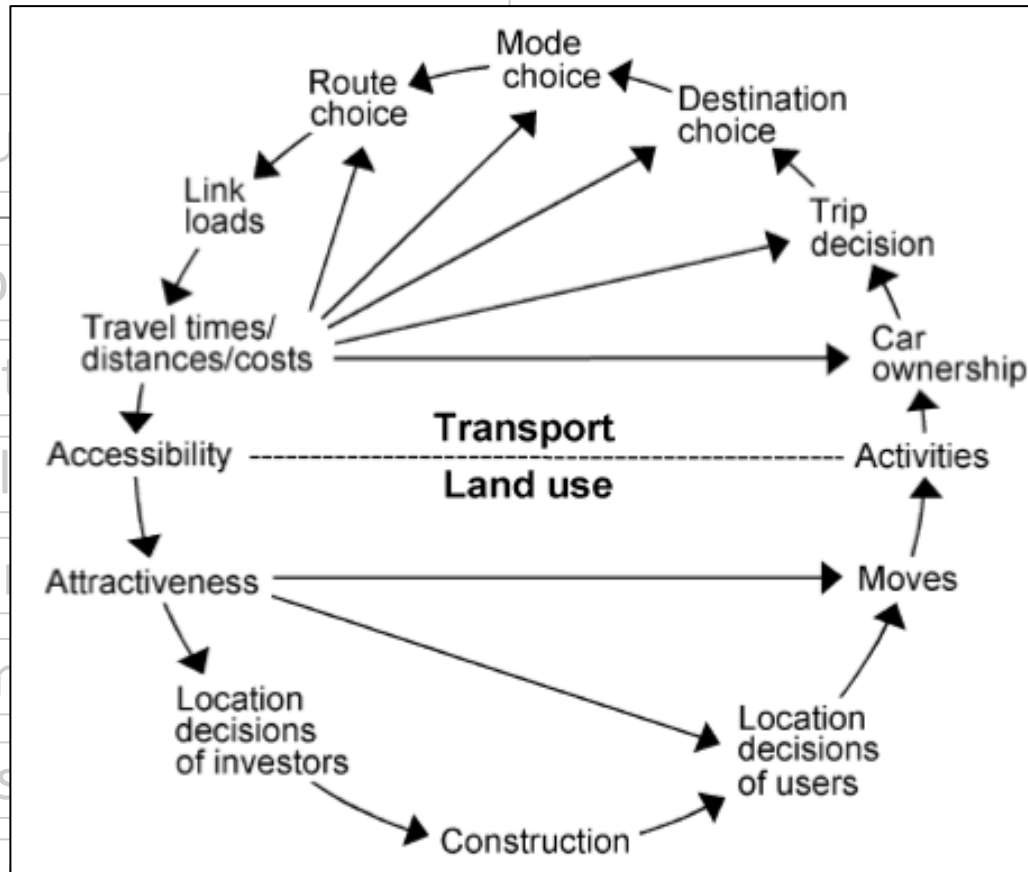


# Literature Review

Forecasting methodologies

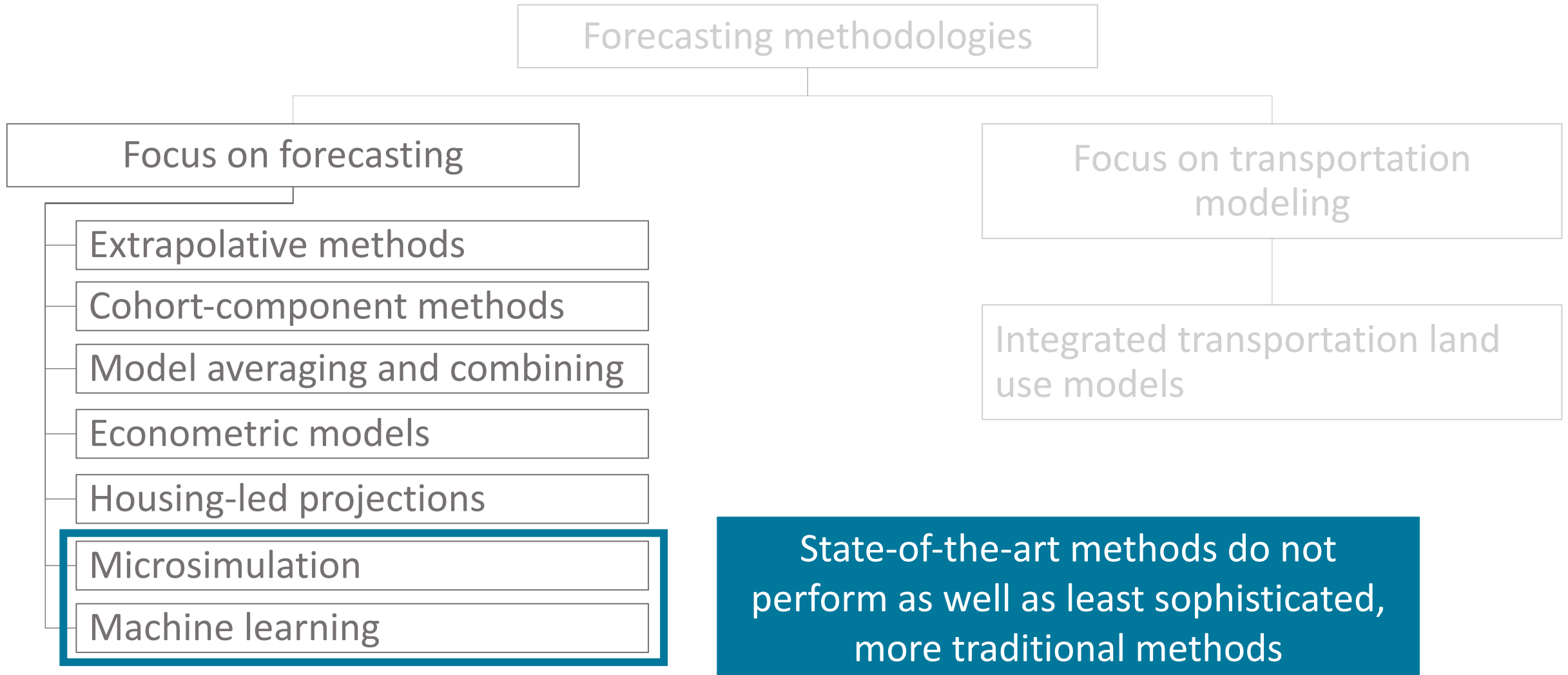
Focus on transportation modeling

Integrated transportation land use models

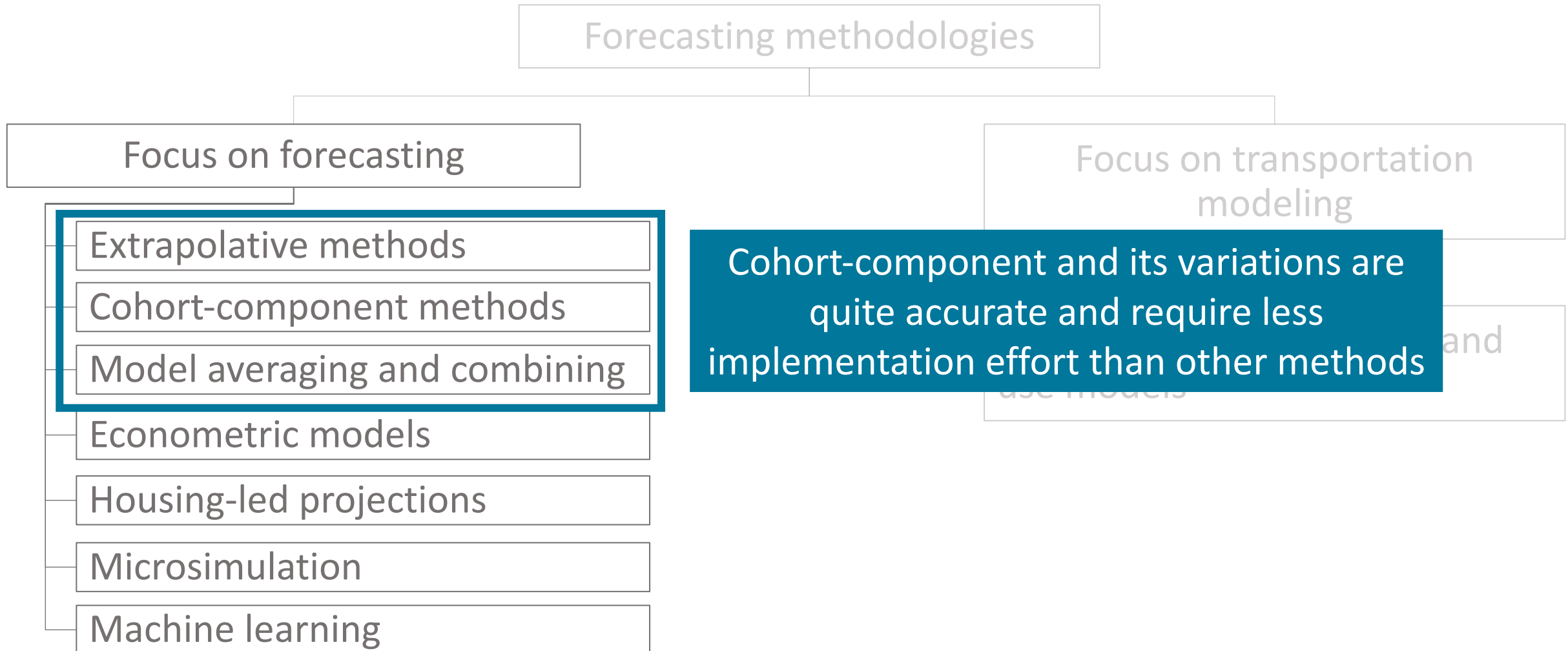


Source: Wegener and Fürst, 1999

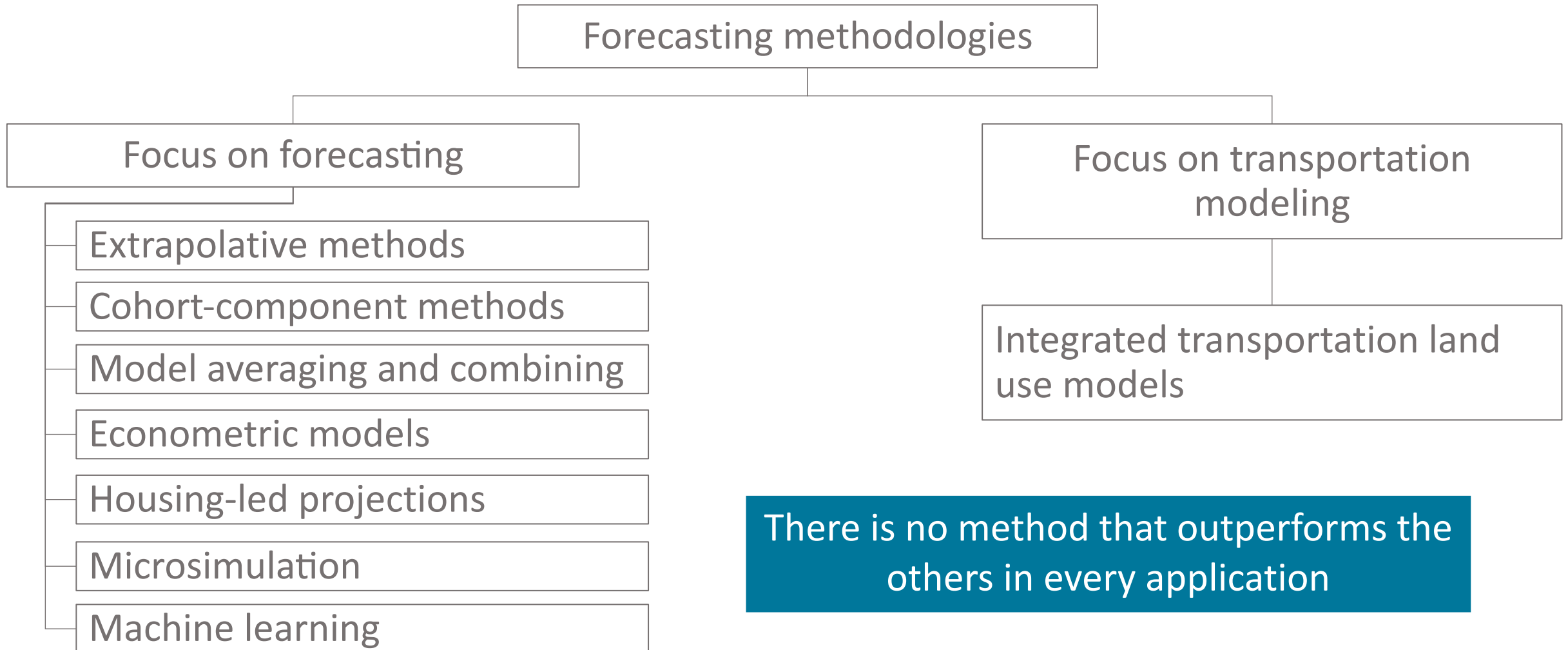
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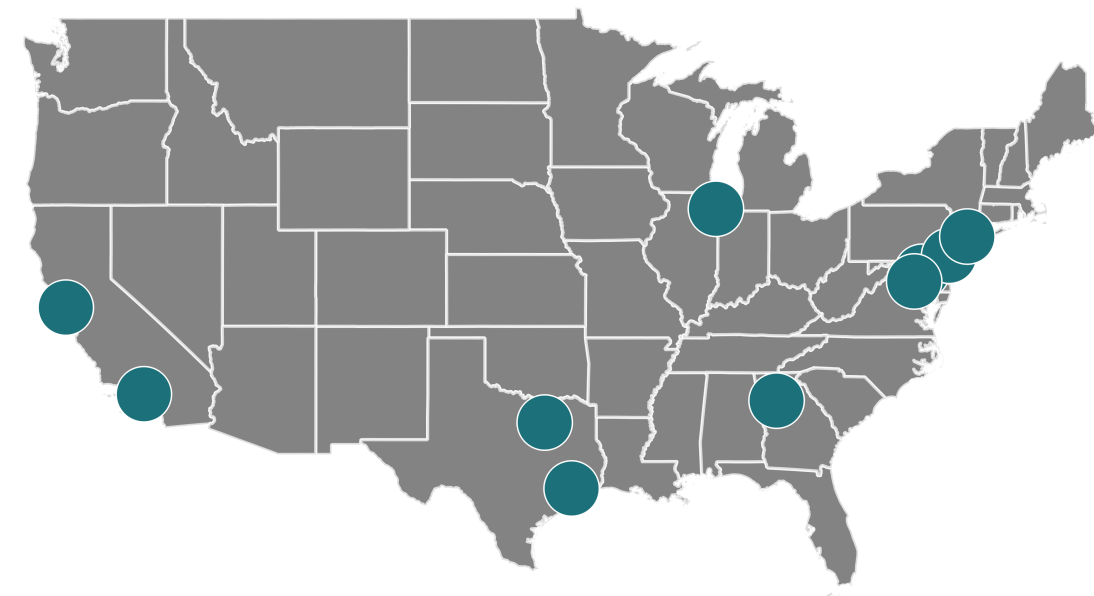


# Literature Review



# Other MPOs' Methodologies

| MPO                          | Baseline / Horizon Year | Baseline Population | Horizon Population |
|------------------------------|-------------------------|---------------------|--------------------|
| New York (NYMTC)             | 2017/2055               | 22.7 Million        | 25.9 Million       |
| South California (SCAG)      | 2012/2040               | 22.6 Million        | 26.7 Million       |
| Bay Area (ABAG)              | 2015/2050               | 7.6 Million         | 10.5 Million       |
| Chicago (CMAP)               | 2015/2050               | 7.3 Million         | 10.6 Million       |
| North Jersey (NJTPA)         | 2017/2050               | 6.7 Million         | 7.7 Million        |
| Houston-Galvestone (H-GAG)   | 2015/2045               | 6.5 Million         | 10.5 Million       |
| Atlanta (ARC)                | 2015/2050               | 5.7 Million         | 8.6 Million        |
| North Central Texas (NCTCOG) | 2017/2045               | 5.7 Million         | 11.2 Million       |
| Delaware Valley (DVRPC)      | 2015/2050               | 5.6 Million         | 6.4 Million        |
| Washington (MWCOG)           | 2015/2045               | 5.5 Million         | 6.8 Million        |
| Baltimore (BMC)              | 2015/2050               | 2.8 Million         | 3.1 Million        |



MPOs were selected according to population size

# Other MPOs' Methodologies

| MPO                          | Frequency of updates | Consultant | Updates produced by | Land Use Model | Staff (FTE) |
|------------------------------|----------------------|------------|---------------------|----------------|-------------|
| New York (NYMTC)             | 4 years              | Yes        | Consultant          | No             | 2           |
| South California (SCAG)      | 4 years              | No         | In-house            | No             | 4 -10       |
| Bay Area (ABAG)              | 4 years              | No         | In-house            | Yes            | 5           |
| Chicago (CMAP)               | 8 years              | Yes        | In-house            | Yes            | 2.5         |
| North Jersey (NJTPA)         | 4 years              | Yes        | Consultant          | No             | 1           |
| Houston-Galvestone (H-GAG)   | 2 years              | No         | In-house            | Yes            | 5           |
| Atlanta (ARC)                | 3 to 4 years         | Yes        | In-house            | No             | 4           |
| North Central Texas (NCTCOG) | 4 to 5 years         | Yes        | In-house            | No             | 4           |
| Delaware Valley (DVRPC)      | 4 years              | Yes        | In-house            | Yes            | 1           |
| Washington (MWCOG)           | 5 years              | No         | In-house            | No             | 5           |
| Baltimore (BMC)              | As needed            | No         | Local Agencies      | No             | -           |

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| Baltimore (BMC)              | As needed            | No         | Local Agencies      | No             | -           |

# Other MPOs' Methodologies: Key Insights



The most popular method is Cohort-Component models



Integrated transportation land use models are a trend



MPOs do not use results produced by any models as a final



There is no one-fits-all approach

# Qualitative Evaluation

|                                    | Cost (\$) | Workforce | Data Needs | Flexibility | Accuracy of Results |
|------------------------------------|-----------|-----------|------------|-------------|---------------------|
| Extrapolative Methods              | 5         | 5         | 5          | 2           | 2                   |
| Cohort-Component Models            | 5         | 4         | 4          | 4           | 4                   |
| Econometric Models                 | 2-4       | 3         | 3          | 5           | 3                   |
| Microsimulation                    | 2         | 3         | 1          | 5           | 3                   |
| Machine Learning                   | 2         | 2         | 1          | 5           | 3                   |
| Integrated Transp. Land Use Models | 1         | 2         | 1          | 5           | 5                   |

5=most positive, 1=most negative

# Qualitative Evaluation

|                                    | Cost (\$) | Workforce | Data Needs | Flexibility | Accuracy of Results |
|------------------------------------|-----------|-----------|------------|-------------|---------------------|
| Extrapolative Methods              | 5         | 5         | 5          | 2           | 2                   |
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| Econometric Models                 | 2-4       | 3         | 3          | 5           | 3                   |
| Microsimulation                    | 2         | 3         | 1          | 5           | 3                   |
| Machine Learning                   | 2         | 2         | 1          | 5           | 3                   |
| Integrated Transp. Land Use Models | 1         | 2         | 1          | 5           | 5                   |

5=most positive, 1=most negative

## Pros

- Easy to implement

## Cons

- Based on past trends only

# Qualitative Evaluation

|                                    | Cost (\$) | Workforce | Data Needs | Flexibility | Accuracy of Results |
|------------------------------------|-----------|-----------|------------|-------------|---------------------|
| Extrapolative Methods              | 5         | 5         | 5          | 2           | 2                   |
| Cohort-Component Models            | 5         | 4         | 4          | 4           | 4                   |
| Econometric Models                 | 2-4       | 3         | 3          | 5           | 3                   |
| Microsimulation                    | 2         | 3         | 1          | 5           | 3                   |
| Machine Learning                   | 2         | 2         | 1          | 5           | 3                   |
| Integrated Transp. Land Use Models | 1         | 2         | 1          | 5           | 5                   |

5=most positive, 1=most negative

## Pros

- Good “cost/benefit”

## Cons

- Limited consideration of external factors (e.g., land use)

# Qualitative Evaluation

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|------------------------------------|-----------|-----------|------------|-------------|---------------------|
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| Machine Learning                   | 2         | 2         | 1          | 5           | 3                   |
| Integrated Transp. Land Use Models | 1         | 2         | 1          | 5           | 5                   |

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## Pros

- Incorporation of spatial and economic variables

## Cons

- Data requirements
- Calibration process

# Qualitative Evaluation

|                                    | Cost (\$) | Workforce | Data Needs | Flexibility | Accuracy of Results |
|------------------------------------|-----------|-----------|------------|-------------|---------------------|
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| Machine Learning                   | 2         | 2         | 1          | 5           | 3                   |
| Integrated Transp. Land Use Models | 1         | 2         | 1          | 5           | 5                   |

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## Pros

- High level of detail of outputs

## Cons

- Data requirements
- Computational requirements

# Qualitative Evaluation

|                                    | Cost (\$) | Workforce | Data Needs | Flexibility | Accuracy of Results |
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| Machine Learning                   | 2         | 2         | 1          | 5           | 3                   |
| Integrated Transp. Land Use Models | 1         | 2         | 1          | 5           | 5                   |

5=most positive, 1=most negative

## Pros

- Data-oriented nature

## Cons

- High level of expertise is required
- Results are not necessarily as good

# Qualitative Evaluation

|                                    | Cost (\$) | Workforce | Data Needs | Flexibility | Accuracy of Results |
|------------------------------------|-----------|-----------|------------|-------------|---------------------|
| Extrapolative Methods              | 5         | 5         | 5          | 2           | 2                   |
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| Microsimulation                    | 2         | 3         | 1          | 5           | 3                   |
| Machine Learning                   | 2         | 2         | 1          | 5           | 3                   |
| Integrated Transp. Land Use Models | 1         | 2         | 1          | 5           | 5                   |

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## Pros

- Accuracy of results
- Incorporates land use-transp. cycle

## Cons

- Data requirements
- Specialized software

# Recommendations

- NYMTC's forecasting methodology is robust and it is not outdated
- In the short term, NYMTC could consider:
  - Improve the readability of the models by migrating to a coding language (Python or R)
  - Explore other land use data sources to enhance the zonal allocation process (e.g., tax parcels, OpenStreetMaps buildings)
  - Review the cohort-component models currently in place and test if variations of the model improve the accuracy of the results
- In the long term, NYMTC could:
  - Continue researching for new trends and developments in forecasting methods

# Thank you!