

Commuting Patterns in Metropolitan Regions of Romania: A Case Study on Railway Station Development Using GIS and Social Survey Methods

Baicu Liviu Gabriel

Doctoral School from University of Architecture and Urbanism, Ion Mincu, Bucharest

INTRODUCTION & AIM

Romania's 22 metropolitan regions show **strong disparities in commuting patterns**, characterized by:

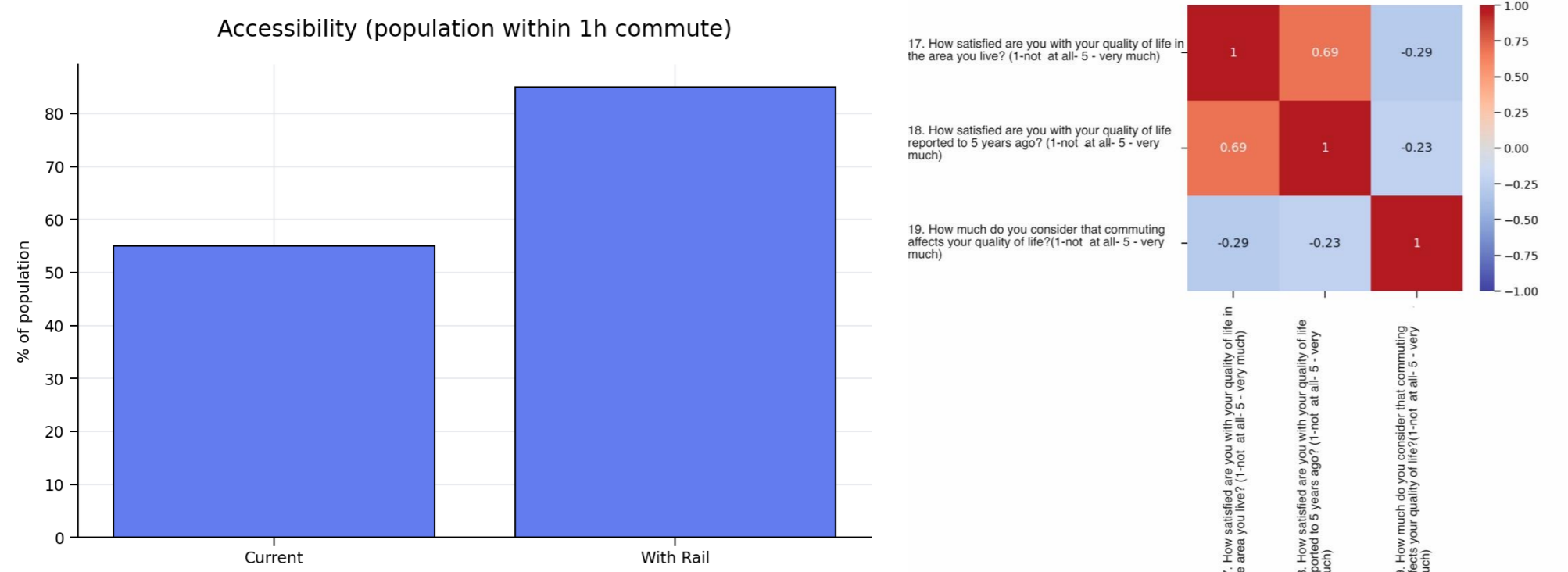
- High **car dependency (>80% modal share)**
- Spatial **suburban sprawl** and congestion
- Underutilized railway infrastructure**

At the same time, a few metropolitan areas (Bucharest–Ilfov, Cluj-Napoca, Braşov, Oradea) are beginning to adopt **Transit-Oriented Development (TOD)** strategies through commuter rail initiatives.

To evaluate how **integrated railway station development** influences:

- Commuting behavior
- Accessibility and travel times
- Spatial growth patterns

using **GIS-based analysis and social survey data**



METHOD

GIS Analysis

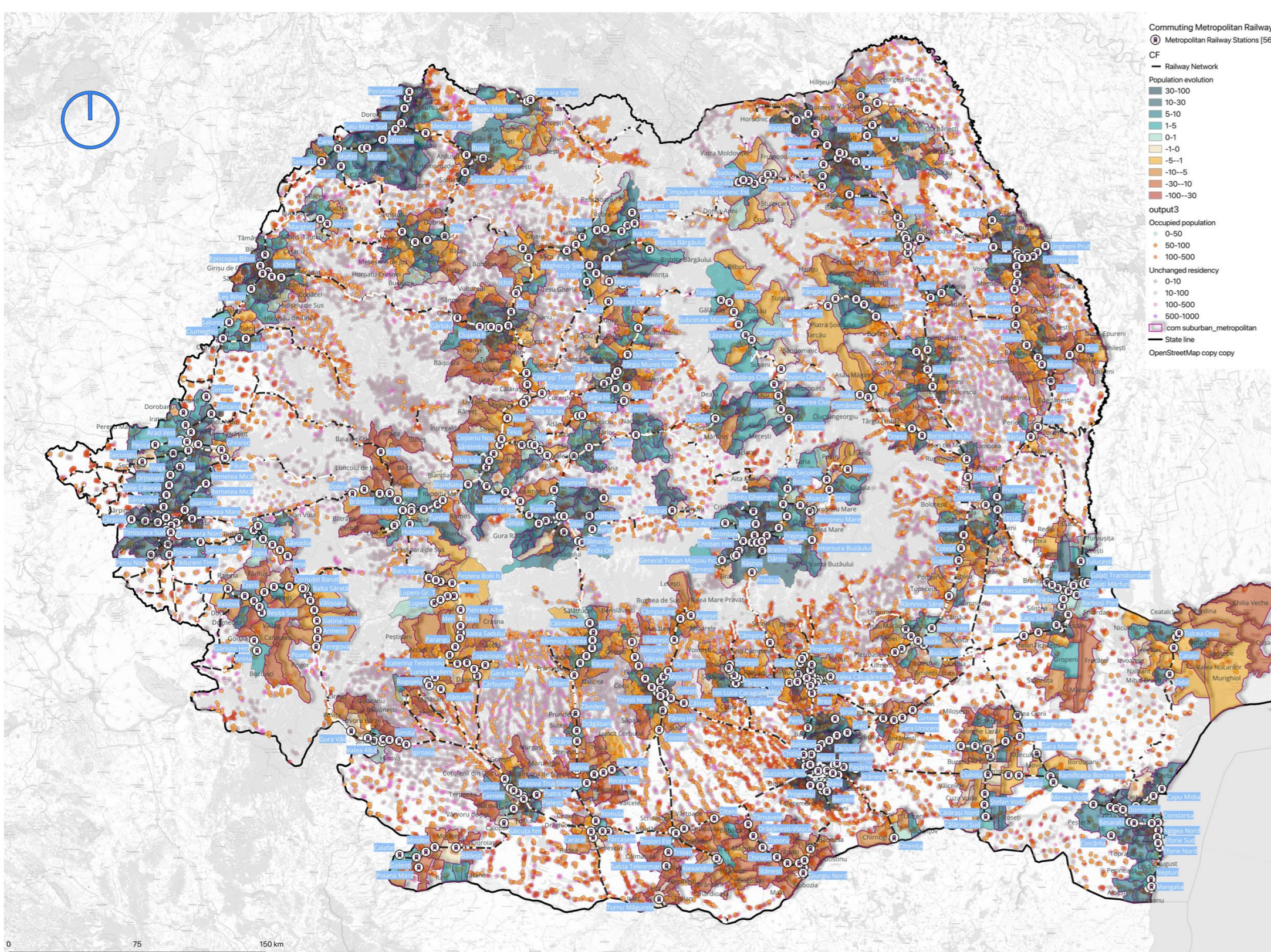
- Mapping of **railway infrastructure and stations**
- Analysis of **urban expansion (2006–2020)**
- Accessibility modelling (**car vs. rail travel times**)
- Identification of **development within 1 km of stations**

Social Surveys

- Commuter perceptions (mode choice, travel time, service quality)
- Willingness to shift to rail
- Socio-economic factors (income, car ownership)

Policy Review

- National strategies (Transport Plan 2020–2030)
- SUMPs and metropolitan rail projects
- European TOD benchmark



RESULTS & DISCUSSION

Metropolitan Typologies

Three groups identified:

Early Adopters

- (Bucharest, Cluj, Braşov, Oradea)
- Emerging rail systems + TOD

Partial Users

- Existing rail underutilized, car-dependent growth

Latecomers

- No rail influence, strong car reliance

Key Findings

Modal Split

- Cars dominate (>80%)
- Rail usage extremely low (~4%)
- Lack of metropolitan integration limits public transport

Travel Time

- Severe congestion → long commute times

Rail projects can **reduce travel time by up to 50%**

Accessibility

- Rail significantly expands **1-hour commuter catchment areas**
- Example: Bucharest accessibility increases from ~55% to >85%

Spatial Development

- TOD emerging in early adopters
- Up to **35% of new development near planned rail corridors**
- Other regions remain **road-oriented (sprawl)**

Socio-Economic Factors

- Higher incomes → increased car ownership
- Governance capacity strongly influences implementation

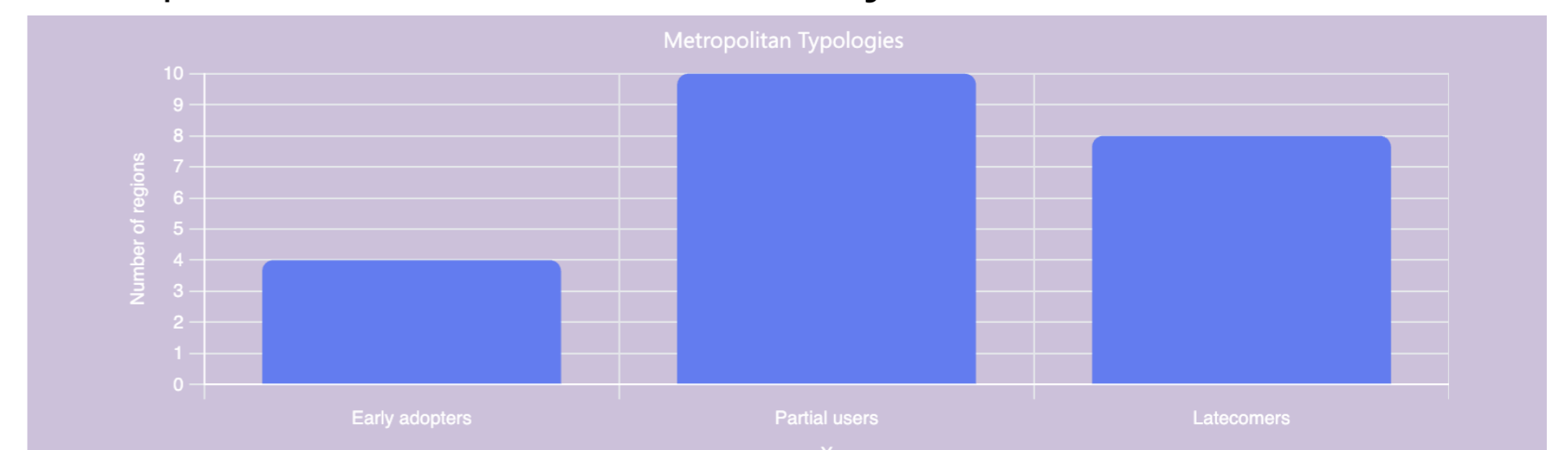
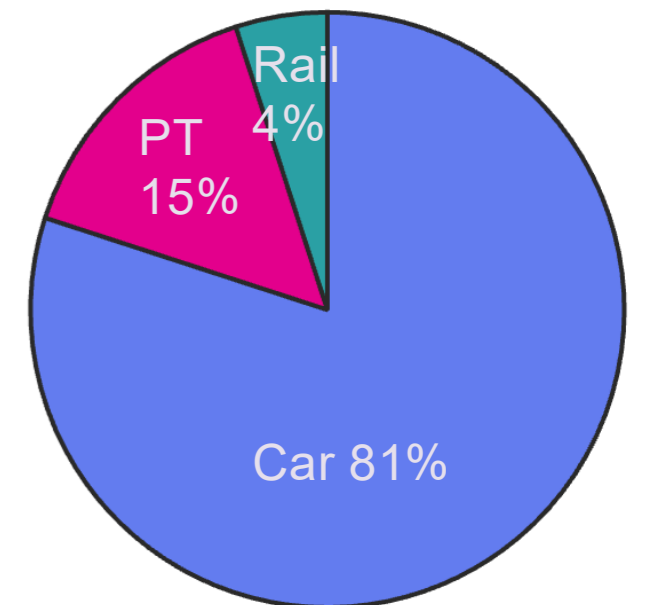
Interpretation

Rail acts as a **catalyst for metropolitan restructuring**

However, **infrastructure alone is insufficient:**

- Requires **governance integration**
- Needs **land-use coordination**
- Depends on **first/last-mile connectivity**

Modal share for commuting



CONCLUSION

Conclusion

Romania's metropolitan areas are at a **transition point:**

- From **car-dependent growth**
- Toward **rail-integrated metropolitan systems**

Early adopters demonstrate that:

- Rail reduces travel times
- Improves accessibility
- Encourages TOD

Without intervention, **regional disparities will deepen**

Railway station development can transform metropolitan regions into:

- More accessible**
- More sustainable**
- More economically competitive systems**

FUTURE WORK / REFERENCES

Expansion of **metropolitan rail pilot projects**

Integration with:

- PPP models**
- Air-right development**

Advanced GIS modelling:

- Multi-criteria accessibility
- Scenario-based investment planning

Integration of:

- Behavioral (survey/biometric) studies**
- Smart mobility technologies**

Baicu L.G (2025), Doctoral Thesis paper no.2

Ionescu-Heroiu, M. et al. (2020)

– Urban Mobility in Romania

World Bank (2016, 2019) – Metropolitan Development

Romanian Ministry of Transport (2020) – Investment Strategy

European Commission (2025) – Suburban Rail Systems

Dumitrescu (2025); Dascălu (2022); Magyar Építők (2025)

All figures, tables and charts are created by the author. © Baicu Liviu Gabriel, 2026