KELPROJEKTAS

CONFERENCE

„TRANSPORT INFRASTRUCTURE INNOVATIONS -2015“

Development of regional transportation models as a supporting tool for estimation of functional efficiency of infrastructural investments

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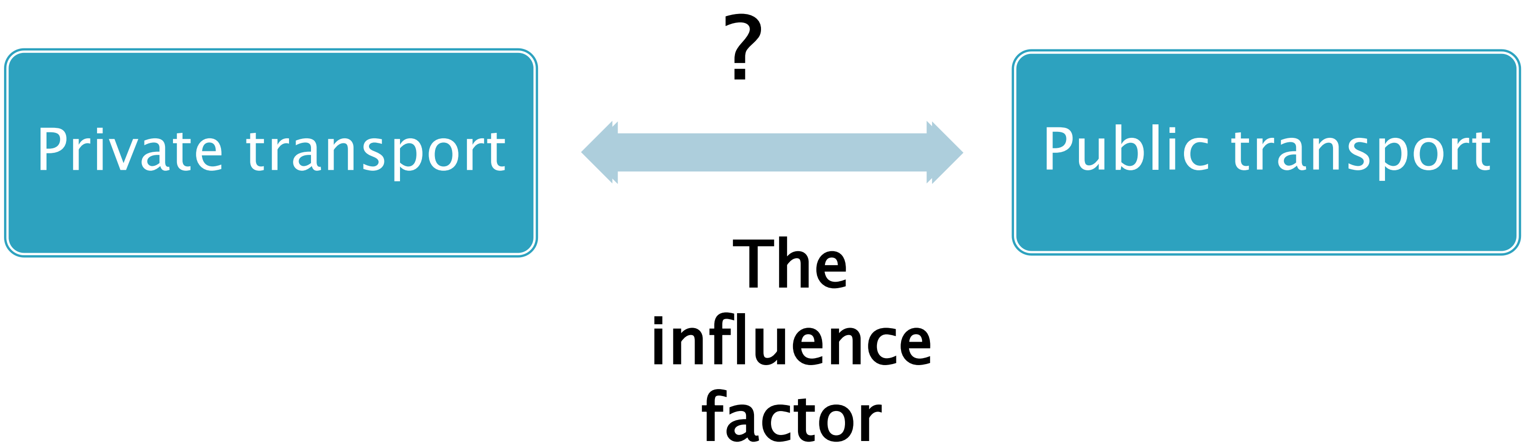
Introduction

- Multimodal approach



- Multimodal approach – necessity in projects financed by EU

Multimodal approach

- Classical approach – four stage models
  - Number of trips generated by TAZ
  - Trip distribution
  - Mode choice
  - Assignment
- Input data?

Input data

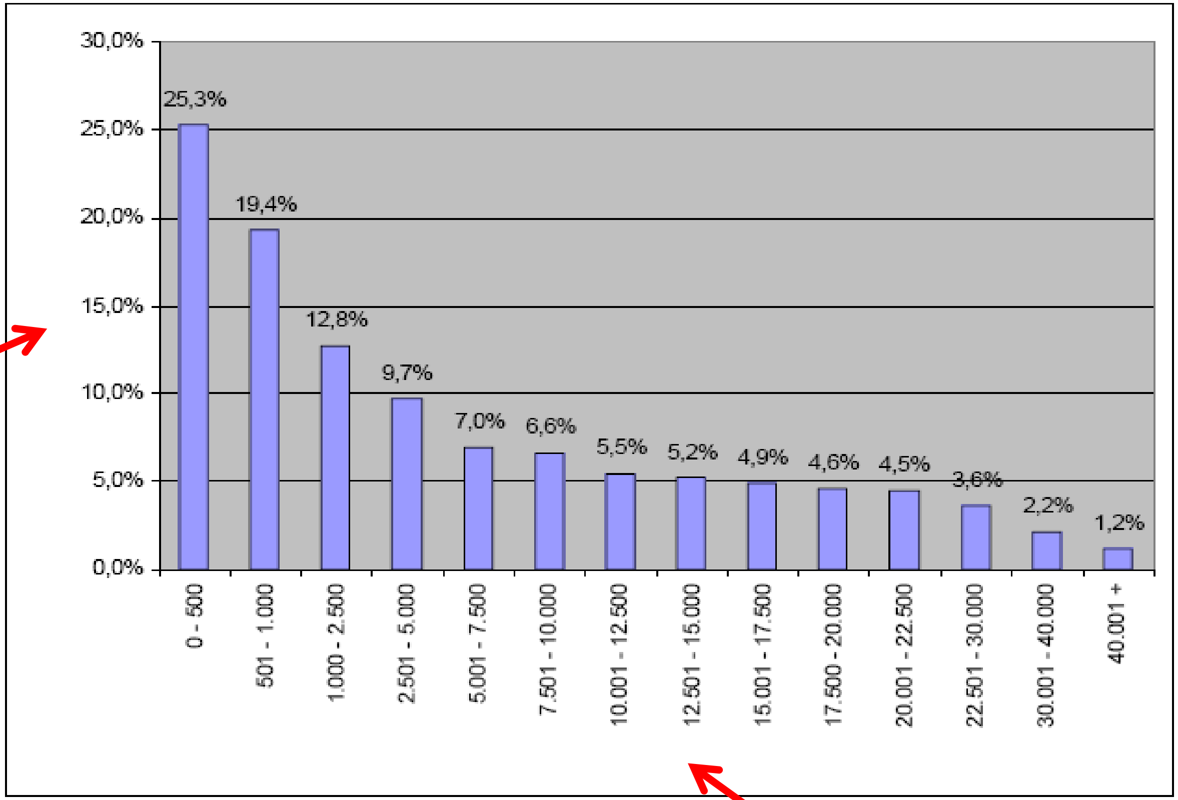
1. Supply – model of the network (roads, bus routes, rail connections, timetable etc.)
2. Demand – results of the comprehensive travel study (household survey)
3. Measurement data (model verification and validation)
   - Traffic measurements
   - Passenger counts

Example of household survey – Malopolska province

- 4 400 households (over 11 000 persons) – 1,2% of the population
- Inhabitants older then 12 years old
- Trip diary
- Opinions about transport system
- Passengers' expectations

Sample size

Average estimation error of the number of trips



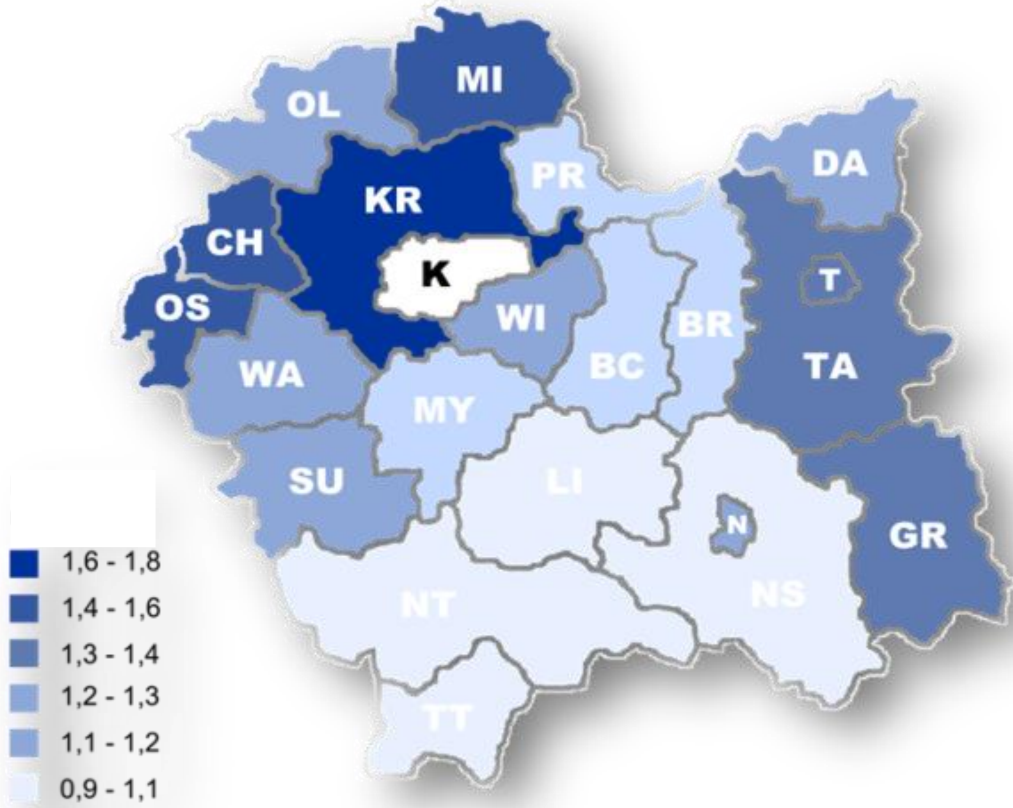
Sample size

Focus Group Interviews

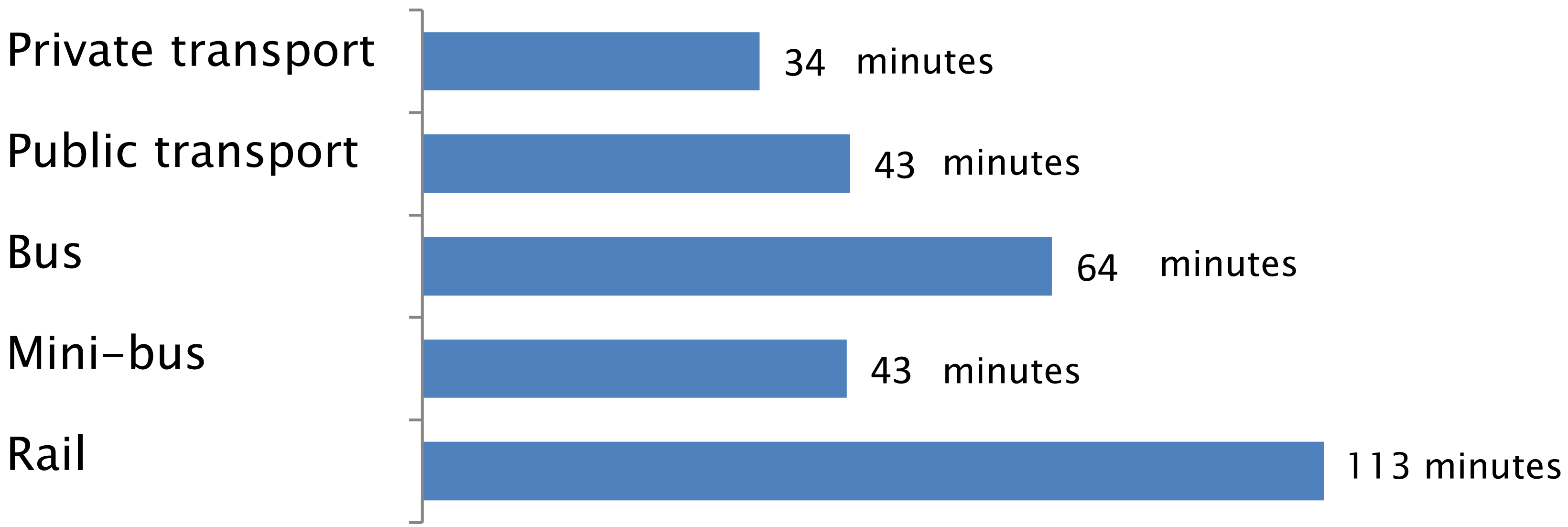
- For selected group of inhabitants
- 6 groups / 6 persons each
- Not representative survey
- Support in household survey form development
- What words/expressions should be used

Chosen results

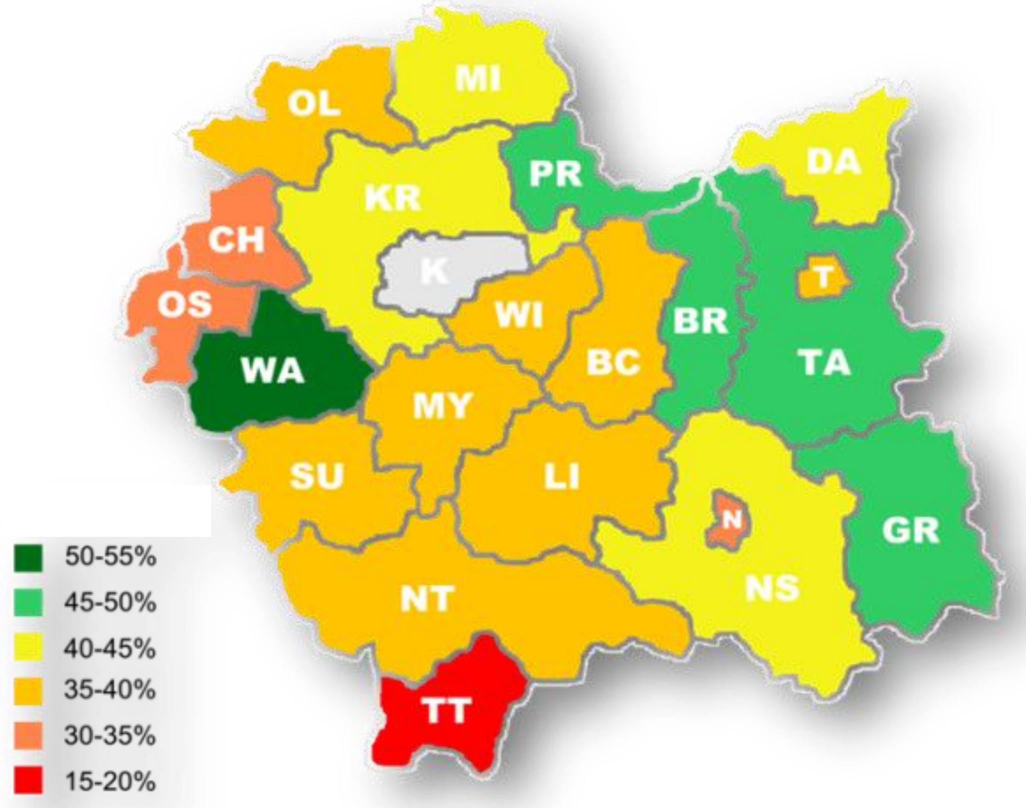
Mobility rates



Average travel time



Modal split – PuT



Chosen results of the qualitative part

- The respondents are convinced of the superiority of private transport (car, bike less often) then public one
- The car is regarded by respondents as the most modern means of transport
- The railway is considered one of the most comfortable, user-friendly means of travel for passengers (in spite of many defects)
- <u>At the moment, the tendency to permanent change to the public transport is small</u>

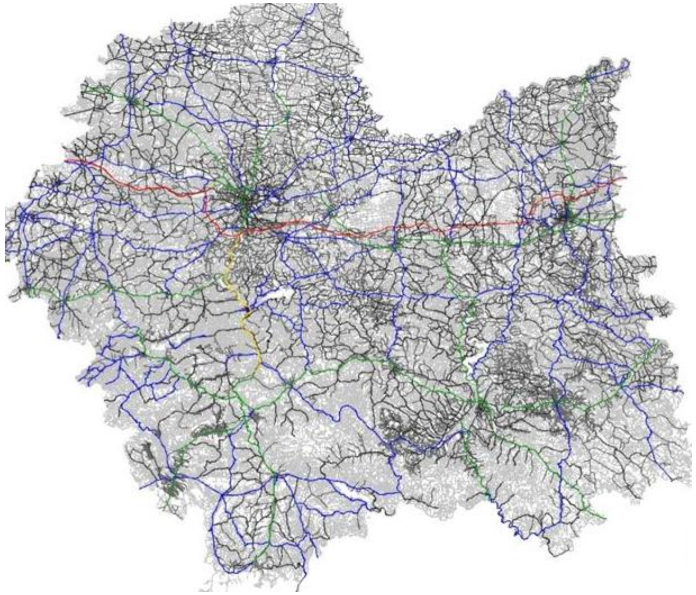
Simulation model of the Malopolska Province (voivodeship)

Administrative divisions of Poland

- 16 voivodeship (provinces)

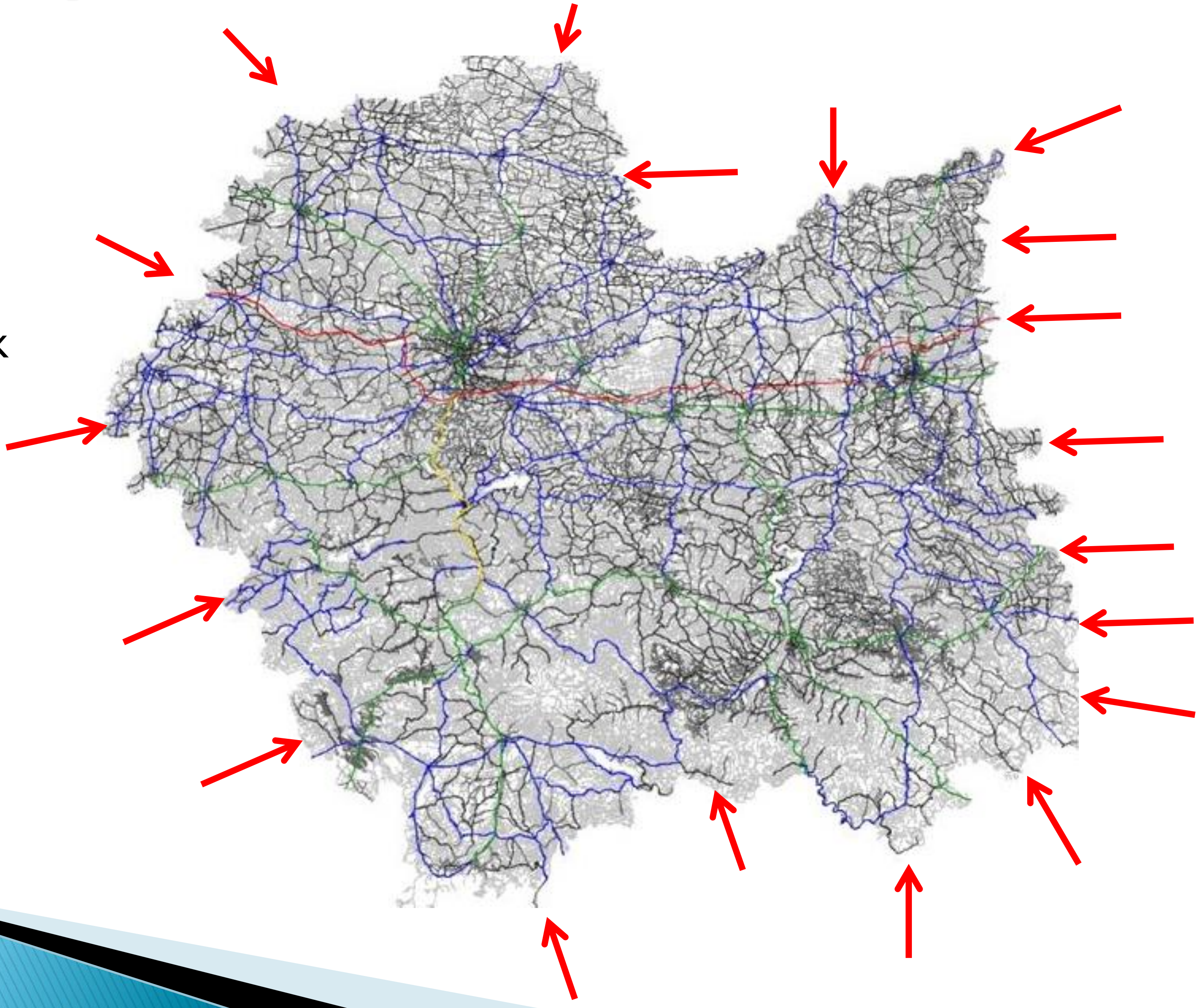
Supply model

- Division of the province into traffic analysis zones (TAZ)
- 245 TAZs
- All national and regional roads
- The most important local ones



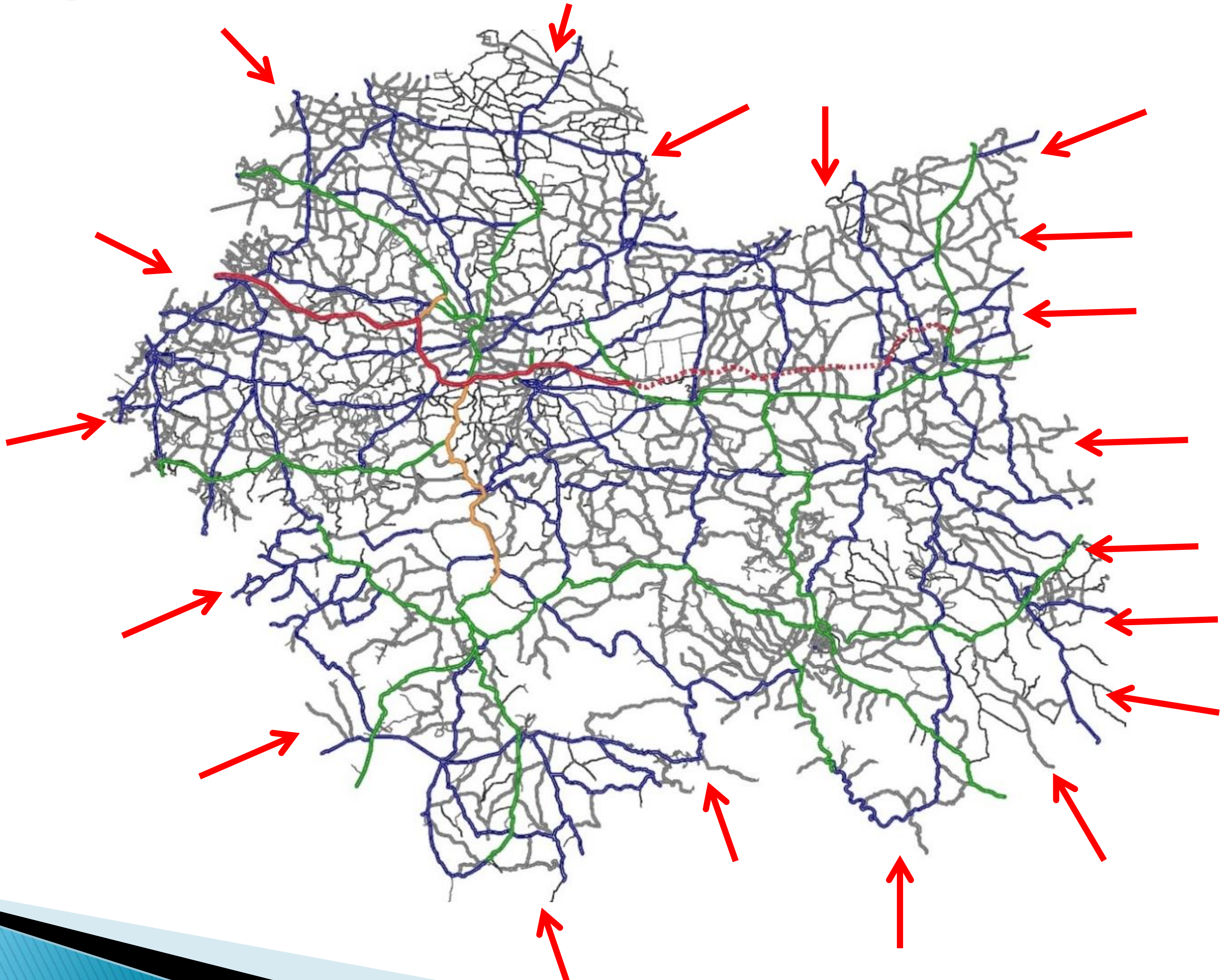
Supply model – road network

Full network
– GIS data

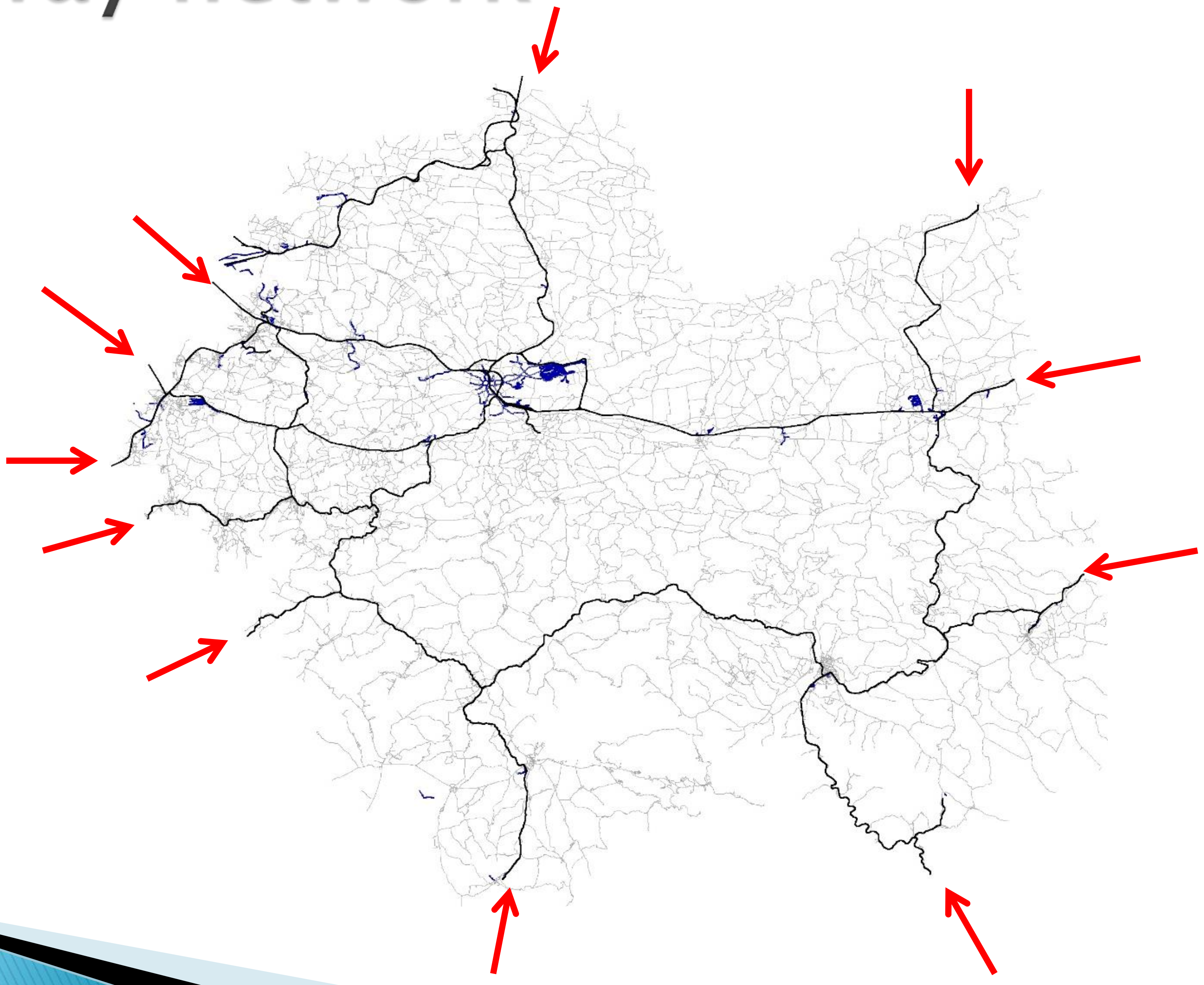


Supply model – road network

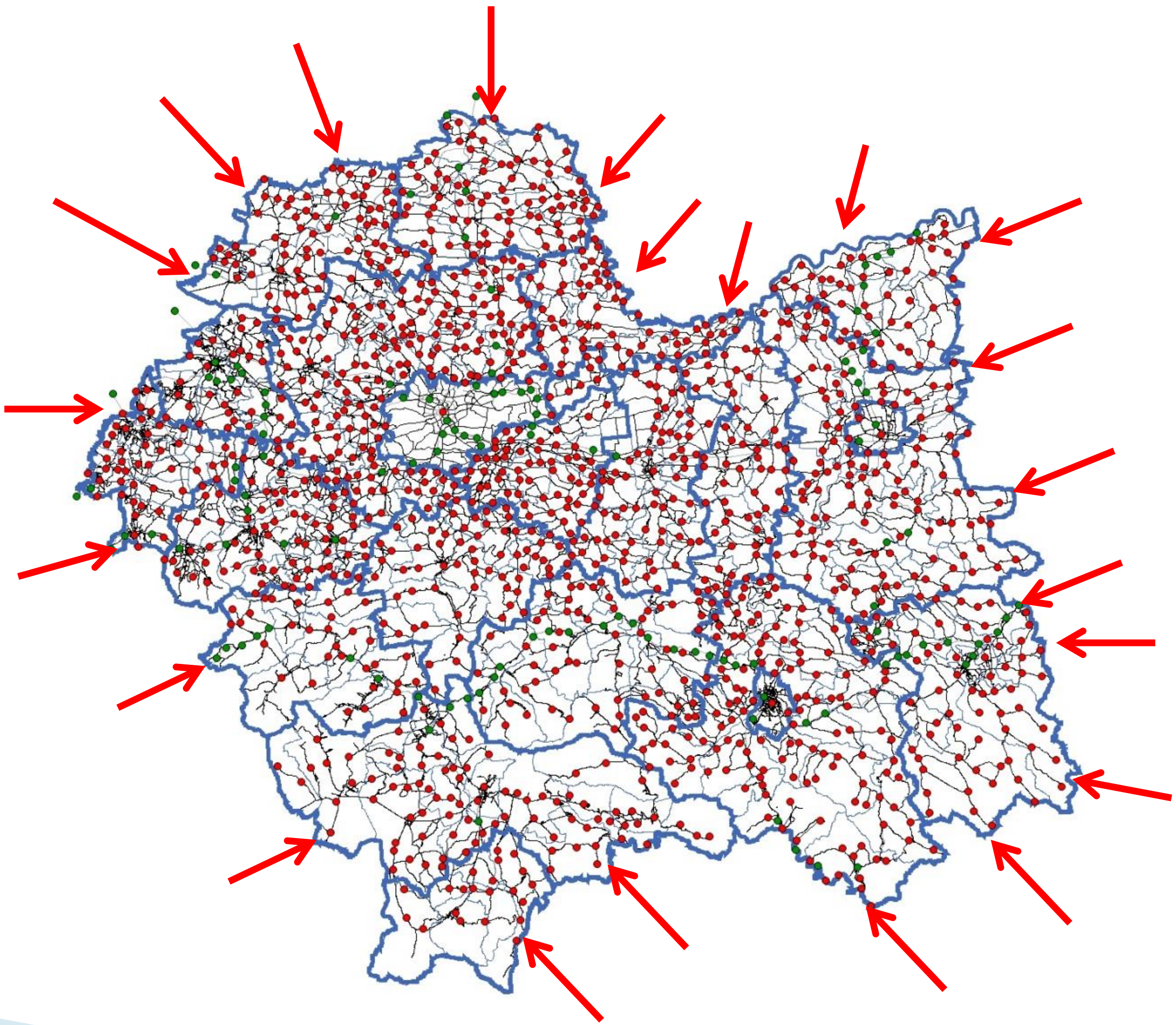
Simplified network – GIS data



Railway network



Bus network

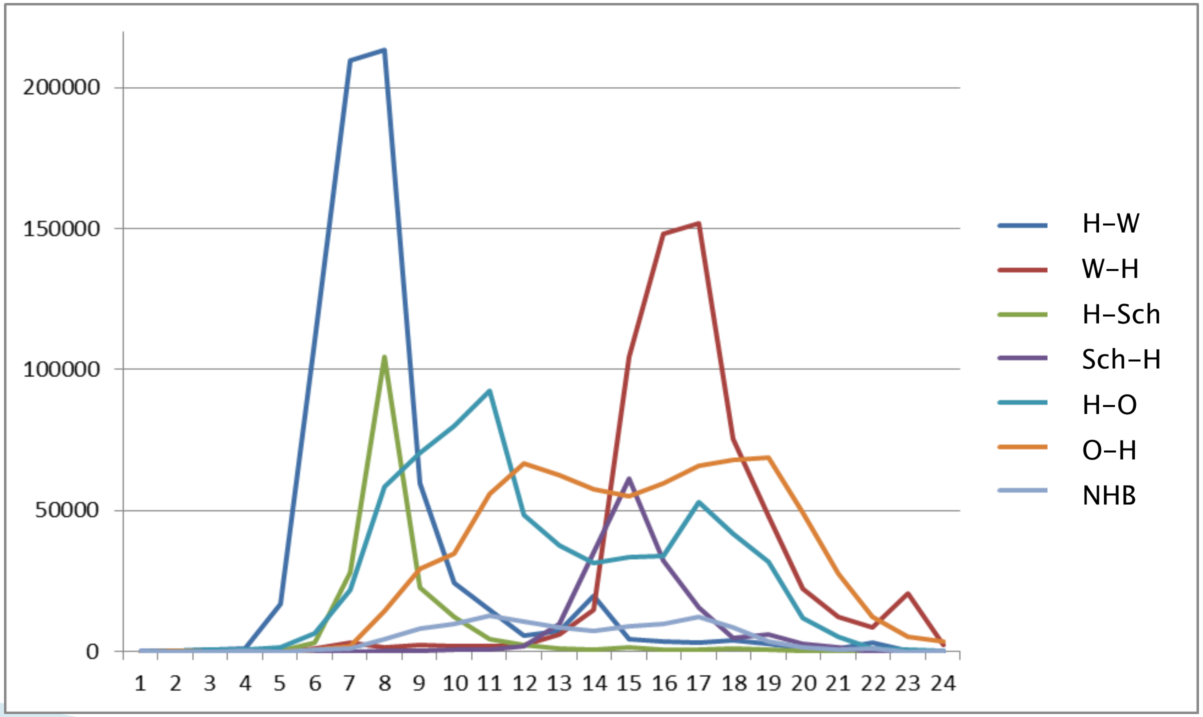


Demand model

- Model refers to 1 hour
- Modelling of stops – one per TAZ
- All accessible rail connections (also lines with potential)
- All bus connections
- Timetable (for whole day)

Demand model

- Four stage approach
- 7 groups of trip purposes
- Hourly share of each trip purposes



Demand model

- Number of trips
- Explanatory variables
  - Number of inhabitants
  - Number of working places
  - Number of pupils and students
- Regression analysis, e.g.:

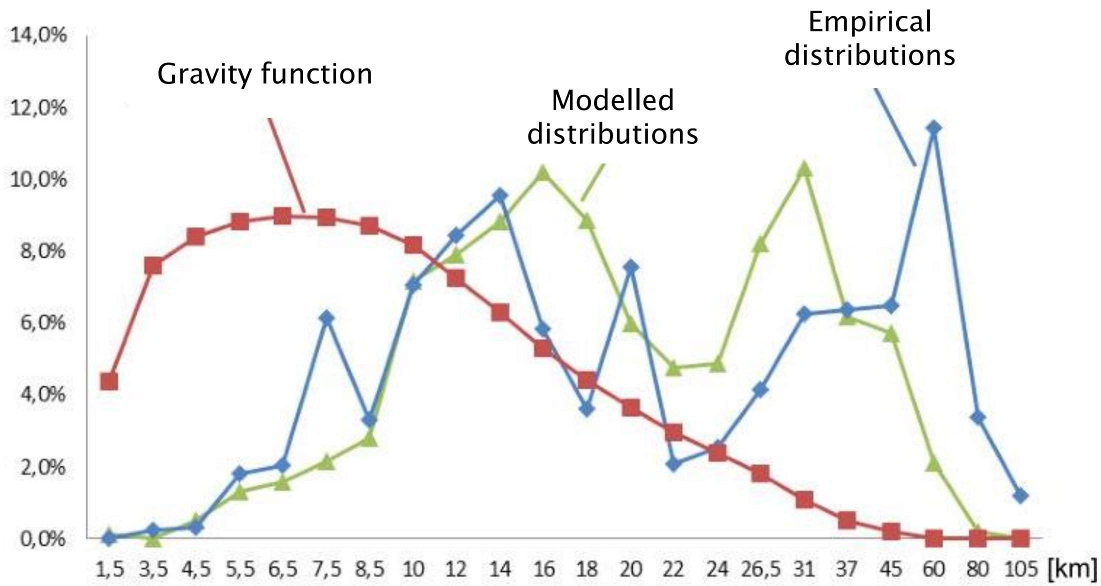
$$P_{Home-Work} = 0{,}72 * l_{inhabitants} \qquad \text{[trips/day]}$$

Gravity

Model parameters

$$F\left(x_{i,j}\right) = \propto x_{i,j}{}^{\beta} e^{\gamma x_{i,j}}$$

Distance between TAZ



$R^2=0{,}82$

Modal split

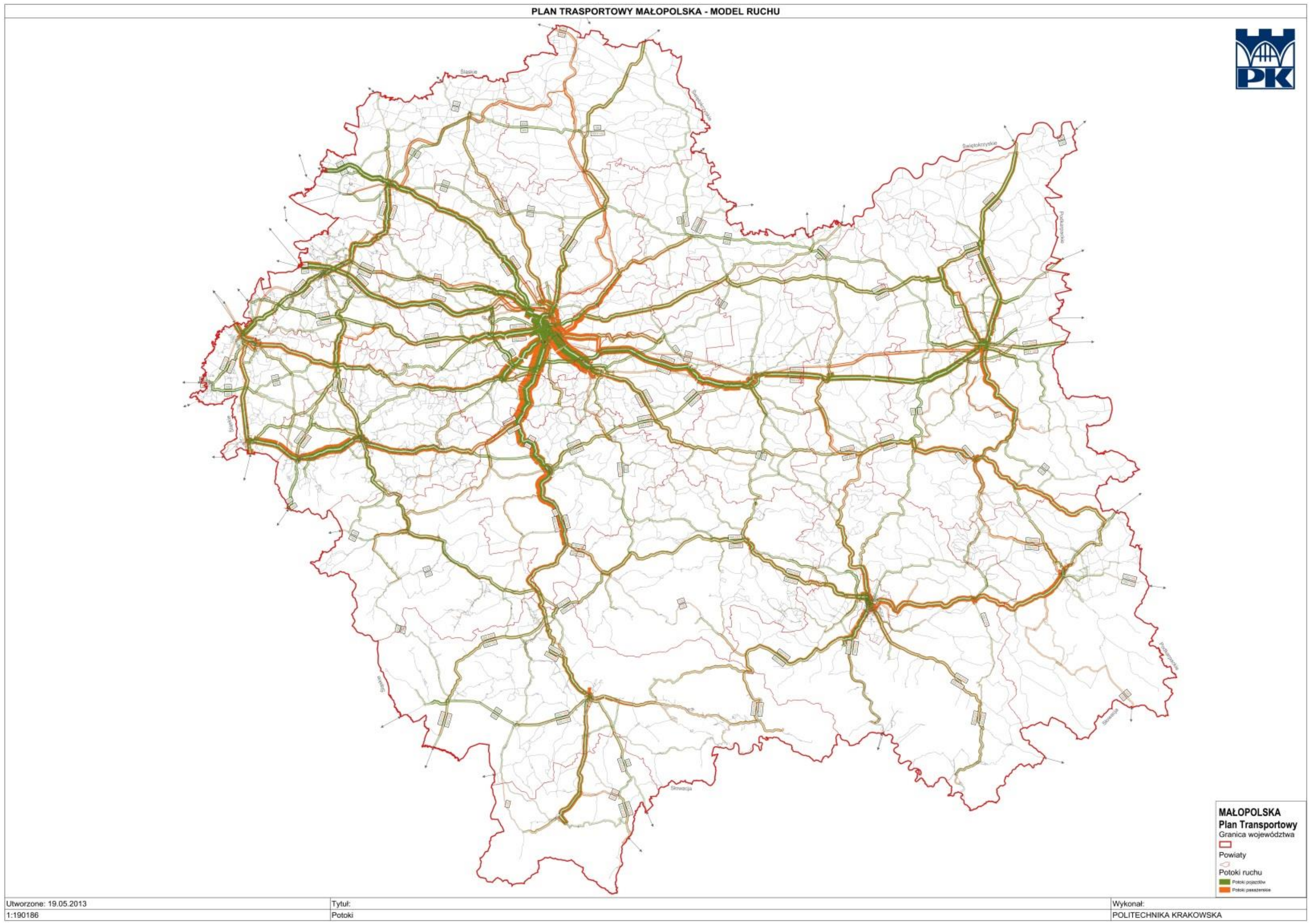
PrT travel time

$$U_{ki} = \frac{e^{-0,03*\beta*t_{PrT}}}{e^{-0,03*\beta*t_{PrT}} + e^{-0,03*t_{PuT}}}$$

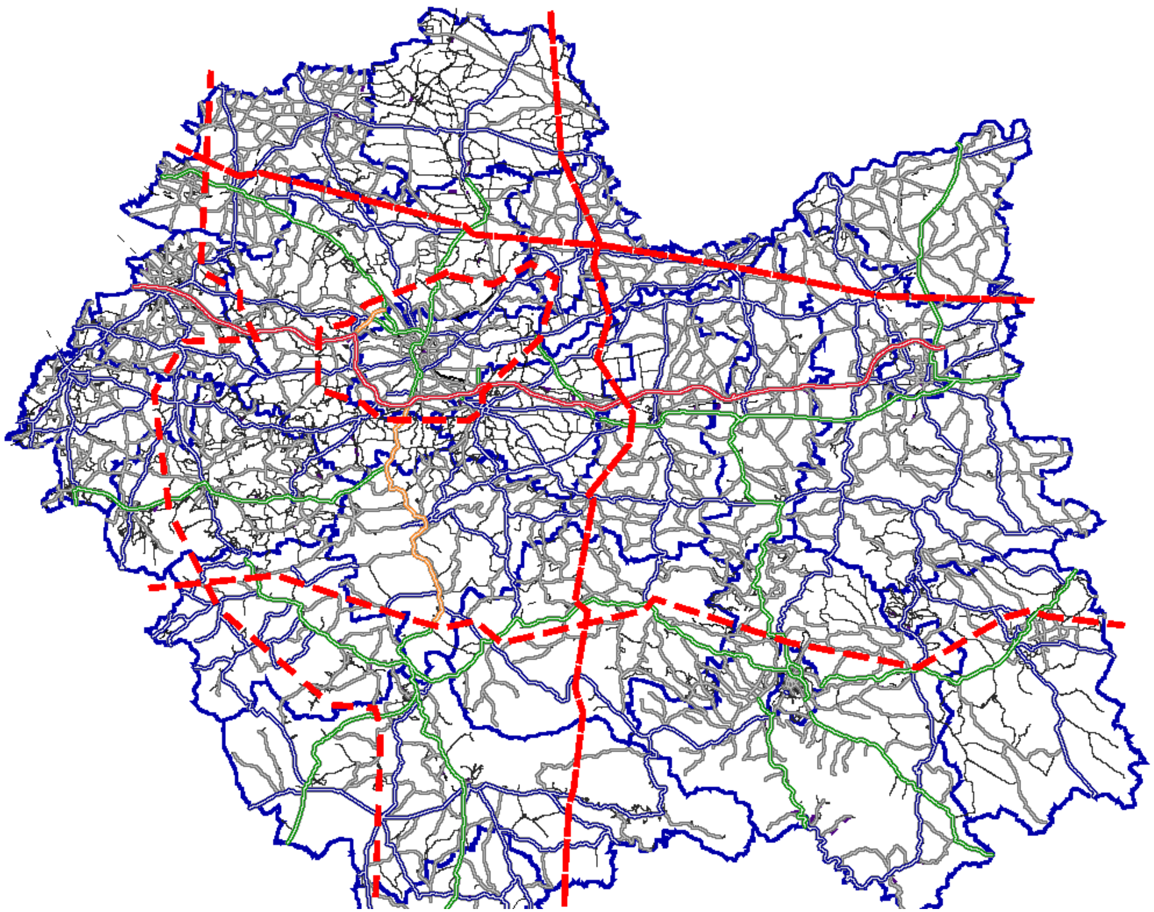
PuT travel time

- β_{PrT}=2,4 *(school related trips)*
- β_{PrT}=2,2 *(work related trips)*
- β_{PrT}=1,8 *(non home based related trips)*
- β_{PrT}=2,6 *(other trips)*

Simulation results



Model validation and verification



Quality of the model

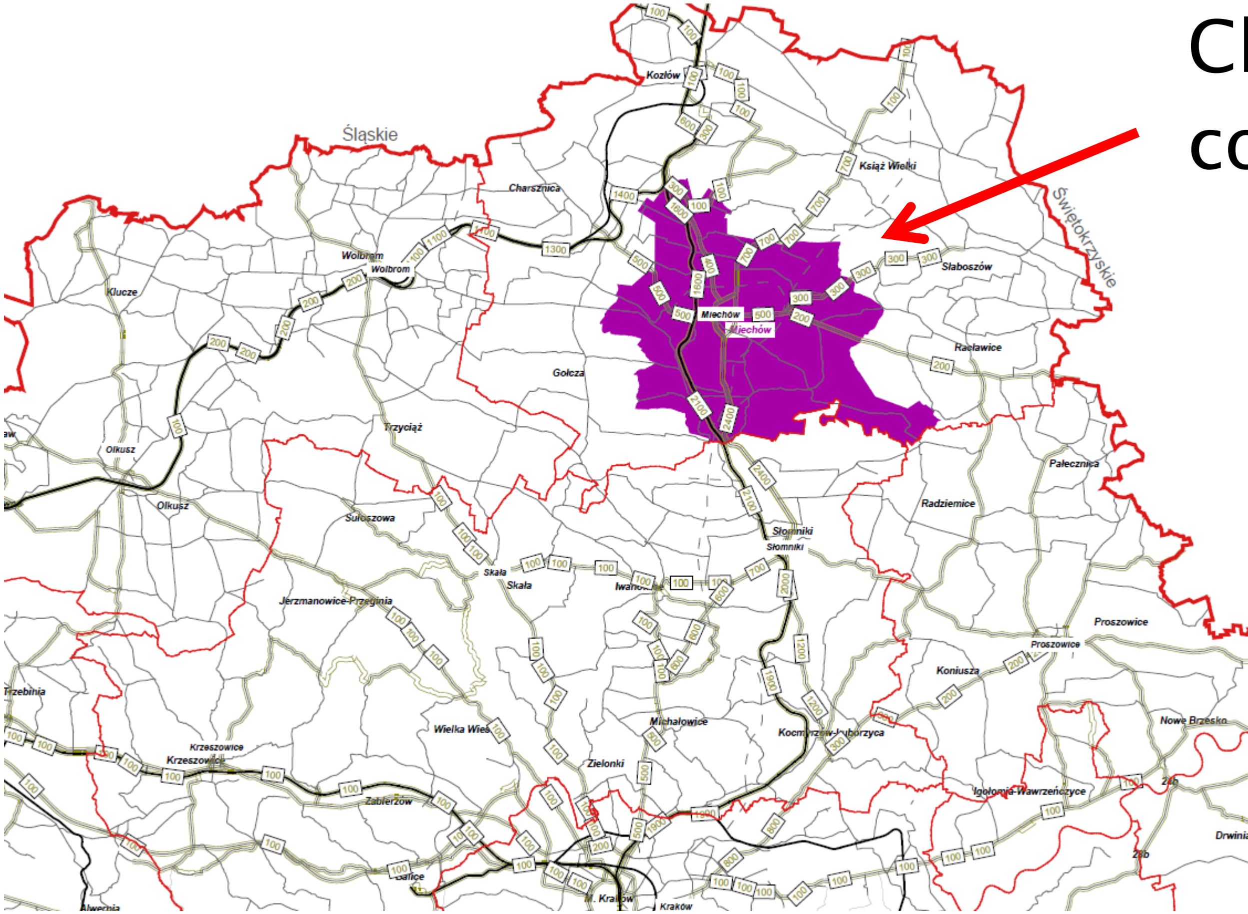
- Public transport
- 124 measurement points
- $R^2=0,89$
- Total sum:
  - 30 692 pas/h measurement
  - 29 625 pas/h model

- Private transport
- 213 measurement points
- $R^2=0,90$
- Total sum:
  - 53 872 veh/h – measurement
  - 54 614 veh/h – model

Application of the simulation models – chosen aspects

- Development of Sustainable Transportation Plan for Voivodeship
- Estimation of the changes in transport infrastructure
- Effectiveness of transport system development
- Adjustment of the bus / rail routes
- Changes in the timetable – re-routing optimization
- Estimation of the demand for new rail connections
- …

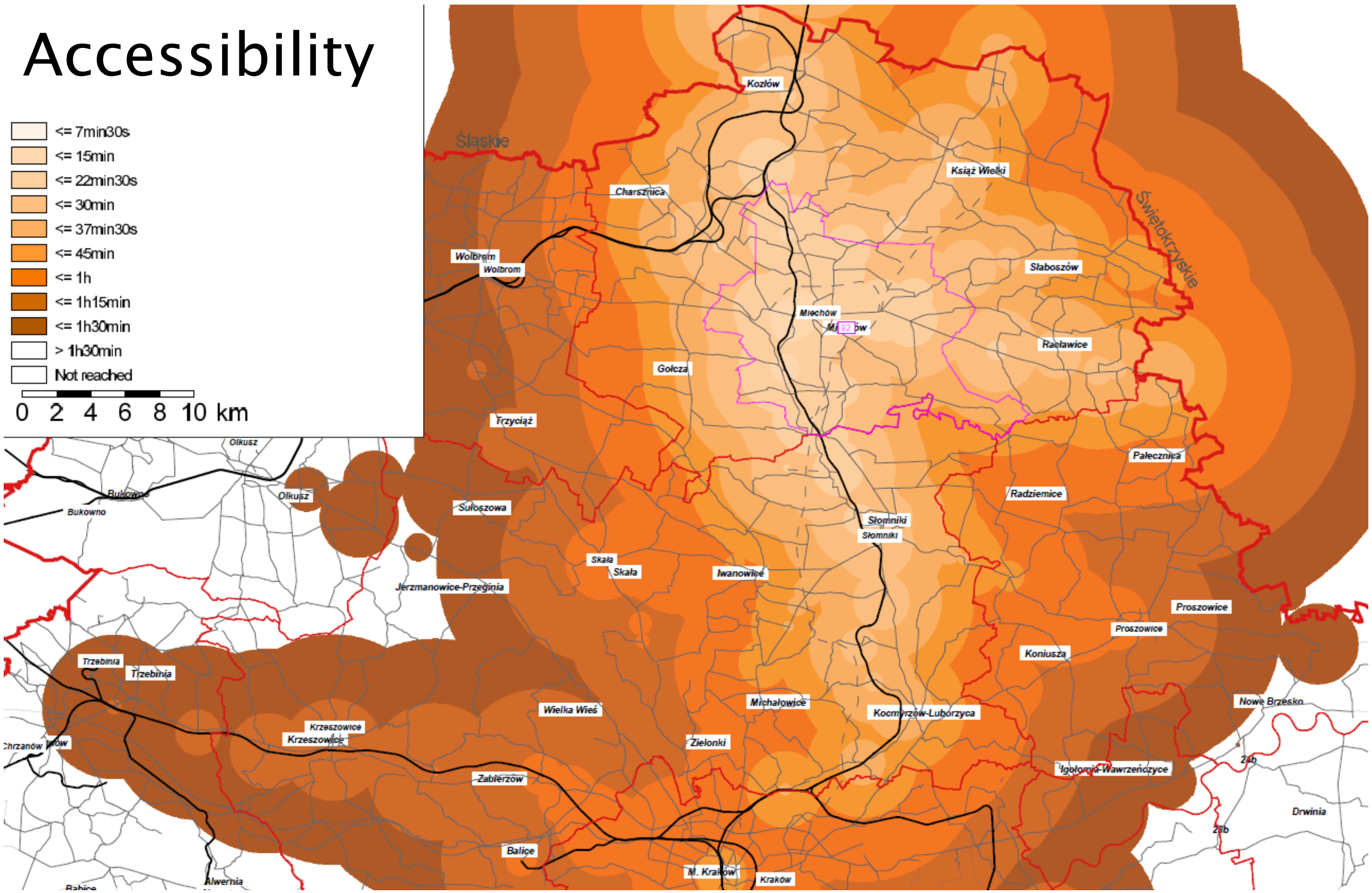
Example 1



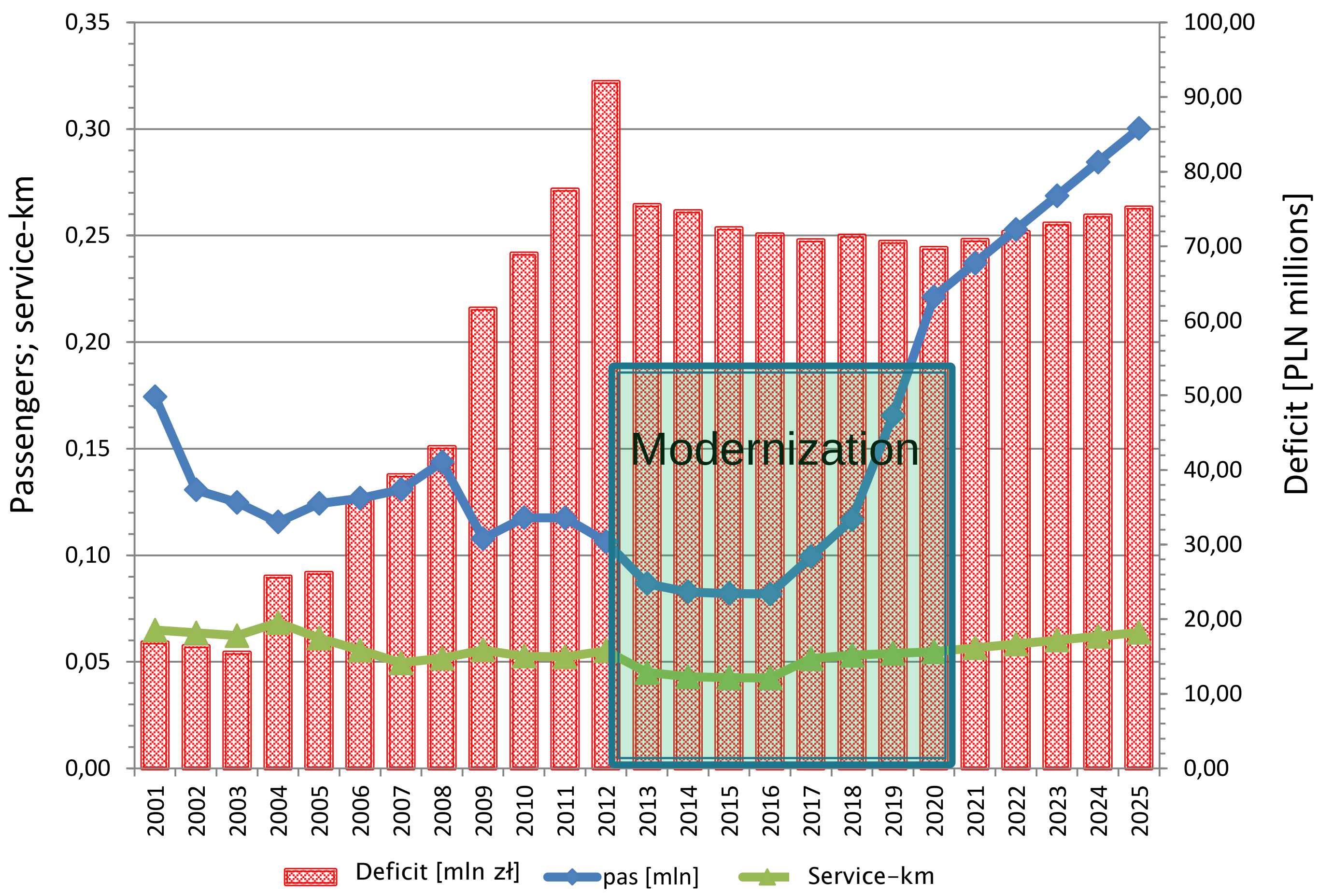
Chosen county

Where inhabitants are travelling?

Example 2


Accessibility
<= 7min30s
<= 15min
<= 22min30s
<= 30min
<= 37min30s
<= 45min
<= 1h
<= 1h15min
<= 1h30min
> 1h30min
Not reached
0 2 4 6 8 10 km
Śląskie
Świętokrzyskie
Kozłów
Książ Wielki
Charsznica
Wolbrom
Słaboszów
Miechów
Racławice
Gołcza
Trzyciąż
Pałecznica
Radziemice
Olkusz
Sułoszowa
Bukowno
Słomniki
Skała
Iwanowice
Jerzmanowice-Przeginia
Proszowice
Koniusza
Trzebinia
Wielka Wieś
Michałowice
Kocmyrzów-Luborzyca
Nowe Brzesko
Krzeszowice
Zielonki
Igołomia-Wawrzeńczyce
Zabierzów
Drwinia
Balice
M. Kraków
Kraków
Alwernia

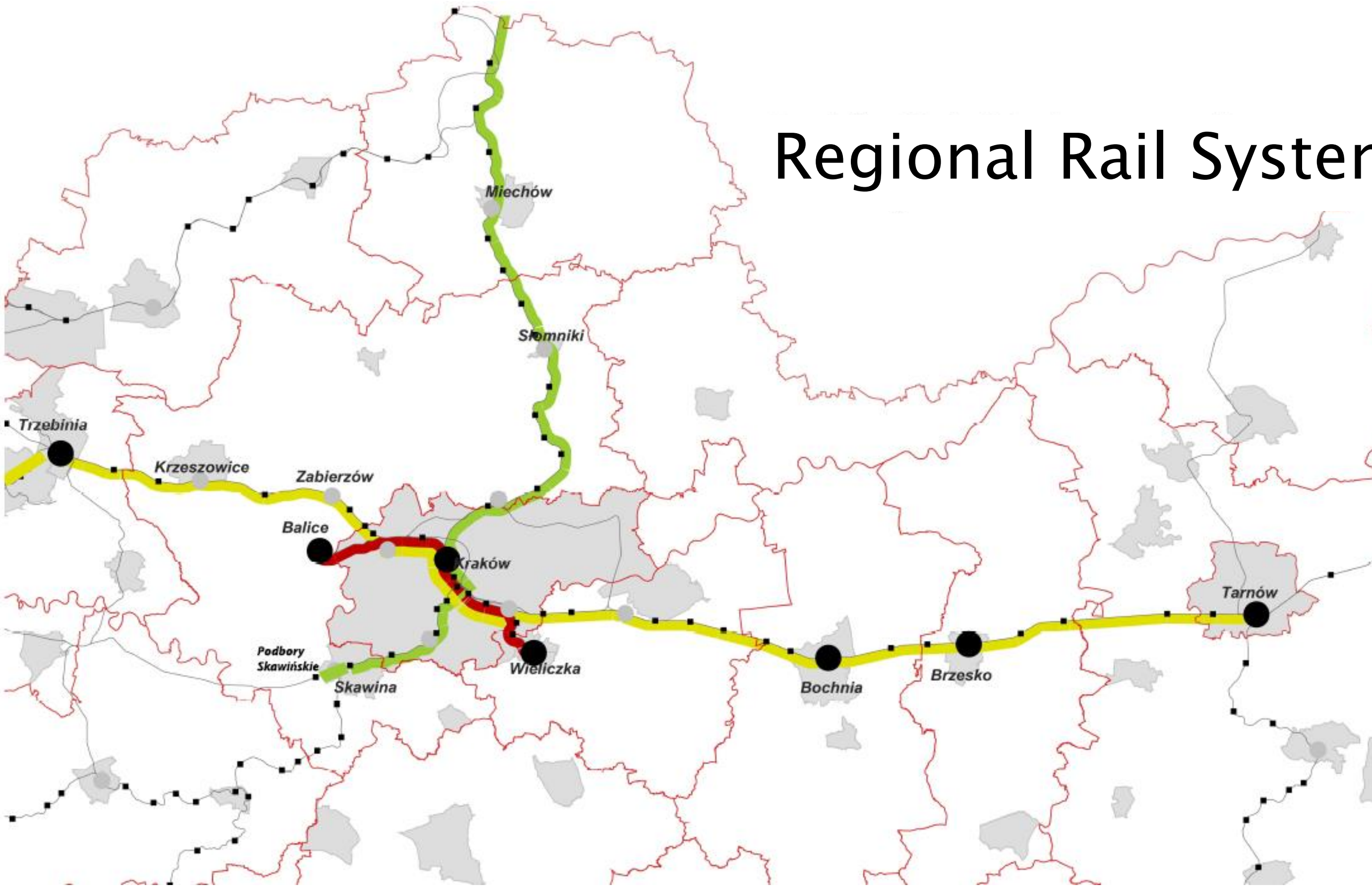
Example 3



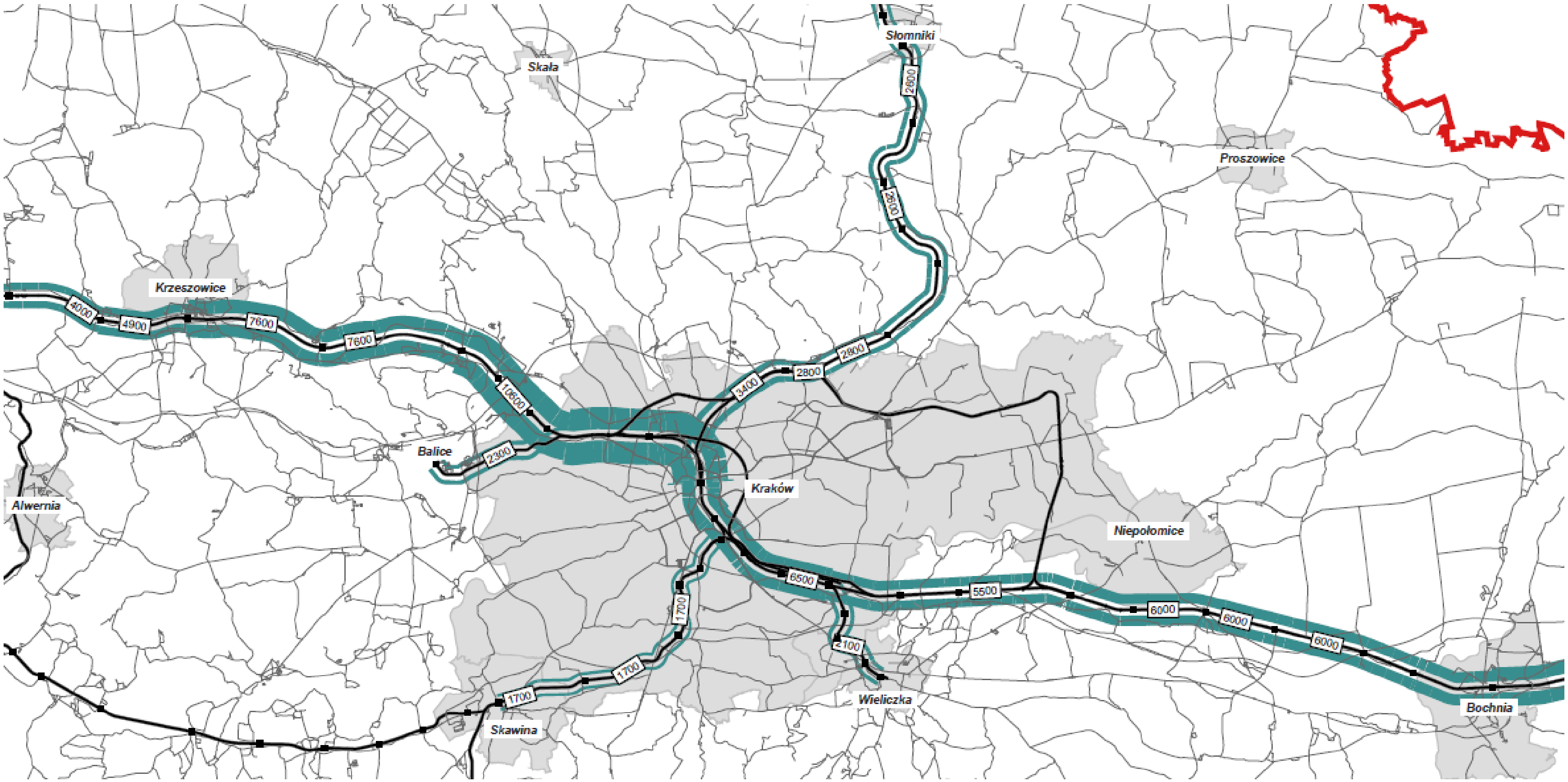
0,35
0,30
0,25
0,20
0,15
0,10
0,05
0,00
Passengers; service-km
100,00
90,00
80,00
70,00
60,00
50,00
40,00
30,00
20,00
10,00
0,00
Deficit [PLN millions]
Modernization
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Deficit [mln zł]
pas [mln]
Service-km

Example 4

Regional Rail System



Example 4



Estimated passenger volume (2015)

Example 5

- Refurbishment of the rail tracks
- Investor – PKP PLK
- Connection to Zakopane and Oswiecim
- Analysis of different scenarios:
  - Train speed
  - Timetable changes
  - Number of connections

Summary

- Comprehensive travel study as a base for model development
- Presented survey results seem to be enough for modelling purposes
- Model verification
- Possible analysis for each hour during a day
- Model application

Thank you!

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