Geographic/Demographic Accessibility of Transport Infrastructure (GDATI)

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Geographic/Demographic Accessibility of Transport Infrastructure (GDATI)

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Background

The motivation for using previously known demographic and geographic indicators for assessing the accessibility of existing public transport systems in cities as a whole was to use them to examine and assess smaller regions, districts, neighborhoods or other spatial entities e.g. post code areas or regular grids. In this way, simulation models allow the calculation of indicators for smaller areas of the city and to compare accessibility of public transport systems in their areas, identify areas of low accessibility and areas attractive in terms of accessibility.

The development of the instrument was focused on several questions*:* Can city-scale accessibility indicators be used to assess the accessibility of micro-scale (region, district, housing complexes, post code areas or regular grids)? Could this be a tool for identifying areas for development due to good public transport accessibility? Could this be a tool for identifying areas with poor public transport accessibility? Could this be an instrument for determining the quality of life for residents in the area of the city?

The planning problem is to understand the accessibility of specific areas within big cities by public transport. The instrument is focused on public transport only, and depends on the availability, and collection, of service data at the requisite scale.

Conceptual framework and theoretical underpinnings

The instrument determines the accessibility of public transport system in the area (Kozlak, 2008) as:

1. Geographical density of public transport network (G^K_p), which is defined as length of roads where the public transport operates, on the area of 1 km^2 of city area.

2. Demographic density of public transport network (G^K_p), which is defined as length of roads where the public transport operates per 10 000 inhabitants.

3. Average density of the public transport network (G^K_{pd}), which is defined as length of roads where the public transport operates, referring to the size of the area as well as to the population.

4. Geographic density of stops (G^J_p) which defines number of stops in the area of 100 km^2.

5. Demographic density of the stops network (G^J_d), which is defined as a number of PT stops per 10 000 inhabitants.

6. Average density of stops (G^J_{pd}) – to calculate this indicator both: size of the area as well as population is used, and those values are related to number of stops.

The Instrument GDATI measures accessibility by comparing demographic (population) and geographic (size of area) data with the length of the transport network and the number of stops.

The concept of accessibility in the Polish context is defined in terms of service quality in the collective public transport system (EN 13816: 2002 "Transportation – Logistics and Services – Public passenger transport – Service quality definition, targeting and measurement"). This normative definition includes 8 categories of service quality criteria for public transport. The two first categories refer to accessibility, describing in general the existing public transport characteristics. These are:

- spatial-temporal accessibility – within the area where the service is provided, referred to in terms of geography, time, frequency and means of transport;
- functional accessibility – in terms of access to the system, including connection to other transport systems;

Values obtained from the simulation model can be compared with other values, eg. values resulting from the standards.

In Poland, these measures are used to assess the accessibility of public transport systems in cities. They are described in the literature (Bryniarska and Starowicz, 2010; Bieda, 2002; Bieda, 2011) and widely used.

Operational aspects

The instrument GDATI measures geographic and demographic accessibility of public transport linear and punctual infrastructure.

$$G_p^K = \frac{K}{a} \quad \left[\frac{km}{km^2}\right] \tag{1}$$

$$G_d^K = \frac{K}{b} \quad \left[\frac{km}{10000\ inhabitants}\right] \tag{2}$$

$$G_{pd}^K = \sqrt{G_p \cdot G_d} = \frac{K}{\sqrt{a \cdot b}} \quad \left[\frac{km}{\sqrt{km^2 \cdot 10000\ inhabitants}}\right] \tag{3}$$

where K is the length of roads where the public transport operates [km], a is the area [km^2], b is the number of inhabitants.

$$G_p^J = \frac{J}{a} \quad \left[\frac{stops}{km^2}\right] \tag{4}$$

$$G_d^J = \frac{J}{b} \quad \left[\frac{stops}{10000\ inhabitants}\right] \tag{5}$$

$$G_{pd}^J = \sqrt{G_p \cdot G_d} = \frac{J}{\sqrt{a \cdot b}} \quad \left[\frac{stops}{\sqrt{km^2 \cdot 10000\ inhabitants}}\right] \tag{6}$$

where J is the number of stops, a is the area [km^2], and b is the number of inhabitants.

Geographic and demographic data may be obtained easily if they relate to the boundaries of the city area. For smaller areas (regions) data may be obtained by using GIS maps. Information about the length of the public transport network may be obtained by using the public Internet tools, transport service deliverers can provide such data or auxiliary data for subsequent detailed calculations. Data on the number of stops may be obtained easily from the organizer of transportation in the city. Stage of data collection is the most time-consuming.

The model under development will use the available tools. Processing will be in the form of interactive involvement of the user. Equipment used for processing will be readily available.

After collecting relevant data, the calculations are not time-consuming.

To perform the calculation technical knowledge at the basic level is required.

To interpret the results technical knowledge at the advanced level is required.

Relevance for planning practice

Information about the level of accessibility of public transport system in the area and its relationship to the quality of life of residents in the area is useful for planning practitioners; although this instrument has not yet been used in the context of planning.

The instrument has previously only been used for the evaluation of existing public transport systems in urban areas (how they ensure the accessibility of the system). Detailed examination of areas with poor and good accessibility in order to understand why has not been carried out. Understanding of these issues currently depends on expert intuition.

In the areas, where weak geographical and demographical accessibility is detected, policy measures should be enhanced in order to increase the level of accessibility (more PT routes, more PT stops). In the areas, where good accessibility is identified, land uses that rely on accessibility investment/development may be introduced (new housing development, new business areas and firms locations).

Strengths and limitations

The instrument has several strengths, including relatively easily available data, simple calculation, and using the same data, you can specify other properties, e.g. average radius or time reaching the stop. The main weakness is the focus on the availability only public transport services with no reference to other features of the public transport system (e.g. frequency).

The instrument has not yet been used in the actual planning context.

We expect that using a simulation model as an interactive package (slide decision), the instrument can support the development of planned areas where there is the demand for transport infrastructure, and for understanding wider spatial development issues (Bieda, 2002).

We are planning improvements to instrument from the scientific and practical point of view. We think that it is possible to include the identification of service frequency into the current instrument at the disaggregated scale of smaller city districts. We are planning to include in the instrument the relationships between indicators of accessibility and quality of life. The instrument will be made available to local government to use the results of the accessibility level assessments and to link them with the quality of life.

References

Bryniarska Z., and Starowicz W. (2010) Results of public transport systems in selected cities, Kraków.

Bieda K. (2002) *Urban Planning and Development Problems after Poland's Transition to Market Economy*, In: The Transformation of the City Space on the Background of Political-Economic Changes in Central Europe, 4th International Symposium for Central Europe, Krakow 2002, (p.103-109)

Bieda K. (2011) *Krakow – Transport and Sustainable Urban Growth,* Zeszyty Naukowe Politechniki Krakowskiej. Kraków.

Kozlak A. (2008) *Ekonomika transportu. Teoria i praktyka gospodarcza*, Wydawnictwo Uniwersytetu Gdanskiego, Gdansk, (p. 38)

Pulawska S., Starowicz W., and Żakowska L. (2011) *Accessibility instruments in urban transport planning in Krakow and other cities in Poland*. 24th ICTCT Workshop Proceedings, Traffic safety management. Tackling the problems in urban areas and at other hot spots. October 27th & 28th 2011

EN 13816: 2002 "Transportation – Logistics and Services – Public passenger transport – Service quality definition, targeting and measurement"

Figures

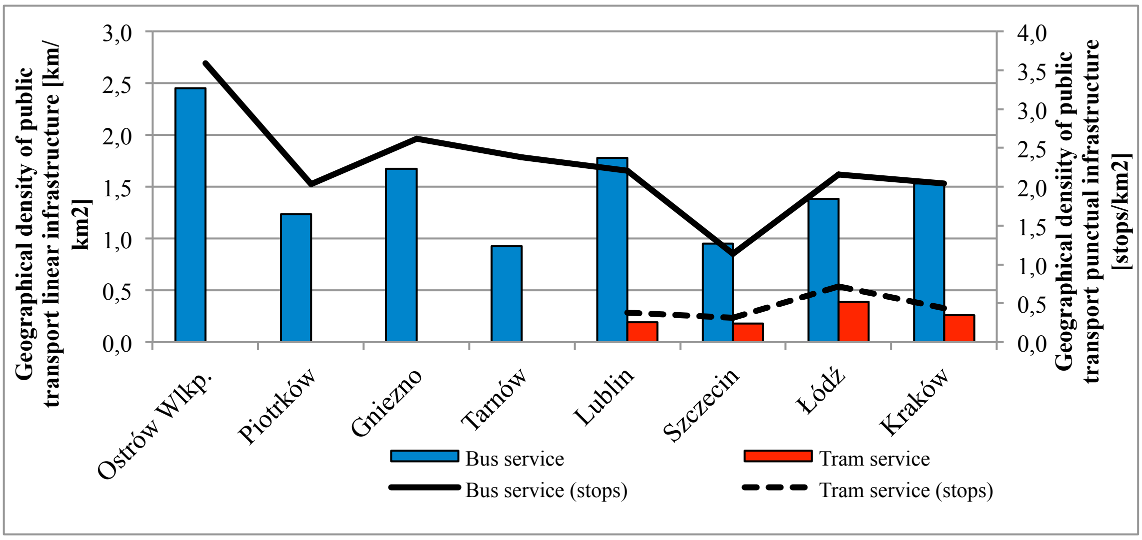

Figure 1 Geographical density of public transport network infrastructure accessed by stops/ kilometre

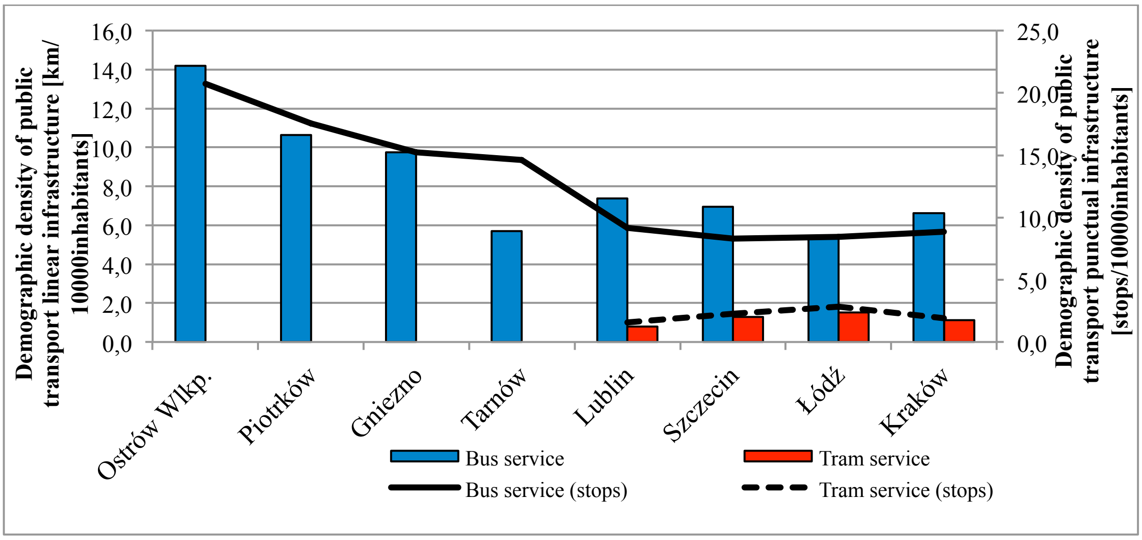

Figure 2 Demographic density of public transport infrastructure based on stops per 10,000 inhabitants

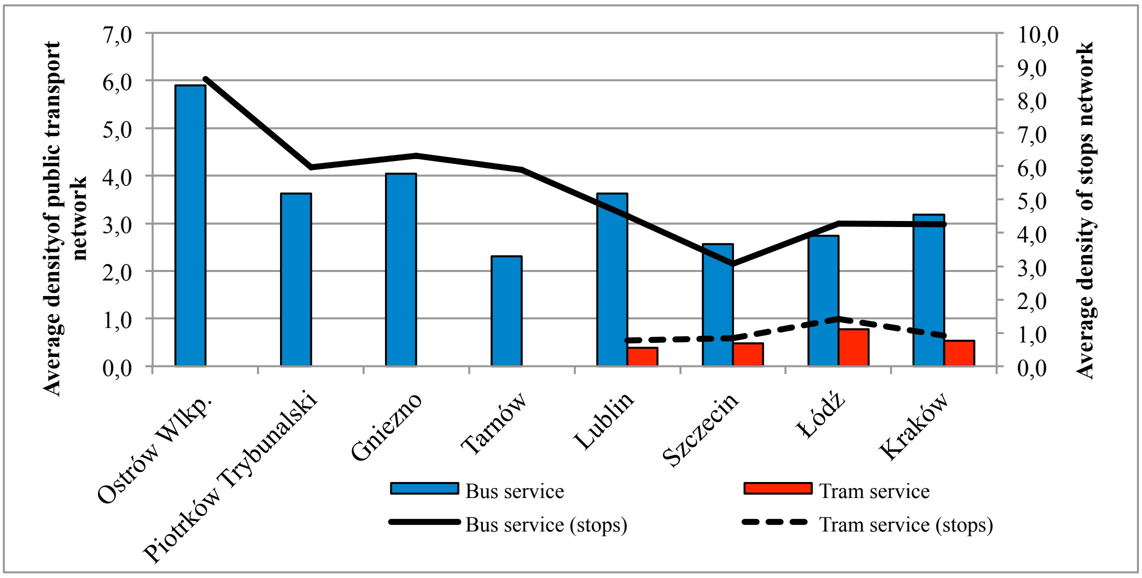

Figure Error! No text of specified style in document. Average density of public transport stops in the network