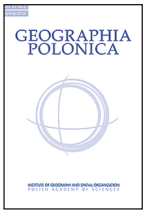

Geographia Polonica
Volume 87, Issue 1, pp. 157-160
http://dx.doi.org/10.7163/GPol.2014.10

INSTITUTE OF GEOGRAPHY AND SPATIAL ORGANIZATION
POLISH ACADEMY OF SCIENCES
www.igipz.pan.pl

www.geographiapolonica.pl

TRANSPORT- AND SETTLEMENT-RELATED TIME EFFICIENCY OF ROAD JOURNEYS TAKEN IN POLAND

Przemysław Śleszyński

Institute of Geography and Spatial Organization
Polish Academy of Sciences
Twarda 51/55, 00-818 Warsaw: Poland
e-mail: psleszyn@twarda.pan.pl

Abstract

Presented here with reference to Poland is a new method by which to assess the efficiency of a country's transport network in relation to its settlement network. The work described proceeds on the assumption that efficiency is greatest where connections by road for private cars take the shortest route in a straight line, without restrictions or limitations in the course of the journey made. Real barriers and limitations arising from bends and speed limits reduce traffic speeds, thereby limiting the efficiency in transport-related and settlement terms.

Key words

efficiency • effectiveness • spatial accessibility • transport network • settlement network • travel time • Google Map • Poland

A matter of key significance in studies of spatial accessibility is the determination of journey times. This reflects the fact that a shorter journey time denotes better communications and greater possibilities for relationships to be entered into, at the same time accounting for relevance in assessing the functioning of transport and settlement systems, as well as socioeconomic development more generally. The measure of spatial accessibility accepted most widely is based around time – this being characterised by a universality allowing for indirect assessment of economic costs.

Research on accessibility is seen to lack universal comparisons as to potential possibilities associated with journey times. Solutions resorted to generally make reference

to absolute journey times, as well as differences between them, for example in different periods.

The index proposed here takes advantage of the fact that transport linkages do not usually take the shortest (straight-line) routes, while speeds achieved in the course of journeys are generally far from the maximum ones possible, thanks to numerous limitations that relate to technical and operational parameters of roads, as well as the intensity of traffic and restrictions provided for in law. The efficiency referred to here is thus a measure of the degree to which the system works, denoting as it does the difference between real and ideal (optimal) times needed to cover a given unit of distance. The difference between the ideal and real times is what gives rise to limitations on transport- and settlement-related efficiency.

A graphic interpretation of the index is offered in Figure 1. The examples provided assume a value for ideal speed v_o equal to 90 km·h^{-1}, as well as a real one expressed as the mean for the whole section of road v_r which stands at 60 km·h^{-1}. Moreover, the real section of road between points A and B is 80 km long, while the straight line distance linking these points (actually the shortest distance running along the land surface, with no account taken of downward slopes in the terrain) is 50 km long. Thus, were ideal movement to be possible, the section would be covered in 33 minutes, while in reality it takes 80 minutes. Division of the real value by the ideal one yields an efficiency index of 41.7%.

The aforementioned methodological conceptualisation was put into effect for Poland and for a set of 332 towns and cities of poviat-capital (i.e. 'county' seat) rank or higher. 1201 unique connections between adjacent towns were selected, and use was then made of the *Google Map* map service in determining journey times, this making it possible to calculate the shortest journey time between the two points. Relevant data were collected in August 2013, for 'outward' and 'return' journeys, the dual times obtained then being averaged for the purpose of this study.

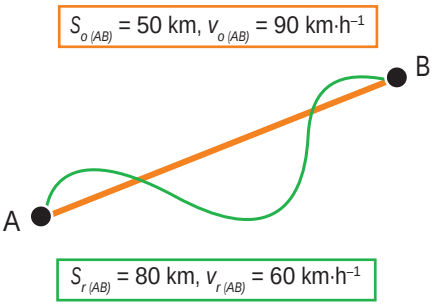

Figure 1. Construction of the index of transport and settlement-related time efficiency

The results were mapped in line with an assumption that the ideal speed v_o = 90 km·h^{-1}, this representing the upper legal limit for single-lane roads in Poland. This gives rise to a situation, in which most parts of Poland can be seen to be characterised by efficiency indices in the range 40-60%. This is a relatively low value, especially given that some connections can indeed by covered by car at much higher speed, since a system of expressways and motorways is in place. In this context, accessibility achievable by car in Poland would still need to be evaluated as unsatisfactory, notwithstanding considerable streams of financing designated for transport inputting from the European Union. It can thus be concluded either that these investments (as matched by domestic funding) are inadequate, or that less than fully effective use is made of them, which is to say in this context that investment priorities do not necessarily coincide with places and routes, at which the greatest efficiency could be achieved were speeds to be raised and flows improved.

Transport- and settlement-related time efficiency is most related to differences in relief and land-use, or else the limitations on the design of routes arising out of these features, as well as restrictions on traffic. Relatively the highest values for indices characterise the areas of north-eastern Poland with

lower populations, while the least-favourable values are noted for mountainous areas in the south of the country, as well as urban agglomerations.

The obtained results were also compiled on a histogram (Fig. 2). Further calculations show that, for 4.8% of connections studied the index assumes values below 40%, while for a further 15.8% it ranges between 40 and 50%. That leaves 43.7% of connections, in which the efficiency at which those distances are covered is in the range 50-60%, 28.0% for which the index has values of 60-70% and just 7.7% of connections, in which values for the index are over 70%.

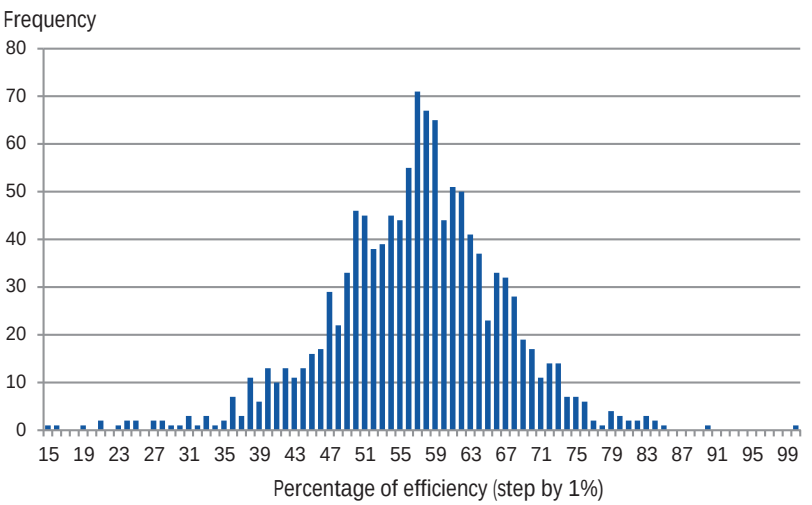

Figure 2. Histogram of indices for road- and settlement-related time efficiency for 1201 analysed connections made using transport by car in August 2013

The efficiency index presented has many possibilities when it comes to modification and development. It would be suitable for use in relation to different categories of towns and cities, the result being indices oriented hierarchically. There is even the theoretical possibility of a calculations being made for the full matrix of points, though this would be very time-consuming and not always justified, since not all relationships are of the same significance (or weight). Seemingly most justified and of greatest interest from both the cognitive and practical points of view is the use of the measurements describing relations between two adjacent hierarchical levels of cities and other units of administration, e.g. between the capital city of a country and the capitals of provinces or regions (voivodships in the Polish case), between regional and local cities and between main centres of units at county level (poviats in the Polish case) and local level (seats of authority of the *gmina* units of local administration), etc. A modification of the index from the point of view of distance – on the basis of a gravitational model and with use made of 0/1 possibilities to travel via two-lane roads – is presented elsewhere (Śleszyński 2009).

Moreover, alongside the data on real journey times obtained from map services (*Google Map*, targeo.pl, etc.), there was also a possibility for dedicated models of traffic speed to be made use of. The latter solution – also extending to the calculation of the indices for time efficiency as regards transport and the settlement network – has been applied several times previously in work done by the author in the context of projects implemented at the Institute of Geography and Spatial Organization of the Polish Academy of Sciences (Komornicki et al. 2010; Więckowski et al.