UN-GGIM: Europe | Work Group on Data Integration | subgroup 2

The territorial dimension in SDG indicators: the contribution of geospatial data and analysis and its combination with statistical data

INDICATOR: 11.2.1 | Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities [tier II indicator]

Brief discussion

At the ***global level***, UN-Habitat (United Nations Human Settlements Programme) and other partners are leading the efforts to compile data for this indicator.

Geospatial data is in the heart and nature of this indicator and, conceptually, the indicator requires two spatial components: the location of the population and the location of the stations. As the indicator is part of Goal 11, the delimitation of cities and human settlements is a prerequisite.

The definition of convenient access is defined by criteria such as distance (e.g., maximum 500m), accessibility for special-need customers, and frequency of service and station environment.

The indicator should be disaggregated by age, sex and persons with disabilities and should be reported in a two year to five year interval based on availability of new data.

The global suggested method to calculate the proportion of the population that has convenient access to public transport is based on the following steps:

a) Spatial analysis to delimit the built-up area of the urban agglomeration;
b) Inventory of the public transport stops in the city and calculation of the service area (various options on type of distance and the actual distance considered convenient as +/- 500m);
c) Calculation of urban area with access to public transport and identification of the population served;
d) Calculation of the proportion of the population with convenient access to public means of transport out of the total population of the city.
   It will be computed as:

$$100 \text{ x } \frac{Population\ with\ convenient\ access\ to\ public\ transport}{Total\ population}$$

Where available information can be disaggregated by various demographic variables as well as variables based on transport frequency and accessibility. The temporal measurement is left out completely for global comparison, but countries that can additionally capture this component are encouraged to collect and report this information as part of the disaggregation.

The basic methodology is described using population data on the level of census enumeration districts which is most likely to be available on a worldwide basis. The recommended data source, however, is the location of dwelling units as GIS data including the number of residents per dwelling unit.

Optionally, data source can rely on census or household surveys that collect information on the proportion of households that declare they have convenient access to public means of transport and possibly also collect information about the quality of the service.

This indicator is categorized under Tier II, meaning the indicator is conceptually clear and an established methodology exists but data is not easily available. No internationally agreed methodology exists for measuring convenience and service quality of public transport. Moreover, data is not harmonized and comparable at the global level. Obtaining this data will require collecting it at municipal/city level with serious deficiencies in some areas, such as data on mass transit and on transport infrastructure.

In addition, an open-source software platform for measuring accessibility, the Open Trip Planner Analyst (OTPA) accessibility tool, is proposed at the global level to be available to government officials and all urban transport practitioners. This tool was developed by the World Bank in conjunction with Conveyal, this tool leverages the power of the OTPA engine and open standardized data to model block-level accessibility. The added value of the tool (free and user friendly) is its ability to easily calculate the accessibility for various settings and transportation scenarios and will ensure a more uniform and standard format for reporting on this indicator.

The analysis of the WG members regarding the metadata on this indicator has pointed out:

- The indicator should reflect the urban dimension in the name as its methodological scope begins with the delimitation of urban agglomeration (e.g., proportion of urban population with convenient access to public transport). At the global level, the definitions underlying the GHSL – Global Human Settlement Layer could be used and at the European level, a common definition of urban areas should be considered based on available common territorial typologies, such as the DEGURBA – Degree of Urbanization.
- On the other hand, measuring access to transport is a relevant indicator to an overall assessment of the national situation and, therefore, it could also be reported for the whole country, including segmentation for rural areas.
- If population data is accurately assigned to point-location by means of geocoding using authoritative address, buildings or dwelling registers, the computation will not only be more accurate, but also more flexible and easier to conduct as no *proxy* data or disaggregation procedure will be needed. This should be the preferred approach in Europe as in the European context a growing number of countries are implementing point-based geocoding infrastructures allowing them to calculate very accurate figures. In the same vein, the calculation of the shortest distance route is more accurate than the Euclidian distance. In addition, availability of data on road networks, including pedestrian walks, as well as on public transport spots and timetable might also be a challenge, especially in order to guarantee global and European comparability.

- The methodology to compute the general indicator measuring the proportion of population only takes into account the home reference points. Other reference points could be considered, such as schools, workplace, markets. This indicator would then measure the proportion of schools, work places and markets with convenient access to public transport. Schools, work places and markets represent a different object type, not to be mixed with population. In principle, they could be measured too, but rather as "proportion of schools, work places and markets" with convenient access to public transport.
- The definition of stops could be a challenge as, typically, large stops have several entrances apart from each other and include all entrances as access points to public transport. Where available all entrances could be included as access points to public transport. Moreover, the meaning of terms such as 'safe and comfortable environment' and 'frequent service' would benefit from further theoretical clarification.
- Information might not be easily available regarding population with disabilities, but another perspective would be to have information on stops accessible for people with disabilities, as anyone can be temporarily injured, or have the need to push wheel chairs or baby strollers (e.g., proportion of population with access to public transport stops accessible for people with disabilities).

At the ***EU level***, the EU-SDG indicator set defined by Eurostat has not included an indicator that has a direct correspondence with the one defined at the global level. It included, however, a similar indicator on the *Distribution of population by level of difficulty in accessing public transport* based on data from the EU Survey on Income and Living Condition (EU SILC) ad-hoc module of 2012. The indicator measures the share of population reporting i) very low; ii) low; iii) very high or iv) high level of difficulty in accessing public transport. This indicator reflects people's perception and is neither based on spatial analysis nor a clear correspondence to the global indicator.

A further European approach was developed by DG REGIO in the working paper *Measuring access to public transport in European cities* (Poelman and Dijkstra, 2015) using geospatial data and public timetable information. DG REGIO study measured networks distances (instead of Euclidean distance) for 29 EU cities [see Box 1], defined using the EU Urban Audit city definition of urban centres (high-density cluster). The study considered: i) gridded population with grid cell sizes 1 km^2 or smaller or house blocks (building blocks corresponding to polygons of the Copernicus Urban Atlas layer (2006) and in areas with no data population was estimated to 100m x 100m grid, downscaling from the EU 2006 population grid), and ii) information on transport stops and road network including footpath information relied on TomTom MultiNet and national data sources on public transport were also used[1]. Transport stops and time table information is not available for all transport networks and for all Member-States, which is an obstacle for calculating the indicator at EU level. Google also provided transport timetables available, but with coverage gaps.

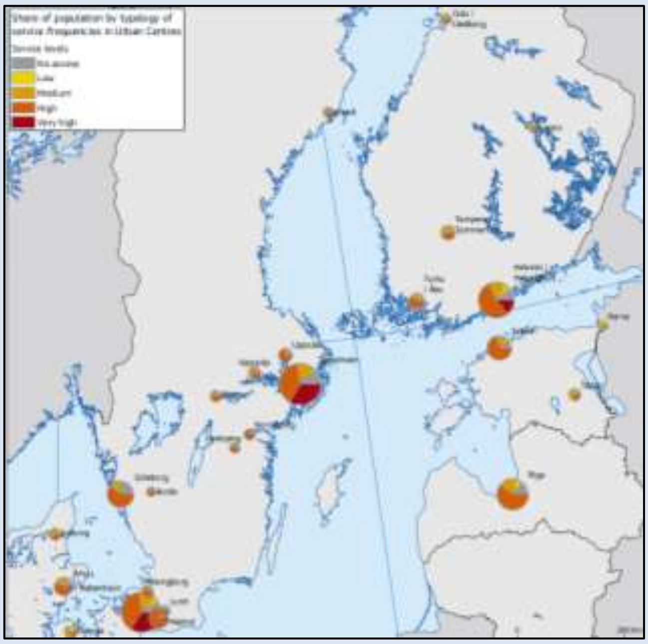
[1] For example, Sweden integrated data available at: http://www.trafiklab.se/api/gtfssverige and Finland integrated data available at http://developer.reittiopas.fi.

Box 1 - Measuring access to public transport in European cities (DG REGIO)

DG REGIO calculation using geospatial information, population distribution and public transport stops timetable took into account:

- The calculation of walking distances (service areas around each stop) using the street network (accounts for obstacles such as rivers, steep slopes, highways and railroads). It was assumed that people would be willing to walk five minutes (417m) to a bus/tram stop or 10 minutes (833m) to train/metro;
- Time table data on departures on a normal weekday (6:00 – 20:00) was considered and five groups based on access and departure frequency were created [see Figure **1**]:
    1. No access: people cannot easily walk to a public transport stop, in other words it takes more than 5 minutes to reach a bus or tram stop and more than 10 minutes to reach a metro or train station;
    2. Low access: people can easily walk to a public transport stop with less than four departures an hour;
    3. Medium: people can easily walk to a public transport stop with between 4 - 10 departures an hour;
    4. High access: people can easily walk to a bus or tram stop with more than 10 departures an hour or people can easily walk to a metro or train station with more than 10 departures an hour (not both);
    5. Very high access: people can easily walk to a bus or tram stop with more than 10 departures an hour AND a metro or train station with more than 10 departures an hour. Very high access is only possible in cities with a metro and/or a train network and depends heavily on the extent of this network.
- Each of the service area polygons is characterized by the sum of the hourly average number of departures available at the stop around which it is created. The study assumed that the stop with the most frequent departures is the most probable choice. The service areas within each of the groups of transport modes were intersected and, in case of overlapping areas, the maximum value of the hourly average number of departures was attributed.

Figure 1 - Access to public transport in urban centres in Denmark, Sweden, Finland and Estonia



Source: Poelman, H. & Dijkstra, L. (2015). *Measuring access to public transport in European cities*. Regional Working Paper, DG REGIO.

At the ***national level***, from the national practices collected (from Austria, France, Ireland, Sweden, and Switzerland), it was possible to identify that this indicator has been calculated for the national context. The results from the EU-SILC ad-hoc module 2012 have been used in the context of evaluating access to public transports in the case of Austria, and in the case of Switzerland the Swiss Health Survey is the reference source to evaluate accessibility for the SDG. National cases have identified the NSI as the agency responsible for the indicator and in the case of France and Switzerland together with the National Geographic Institute and the

Swiss Federal Office for Spatial Planning, respectively. In the case of Sweden, most likely responsibility for this indicator will also include the Transport Analysis. As with all SDG 11 goals, the definition of the geographic delimitation of the urban areas is necessary. Countries used either the EU definition or followed their national methodology. All five countries have data sources with population data geocoded to address or building point location, which can be used for the proximity to the stops (spatial analysis) as well as for the demographic disaggregation of the indicator by age and sex.

It was pointed out that the indicator would require reliable data on public transport and its stops, and possible data sources were mentioned. In France data on public transport stops exists, but it is provided by the local authorities or cities themselves. So the main difficulty would be to gather the information at national level, from various providers. A good example for this is Sweden, where data on public transport stops (coordinates and traffic frequency) is available as open data in GTFS format (Google General Transit Feed Spec) and is provided jointly by the public transportation service providers (www.trafiklab.se).

In the case of Austria the data on transport stops and timetables of provided transport modes is gathered by the organisation VAO (Verkehrsauskunft Österreich) and provided to various routing applications for intermodal door to door routing. However the access for statistical purposes has not been clarified yet. More recently, transport projects carried out by the Austrian Conference on Spatial Planning and the Austrian Ministry for Transport, with the collaboration of Austrotech, have produced two relevant products, namely: a $100m^2$ grid matrix with travel time of the best available intermodal route based on criteria such as type of transport, time and frequency of service, number of changes; and a $100m^2$ grid with a public transport quality grading system, providing for each cell information on how well each grid cell is serviced by public transport (including aspects such as type of transport, distance to stop, timetable information). Products like these could be a useful tool to measure accessibility based on data at a very detailed geographical level.

In terms of geographical information, the calculation of this indicator for the Irish context relies on data from the National Transport Authority, which is made available as open data (data.gov.ie) on a regular basis. The data for public transportation networks and stations, along with road network, includes coordinates along with extensive information about routes, trips and traffic frequency for each stop. Data is provided through an API under open data license in GTFS (Google General Transit Feed Spec) format. Information relating to identifying stops with “frequent service” during peak or off-peak travel times can be done by using the time-table information connected to each stop.

In the case of Switzerland and Sweden, national indicators have been proposed to address the global target 11.2 on *access to safe, affordable, accessible and sustainable transport systems for all*. Switzerland has defined at the national level the indicator *Autonomous utilization of public transport by persons with disabilities*, with the purpose of measuring the percentage of seriously handicapped people between 15 and 64 years old living in private households which can use public transport autonomously (without aid by third persons) and without difficulties. The indicator is based on the results of the Swiss Health Survey and, therefore, represents a subjective self-estimation of the persons questioned. In addition, Switzerland has proposed another indicator, the *Average distance to next public transport stop*, but aiming mainly to support target 9.1 concerning the quality of infrastructures. This indicator relies on:

i) point-based population (population and household statistics are geocoded up to the building level and updated annually);
ii) national road network as a product of the large-scale topographical landscape model produced and maintained by the Swiss Federal Office for Topography Swisstopo (Swiss NMCA), revised and actualized at a six-year periodicity, i.e., every year one sixth of the national territory of Switzerland is updated;
iii) public transports stops from the Federal Office of Transport, combined with further analysis of cadences from Federal Office for Spatial Development (data available in the Swiss geographical portal).

In the case of Sweden, the Swedish National Board of Housing, Building and Planning proposed to measure accessibility to public transport based on the number of dwellings and new dwellings developed in proximity of public transportation stops, which has been calculated based on geospatial data on households and public transport stops [see Box 2].

Box 2 - Sweden national complementary indicator on Housing in proximity of public transportation

As a national complementary indicator, the Swedish National Board of Housing, Building and Planning proposed to measure the number of dwellings and new dwellings developed in proximity of public transportation stops. The rationale for this indicator is to follow up the sustainability of urban planning; assuming that housing close to public transports will require less need for cars. The indicator will be updated annually in order to follow the trend of new housing in proximity of public transportation
The steps for calculating the indicator are the following:

Step 1: public transportation data, select only those stops that match the desired frequency of departures.

image showing all public transportation stops (yellow dots) and transportation stops considered "frequently trafficked" (yellow dots surrounded by a bigger white dot)

Step 2: create service areas around each public stop: Buffers with varying sizes (400, 1 000 and 2 000 meters).

image showing frequently trafficked public transportation stops with service areas

Step 3: conduct a point-in-polygon operation to find out which dwellings are within the range of the service areas (both in total and dwellings in buildings completed during the reference year of interest).

image showing buildings with registered dwellings together with service areas of public transportation stops

Step 4: conduct a point-in-polygon operation also on population data geocoded to the level of address locations to find out how many people live within the range of the service areas.

Step 5: use the total figure for dwellings and population by county and municipality to calculate a share.

Step 6: publish the information in the Statistical database from which the National Board of Housing, Building and Planning can retrieve data either by means of searches or by means of machine-readable data served through an API.

The results show that, on national level, 78% of all dwellings are located within 400 m from a "frequently trafficked" public transport stop and 90 % of the dwellings were located within 1 000 m.
Among the new dwellings (completed throughout the year of 2015) some 83% were located within 400m from a frequently trafficked public transportation stop.

Source: Lantmäteriet, Trafiklab and Statistics Sweden.