



# Accessibility Tool for Road and Public Transport Travel Time Analysis in Västra Götaland.

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## Background

The technical components of the accessibility instrument was initially developed by the consultancy firm WSP (Dr. Svante Berglund ) for Region Skåne. The main aim was to create a better understanding of the geographic accessibility within the region, paired with a strategy to strengthen the knowledge and use of micro-data in regional/local planning. Region Västra Götaland observed this work and the Department of Human and Economic Geography were commissioned to convert the Skåne-model to meet the specific conditions of Västra Götaland.

There was a clear planning-practitioner related aim behind the project. Planners had identified a need for more detailed data as well as being able to compare accessibility to amenities for both road and public transport. Important planning issues at this point in time were linked to the development of a new regional infrastructure plan for both road and public transport. An important part of the project was to spread knowledge about the tool through a series of workshops. There were no direct scientific questions involved. This was something to be developed after that the tool was successfully launched. The accessibility tool was furthermore also intended to act as platform to initiate long-term planner-academy collaboration.

## Conceptual framework and theoretical underpinnings

The instrument defines accessibility as the possibility to connect origin and destination points for a specific purpose. The accessibility tool has no predetermined restriction in terms of accessibility measures. However, at the current development phase, two different measures are used; a location based accessibility measure and an isochronic or cumulative opportunity measure. In both cases travel times are used as distance functions, thus the travel time is the taken into consideration as a cost. The estimation of travel time is further described in section 3.

. Since this particular instrument originally was developed outside of our organization there were no direct theoretical considerations behind the framework from our part. The main attraction in terms of theoretical underpinnings lie in the possibilities to combine the relatively simple travel time measures with other socio-economic and land-use data for geographical analysis of for example regional and local labour-markets, commuting patterns or the potential for public transport.

Definition and measures were chosen mainly on the basis of being easy to communicate with practitioners and the general public. For future developments of the instrument we are looking into the implementation of more advanced measures (see section 5).

## Operational aspects

*Accessibility types calculated:*

- travel times using public transport systems (see figure 2)
- travel times by private car (see figure 2)
- potential customers within a defined catchment area
- number of business establishments/number of potential workplaces within a catchment area (see figure 3)
- walking times to public transport stops and to local facilities included in the total trip (third data-input in the travel time estimation for public transport discussed on page 3)
- generalized walk times/bicycle times to public transport services or to local facilities included in the total trip

The initial set-up process is universal for both car and public transport. The very first step is to create a grid of 500x500 meter cells covering the area of study. These cells are then used as basis for the rest of the input data processing, as well as the final accessibility computation. See figure 1 for an overview of the input data and the set-up process described in this section. It is important to understand that there are two separate “layers” of the instrument. The **set-up/preparation layer** and the **accessibility calculation layer**.

The input data process for accessibility analysis by car is relatively simple. Travel times are calculated based on the speed limit and the length of each link. Shortest path analysis is then carried out throughout the links with the help of TransCAD software. Output consists of three variables for each starting cell: ID-number, travel time/opportunity and the selected destination cell. The travel time estimation for public transport is more complex and computed with a purpose-built software package that requires four different data-inputs.

1. The first input verifies which cells that are completely located in water. These will be excluded from the computations.
2. The second input is an OD matrix of travel times between public transportation stops. The process of preparing this input requires significant computer power. It includes computations of travel times between 9200 (84 640 000 possible relations) public transport stops.
3. To create the third input file, all stops are connected to the road network. The input is then calculated through the road network and includes walking times between each cell and its five nearest public transit stops.
4. In order to minimize the risk of unreasonably long travel times with public transport on short distances a fourth input with walking travel times is created. This time is used instead of public transport travel-time when the distance between the starting cell and the destination cell is two kilometres or less.

All data except for public transport time-table information is used with only smaller quality control processing. The process of extracting travel times between public transport stops is very time consuming and requisites a customized selection-script that differs depending how the respective public transport authority have organized their database.

**Table 1** Summary of data input requirements and access

Input data	Explanation	Availability
Base Map	Topographic and land-use data	At a cost from the Swedish Land Survey
Road network	Official national road network database NVDB	At a cost from the National Road Authority.
Public transport time-table data	The same database as the regional transport authority use for the online travel planning service.	Raw data freely available but the selection of data for the instrument requires consultancy competence at a high cost
Socio-economic micro data	Official spatial register data of individuals and workplaces.	At a cost from Swedish National Statistics Bureau

The time to fulfil the set-up process including all input data takes two-three weeks under ideal conditions. This includes calculations, data handling, conversion and testing. Once established, the accessibility calculations for a standard question (e.g. the travel time to the nearest grocery store from all 177.000 500 m cells finishes in less than one minute on a standard computer. The most time consuming analysis is the calculation of a catchment area for each cell (se figure 3) which approximately needs two days of continuous computation.

Managing the set-up/preparation layer requires a high level of expertise in database management and travel time calculation as well as GIS software. The accessibility calculation layer can be handled through a relatively simple step-by-step instruction manual, only requiring a basic understanding of computers and data handling.

## Relevance for planning practice

The instrument produce information about travel time for car and public transport to one or many selected destinations on a 500 m resolution for the entire region. It is also geographically compatible with a large amount of socio-economic data for further analysis. The data is easy to export to any GIS or statistical software for analysis and visualisation.

During 2010-2012, the instrument have been directly involved in a project together with national, regional and local development agencies in order to understand accessibility problems of remote areas. The planning problem was: *how can we improve accessibility to commercial services in sparsely populated peripheral areas?* Maps and tables for this project produced with the accessibility tool have been presented and discussed with planners and politicians at three different occasions, for more details see (Eldér and Larsson 2011). Overall, participants expressed a consensus of positive opinions the maps turned out to be an important instrument for initiation of discussions. The following issues were raised:

- Maps gave a good overview and have a great potential to enhance the planning process.
- Substantial lack of relevant data and tools on the local level.

- As of for now, the municipal planners do not have access to data and sufficient planning tools which often makes it problematic for politicians to accurately consider the best decisions. This sometimes results in difficulties for politicians to resist vested interests and locally powerful actors.
- Small rural municipalities have very limited resources which makes it difficult to manage a complex planning tool. There is a strong concern for a multi-level cooperation around the accessibility tool and GIS-data. The spread of knowledge is a key subject to this matter, not only between users and developers but also to politicians.
- The combination of planners with experience and detailed knowledge of local conditions and the technical and in-depth knowledge of data provided by the researchers and the accessibility tool created a “knowledge-spillover” effect. The researchers could provide information of the potential of GIS-data and analysis that participants were unaware of. Vice versa, the researchers have limited information about the local reality in the municipalities and the practical work carried out by the planners.

A further impact on planning has been gained through a two-day accessibility instrument workshop aiming at regional planners. Six persons first learned the basics of the accessibility calculation layer thereafter each participant brought a planning problem from his/hers everyday work to be analysed with the instrument. This resulted in the following experiences of possibilities and limitations:

- + The tool brings new information and has a potential thanks to the possibilities to compare car and public transport at a high geographical resolution
- + Maps is a very useful way of communicating large amounts of data
- + Works on a standard computer
- Complex and non-intuitive system that requires expert knowledge and resources to set-up and maintain.
- Depends on partly complicated data input and processing structure
- Requires expensive commercial software (TransCAD)

## Strengths and limitations

*What are the most important strengths and weaknesses of your instrument from a **scientific** point of view?*

So far the scientific aspects have not been addressed specifically. However, there lies large potential in the high geographical resolution which provides analysis beyond traditional administrative borders. The possibility to analyse accessibility with public transportation at such scale, as well as the opportunity to compare accessibility by different travel modes is also important advantages. One of the key strengths is the spatial link between travel time output and official socio-economic micro-data of individuals and workplaces. The most important weakness in our opinion is connected to the rather inflexible and time consuming process of preparing the instrument for analysis.

*What are the most important strengths and limitations of your instrument from a **practice** point of view?*

The strength is the high geographical resolution and the possibility to compare car and public transport. Once set-up, the calculations are possible to perform on an ordinary computer which greatly enables the potential use. It still needs a lot of resources and knowledge to set-up and maintain which is a potential problem for the continuous use.

*What were the most important positive and negative reactions of planning practitioners?*

See section 4

*Which improvements are you planning to address **scientific** limitations?*

- More advanced distance and time measures as well as implementing costs. For public transportation we have an ambition to expand the time window of analysis to include weekends and evenings and for the car-analysis the next step is to include various factors that affect connectivity such as traffic lights, congestion and one-way streets.

*Which improvements are you planning to address **practice** limitations?*

- Possibilities for simple and efficient handling of scenarios. In the current version the process of adjusting the tool for probable future conditions (e.g. a planned highway or bus-link) is complex. We plan to provide a thorough guide complemented with prepared datasets for planners.
- One further plan is to adjust the script in TransCAD in order to make the tool more dynamic in handling scenarios.

## References

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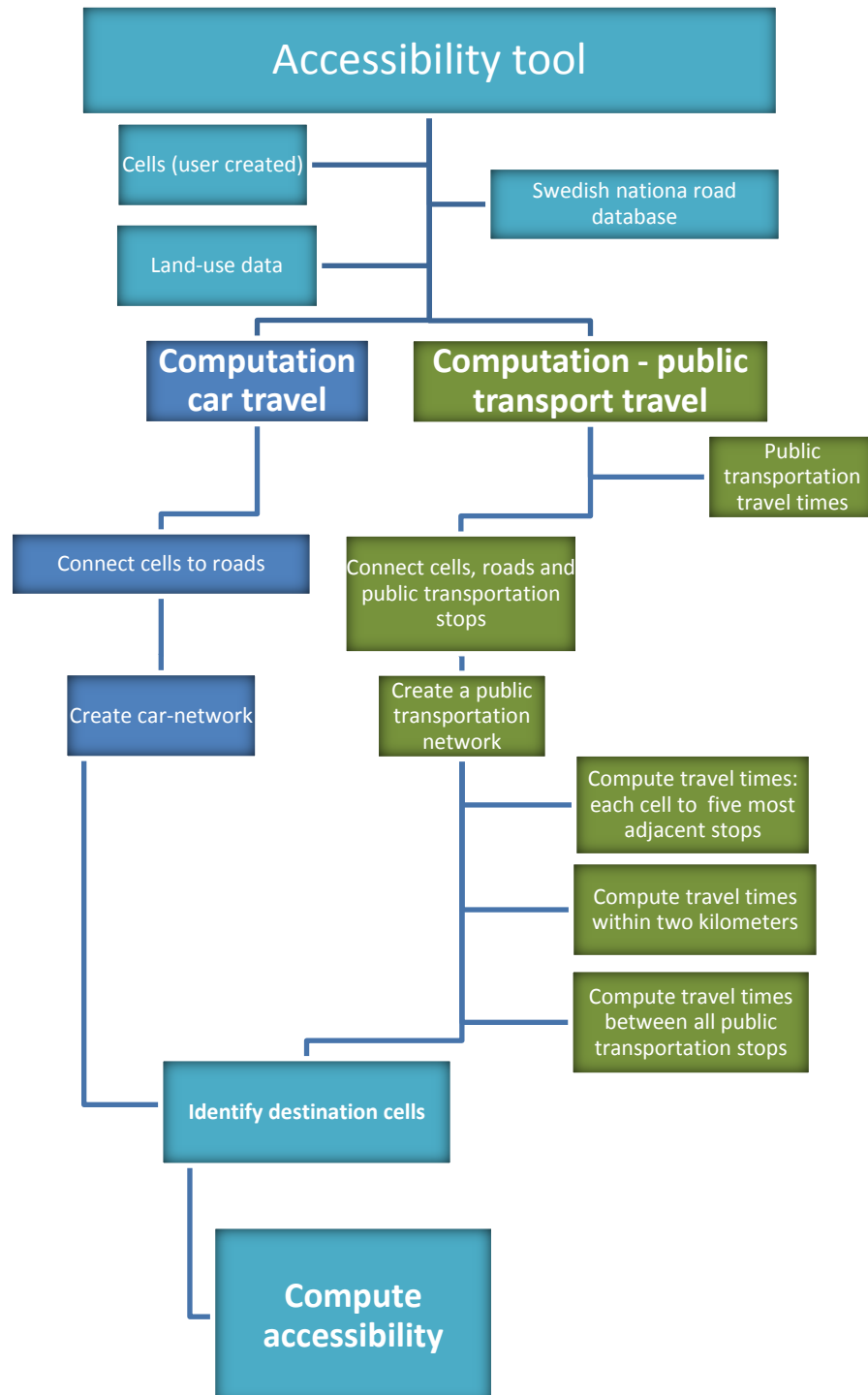
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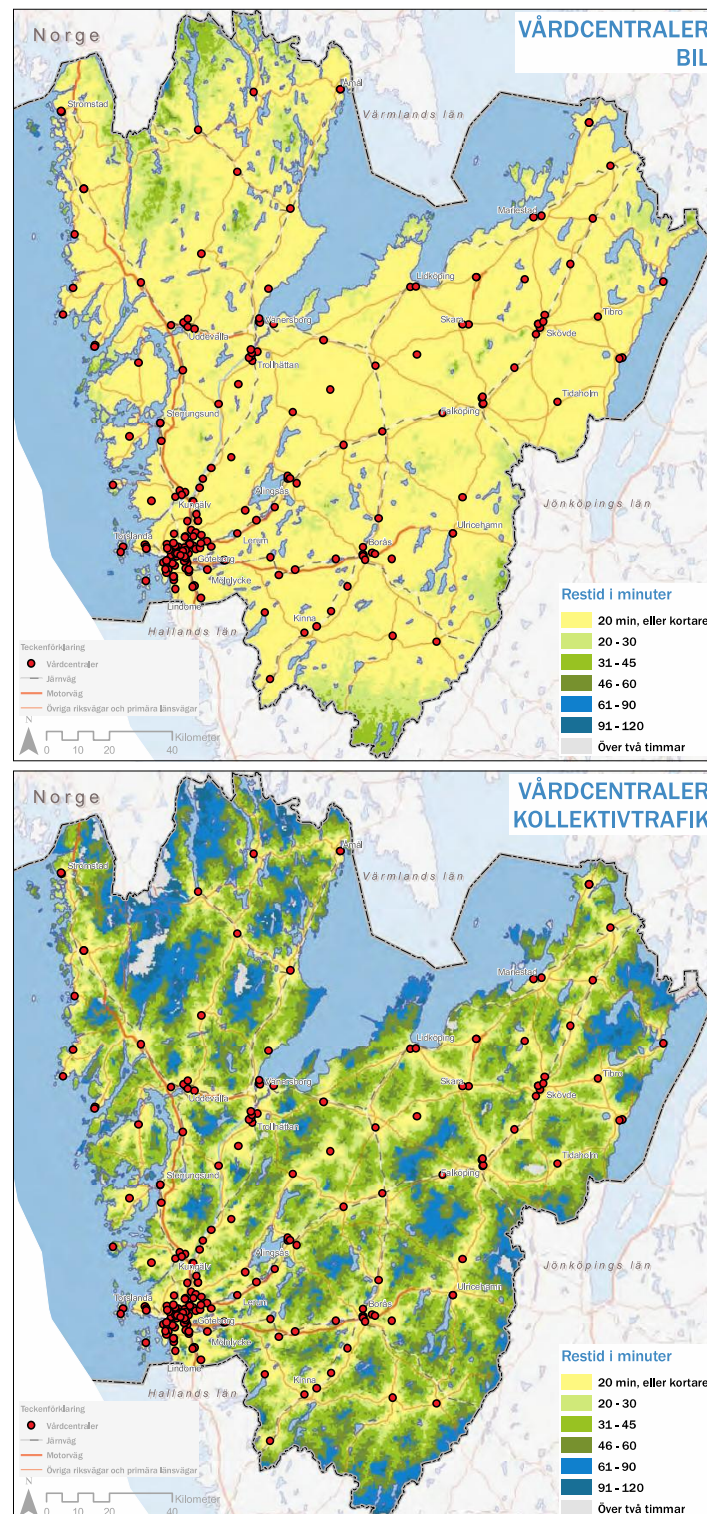
## Figures

**Figure 1** Structure, inputs and outputs of the accessibility tool





**Figure 2** Accessibility to nearest medical centre by car (top map) or public transport (bottom map). Total travel time in minutes



**Figure 3** Potential number of persons with tertiary education in within 60 minutes travel time by car (top map) or public transport (bottom map).

