# Bicyclists' accessibility in urban areas – an evaluation using the TVISS method

**Linnea Viklund**
**Trivector Traffic AB, Lund, Sweden**
**linnea.viklund@trivector.se**

Many Swedish towns strive to become more pedestrian- and bicycle friendly, although professional planners, politicians as well as bikers argue in which directions their towns are moving. Who is right? Could it be that nobody knows because there is no standard way to measure accessibility? Now that we've decided that walking and biking are important transport modes, how should we measure if the town becomes more pedestrian- and bicycle-friendly? Accessibility to work, school, service and recreation could be the right aspects to measure.

Trivector has used GIS to measure accessibility in several different ways, mainly on a local level. Accessibility is a very important concept in the process towards a sustainable society. It is of great significance that children can reach their schools without being driven by car by their parents; that disabled people can get to the bus stop and further on to the city centre or their jobs; that people without a car or driver's license can get around with public transport or by walking or cycling. These are only a few reasons why accessibility is of such importance. The Swedish government has over the last years also realised the importance of accessibility; hence it is one of the major political transportation goals.

Nevertheless, it has always been difficult to measure accessibility in an adequate way – some of the indicators used are so over-simplified that they can be misguiding, others are so complex that they are difficult to understand. These problems have made it difficult for politicians to grasp the importance of accessibility. Now, by using GIS, there is finally a method to measure accessibility in an adequate way.

## The TVISS method

The TVISS method was developed by Mats Reneland, Chalmers University of Technology, in cooperation with the Swedish National Road Administration, SNRA. Trivector took part in a research project to put the method into practice in six cities in Sweden; Alingsås, Helsingborg, Säffle, Trelleborg, Umeå and Luleå. The project was financed by SNRA and several consultancy firms were involved, each being responsible for one city.

During the past two years, Trivector Traffic has investigated how accessible the pedestrian and cycling network in Luleå (60 000 inhabitants in northern Sweden) is for different target groups. The work started in 2002 with a major investigation of the road network. Three people were employed to do the investigation, which took about one month. The information was collected with a pocket PC on site and then put into a geographic information system with large analysis potential.

In the field, firstly the investigators register the type of road, for example footpath, bike path, sidewalk etc. Then, the road width is registered. Other examples of attributes are type of pavement, lighting, type of crossing and the presence of obstacles, stairs and ramps. In total about a hundred attributes were chosen between for each road segment.

After the entire network has been digitized, the network is checked to make it topologically correct. When the network is complete, the shape file and database contains several thousands of small road segments, each associated with a lot of information about road type, width, lighting, paving etc.

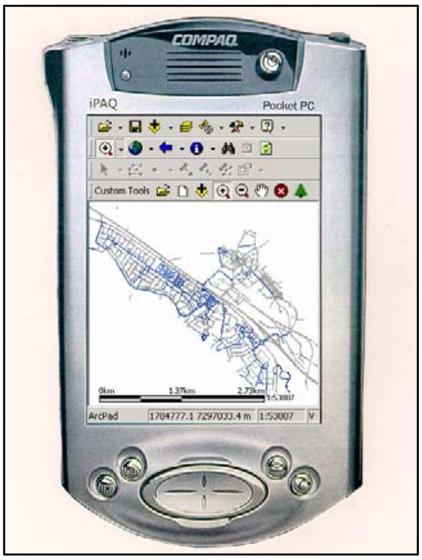


*Figure 1. The handheld PC showing a map in ArcPad*

The GIS has been used to investigate the network's accessibility, regarding for example safe school paths for children and safe routes to nearest public transport stop or grocery store for disabled people. For every user group of bicyclists or pedestrians, for example children, adults or disabled people, a group of criteria were set. The criteria were utilized to select a network of accessible paths for the user group in question. For example, rough paving is not acceptable for anybody who is in a wheel chair, and bicyclists also find rough paving annoying.

Firstly, all of the road segments with deficient standard were removed from the network. The new, limited network was co-ordinated with statistical data about the population and with a point file showing the location of the destination points. An analysis was carried out using Network Analyst and an application written by the Swedish company SweGIS. This run resulted in two output files: A polygon file containing a buffer zone around the approved accessible network and a point file with all the people that had an accessible way to the destination point.

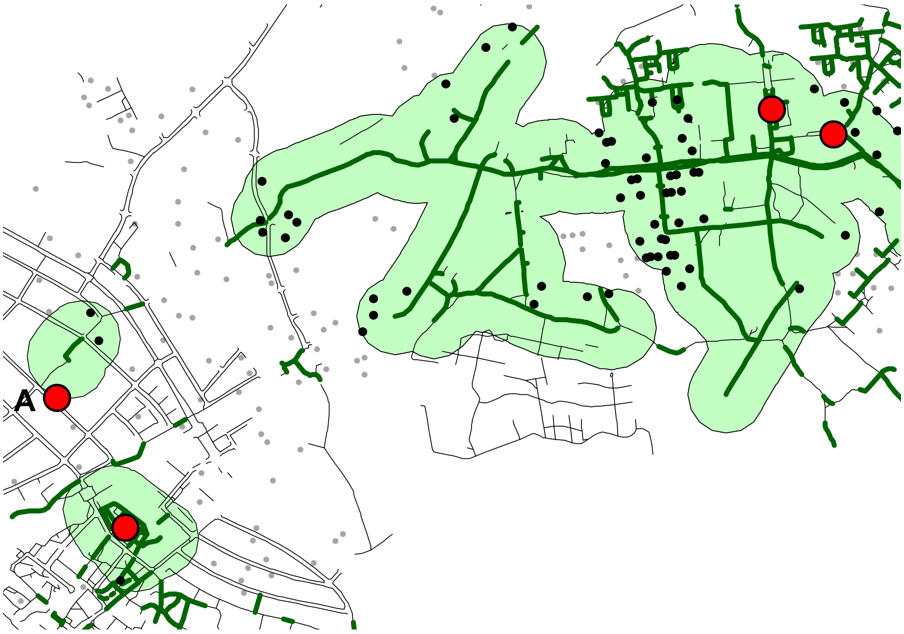


*Figure 2. Buffer zone around the accepted network for children's way to school. Red circles are schools and small black dots represent children that have an accessible path to school. Grey dots outside the buffer zone represent children that do not have an accessible way to school.*

In figure 2, the bold lines represent the network for children's way to school. In the newly constructed housing area in the eastern part of the image, there are a lot of paths suitable for children, while in the older housing area in south-west, children should not be allowed to walk or bike to school by themselves. The double lines in the south-west are sidewalks, and obviously there are no safe crossings there.

# Using the TVISS method for measuring bicyclists' accessibility

One of the problems with the first TVISS method was that there was no scale when classifying segments. A road segment was simply either approved or not approved. There was no intermediate grade for all of the road segments that were "almost OK". As a consequence, the SNRA financed a new project for

Trivector in order to develop a more balanced scale for measuring the accessibility for bicyclists in urban areas.

The new, nuanced scale has three levels; red, yellow and green. The scale is different depending on the age-group of the bicyclists. Adult bicyclists can handle more difficult traffic situations than teenagers, though both groups can be allowed to bike on roads with other traffic, as long as the traffic is moving slowly. Children can by no means be allowed to bicycle on their own on roads where they risk meeting cars. In table 1, demands on green and yellow links are shown.

*Table 1. Demands on green and yellow links*

<table>
<tr><th></th><th>Children 6-12 years</th><th>Teenagers<br>13-18 years</th><th>Grown-ups<br>>19 years</th></tr>
<tr><td colspan="4">GREEN link</td></tr>
<tr><td>Road type and width</td><td>Bike path not adjacent to street, width ≥ 1,2 m<br>At most 100 meters from home to bike path</td><td colspan="2">Bike path or lane, width ≥ 1,2 m<br>Bike lanes adjacent to traffic (with difference in level) is approved<br>Paths with little car traffic is approved<br>At most 100 meters from home to bike path</td></tr>
<tr><td>Lighting</td><td>Separate lighting for the bike path in question is required</td><td colspan="2">Street lighting or separate lighting for the bike path in question is required</td></tr>
<tr><td>Paving</td><td colspan="3">Asphalt or large paving flags</td></tr>
<tr><td colspan="4">YELLOW link</td></tr>
<tr><td>Road type and width</td><td>Bike path or lane, width ≥ 1,2 m<br>Bike lanes adjacent to traffic (with difference in level) is approved<br>At most 100 meters from home to bike path</td><td colspan="2">Bike path or lane, width ≥ 1,2 m<br>Bike lanes adjacent to traffic (with painted line) is approved<br>Paths with little car traffic is approved<br>At most 100 meters from home to bike path</td></tr>
<tr><td>Lighting</td><td>Street lighting or separate lighting for the bike path in question is required</td><td colspan="2">No demands</td></tr>
<tr><td>Paving</td><td colspan="3">Gravel, small cubic paving stones</td></tr>
</table>

Road segments marked with red are not at all recommended for bicycling. A red segment could be for example a road where vehicles drive in 50 or 70 km/h. At the yellow level, segments are OK but not optimal. An example of a yellow segment is a bicycle path that is too narrow and has a rough paving. The green segments are those that are designed for bicyclists, and that are safe and accessible for the group in question.

Furthermore the crossings were graded depending on their safety and design. For children in the green road network, only overpass or underpass crossings are allowed. In a yellow intersection for children, crossing vehicles are accepted as long as bumps secure that speed is reduced below 30 km/h. Unsignalized intersections and intersections without bumps are always classified as red in children's bicycle network.

The new, balanced scale was utilized to select and delete all road segments that were not green or yellow. With Network Analyst and an extension created by SweGIS in Gothenburg, fourteen different analyses were made for each city. Among others, children's accessible bike path to school and adults' accessibility by bike to a grocery store were tested.

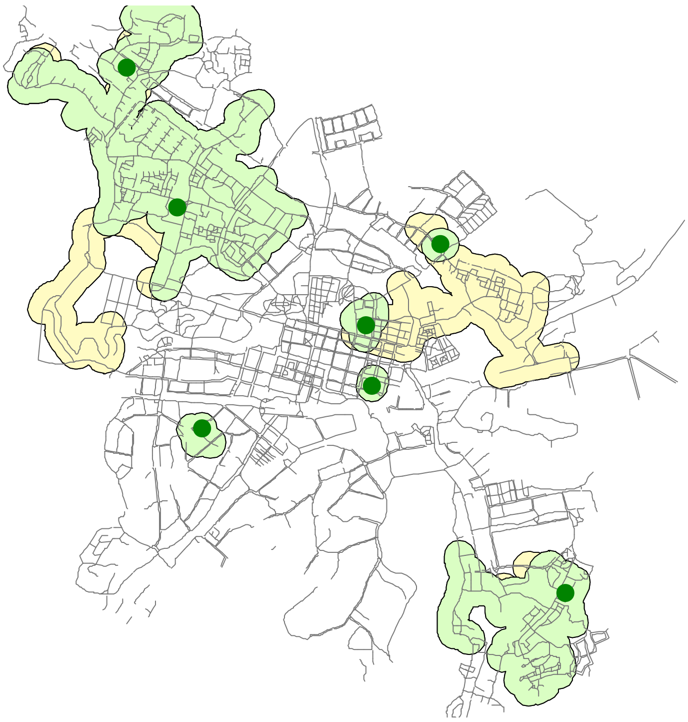

*Figure 3. The city of Alingsås with its yellow and green buffer zone for children's way to school. Green dots represent schools. Naturally, the yellow network also contains all green segments, since the requirements on green segments are always stricter than on yellow ones.*

The results varied a lot between the six cities. In Säffle, only 5 % of the children between 6 and 9 years of age have an accessible green cycle path to school, while 17 % of the children in Helsingborg can have a safe (green) bike trip to school. If yellow bike paths are accepted as well, 12 % of the children in Säffle and 45 % of the children in Helsingborg can bike to school by themselves.

Among grown-ups, 17 % of the inhabitants of Säffle and 26 % in Luleå have an accessible green bicycle route to the nearest grocery store. If both green and yellow bike paths are accepted, the numbers rise to 18 and 44 % respectively.

We can clearly see the difference between different kinds of planning philosophy. In most cities, there are some newly built-up areas where planners have made an effort to separate vulnerable road users from cars and other heavy traffic, for example by using over- and underpasses instead of intersections. This effort pays off in a large share of green and yellow bicycle paths in those areas. In the city centres and other areas where cars and vulnerable road users are mixed, many paths as classified as red. This clearly shows in figure 3 above, where the city centre in the centre of the map does not have any continuous green or yellow network.

Results of the analyses can be shown either as maps or as percentages of a certain age group. As an example, 22 % of the children (6-9 years) in Luleå can bike safely to the sports centre. By using percentages, the accessibility in different cities can be compared for a specific age-group.

When looking at a map with a town's green and yellow areas, it is clear which residential areas need an improved standard for bicyclists. In areas where no green or yellow network exists, the map can show which "critical spots" must be reconstructed in order to extend the green or yellow network. In some cases, it may be enough to reconstruct one single intersection or one deficient link, in order to open up a continuous green or yellow network for all the people in a specific housing area. When making a priority list for bicycle measures, this method can show which measures will be of advantage to the most people.