

Using GIS for safety children cycling – example of Pardubice city

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Abstract: Using bicycle as a mean of children transport is far less common in these days than it was in the past. Mostly, this situation happens because parents are more afraid of rush traffic on the streets. Would they be more comfortable if they could select safe route on the Internet? In this article we show that today's WebGIS portals, focused on cycling, mostly do not give parents this possibility. We try to show a simple way how to make available necessary information while maintaining clarity of output map. Furthermore, there is also a suggestion how to deal with data collection and digitization.

Key-Words: cycling, bikeway, children, WebGIS, geographic information system, Internet

1 Introduction

Cycling as a mode of transportation is not a minority trend, but the full form which supplements other modes of transport. [10][22] Despite this fact, more and more people use car as the main mean of transport, even at very small distances. For example in the European Union 30% of all car journeys are less than 3 km long. Efficiency of different means of transport can be explained on this example: in the city can be transported on lane 3.5 meters wide (normal lanes) for 1 hour, 22 000 people by tram, 19 000 people on foot and 14 000 people on a bike, but only 9,000 people by bus and 2,000 people by car. [2]

All over the world are becoming more frequent traffic jams, pollution and a dramatic increase in obesity, particularly in the U.S. The rationale for promoting cycling is that it would shift some trips from the car, thus reducing roadway congestion, parking problems, air pollution, noise and energy use. Cycling is therefore increasingly recognized as a clean, enjoyable and sustainable mode of transport in urban areas, and a means to encourage physical activity as a component of public health [14].

Public policy makers increasingly promote cycling as an alternative for commuting or recreation purposes. The key to this is to provide appropriate bicycle facilities such as wide lanes and bicycle paths. Investment in cycling facilities improves the level of cycling in the country and is an important part of the government initiatives to increase the number of cyclists. Linking cycling infrastructure,

particularly in the form of urban networks of protected bikeways and bike trails and regional networks also allows smooth movement of cyclists and bikers.

Definition of bikeway is not unified but it covers segregated cycle facilities consisting of marked lanes, tracks, shoulders and paths designated for use by cyclists and from which motorised traffic is generally excluded.



Fig. 1: Example of bikeway marking [19]

Bike trail is a route for cyclists marked by landmarks or tourist traffic signs. Bike trails should effectively link points where cycling can be assumed. Bike trails may be places on bikeways, or roads.



Fig. 2: Example of bike trail marking [19]

Bicycle paths (bikeways and bike trails) form an irregular network of inconsequential territory. Partial organization is only at the level of individual regions that are trying to coordinate the building of bikeways and local bike trails. The main problem is also in the competencies. Cycling as the mean of transport is covered by ministry of transportation but recreational cycling is supported by ministry for

regional development. As a result, it may happen that bike trails are built out of bikeways, along local roads.

To best use limited funds it is necessary to determine city districts that need to be preferably improved and what kind of cycling facility have to be build. Solving the problems of cycling in urban areas is mainly in the compromise use of roads shared with motor traffic and pedestrians. When city council decides to support mainly commuting cyclists they should bear in mind that commuting cyclists prefer fast and safe way. Recreational cyclists are willing to accept detour in 10% of path length if this way will be calm and scenic. [15]

2 Types of cyclists

When dividing cyclists into types, usually the division is based on two categories: recreational and commuter. This division is justified by the division of competencies in the field of cycle transport. Cycling as the mean of transport is covered by ministry of transportation but recreational cycling is supported by ministry for regional development. In the following text is added category of children's cyclist, which has its own characteristics and therefore cannot be simply assigned to one or the other category.

2.1 Commuting cyclist

The term "commuting" covers driving to work, to school, shopping and so on. Mainly it represents the way of transport - fast, cheap and clean. The requirements for route selection are secure communications without the high elevation and the possibility of safe storage of the wheel. When users move around the city usually take into account the parameters of the bikeway marking, safety, slope, surface, length or type of communication [20] [21]. Commuting cyclists are goal oriented; their goal is to move from A to B with minimum effort. As some studies suggest, they are not so dependent on the weather. Commuting to work and school in the Czech republic has the largest proportion in region Pardubice (7,4%), region Olomouc (6,5%) and in region Hradec Králové (6,1%). City of Prague is in last place (only 0,6%). [8][25]

2.2 Recreational cyclist

Cycling is not only useful, being the way of transport, but it is also fun. Cycling is a great way to explore: fast enough to cover the ground and provide a continual change of scene but slow enough to take it all in. Recreational cyclists are also goal oriented but their goal is not to pass the trail

with minimum time but to find clean scenic way without crossing with busy road routes, required is quality marking of trails and necessity is some service in the surrounding (restaurant, accommodation, bike storage...).

In this group there is often the requirement for cruise route with different route for departure and return [20] [21].

2.3 Children cyclist

Children cyclists are much more vulnerable than adult. It is because of less motion stability, their perception is not on the high level, they also do not predict situations as adults do and children are more prone to distraction. Safety concerns are a key reason why many parents don't let their children cycle to school. Actual injury risk is only part of the picture. Parents are feeling personal guilt if their child is injured cycling to school.

All these attributes caused today's situation when majority of children do not commute by bike to school or afternoon classes. European commission [2] declares that as many as 20 % of journeys in the rush hour period, in town; involve transporting children to school in cars.

Despite the problems with children cycling, it has to be said that cycling is a good way to encourage young people to take exercise on a daily basis and it is the way how to promote cycling for the future. Children who were used to cycling in the childhood are more likely to be commuting and recreational cyclist in the adulthood.

3 How to enhance children cycling

3.1 Infrastructure establishment

Cycling infrastructure involve mainly cycling paths (bikeways and trails) that gives cyclists the feeling of safety on the road. To January 1st 2012 was in the Czech Republic prepared total of 1903 km of cycling paths. The largest network of trails is in the capital city of Prague and in the region Central Bohemia. The large number of paths is also in Moravian-Silesian region, region Zlín and region Olomouc. [11]

Equally significant are also other cycling facilities that give feeling of safety storage of parked bike. Unfortunately bicycles are often stolen, mainly in the rush places so safety storage is necessary condition for cycling enhancement. Extended network of bicycle rental or possibility to take bike to the bus or train represent additional infrastructure. From the children cycling point of view it is necessary to emphasize two infrastructure features:

safety on the road and safe bike storage. Bikeways can be carried by roads or outside. Bikeways on the road can be marked as “with-flow” or “contra-flow” lane. These lanes can be used exclusively by cyclists or can be shared with buses, taxi or tram. Adult cyclists have normally no problem using all those on-road bikeways but children (because of the features mentioned previously) can be vulnerable. For this reason, it is appropriate to use mostly outside-road trails and where it is not possible, choose a less busy road. Safety bike storage should be provided by schools, sport centers, and other facilities providing recreational activities for children.

3.2 Actions for promotion

Promotion actions for adults are based on two main actions in the Czech Republic „European week of mobility” and „Cycling to work” action. Children education of bikeability (the ability to ride bicycle safely on the road) is now on the poor level in the Czech Republic as can be seen from the following information [12]: In the Czech Republic is currently the traffic education in nursery schools and at the first level of primary schools (elementary teaching), with a focus on the issues of safe walking and orientation on the road (Framework Educational Programme for basic education). Older children can learn how to ride well and safely mainly because of the dedication of teachers at their free time or thanks to the courses on special playground with bike transport focus. According to the increasingly unfavourable statistics of traffic accidents, this situation does not meet the needs of our society and education of bikeability has to be enhanced.

In the contrast to Czech Republic can be given comparison with Danish promotion of bikeability. The main objective of the project is to motivate people to ride a bike instead of car (especially in urban areas). Although Denmark is equipped with good cycling infrastructure in recent years, the proportion of cycling traffic decreased (between 1990 and 2009 by 14%). Support for cycling is though necessary in order to improve air pollution, public health or to effectively reduce the traffic congestion the city. [1]

3.3 Development of WebGIS portals

Popularity of cycling has led to development of large amount of bikeways and bike trails. This situation brought requirement for availability of information on cycle routes accessible on the Internet.

It is necessary to say that already exist many information systems, with data focused on cycling,

available to the general public. These systems usually use geoinformation technologies because maps and data generated using geographic information systems can be easily used and published on the Internet. [13]

Web portals serve as support for cyclists planning routes. Information published on those portals usually do not concern only cycle routes, but put them into context of other facilities with relation to cycling. These facilities include [1]:

- information centres,
- accommodation,
- possibilities of refreshment,
- transport with bike (bike bus),
- bicycle rental,
- bike service,
- hospital...

Additional information published on WebGIS portals can be [4]:

- monuments,
- tourist marking,
- background orthophotomap,
- cadastral map...

3.3.1 Examples from abroad

As the best example of WebGIS solution for cyclists can be mentioned bicycle suitability map for Broward County. In the mid 90’s Metropolitan Planning Organization developed the first bicycle suitability map based on Bicycle Safety Index Rating (BSIR) developed by Davis [9]. Today is used slightly adapted Road Condition Index (RCI) that takes into account 20 factors that affect bicycling. Information about bikeways can be displayed in the map or used as a criterion for adequate route selection. Optimization criteria can be selected from fastest, simplest, shortest, scenic and safest route. [16]

The German software-development company alta4 Geoinformatik AG developed a bike routing tool for the german tourism agency of Schleswig-Holstein. Portal gives the possibility to choose fastest, shortest or scenic (thematic) route. New features like the export of GPS data in several formats like GPX,KML or OVL are now available. [18]

3.3.2 Examples from Czech Republic

Pardubice region cycling portal - provides data at a scale of 1:1000. Bicycle paths are divided into local, regional, transregional and European. The map shows the information centres. The portal functions include zoom, scrolling image, locking recess,

selection lines or measuring distances and areas. Searching for safe passage on the portal is not possible. [1]

South Moravian region cycling portal - the most interesting function of the portal is route selection function display of points of interest. The interest points that can be displayed are cinemas, museums, cycling services, monuments and more. After positioning the mouse on the icon, description of the item is displayed. On the portal exist the prearranged routes. Each road has a verbal description and route parameters (e.g. intensity, length, elevation and other). Searching for safe passage on the portal is not possible. [7]

Cyklo server- this portal has zoom function, map shift, routes selection and distance measurement, labeling of points with description, display of elevation profile and export/import data in format GPX. This portal combine several map layers (e.g. underlying Google map, tourist map, layer with tourist attractions or layer with possible trips). After logging it is possible to save trip information. [6]

Tourist map portal Vysočina – possibilities of portal cover zoom function, map shift, setting the start, end and middle points of route. Elevation profile can be calculated, routes and areas can be measured. Buffer function is used for selection of points near selected route. In addition to cycling routes can be viewed also a route for car or walkers. Server allows to export data to format GPX and KML. The route can be sent by e-mail. [26]

Cycling South Moravia and Bike portal in region Karlovy Vary – both portals offer many types on cycling trips (just as a static text). Portal also includes interactive cycling map, the map is a possible shift, zoom, set the start line, the end of the route and point of transit. The route can be filtered based on the surface (surface to determine the different types of cycles) or difficulty (for athletes, children and other) and omit the routes that are dangerous. When planning a trip to view points of interest (cycle, cinemas, monuments, caves and other). You can also view some points of interest in 3D perspective. Both of these portals are user friendly. [5][17]

Cycling routes Ústí nad Labem - map can be zoomed in and shifted. It is not possible search routes, biking trails are only marked on the map. The map shows significant objects. Bicycle paths are highlighted in each section on a surface (the surface for road bikes, hardly passable, uneven surface and others) and the safety sectors (safe route, busy car traffic, steep ascent (descent) and others). [3]

Overall, the portals provide sufficient information to cyclists in order to be better prepared before riding. This statement applies fully for adult recreational cyclists who easily manage safe ride on the road. Nevertheless, cycling portals have some constraints that limit their usage on this type of cyclist (recreational, adult), these include the following.

1. Cycling portals display mainly marked bike trails that lead through places of interest (routes of commuting cyclists usually leads through non interesting places, without marking).
2. Information gathered on those portals does not cover data about bikeways on the trail, which makes portals insufficient for transportation with young children.

4 Proposal for utilization of WebGIS to support children's cycling

Cycling with young children, or the children themselves, requires safe routes and good planning. When planning a safe routes, parents can rely on personal experience (they can go personally through the route), or bet on geoinformation technologies to help them find a safe route. Examples from abroad show that it is possible to prepare WebGIS portal containing information about route safety (on-road or outside-road bike lanes, dangerous places...). At present, however, such a portal in the Czech Republic does not exist. Only at the universities some projects are arising that map city networks of cycle paths, including hazardous locations. As an example can be mentioned theses [24] [23]. This situation motivated prepared article. Before the proposal was prepared, we passed informal interviews with parents of young children (4-8 years old) from Pardubice city in order to find what information is missing about bikeways in Pardubice. The inquiry arose demand to display a complete map of Pardubice (in the form of internet portal), which indicates the suitability of ways for cycling of young children.

Pardubice city is very suitable for cycling because of flat terrain. Percentage of people commuting is highest in the Czech Republic 16%. Still lot of parents are afraid of cycling with small children and unnecessary use cars for delivery to school and leisure classes. We are convinced that clear comprehensible children bike suitability map on the Internet can help to solve this problem.

Basic data model would use necessary enlargement of street sections file. This file contains identification of street sections between intersections and type of road (highways, main roads, minor roads). Attribute of bikeway has to be

assigned to each section in this notation (x for non-existent, r for on-road bikeway, o for outside-road bikeway). The reason for presenting only two types of bikeways is an effort to maintain clarity of the output map. The second reason was that parents put emphasis on the distinction between on-road and outside-road bikeways, while the interaction with pedestrians was not identified as a problem.

Information about trails should be kept in separate file linked with street sections with many-to-many relationship.

Third file should contain information about dangerous places on bikeways and roads where cyclists can be injured. This file would contain ID of street section as a link.

One would expect that bikeways are built off the main roads and therefore the attribute “type of road” for bikeways would not be necessary. Nonetheless the map displayed below shows that sometimes there is interference between main road and bike way, which can be potentially dangerous place for children cyclists. Therefore, the “type of road” attribute must be saved also for bikeways, in order to display those that are outside-the road, or on a minor road.

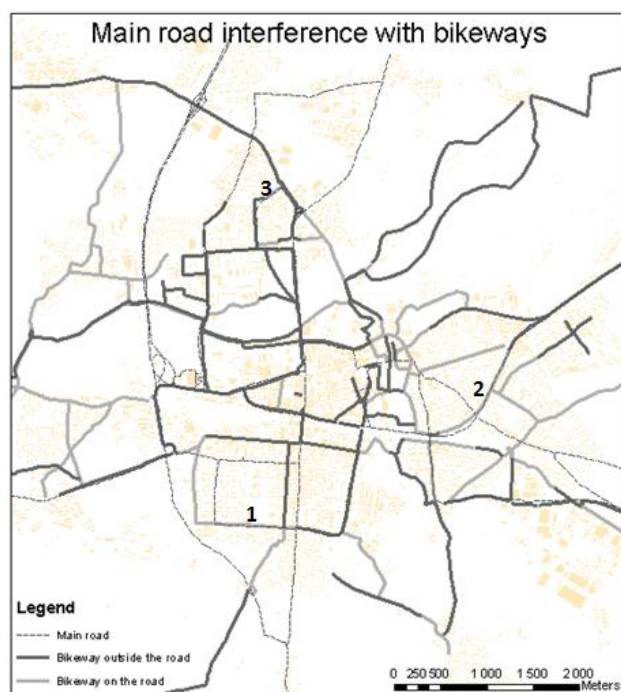


Fig. 3: Interference between main road and bikeways (three potentially dangerous places were found)

Proposed model can be easily applicable in any town under condition that the data about bikeways will be gathered and saved in digital form. Many municipalities today, does not have digital

evidence of bikeways, on the other hand, university students at their bachelor theses proved to be able to gather such data. Nevertheless, to use students for data collection, coordination should be ensured at the national level. Otherwise happens, as it is sometimes today, that one theme handle more students.

5 Conclusion

The aim of this article was to show that there are large reserves in the use of WebGIS portals as a tool for supporting children's cycling. Simultaneously, this article shows a simple way how to make available information about safe routes for parents and their children. Furthermore, there is also a suggestion how to deal with data collection and digitization.

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