

Unified GIS database on cycle tourism infrastructure

Michal Bíl*, Martina Bílová, Jan Kubeček

Transport Research Centre, Líšeňská 33a, 636 00 Brno, Czech Republic

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ABSTRACT

Bicycles are used in the Czech Republic for commuting to work and for leisure time activities. This is reflected in the cycle trail administrators' offer to make the existing network denser, design new routes, mark their courses and install a complementary cycle infrastructure.

However, extensive growth of these activities in the last years has led to the loss of overview information on the overall cycle trail network. That is the reason for producing a methodology of capturing and representing the information. A unified GIS database on the cycle infrastructure (UDCI) was created and includes a data collection system with the use of GPS, the coding of descriptive information on cycle trail segments and the administration of GIS layers in a topologic data model. The methodology of the UDCI application is demonstrated with a specific example of a cycle trail network in the South Bohemian region.

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1. Introduction

Not only is cycling in the Czech Republic popular as a transport mode, but also as one of the possible ways to spend leisure time. Bicycle use as a transport mode for commuting to work is a preferred mode for 6% of the population (SLDB, 2001). Since the terrain in the Czech Republic is diverse, this value differs in different regions. In some districts, such as Pardubice and Nymburk, which are located in lowlands, around the river Labe, 19% of the population uses a bicycle for commuting (Martinek, 2007, p. 64).

The use of bicycles for cycle tourism is not systematically monitored, although cycling is a very popular way to spend holidays and leisure time. According to the study INCOMA GfK (2007), cycling is regularly practised by 10% of the population, while another 10% practise cycling irregularly. Similar to other European countries where cycle tourism is on the rise (e.g. Ritchie, 1998), attention is currently being paid to building a cycle infrastructure in the Czech Republic. To improve the quality of services for cycling tourists, a system of safe cycle trails, which provide access to the regional cultural and natural points of interest, is being defined. Cycle trails are marked trails running along roads, including local, field and forest roads. They have both a transport as well as a recreational purpose. A part of the network follows the idea of the Greenways system (e.g. Gobster, 1995; Ryan, Fábos, & Allan, 2006; Toccolini, Fumagalli, & Senes, 2006; Turner, 2006).

The organization which deals with the cycle trail marking is the Czech Tourist Club (KCT, <http://www.kct.cz/>). They have been building a complex system of walking tourist trails in the Czech Republic since 1889. Cycle trails have been marked in a similar way since the 1990s. The approximate total length of all marked cycle trails in the Czech Republic on 1 December 2010 was 39,000 km.

There are two ways of marking cycle trails. Where cycle trails run on roads, road signs and marking are used. Where they run on the terrain, trail marks are applied on natural or artificial surfaces such as trees, rocks, building walls, etc. The established colour design of red, blue, white and green, with a yellow stripe at the bottom and at the top, mark these trails. Supplementary markings, particularly at junctions and crossroads, use small yellow boards with additional information about the destination and its distance in kilometres. These are marked in two ways (Fig. 1).

When determining the course of cycle trails, attention is paid to cyclists' safety and the need to ensure traffic flow. Therefore, when designing the course of cycle trails within the Czech road network, the maximum focus is on the inclusion of secondary roads with lower motorised vehicle traffic volumes, which was set to the maximum of 2000 vehicles/day (Bílová, Bíl, Kala, & Martinek, 2008, p. 64). A gradual systematic release of roads from the network of cycle trails and their replacement with safer trails exclusively for cyclists is a desired trend, since cyclist accidents with fast driven motor vehicles are the most frequent cause of fatal accidents in the Czech Republic (Bíl, Bílová, & Müller, 2010).

Apart from KCT, the building of cycle trails is also provided by local administrations, which often leads to problems in work coordination and thus in the homogeneity of their provided data.

* Corresponding author. Tel.: +420 602 361 748; fax: +420 548 423 712.
E-mail address: m.bil@seznam.cz (M. Bíl).

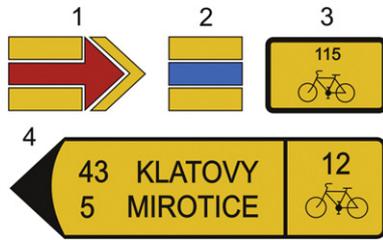


Fig. 1. Examples of cycle trail marking in the CR. 1 and 2 – strip marking of cycle trails in the terrain involves application of colour onto a firm background, mostly on tree trunks. 3 and 4 – bicycle traffic signs placed on poles at the side of roads. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

This disorderly development had negative effects for example at administration borders, where in some cases the cycle trails do not follow each other. The situation became unsustainable over time and a new approach of creating a unified system of cycle trail markings at a national level and mapping of the existing cycle trail network was created. *The Unified GIS Database of Cycle Infrastructure in the Czech Republic* (UDCI).

UDCI methodology aims to:

1. Create a unified system of cycle trails in the Czech Republic

The extent of the whole network, the course of individual trails, points of parallel courses and systematic numbering of cycle trails will be determined. Administrators will need to optimize the locations of the supplementary cycle infrastructure, plan for repairs, etc.

2. Improve cycle traffic and cycle tourism safety

Mapping will make it easier to identify locations where the cycle trails run along unsuitable roads with high volumes of motorised traffic or other obstacles that are hazardous for cyclists. At the same time, the frequent use of unpaved roads in natural areas by cyclists may cause more intensive erosion and also have an impact on local ecosystems (e.g. Lynn & Brown, 2003). The mapping of these locations will help the administrators plan repairs and reduce these effects through actions like reinforcing cycle trail surfaces.

3. Support and promote cycling and cycle tourism

A unified and interconnected system of cycle trails will be more attractive for cyclists and cycling tourists, who would not need to spend extra time planning a route between unconnected cycle trails. The information in the database will also contain data on the attractiveness to tourist and interesting sites along a given cycle trail. The data will be provided to cartographic organizations as a basis for map printing and cycling guidebook production.

Appropriate cycling databases and technical maintenance of the cycle trail equipment is the responsibility of regional authorities. The further text shows the principle of UDCI and its application with an example of a mapped cycle trail network in the South Bohemian region.

2. Methodology

The UDCI is a system composed of two parts:

- Mapping and data collection on cycle trail routes and locations of the technical infrastructure (bicycle stands, information

boards, picnic sites, etc.) for which GPS devices and a coding system for the collected data can be used.

- Processing GPX files from GPS devices and the creation of a topological data model in GIS with a unified system of filed data.

Data on the cycle infrastructure are entered into UDCI in three ways. The most important is the actual cycle trail network field mapping using GPS devices. The second is importing the existing data from various sources, such as existing shapefile format files (ESRI, 1998) from managers or organizations that have carried out the marking of cycle trails. The third is represented by an analyses made in GIS on data provided by the first two ways. This particularly includes the calculation of the length of sections, the identification of parallel sections, intersections and the insufficient, excessive or damaged marking of cycle trails, etc.

For each object in the database, attributed data are assigned that differ according to the geometry of the element they describe:

2.1. Cycle trails

These data refer to the *general* character of a cycle trail and are listed in the summary table for all cycle trails. The geometry of cycle trails is generated as a sequence of individual sections (see below). Cycle trail parameters are listed in Table 1.

2.2. Cycle trail sections

The basic element of the topological cycle trail data model is a *section*. It is defined as the linear unit of a cycle trail route that is homogenous in terms of attributes and geometry. A given sequence of sections makes up a specific cycle trail. A new section originates when any mapped parameter changes (Table 2).

Table 1

List of attributes applied on cycle trails. These data are filled up only during data processing at the desk and they relate to the entire route.

Parameter	Value	Note
<i>Cycle trail index</i>	Cycle trail number Other indexes No index	Unique in the Czech Republic. Usually a logo, title, etc. Assigned in GIS.
<i>Cycle trail title</i>		<i>The chain describing the usual title of a cycle trail. In case a cycle trail has no title, an empty character is made.</i>
<i>Cycle trail length</i> <i>Cycle trail category</i>	Long-distance Regional Local	<i>Value in km generated in GIS.</i>
<i>Cycle trail marking type</i>	Traffic Stripe Others, non-standard	<i>Describes the way of marking a cycle trail in the field.</i> Signs and boards. Typically markings in paint on trees.
<i>Cycle trail course</i>		<i>Briefly describes where a cycle trail runs, providing a list of important sites or important orientation points (text box with a list of destinations).</i>
<i>Implementation status</i>	Planned route Road under construction/markings Implemented	

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