ELSEVIER
Available online at www.sciencedirect.com
SciVerse ScienceDirect
Procedia - Social and Behavioral Sciences 48 (2012) 589 – 596
Procedia
Social and Behavioral Sciences

Transport Research Arena– Europe 2012

SAFECYCLE: e-safety applications for safe cycling in Europe

Ronald Jorna[a*], Henk Jan Zoer[a]

Mobycon, PO box 1149, 8001 BC Zwolle, The Netherlands

Abstract

In the years to come urban areas in the EU face the challenge of making transport sustainable in terms of environment and competitiveness. Cycling is a perfect means of transport in urban areas. Cycling is the most energy efficient and environmentally friendly mode of transport, and cycling is suitable for short distances. However, cyclists are considered as vulnerable road users. Therefore, actions to promote cycling in cities should go together with improving road safety. The Safecycle project team is convinced that decision makers have to look at intelligent solutions to improve the safety of cyclists. ICT can be used to develop intelligent applications that assist cyclists and other road users to avoid, prevent, or mitigate accidents. The main goal of the Safecycle project is to identify and analyse intelligent applications that will enhance the safety of cyclists in Europe, which are called e-safety applications. This paper gives a first state-of-the-art overview of e-safety applications for cycling, showing various types of applications, their potential impact, and different target groups.

Keywords: cycling, road safety, ICT, ITS

[*] Corresponding author. Tel.: +31 (0)38 - 422 57 80
E-mail address:.r.jorna@mobycon.nl

doi:10.1016/j.sbspro.2012.06.1037

1. Introduction

Of all traffic fatalities in the European Union approximately six per cent are cyclists (ERSO 2009). This percentage slightly increased since 2000. Apart from general factors, such as speed and weight of motorised vehicles (Keigan et al 2009), the main causes of cycling accidents are lack of visibility and lack of vehicle control. Data suggests that countries with higher cycling investments tend to have higher cycling rates and lower cycling mortality rates (ERSO 2009). Due to a higher amount of bicycle trips and kilometres cycled, cyclists are perceived and expected in traffic (Hydén et al 1998). It makes their coexistence with other road users mutually smoother.

There are many traditional ways to reduce the risk of cycling accidents, such as building separate cycling infrastructure, increasing the visibility of cyclists and reducing car speed where cyclists and cars share the same road. The Safecycle project (co-funded by the European Commission – DG MOVE) is taking a different and more innovative approach by investigating how intelligent applications can be used to increase the safety of cyclists. One of the Safecycle objectives is to identify these applications, which are called e-safety applications.

In this paper we start with a definition of e-safety applications for cycling. Thereafter we briefly describe the Safecycle project, followed by a deeper look into the various types of e-safety applications for cyclists. Finally, we look at the potential contribution of these systems to improve road safety, either by avoiding accidents or by reducing the impact of accidents.

2. E-safety for cycling

E-safety applications are related to Intelligent Transport Systems (ITS) and Information and Computer Technology (ICT). ITS are a complex of technologies that are derived from ICT and applied to transport infrastructure and vehicles. More specifically some of the individual technologies are wireless communication devices, geographic information systems or electronic sensors (Stough 2001). With ITS, it is possible to improve cycling safety rates. Especially in cultures where traffic behaviour and infrastructure are not cycling-friendly yet. In this paper, we have combined ITS and ICT for safer cycling into e-safety for cycling.

Contrary to the automotive sector, the bicycle industry has incorporated e-safety only to a very modest extent. Some examples of existing e-safety applications for cyclists are GPS devices or electronic rear view mirrors. However, most of these applications are aimed at increasing cycling comfort. It seems that e-safety applications for cycling is a green field domain. By improving the level of collaboration between Europe’s ITS suppliers, bicycle manufacturers, public authorities, and cyclist’ associations, it should be possible to increase the safety of cyclists in Europe. This is also in line with the European ITS action plan (European Commission 2011).

With millions of bicycle trips a day in Europe it is highly justified to carry out research in which knowledge about e-safety applications for cycling is spread, and to promote a wider uptake of e-safety applications. This is exactly what the aim is of the Safecycle project: increased knowledge and awareness about e-safety applications for cyclists.

3. The Safecycle project

The Safecycle project brings together three different fields of expertise (see figure 1):

- Cycling
- Road safety
- ICT

Figure 1: Positioning of Safecycle

The expected outcome of Safecycle is a comprehensive overview of the state-of-the-art in e-safety for cycling, together with the identification of applications with the best safety potential. The identification is based on a SWOT analysis. A SWOT analysis is used to evaluate the strengths, weakness, opportunities and threats of each selected e-safety application. Strengths are internal attributes of the application that are helpful to the achievement of more safety, whereas weaknesses are internal attributes of the application that are harmful. Opportunities are external conditions that are helpful to the achievement of more safety. Threats are external conditions that are harmful to the achievement of more safety (Hay & Castilla 2006). A multidisciplinary team representing a broad range of perspectives carries out the SWOT analysis. In the end all SWOT analyses are brought together. The ten applications with the best results will be selected for an impact assessment.

After identifying the impact of e-safety applications on safety for cyclists the project focus moves to developing a research and demonstration agenda. Setting up a Safecycle platform is one of the last project steps. The platform will function as a vehicle for matchmaking between relevant parties and for communicating results. Possible platform members are:

- Governments and public administrations;
- Associations and networks;
- Industries;
- Developers interested in cycling and safety.

Safecycle started in June 2011 and finishes in November 2012. Figure 2 shows the project structure.

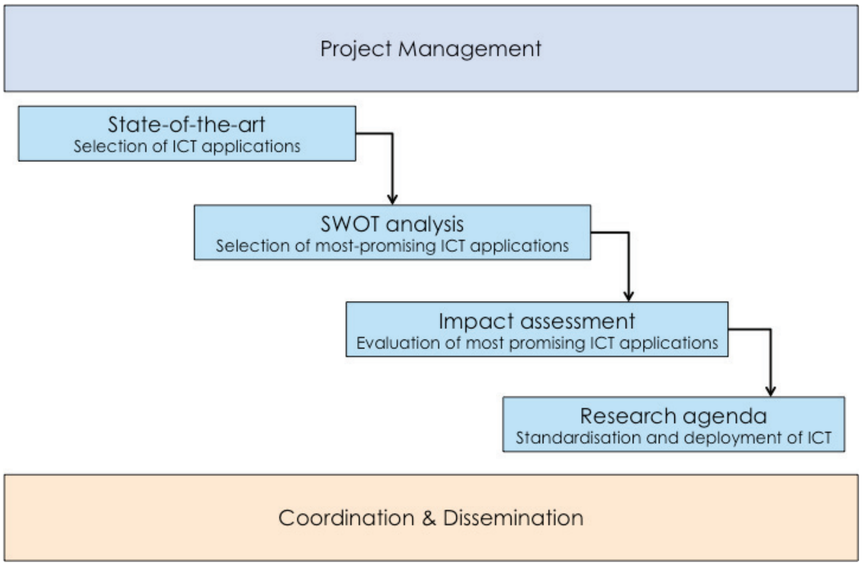

Figure 2: Structure of the SAFECYCLE project

4. A first inventory of e-safety applications

E-safety applications are developed to help cyclists avoid, prevent, or mitigate accidents. While collecting data and information about e-safety applications it became clear that the applications should be divided into five different categories:

- E-safety applications on cyclists.
- E-safety applications on bicycles.
- E-safety applications in other vehicles.
- E-safety applications in infrastructure.
- E-safety applications on the web.

At this moment a first inventory of e-safety applications is ready. In the next section we describe the results. Per category an example is given. The selection is based on what the writers find most promising at this moment. Further analysis is part of the next project steps. The overview does not intend to give a complete picture. It gives a first impression. The maturity of the applications varies from 'initial ideas' to commercially available applications.

4.1. E-safety applications on cyclists

In this category we find clothes or accessories that can be attached to the body of the cyclist. An example of an e-safety application on cyclists is the 'speed vest' (Clark & Hansen 2011). When the cyclist wears the vest, it shows the actual speed of the cyclist at the back of the vest. As a result, the visibility of the cyclist improves and other road users are able to anticipate better on the speed of the cyclist.

4.2. E-safety applications on bicycles

In this category we focus on applications on or integrated in bicycles. There are interesting varieties of applications directly related to the bicycle. We grouped the applications in five clusters, related to: power supply, physical problems of the cyclist, design of the bicycle, communication with other road users, and general road safety issues. We take an application related to physical problems as an example. Physical problems may lead to lower use of bicycles, although it is not always necessary. From a "design for all" point of view, bicycles should be available for all kinds of users, also with often occurring impairments like hearing or stability problems. An application like HindSight (Cerevellum 2009) offers a solution for people with head movement problems by using a rear camera and a display on the steer.

4.3. E-safety applications in other vehicles

This category focuses on applications that are part of vehicles. We grouped the applications as follows: applications that mitigate the impact in case of an accident, applications that are able to detect obstacles or vehicles that are difficult to see, speed, and assistance in difficult situations. We take the airbag for vehicles as an example of an application that mitigates the impact in case of an accident. The Dutch research organization TNO is developing an airbag for vehicles meant to protect cyclists in a collision. The focus is not on the users of the car itself, but on cyclists. The airbag system is applied to the whole windscreen and parts of the side doors, and is activated during a collision (TNO 2012), thus reducing the impact for the cyclist.

4.4. E-safety applications in infrastructure

This category includes applications that are part of road infrastructure used by cyclists. We divided these applications in the following clusters: cycle lanes, intersections, speed, and detection of danger and warning systems. We take an application for intersections as an example. An application suitable for countries with a lot of rainy days is a rain sensor that allows faster green for cyclists when it rains. This can be found for example in the city of Groningen in The Netherlands. Reduced waiting times increase cycling comfort in general, and also enhances the safety of cyclists. It is generally expected that cyclists commit less red light offences when a rain sensor is available at intersections with traffic lights.

4.5. E-safety applications on the web

We divided this category into web applications and applications for nomadic devices. Applications for nomadic devices are specifically developed for smart phones or tablets. Web applications are developed for desktop computer use. A lot of web applications have an educational or informational purpose. There are different route planners on the market with a strong focus on safety aspects during the trip. An interesting example is CycleStreets (CycleStreets 2012), a combination of a website and a smartphone application. The user obtains information about distance, travel time and the amount of burned calories. Apart from that, information is given about dangerous locations along the route and busy spots that require special attention. The application is interactive as users can upload pictures of and comments about dangerous locations.

Apart from the above five categories there are also combinations possible. The combinations are called cooperative systems. Cooperative systems are systems by which a vehicle communicates wirelessly with another vehicle (V2V – vehicle-to-vehicle communication) or with roadside infrastructure (V2I – vehicle-to-infrastructure communication, and I2V – infrastructure to vehicle communication) with the ultimate aim of achieving benefits for many areas of traffic management and road safety (POLIS, 2010). An example related to Safecycle is a system where bicycles are transmitting signals, which are received by intelligent infrastructure. The signals are processed and transmitted to other vehicles or traffic signs. This is a typical case of V2I.

5. Aim and target group of e-safety applications

In the above classification it has already been touched upon: some e-safety applications are aimed at avoiding an accident, whereas other e-safety applications are more aimed at reducing the impact of a collision. It is also possible that applications reduce both the chance and the impact. This distinction gives a good opportunity to compare the various applications.

In addition it is also interesting to see for which target group e-safety applications have the highest potential effect. For example, we can distinguish between young children (blind spot systems), teenagers (reducing red light offences) and elderly people (safer cycling routes). Some applications are suitable for all types of cyclists, such as the bicycle airbag for cars. For producers of e-safety applications it is important to know the size of their potential target group and thus their potential market. From a socio-economic point of view it is important to know the specifications and the size of the target group in order to estimate the impact of an e-safety application on road safety.

Similarly, it is interesting to analyse what type of accidents can be avoided. Here one can think of accidents due to poor visibility of cyclists, cyclists who are not detected by vehicles, red light offences and unawareness of unsafe situations. Examples are depicted in figure 3.

E-safety applications to avoid accidents	Example 1	Example 2
Visibility of cyclists	Intelligent bicycle lights	Virtual cycle lanes
Cyclist detection	Blind spot detection	Night view systems
Bicycle friendly infrastructure	Bicycle preference traffic lights in case of rain	Anticipating traffic lights
Internet applications	Safe journey planner	Map unsafe situations for cyclists

Figure 3: E-safety applications to avoid accidents

By linking these factors with the aim of the e-safety application (reducing chance vs. reducing impact), a first picture can be drawn of the potential contribution of e-safety applications to the safety of cyclists (see figure 3). The estimated impact is based on an expert opinion of the Safecycle project partners, taking into account the size of the target group per application, the frequency of accident causes and the type of impact.

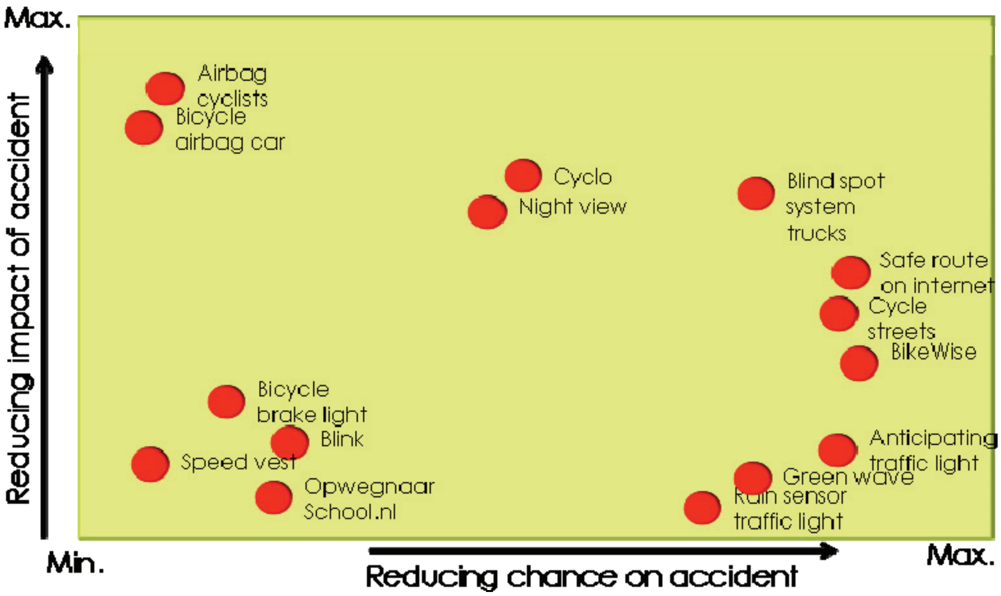

Figure 3: Potential impact of e-safety applications on the safety of cyclists

Figure 3 gives a first impression of the direction in which Safecycle is moving. In the course of the project the impacts will be quantified or qualified. At that time we are able to draw a clear picture of the potential contribution to safety of e-safety applications.

6. Future activities to make SAFECYCLE a success

The overview of state-of-the-art e-safety for cycling and identifying the potential role of e-safety applications is only a first step in making cycling safer. Raising awareness and matchmaking between relevant parties is an important next step. Dissemination activities are an important part of the Safecycle project. Workshops, interviewing experts, newsletters, and building the Safecycle platform are on-going activities throughout the project. Finally, a Safecycle conference is planned for October 2012.

Acknowledgements

The authors want to acknowledge Marjolein de Jong (University of Hasselt - IMOB), Antonino Tripodi (University of Rome - CTL) and Radomira Jordova (CDV) for their contributions to the Safecycle project. Without their contributions this paper would not be written.

References

Cerevellum (2009), "Hindsight". Cerevellum.com. http://www.cerevellum.com/#/home (21 January 2012).

Clark, B. and M. Hansen (2012), *Speed Vest.* Minneapolis: Clark & Hansen.

CycleStreets (2012), *CycleStreets.* CycleStreets.net. http://www.cyclestreets.net/ (21 January 2012).

European Commission (2011), *Intelligent Transport Systems in action.* Luxembourg: Publications Office of the European Union.

European Road Safety Observatory (ERSO) (2009), *Pedestrians and cyclists*. Brussels: ERSO.

Hay, G. J. and G. Castilla (2006), *Object based image analysis, Strengths, Weaknesses, opportunities and Threats*. University of Calagery: The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences.

Hydén, C., A.Nilson & R. Risser (1998), *WALCYNG. How to enhance WALking and CYcliNG instead of shorter car trips and make these modes safer.* European Commission: WALCYNG.

Keigan, M., R. Cuerden and A. Wheeler (2009), *Analysis of police collision files for pedal cyclist fatalities in London, 2001 – 2006.* London: Transport Research Laboratory.

POLIS (2010), *POLIS position paper on cooperative systems*, Brussels: POLIS.

Stough, R. R. (2001), *Intelligent Transport Systems.* Cheltenham: Edward Elgar Publishing Limited.

TNO (2012), *SaveCap.* Safecap.org. http://www.savecap.org/ (21 January 2012).