B-ITS (Bicycles and ITS)

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Abstract

C-ITS (Cooperative ITS) is a well-known term and concept in the ITS domain. It can be seen as the 'new' ITS connecting vehicles to infrastructure and vehicles to vehicles with wireless technologies. B-ITS is a relatively new domain which encompasses all ITS systems and service in the cycling domain, to make it safer, more attractive, more efficient. In this paper we present the Bicycle Pyramid, based on Maslow's pyramid, and how it can be used to link ITS systems and services to fulfil the cycling needs. This is followed by a description of the challenge to integrate cycling and ITS, and the approach followed in the BITS project, a project focussed on the implementation of ITS in cycling in various European cities.

Keywords:

ITS, cycling, data

Cycling as a green transport solution

40 million adult EU citizens cycle daily, a further 78 million monthly. In cities like Copenhagen (DK) cyclists form over 30% of daily travelers and in Zwolle (NL) this is 48%. There is also a wave of innovation with the rapid growth of Pedelecs (Pedal Electric Assisted Cycles). Sales in the EU were around 1.3 million in 2015, rising from 500,000 five years ago. Cycling is now an alternative transport choice competing with cars and public transport in the 20km journey range (and longer if combined with Public Transport) and the EU's fastest growing form of e-mobility.

Cycling is a major part of the mobility mix in the north-western Europe (and to a lesser extent in southern and eastern Europe), contributing to economically vibrant, less congested, healthier and low emission cities. Increased use of the bicycle is one of the best ways to combat the negative impacts of other persona. According to Fietsberaad (2010), a 10% increase in cycling relieves congestion by 11-15% and according to ECF the total amount of CO2 emission per km per bike is 21gr compared to 271gr by the average car.

Bicycle Pyramid

Given the above, a modal shift from car to bicycle is therefore desirable. To realize this shift, insight is needed in what factors determine one's choice for a certain mode of transport. Derived from the Maslow's hierarchy of needs (Maslow Pyramid) and Herzberg's Two-factor theory, the Province of Overijssel has developed a similar hierarchy of needs for cyclists (Koersdocument Fiets Overijssel, 2014), showing the factors influencing modal shift from car to bike (figure 1).

Firstly, cycling has to be safe and reliable and should be (relatively) fast. Next, cycling should be easy, e.g. clear routes, easy bicycle parking, etc. Once these levels have been matched, comfort and user experience become important. Levels 1 and 2 are 'dissatisfiers', level 4 and 5 are 'satisfiers', and level 3 is in-between.

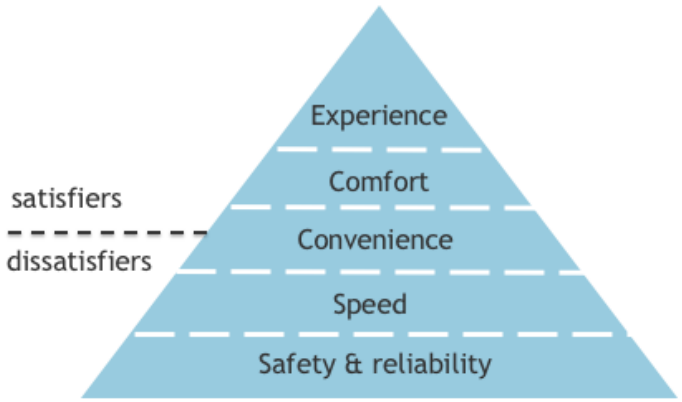

Figure 1 – Bicycle Pyramid

Bicycle Pyramid and Smart Cycling

The Bicycle Pyramid originally consists of five steps. For the purpose of the B-ITS concept, some needs have been grouped, resulting in the following three groups:

- At the highest level: Comfort and Experience
- In the middle: Speed and Convenience
- At the lowest level: Safety and Reliability.

Traditional cycling policy often aims at physical measures (e.g. infrastructure and parking). But a Smart Cycling Strategy uses the power of Intelligent Transport Systems (ITS) to address the Bicycle Pyramid needs! For example: collision warning for bikes will increase the safety of the cyclist and smart bicycle parkings will make finding a parking place in a large bicycle parking more convenient.

There is currently no coordinated effort to bring cycling in to the field of ITS, even though there are innovators and scalable pilots at local, regional and occasionally Member State (MS) level creating valuable localised data. EC's ITS Action Plan has published delegated acts on updating real time transport data and multi-modal transport information, in which MS will have a National Access Point

(NAP) where data will be collated, assessed and made accessible for re-use. It has also given a mandate to the European Standards Organisation to develop and review Multimodal Travel Information data and services standards. The B-ITS concept responds to the directive, by contributing to the NAPs and linking it to the CentralDataHub (CDH).

Governments seek ways to encourage travellers to take up cycling. ITS improves the safety, reliability, speed, convenience, comfort and experience of cycling. In the B-ITS concept the idea is to close the data loop on cycling data and open up these data for cyclists, policy makers and other stakeholders (e.g. app developers or other businesses). Through applications for cyclists (e.g. interactive/smart traffic lights, nudging apps, smart routing and parking, tracking) cycling will become a more attractive transport mode. At the same time, these ITS applications will generate valuable data, which feeds back directly to cyclist. In addition, these ITS systems will produce data on cyclists and infrastructure utilization, which provides valuable input for cycling policy. Improved policies will then attract more cyclists and generate even more (floating) bike data, thus closing the loop (see figure 2).

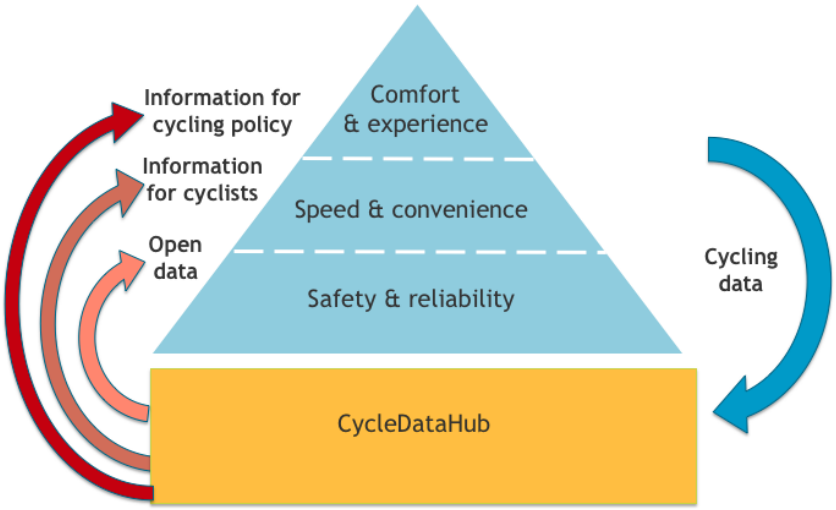

Figure 2 – Bicycle Pyramid for the B-ITS concept

The challenge: integrating cycling and ITS

Although the benefits of cycling are well accepted, local authorities lack information on cycling (behaviour, intensities, safety, parking). A large proportion of cyclists' accidents are not recorded (InDev project, 2015). In order to develop a proper cycling strategy, this information is urgently needed. The lack of cycling data does not only affect the uptake of cycling but also the multi-modal transport system as a whole. As cycling has a huge potential on long distances if combined with public transport (in the Netherlands more than 40% travels to the train by bike) while the availability of data is very poor compared to other modes. Therefore, the lack of cycling data impedes other sustainable modes as well. There are wider structural barriers that limit exploitation. Localized data is stuck in proprietary systems, collected at the city level, not even nationally or at European level. With ITS industry being increasingly European and global, cycling will thus be neglected as a mode. The retail sector, employers and city

departments cannot access or exploit open data sets. Issues of privacy and ownership are not addressed on a consistent basis. Data is not integrated with ITS from other modes – essential for Mobility as a Service (MaaS), ITS and network planning. As there is no market advantage to collect user data for travellers who do not buy tickets, new commercial services are potentially conflicting with policy objectives. The health sector knows the importance of enhancing physical activity and enabling travellers to reduce exposure to air pollutants but initiatives are not commonly allied to transport.

Integrating cycling with ITS supports a number of European policies. The BITS project contributes to EU's transport policy (Whitepaper, 2011), aiming at 60% reduction of CO2 emission by 2050. Similarly it is fully in line with the ITS Action Plan (2008) that states 'it is high time for Intelligent Transport Systems to play their due role in enabling tangible results to emerge', and the ITS Directive 2010/40/EU which aims at accelerating the deployment of ITS across Europe. It will also strengthen the EU urban mobility policy (Urban Mobility Package), by 'sharing experiences, show-casing best practices, and fostering cooperation', promotion of competitive and resource-efficient urban mobility (COM(2013) 913 final) and deployment of ITS in urban areas (Expert Group on ITS for urban areas). Through the CycleDataHub (see below) it also allows for better access to and re-use of data, thus unlocking the potential of transport data as described in the Public Sector Information (PSI) Directive, the Digital Agenda for Europe and the revised Open Data Strategy.

Early B-ITS initiatives

In the past some initiatives have been taken to integrate cycling and ITS. For example, ECF and its Cycling Industry Club have made a priority of getting cycling on the agenda at among others the ITS World Congress in Copenhagen. These events helped to integrate cycling with broader ITS and multi-modality. Other projects on open data and big data on cycling are the Smarter Cycling Initiative, Smart e-bikes and Bike Data Project. EU projects SAFECYCLE and VRUITS give good examples on how to increase cyclist's safety through ITS. ITS will boost cycling, with good examples of health arguments and personalised travel planning advice in the SWITCH project and gamification and social media in the B-Track-B project. The results of SHARE-North can be used to see how ICT helps to promote bike sharing schemes. ALLEGRO looks at the role of ICT on choice behavior.

The BITS project and its ITS pilots

The Bicycle Pyramid forms the theoretical basis of the BITS project that was launched in January 2019, which is partly funded by the Interreg Vb North Sea Region programme of the European Commission. Six demonstration sites have different levels of bicycle infrastructure, bicycle use and bicycle policy. This means that these demonstration sites will have different priorities on the Bicycle Pyramid.
BITS will stimulate the take-up of cycling - a green transport solution for personal transport - as it will:

1. **Apply ITS** to directly improve the bike-trip, stimulating the take-up of cycling.

2. **Create a CyclingDataHub**, create added value through bringing together various cycling data in one virtual platform.
3. **Collect, process, manage and use these cycling data** to get a better insight in specific needs of cyclists to drastically improve cycling policies, anchor cycling in the broader mobility policies and share this data to be used for a multi modal future.
4. **Reach out to other cities** (outside the partnership), to existing cyclists and non-cyclists.

The project will bring together the many actors and interested parties in the cycling data eco-system with the result that an architecture will be created for dispersed cycling data sets to be aggregated into a valuable, information rich and exploitable CyclingDataHub.
Using the results of the project will have long term impact on EU goals:

- Increased levels of cycling and safer cycling through the integration and exploitation of data.
- Improved competitiveness of EU businesses in the sector, especially small and medium-sized enterprises.
- Improved broad exploitation of ITS by integrating cycling with other transport modes.

ITS implementations
The BITS project has 4 types of ITS implementations, divided across 6 demonstration sites:

- Information to cyclists (Green)
- Interactive ITS (Purple)
- Infra-based ITS (Orange)
- Bicycle data collection (Red)

An overview of implementations, sites and expected effects is given in the following picture (figure 3). As can be seen in figure 3 and table 1 below, the four groups encompass a total of 23 demonstrations. Each type is demonstrated in at least 3 cities/regions, and for each type at least 3 different applications are demonstrated, each fitted to the local needs and circumstances. But at the same time each application will provide data in a standardized format to the CyclingDataHub. This data will be analysed and visualised through a GIS-application.

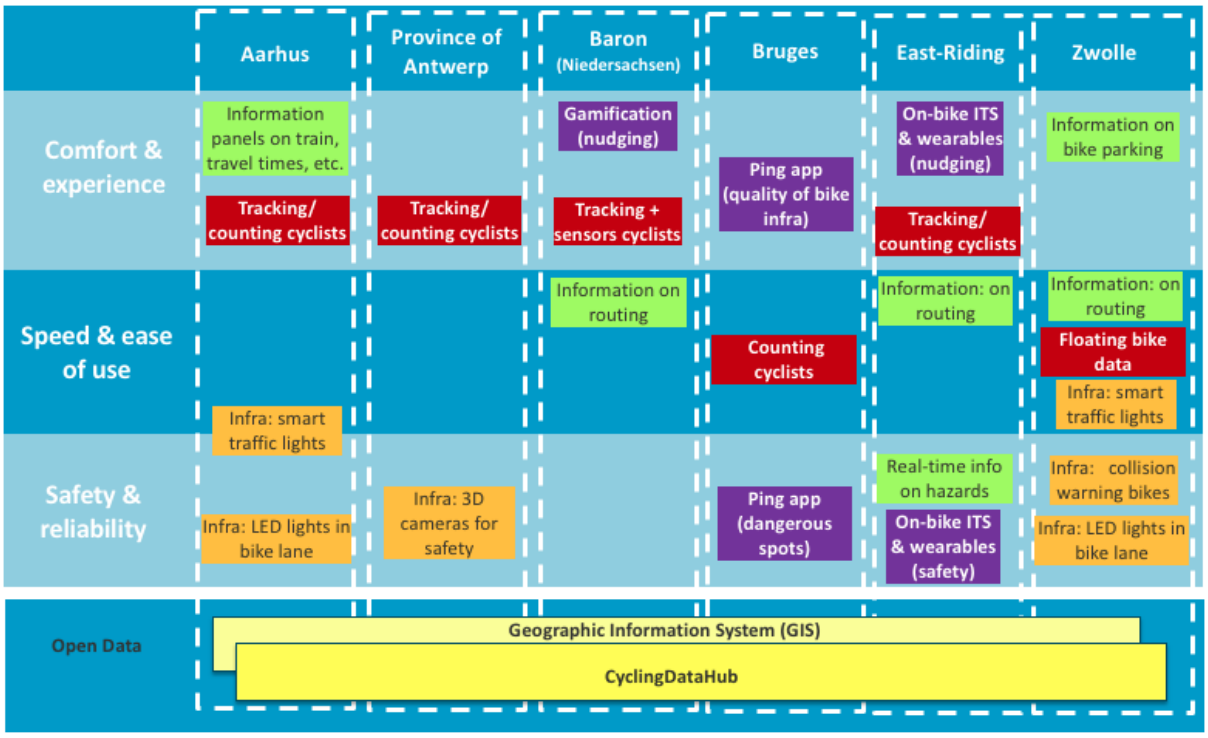

Figure 3 – B-ITS implementations in the BITS project

Table 1 – B-ITS categories in the BITS project

ITS category	ITS demonstrations
ITS implementations that are infra-based systems:	• Smart traffic lights (2) • LED in bike lane (2) • 3D cameras for safety (1) • Collision warning (1)
ITS implementations that are focused on collecting bicycle data:	• Tracking cyclists (4) • Counting cyclists (1) • Floating Bicycle Data (1)
ITS implementations concern information provision to cyclists:	• Information panels on train, travel times etc. (1) • Information on routing (3) • Information on bike parking (1) • Information on hazards (1)
ITS implementations that are interactive systems (e.g. apps):	• Ping app - for safety and quality of bike infrastructure (2) • On-bike ITS and wearables - for safety and nudging (2) • Gamification – nudging (1)

Common need on cycling data

The public authority partners share the need to understand the use of their cycle infrastructure and they all started collecting cycle data to see the potential and to increase the number of cyclists, frequency of

cycling, distance cycled and traffic safety. This common need on data to understand the potential of cycling (also in relation to multimodality), their search on the right technology to grasp the behavior and needs of cyclists, to understand the demand for ITS systems by cyclists, and the lessons learned out of cycling history are a joint asset of the BITS project.

CyclingDataHub (CDH)

The project's approach is to use ITS demonstrations that will provide localized cycling data sets which will be aggregated and integrated into a CyclingDataHub (CDH). It will provide Big Data for business use, policy makers and integrated into transport planning and intermodal services such as MaaS.

The aim of the joint CDH is to bring together the various data from the ITS applications across the various cities, to process and analyze these to look for added value. A standardized data format will be formulated and (where possible) the data will be published as open data. The CDH will also be input for the evaluation of the ITS pilots.

The project proposes the strategic leap – the localized cycling data must be brought into structured processing methodologies to deliver reliable and replicable insight. It must become Big Data and it must become Open Data, meeting the challenges set out in the overview. This has never been done on this scale before. For the SMEs involved the project has the effect of creating a virtual ecosystem to share expertise and access support.

The following image (figure 4) shows the architecture of the CDH. One the right hand, BITS pilots will provide data that will be linked to the CDH, aggregated, integrated, analysed and visualised. On the left hand, the CDH serves as an open platform for all partners and stakeholders to state their available data and provide links to these data so interested parties know which data is available and where they can get it. This is presented in the bottom row.

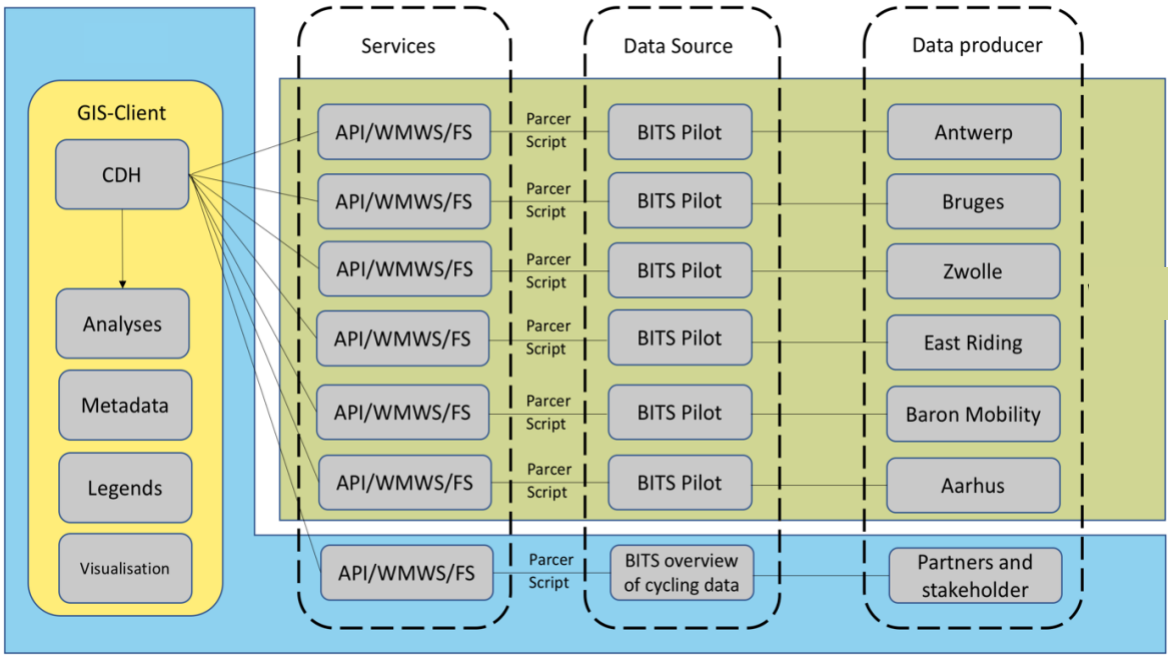

Figure 4 – CycleDataHub

The presentation

During the presentation we will elaborate on the concept of cycling and ITS and de state of the art within this concept. Experiences from the BITS project so far will be shared and reflected on. Future steps will be explained, and participants will be invited to stay involved in the project.

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