Recommendations Report

University College VIVES

26/12/2022

Authors: Griet Vanwynsberghe, Rebecca Thys, Hans Vermeersch
Project coordinated by Province of Overijssel

This project is supported by the Interreg North Sea Region Programme (Priority 4, Promoting green transport and mobility) of the European Regional Development Fund of the European Union.

Content

1. Introduction

In this report we have formulated recommendations for future projects based on the experiences with the different pilots during the BITS project. We do not primarily focus on recommendations on individual pilots as those have been discussed in the individual pilot reports, but we try to aim at more general recommendations for each category of pilots.

We observe three major categories of pilots. A first category is pilots that aim at directly informing or motivating individuals. These are for example the pilots using motivational or informative signs next to the road, pilots that created apps to motivate people to cycle and implementations that focus on giving access to bikes trough a renting or library system.

A second category concerns pilots that aim at improving infrastructure to increase safety, speed or comfort for cyclists and by doing so indirectly hope to add to the motivation of individual cyclists. It involves for example pilots exploring the use of smart lighting for supporting the safety and comfort of cyclists while also considering the ecosystems and the animals living in the area. It equally involves the pilots trying to make intersections safer by using cameras to evaluate the risk for accidents or near accidents or by placing signs and by installing smart traffic lights that interact with cyclists. The BITS project equally includes pilots that aim at creating the speed for cyclists by shortening the waiting time at traffic lights and to add to the comfort of cycling by installing digital signs to inform about the available parking facilities in the city.

A third type of pilots focusses on data collection to inform and influence cycling policies that should facilitate and motivate people to use their bikes. Data are collected in different manners, by way of various types of sensors: counting sensors, light and temperature sensors, sensors that detect movement or particulate matter sensors to measure air quality. Data are equally collected by GPS and by cameras and 3D cameras. Some pilots aim at aggregating different types of data and still other to visualise data.

In formulating recommendations, we think of future projects. We aim specially to formulate some recommendations that allow us to better design future ITS implementations for cycling. The recommendations described in this report are based on the results of the different pilots and the experiences the different pilot stakeholders had during the process. Project partners for each pilot gave feedback on how they experienced the experiment, either during the recommendation workshops or by responding to a form distributed among the project partners. Some remarks have to do with the design of the pilot, or the technology developed, but others are equally more practical in nature and discuss the logistics or the need for collaboration or communication.

2. Recommendations on Motivating Cycling

We see three types of recommendations that we can give concerning the pilots addressing individuals in a direct way. The first type concerns reflections on the preparation of a pilot. A second type is linked to the course of the pilot and a third concerns considerations to make after a pilot ends.

2.1. Recommendation on science-based pilots

- The results of the BITS-survey came two years in the project. Ideally these results should be available at the start of the project. For future projects we argue it would be a good thing to design pilots more directly based on the comprehension of what factors play an important role in people's choice to cycle or not. In the BITS survey we read about four major incentives. A first is the reduced impact on the environment as compared to other means of transport. A second is the fun factor and a third is the positive impact on physical and mental health. A fourth the limited cost of cycling. The most important obstacles are the weather conditions, the lack of practicality of comfort and safety issues.
- These results allow us to an important degree to understand successes and failures in individual pilots. It has for example been difficult to 'proof' a positive impact on an increase in cycling following the installation of a parking referral system. Having a free parking spot is an issue that is not of the main concern of individual cyclists. It can be important for local government to limit the excessive number of parked bikes in the city centre; however, it is less of a concern for individual cyclists, and it does not extra motivate people to take their bike. On the other hand, some of the success of the apps to motivate people followed the feedback the app gave concerning health indicators. It appeared to be a greater motivator than the gamification included in the app. We find this in line with the results of the BITS survey.
- Two of the most important incentives, i.e. the reduced impact on climate change and the fun factor, are underrepresented in the designs of the pilots. Still, some inspiration on how to include these incentives can be found in four BITS-pilots. In the Sniffer bikes (Zwolle) and Shared bikes (Overijssel) pilot for example. Both pilots offer a particulate matter sensor to the bikes allowing to measure the air quality. Participants reported positively on the added value of the particular sensors. They felt motivated to participate to the mapping of the air quality in the region. Moreover, the CO2 fit challenge piloted by Baron Mobility included feedback on the amount of CO2 saved. This particular aspect of the CO2 fit challenge appeared to be a very good motivator. Finally, we refer to the Rope Light pilot in Aarhus. Although the rope light has not been designed for its fun factor, it was the artistic element of this pilot that was most strongly appreciated. We suggest for future projects to even more strongly emphasize these motivations to increase cycling.

2.2. Reflecting on diversity among cyclists and the need to address less privileged groups

- The BITS survey equally showed different types of cyclists: the Die Hards, the Happy Cycler, the Procrastinators and the Car Fanatics. Happy cyclists and Diehards are on average higher educated compared to Procrastinators and especially Car fanatics. In proportion, more people running a household full-time and unemployed people can be found among the Car fanatics and more retired people can be found among the Diehards. These results show that different populations need a different approach to increase cycling. Notwithstanding

we find few examples in the pilots that explicitly address differentiation according to various populations or types of cyclists. It would be good to identify differences among cyclists when designing a pilot and addressing these differences in their experiments. The Withernsea pilot on the bike library is the one of the few pilots that explicitly addresses a sub-population. They rent bikes to people that do not own a bike and thereby address a less privileged population. Thereby they achieved a direct impact on this group of people. They can show a good impact on physical and mental health indicators for the participating people. Moreover, in the light of the urgence of climate change it is crucial to include all layers of the population in the narrative of the green transition.

- Gamification works but not for everyone. It worked better in companies as compared to individual citizens. It appealed to those already using a bike. Moreover, its impact appeared to be limited in time. We argue therefore that in designing gamification variation among cyclists should be considered.

2.3. Choosing the right location

- A first important practical issue project partners report on is the choice of a location for a pilot. This is for example true for placing signs with information or motivational messages. The parking referral system in Zwolle learned that information should reach the cyclist when he or she needs the information. When the information on free parking spaces is shown too far from the actual parking facilities the information has not been noticed and when it was it has not been considered. Moreover, for testing motivational signs equally the right spot should be found. The pilot of Cycledata showed that an intersection where there are already many signs and stimuli, has been an important obstacle to observe impact of the motivational signs. Alternatives for visual signs should be explored in these cases.
- Another aspect of the location is linked to the electric wiring for example. Not having enough power to install informational or motivational signs proved to be a major obstacle for testing a pilot.

2.4. Collaboration with local authorities & communication campaigns

- Many project managers emphasize the importance of a good collaboration with local authorities. Making sure that each of the partners in realizing a pilot are well aware of their role and take it seriously. Based on these recurrent comments by project managers, we suggest investing enough time in relations with local authorities.
- The same is true for communication. Behavioural change does not come easily. The project managers of the Cycledata pilot ‘more cyclists, more trees’ argued that the success of the pilot could not have been reached by only placing the sign. Communication has been multiple, from local newspapers to the organization of an additional challenge and a public event for planting the trees. In other pilots project partners only rarely invested in additional communication. For future BITS projects, we argue that investing in communication should be an important factor in setting up a pilot for motivating people to cycle more.

2.5. Short-term vs long-term impact

- We recommend experimenting with various lengths of test periods. Further research is needed on the time of exposure that is required for motivational signs to generate a sustainable impact. The current BITS pilots do not allow us to draw clear conclusions in this regard. The pilot of Cycledata “More cyclists, more trees” showed an important impact, however only for the time the motivational sign has been placed. Afterwards the number of

cyclists dropped rather rapidly to the pre-pilot level. It can be considered as an example of pilots generating a short-term impact. We suggest that experimenting with- shorter and longer test periods within a same pilot could shed more light on the level and time of exposure that is needed for an impact to remain over time. Moreover, if the test period had been an entire year instead of a few weeks as in the current pilot, it would have been easier to isolate the impact of the motivation sign from other possible intermediary factors such as the weather conditions and thereby allow a more fundamental understanding of the impact of the sign.

- We recommend also designing pilots including longitudinal measurements. In general, an app is a good tool to change behaviour. The example of the apps piloted by Baron Mobility learned that gamification only resorted a short time impact. The feedback on health indicators and CO2 saved on the other hand reached a more sustainable impact. However, the question remains whether this impact still remains, even when the people are no longer using the app. A follow-up measurement on bicycle use, even in a period no app is used, could enlighten this question. The same is true for motivational signs. A measurement long after the sign has been removed would teach us more about the sustainable impact of such actions.
- We recommend furthermore pilots with a comparative design. Further research is needed to address the differential impact of addressing positive incentives on the one hand and of mitigating obstacles on the other regarding sustainable impact. The current pilots show that addressing positive incentives resort more easily in a positive impact. The impact of the informational signs in the Wayfinding pilot in Zwolle for example appeared to be non-existent, whereas the impact of a return on health indicators (apps demonstrated by Baron Mobility) and a positive impact on the environment (Cycledata pilot) showed a clear increase of cycling. We suggest that the impact of addressing positive incentives not only could be easier to achieve, but possibly also could be more sustainable. However, further research or further pilots are needed to verify this hypothesis more thoroughly.

3. Recommendations on Infrastructure oriented ITS applications

With respect to infrastructure oriented ITS applications, recommendations can be made regarding (I) the need for better cycling infrastructure, (ii) the short vs long term impact of interventions, (iii) the importance of setting priorities, (iv) the difference between objective and subjective change, (v) the requirement of new forms of expertise.

3.1. The need for better cycling infrastructure

- The results of the BITS survey clearly indicate that respondents in the BITS regions are in general quite critical of the condition of the existing cycling infrastructure and a substantial part of the population asks for more investments by authorities.
- While the subjective experience of the state of the infrastructure is one important source of information for policymakers, for several reasons 'the subjective experience' and the 'objective state' are not necessarily strongly associated (see 3.4).
- Several BITS pilots have shown that more objective data can be collected on, for example, cycling comfort or safety. Generalised uptake of these innovative systems can further improve and objectify policy regarding infrastructure improvement. The use of ITS or apps may supplement changes in physical infrastructure, help to develop changes in physical infrastructure and/or can make existing physical infrastructure more safe or comfortable possibly at a lower cost than pure infrastructural changes. The pilot in Aarhus, for example, gives upcoming cyclists more time to pass a downhill crossing, what increases their safety without drastically changing the crossing.
- Objective data on how to improve infrastructure should and will not replace other existing forms of decision-making. It does not make existing forms of expertise obsolete; it asks for new forms of expertise.

3.2. Short-term vs long-term impact

- While pilots that directly work on the individual's motivation work primarily in the short-term, projects on making infrastructure more intelligent and/or safe (by using ITS) are more effective on the long-term if they are part of a systematic and planned attempt to make cycling more interesting by changing the cost/benefit ratio for individuals. While sometimes there can be quick wins, isolated infrastructure works or adaptations (even with ITS applications) should not be expected to result in a sudden change of mobility related behaviour.
- To have a long-term impact however, infrastructural interventions should be systematic and encapsulated in a larger cycling policy plan that is future oriented. European quality standards on infrastructure allowing inter-local and international comparisons may increase pressure on authorities to work towards progress. The goal of these plans should be lowering the costs and increasing the benefits of cycling compared to other modes of transportation so that it is in the interest for citizens to adapt their behaviour.

3.3. Setting priorities

- In the BITS project infrastructure-oriented pilots have focused on a diverse range of issues like making crossings safer, setting steps towards higher quality bicycle path surfaces, increasing access to bicycle parks and improving bicycle path lighting. Not all interventions

can be expected to increase the benefits of cycling or decrease its costs and as such stimulate the uptake of cycling in an equal way. An important lesson learned here is the importance of a helicopter view and deciding on the priority of the intervention regarding the overall needs within a particular area. This does not mean that costly experiments cannot happen. However, it is an important element to be integrated in the communication concerning the pilot. For example, in the case of the rope light pilot, the argument that the technique could later be used and upscaled in other situations can justify the costly investment.

- It is advisable to, in a larger cycling policy plan, to formulate priorities based on a cost-effective and as such in a data-driven way. Infrastructure driven interventions have a higher chance of influencing the perceived costs and benefits of cycling if they hook up with the citizens' motivations for cycling (or not cycling) and their perceived barriers to cycling.

3.4. Objective vs subjective change

- Projects initiating change in the (cycling) infrastructure with or without BITS applications aim at 'objective' improvements. Objective improvements do not always translate neatly into an improvement as experienced by citizens or even cyclists. Changes may be too small to notice (while still objectively making, for example, a crossing safer), cyclists may be unfamiliar with the changed infrastructure or – many cyclists use cars as well – notice the disadvantages of the changed infrastructure using another mode of transport (than cycling).
- In 3.1. we already mentioned the remarkably low satisfaction with the cycling infrastructure that may be the result of the low number of cyclists in the East Riding area. As such the perceived change by citizens is not only a result of objective change, but from citizens' expectations and changes in these expectations. It could, for this reason, be argued that if there is an increase in cycling, this may affect cyclists' expectations regarding the state of the infrastructure.
- The introduction of ITS systems that communicate with cycling infrastructure should consider the importance of their 'credibility', 'reliability' and user friendliness from day 1 of the introduction. Failing to secure these three issues may radiate negatively on the perception of the end users' and may discourage the use of these systems. A wild growth of systems/apps/dashboards should be avoided as well, so it is advised to use and build on existing systems or apps to introduce new functionalities.
- One important factor that can help to transform objective change into subjective experience is a well thought of communication and a behavioural campaign that reacts to the citizens' motivations and concerns. In this regard, it is important to notice that citizens are not a homogeneous mass and different types of citizens exist with respect to cycling related attitudes and behaviours (see cyclists' typology in the final report). Communication and behavioural campaigns should target these different groups with messages that take into account the concerns and motivations of these groups.
- Next to a communication and behavioural campaign, very important is the issue of scale. The importance of this is, for example, clearly shown by the Schwung app pilot (Zwolle). A first lesson learned concerns the scale that a pilot must reach to convince people of the impact it has. The potential of the Schwung app is strongly underscored by its users. However, they equally claim that to really have an impact, more and preferably all traffic lights should be connected to the app. To have an impact on the motivation to choose for a cargo bike over a fossil-fuelled vehicle, a critical level should be reached of equipped intersections. The time that is gained by activating the app must reach to point that is really

experienced by the couriers (and citizens) and not only proven by the objective measurements. The bike couriers give the excellent suggestion to add a summary of the amount of time saved to the Schwung app.

3.5. The requirement of new forms of expertise

- ITS application have the potential to transform cycling infrastructure in a strong way. These innovations, however, require new forms of expertise on behalf of policy makers associated with public authorities as well as stakeholders in private companies. It is, for example, important to have sufficient technical expertise and knowledge about new technologies and successful system providers in order to write up tenders, to understand how these technologies can generate new forms of data and how these could be used to answer policy questions.

4. Recommendations on data

4.1. Recommendations on data gathering in function of policy

With respect to collecting data to support cycling policies we can, based on the experiences in the BITS-project, formulate some recommendations on (i) objectifying cycling policy, (ii) the limits of objective data, (iii) the need for new forms of expertise, (iv) the political commitment to stimulate cycling.

Objectifying policy

- As several BITS-pilots have showed: gathering objective data using ITS-applications may give policy makers very valuable information to guide them in decision-making and identifying priorities for realizing change in one or more of the BITS pyramid key-concepts (safety, comfort, speed, ease of use...)
- Objective data gathered by ITS should be considered an additional and often relatively new source that can supplement and, in some cases, replace more classic forms of data collection as they are less labour intensive and/or 'educated guesswork'. While some forms of ITS are innovative and sometimes experimental, their use should be encouraged as they offer excellent learning opportunities and may stimulate further innovation in the field.
- 3D camera gives an overview of different indicators at once - behaviour of different road users, their tracks, speed, origin and destination and near accidents etc – that go far beyond the possibilities of human observation and data-collection. Near conflicts, for example, happen nearly 1.000 times more frequently than accidents and allow for statistical analyses that are much higher in precision, and many accidents would not have been fully registered without ITS

Objective data do not exclude bias and don't interpret themselves

- ITS-applications only observe what you ask them to observe and they don't interpret the collected data. A smart camera, for example, does not detect weather conditions, is not aware of temporary circumventions, is not able to take into account, for example, the impact of COVID-19 or changes in traffic due to closures or openings of businesses or factories in the neighbourhood and is not aware of the broad spatial surroundings. Interpretations of data, images and statistics – including anomalies that may bias the data - remains the work of human actors.
- Be aware that technology is not flawless and even relatively simple forms of objective data (like counting) may run in unforeseen problems: technical malfunctions have complicated several pilots during the BITS project, for example the counting pilot in East Riding and the Machine Learning pilot in Aarhus, in which incompatibility issues of technical equipment of two providers obstructed the pilot success.
- Good data are collected for a specific goal and that goal defines the adequate circumstances in which they should be collected.
- To obtain sufficient and valuable data about cycling volumes it is important to make a thoughtful selection concerning the particular spots, the timing (winter vs. summer) and the number of countings. Data should be collected during a time-frame sufficiently long to rule out seasonal effects and minimise the impact of short-term anomalies.
    - It is critical that the way of measuring remains the same over time. If other types of measurement or other forms of technology are used, for example for using bicycle path surface quality, this will downsize the added value of collecting objective data

as bicycle path surface quality monitoring is often only useful when implemented over a longer time-frame.
    - There is a need for common standards on data-collection to maximize comparability, as comparative analyses may substantially enrich the interpretation of data.

Building (new forms of) expertise

- Even for relatively simple forms ITS data (e.g. counting systems) some form of training/expertise and/or experience is needed to fully interpret the data. Previous internal (practical) expertise in setting up counting systems at particular spots in the city is valuable in installing this type of ITS in the short term.
- For innovative ITS applications the expertise needed to draw conclusions from raw data, is often more specialised and technical/sophisticated. While local governments (responsible for cycling policies) seldomly have this kind of expertise, new forms of (public-private or other forms) cooperation may be necessary, that require all stakeholders to understand the possibilities that ITS applications may offer and clearly formulate the research questions that require an answer.
- Another domain in which new forms of expertise should be build is the field of 'Citizen Science'. ITS applications – for example during the Snifferbike pilot – make the participation of citizens in data-collection projects not only possible but sometimes necessary. Motivating and training citizens to participate in research projects can be an important added value as it can make projects cost-effective and can help to build a support base for introducing policies based on these projects.

Policy choices need data, but data do not solve issues in itself

- Collecting nor analysing data does in itself solve questions or problems, it can help to make policy decisions more objectively. However, this requires political willingness for long-term planning and investments in cycling.

4.2. Recommendations on data sharing and visualization

With respect to more systematic data sharing, comparing and visualisation, recommendations can be made on the following topics: (i) the consortium of partners, (ii) setting standards for data architecture and standardisation, (iii) rules on data ownership, privacy and GDPR, (iv) choice of data platform, (iv) the expertise required and (v) continuous attention for 'data reflex', promotion and valorisation.

Consortium of partners

- The impact of creating increased opportunities for data sharing, comparison and visualization is most often most substantial if efforts towards this goal are enduring and sustainable over a long period of time following a stable strategy and goal.
- To increase sustainability, a strong partnership should be built between platform developers with stakeholders willing to supply data and actors interested in working with the data available.
- The mutual dependency between these actors requires often a long(er) term commitment towards a common goal.
- As data should not be collected and shared just for the sake of collecting data, the common goal(s) and the nature of the data that should be made available should be sufficiently clear to all partners. Working with 'use cases' could be a good approach, where all data collected are needed to fulfil one or more use cases. For example: to develop a bicycle parking guidance system, the minimum you need is the number of available parking places in bike

parkings and possibly historic parking data to be able to make forecasts on available parking spaces.

- If data sharing is project based, from the start on a strategy should be developed to maximize guarantees on sustainability and reaching out to potential partners outside of the initial project.

Data architecture & standardization

- A crucial step towards data sharing is the inventory beforehand of **the type and timing of the data to be collected**. During the BITS-project, the team encountered many practical problems due to changed data structures during the process of the data collection and data analysis, which lead to (huge) data problems and delays.
- Equally important are the choices made and the standards set with regard to s**tandardisation of data**. Currently, cycle data varies enormously in format and type and the concepts they measure are often defined differently, which makes comparisons difficult. Within the BITS project a plead was made to make cycle data more uniform so much more can be done with the many data sets that are being collected. Bicycle counting in Lisbon cannot be compared with bicycle counting in Antwerp only because different data formats are used. In particular for multimodal systems, or to promote traffic safety, bike sharing data systems, bike parking information systems should be able to communicate with smart city applications, in public transport apps, with other mobility modes and sensors. This not only means a further standardization of the data itself, but also information exchange based on common standards such as GBFS and/or INSPIRE. The BITS-project was a first step to create further awareness on this topic on an EU level.

Data ownership, privacy and GDPR

- Another major lesson learned concerns the **management of privacy relevant data** in terms of GDPR. A lot of data is collected and presented on the platform and some data is privacy sensitive. Different perspectives and approaches concerning GDPR exist in the different NSR countries. There remains a strong need to have a profound debate concerning GDPR. Finding a good balance between GDPR and making tracking data available is very important.
- Data ownership is another issue, where also commercial motives come in. How to deal with data that was collected by a company for a client and therefore ownership is defined and not necessarily openly available? Was the tender by the (public or private) client clear on data ownership? These questions have a direct impact on the availability of datalinks, on the open format of the data and on data policy. Bicycle data managers, companies and policy makers are generally looking for solutions on this level. When releasing a tender, it is therefore advised that the ownership issues need to be thoroughly considered and clarified in the tender.
- Based on experiences within the BITS project the advice is given to take sufficient time to consider what data will be collected, in what format, how many data will be collected and how the data will be analysed afterwards. This reflection process may tackle many time-consuming considerations and frustrations afterwards.
- The BITS project succeeded, in particular in the Cycling Data Hub, to overcome some of these ownership issues by sharing links to the data instead of sharing a copy of the data and by disclaimers. This choice had several advantages. No ownership issues occurred, the data behind the datalink can easily be kept up to date and always remains the responsibility of the owner.

Choice of platform

- It is important to select a user-friendly and sustainable platform to build upon. After a thorough research process, the choice was made for the **ArcGIS online platform** as tool for the CycleDataHub (CDH). ArcGIS is a sustainable platform, which is a benefit for the continuation of the CDH after the BITS project. It is also a user-friendly platform.
- It is important to 'test' user-friendliness early in the development process by installing feedback processes involving all stakeholders of the project. An adequate methodology in this respect could be 'service design', a way of developing new services by taking into account the needs of all stakeholders seriously throughout the full development process.

The expertise required

- The development of the CDH demonstrated that **the initial building of the hub** went relatively smoothly and no technical expertise was needed, although it needed a substantial time investment to develop. The further automation however needs external professional expertise, which went beyond the scope of the BITS project.
- Next to technical expertise (e.g. working with large data sets) domain specific knowledge is needed. For example, the Sniffer bike pilot in the BITS-project collected data on air quality. As a non-expert in air quality data, it was hard to make interpretations about how bad or moderate air quality had been. Or another example: what are accepted measurement errors in these kinds of data collections? Support of domain experts is often needed to set standards and/or to clarify data interpretation. It is important to map these forms of expertise needed at the start of the project.

Stimulating of data reflex, promotion and valorisation

- An important lesson learned from the BITS project is the need for and the importance of a continuous investment in stimulating the **data reflex** among (potential) providers and users, such as governments and other organisations.
- Within the automobile sector, the awareness concerning data exists already for a long time. Within the bicycle domain, however, data awareness was a few years ago nearly non-existent. Within the BITS project successful steps to enlarge this data reflex have been taken, but there is plenty of room for further growth. The concept 'data reflex' as developed within the scope of the BITS project contains a four-step approach[1]: (1) availability: the first step implies that data is collected and available; (2) understand: providers and users need to understand the data, both technically and content wise; (3) process: data must be processed correctly, e.g. concerning GDPR; (4) publish: data needs to be shared, so it can inspire others.
- While, within the BITS project, the development of the platform requested almost all the efforts and time of the partners, fewer efforts were undertaken to continuously collect data sets among data providers or to promote the platform among other users. This is important as it may feed a continuous dynamic to a 'developing and evolving' platform: the more shared data on this platform, the more valuable it becomes. More data will attract more users, will bring more insights and comparisons and this will generate more new delivered data sets. And moreover, the more available data and comparisons, the more useful it becomes for data driven policy and policy recommendations. An important lesson learned is to always keep in mind and look ahead to invest in the promotion of the platform while the technical structure is built.

- Related to the promotion of the platform, it is recommended to take the time to monitor and evaluate the accessibility and user-friendliness of the platform continuously. These steps may increase the relevance and value of the platform even more.

5. Recommendations on evaluating

During the BITS project many innovative pilots have been implemented often on unexplored terrain. The recommendations formulated in this report are based on both successes and failures and may offer some guidance to future projects. In this last section some recommendations are made in respect to the evaluation of pilots.

5.2. The evaluation paradox

- It is a good practice for policy makers to develop integrated plans for increasing cycling (or make cycling more attractive and more competitive compared to transport modes that are less environmentally friendly) based on practices that are 'evidence-based' and have proven to be effective and efficient. The BITS-project, as one of the first large-scale projects that implements ITS solutions with respect to cycling and cycling policy, is an important platform to test the added value of these solutions and to generate 'evidence based good practices' that can be studied by interested stakeholders and/or upscaled throughout Europe. One important lesson we learned during the project, is what could be called the 'evaluation paradox'. Pilots are, by nature, limited in scope – they focus on one specific intervention that may have an impact on certain aspects of cycling, e.g. directly on the motivation to cycle, or indirectly in attempting to increase safety, speed, comfort, and quite often also in a limited area.
- Pilots that focus on the motivation to cycle, for example by increasing competition between cyclists, can under certain conditions increase cycling in the short term, however, it is doubtful that large groups of participants remain motivated by the pilot actions over time. To remain impactful, continuous resources should be spent to keep motivation amongst participants high. However, several pilots indicated that impact appeared lower when organized challenges, for example, were not limited or rounded up within a specific timeframe but rather continuously over time.
- At the other hand, pilots that focus on improving infrastructure by ITS solutions and improve speed, comfort or safety have the potential to decrease the costs of cycling and increasing its benefits compared to other forms of (more polluting) traffic. Due do the limited areas on which the pilot is focussed – for example one or a limited number of crossings or a short traffic lane – the pilot is unlikely to make sufficient impact with regards to what it promises (e.g. increased speed or comfort) that it affects the experience of cyclists (or non-cyclists) in daily life, that it would work as a 'behavioural changer'. Failure in showing beneficial effects, the pilot may risk not generating sufficient enthusiasm with policy makers, funding agencies or investors to make steps towards upscaling, while that upscaling is often necessary to make a difference in the experience of cyclists.
- With respect to this paradox it is important during the evaluation process for the evaluators to (I) engage actively with the stakeholders to capture their expectations (ii) help to formulate realistic goals, and (iii) manage expectations with respect to possible outcomes of a trial.
- The third kind of pilots – those that focus on collecting data or making data more comparable, visual or open to a larger population – may only have impact on the experience of cyclists on the long term as they help policy makers and traffic experts to detect policy flaws or opportunities to implement new measures.

5.2. Discussing negative outcomes, importance of proxies

- Another important lesson is that evaluation studies should also focus on potential negative outcomes of interventions. In a general way, for example, it can be argued that when cycling is promoted and there is an uptake in cyclists without substantial changes in global infrastructure that focus not only on cyclists but especially on motorized vehicles, one can expect the number of accidents involving cyclists to increase over time. Equally, giving priority to bike couriers to move faster trough the traffic, can lead to congestion problems and an increase of CO2 at certain locations in the city. These possible negative effects should also be included when designing the pilot. Potential negative consequences are not always easy to detect based on small scale pilots as – like the positive effects – they may be rather limited, however, when scaling up they may become visible. In addition, it is almost impossible to statistically identify a decrease or increase in accidents in the short time of the evaluation period. Even if a decrease or increase could be detected at a pilot site, it is far from certain that this kind of positive or negative effects is due to the pilot itself, making any evaluation effort still more complicated.
- One can try to focus evaluation efforts on measuring proxy variables and theoretical estimates on how a change in perception of cyclists and non-cyclists on some of the core variables of the BITS-pyramid - e.g. safety, comfort, speed, experience in a more 'abstract' sense - could motivate them to cycle more. This exercise - like we have done so for several pilots - is often worth the effort, however still speculative as 'perceptions' often differ from the reality at the pilot area. And as mentioned earlier, the decision whether or not to cycle (more) depends probably more on a general perception by individuals that the benefits of cycling outweigh the cost to a larger degree than other (motorized) forms of transport. For this reason an informative evaluation exercise should include information on the process of the pilot, extensive communication between researchers and the pilot-owners and reflection by stakeholders and experts on the results.