

Implementing BITS

Lessons learnt to support the user requirements analysis, design and procurement of future cycling ITS

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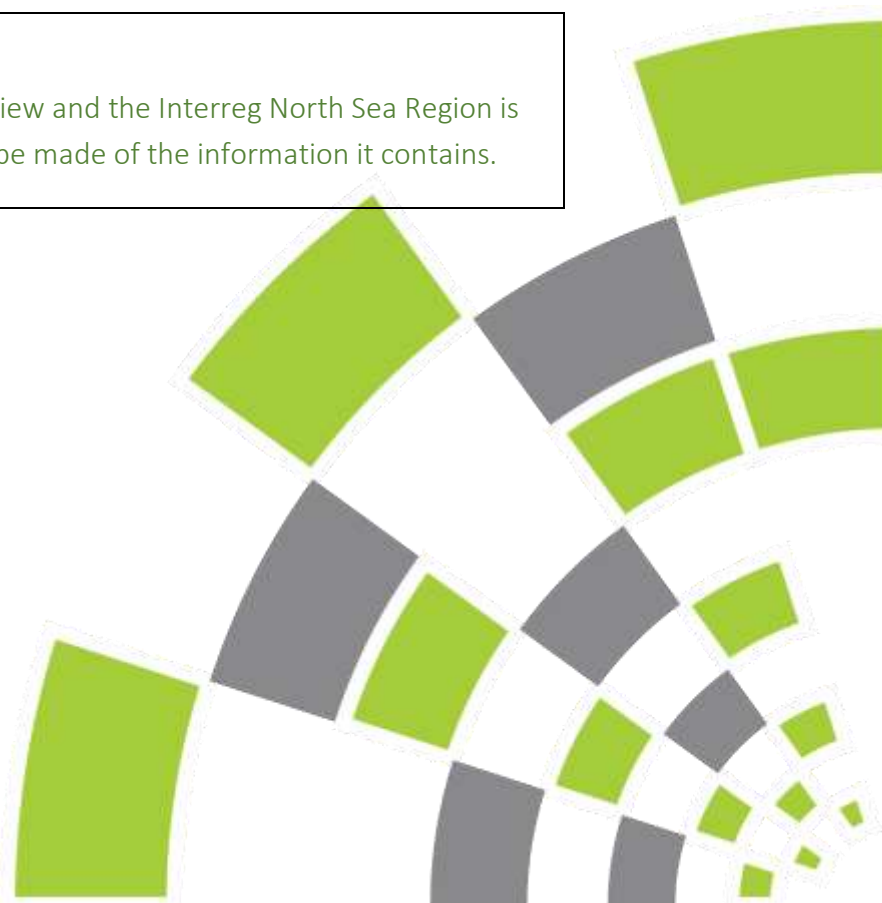


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Introduction

Cycling is increasingly being seen as a solution for challenges related to sustainability, health and our living environment. Developments in terms of technology and data have an impact on the cycling domain and offer the potential to make cycling safer and more attractive. The exact possibilities of these developments in stimulating cycling are to a large extent unclear and the knowledge that does exist, is fragmented and context specific. With 10 partners (cities, regions, universities and other organisations) implementing cycling ITS on a large scale and in different contexts, the Bicycles and Intelligent Transport Systems (BITS) project is the first of its kind and a promising step towards a more digitalised and sustainable transport system. By collectively collecting, analysing, and sharing data and knowledge, we get a better understanding of the potential of cycling ITS and how to practically implement it.

In this report, we share the most valuable insights and lessons learnt from the project so far that could help both BITS partners and others in the further rollout of cycling ITS.

This report provides for the second deliverable of activity 1, work package 3: Report with user requirements/functional design to inform codesign of ITS solutions and support procurement. This deliverable is aimed at collecting and sharing knowledge and experience of both BITS partners and stakeholders about how to find and select the appropriate ITS solution and how to implement it effectively. The input for this report consists of a dedicated session with all partners and the experiences so far of the project management and implementation work package leader.

This report will guide you through the implementation process of cycling ITS and share experiences from the BITS project so far. The steps distinguished can be found in figure 1.



FIGURE 1: STEPS IN IMPLEMENTING CYCLING ITS

Foundation

Getting people on board

Implementing ITS solutions within the cycling domain is a relatively new development. Besides this, ITS is by definition a technology-based solution that differs significantly from traditional solutions like cycle paths and parking facilities. This innovative character can have different effects on people: it excites some, but also sparks resistance with others. Understanding of the realistic opportunities is important to be able to have a sensible dialogue.



We found cycling ITS is positioned at the intersection of two major developments, namely digitalisation (or more mobility specific: smart mobility) and the shift to more sustainable, active and space efficient mobility (like cycling). These two developments are getting attention on almost all government levels, from local and regional to national and European, and the COVID pandemic even strengthened this. However, cycling ITS is still quite unknown. This is partly the case because smart mobility and cycling are often themes that are being dealt with by different policies, financial resources, people and even departments. We found it was important to advocate for cycling ITS in both camps:

- to make ITS policy makers aware that an ITS strategy without cycling and active mobility is missing a fundamental element
- to make active mobility policy makers and planners aware that ITS solutions (or in a broader sense: technology and data) offer a new range of opportunities to help them in achieving their goals.

To inspire people, we found it works best to bring specific examples of solutions and their effects. With our State-of-the-Art inventory, we created an overview of existing solutions that can be consulted for inspiration. You can find it [here](#). On the same website you can also find various articles on best practices of cycling ITS.

To convince people it is important to be able to show proven results of cycling ITS. Unfortunately, this prove is often still lacking, mostly because cycling ITS is not widely implemented yet, but also since many implementations are not (properly) evaluated on their costs and benefits. With our evaluation and communication approach we try to contribute to this.

Revision of the ITS directive

As BITS, we try to contribute to the awareness of the importance of active mobility and the opportunities for ITS in this respect on all policy levels. On the EU level, Cycling Industries Europe is collaborating with BITS partners, industry players and the EU to do this. An example of this is their participation in the consultation with the public and stakeholders on possible measures and potential impacts of a revision of the ITS Directive. The key aspects they highlighted in this consultation:

- The current over-emphasis on motorised travel and the need to boost ITS in active mobility and cycling.
- Request for a better focus on urban ITS strategies, with a strong support for cities and regions.
- A European comprehensive approach on ITS, bringing together the different modes of transport in an efficient multimodal system.

See [here](#) for an article about the consultation and our contribution.

Embed in policies

When cycling ITS is being implemented, we found it is often in the form of pilots. Although this might be a good first step with new concepts, the goal should be to make cycling ITS an integral part of our mobility policies and working practices. At the moment, cycling ITS is often seen as icing on the cake. It is the sweet and shiny thing that might make your new cycle path make the local news. We have learned that it can be very challenging to try to take cycling ITS from the pilot sphere and make it an integral part of policies. Actually, this is a challenge we are still dealing with.

Eventually, one should be able to look at a challenge and make the decision whether this asks for an ITS solution, an infrastructure related solution, a combination or something else. To be able to realise this, cycling ITS should be embedded in both policies and working practices. Some of our lessons learnt so far:

- On a policy level, it helps to create a strategy on cycling ITS and cycling data. This strategy should not only include a vision on the role of ITS in cycling and cycling in ITS, but also on collaboration and the different roles public and private organisations will have in this respect.
- To be able to do this, it is advised to work together with stakeholders to define such a strategy to be able to capture innovations and new technologies as good as possible.
- Having common definitions prevents unnecessary misunderstandings and speeds up the process.
- Something challenging is the scale in such strategies. Interoperability and common standards are important themes when it comes to ITS and data. This makes alignment of strategies with other government levels and authorities even more important.

Cycling ITS in the policy of Antwerp

"It is basically the BITS project that has guided The Province of Antwerp towards a more strategical approach on ITS for cycling. The Cycle Barometer (Fietsbarometer) started out as a tool to register and monitor the level of cycling both in space and quality. The main motto was that only data could provide an objective insight in the quality of infrastructure, the quantity and experience of cyclists, the quantity and severity of accidents, to define priorities for investments in cycle infrastructure and provide a data service to other policy makers. The interaction between province, communities and subcontractors in this is still one of mutual learning (what do you need? what do you have?). Important in view of strategy is the recent development towards an interprovincial Cycling Barometer. This project has made a strategical approach on the needs for cycling ITS much more urgent and necessary. Thanks to BITS the focus widened from data needs for substantiating our own policy, to other authorities, research institutions, SMEs and civilians. BITS partners have exchanged knowledge and documents. For the further development of the Cycle Barometer a structural cooperation between the Flemish provinces is agreed and a project manager has been appointed to develop a cycle data strategy." – Steven Soetens (Cycle data expert, Province of Antwerp)

Vision of Overijssel on embedding cycling ITS in working practices

“To stimulate the integration of infrastructure plans and ITS solutions it is first of all important to include this in European and national bicycle policies.

Please note that ITS solutions are not always connected to new infrastructure plans, but can also help to improve the existing bicycle routes and infrastructure. An important topic is giving the cyclists more priority on those routes by use of for example smart traffic lights. Funding therefore should not be concentrated on new infrastructure plans only, but on improving existing infrastructure as well.

Another topic is the integration of smart cycling in the world of smart mobility. Nowadays, smart mobility is all about cars. Smart mobility policies should therefore be extended with a smart bike chapter. This helps in finding car solutions that might work for cycling as well, but more important, it ensures cycling is not forgotten within smart mobility. When thinking of smart cities and smart mobility, smart bike solutions should be considered as well. An integrated approach is vital, not only for smart cycling, but for smart mobility and smart cities in general.” – Wim Dijkstra (strategic mobility advisor, province of Overijssel)

Embed in working practices

Another challenge in lifting cycling ITS from the pilot sphere can be to embed it in working practices and the day-to-day toolbox of professionals like traffic engineers and mobility planners. Some of the lessons we learnt in this respect:

- Applying ITS is often not in the toolkit of infrastructure planners and cycling policy makers. ITS is a topic often covered by different teams or departments.
- This seems to be a consequence of the fact that working with ITS and data requires different skills and approaches than more traditional infrastructure planning. However, it makes it challenging to come to an integrated approach or to make ITS something to consider within a broader solution.
- To be able to improve results, it is important to include knowledge on the possibilities, options and pros and cons of certain ITS solutions and data opportunities from the beginning. This requires both new specialists to be included in the teams as time and experience for the team to get familiar with these new options and their characteristics.
- From a top-down perspective, one could consider implying ITS within infrastructure plans. This forces infrastructure planners to consider ITS and facilitates possible financing issues. However, proper expertise is still vital.

Preparation

Choose and find solutions

Choosing and finding the right solutions can be challenging, on the one hand because the number of options may still be relatively small, but also because we often don't have a complete view of what options do exist. As a consequence, it is easy to be guided by specific products and their suppliers while this might not be the optimal choice in a specific case.



To deal with this, it helps to thoroughly prepare in advance what you want to do, before committing to certain suppliers. This can be challenging as it is helpful to get in touch with these suppliers to get a good idea of the possibilities out there, which is especially helpful in a situation where knowledge on cycling ITS might still be limited. Another challenge might be to find multiple potential suppliers to invite for a tender, especially when specifications have already crystallised quite a lot. Proper market exploration and consultation helps in both exploring opportunities and preventing you from focusing on a single solution.

We believe the solution to this challenge is to use a goal-oriented approach instead of a product-oriented approach. An example of this is an objective based tender, where only objectives and conditions are stated without defining the specific solution/product.

BITS Survey

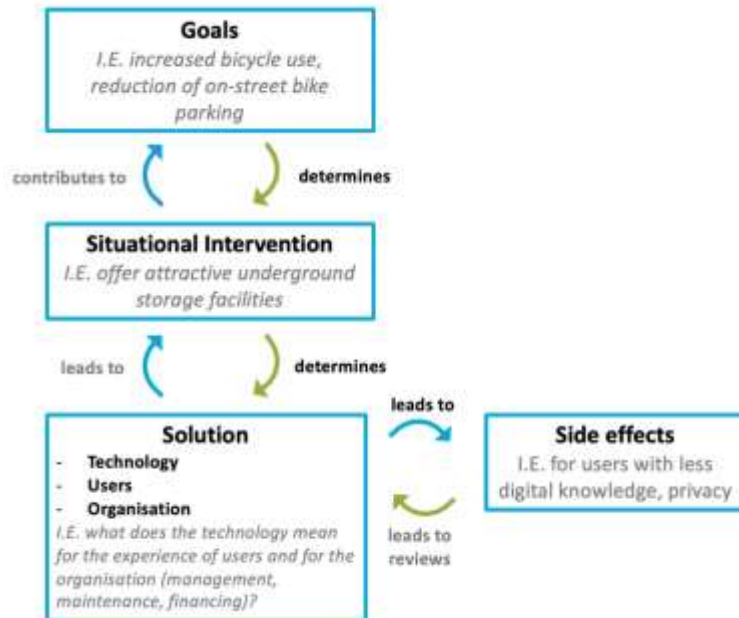
In spring 2020, we conducted a survey in all implementing cities and regions within the BITS project. This survey gives a unique insight into what consumers want from ITS services. As far as we know this is the only independent research into consumer attitudes towards cycling ITS that exists at the moment. If you want to learn more about the survey, please see [our article](#).

How to apply a goal-oriented approach?

Mobycon developed a step-by-step approach for goal-oriented and demand based smart mobility solutions and applied it to smart parking solutions for bikes. Here is a part of an article on this:

1. Proceed in a targeted manner

By naming the goals explicitly, you force yourself to take a critical look at what you actually want to achieve and then consider which interventions will contribute best. Who is your target group? What do you want to achieve and in what context are you operating? This, in turn, becomes an extension of the vision for cycling and the use of public space in a broader sense. By asking these kinds of questions you look at the issue from a broader perspective, preventing an unnecessary push for technology. ITS is a means, not an end in itself.



2. The solution is about more than technology

Technology should always be seen as one component of the broader solution. It should also consider the relationship with the users (Who will be affected by the solution?) and the organisation (Which processes and structures influence the solution? What costs are involved?).

3. Be alert to context and side effects

We do not implement solutions in a closed lab environment, but in the public realm. This often results in unintended side effects on the environment and vice versa. For example, the use of a parking facility is highly dependent on the parking plan and the use of space in the surrounding area (underground parking facilities, for example, can remain underused if street parking is not maintained). In addition, there are all kinds of possible side-effects when using ICT in the public domain, both positive and negative: from impact on mobility and behaviour to issues of privacy, security, inclusiveness and technological lock-ins.

4. Monitor and evaluate

Continuous monitoring and evaluation of the solution is a prerequisite within our approach: What change does the solution lead to and does it contribute to the goal? How are the technology, users and organisation aligned and is the solution used as intended? What side effects are there and what is done with them?

You can find the whole article, including specific parking solutions, [here](#).

Data reflex

Targeted data collection is currently the most important source of bicycle data. However, the application of ITS in cycling is creating many new possible data sources. ITS provides data by definition and, if used and interpreted correctly, this data can provide valuable insights. In order to grasp these opportunities, we must first of all be aware of them and know how to make use of them.

This concept has been named the 'data reflex' by the province of Antwerp and they developed a four-step approach for this:

1. **Available:** The data-reflex starts with seeing opportunities and ensuring that data become available. This means arranging from the start that data is collected, and that you will have access to it.
2. **Understand:** You have to understand the data, both in terms of information value and how it is technically constructed: what can you do with it and what can't you do with it?
3. **Process:** Data must be processed correctly. How do you convert the data into valuable information? And how do you ensure that the data can be used by others without sacrificing privacy?
4. **Publish:** The final step consists of sharing and inspiring. By sharing data and techniques we offer each other the opportunity to learn and develop new ideas.

A major challenge we experienced in this is that getting access to the right data requires good agreements in the beginning. The difficulty is that authorities in this phase focus on the functional requirements and might forget to pay attention to the low hanging fruit in terms of data that the solution offers. In addition, it is not always clear yet what these opportunities will be as the solution might not be clear yet either. Part of a data reflex is therefore training yourself to spot the right opportunities early on in the process when they appear.

Data reflex in BITS

The data reflex is a central concept in the BITS project, as East Riding of Yorkshire Council also shows. East Riding is a municipality with virtually no bicycle facilities and bicycle use. The municipality wants to break through this by, among other things, introducing a bicycle library. Residents can borrow a bicycle that suits their needs: from 'regular' bicycles and e-bikes to all kinds of adapted bicycles. Bicycle coaches then literally help them on their way. By using different sensors in the bicycles to collect data on their use, local authorities gain insight into user behaviour and can invest more specifically in bicycle facilities. Their use is also analysed on a personal level and the bicycle coaches use this to improve their approach. If someone suddenly stops using the bicycle, they can plan a conversation to determine what may have changed and if/how they can help. Data is often a 'by-product' of ITS applications, as shown in multiple other examples in our project. Dynamic bicycle path lighting turns on when a cyclist is detected and turns off again after they've passed. It's a great application to save energy and reduce light pollution. However, every time a lamp goes on, a cyclist can be counted as well. An app that sets a traffic light for cyclists to green can, in combination with the control phasing of the traffic light, also provide insight into the number of red-light negations. Traffic experts who purchase ITS solutions for improving cycling conditions in their city should therefore not only look at the primary purpose of the ITS application (bicycle lending, lighting, reduced waiting time), but also at other data that can be collected via the ITS applications. Of course, the right agreements need to be made with the supplier (data format, ownership of the data, frequency of the data, etc.).

This text is a cut-out of an article published earlier on this topic. You can find the article [here](#).

Contract suppliers

When it comes to contracting suppliers for a solution, there are some specific lessons that can be taken into account (additional to the prior paragraphs):

- Be aware of the risks of vendor lock-in. With ITS there is a risk of developing a dependency on a specific vendor for certain products or services. It might be easier to work with the same supplier over and over again, but it is advised to prevent vendor lock-in as much as possible as it can make switching or adding products and services of others very hard or costly. Especially in a domain that is rapidly innovating, like cycling ITS, vendor lock-ins prove a serious risk in being able to experiment and innovate.
- However, working with different suppliers also yields challenges in terms of interoperability and comparability of data. It is therefore recommended to work with agreed standards as much as possible. There are various initiatives for standards for cycling data on both national and EU level, although still in an early phase. We would advise to check with your authorities what is in place or being developed at the moment to prevent reinventing the wheel. Also, these standards are often developed with stakeholders/suppliers, making it more likely your potential supplier can comply.
- Make sure to clearly define requirements in terms of data and plan enough time to discuss them with potential suppliers. This also includes agreements on data protection (including what happens if something goes wrong), defining the user rights and ownership of the data and the content, quality, format and frequency of the data.
- In most of these lessons, there is a tension between choosing ready-made or tailor-made solutions. The first is often easier and less costly to implement, but also less adapted to specific needs and less flexible in terms of interoperability and data.

Traffic lights in Aarhus

The last point often applies to smart traffic lights. Traffic lights are often part of long lasting and rigid contracts. The emergence of smart traffic light applications brings the need to be able to connect other systems to the traffic lights (e.g. weather sensors, priority apps) and intervene in and experiment with different phasing settings. A few years ago, the municipality of Aarhus chose to renew the way they contract traffic lights. Although this was costly, both in time and investments, it gave the municipality more flexibility and the possibility to intervene quickly and experiment when and how they want, making it a good investment on the long run.

Implement the solution

There are various challenges you can come across when implementing the eventual solution. So far, we have learned technological challenges are often not the major ones, although they can lead to delays. Some of the challenges we have encountered are:

- Budget: it is often hard to determine the right budget upfront as there are often not many references. A good market consultation can help with this. We also experienced prices can vastly differ between suppliers. We expect this to be a consequence of the different technologies that are being used and the extent to which parties aim to earn back investment costs.

- Time: implementations often take (much) longer than expected to go live. This is caused by multiple reasons: waiting for necessary permissions, high working pressure, difficulties in the tender process.
- COVID: a lot of implementations in BITS require some sort of contact between people and departments. Due to the COVID situation during this phase of the project some implementations were delayed.

Gamification App in Oldenburg

In Oldenburg a mobile application with gamification and tracking functions was tested, which nudges and encourages people in the region of Oldenburg to cycle more often. The app is used to track the routes by bike and collects cycling data in order to get a better insight into cycling behaviour. For users it is possible to take part in challenges and win prizes. A virtual currency can be collected for every kilometre cycled. This currency can then be exchanged for vouchers at different local stores, restaurants, or cafés in Oldenburg. An overview of their own data (speed, km driven, calorie consumption, CO₂ reduction compared to driving a car) enables users to become aware of their own mobility in general and the influence of their mobility behaviour on the CO₂ budget. During the implementation, difficulties arose mainly in terms of timing and due to Covid-19. The arrangements with the supplier were more complex than initially assumed and COVID 19 made it difficult to win sponsors and participants.

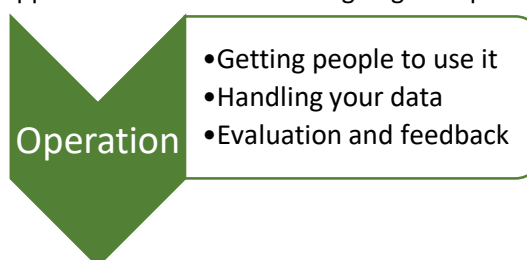
At the moment of writing (May 2021) five challenges have been successfully completed. 341 participants cycled 102.737 km in total and saved 25.639 kg CO₂ emissions compared to car use. Now it is the goal to transfer the gamification approach to companies in order to motivate employees to travel to work more often by bike. To be continued!

Operation

Getting people to use it

Some cycling ITS function more or less on the background, whereas some others require active participation of the cyclists. In case of the latter, citizens need to be convinced to participate and motivated to keep using the application on the long term. In our work so far, we have found the following success factors:

- Think from the user's perspective: what is in it for them and is what we ask them to do for that proportionate?
- Rewarding participants can be an option, but it is advised to have a clear strategy on how to proceed once the rewards are finished.
- Especially on the long term the user will need to be convinced that (s)he is benefiting from it. Especially with ITS that have a less clear/visible impact, it is important to communicate this impact well, for example with meaningful visualisations.
- Carefully think about the user experience and design from their perspective. When designing technological solutions, the focus is often on the functionalities. However, to make it attractive for people to use and keep using it, user friendliness is key.
- Also consider who might not be able to use the application. The more we are going to depend on technological innovations in our mobility system, the more important it becomes to take into account how we deal with those who cannot or don't want to make use of these technologies.



The sniffer bike

The sniffer bike initiative shows that a motivation for people to participate may also be not mobility related. In May 2019, the first sniffer bike project was launched by BITS advisory group member, the province of Utrecht. In the project, bicycles were fitted with measuring equipment to allow residents to play a role in collecting data on, among other things, bicycle use (using GPS) and air quality.

An important reason for the province of Utrecht to launch the pilot was to get a better picture of the cyclist. According to Eric van Dijk (Province of Utrecht), this is partly because there is still a lack of valuable knowledge on the behaviour of cyclists, but also to ensure that bicycles can be better represented in data and models than they are at present. [...] Although the experiment did produce useful data, you could say that the greatest success for the province was something else. It soon became clear that there was a common interest here, both with the participants and with various themes within the province (air quality, bicycle data, knowledge development). This made it possible to have constructive and substantive discussions: "*You encounter other ideas, other lines of reasoning. Most people are in good spirits and open to exchanging ideas, but you need a platform to do that*". The sniffer bike project provides this platform and enables citizens to participate in the discussion of important issues.

Want to know more about the sniffer bike, it's application in other areas and our view on digital participation. You can our article [here](#).

Handling your data

Once implementations are up and running and data is being generated, the data need to be properly dealt with. Besides the proper pre-processing, analyses and interpretations, this includes the sharing of the data. Some of our lessons in that respect:

- Establish methods and agreements for data protection and data transfer to third parties. Especially when working in a consortium, this is a condition to be able to share data amongst partners.
- Try to make data open, usable and findable. Although 'open data' is a topic that is getting more and more attention, we found there is still very little data available and what is there is often hard to find and hard to interpret. When making data open, one should also consider who can use it (language, metadata) and who can find it (where is it published?).
- Increasingly, data are made public through so-called online dashboards. An example can be found [here](#) for the province of Gelderland.
- It helps to think about the right formats or to comply with existing standards.

The CycleDataHub and Open Bicycle Data portal

Within BITS, we have two major projects that contribute to the availability of useful and valuable cycling data:

- Open Bicycle Data portal: The university of Oldenburg works with a group of ambitious students to process data from the BITS implementations and comparable ITS elsewhere and make the data available on <https://bicycle-data.de/>. In their work they make data from different sources comparable by using similar formats and KPIs and they make the data available and interpretable with visualisations and clear explanations. For an article and webinar on their work, please see [here](#).
- The CycleDataHub: The province of Antwerp developed and launched [the CycleDataHub](#) (CDH). The CDH serves as an international platform to share and find bicycle data. The aim is to provide a central hub where anyone can discover what data on cycling is available. Not only BITS partners use it to share their data but also others are stimulated to do so.

Evaluation and feedback

As cycling ITS are often relatively new solutions that still need to prove themselves, a proper evaluation is very important, not only to measure the effect of the specific implementation, but also to contribute to further development. Although the evaluation comes at the end of the implementation cycle, we believe it is important to think about how implementations will be evaluated before they start. This gives on the one hand the opportunity to conduct baseline measurements and make sure the right agreements in terms of data are in place, and on the other hand it is in this phase still possible to finetune the implementation.

We found it very valuable to not only measure the direct results (e.g. usage of a certain implementation) but to measure the impact on policy goals like stimulating cycling and contributing to health, safety, sustainability and social inclusion. These goals are often hard to measure and require assumptions and estimates, but do give a better idea of the impact of ITS implementations and how they compare to other measures.

Measuring the impact of cycling ITS

In BITS, the aim is to increase bicycle use with the use of ITS. In our evaluation, one of the major challenges is to estimate the actual impact of ITS in bicycle use. In a lot of cases, bicycle use before and after implementation can be measured, but it is hard to determine to what extent changes can be attributed to ITS, as also other factors (changes in infrastructure, weather conditions and the pandemic) can have an impact. In order to get a feeling about the receptivity towards the various types of cycling ITS, BITS partners conducted a survey in all participating cities and regions. If you want to learn more about the survey, please see [our article](#).