BITS
Bicycles and Intelligent Transport Systems

Evaluation report

Measuring bike
City of Bruges

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Project coordinated by Province of Overijssel

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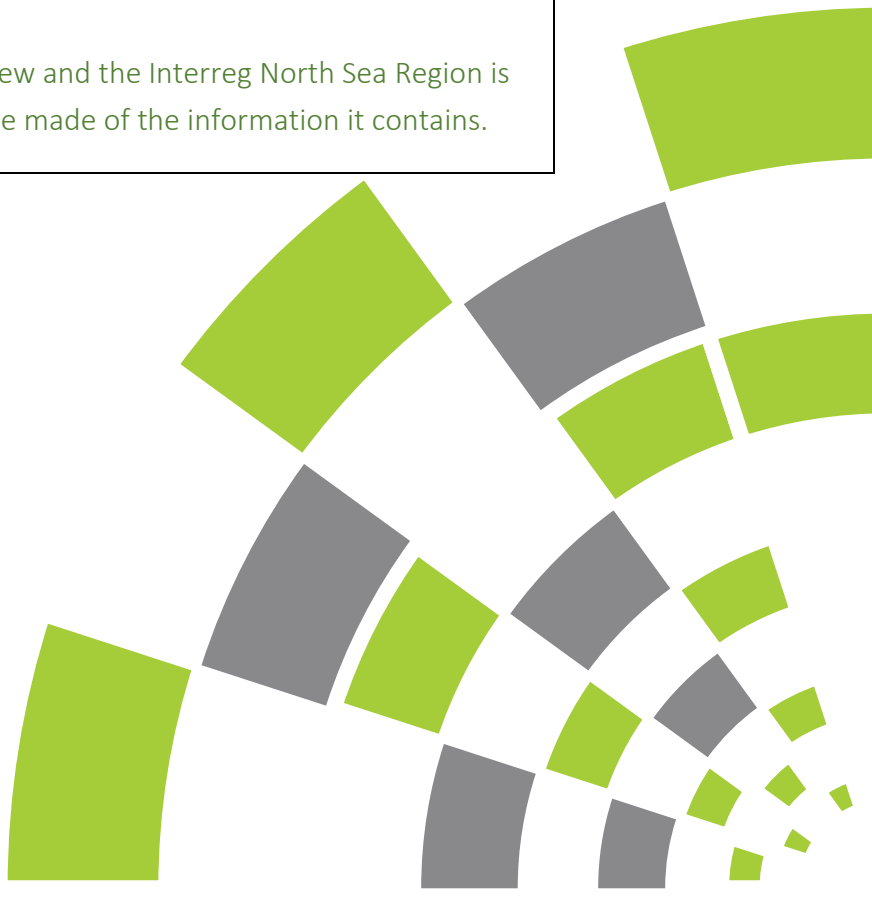

Interreg North Sea Region BITS
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Short description

In this pilot, a measuring bike ('meetfiets'), a bicycle equipped with different sensors able to detect imperfections on the cycling paths, cycled on the roads in the city centre of Bruges in 2020 and 2021 while measuring the quality and comfort of the infrastructure. The Fietsersbond's measuring bike evaluated the strengths and weaknesses of the selected cycling routes. Thanks to these measurements, the city of Bruges will have a clear view of the status of its bike paths and can use the findings to make appropriate decisions and to improve the bike network in the future.

Type of ITS

Bicycle with different sensors measuring quality of infrastructure
The city of Bruges rented the system from the Fietsersbond. All included, they paid between 6.500 and 8.500 euro for 150 cycled km.

Timeline

The measuring bike cycled on the roads in the city centre of Bruges in 2020 and 2021 on six days (04/11/2020, 05/11/2020, 20/05/2021, 15/09/2021, 17/09/2021, 19/10/2021). A thoughtful selection of cycle paths and roads was made by the team of mobility experts of the city of Bruges. In total more than 150 km of the locally functional bicycle route network was examined.

Hypothesis

By using the measuring bike, the aim of the city of Bruges was to collect information on the quality and comfort of their bicycle infrastructure. Objective information about the quality of the cycling infrastructure allows the city to create a priority list concerning future projects (e.g. installation of new cycling infrastructure or the reconstruction of particular roads or cycle paths).

Data sources

- Results of the data collection of the measuring bike (incl. internal discussion notes of the city council)
- Good practice example of the Province of Antwerp
- International literature
- Interview with project managers about the evaluation of the pilot

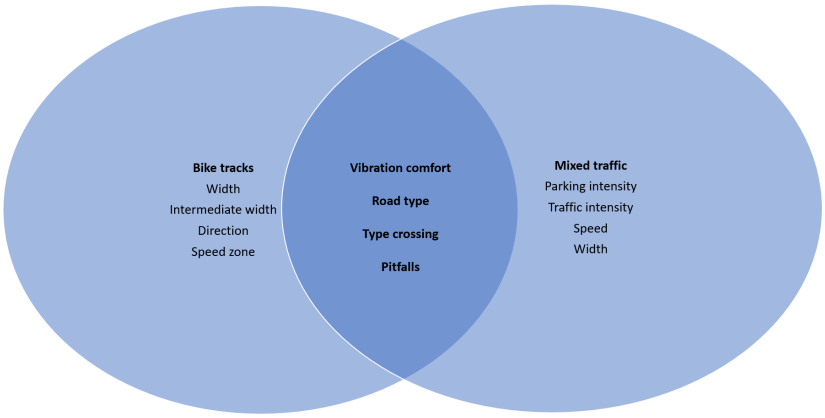
Analysis

Report of the pilot

In 2020 and 2021, on six days in total, the measuring bike cycled on 150km of cycle paths in different part of the city of Bruges. The measuring bike gives a clear objective picture (roadmap) of the characteristics

and quality of the existing cycling infrastructure, but also of the road infrastructure where the cyclist is led in traffic.

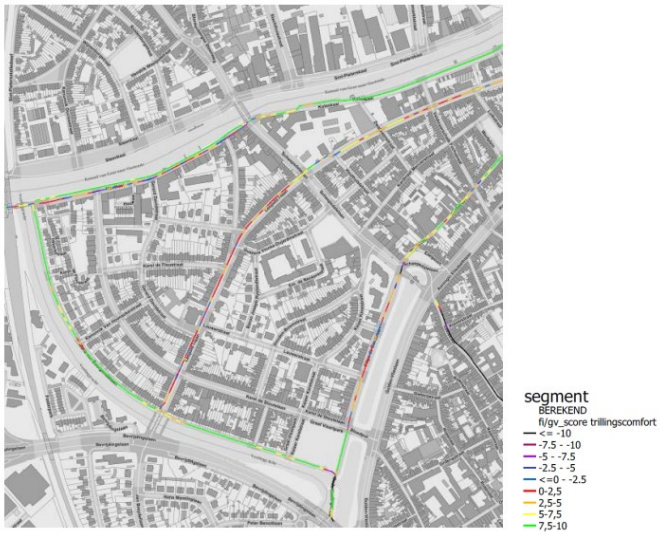
In particular, the measuring bicycle systematically registered and continuously measured several variables (e.g. road type and material, width and vibration comfort, crossing type, regulatory/non-regulatory intersections, weighted mixed traffic score) for every 12.5m of the cycling route, with a photographic registration per 40m.



Source: Fietsbarometer, Province of Antwerp (2017)

The results were analysed by the city of Bruges. The results of the measurements draw attention to the fact that not all infrastructure is properly built, designed or maintained. The registrations in 2020 and 2021 both showed that the choice of material and the quality of execution determine the comfort of the cycling infrastructure. In particular, asphalt seems to be preferable for the construction of cycle paths and roadways for mixed traffic in order to improve comfort of cycling. Concrete

is a second, but less preferable option. Natural stone is not recommended unless it concerns sawn natural stone (e.g. cobblestone) which is executed in a high quality including narrow filled joints and levelled correctly. In addition, the measuring bike shows that a conscientious monitoring of the flatness during and after the construction work is recommended. When zooming in on the roadmaps of the city centre, it also became clear that speed bumps (see picture) may have a clear negative impact on cycling comfort. Furthermore, while asphalt results in the highest cycling comfort, this material also carries a risk of cracking in the long term (e.g. due to tree roots or decreasing quality). Clearly, the quality of asphalt surfaces also may differ significantly. In general, the most problematic areas causing the highest level of vibrations are surface roughness (e.g. concrete, natural stone, cracked asphalt) and speed bumps.



Example of a roadmap – level of vibrations

Next to the results of the data collection of the measuring bike itself, the city of Bruges puts forward the usefulness of the measuring bike as an instrument in evaluating the quality of the construction at the point of delivery. Using the measuring bike as an instrument to measure comfort and safety of the infrastructure upon delivery is particularly recommended in case of the use of natural stone and concrete. For constructions in asphalt, the measuring bike may be used in cases of observed inconsistencies during a regular bike test by an employee.

Impact

Cycling infrastructure and, in particular, a well maintained and constructed pavement surface may contribute to a safe and comfortable ride. Vibration is not a desirable feature for cyclists. Therefore, vibration due to the infrastructure that is not properly built, designed or maintained, is perceived as discomfort during the ride (Gogola, 2020). Also, defective pavement surfaces and insufficient maintenance can expose cyclists to health risks through accidents or injuries such as excessive hand arm vibration, problems with the back or other parts of the body (e.g. saddle pains) and even stress (Bayram et al., 2018; Gadsby et al., 2021).

In general, bicycles are mostly designed for urban environments (e.g. city and urban bicycles) and are not equipped with the suspension to reduce the vibration. While wearing gloves, adjusting tyre pressure (or

tyre type) or avoiding specific routes which require riding over defective pavement surfaces all seems to be used by regular cyclists to improve the comfort, the importance of the pavement surface design and maintenance condition is still paramount in influencing the overall extent of cycling in cities (Bayram et al., 2018).

Given the objectives of the BITS project, the uptake of cycling by non-cyclists or the increase of cycling by the cyclists can only be realized indirectly by this type of ITS. More specific, as supported by the literature (e.g. Foster et al., 2011; Gogola, 2020), an improved quality of the cycling paths may generate improved comfort and less health risks which may stimulate cyclists to cycle more. Hölzel et al. (2012) even concluded that improving the bikers comfort, for instance through cycling pavement surfaces constructed from asphalt, may encourage a greater uptake of cycling by new cyclists. Accordingly, we assume that an increase in cycling use may be expected and realized in the long term, not at least because this type of ITS helps to ameliorate some of the risks of cycling as well as to develop reasoned cycling policies in municipalities. In short, we can conclude that improved safety in the wider area in the long term will eventually lead to an increase in cyclists.

Experiences project managers

An interview with the project manager took place in May 2022. Several **positive aspects** of the measuring bike were mentioned in the evaluation meeting. First of all, the project manager highlighted that the data resulting from the measuring bike provides objective information about the comfort of the cycling infrastructure at that point in time. Objective information is very valuable to evaluate the cycling paths and roads in the city centre in addition to subjective information such as complaints, notifications or subjective experiences of citizens. Also, the details of the information provided by the measuring bike proved to be valuable. It makes clear that the surface quality can be very different, depending on the type of material as well as the way it is constructed. Secondly, as another positive aspect, this type of intervention is easy and quick to implement. Once the measuring bike is ordered and is riding in the city centre, the information about the comfort becomes available quickly. This is particularly helpful in evaluating the quality of new or reconstructed roads or cycle paths upon delivery. Thirdly, the fact that the measuring bike is provided by a trusted external partner (i.e. Fietsersbond) makes that any problems or failures, technologically or other, are not on the account of the city. Also, the selection of and the decision about the best provider of the measuring bike has been considered very easy. Fourthly, a team with targeted expertise in mobility at different locations in the city centre proved to be very useful to select the areas where the measuring bike could be used. Other objective data such as countings were not yet available to make this selection. Similarly, complaints or notifications made by citizens in the online portal were considered not directive/clear enough to take them as a point of reference. Such expertise also allows to update the hotspots or locations quite easily when using the measuring bike in the future.

According to the project manager there are hardly any **negative aspects** or problems related to the measuring bike. The cost of the measuring bike and the fact that you depend on an external partner are both mentioned as minor disadvantages. A pitfall of this ITS may possibly be any technological improvements of this type of intervention. For instance, it will be important to be aware that the way of measuring remains the same over time. If other types of measurement or other forms of technology are

used by the measuring bike in the future, it will downsize the added value of the ITS intervention in observing objective trends in surface quality of cycling infrastructure.

Overall, the **goals of the pilot are reached** according to the project manager. The project manager would definitely recommend this ITS intervention to others. In particular, due to the measuring bike, it is possible (1) to have insights into the comfort of particular cycling infrastructure by analyzing the surface quality very thoroughly, (2) to evaluate new construction projects upon delivery, and (3) to decide upon new projects or policy priorities in the future (e.g. information about the bad cycling infrastructure can be placed on the political agenda). The ITS intervention may help to improve the cycling comfort and, as such, this may motivate people to cycle more. Indirectly, this intervention may lead to more cyclists or to a reduction of CO2 emission.

Conclusions

With the results of the pilot, the city of Bruges is provided with information about the current status of road surface for cyclists. By using the measuring bike, it is possible to process relevant data, to evaluate old and new infrastructure quality regularly and to enhance the level of road network maintenance for cyclists. As such, we can conclude that the main goals of this pilot are reached. However, to keep in mind, still different measuring systems exist and are often not comparable. It is worth mentioning that, in another BITS pilot, the province of Antwerp and the university of Oldenburg are working on a tool which has the potential to compare the results of different surface quality measuring systems.

Publications

Bayram J., Taylor M. & Oliver C. (2018). *A study of cyclists hand-arm vibration exposure*. Paper presented at UK Conference on Human Responses to Vibration 2018, Ascot, United Kingdom.

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