BITS
Bicycles and Intelligent Transport Systems

Evaluation report

Bike chain
Province of Overijssel

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Project coordinated by Province of Overijssel

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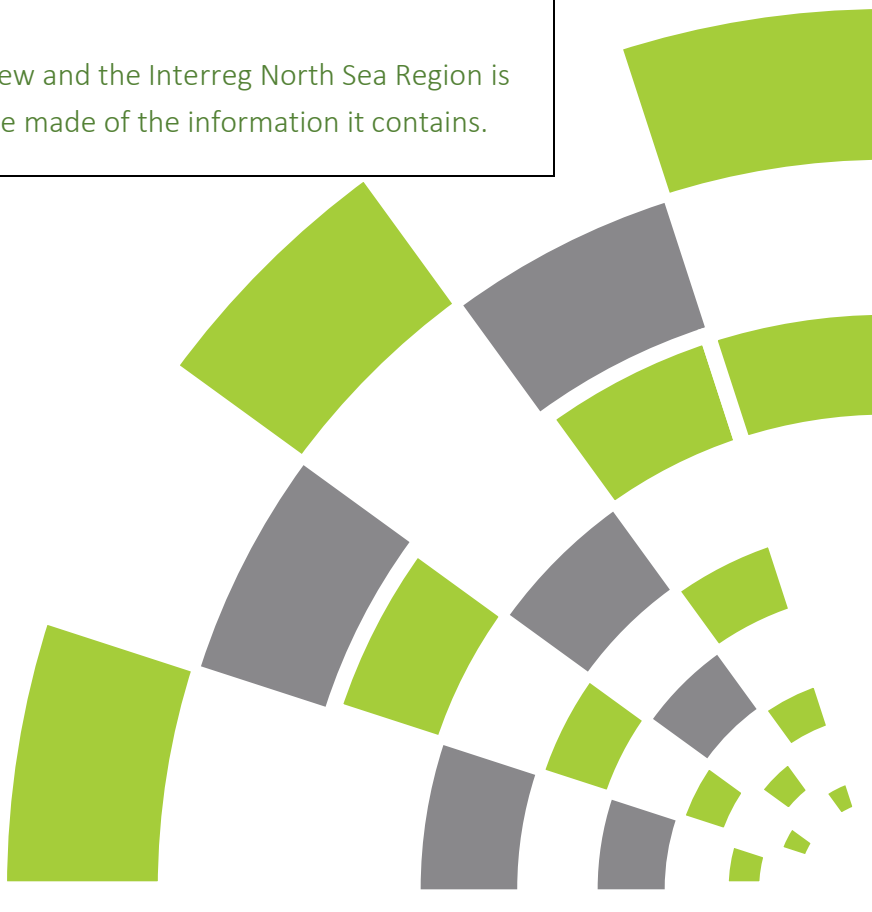

Interreg North Sea Region BITS
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Short description

The bike chain ITS implementation stimulates cyclists to cycle in a group and to reduce speed differences when approaching traffic lights. When three or more cyclists form a group when approaching the traffic light, they get priority green. This should increase convenience of cycling.

Type of ITS

Camera system detecting groups of cyclists.

Timeline

The ITS implementation was prepared during the last months of 2021 and the beginning of 2022. On 9 May 2022 the pilot was officially opened. In the first weeks, the system experienced some problems and had a few time periods the system wasn't working among others due to extreme weather conditions and vandalism. On 30 June, experiences of users were collected via a user survey.

Hypothesis

The system motivates cyclists to form a group and if they do so, they get priority green and can pass the traffic lights faster. They thus don't need to stop and this will increase their speed and convenience of cycling. Cyclists will get more motivated to cycle.

Data sources

- Preparational and evaluational meetings with the project managers, both from the Province of Overijssel and from Sweco.
- Statistics on total amount of cyclists, waiting times, traffic intensity, amount of vehicles crossing a red light etc.
- Results of the user survey

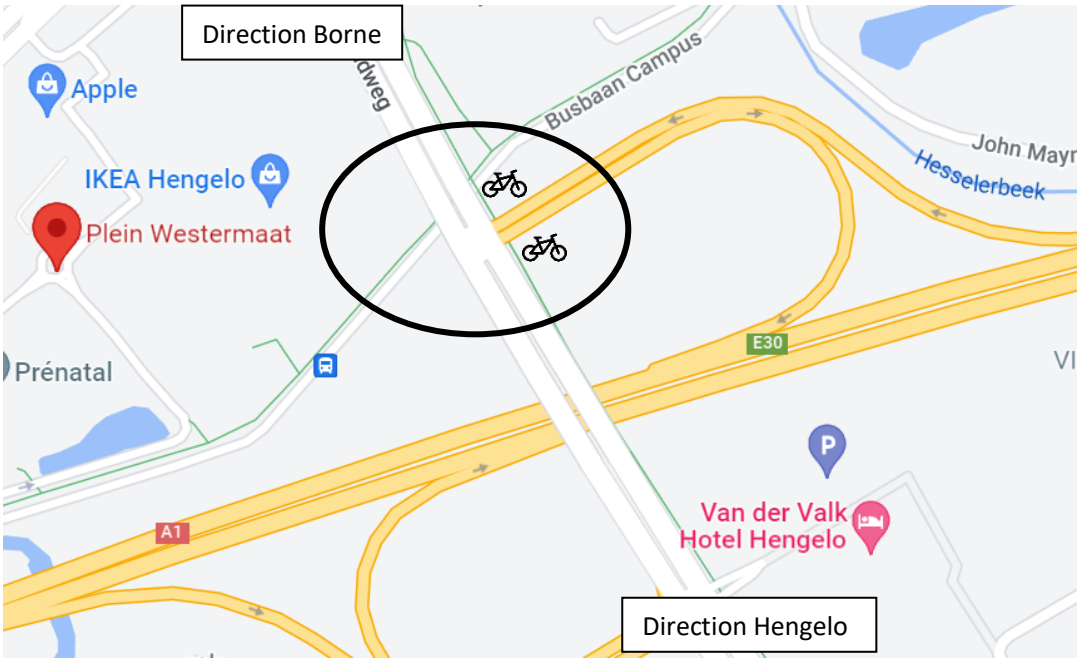
Analysis

Report of the pilot

Following an intensive preparational process from the side of Sweco, the responsible company, and in consultation with Province of Overijssel, responsible partner within the BITS project, and with VIVES concerning the evaluation, the bike chain was officially launched on 9 May 2022. With a press release and in attendance of the responsible alderman, the ITS implementation was opened. The bike chain is implemented on the N743 between Hengelo and Borne, where the N743 crosses the northern driveway of the A1 (see image below). This is a bi-directional cycle path and the bike chain also works in both directions. This is a busy intersection both with traffic going on and off the A1 and with traffic between Borne and Hengelo and thus with often longer waiting times for cyclists.

This is an overview of the six driving directions that will be used in analyses below:

- Fc09: traffic on N743 coming from Borne and going left to A1
- Fc10: traffic coming from A1 and going right in the direction of Borne
- Fc12: traffic coming from A1 and going left in the direction of Hengelo
- Fc61: traffic on N743 coming from Hengelo and going right to A1
- Fc27: cycle path from Borne to Hengelo
- Fc88: cycle path from Hengelo to Borne



Due to storm weather and vandalism during some days the cameras weren't working. On the southern path, the camera wasn't working between 20 May 2022 (starting on 15:26h) and 31 May (ending on 07:05h). On the northern path, the camera wasn't working between 26 May 2022 (starting on 03:19h) and 17 June (ending on 09:16h).

Different relevant indicators can be studied using the data that was collected by the cameras. A first indicator is **the traffic intensity**. Comparing a time slot at the end of June (i.e. working days between 21 and 30 June 2022) and in the beginning of September (i.e. working days between 5 and 16 September 2022) with a time slot before the bike chain was installed in April (i.e. working days between 4 and 15 April 2022), we see an overall decrease in the amount of vehicles with 6,01%. A decrease going from 534 to 500 vehicles in absolute numbers on average per day after installation was noticed compared to the reference period before the installation. Important to note here is that the weather in April, the reference period, was rather wet and cold compared to warmer and dryer summer weather at the end of June and the beginning of September.

Since we have no exact numbers during the same measurement periods for cyclists, making comparisons here is harder. Unfortunately no exact counting data are available on the amount of cyclists before and after installation of the ITS system. We do however have some bicycle counting data during May and June 2022 (months in which the bike chain was most often operational) and from these data we conclude that more cyclists use the cycle path from south to north (thus from Hengelo to Borne), i.e. about 7% more in that direction. Next to that, three times as many cyclists were counted on weekdays compared to days in the weekend. More than 400 cyclists on average per day were counted during a weekend day compared to over 1500 cyclists on average during a weekday.

Information on the **average waiting time for the first driver** is also available. This waiting time starts the moment this driver arrives at the red light and runs until he or she gets a green light. When analysing the data of the four driving directions for vehicles, two directions experience a shorter waiting time for the first driver waiting during traffic hours (i.e. between 07:00h and 09:00h and between 16:00h and 18:00h) after installation. In these hours, fc09 has an average gain of 9,4 seconds and the fc10 had a small gain of 1,3 seconds. The two other directions experience a longer waiting time for the first driver waiting of 6,4 and 5,3 seconds after installation of the bike chain. The cyclists also experience an increase in waiting time for the first arrived cyclist after installation. One driving direction has to wait 4,2 seconds longer, the other 3,6 seconds. For all the directions with an increase, these waiting times increased with 18 to 31%.

Table 1: Average waiting times (in seconds) during traffic hours (7-9h and 16-18h) before and after the installation of the bike chain.

	Pre installation (in sec)	Post installation (in sec)	Difference in sec (%)
Fc09 (vehicles)	42,5	33,1	-9,4 sec (-22%)
Fc10 (vehicles)	15,5	14,2	-1,3 sec (-9%)
Fc12 (vehicles)	33,1	39,5	+6,4 sec (+19%)
Fc61 (vehicles)	17,3	22,6	+5,3 sec (+31%)
Fc27 (cyclists)	19,4	23,6	+4,2 sec (+21%)
Fc88 (cyclists)	20,0	23,6	+3,6 sec (+18%)

Taking a look at the waiting times during the day hours for cyclists (i.e. between 06:30h and 20:00h), these increased with 2,8 and 2,2 seconds. The partners from Sweco were not surprised by the increased waiting times for cyclists, since due to the bike chain in general more cyclists get green and can pass. In the less

occurring case that someone has to wait at the traffic lights, this is slightly longer than it used to be before the installation.

The **numbers of vehicles driving through a red light** unfortunately increased after installation of the bike chain. The total amount of drivers crossing a red light goes from 1,46% before installation to 1,63% after installation on average per day. In absolute numbers, this are 62 vehicles on average per day. For one driving direction the amount of vehicles crossing red slightly decreased with 5,7%. For the other directions the amount of vehicles crossing red increased with 2,9%, 27,1% and 34,8%. This is a total increase of 11,9%. This is an unfortunate consequence of the bike chain.

Remarkable as well is that almost twice as many people are crossing red when they are driving in the direction of the A1, compared to the other two directions coming from the A1. This phenomenon did not change due to the installation of the bike chain and was already a determination before.

Table 2: Average amount of vehicles crossing a red light daily.

	Pre installation	Post installation	Difference
Fc09 (vehicles)	21 (0,41%)	19 (0,38%)	-5,7%
Fc10 (vehicles)	10 (0,24%)	12 (0,31%)	+27,1%
Fc12 (vehicles)	9 (0,48%)	9 (0,49%)	+2,9%
Fc61 (vehicles)	18 (0,33%)	22 (0,45%)	+34,8%
TOTAL	**58 (1,46%)**	**62 (1,63%)**	**+11,9%**

Finally, we take a look at the **total cycle time** before and after the installation of the bike chain. This is the time the green light starts for a certain direction until the start of the next green light for this same direction. We'll discuss the average of traffic hours (07:00h-09:00h and 16:00-18:00h) and the average during daytime (06:30h-20:00h). All details can be found in Table 3. During traffic hours, the total cycle time decreased for one driving direction for vehicles with 2,2% and increased for the other three directions for vehicles with 2,6% to 13,7%. In seconds this is an increase of 1,3 to 9,9 seconds. Focusing on the cyclists, a decrease is found of 6,8% and 11,2%, which is 5,8 and 12,2 seconds. During traffic hours, drivers on the fc12 experience a greater loss compared to the gain of the cyclists.

Table 3: Total cycle time before and after installation, during traffic hours and during daytime.

	Traffic hours (7-9h and 16-18h)				Daytime (6h30-20h)			
	Pre (in sec)	Post (in sec)	Difference (in sec)	Difference (in %)	Pre (in sec)	Post (in sec)	Difference (in sec)	Difference (in %)
Fc09 (veh)	73,9	72,2	-1,6	-2,2%	61,3	63,2	+1,9	+3,1%
Fc10 (veh)	52,5	53,9	+1,3	+2,6%	44,7	47,0	+2,3	+5,2%
Fc12 (veh)	72,7	82,6	+9,9	+13,7%	73,5	80,0	+6,4	+8,7%
Fc61 (veh)	61,1	66,1	+5,0	+8,2%	51,2	55,6	+4,4	+8,6%
Fc27 (cycl)	85,1	79,3	-5,8	-6,8%	106,0	89,9	-16,1	-15,2%
Fc88 (cycl)	108,7	96,5	-12,2	-11,2%	105,4	91,9	-13,4	-12,8%

During daytime, the numbers follow the same pattern. For the four directions of vehicles an increase of total cycle time was determined. This was however a rather small increase of 3,1% to 8,7%, or of 1,9 seconds to 6,4 seconds. The cyclists however experience a shorter total cycle time of 13,4 and 16,1 seconds. In percentages, this is a decrease of 12,8% and 15,2%. We can conclude that the cyclists gain more than the vehicles lose due to the installation of the bike chain.

Next to the numbers on waiting times and priority green, experiences of users have been collected through a **short survey**. Users were addressed on the road, while passing the intersection with the bike chain and asked for their feedback. On 30 June 2022, a sunny day, data was collected during six hours and 30 minutes, in the morning and in the afternoon. In total, 232 cyclists gave their input.

An important nuance before the results of the survey are shared is that most of the cyclists who have given their feedback were cyclists standing still exactly at the intersection of the bike chain. This means that these cyclists didn't get green light and had to wait, which could have an impact on their given feedback. Therefore, also some cyclists were asked for input at a intersection before and after the 'bike chain intersection'.

If we look first at the profile of the surveyed participants, 56% of them is a male and more than 50% of the respondents is a commuter. One out of three is a student. Tourists, people doing shopping or sporting form only very small groups among the respondents.

Cyclists were asked for their general opinion on the bike chain. 46% indicated they found it a good to very good initiative. One out of three remained neutral about it and 19% evaluated it bad to very bad. 60% of the respondents didn't agree they went faster with the bike chain and 88% indicated they wouldn't be using their bicycle more often because of the bike chain. 93% even indicated they wouldn't leave their car or another motorized vehicle at home because of the bike chain. On the other hand, 64% of the respondents think it's a good idea to roll out the system on a larger scale in the city. One out of three indicates to be cycling with unknown people to form a group and receive faster green.

We can conclude that almost 50% of the users is positive about the bike chain and would like to see it more often in the city. However, not all cyclists believe they travel faster due the bike chain and it mostly doesn't motivate them to cycle more often or to use the bicycle instead of the car. One third of the cyclists cycles with unknown people to receive a green light. An important nuance here is that the experienced gain for cyclists could be limited since the bike chain is only installed on one intersection.

Impact & conclusions

The objective of the bike chain in Hengelo was that when motivating cyclists to cycle in a group, they could pass the traffic lights faster. Their speed and convenience of cycling would thus be increased and this would eventually motivate them to cycle more.

Based on the analyses made above, we can conclude that the total cycle time (the time between the start of a green light and the start of the following green light for one direction) increases slightly for vehicles, but decreases more significantly for cyclists. We can conclude that this is a win-win situation, since the system of the bike chain works for cyclists and gives them priority on the one hand and on the other, the

overall impact on vehicles is limited. We do however notify a longer waiting time for the first driver arriving at a red traffic light, also among cyclists and we determined more vehicles crossing a red light since the installation of the ITS system. Looking at the subjective experience of cyclists, the majority of them doesn't have the feeling they travel faster and the bike chain wouldn't motivate them to cycle more often or to choose the bike instead of a motorized vehicle. However, two third of the respondents think it's a good idea to roll the system out on a larger scale. These conclusions don't contradict each other: the experienced effect of only one traffic light with the bike chain will be rather small for the cyclists. If however this ITS implementation would be rolled out on a longer route with several traffic lights following each other, the effect for the cyclists would be much larger and cyclists would actually experience the difference.

Taking a look at the BITS objectives, no conclusions can be made concerning the target of 10% increase in take-up of cycling among target groups. Since no data is available on the total amount of cyclists before and after installation, we cannot make conclusions on this objective. Using the survey data, however, 12% of the respondents indicated to use their bicycle more often due to this ITS implementation, so a potential increase in cyclists could be expected based on this survey. The second objective, concerning a decrease of 9% of CO2 emission, is also hard to check. We notify a decrease of 6% of motorized vehicles in the post installation period compared to the pre installation period. We can however not conclude that this is a direct consequence of the bike chain. On the contrary, it is more plausible that contextual factors, such as the weather, are the cause of this decrease compared to the bike chain itself. Moreover, potentially more vehicles waiting for the traffic lights could even have increased the CO2 emission on the intersection. This is however hard to measure since it depends on the amount of vehicles, the type of vehicles, the waiting times for different driving directions etc.

It was unfortunate that no counting data on the amount of cyclists before and after installation of the bike chain was available. Moreover, exact numbers on the amount of times the bike chain started working due to a group of three or more cyclists and gave priority to cyclists is also not known. An estimation can be made, but in the case of two groups riding closely behind each other, the traffic lights remained green and this was counted as one action, while in reality two groups passed by. Moreover, due to external factors, the systems was a few times not working. What the potential impact was on the loss of credibility among users was not measured and is hard to measure as well. However, it would have been interesting to be able to take this into account as well.

This system was introduced on this specific intersection. It will be interesting to investigate the similar or different impact it has in a totally different context, for example in a city centre or on an intersection with less cyclists. This will be a topic for future research.

Experiences project managers: lessons learned

- What do you think are positive aspects of the pilot? What are aspects that went smoothly and well? What do you think is the added value of this pilot?
  Cooperation between government, suppliers and consultancy firm. Communication to the outside world about the ITS implementation, including press release and presence of the press and alderman at the opening. There was a behavioural campaign before and during the trial,

including extra signage, to point out the working method of the Bicycle Chain to cyclists. All this has been important for the success of the test.

- What problems have you encountered? What barriers have you encountered?
  Corona pandemic, as a result of which the representativeness was not always optimal and the pilot had to be postponed. Due to storm damage and vandalism, the system did not work for about 3 weeks. Occasionally the (wireless) connection was lost, so the system did not work. This can be at the expense of credibility and reliability.
- Has the pilot achieved its goal?
  Yes, the goal was to determine whether it was possible to influence the behaviour of cyclists through reward. This appears to be possible and, in addition to the data analysis, has also been shown by an experience study.
- What recommendations do you make to others?
  Make sure that from day one there is a credible and reliable system, this promotes follow-up behaviour. Always combine the Bicycle Chain with communication and a behavioural campaign. In addition to prioritizing groups of cyclists, more comfort to individual cyclists can also be considered during the quieter hours.