# Executive summary - Mobilidata Monitoring and Evaluation

In the Mobilidata program, governments, companies and researchers work together to bring innovative technological traffic solutions to the road user. These should bring benefits to end-users such as increased safety, smoother traffic flow and reduction of emissions. The task of Monitoring & Evaluation, integrated into project A – Mobilidata core, is to assess whether these objectives are achieved in a demonstrable and socially responsible manner. Project A consists of the implementation of numerous C-ITS use cases, the entire Mobilidata system architecture - except for the intelligent traffic light controllers - and the MobilityAnalytics component. Monitoring & Evaluation is also important for the activities in project B – iTLCs.

Within Mobilidata, many use cases are being rolled out in Flanders. These use cases are divided into four different groups of services: (i) warning services, (ii) prioritisation/traffic light services, (iii) information services and (iv) road code services. Monitoring & Evaluation focuses on several elements that together allow to verify the impact of these services: (i) Technical monitoring, (ii), data quality, (iii) acceptance, acceptability and use, (iv) behavioural change, (v) societal consequences and (vi) business models. Elements (i), (ii) and (iii) are the absolute prerequisites for having a behavioural impact (iv). A behavioural change is the basis for a societal impact (v), which can leverage strong business models with collaboration between public and private stakeholders (vi).

**Technical evaluation**

From a technical perspective, the Mobilidata programme is evaluated positively. The system as a whole, its capacity and reliability at component level are continuously monitored. Each quarter, an evaluation report on the performance of the communication to vehicle applications, the communication between the different Mobilidata packages (Public Information Provider, Interchange, Traffic Light Interchange, Context Adapter and Context Broker), the application functionality and performance is produced.

In addition to this reporting in the context of Monitoring & Evaluation, the various components of Mobilidata (PIP, MI, TLEX, etc.) are continuously monitored with the aim of proactively guarding processes that run into e.g. resource constraints. This monitoring is crucial for a program where reliable services are rolled out on a large scale as a product, a positive change from previous pilots or test projects. The product, rather than project, nature of many of those components and the growing number of service providers and end users encourage the private partners to continuously improve and refine this real-time monitoring.

Based on the monitoring of several relevant KPIs, it can be concluded that the technical backbone for the Mobilidata programme meets the set expectation. In addition, particular attention was given to the deployment of services on the ground: strict acceptance tests

ensured that no service was rolled out without verifying the practical and technical functioning of the services as experienced by an end user.

Over the past year, a degree of availability of the various technical components was achieved that complied with the agreed SLA. This means the following for the different components and services, once they are operational:

- TLEX: 99.9% availability
- Priority Configutor & Validator: 99.5% availability
- Mobilidata Interchange: 99.9% availability
- Other components and services: 99.5% availability
- In addition, the permitted downtime for scheduled maintenance was also met (max. 15 minutes, once a month; max 4h once a year).

The original objective of the programme to achieve 250 iTLCs was almost achieved at the end of the programme. By 30 June 2025, 201 iTLCs were operational, which had grown to 224 by 31 July 2025. By the end of August around 240 iTLCs were operational. The remaining iTLCs are in progress and will be realised in the near future. With this, approximately 1 in 8 traffic lights arranged intersections in Flanders are equipped with an iTLC.

**Data quality**

Data quality is an important factor for the success of C-ITS services. The Mobilidata programme examines them in different ways. On the one hand, a comparison is made between different public data sources (GIPOD, traffic sign database, accident information) and (private) data sources compiled based on user communities (e.g. Waze).

The importance of such public sources should not be underestimated. Several services deployed under Mobilidata are almost exclusively dependent on public data sources. This is the case, for example, for services connected to intelligent traffic light control systems (iTLC), dynamic speed limits etc.

For services where both public and private data sources provide a meaningful basis, extensive statistical information shows that the added value of the public data sources is real, but at the same time rather limited. Often more relevant, accurate or complete information can be displayed to the end user based on a community-based data source. The added value of public data sources can then mainly be found in three elements: (i) include future issues in the map data (e.g. planned road works), (ii) provide information on locations where there are few “community” users, and (iii) report incidents or accidents. The selective further development of public sources, particularly where the added value compared to community-based data sources is greatest, therefore seems appropriate.

A strength of Mobilidata lies in the possibility for service providers to enrich and offer the information available through the Mobilidata Interchange to end users themselves. This is what was done in practice in the connected applications for the various services. Based on

end-user surveys, it appears that the vast majority of end-users are satisfied with the data quality. Alerts and other notifications are considered timely, relevant and correct. This is an indirect statement about the quality of source data, which supports the acceptance and use of C-ITS notifications.

**Acceptance, Acceptability and Use**

Before and after the use of the C-ITS services rolled out in the Mobilidata programme, end-users are extensively questioned about their attitude towards these services. This happened to users of the applications on which the Mobilidata use cases were rolled out.

- **Alert services (risk notifications)** are perceived as very useful and user-friendly. More than 80% of the users surveyed found that the application contributes to factors that improve road safety by alerting drivers to danger, making drivers more alert and allowing them to make better decisions. This also confirms the claim that the service has a positive influence on driving behaviour.
- The experience with the **Traffic Light Service (services connected to intelligent traffic lights)** is positive. More than 80% of users indicate that these services allow them to set neutral or customized behavior based on the information about the traffic lights they receive. There is still room for improvement, but that strongly depends on the method chosen by the application builder to bring information to the user (HMI: human-machine interface). Focus groups confirmed overall satisfaction, especially with priority for emergency services. For other groups, such as public transport and freight traffic, there was support with some nuances. Technology is considered crucial to assign priority dynamically and fairly. Opinions on the environmental impact differ depending on traffic.
- The **road code service (reporting traffic rules, such as speed limits)** is assessed critically, in particular its timing and user-friendliness. Again, it mainly depends on the human-machine interface chosen by the application builder. During focus interviews, it was stressed that the service is useful for traffic warnings and compliance with rules. This user experience is strongly related to the quality of the source data: the better the data quality of public data, such as the traffic sign database, the better the user experience will be. The application has a positive impact on road safety, as notifications help drivers adjust their speed and response time.
- Users' expectations and experiences with the **Information Service** were largely similar, with only minor differences. Users rate the timing of notifications and the ease of use after use neutrally. Based on preliminary studies, before users had experience with the services, better results were expected. This also depends heavily on the quality of the source data. Focus groups confirmed that the service is generally assessed positively, but there is room for improvement, especially in

personalisation and customisation to individual preferences in terms of the timing of the notifications.

**Behavioural change**

A key objective of Mobilidata is to achieve safer and more sustainable mobility, with smoother traffic and better flow through the roll-out of C-ITS services and iTLCs. To achieve this, it must be assessed that (positive) behavioural changes take place. In the context of Monitoring & Evaluation, tests have taken place that can demonstrate this, although severely limited by restrictions imposed for privacy reasons or restrictions imposed by the timing of the deployment of the C-ITS services. The behaviour of users of C-ITS warning services was compared with the behaviour of road users who do not use these services, in particular shortly before, during and after approaching a location where a C-ITS warning was issued. Specifically, these services are interesting in terms of behavioural change because they explicitly warn users about security risks.

These tests show that users of the warning services often adjust their behaviour, either in speed driven or in braking behaviour. As an example, we take the warning for tail ends of traffic jams. For this type of warning, we find a speed difference: between the notification and the crossing of the event, the speed of an informed user decreases by 4km/h more compared to the speed of an uninformed user . For some other types of warnings, we find improved braking behaviour.

Regarding the monitoring and evaluation of road safety and traffic flow, the introduction of intelligent traffic light control systems (iTLC) is a two-sided story. Road safety and flow are integrated into operationalisation in such a way that a quantitative comparison with existing control installations is not possible: some parameters, which have an impact on road safety but do not depend on the technology used (iTLC vs. existing installations), are otherwise operationalised. Parameters that have an impact on road safety when handling the light phases are minimally unchanged from existing installations at iTLCs, and in some cases even stricter. This means that a one-to-one comparison is not possible.

However, at a qualitative level, the potential impact of iTLCs in terms of road safety can be looked at. After all, when deploying, it is checked whether all known parameters, which have an impact on safety, have actually been correctly implemented. This means that the approach to partial conflicts, intergreen times, intermediate red times etc. is at least equivalent, and sometimes even handled ‘safer’ than with the relevant existing installations. This statement can be accepted based on traffic-technical parameters.

In addition, in the long term, it can also be looked at whether fewer, equal or more accidents are reported at different intersections with iTLCs. However, this is outside the duration of this M&E action. It can already be noted that through the use of iTLCs, several use cases are implemented that certainly have an impact on road safety, e.g. through the absolute prioritisation of emergency services. Expert users (with relevant expertise in the field) have

tested the various systems in the field and have not found indications for poorer road safety. Under good conditions, greater variability in the light phases can also lead to a smoother flow, which is indicated by experts as an important condition for fewer red-light negations.

Public coverage took place as part of the prioritisation of emergency services to iTLCs . It briefly and powerfully outlined the benefits for priority vehicles: helping to prevent traffic dramas by accompanying priority vehicles on smoother and safer crossings, with the green light. In 97 % of the affected sections, the intersection was cleared off other traffic and the emergency service vehicle was able to drive safely through greenery.

Based on traffic parameters, this stricter (road safety) starting position could have an impact on flow. We note that this was not examined in practice in scenarios that aimed for a direct comparison. The phased roll-out of iTLCs, combined with the unsuitability of allowing road users to continue driving in suboptimal conditions, has not been tested against a control group (non-iTLCs with similar crossroad characteristics, but with potentially less stringent safety parameters).

However, the approach behaviour and waiting times of road users using C-ITS services supported by Mobilidata could be tested. The results do not allow us to conclude with absolute certainty that reporting time-to-green has a positive effect on the way users approach an iTLC-equipped intersection. However, we do find indications for this. We find significantly lower waiting times for users of the so-called time-to-green service. These are indicative of improved flow.

The combination of these findings leads experts to indicate that an improved balance between road safety on the one hand and traffic flow on the other seems to be supported by the introduction of iTLCs. In particular when there are free-flow conditions, when a clear and selective reduction in waiting times is possible compared to pre-defined restrictions, and when there are sufficient connected road users, a significant improvement is possible (as reported earlier yielding up to a 20% reduction in waiting time).

An absolute comparison between TLC and iTLC, especially in terms of flow, was not possible. The comparison of on the same basis (parameters) between (possibly very) dynamic iTLCs and a very well thought-out Vplan designed to fit a specific traffic situation was not possible. It is correct to assume that both iTLC and TLC are limited by saturation (or close to it). However, the intrinsic dynamics of iTLCs (and possibly simple adaptability / adjustment) allow to continue to achieve that performance better and more efficiently, even if traffic demand changes. In addition, the iTLC is a tool that allows the (local) traffic policy (which can be dynamic in time and space) to be concretely translated into practice. In other words: in order to achieve a better flow (service provision) for specific target groups under certain conditions, iTLCs are most likely to be preferred (e.g. for absolute priority 24/7 for priority vehicles, or faster and longer green for cyclists in the morning rush hour on routes that facilitate many cyclists, more tailor-made green for trucks in and out of the port, etc.). Some

of the functionalities require connected road users, others can reach a certain level based on the current detection but only reach their full potential with connected road users.

**Social impact**

The social impact of Mobilidata can be extrapolated based on the individual behavioural changes (measured) and indicated acceptance and use of the C-ITS services. To this end, a quantitative analysis was carried out using the C-Roads model, as well as a qualitative analysis using literature research. Variation in the final use (penetration) of the C-ITS services deployed in Mobilidata was explored in different scenarios. The penetration rate varies across scenarios between 25.70% use (minimum) and 50.61% use (maximum) in 2040.

In all scenarios, thanks to the C-ITS services within Mobilidata, the social consequences have a very positive net result. For the use cases that could be analysed using the C-Roads model, especially the services that report risks to road users, the net present profit (the expected cost savings) over the period from 2021 to 2040 is between +159 and +220 million euro, representing an average of +8,3 to +11,6 million euro per year (net present profit/20y). Over the entire duration, the benefits are between 16 and 25 times as high as the costs. This result is even more positive if we also look at things that are not included in the C-Roads model, such as improved traffic light flow and a more reliable traffic and transport network.

A remark about this result is that the positive effects often do not translate to a direct financial gain for the government, in contrast to the costs that are incurred by the government. Effects such as a decrease in the number of fatalities, a decrease in the number of traffic jams and an improvement in the flow of traffic lights are positive for society. In addition, possible infrastructure savings, thanks to the deployment of C-ITS services, have a direct impact on the budget of the mobility and public works policy area, but these are more difficult to specify in terms of level and timing compared to costs.

**Business models**

Creating viable and sustainable business models is a complex but necessary process to make the large-scale deployment of C-ITS services as sustainable as possible. This is achievable if there is sufficient focus on cooperation, scale and social benefit. C-ITS services offer tangible added value in terms of road safety, traffic flow, environmental benefits and comfort for road users. They influence effective behaviour and generate significant social benefits. Their success depends heavily on the technical reliability, timing and acceptance by users. In particular, user acceptance can be reflected in scale: the more users, the more reason there is for (e.g.) service providers to make an effort.

A single business model is not enough to cover all applications. Given the variety of stakeholders involved (governments, professional users, individuals, service providers, OEMs, etc.) and their different interests and earning opportunities, a hybrid approach is necessary. This means that a main business model with common building blocks is appropriateto which

specific refinements per use case group are added. These should allow to reach a sufficient scale.

Central to this main business model is the public-private partnership, in which governments invest in infrastructure, data quality and policy anchoring, while private parties add value through applications, services and customer-oriented innovations. This shared model offers sufficient flexibility to respond to developments in technology, market readiness and policy objectives. There is a good chance that a first step (investment) must be taken by the public stakeholders, which ensures a more impactful scale, which attracts private parties.

The benefits can significantly outweigh the costs, especially when the deployment is smartly structured with shared platforms, reusable infrastructure and economies of scale. The necessary preconditions are therefore clear: standardisation, interoperability, transparency, and a strong commitment to monitoring, quality assurance and user-centric design.