Data-driven transportation systems – Evaluation of a Delphi study

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TRANSPORT ANALYSIS

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Preface

During autumn 2024 and spring 2025, Transport Analysis conducted a Delphi study of data-driven transportation systems. An expert panel consisting of 115 participants assessed the importance of data-driven systems, key actors, system effects, and uncertainties. This memorandum summarises an evaluation of this study. The purpose was to validate the process and main outcomes of the Delphi study.

Tom Andersson served as project manager of the Delphi study and its evaluation, with Maria Melkersson as deputy manager. The work was carried out in collaboration with the Swedish National Road and Transport Research Institute (VTI), where Daniel Rudmark served as the main point of contact.

We extend our warmest thanks to all members of the expert panel who took the extra time to respond to our follow-up questions in the evaluation.

Stockholm, August 2025

Andreas Tapani

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Content

Summary

This evaluation assesses the implementation and outcomes of a Delphi study on data-driven transportation systems, conducted by Transport Analysis during 2024–2025. The aim was to identify key systems, actors, expected benefits, and uncertainties relevant to transport policy over the next 5–10 years. The evaluation is based on a web survey distributed to the 115 members of the expert panel, of whom 61 (53%) responded.

The findings indicate that the Delphi study largely achieved its purpose and objectives. A clear majority of respondents felt that the study addressed genuine knowledge needs and gaps, for instance, the lack of holistic perspectives on data-driven systems and national digital transport infrastructure. However, a few respondents viewed the broad approach as a limitation, pointing to the need for deeper discussions on organisational and technological issues.

The panel process was generally well received. Most respondents found the time commitment reasonable and the instructions clear. Some expressed a wish for more direct interaction among experts; however, this is inherently constrained by the Delphi method, which avoids direct discussion to preserve the independence of individual judgments. A future permanent national expert council on digital transport infrastructure would provide a more appropriate setting for in-depth expert discussions and informed decision-making.

We also asked participants for their views on three potential follow-up studies. Respondents prioritised an evaluation of national transport-related databases over impact assessments and market analyses of data-driven systems. This aligns with a key outcome of the Delphi study: the need to reinforce national digital transport infrastructure as a foundation for data-driven transport systems. In line with this, respondents called for stronger and more sustained public sector leadership.

The participants represented business, public authorities, and academia, with slightly higher participation from public authorities. This group also showed less differentiated preferences across the proposed follow-up studies, whereas support for database evaluation was more pronounced among business and academic respondents. This may reflect more uncertain priorities among transport authorities.

In open-ended comments, participants suggested future initiatives focused on governance frameworks, collaborative expert platforms, and real-world system demonstrations. These reflect a shared view that efforts must shift from short-term and siloed projects to long-term, coordinated action. Institutional capacity, rather than technological capability, is seen as the main bottleneck.

In summary, the evaluation supports the findings of the Delphi study – particularly the need for national governance of and investment in digital transport infrastructure. It underscores the importance of implementation-oriented efforts, including long-term planning, structured stakeholder engagement, regulatory alignment, and adequate resource allocation. System priorities must be translated into practice by setting targets and allocating funding for data-driven systems, e.g., national transport databases over a 5–10-year horizon.

1 Background

Digitalisation, connectivity, and automation are rapidly transforming Sweden's transport system. At the same time, there are voices raising concerns about a lack of national coordination and strategic governance in these areas. Against this background, Transport Analysis (2025) conducted a Delphi survey in collaboration with the Swedish National Road and Transport Research Institute (VTI).

The purpose was to identify key data-driven systems that can contribute to more efficient, safe, and sustainable transport systems in Sweden over a 5–10-year horizon, as well as to map relevant stakeholders, benefits, and uncertainties. Our main goal was to generate a knowledge base to support policy development and national implementation of the EU ITS Directive and the EU's data and mobility strategies.

A total of 115 experts participated from industry, public authorities, and research. There was a high level of consistency in expert assessments. The same general patterns in prioritisation and weighting of response options were observed across all three sectors: business, public authorities, and academia. Moreover, there was a strong correlation between the aggregated priorities and individual scores. The more experts who prioritised a given response category, the higher the individual scores tended to be.

Three system categories were prioritised as particularly important:

- Connected systems and remote control systems, e.g. weather alerts, eCall (automatic emergency alerts), and smart parking services.
- Infrastructure and vehicle databases, e.g. the National Road Database (NVDB) and the Road Traffic Register.
- Traffic management systems and digital twins, e.g. infrastructure and traffic models for simulation, traffic monitoring, and real-time information.

These system categories form the core of a national digital transport infrastructure capable of supporting data-driven governance. They were viewed as essential for realising societal benefits such as improved traffic safety, reduced climate impact, and more efficient traffic flows. Benefits related to productivity and market efficiency were ranked lower, consistent with the lower priority given to market-driven systems such as Mobility/Logistics as a Service (MaaS/LaaS).

The most frequently mentioned barrier was the lack of public governance and leadership, both in vertical terms (coordination of stakeholders and standardisation) and horizontal terms (public-private collaboration). The absence of clear responsibilities, objectives, and resources among public authorities was highlighted as particularly problematic. Other key areas of uncertainty included data quality, data availability, and legal frameworks.

The experts called for a shift in perspective, from siloed innovation initiatives and projects to long-term public commitment to and engagement in digital transport infrastructure (DTI). DTI serves as the foundation for the integration of data, systems, and services. Such national resources should be planned, developed, and managed with the same rigour and systematic approach as physical infrastructure. The provisioning and management of data, along with APIs and metadata, should be treated as long-term and strategic investments.

The expert panel demonstrates broad, cross-sectoral consensus on what actions are required. Stronger public sector leadership is needed to harness the potential of data-driven transport

systems. This includes clarifying goals, responsibilities, and long-term funding. At present, the necessary governance and strategic leadership are lacking. Current digital policies and initiatives are focused primarily on building technical capability and capacity to support market, business and operational needs. National digital transport infrastructure needs are largely left out of account. Technology is therefore not the primary barrier; rather, it is the absence of long-term mandates, accountability, and resources.

The expert panel indicated a need for profound changes in the governance of data-driven transportation systems, particularly in the coordination and management of digital transport infrastructure. The final step was to assess the validity of the Delphi study by asking the participants to evaluate its implementation and its contribution to the body of knowledge in smart and intelligent transportation systems.

On the one hand, we want to understand how the expert panel perceives the Delphi study: *Do we share a common understanding of how it should be interpreted and applied?* On the other hand, we want to explore its consequences: *What are the best next steps?*

The evaluation was not a planned or official task for the expert panel, but rather an additional voluntary activity to which we invited the participants after the final report. The goal was to gain further insight into the Delphi study's utility and impact. This memorandum describes the design of the evaluation and summarizes its results.

2 Method

All 115 participants in the Delphi survey received a personal email invitation to take part in the evaluation. A reminder was sent one week later. The invitation included a link to the online questionnaire, which was administered using the SurveyMonkey platform. The estimated time required to complete the survey was 5 minutes, while the actual average completion time, according to SurveyMonkey, was just under 4 minutes.

The questionnaire consisted of five core questions and one background item. The latter replicated the Delphi survey's sector affiliation question:

Which sector do you primarily work in?

- Business
- Public authorities
- Academia
- Other, please specify.

The five core questions listed below were designed to capture participants' perceptions of the expert panel's outcomes, time commitment, implementation, information channels, and priorities for potential follow-up initiatives.

The first question aimed to assess the value and usefulness of the Delphi survey. It included fixed response options as well as an open-ended field for comments on the survey's knowledge contributions.

The second, third, and fourth questions focused on the panel process itself: the time required, its implementation, and the extent to which participants engaged with the results beyond the panel's website.[1] Reasonable time requirements, consistent interpretation of instructions, and active engagement with the results all contribute to the quality of the outcomes, grounding them in a balanced set of expectations and contributions from the experts.

The fifth question addressed participants' perceptions of three proposals for how Transport Analysis could build on the results of the Delphi study. The proposals reflected distinct types of in-depth knowledge needs that we identified in the Delphi study: (1) impact assessment of data-driven systems, (2) evaluation of existing national databases, and (3) market analysis of open and public transport data. The respondents were also invited to provide comments and suggest additional ideas.

[1] In the Delphi study, the panel's website (SurveyMonkey) served as the main information channel. This is where we published and managed the questionnaires. Information about the expected time to complete a questionnaire was shared by email, as well as repeated on the panel's website. We estimated the expected time by completing the form ourselves. It was generally 10–20 minutes longer than the mean response times: 40 minutes, 32 minutes, and 21 minutes respectively. The second and third questionnaires represented the most direct and significant outcomes of the earlier panel rounds. The website also included general information, definitions of key concepts, and a selection of questions raised by participants, along with our responses. In addition to the panel's website, we shared key findings via email, LinkedIn, and a dedicated web page on the Transport Analysis website. After the third and final panel round, participants were invited to a seminar where the main results were presented. They were also given access to a draft version of the final report. In both cases, opportunities for feedback were provided.

Survey questions

1. Has the expert panel addressed any general or specific knowledge needs or gaps regarding data-driven, smart, and intelligent transport systems?

Please select the option that best reflects your overall assessment.

- *Yes, in several important respects*
- *Yes, to some extent*
- *No*
- *Don't know / Cannot answer / Prefer not to answer*

If you answer "Yes", you are encouraged to specify the most important knowledge contributions in the open-ended field below.

2. Did the expert panel require more or less time than expected?

- *Significantly less time than expected*
- *Somewhat less time than expected*
- *As expected*
- *Somewhat more time than expected*
- *Significantly more time than expected*
- *Don't know / Cannot answer / Prefer not to say*

3. Do you have any comments or feedback on the implementation of the expert panel? If so, please feel free to write them in the field below.

4. How have you accessed the results from the expert panel? Please select all options that apply to you.

- *Email from Transport Analysis*
- *Website of Transport Analysis*
- *The seminar on May 7th 2025*
- *The final report*
- *Other sources or channels. Please specify in the field below.*

5. Transport Analysis is considering three potential follow-up projects based on the results of the expert panel. How would you prioritise the societal value of these projects?

Please select one response option per project (row).

Project ideas:

- *Knowledge synthesis on impact assessments of data-driven systems, e.g. route optimisation*
- *Evaluation of market demand of transport data from public authorities, e.g. Inrix*
- *Evaluation of critical national databases, e.g. National Road Database (NVDB)*

- *Other project ideas? Please elaborate in the field below.*

Response options to each project idea:

- *Not at all important*
- *Less important*
- *No opinion*
- *More important*
- *Very important*

Likert scale responses were recoded as -2, -1, 0, 1, and 2 to enable statistical analysis of the three main project ideas. Open-ended project suggestions were excluded from the recoding, as they typically addressed broader or cross-cutting needs.

3 Results

The evaluation survey was distributed in mid-June 2025. Of the 115 expert panel members, 61 responded, i.e., a response rate of 53 percent. This rate is considered acceptable, given that the survey was not announced in advance and was conducted close to the Midsummer holiday and the general vacation period in Sweden.

The sectoral distribution of participants is presented in Table 1. Compared with the Delphi survey, the evaluation shows a slightly higher proportion of respondents from public authorities and a slightly lower proportion from academia. This may indicate greater perceived relevance or interest among public authority representatives.

Table 3.1. Distribution of participants by sector in the Delphi and evaluation surveys.

Sector	Delphi	Evaluation
Business	40	19
Authorities	44	28
Academia	29	12
Other	2	2
Total	115	61

Remark: Participants were asked to indicate the main sector of their professional activity. Those who selected "Other" were asked to specify further. In the Delphi and evaluation surveys, four and two "Other" responses, respectively, were recoded into one of the three main categories. The remaining two responses in each survey were too vague to recode (e.g., "innovation").
Source: Delphi survey, Transport Analysis.

3.1 Knowledge outcomes

Most respondents (52 out of 61, or 85 percent) indicated that the expert panel had addressed knowledge needs or gaps either to some extent or in several important respects. The distribution of responses was similar across sectors (Figure 3.1), although there was a slight tendency toward more positive responses among representatives of public authorities.

Half of the respondents (26) provided open-ended comments on what they considered to be the most important knowledge needs and gaps. These responses were grouped into three main categories: (1) the need for a holistic view of digital transport systems, (2) differing stakeholder perspectives and priorities, and (3) the needs related to national digital transport infrastructure, e.g., governance, technology, regulatory frameworks, accountability, standards, management and communication, as well as data provision and sharing.

The open-ended responses did not include any explicit criticism. However, a few respondents noted that the survey was very general and broad and did not allow for in-depth discussion of specific problems or technologies.

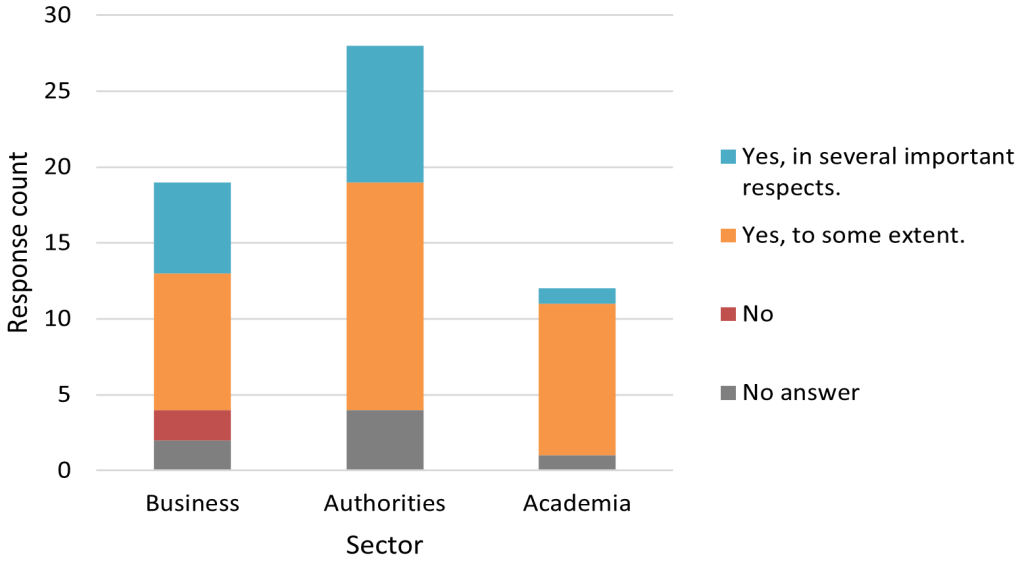

Figure 3.1. Knowledge outcomes. Sectoral distribution of overall assessments of whether the Delphi study addressed identified knowledge needs or gaps.

The participants' responses align well with the purpose of Delphi surveys, i.e., to gather and consolidate expert judgments to inform decision-making on complex or uncertain future issues. In this case, the aim was to clarify national priorities for data-driven systems. The responses to the first question support this objective. According to the experts, the main value of the Delphi survey lay in the holistic view, particularly reflected in the call for increased and coordinated efforts on national digital transport infrastructure.

The strength of the survey thus lies in its holistic perspective. At the same time, this makes it challenging to meet participants' diverse interests, address specialised issues, and account for specific applications of information and communication technologies.

3.2 Survey response time, execution and engagement

The second question concerned the perceived time commitment, i.e., whether participation in the expert panel required more or less time than expected. The distribution of responses was well centred and symmetrical around the option "as expected". More than half of the participants (35 out of 61, or 57 percent) reported that the time required was "as expected". Eleven and twelve respondents indicated that the panel required somewhat more and somewhat less time, respectively, while one respondent each reported significantly more and significantly less time.

Just over a third of the respondents (23 out of 61, or 38 percent) provided open-ended comments on the implementation of the Delphi survey. Most were positive, noting that the panel was professionally conducted and that the instructions were clear. At the same time, several participants expressed a desire for more dialogue and exchange between experts. Some respondents found the questions difficult to interpret. A few requested either more or less guidance on how to make their assessments.

The main criticism concerned the lack of expert interaction and the limited concreteness regarding data-driven systems. This largely reflects limitations inherent in the Delphi survey design. In any Delphi process, direct interaction between experts is intentionally avoided in

favour of generating a quantitative overview of consensus. In our case, the approach was also deliberately broad rather than in-depth in its treatment of systems

Email was the most common channel for accessing results beyond the panel's web page. It was mentioned by 43 out of 61 participants (70 percent). More than half of the respondents referred to the results seminar and the final report. Over a third (21 out of 61, or 34 percent) accessed the Transport Analysis website (not to be confused with the panel's questionnaire page). A few participants also followed the reporting of results via LinkedIn.

3.3 Action priorities

The highest-rated response option was the evaluation of national databases, with 49 out of 61 participants (80 percent) rating it as "more" or "very important". The corresponding figures for impact assessment and market analysis were 39 and 38 participants respectively, just over 60 percent in both cases.

A quantitative recoding of the responses shows a higher mean value for the database option compared to the other two: 0.97 (95% CI: 0.87–1.21), versus 0.70 (95% CI: 0.47–0.94) for impact assessment and 0.62 (95% CI: 0.38–0.72) for market analysis. This response pattern was particularly pronounced among participants from business and academia. The priorities were less clear among representatives from public authorities.

Over one third of the participants (22 out of 61, or 36 percent) provided open-ended responses to the question on potential follow-up projects. These responses included either original project proposals (12) or more general comments (10) related to the survey or the perceived need for further action. Three recurring themes were identified.

1. Respondents emphasized the need to treat digital infrastructure with the same level of commitment as physical infrastructure, including clear mandates and dedicated resources.
2. Several participants proposed collaborative platforms, such as strategic roundtables or multi-stakeholder working groups.
3. Respondents stressed the importance of real-world system demonstrations and pilot testing, as well as the need to consider actual use and users.

Taken together, the three themes point to a broad expert consensus on the need for stronger public governance, concrete implementation, and improved national coordination.

4 Conclusions

The evaluation indicates that the Delphi study largely fulfilled its purpose and objectives. The aim was to clarify expert views on data-driven system priorities and, in doing so, to provide knowledge support for policy development. The survey adopted a broad approach and successfully captured the shared perceived need for stronger public commitment to national digital transport infrastructure. However, this breadth came at the expense of technological depth and specificity.

Public authorities appeared slightly more engaged than businesses and academia. This was reflected in their somewhat higher participation rate in the evaluation and their slightly more positive views on the outcomes of the Delphi study. This is not unexpected, as the study emphasised the cross-sectoral need to strengthen national digital transport infrastructure, an area for which public authorities generally hold primary responsibility.

Participants prioritised the evaluation of national databases over impact assessments and market analyses of data-driven systems. This aligns with the main findings of the Delphi study, i.e., the need for stronger long-term governance and sustained investment in national digital transport infrastructure, and the importance of moving beyond isolated, short-term innovation projects. The results reflect a shared understanding of both the challenges and the needs ahead, as well as the central role of public authorities in driving and implementing solutions.

Representatives of public authorities exhibited less differentiated preferences for follow-up initiatives compared to participants from business and academia. While the latter clearly prioritised the evaluation of national databases, e.g. NVDB, public authorities assigned relatively equal importance to all three options, i.e., in addition to evaluation, also impact assessment and market analysis. This lack of differentiation may reflect a central challenge raised in both the Delphi study and its evaluation, i.e. unclear public priorities.

Digital and transport policy documents (EC 2025; GoS 2025a, 2025b, 2024; SOU 2025; STA 2024a, 2024b, 2024c) emphasise the need to strengthen digital capacity and capability in order to enhance organisational performance and improve transport system efficiency. In practice, however, initiatives are often implemented as siloed, short-term projects rather than as institutional or operational reforms. This may contribute to a growing gap between technological development and regulatory adaptation, with the latter increasingly lagging behind. Without long-term public commitment to national digital transport infrastructure, there is no stable foundation for regulating or scaling up new technologies.

To conclude, addressing data-driven systems in broad and general terms – at the expense of depth and specificity – entails certain risks. It may complicate the recruitment of relevant expertise and introduce significant variation in how participants interpret key concepts and questions. While a few comments in the evaluation reflect these concerns, the majority do not.

Overall, the evaluation highlights the need for stronger public governance and leadership in the development of digital transport infrastructure. The next step is to translate these priorities into practice by defining concrete development plans and resources, e.g., by setting targets and allocating funding for national transport databases over a 5–10-year horizon.

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Transport Analysis is a Swedish agency for transportpolicy analysis. We analyse and evaluate proposed and implemented measures within the sphere of transportpolicy. We are alsoresponsible for official statistics in the transport and communication sectors. Transport Analysis was established in 2010 with its head office in Stockholm and a branch office in Östersund.

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