Institute of Transport Economics
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ENGLISH **Summary**

Possibilities for improved modelling of transport measures in cities

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Transport models are a central tool in transport planning and are constantly being further developed. Trends such as urbanization, micromobility, and automated transport, as well as the increased need for scenario methodology, enhance the need for more dynamic, detailed, and flexible transport models in cities.

In the present report, we conduct a systematic review of 10 transport measures and highlight specific opportunities for further development of the RTM system, as well as possibilities found in other modeling approaches, including agent-based transport simulation models.

The report summarizes the findings from a project commissioned by NTP Transport Analysis and Economics. The project's task was to identify the needs for further development of the existing model system (RTM) and other methods for transport analysis in cities.

The report is part of a process of assessing and developing future transport models and can be considered a follow-up to TØI Report 1819/2021 " A forward-looking perspective on Norwegian transport models. Opportunities for improved models with a focus on travel in urban areas." In the present report, we conduct a more systematic review of 10 measures and highlight specific opportunities for further development in the RTM model system, as well as the possibilities offered by other modeling approaches.

The report is limited to 10 analysis needs. Based on input from the client, we have selected the following 10 measures/development dimensions:

1. Electric car as a separate mode (means of travel)
2. Change/shift in departure time
3. Flexible tolls/road pricing
4. Parameter adjustment after COVID-19
5. Parking and zero-emission zones
6. Car sharing/Robotaxis
7. Micromobility
8. Fare systems for public transport
9. Traffic flow for (super) buses
10. Microscopic/dynamic traffic management

For a systematic review, we have defined 7 questions to answer for each of the 10 measures:

1. What does the measure involve?
2. Which behavioural dimensions and mechanisms are important to capture?
3. What data is needed?
4. How is the measure or similar measures handled in the current RTM, and what are the limitations?
5. What are the possibilities for further development of the RTM system?
6. Which other methods/models can be used/developed to analyse the measure?
7. How can other models be specifically applied/developed further?

The methodological approach has been:

1. Gathering experiences from project team members and other researchers/consultants
2. Literature review
3. Following up on relevant and ongoing projects around model development
4. Testing selected measures in a model framework for agent-based simulation (MATSim)

In the systematic review, we discuss key needs for capturing various behavioral dimensions and mechanisms. These needs will vary significantly among the 10 measures. Assessing these needs is necessary to determine which model types are expected to provide the best answers to future issues and which model types are worth investing in for future transport planning.

We consider four types of models/model systems relevant for urban transport; three models currently used in Norway (though to varying degrees) and one possible model system for the future.

- Model Type 1 (M1): A classic traffic simulation model with exogenous demand. An example is Aimsun, which is used by SVV to model detailed traffic flow in cities.
- Model Type 2 (M2): The current RTM system with TraMod_by as the demand model and a traffic management model coded in Cube Voyager.
- Model Type 3 (M3): Agent-based traffic simulation models. MATSim and POLARIS are the most commonly used frameworks for agent-based models, though many other options exist.
- Model Type 4 (M4): A model system consisting of a LUTI model (Land Use and Transport Interaction), an activity-based demand model (ABDM), and a traffic simulation model. Such a model system is considered the most comprehensive and detailed system that can be constructed from known models.

Our feasibility study shows that the following measures/model dimensions can be effectively handled within the RTM system:

- Parameter adjustments post-COVID (excluding congestion costs)
- Parking and zero-emission zones
- Electric car as a separate mode
- Flexible tolls (if flexibility is limited to fixed time periods and if changes in departure times are not expected to play a significant role)

Parameter adjustments post-COVID (excluding congestion costs) and parking and zero-emission zones can largely be captured with improved calibration and/or manipulation of utility functions and zone data. Long-term preference changes post-COVID can be captured in the longer term by re-estimating TraMod_By with post-COVID travel data. In the short term, increased remote work should be captured via calibration of the frequency model (fewer work trips).

For electric cars and flexible tolls, further development projects have been conducted since the start of this project. These have led to improved functionality in the RTM or will do so in the near future. It can be argued that 1) the proposed and partially implemented changes largely maximize the potential in the RTM, and 2) the proposals will have limited utility in the long term within static and macroscopic model systems.

For effective modeling of flexible tolls and time-differentiated fare systems, capturing shifts in departure times is crucial. Shifting departure times can be implemented in the RTM to some extent, but it makes the model significantly more complex and computation-intensive. Generally, measures with a more dynamic character are better captured in models with an explicit representation of time.

The same applies to measures like accessibility for (super) buses and microscopic/dynamic traffic management. These are better captured with other types of models. It is technically possible to link TraMod_By with a dynamic and micro-/mesoscopic traffic management model, but the implementation will necessarily involve data transformations to handle different data structures. Integrated models with the same data structure in demand modeling and traffic management (as MATSim has) are preferred. Accessibility for (super) buses can potentially be adequately captured in RTM/Cube Voyager if the interest is in travel times (and not the spatial distribution of congestion) and if resources are allocated to calibrate VDF functions and speed models.

Modeling robotaxis (with endogenous waiting times) and micromobility (with endogenous availability) cannot be effectively captured in the RTM system. Here, state-of-the-art models are considered necessary.

The report discusses how our feasibility study can contribute to formulating recommendations for future transport models. One requirement for transport models that has gained significant traction in recent years is the need to capture the effects of various complex future scenarios and to make the uncertainties in implicit and explicit assumptions transparent.

This leads to two overarching goals:

- To be able to analyze many different future scenarios, including the effects of new technology.
- Faster computation times so that many scenarios/combinations of scenarios can be tested.

These goals place different—and somewhat conflicting—requirements on transport models. The first goal requires flexible transport models, and for some types of analyses, detailed and dynamic models. The second goal requires simplified transport models to reduce computation time.

In this context, it is interesting to consider the differences in analysis needs between urban areas and the regional/national level. Some future scenarios will likely be more central in cities and will therefore require good representation in urban models, while other measures will be more relevant for regional analyses, such as motorway projects. Another example is micromobility, which will require explicit representation in urban analyses, while it can be captured more simply in regional analyses/models, for example, by adjusting down the access time to trains and long-distance buses.

As discussed in in the report, the RTM/NTM6 model system is well-suited for regional/national analyses of a strategic nature. For goal 1, it is possible that TraMod_by could be made even more flexible. For goal 2, consideration should be given to simplifying the RTM model (e.g., fewer zones, fewer segments, no/fewer iterations). Some of this is already manageable through options programmed into the Cube user interface.