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The issues in modelling freight transport at the national level☆

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ABSTRACT

Several countries in Europe and elsewhere have a national freight transport model. This paper discusses some old and new issues for these models, based on experiences in at least seven European countries. These issues have to do with the institutional organisation of the work on model development and use, how confidence in these models can be determined and increased, the questions the national freight models are asked and their scope and level of detail. But also what the model philosophy (e.g. aggregate, disaggregate, deterministic, stochastic) should be and which influencing factors should be included. New directions are discussed, such as the trend to include more aspects of logistics decisions of firms. This increases the data requirements of the models. The potential of big data is discussed as well as approaches that use less data but more assumptions.

1. Introduction

In Europe, a number of countries have developed national freight transport models to assist national governments in decision-making on future transport infrastructure and transport policies.[1] The same is true for some other small to medium-sized countries elsewhere. In large countries like the US or China, regional models (e.g. state-wide models in the US) will be more comparable to the European national models, in terms of issues covered and detail provided, though many of the same issues are also relevant for national freight models for such countries.

In recent years, many national freight transport models have changed considerably, moving away from the four-stage model that was originally developed for passenger transport, especially by including more aspects of transport logistics and sometimes even inventory logistics.

However, new types of models lead to new issues to be solved. Transferring concepts from operations research developed for the individual firm level, from behavioural economics, from computer sciences or elsewhere raises all kinds of new questions, both in terms of model specification and data. Model teams in various countries have encountered such issues and between countries there appears to be a large degree of agreement on the current issues for modelling freight transport at the national (state-wide) level.

Nonetheless, there are a number of challenges that clients face in commissioning a national model. Which specific questions should the model address? Does the client want to "run" the model or is he happy to contract out the development and operation? Does the client intend to make the model available to other users? How will the model be maintained, both in the sense of enhancements/updates and of ensuring that it can still be operated?

There are also questions of model specification and, critically, whether data is available (or can be collected) to support the level of detail required. This in turn affects the level of confidence which can be placed in the model output.

☆ This paper is based on discussions between the authors at a seminar on national modelling at the International Freight Transport Modelling Workshop on 20–21 March 2014 at the German Aerospace Center in Berlin.

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[1] National freight transport models are usually not restricted to domestic flows, but also include import and export flows and sometimes transit flows.

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Thus, there are many issues to discuss, and they are quite varied. Based on the experiences of the authors from national freight transport modelling mainly in Norway, Sweden, Denmark, the Netherlands, Belgium, Germany and the UK, this paper will provide a review of these issues. For the purpose of the discussion, we have classified them under four main headings, as illustrated in Fig. 1.

In a little more detail, the key questions are as follows:

- Institutional:

a. Organisation: how do we structure the work on model development, application and maintenance?

b. Confidence: What can be done to determine the level of confidence we can have in the model outputs? And what can be done to increase confidence?

- Requirements:

a. What is being asked from the models?

b. What are the appropriate scope and level of detail of the model?

- Specification:

a. which model philosophy do we choose? Which additional influencing factors of freight transport could be incorporated in the model?

b. New directions: what are the new model components (modules) that could be added to the existing frameworks?

- Data:

a. Data wish-list: what kind of data is ideally needed for the new types of models? How can we obtain these data? How can we make the best of "Big Data"?

b. Data use in practice: what can we do if these data are not available? What can we do with the data that we have?

These issues are discussed in more detail in the Sections 2–5, respectively. Finally, Section 6 contains a summary and conclusions.

2. Institutional aspects

2.1. Organisation

Two main approaches for the organisation of modelling can be distinguished. Firstly, the conventional approach involves the creation of a broad model platform of the national transport system for general policy support to the government. In the organisation of modelling efforts, continuity is of prime importance. The development, maintenance and use of national freight transport models are matters that span many years and during this period a stable environment that commits to the model is important for success. Secondly, a complementary and increasingly popular approach is to develop case-based models around a single policy issue of national importance that does not allow broader usage. Besides national government, other stakeholders such as private parties, NGOs and other governmental bodies are grouped around a single issue. Critical success factors for both approaches include involving the users of the models as early as possible, clear ownership of the model by one organisation or a group of organisations that can act as a single body, transparency about the model (including use of the model by third parties, consultants as well as academics) and using different tracks for daily model application and further innovation.

In the Norwegian National Freight Model (in short NGM), the first approach has been chosen, developing it as a broad model covering all freight transport (domestic and for export and import) in one model. The model is using a fairly detailed network (the network from the long distance passenger model) for all modes, detailed freight flows (before mode distribution) on a zone to zone level, detailed cost models for 11 modes (some modes are divided into sub-modes for modelling reasons), with close to a hundred different transport units for road vehicles, vessel types, train types etc. The philosophy has been that by simulating optimal transport choices from the point of view of transport users – minimising logistical costs – the various micro-economics-based decisions will on an aggregate level give good predictions for transport flows. The model has been developed over nine years in various versions through a cooperation between Significance, Institute for transport economics in Norway (TØI) and SITMA AS. The commissioner for the development and the management of the project has been a joint group from the Road Authorities (head of project), the Rail Authorities, the Coastal Administration and Aviation (the air traffic authorities). The results achieved actually support the hypothesis of getting a good fit with statistics, also on detailed levels like terminals and ports, as well as though the networks, from this aggregated micro-simulation approach. This has also made the model quite suitable for project and policy analysis. The detailed level of the model is especially useful in this context. The logistical costs are treated at a very detailed level, which enables the users to simulate the effect of a broad variety of parameter changes, both exogenously given, and policy driven. The detailed level of the output information—down to individual transport chains and shipments, also enables more detailed analysis for specific projects (de Jong et al., 2013).

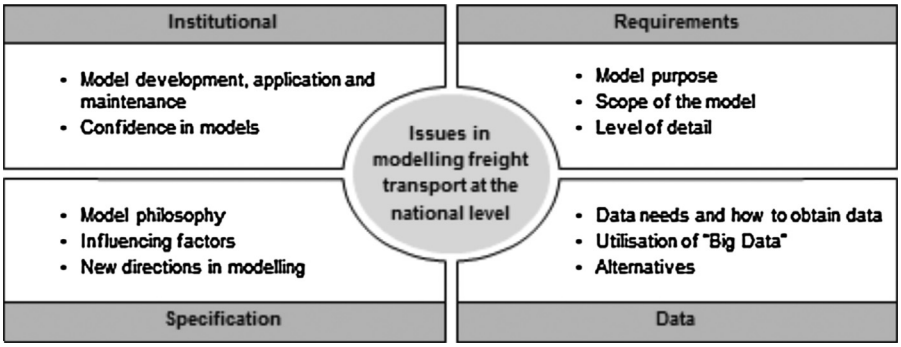

Fig. 1. Overview of the issues in modelling freight transport at the national level.