

Method for assessing indirect land-use effects of major transport measures and their consequences for traffic development and land consumption

TØI Report 1987/2023 • Authors: Aud Tennøy, Oddrun Helen Hagen • Oslo 2023 • 99 pages

The Institute of Transport Economics (TØI) has, on behalf of and in collaboration with Bane NOR, developed and described a qualitative method for analysing the effects of major transport measures (railways and roads) on land use development in urban areas, and the consequences this entails for car dependency, traffic volumes development and land consumption in such areas. The purpose is to provide a tool for analysing important effects and consequences that are not elucidated in existing methods. The method has been developed as a systematic and knowledge-based planning analysis. The method description in this report contains a knowledge base, a description of how the knowledge base can be used in analyses, and of how the analyses are to be carried out and concluded. Templates have also been developed that can be used by those who will perform this type of analysis, as well as an example of such an analysis.

Purpose, background and assignment

The purpose of this assignment has been to develop a qualitative method for analysing the effects of major transport measures (railways and roads) on land use development in urban areas, and the consequences this entails for car dependency, traffic volumes development and land consumption in such areas. The purpose of developing the method is not to replace existing methods, but to provide a tool for analysing important effects and consequences that are not elucidated in existing methods.

It is well documented that the development of different parts of the transport systems affects land use development in cities and urban regions (indirect land-use effects), and that this land use development affects traffic volumes development and land consumption. Some types of transport systems development stimulate land use development as car-based urban sprawl, which increases car dependency, traffic volumes and land consumption. Other types of transport systems development stimulate land use development as densification and transformation in and close to city centres, which results in reduced car dependency, traffic volumes and land consumption. These relationships are complex. The complexity is exacerbated by the fact that the land use development that is stimulated must be considered both in a local and in an

urban regional perspective. If land use development takes place as densification and transformation in and around a centre, but in a location where it also contributes to a more car-dependent overall land use structure, it will contribute to increased car traffic in the urban region.

However, the indirect land-use effects caused by changes to the transport systems, and their consequences for car dependency, traffic volumes development and land consumption, are not elucidated well in environmental impact assessments and other analyses. This may be because there is a lack of good methods for analysing this. For example, good methods for analysing such effects and consequences have not been described in the Norwegian Public Roads Administration's 'Handbook V712 Impact Assessments' or in the Norwegian Environment Agency's 'Guide for impact assessments for climate and environment'. Existing methods are rigged to evaluate the measure in itself and assume 'all else equal', including that they do not take into account that the transport measures assessed may have indirect land-use effects that have consequences for traffic volumes development and land consumption. This can result in significant errors in the analyses forming the basis for decision-making related to whether and which transport measures should be implemented to solve transport or other societal challenges. Such decisions affect the possibilities for achieving the goal of zero growth in traffic volumes in urban areas. Increased traffic volumes and land consumption cause increased greenhouse gas emissions and increased degradation of nature, agricultural areas and other green areas, which makes it difficult for Norway to achieve important goals related to greenhouse gas emissions and protection of nature. There was therefore a need to develop better methods.

Bane NOR commissioned the Institute of Transport Economics (TØI) to develop and describe a method for analysing the indirect land-use effects of various types of transport measures and the consequences this has for development of traffic volumes and land consumption in urban regions. The method is aimed at major transport measures related to railways and roads. The purpose of developing the method is to include such indirect effects and consequences in assessments of major transport measures in a better way than today. The method can be used both in assessments of specific plans, in discussions of principles about various concepts and when comparing alternative solutions and concepts.

Only the indirect land use effects and their impacts on traffic volumes and land consumption are included, as illustrated in Figure S1. Assessment of direct land-use changes (related to the actual development), direct effects of the transport measure on travel behaviour (for example changes in passenger numbers on railways due to changes in travel time) and direct greenhouse gas emissions associated with realisation of the measure itself are not included. These and other effects and consequences must be analysed using other methods.

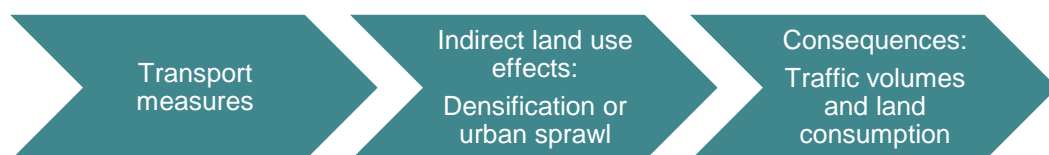


Figure S1: Transport measures have indirect land-use effects that have consequences for traffic volumes development and land consumption.

The lack of descriptions of methods for analysing the described effects and the consequences may be due to the complexity and difficulty of analysing them using quantitative methods. The method has therefore been developed as a qualitative, systematic and knowledge-based planning analysis. It consists of a knowledge base, a description of how the knowledge base

can be used in analyses and a description of how the analyses are to be conducted and concluded. Templates have also been developed that can be used by those who will perform this type of analysis, as well as an example of such an analysis. Carrying out the analyses requires planning expertise.

Discussions and exchange of experience between the project teams from Bane NOR and TØI have been central to the development of the method. The method has also been tested in a workshop with several employees from Bane NOR, and the feedback has been used to improve the method and description. The discussions in the workshop also formed the basis of the example of an analysis according to the method. We expect that there will be a need for further development of and clarifications in the method when it is put into use.

Knowledge base

The report includes a knowledge base that will support the analyses that are carried out. The knowledge base summarises research-based knowledge related to the relationships between land use development, development of transport systems, changes in travel behaviour and changes in traffic volumes. These are complex relationships, but they are well documented, both theoretically and empirically. The relationships to be analysed using the qualitative method are how changes in transport systems affect land use development, and how this in turn affects travel behaviour, traffic volumes and land consumption. These cause-effect chains are indicated by fatter arrows in Figure S2. The mechanisms shown in the figure are described in the knowledge base.

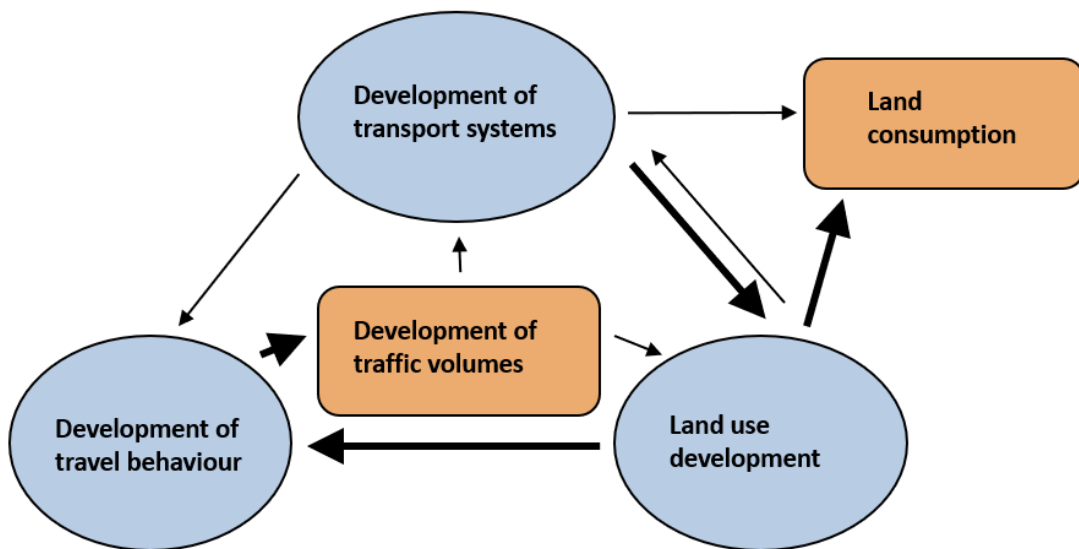


Figure S2: Relationships between development of transport systems, land use development, travel behaviour, traffic volumes and land consumption (based on Tennøy 2012). The bold arrows illustrate the relationships that this method has been developed to analyse.

The short version is that some types of transport system developments stimulate land-use development as car-based urban sprawl, which contributes to increased car dependency and traffic volumes, while other types of transport systems development stimulate densification and transformation in and close to city centres that contribute to reduced car dependency and traffic volumes. How transport systems and land use are developed also affects how much green space is consumed. Urban sprawl must be expected to contribute to consumption of agricultural, natural and recreational areas, while densification and transformation normally will not. Land use development that contributes to increased polycentricity and/or that contributes to pulling desired and realistic growth out of the main city centre in the urban

region can contribute to increased car dependency, traffic growth and land consumption, even if it locally contributes to densification and transformation in and around a centre or a station. Analyses must therefore be carried out from both a local and a regional perspective.

The extent to which changes in transport systems affect traffic volumes and land consumption will vary with the pre-situation, the local context and the measures implemented. It also depends on the land-use planning and policies of relevant municipalities. We generally do not take a position on the latter in the knowledge base.

Method

The method has, as said, been developed as a systematic and knowledge-based planning analysis, which aims to make the assessments and conclusions easy to understand, discuss and verify. As mentioned, the method description includes a knowledge base that summarises relevant research-based knowledge. The intention is that this, together with information about measures and context, shall provide sufficient information to carry out the analyses. The analyses and assessments require professional judgement, and thus also planning expertise of those who carry them out. The answers are not given as absolute or percentage changes in land use development, traffic volumes or land consumption, but as qualitative assessments and descriptions of whether various transport measures stimulate land use development that contributes to either growth or reduction in traffic volumes and land consumption in affected urban regions.

In brief, the method shall be carried out as an iterative process in which land use effects and consequences for traffic volumes and land consumption of suggested transport measures are assessed qualitatively. It is described how the knowledge base should be used to support the analyses and how the analyses should be carried out. The qualitative assessments and analyses shall be written in accordance with the templates and tables in the appendix.

The method is implemented in four stages: Preparatory work on clarifications and definitions; analyses and discussions of each alternative; comparison of alternatives, controls, assessment of goal achievement, and formulation of reasoned conclusion, as illustrated in figure S3.

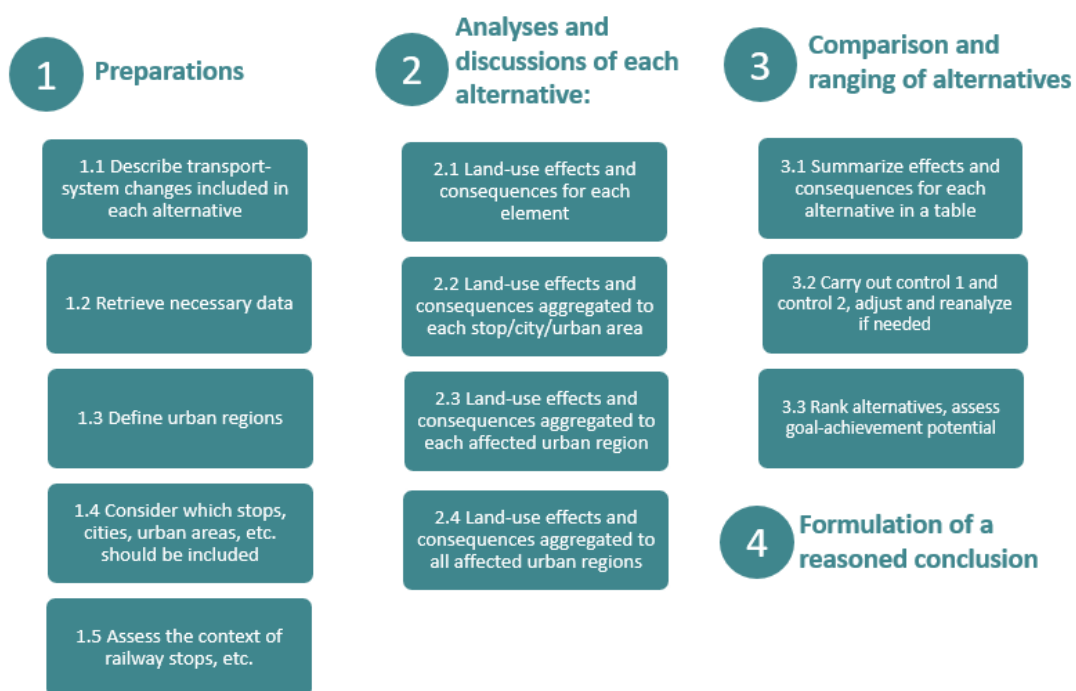
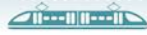


Figure S3: Schematic representation of the method.



First, preparatory work is carried out, with clarifications and definitions, intended to make the analyses easier to carry out, less resource-demanding, and more focussed on the effects and consequences that are expected to be greatest and/or most important. In this important phase, those who do the analyses must describe which changes or measures are included in the various alternatives. They shall collect knowledge concerning contexts, define which geographical areas are included in urban regions that are affected, and briefly describe how these urban regions function. They will also consider which stops, cities, urban areas, etc. should be included in the analyses and which should be excluded. Furthermore, assessments shall be made of the context of the relevant transport measures, particularly those related to railway stops. This preparatory work will also contribute to making the analyses more transparent, verifiable and understandable.

Analyses and discussions of each alternative are then carried out concerning the expected indirect land-use effects of the transport systems changes included in the alternative, the consequences these will have in terms of traffic development and land consumption, as well as how strong these can be expected to be. Here, the knowledge base and descriptions of how this should be utilised are central. The alternatives are analysed separately. Analyses are first made of each element (change), then aggregated to each individual stop, city or area affected, then aggregated to each urban region, and finally aggregated to all urban regions affected. This is done for all alternatives.

Furthermore, the alternatives will be compared and discussed against each other. The results of the analyses are first summarised in a table, and a control (Control 1) is made to check if the assessments are consistent and whether they are in the right relationship to each other. If they are not, one must return to the former assessments of the alternatives, adjust and reanalyse them, make a new control, etc., until they are consistent. The alternatives are then compared and discussed on the basis of four defined criteria. A new control (control 2) is made to check whether the assessments are consistent and whether they are in the right relationship to each other. If they are not, one must go back in the assessments, adjust and reanalyse. Once these assessments and, if relevant, adjustments have been made, the alternatives can be ranked in terms of which alternative that most strongly affect land use development in directions that can help reduce car dependency, traffic volumes and land consumption. It should also be assessed, for each alternative, whether they actually contribute to such a development.

Finally, a reasoned conclusion should be formulated, where the alternatives are ranked with respect to the extent they are considered to contribute to land use development that contributes to stabilising or reducing car dependency, traffic volumes and land consumption. This should include a brief explanation for the conclusion. The conclusion should be written so that it can stand alone, i.e., so that the reader can understand what reasoning and assessments have been made and why this ranking has been reached, without having to read the analyses.

The qualitative assessments and discussions to be made are demanding. One must ensure that they are consistently carried out and that they are comparable both within and across alternatives. The two controls described above have been put in place to ensure this. It is very important that the assessments made along the way are described and explained. This shall ensure that the analyses are transparent, understandable and verifiable, and that others can discuss or dispute the assumptions, understandings and assessments on which they have been based. It is emphasised that this is an iterative process, where during the analyses there may be a need to go back and change or adjust assessments made in previous steps.