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Cross-Border Transport Modelling in the Region of Aache

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1 ABSTRACT

For transport planning, as well as for other planning jobs, it is necessary to have information about the general conditions. To estimate traffic volumes and to identify the need for measures, knowledge about the future transport demand is necessary. The development of transport demand depends on many factors as well as on the general situation, so an estimation is quite complex. Therefore transport models are often used as a basis for the decision-making- and planning-process. At the moment different stakeholders usually use different models with different data and their own focus – even in the same city. In many transport planning processes different stakeholders (e.g. from the city council, transport association) are involved, so collected data and results have to be discussed many times and difficulties in the coordination and decision-making-process can occur. Aachen is located on the border to the Netherlands and Belgium, so there is a tight interaction between the municipalities (e.g. cross border business park, cross border public transport), which are located close to the border. Data and information which is needed for the planning process are kept and used in wide differentiation and with a variety of definitions and considered areas by the different institutions and stakeholders (e.g. city council, road administration, transport association) in Germany, Belgium and the Netherlands. Therefore, the plausibility and consistency is not always given in the regional context. Essential for future projects as well as for coordinated planning across the borders is a reliable and coordinated basis between the different institutions.

The StädteRegion Aachen (association of municipalities), Straßen.NRW (road administration) and the AVV (Aachen Transport Authority) are responsible for different spatial and traffic planning tasks. Therefore they have awarded the development of a cross-border and georeferenced data platform combined with a macroscopic cross-border transport model to create and keep a high quality and consistent basis for regional planning in the region of Aachen. The aim is to build up a standardized and continuing database, which provides necessary basis data for different types of planning for every stakeholder in the region. This is a challenging process in which most regional stakeholders of the three countries should participate to guarantee reconciled data. During the development of the data platform and the transport model due to the data a lot of inconsistencies can occure which are required to be solved. Just two of them are the use of coordinate systems and commuter statistics. In the process of building up the model available data and information about the over 60 municipalities in three countries are used. Therefore it was necessary to combine map bases (e.g. private traffic network, zonal structure) of different suppliers. It has to be taken in consideration that all countries of the planning area, are using different coordinate systems. In Germany mainly Gauss-Krüger is used, whereas in the Netherlands Rijksdriehoekstelsel and in Belgium Belge Lambert 2008 System is common. A transformation of coordinates can lead to distortions. So it is necessary to check different key factors of the model (e.g. distances) and correct them. There is always a problem with merging maps form different suppliers. Inaccuracies on border crossings can occur even in areas of the same country. The trip generation is based on commuter and structural data. When comparing the correspondent balances (e.g. gainfully employed persons – jobs compared to commuter balance) there are great differences especially in the cross-border balance. Therefore it is necessary to rework and to adjust the data, but the reliability of the chosen approach has to be taken into account. The national statistic of people who commute to work depicts the interconnections very detailed. NRW and the province of Limburg for example are collecting commuter data on municipality level. Looking at the cross-border commuter data it is obvious that this data was collected on a more aggregated level. And due to different methodologies the data cannot be combined easily so it is necessary to develop an approach and reconcile it with all stakeholders. This preparation work has to be communicated well to all regional stakeholders, so that they understand and support the data adjustments. The participation of all regional stakeholders in the process of setting up the data platform and the transport model is crucial so that in the end all stakeholders trust the data and use this model as base for planning actions. Therefore the process of participation consists of a broad involvement of the stakeholders in data collection, data adjustments and information about the model calibration.

2 INTRODUCTION AND BACKGROUND

For transport planning, as well as for other planning jobs, it is necessary to have information about the general conditions. To estimate traffic volumes and to identify the need for measures, knowledge about the future transport demand is necessary. The development of transport demand depends on many factors as well as on the general situation, so an estimation is quite complex. Therefore transport models are often used as a basis for the decision-making- and planning-process. At the moment different stakeholders usually use different models with different data and their own focus – even in the same city. In many transport planning processes different stakeholders (e.g. from the city council, transport association) are involved, so collected data and results have to be discussed many times and difficulties in the coordination and decision-making-process can occur.

Aachen is located on the border to the Netherlands and Belgium and is a part of the Meuse–Rhine Euregion. In this region there are a lot of cross-border trips concerning different areas of life such as studies, work, shopping or leisure . Therefore a tight interaction between the municipalities located close to the border exists. Examples for this cooperation are the cross-border German-Dutch business park (AVANTIS), the successful concept of the regional train called “eureogiobahn”, which operates in Germany and the Netherlands or the platform especially for the problems concerning the cross-border public transport (such as tariff regulations or improvement of international connection). Data and information, which is needed for the planning process are kept and used in wide differentiation and with a variety of definitions and considered areas by the different institutions and stakeholders (e.g. city council, road administration, transport association) in Germany, Belgium and the Netherlands. Therefore, the plausibility and consistency is not always given in the regional context. For future projects as well as for coordinated planning across the borders a reliable and coordinated basis between the different institutions is essential. Therefore the StädteRegion Aachen (association of municipalities), Straßen.NRW (road administration) and the AVV (Aachen Transport Authority) have awarded the development of standardized and continuing database combined with a macroscopic cross-border transport model, which provides necessary basis data for different types of planning for every stakeholder in the region. This is a challenging process in which most regional stakeholders of the three countries should participate to guarantee reconciled data. Therefore the process of participation consists of a broad involvement of the stakeholders in data collection, data adjustments and information about the model calibration. Representatives of the regions and cities are informed and participate in regular meetings about the structure and calibration of the model. Furthermore they provide data and are involved in the development of data adjustment methods.

Fig. 1: study area

3 STUDY AREA AND MODEL STRUCTURE OF THE TRANSPORT MODEL

The aim is to build up a standardized and continuing database, which provides necessary basis data for different types of planning for every stakeholder in the region. The cross-border traffic model is based on the four-step approach. In this trip-based model trip generation, distribution, mode choice and route choice are calculated sequentially although there is a feedback between the different stages. To forecast the travel demand for the study area (area where expected policy impact should be analysed) it is necessary to take into account the interaction areas outside the study area, where trips into the study area are generated or out of the study area are destinated (external stations ES). Therefore all municipalities with relevant commuting traffic are included in the model but on a more aggregate level.

The study area consists of the four German regions StädteRegion Aachen, district Heinsberg, district Düren and a part of the district Euskirchen with 40 municipalities, the region of Südlimburg in the Netherlands with 17 municipalities and the four German speaking municipalities of Belgium (see fig. 1).

These municipalities are divided into 1226 traffic analysis zones (TAZs) taking into account data availibility, main traffic borders and an possible aggregation on district and minicipality level.

4 CHALLENGES BUILDING UP A CROSS-BORDER TRANSPORT MODEL

Data availability and the comparability and/ or compatibility of this data is always a challenge developing transport models. Due to the different methodologies and data aggregations the data cannot be combined easily. These difficulties increase in cross border planning processes even more.. Therefore building cross border transport models it is necessary to develop an approach and reconcile it with all stakeholders (see also other cross border transport models e.g. VKM AT-CZ-SK-HU 2009). This preparation work has to be communicated well to all regional stakeholders, so that they understand and support the data adjustments. The following examples should explain the related problems and resulting consequences in the process of developing a cross-border transport model.

4.1 Compatibility of map bases

In the process of building up the model available data and information about the over 60 municipalities in three countries are used. Therefore it was necessary to combine map bases (e.g. private traffic network, zonal structure) of different suppliers. It has to be taken in consideration that all countries of the planning area, are using different coordinate systems. In Germany mainly Gauss-Krüger is used, whereas in the Netherlands Rijksdriehoekstelsel and in Belgium Belge Lambert 2008 System is common. A transformation of coordinates can lead to distortions (see fig. 2). So it is necessary to check different key factors of the model (e.g. distances) and correct them. There is always a problem with merging maps form different suppliers. Inaccuracies on border crossings can occur even in areas of the same country. Therefore the adjustment of maps, before generating data through intersection between different maps, is unaviodable although it is an time-consuming work.

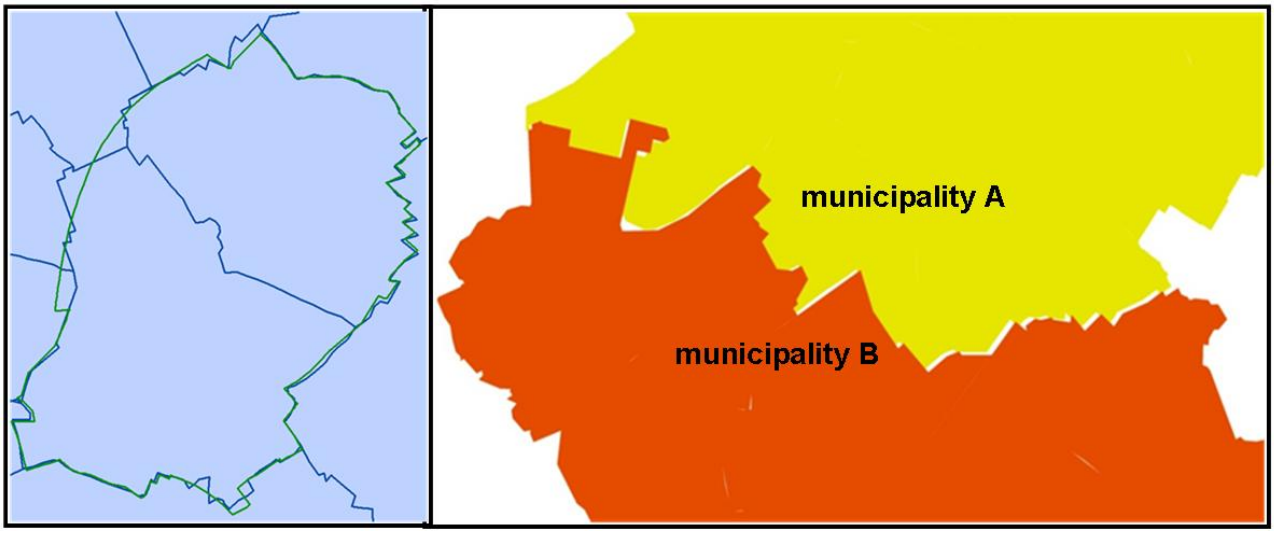

Fig. 2: Inaccuracies due to merging different maps

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4.2 Commuter and structural data of land-use and travel behaviour

The calculation of the trip generation is based on commuter and structural data of land-use and travel behaviour.When comparing the correspondent balances (e.g. gainfully employed persons – jobs compared to commuter balance) there are great differences especially in the cross-border balance. Therefore it is necessary to rework and to adjust the data, but the reliability of the chosen approach has to be taken into account.

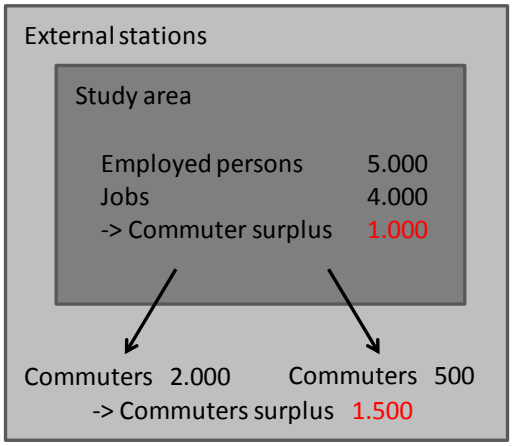


Fig. 3: imbalance of commuter and structural data (hypothetical example)

The national statistic of people, who commute to work, depicts the interconnections very detailed. In the German region of North Rhine-Westphalia and the province of Limburg in the Netherlands for example commuter data is collected on municipality level in national statistics. Looking at the cross-border commuter data it is obvious that this data was collected on a more aggregated level. Cross border commuter data does not show the originating or destinating municipality for foreign countries but only the country (e.g. the Netherlands or Belgium) the people commute to or from. The commuter data from the Netherlands for example just shows the number of people, who commute to Germany. There is no differentiation in German regions or even municipalities. Same for German statistics, they supply the number of commuters from the Netherlands to Germany but not the district or municipality of origin in the Netherlands (see fig. 4). Due to this fact it is necessary to disaggregate this data to obtain an origin-destination matrix on municipality or

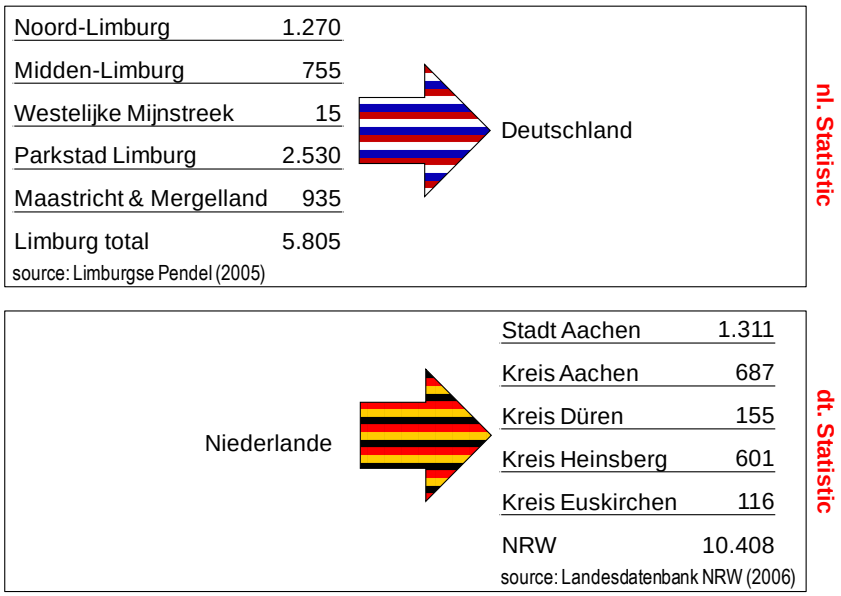


Fig. 4: Commuters from Limburg to the region of Aachen in German and Dutch commuter statistic

There is not only the problem with the spatial aggregation but also with the availability of cross-border data in general. The Dutch commuter statistic for example shows the commuters to and from Germany, whereas the German statistic only supplies the number of commuters from the Netherlands to Germany but not the other way around (see fig. 5). The reason for that is a differentiation in the methodology. In Germany the

number of jobs liable for social insurance contribution is recorded, whereas foreign employers do not send any information about German employees to German agencies . Due to that fact the employment statistic does not show how many German employees work in foreign countries. In The Netherlands everyone who works abroad is recorded by his health insurance. Every employee living in the Netherlands and with a certain maximum income has to have a Dutch health insurance. Therefore in comparison to Germany the Dutch department for statistics (CBS) is able to record every Dutchman and Dutchwomen living in the Netherlands and working abroad.

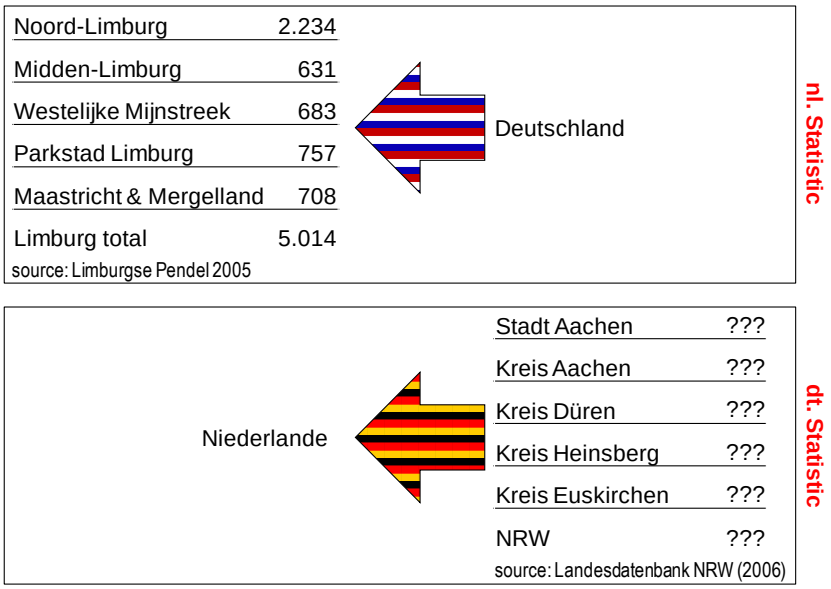


Fig. 5: Commuters from the region of Aachen to Limburg in German and Dutch commuter statistic

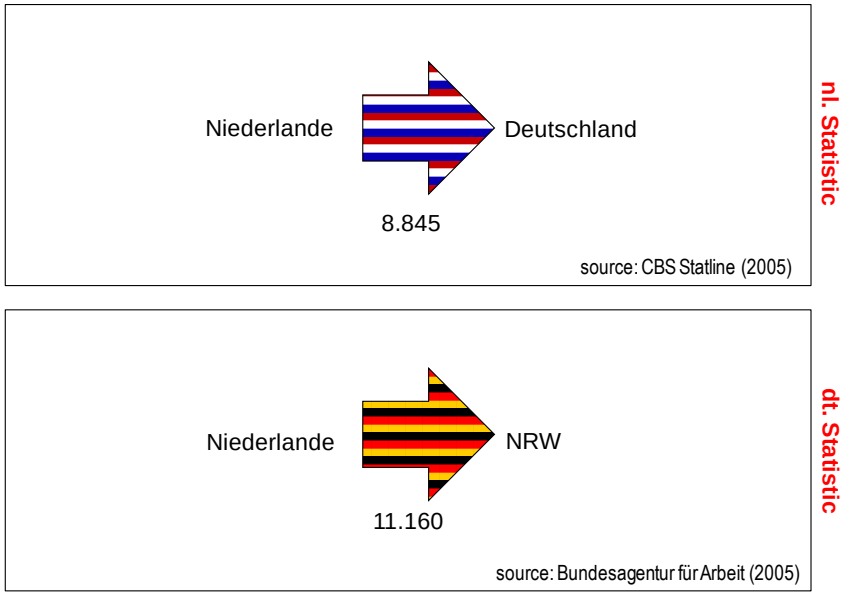


Fig. 6: Commuters from Netherland to the Germany in German and Dutch commuter statistic

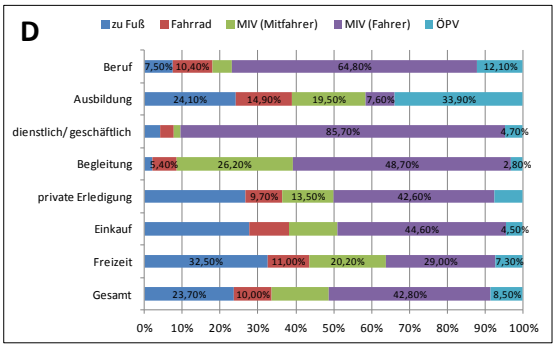
Due to the differentiation in the methodologies recording the commuters and the definition about what commuters are, the data about the commuting transport differs between Germany and the Netherlands. A closer look to the statistics verifies this fact clearly. Due to the German statistic North Rhine-Westphalia has 11.000 commuters from the Netherlands whereas the Dutch statistic has recorded only 9.000 commuters from the Netherlands to whole Germany (see fig. 6). One reason is that the responsibility for Dutchman/ Dutchwomen, who are living in the Netherlands and working abroad, to have a Dutch health insurance is related to their income. If they have a certain income, they do not need a Dutch health insurance anymore. That means that a certain amount of cross-border commuters is not recorded in the Netherlands. The Dutch research office E,til estimates that the actual amount of commuters is 10 % higher than the CBS records (E,til 2011, page 22). Additionally the CBS does not record any cross-border commuters, who work less than

twelve month in a foreign country. But these two reasons just explain some part of the difference in the commuter statistic, so there have to be more explanations. To analyse this discrepancy enquiries to identify the differentiation of the recording methodologies. The research work is complicated by the accessibility of data and communication problems. Another challenge lies in the development of a useful approach how to handle the noticed differentiation and reconcile it with all stakeholders.

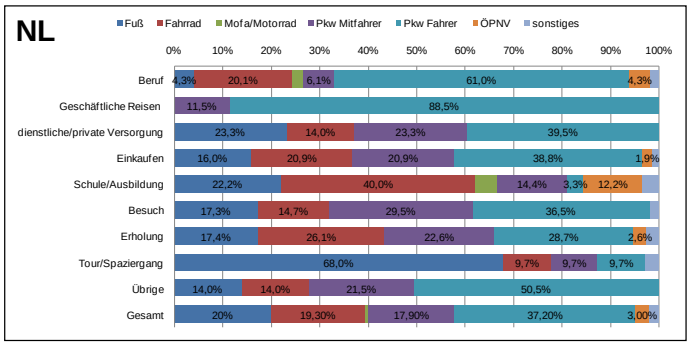
To develop an approach this data was first verified by the methodologys of the used statistics and compared with the number of jobs and employed persons in the region. In the next step this data was verified by known cross border traffic (counting stations) and the percentage of work trips.

4.3 Travel behaviour

To forecast travel demand information about travel behaviour is necessary. The calculation of trip generation requires knowledge about how many trips are made and for which purpose are they made by different groups of people (e.g. elderly, students, employees). To model the distribution of trips and the mode choice data about trip length and mode choice of people differntiated by trip purpose are used. The travel behaviour varies due to the group of people and region because of different activities and land-use. Since the land-use is heterogeneous in the study area (urban and rural districts) and the variety of travel behaviour between regions is even stronger between different countries a region-specific survey would be the optimal database for data about travel behaviour. But such a survey is very expensive and takes a lot of time, so existing surveys have to be used. For Germany there is the MiD (Mobilität in Deutschland) and for the Netherlands the MON (Mobiliteitsonderzoek Nederland). Both surveys are carried out in the whole country to analyse the mobility behavior of the inhabitants. Belgium has a comparable survey for Flanders but not for the Walloon region, where the Belgium study area is located. Moreover there is a local mobility survey carried out in the StädteRegion Aachen. A comparison of mode choice in the Netherlands and Germany shows the necessity of a cross-border traffic model that depicts the travel behaviour differentiated by the countries. In the Netherlands for example the bicycle (as a mode) is more important than in Germany, whereas in Germany the public transport plays a bigger role in commuting traffic (see fig. 7).



Source: MiT 2008



Quelle: MON 2007

Fig. 7: Mode choice in German and Dutch surveys

Besides the country-specific travel behaviour, the location of regions close to the border influences the destination choice. There are existing impediments and incentives (e.g. language skills, difference in price, fare or a differentiation in the job markets), which have an influence on the modal and destination choice of a person. Due to that fact it can be assumed that the travel behaviour in the inland is different to the travel

behaviour in the border areas. To verify this, according to AHRENS/SCHÖNE (2008, page 87), the following information is needed:

- Frequency of border crossing/journey to the neighbouring country
- Motive/purpose for border crossing
- Modal choice for border crossing
- Activities in the neighbouring country

Since there is no such empirical survey for the region of Aachen, which takes the characteristics of the border area adequately in consideration, available surveys and data have to be used. The frequency of border crossings by car are counted at some streets and the activities in the neighbouring country can be taken from regional and municipal statistics. To estimate mobility indicators for the different regions different surveys have to be used. The differentiation of the German MiD would take the entire region North Rhine-Westphalia into consideration, with this the characteristics of the examined planning area cannot be emphasized totally. But for some parts of the German study area there has been carried out a local survey, which can be used additionally. The use of the Dutch MON for the Netherlands seems to be suitable because the data refers to the province level and the Dutch planning area is the province of South Limburg. When using both mobility surveys (MON and MiD) there is a problem with the compatibility. Due to the different survey methods and definitions a classification is not simple. Whereas the MiD has seven trip purposes the MON has nine (see fig. 8). The Dutch trip purposes "Visit", "relaxation" and "tour/walk" could be combined by the German trip purpose "leisure". A classification of the private and on business purchase is much more complicated. To find an exact equivalence it is necessary to have a closer look on the survey methods of MiD and MON, which is again complicated by the language barrier and the availability of the relevant data.

Mobiliteitsonderzoek Nederland 2007 (MON)		**Mobilität in Deutschland 2008 (MiD)**	
Work (Van en naar het werk)	16,4	Work (Arbeit)	15,7
Business trip (Zakelijk bezoek in werksfeer)	2,6	Official purchase (Dienstliche Erledigungen)	1,3
Official/ private supply (Diensten/persoonlijke verzorging)	3,6	Private purchase (Private Erledigungen)	13,1
Shopping (Winkelen, boodschappen doen)	20,7	Shopping (Einkaufen)	20,8
School/ apprenticeship (Onderwijs/cursus volgen)	8,9	Education (Ausbildung)	6,7
Visit (Visite/logeren)	16,7	Leisure (Freizeit)	33,4
Relaxation (Sociaal recreatief overig)	13,8	Company (Begleitung)	9,1
Tour/ Walk (Toeren/wandelen)	9,5		
Others (Overige)	8,2		

Fig. 8: trip purposes in German and Dutch surveys (source: MON 2007, MiT 2008)

The data and information of MON, MiD and the local survey have been compared and comparable trip purposes have been built by aggregating or disaggregating the data of the surveys.

4.4 Traffic counts and traffic volumes

To check the plausibility of traffic assignment results counter values from the traffic census are used. In the study area continuous counts and manual counting data are available. The results of counting stations which are located close to the border of the neighbouring country should be used if available. For many border crossings between Germany and the Netherlands there are counter values available on both sides. Comparing the border crossing-point A4 (GER) or rather A76 (NL) near Vetschau shows a difference of 2 % in the average weekday daily traffic in 2008. There are no slip roads or exits between these two continuous census points. Still there is a difference in the counter values. On a border crossing-point further north, A57 (GER) or rather A77 (NL) is even a difference of 8 % (see fig. 9). Without an adjustment and a plausibility of the counter values difficulties in the calibration of the traffic assignment can occur because two alongside census points indicate different counter values. For a practical adjustment or rather a selection of counter values it is helpful to analyse possible reasons for the differences noticed. Reasons could be for example the counter- and processing methodology, the number of valid days and possible term definitions. To clarify this, a close

and intensive exchange with the Dutch colleagues is very important. Based on this information adjustments and the selection of counter values can be made.

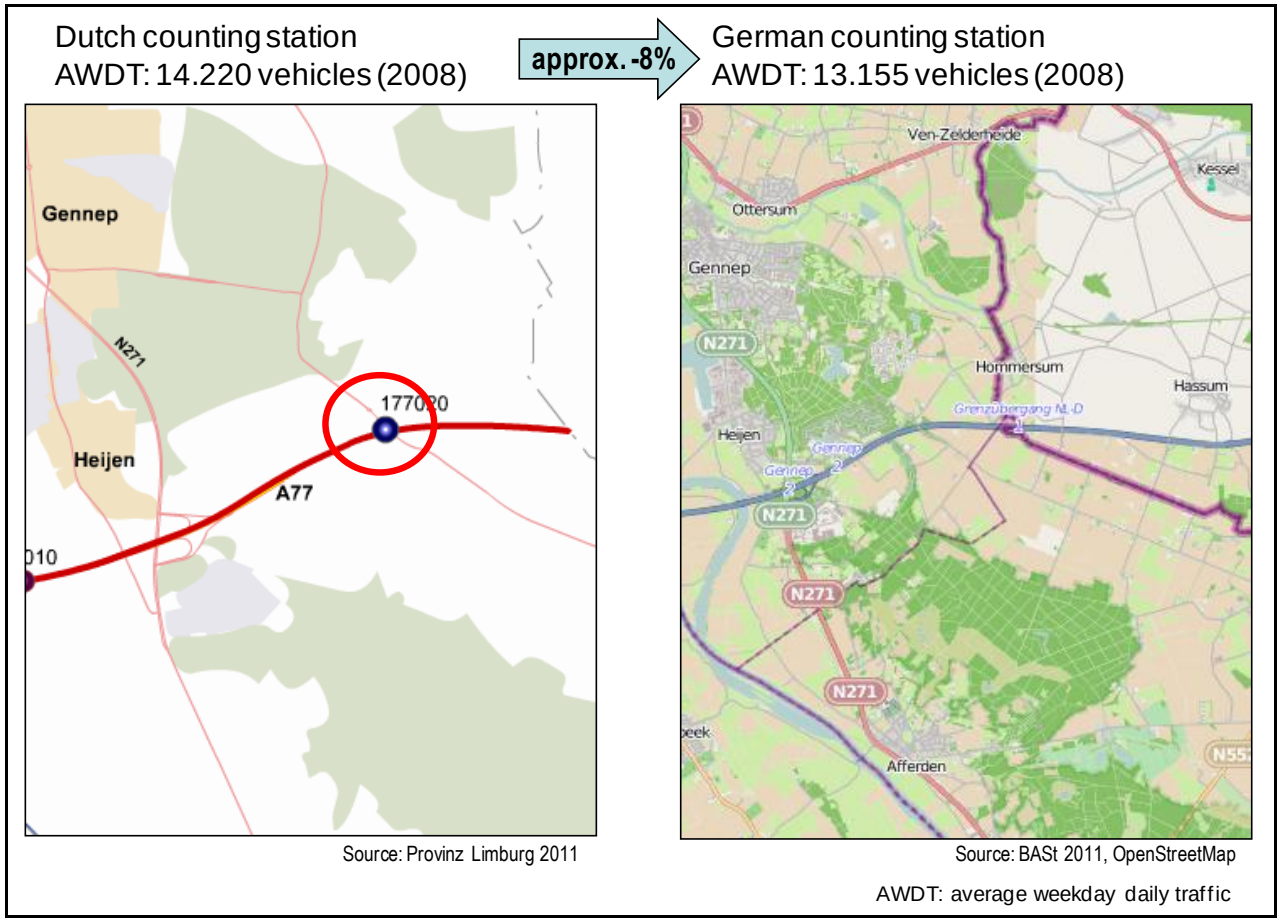


Fig. 9: Comparison of Dutch and German counting stations

5 CONCLUSION AND PERSPECTIVE

For transport planning, as well as for other planning jobs, it is necessary to have information about the general conditions. Therefore transport models are often used as a basis for the decision-making- and transport planning-process. In these processes many different stakeholders are involved and data and information which are needed for the planning process are kept and used in wide differentiation and with a variety of definitions and considered areas by the different institutions and stakeholders (e.g. city council, road administration, transport association).So collected data and results have to be discussed many times and difficulties in the coordination and decision-making-process can occur. These difficulties increase in cross border planning processes even more.

Therefore the development of a cross-border data platform combined with a macroscopic cross-border transport model in the region of Aachen is an important step to create and keep a high quality and coordinated and consistent basis for regional planning data. The process of the development is challenging since many stakeholders have to be involved and the difficulties due to data inconsistencies based on different methodologies and definitions have to be solved. The developed approaches for data adjustments have to be discussed and reconciled with all stakeholders and these discussions have to be prepared well like most stakeholders aren´t used to think about data variation and the effects different methodologies might have on results. So these topics need to be communicated well to all regional stakeholders, so that they understand the reasons and support the choosen aproaches for data adjustments. Therefore the process of participation accompanying the development of the data platform and transport model consists of a broad involvement of the stakeholders of the three countries in data collection, data adjustments and information about the model calibration. This has been done by an accompanying advisory broad and a broad interaction with each municipality and region of the planning area. All basis data (e.g. inhabitants, employees) and the apraoches of data adjustments due to regional consitency have been discussed with each municipality.

Commuter data, mobility behavioral, data from counting stations and for the calibration of the model were discussed in regular meetings of the advisory board. The next step is the discussion of the model (calibration, results) with all participants (advisory board and each municipality/ region).

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