URBAN FREIGHT TRANSPORT STRATEGY IN BRUSSELS

Hughes DUCHATEAU
STRATEC Consultancy Belgium

1. THE GENERAL TRANSPORT POLICY OBJECTIVES

The general policy objectives of the Brussels-Capital Region are identified in the regional Development Plan of the Region. At least two of them involve directly the transport system:

- to stop and reverse the decreasing population trend, and
- to maintain the economic viability of the Region.

In terms of targets for the transport system, these objectives imply that:

- quality of life should be significantly improved, notably through reduction of the (insecurity) and environmental impacts of the road traffic, and
- accessibility should be improved, without any significant extension to the road network.

The transport policy objectives are developed in a global mobility plan, called the IRIS Plan. At first the IRIS Plan was only targeted for the personal transportation, but the Brussels ministry in charge of the transport policy decided to carry out the original plan with a specific freight traffic plan.

2. AIMS OF THE STUDY

The study is carried out within the framework of a reformulation of the freight transport policy in Brussels. The **aims** of the study are to draw up a diagnosis of the present impacts of freight transport on the environment in Brussels, to identify the trends and to elaborate a global strategy to cope with the results of the diagnosis. The study is carried out on request of different groups of interest, which are demanding a ban or the suppression of heavy freight traffic in the urban area.

More particularly, the **objectives** are to analyse the present situation and to assess the potential traffic and environmental impacts of traffic restriction rules combined with the implementation of an urban transhipment centre (UTC) to separate the heavy trucks and vans.

A freight model compatible with the existing passenger model has been designed, in order to evaluate freight traffic impacts on the general traffic conditions. It is necessary to do the things this way because of the interactions between freight traffic and private traffic, which are making these impacts highly non-linear.

3. METHODOLOGY

3.1. General Approach

The first question to be answered by the study was to quantify the present impacts of freight transport on the urban traffic. It has been done through the following procedure;

- modelling the demand generated by the private cars and vans, the demand generated by the light trucks and the demand generated by the heavy trucks;
- assign, on a model of the road network, the total demand and calculate indicators of the present situation (total travelling time, total travelling distance, total fuel consumption, local accessibility's, distribution of the travelling distance across the various road categories, traffic, traffic noise and pollutant emissions link by link of the network, ...);
- assign on the same network model the demand generated only by the private cars and vans and calculate the same indicators;
- analyse the difference in the indicators values between the two assignments as with the impacts of the truck traffic.

This procedure gives a sharp picture of the present situation.

The second question was to examine different scenarios of the freight transport policy and assess them regarding the following points of view:

a) evaluation of the traffic:

- **network traffic load**;
- **performance indicators** (the total distance travelled on the network by vehicles, the overall duration of travel on the network carried out by the vehicles, the average speed of the vehicles, the traffic load on the network, the fuel consumption);
- **accessibility** (the approach to representing accessibility consists of calculating the average duration of journeys to and from each district and comparing the evolution of the figures computed with the «trend 2005» reference scenario;
- **variations in vehicle travel duration times**;

b) evaluation of the environmental impact :

- **the variation in energy consumption**;
- **the pollutant emissions** (CO, CO2, Nox, COV). The consequences of the scenarios in terms of atmospheric pollution are calculated by using a specific emissions model produced by STRATEC for, and with the help of the IBGE (Institut Bruxellois pour la Gestion de l'Environnement), which calculates the principal pollutant emissions by vehicle type (heavy or light) and by engine type (diesel or petrol);

- **the noise emission**. The evaluation of noise in the various scenarios is made on the basis of calculations using the program CADAB (Cadastre du bruit), which has also been developed for the IBGE. For each link, the programme calculates a noise-discomfort index figure as a function of the light-vehicle traffic volume, of the heavy-vehicle flow, of the average speed, and of the characteristics of the street or road.
- **the deterioration of road surface**. Heavy traffic is the prime cause of roadway deterioration. All measures which restrict heavy traffic to specific roads designed to withstand the heavy loads or which limit heavy traffic to specific zones, must therefore be considered as sources of significant financial savings for the public authorities.
- **the visual intrusion effects**.

c) economic evaluation :
- **Users' benefits and savings** (travel time save, variations in vehicle operating costs, impact on the various sectors : industry, retail sale, logistic and transport sectors);
- **Benefits and savings for the society** (costs of accidents, cost of atmospheric pollution, estimation of the operating cost of the measures).

3.2. Building origin-destination matrices

Three matrices were built, one for each user vehicle group, namely: cars (including bikes and vans), «light» trucks, «heavy» trucks.

The available means (from the existing passenger model IRIS) were:
- the global origin-destination matrix (1991) and its forecasting (2005), where vehicle categories were not distinguished (255 origin-destination zones, matrix of a total of more or less 210.000 PCU's (Particular Car Unit) during one hour at morning peak time);
- categorised traffic counts (almost 400 moves);
- the network (approximately 6000 links, 2000 nodes).
- SATURN: a transport modelling software.

3.2.1. A priori matrices

By linear interpolation between the 1991 global matrix and its forecasting, we computed the **1996 global matrix**. This has been split into «car» and «truck» matrices on the basis of the average proportion of these vehicles in the 1991 traffic counts (converted in PCU's). The «**truck**» matrix has then been split into «light truck» and «heavy truck» matrices.

The first choice was that of determining what trucks would be «**light**» or «**heavy**». Usually, vehicles are converted into Particular Car Unit (PCU). For instance, one truck may be regarded as equivalent to two PCU's, reflecting the place required and the ability to move rapidly, which are the essential attributes of a vehicle as long as the impact studied is congestion.

When other impacts, like air pollution, visual intrusion or road damage, are to be analyzed, this conversion becomes even more difficult. As a matter of fact, road damage is inversely proportional to an exponential of the load per axle, air pollution is related to engine and fuel characteristics and visual intrusion is probably a function of the volume, other qualitative attributes and the place where the truck moves.

Furthermore, practical considerations were also important: traffic counts were to be compatible with the criteria used to distinguish the above mentioned vehicles. In other words, the classes of vehicles to be counted had to be clearly defined and rapidly determined (for example, «heavy trucks are those having a surface > 20 m^2» is clear but not easily visible when the vehicle is in motion). We finally decided, regarding foreign experience, that the «light trucks» would be these with two axles and the remaining trucks would be «heavy trucks». We found (1996 counts) that approximately 7/10 of the trucks were «light» and we split the matrix on this basis.

3.2.2. Traffic counts

Traffic counts have been realised in order to update and complement the available information. These were mainly «small cordon» counts surrounding the main freight traffic generators (harbor area, industrial district, slaughterhouse neighborhood), and also screen line counts and large cordon counts spread out all around the urban area. Identification of plate number has also to be conducted aiming at both providing information on the **entering and leaving** traffic and to estimate the time spent in the cordon.

3.2.3. Furnessing the a priori matrixes

The traffic counts allowed us to distinguish the number of trucks that simply passed through the cordon from those supposed to have carried out (un)loading operations there. These entering/leaving information constitute the margins of the matrices (**row and column sums**) used to correct them by means of the **Furness** algorithm (algorithm used to correct a prior matrix in order to satisfy the new generation/attraction constraints, often called «bi-proportional» because of the satisfaction of both generation and attraction constraints).

3.2.4. Matrix estimation (iterative) process

A priori matrices are assigned to the network model. Assigned flows are compared to counted flows on the cordons area and on the screen lines and matrices are corrected in order to minimise this difference when assigned the next time.

Rail and river matrices have also been built for the current 1996 situation using statistics.

The map in annex represents the spatial units used for the model.

3.3 Building «present trends 2005 matrices»

After building the current situation, we built trend matrices for 2005. These are «business as usual» matrices. They do not include any kind of transport policy measure or platform implantation.

In order to find a way of predicting matrices in the year 2005, a regression analysis has been carried out between number of trucks (from and to each zone) and three planning variables, namely population (P), employment in industrial activities (I) and wholesale employment (W). R^2 are more or less 85% and the relation of the form is:

number of trips (entering or leaving) = 0.002 P + 0.015 I + 0.025 W

This relation has then been used to predict, on the basis of the land use plan, the future traffic. The matrices have then been computed, again, by means of the Furness algorithm.

3.4. Alternative freight transport policy scenarios

Six scenarios have been proposed.

N° Scenario	Scenario 2005A
Name of the scenario	Enforcing parking avoidance near principal cross roads sections of the main regional road network
Description of the scenario	This scenario enforces banning of the illegal parking operations near the main crossings of the regional roads during the peak periods.
Aims of the evaluation	- roads capacity changes due to the scenario ; - impact on general traffic and congestion ; - impact on noise and pollutant emissions ; - impact on industry, whole sale trade, transport and logistic sectors

N° of the scenario	scenario 2005B
Name of the scenario	Restricted traffic rules for the heavy vehicles
Description of the scenario	This scenario introduces restriction traffic rules for heavy trucks on the Brussels territory except in industrial and wholesale zones during the peak periods.
Aims of the evaluation	- matrices changes due to the scenario - impact on general traffic and congestion - impact on the transport price - impact on noise and atmospheric pollution - impact on industry, whole/retail trade, transport and logistic sectors

N° of the scenario	Scenario 2005C
Name of the scenario	Urban Transhipment Centre covering the Centre Ring Road
Description of the scenario	This scenario provides for the creation of an Urban Transhipment Centre (UTC) in the harbour zone for the traffic of heavy vehicles arriving (inbound or outbound) on the Centre Ring Road
Aims of the evaluation	- matrices changes due to the scenario - impact on general traffic and congestion - impact on the transport price - impact on noise and atmospheric pollution - impact on industry, whole/retail trade, transport and logistic sectors

N° of the scenario	Scenario 2005 D
Name of the scenario	Urban Transhipment Centre covering the Pentagon area
Description of the scenario	This scenario is a more realistic variant of the previous one, limiting the ban on heavy vehicles exclusively to the Pentagon area (=500 hectares, 3 % of the total Brussels region surface) and establishing the Urban Transhipment Centre in the harbour area. The assumptions applied in this scenario are identical to those mentioned in scenario no.2005C, with the exception that the traffic restriction zone is limited to the Pentagon area.
Aims of the evaluation	- matrices changes due to the scenario - impact on general traffic and congestion - impact on the transport price - impact on noise and atmospheric pollution - impact on industry, whole/retail trade, transport and logistic sectors

N°of the scenario	Scenario 2005[E]
Name of the scenario	Development of the sea and river freight transport, building
Description of the scenario	The scenario hypothesis are the following: further Development of the harbour area, building a new big warehouse for one of the most important logistic companies set up in the harbour area, updating the warehouses owned by the harbour authorities, investments in material and infrastructures like transhipment equipment, storage facilities.
Aims of the evaluation	- matrices changes due to the scenario - impact on general traffic and congestion - impact on the transport price - impact on noise and atmospheric pollution - impact on industry, whole/retail trade, transport and logistic sectors

N° scenario	Scenario 2005F
Name of the scenario	Scenario for environment
Description of the scenario	Banning of transit movement in residential areas. Using environmental legislation to impose specific routes to the heavy vehicles, using noise protection material for residential building...
Aims of the evaluation	- qualitative analysis of the impacts produced by pollutant emissions and quality of urban life

4. RESULTS AND CONCLUSIONS

The following table presents the main comparative results of the different scenarios. The appendix contains the tables of results concerning the noise and pollutant emissions.

	Total distance travelled on the network by the vehicles (PCU*km)	**Average speed of the vehicles (kph)**	**Fuel consumption (l)**
Scenario 2005 « business as usual »	851 547	20	134 353
Scenario 2005A parking operations avoidance	- 1,93 %	+ 29,76 %	- 12,3 %
Scenario 2005B Restricted traffic rules for heavy vehicles	+1,26 %	- 1,85 %	+ 2,14 %
Scenario 2005C Urban Transhipment Centre covering the Centre Ring Road	+ 2,91 %	- 6,5 %	+ 6,21 %
Scenario 2005D Urban Transhipment Centre covering the Pentagon area	0	0	0
Scenario 2005E Development of the sea and river freight transport, building	+ 0,09 %	- 0,36 %	+ 0,26 %

Scenario with an improved enforcing of banning the illegal parking, mainly on the approach of the main crossings of the regional network, has important positive impacts on traffic conditions and on the quality of urban life. Because the congestion is considerably reduced, all the traffic performance indicators are improved: the average speed is increased, the average duration of travels, characterising the accessibility, is decreased, the overall duration of travel on the network carried out by the different categories of vehicles is also decreased.

Due to the better traffic conditions on the network for all the different users, the environment impacts are also positively borne.

Scenarios addressing the establishment of an UTC in conjunction with the banning of heavy vehicles from the zones of the Centre Ring Road or the Pentagon area, have only negative impacts on traffic and environment.

The scenarios increase the traffic flows bound for the Urban Transhipment Centre, but also in the zones which are affected by the ban. At the level of the Brussels-Capital Region, these scenarios give rise to the road users as a whole, to an increase in travelled distances and in the duration associated with these travels. The increase in the distances and times of travel in conjunction with a reduced speed has a negative bearing on the average time needed for inbound and outbound access. This negative impact is however minimal at the regional level. On the contrary, at the local level one can see a deterioration in accessibility to the district where the UTC is located. The reason for the considerable increase in the time needed for the inbound access is the large number of vans generated by the UTC. The average time needed to access the outbound traffic is also increasing.

Furthermore, in parallel to the aspects associated with vehicle traffic, these scenarios are likely to have adverse effects on parking. Indeed, the switch from heavy vehicles to vans could lead to an increase in parking problems during delivery at the destination point. It should be reminded that, in terms of hauling capacity, a medium-sized two-axle truck is the equivalent of 5 vans, and a lorry of more than two axles compares to 12 vans while the road occupancy of a truck is equivalent to only 1,5 vans and that of a lorry to 3,2 vans.

Because the deterioration of the network performance, these scenarios lead to negative environmental impacts:

- the annual fuel consumption is increasing when all the users are considered together. This increase in fuel consumption is caused by two factors: the increase of the number of vehicles per km and the decrease of the average speed, which causes the rising of the specific fuel consumption. During the peak hours, the impact of the second factor is much higher than the first;

- the scenarios lead to differentiated increases in pollution, according to the type of pollutant in concern and depending on the model and type of vehicle implicated in its emission. CO2 and VOC increase because the increase of light vehicles in comparison to the trucks and Nox, by contrast, which is generated mainly by road transport diesel vehicles, diminishes as a result of the reduced presence of heavy vehicles on the network;

- the scenarios give rise to relatively significant effects regarding noise. It leads to an increase of road distance where the noise exceeds 75 dB(A). This increase occurs especially on the local road network, which, considering the importance that the inhabitants place on the acoustic quietness of their residential quarter, could have damaging consequences for settling in this area.

The implantation of a CDU combined with restriction traffic rules lead also to negative impacts on users' and society costs. Change from trucks to vans and, consequently, lengthening of the travel times of the private motorcars lead to economic lost and to the increase in fuel consumption.

The overall investment for realising an UTC type would be in an order of disproportionate magnitude in comparison with the benefits, in conjunction with the perspective of adding thousands of delivery vans to the present traffic volume.

The consequences for various sectors have been assessed as follows.

The big food-trade and department stores consider themselves to be the first ones to be menaced by the application of a measure aimed at restricting access to the Centre Ring Road. They will react by raising their sales prices and, possible, by moving to the periphery of the city and to the suburbs.

For the small shop owners located along the Centre Ring Road, the principal annoyance will be the need, forced upon them by a measure as described above, to adapt their vehicle fleet. Keeping in mind that the shop owners' need to amortize their current vehicles, a transitional period of some 3 to 7 years would have to be instituted to allow them to adapt their vehicle pool.

Traditional industries, with their reliance on the canal and on railways, should not experience an accelerated decline because of such a measure. By contrast, more recent industries, which depend on roads, would see themselves even more encouraged to move to suburban zones, which are better connected to the motorway network.

Among the transport companies, one must differentiate between integrated logistic enterprises and the small independent carriers. The former does not believe in the success of the public UTC. They are, however, in favour of the traffic restriction to the extent that it keeps the small carriers from carrying out an end-to-end journey because, unlike the big firms, they do not own of their own transshipment facilities. The latter sees in the UTC the means to offset their handicap caused by the ban on entering the city. The UTC offers them the possibility to carry out a change to smaller vehicles, thereby partially offsetting their lack of transshipment infrastructure.

One of the few advantages provided by such measures would be the positive visual impact in the zone where the traffic ban is applied and where the trucks would be replaced by smaller vehicles. However, this impact seems subjective—who would prefer 10 vans to one truck, or vice versa?—and, at any rate, very difficult to translate into figures.

What is made absolutely evident by the evaluation of these scenarios, is that the benefits expected in terms of traffic in the light of the high amount of investment and operating costs generated by the establishment of an UTC, are almost non-existent. To overcome the traffic problems, therefore, cannot be brought forward as a reason for justifying an UTC.

By contrast, an Urban Transhipment Centre could be envisaged as an economic, non-bureaucratic activity offering itself to be set up in the territory of the Brussels Region to generate positive economic effects.

The restructuring currently under way in the domain of logistics leads to an increasing economic need for such transhipment centres. However, the range of action of this type of centre largely exceeds the metropolitan area of Brussels. For such a centre, vast complexes dimensioned on an international scale are required, owned by private operators who are logistics professionals.

The establishment of such centres will depend on the presence of multi modal services. The road will remain the dominant transport mode in the future. Accessibility by road, therefore, is primordial. Aeroplanes, too, will enjoy considerably increased demand as a result of the trend towards a globalised economy. Similarly, railways may increase their activities—for the transport of certain, specific types of freight—on a par with the increase of the average transportation distances in Europe (opening of the unified market to new partners, outreach to the east), if the prerequisites in terms of interoperability and service quality are fulfilled.

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