HOW DO URBAN POLICIES WORK ON URBAN GOODS TRANSPORT FLOWS?

Christian Ambrosini, Jean-Louis Routhier, Florence Toilier
Lyon 2 University, Laboratoire d'Économie des Transports (LET)
14 avenue Berthelot 69363 LYON Cedex 07 France
Tél. 33 (0) 4 72 72 65 26; 6465; 6517, Fax. 33 (0) 4 72 72 64 48
christian.ambrosini@let.ish-lyon.cnrs.fr; jean-louis.routhier@let.ish-lyon.cnrs.fr;
florence.toilier@let.ish-lyon.cnrs.fr

Abstract

This paper concerns the implementation of a specific urban freight model, initially ordered by the French Transport Ministry, for analysing and comparing the outputs of a few simulations derived from various scenarios. These scenarios are based on appropriate assumptions on possible evolutions over a twenty years period in the field of urban logistics, in order to control the urban freight flows regarding the purpose a sustainable development.

A reference scenario takes into account the general trends observed in France between 1982 and 1999, concerning the number of premises and jobs in the different economic activities, the number and types of goods vehicle, the structure of operating and organisational modes and the freight flows including the household purchasing trips.

According to the reference scenario, it becomes possible to compare and understand urban goods movement changes, by implementing the model introducing variations, such as activity relocation or urban distribution centre whose impacts concern not only the freight flows themselves but also the whole urban logistics organisation. In this way our approach is policy oriented for local authorities.

Keywords: Urban freight transport modelling; Urban policy; Decision making aid
Topic Area: B5 Urban Goods Movement

1. Background and stakes of the study

In the early nineties, the authorities of the European countries became discovered the nearly complete lack of data on urban goods movement (UGM). Hitherto the heavy lorries traffic was limited in town centres while top priority was given to the private motor vehicle traffic. Consecutively, difficulties appeared, pick-up and delivery operations leading to the relocation of activities to urban outskirts and to the devitalisation of town centres. It resulted in various initiatives in many countries: experiments instigated by authorities in some of them, more systematic research programmes in others, France was one of them (French urban freight transport web site: http://www.transports-marchandises-en-ville.org/).

In the French case, the initial goal was to build a comprehensive data base in order to help decision-makers in the field of urban goods movement. With this aim in view, quantitative surveys have been implemented in Bordeaux, Marseilles and Dijon and experiments have been launched simultaneously in several French cities (Dufour, J.G., Patier, D., 1997). The first analysis on cross section data revealed that many ratios were constant for different cities. Owing to these constant ratios, it was possible to build a model (the "Freturb model", see point 2.). The Freturb model has been carried out in such a way that it is able to simulate the generation of freight vehicles flows in urban areas according to various scenarios. A software of this model started to be implemented in several French cities.

One of the main stake of this approach consists in creating a relevant tool for local authorities, in order to carry out urban land use implementations by having rough estimates of vehicles flows generated by the impacts of any particular measure. Thus the use of the model allows a better management of the decisions, notably regarding the location of activities in various zones of the city.

Here a significant remark to emphasise that passenger transportation models based on a “four-step” structure (flows generation, origin/destination distribution, modal split and assignment on the network) cannot ever be implemented concerning freight flows, because it is not relevant to consider freight flows according to an origin-destination way, due to the complexity of the implementation of the pick-up and delivery rounds.

Our concern is today reinforced by the energy questions and the environmental impacts of vehicles movement (pollution, greenhouse gas, noise).

Household purchasing trips and deliveries of the retail shops are mutually dependent. That's why generated purchasing trips by private cars consist in an integral part of urban goods movement.

This paper presents some relevant and contrasted scenarios of urban land use development. These scenarios are based on appropriate assumptions on possible evolutions over a twenty years period in the field of urban logistics. The implementation of the Freturb model aims to:

- reveal urban goods movement changes (the number and types of vehicles, the amount and types of flows);
- show what urban planning policies are the most appropriate for a sustainable urban management about regulatory decisions, technological innovations, changes in the logistic systems, considerations about new types of vehicles or new ways of locating the urban economic activities.

Our approach is policy oriented for local authorities. The model has to run to measure the sensitivity of the results according to various scenarios. Please note that we do not consider the role of the different actors involved, i.e. the question of knowing if measures are more or less easily accepted by the economic agents is not presently studied.

2. Methodology of the Freturb model

The Freturb Model was build simultaneously with specific thorough surveys concerning 4,300 premises, describing 11,600 delivery and collection operations, as well as interview-surveys of 2,200 drivers (Ambrosini, C., Routhier, J.L., 2004). These surveys were ordered by the French Transport Ministry to help the local authorities decision making.

The Freturb model shows specific features: Essentially, it is not based on a freight origin-destination matrix, because it is inappropriate to provide good vehicles flows estimations regarding the rounds (75 % of the pick-up and delivery flows). The premises where pick-ups or deliveries are carried out have been considered as a relevant basic unit, because information can be simultaneously collected about the logistic chains, the goods, the vehicles, the activities, …

Four main sequential modules (see figure 1) compose the model (Routhier, J.L., 2000):

- a generation of the pick-ups and deliveries in each urban area. Structural variables consist of the activity types, the number of jobs of the premises, the type of premises, the number of subsidiaries. In addition to pick-ups and deliveries the model includes household purchasing trips, so that it is possible to compare UGM and household purchasing trips;

- a module of road occupancy by running vehicles. It is based on the distance travelled between two stops. It is estimated in each area, according to the number of stops of the rounds, the vehicle type, the operating mode and the density of activities. The length of the direct trips and the length of the approach trips (in case of rounds) are based on the distance to the town centre;
- a road occupancy by stationary vehicles module. It calculates the duration of space occupancy (illicit on road parking, no parking allowed, private parking spaces) according to demographic and activity density on one hand and to the number of stops of the rounds trips and the vehicle type on the other hand;
- a module of road occupancy at any instant, based on the opening hours of each economic activity. In this case, it is useful to display UGM peak and off-peak hours.

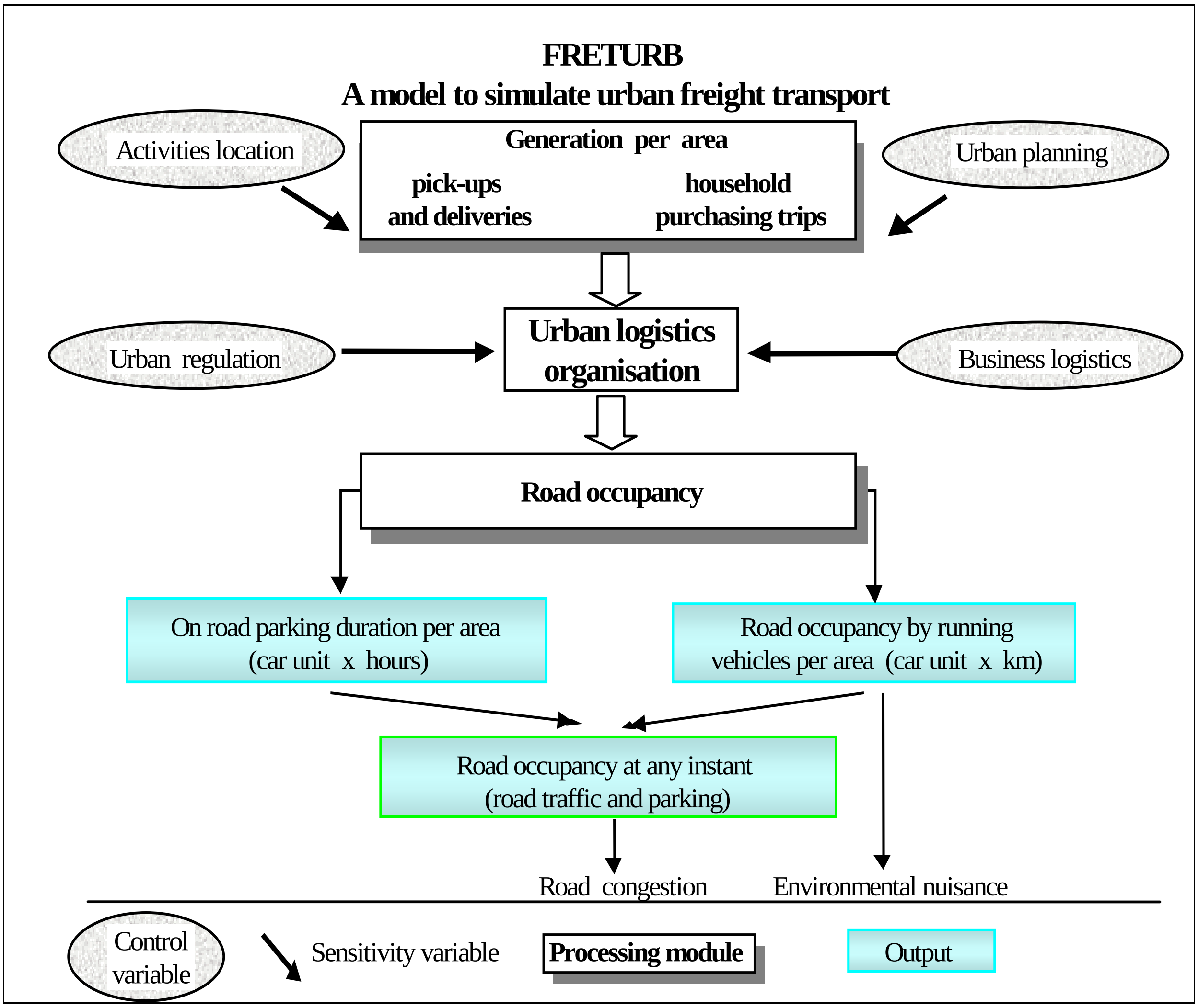

Figure 1: the structure of the Freturb model

The implementation of an environmental assessment module is ongoing.

Various simulations can be undertaken by modifying some of the control variables. (Routhier, J.L., et al., 2001). These ones have a strong impact on the freight flows generation. As figure 1 shows it, they concern:

- activities location (urban sprawl, economic forecasting);
- urban planning and land use, urban fabric to face the devitalisation of town centres;

- urban regulation (parking, road traffic, urban master plans);
- business logistics (operating and organisational modes, vehicles size, specific urban vehicle, clean urban vehicle, urban distribution centres).

Let us stress here that the Freturb model, as a simulation tool, clearly shows the significant impacts of the activity type and the activity location on the freight flows. But it cannot explain the logistic changes in any activity.

3. Scenarios and selected assumptions

3.1. Methodology and 1999 situation

The Lyons conurbation in France, composed of 106 communes of the urban district, forms our study area. It counted in 1999, 1,300,000 inhabitants, 1,046 km², 83,557 premises and 652,000 jobs. It has been divided into three parts: the town centre, the closest suburbs (ring 1) and the more distant communes (ring 2, see figure 2).

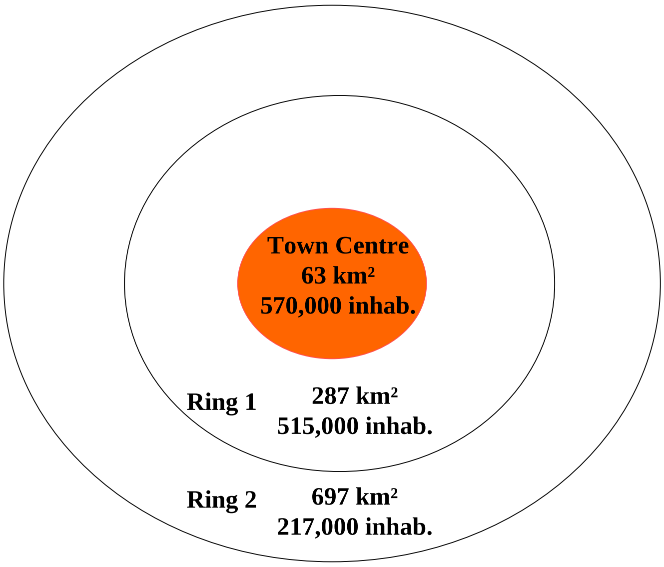

Figure 2: the Lyons conurbation

Our analysis weighs up the residence and activity densities on the one hand and their impact on the freight vehicles flows and the travelled distances on the other hand. Consequently the role of city size and the question of urban sprawl are put forward.

Several indicators are produced (in particular trip length, trip duration, on road parking duration) in order to bring information to more relevant analyses, according to:

- the types of vehicle,
- the covered zones (according to the rings),
- the activity types,
- the operating modes (hire or reward or own account),
- the organisational modes (direct trips or rounds).

1982 and 1999 data, including demographic, employment, activities and freight flows data, have been gathered in the Lyons area in order to feed the model. Due the lack of knowledge about the logistics practice in the early eighties we have been obliged to base the modelling assumptions on the logistics practice in the late nineties. Location and activity structure impacts on pick-up and delivery flows and urban goods movement are specially considered.

The Freturb model gives an account of the development of the Lyons conurbation between 1982 and 1999, trying to estimate the impacts of changes in the spatial configuration of economic activities (number of premises and number of jobs according to the activity in each commune). We focus on the following indicators:

- - the number of pick-ups and deliveries;
- the travelled kilometres, according to three types of vehicle (light commercial vehicles (< 3.5 t), rigid lorries and articulated vehicles);
- the on street parking duration, which impacts the traffic congestion.

Note that the model is calibrated from a logistic behaviour given by several 1995-99 surveys. Organisation and management of the logistic chains have been analysed according to a large typology of activity premises (116 types according to the nature of the activity and the size of the premises) and the results correspond to a "theoretical" logistic organisation similar to the results of those surveys (Patier, D., *et al*., 2000). That is the reason why this model is relevant for industrialised countries only.

The following table shows the structure of the activity in the three rings. It will be a base for comparisons with our scenarios.

Table 1: the main parameters per ring in 1999, Lyons

1999	Number of premises	Number of pick-ups/deliveries	Number of jobs	Average km/trip*
Town centre	45,400 (54%)	248,800 (39%)	328,800 (50%)	5.7
Ring 1	25,000 (30%)	253,500 (40%)	223,900 (34%)	8.0
Ring 2	13,200 (16%)	134,700 (21%)	99,200 (15%)	9.7
Total	**83,600 (100%)**	**637,000 (100%)**	**651,900 (100%)**	**7.5**

*We mean by trip, the movement of a vehicle between two pick-ups or deliveries stops in the course of a round.

3.2. General trends between 1982 and 1999

In the table 1, it can be mainly observed that the total number of premises increase by only 11 % and the number of jobs by 12 %. However changes are very different according to the activity:

- - a high concentration in the commercial activities (a twofold rise in the number of supermarkets and a 24 % decrease in the number of retail shops);
- - a high concentration in the warehouses and depots (a 66 % drop in the number of them), and a 4% increase of jobs;
- - an important decrease in the industrial activities (a 11 % decrease of the premises and a 25 % drop of jobs);
- - a large increase in the tertiary activities (especially the services, the craft industry and the wholesale trade);
- - the important increase in the minor agricultural sector is due to the development of services concerning public and private gardens.

Table 2: evolution of the activity structure between 1982 and 1999

Activities	Number of premises 1982	Number of premises 1999	Evolution (%) 82-99	Employment 1982	Employment 1999	Evolution (%) 82-99
Agriculture	515	1,553	202%	1,390	3,090	122%
Craftsmanship / services	16,879	24,288	44%	50,733	96,578	90%
Wholesale trade	3,205	5,172	61%	22,997	37,960	65%
Warehouses	1,926	656	- 66%	13,460	14,006	4%
Supermarkets	72	178	110%	7,159	13,134	83%
Industries	9,403	8,396	- 11%	175,802	132,054	-25%
Retail trade	21,612	16,517	- 24%	70,812	73,548	4%
Tertiary (office)	21,942	26,797	22%	238,760	281,524	18%
Total	75,554	83,557	**11%**	581,111	651,894	**12%**

Table 3: evolution of pick-ups and deliveries between 1982 and 1999

Activities	Number of pick-ups/deliveries per week 1982	Number of pick-ups/deliveries per week 1999	Evolution (%) 82-99	Number of deliveries / job (%)
Agriculture	1,018	2,696	165%	19%
Craftsmanship / services	67,036	101,945	52%	-20%
Wholesale trade	100,408	147,478	47%	-11%
Warehouses	83,641	83,103	-1%	-5%
Supermarkets	4,739	9,259	95%	6%
Industries	142,303	124,059	-13%	16%
Retail trade	143,901	125,554	-13%	-16%
Tertiary (office)	38,215	42,916	12%	-5%
Total	581,261	637,010	10%	-2%

Assuming a same logistic structure in each activity in 1982 and in 1999, all these modifications come with changes in the number of pick-ups and deliveries but not in proportion with these evolutions.

It can be seen as an impact of the economic integration in some activities (notably wholesale and retail trades, warehouses): it results in a decrease in the ratio number of deliveries/job in those activities (table 2). Let us note that the concentration comes with a sustained urban sprawl from town centre to the outskirts.

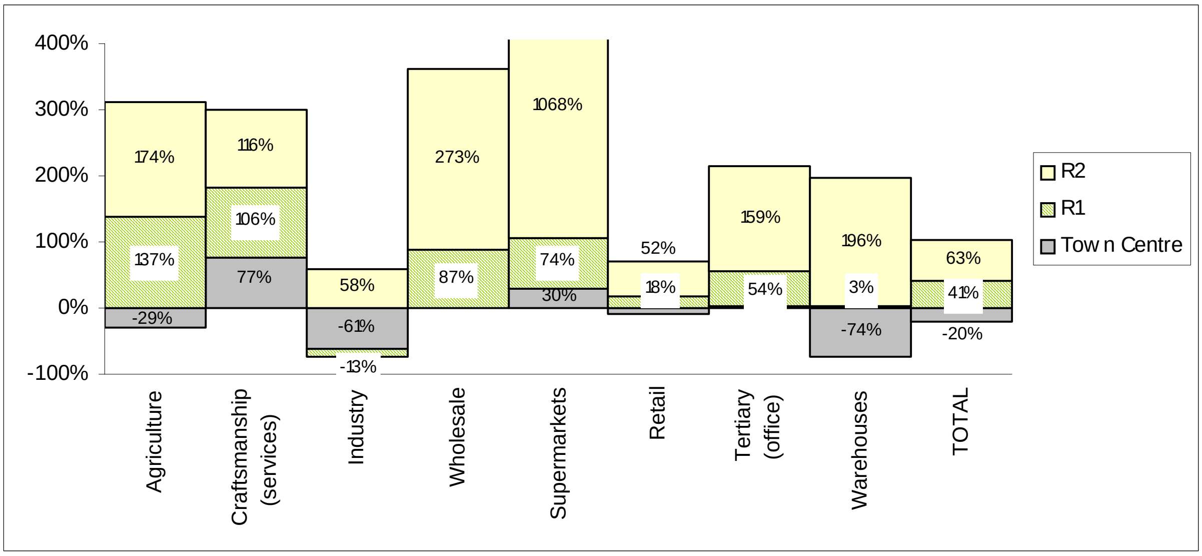

Figure 3: evolution of employment between 1982 and 1999

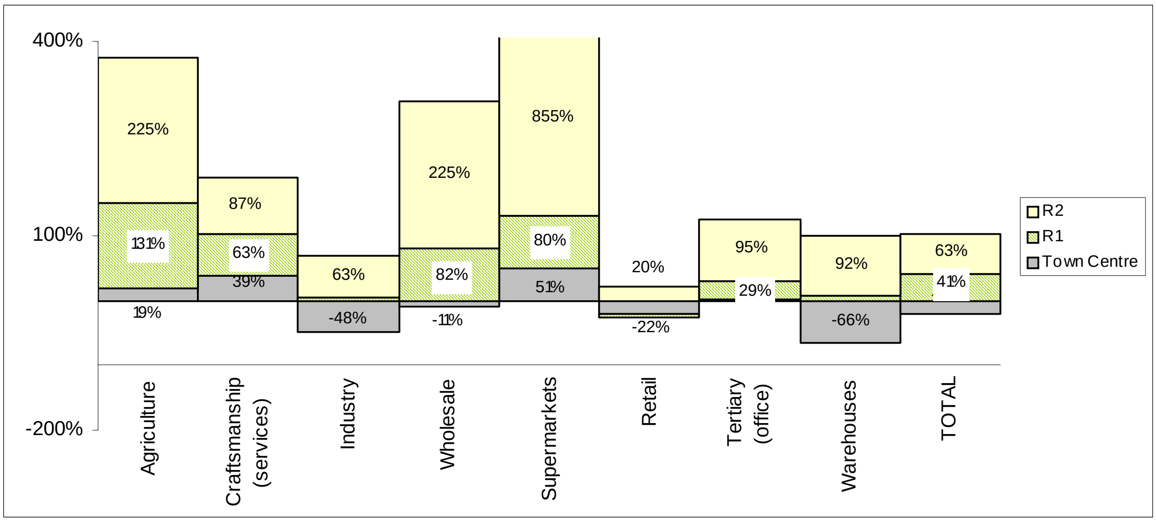

Figure 4: evolution of pick-ups and deliveries between 1982 and 1999

As regards the employment, figure 2 shows that industries have strongly left the town centre and have relocated in the distant outskirts, just as the warehouses. In the contrary services have experienced a significant development in the town centre compared with the other activities.

If we consider the same types of activity and the same areas, figure 3 shows that downward trends are less strong for the vehicles movement than for the employment in industries and warehouses. Likewise, for the services, upward trends are stronger for the employment than for the vehicles movement. In any case, the relocation of activities comes with a concentration and a rationalisation in transport operations.

Besides, urban sprawl between 1982 and 1999 has a significant impact on the number of deliveries and the travelled kilometres, as shown in the following tables 4 and 5:

Table 4: evolution 82-99 of the number of deliveries by vehicle types

(% 82-99) Rings	Light commercial vehicles (< 3.5 t)	Rigid lorries	Articulated vehicles	Evolution of the number of pick-ups and deliveries
Town centre	-13%	-26%	-40%	-20%
Ring 1	28%	26%	21%	26%
Ring 2	85%	97%	101%	92%
Total	11%	9%	7%	10%

Table 5: evolution 82-99 of the number of travelled kilometres by vehicle types

(% 82-99) Rings	Light commercial vehicles (< 3.5 t)	Rigid lorries	Articulated vehicles	Evolution of the travelled km
Town centre	3%	-17%	-37%	-13%
Ring 1	50%	44%	30%	42%
Ring 2	118%	136%	108%	122%
Total	37%	33%	15%	30%

Table 6: commercial vehicles average kilometres / trip in 1982 and 1999

Average km/trip	1982	1999
Town centre	5.3	5.7
Ring 1	7.1	8.0
Ring 2	8.4	9.7
Total	**6.3**	**7.5**

Table 7: evolution of the number of kilometres / trip by vehicle types

Evolution km/trip 82-99 (%)	Light commercial vehicles (< 3.5 t)	Rigid lorries	Articulated vehicles	Average km/trip
Town centre	18%	11%	5%	8%
Ring 1	17%	14%	8%	13%
Ring 2	18%	20%	3%	15%
Total	**24%**	**23%**	**8%**	**18%**

The number of pick-ups and deliveries is decreasing in the town centre, notably those carried out with articulated vehicles and rigid lorries. In the first ring of the conurbation, the increase is slightly more important for light commercial vehicles (28%) and rigid lorries (26%) than for articulated vehicles (21%). The highest increase can be observed in the second ring, especially for rigid lorries and articulated vehicles.

The increase in total travelled kilometres generated by the pick-up and delivery vehicles (+30%) is more significant than the increase in total number of deliveries (+10%). It is the consequence of premise sprawling in the most outlying outskirts and activity changes between 1982 and 1999 towards activities generating longer trips (more direct trips carried out in own account).

Table 6 and right column of table 7 clearly shows that the average distance per trip increase according to the ring (from the highest density in the central zone to the lowest on the outskirts of the conurbation) and through the period 1982-1999 due to the urban sprawl. The average distance per trip shows a 18% increase (from 6.3 km/trip to 7.5 km/trip).

Table 7 shows a significant increase in the evolution of kilometres / trips for light commercial vehicles almost uniformly in the three zones. In the first column of the table the total value (24%), which is an average value concerning all the light commercial vehicles, exceed above values because the number of the shortest trips is much more important than the number of the longest trips inside the whole conurbation.

3.3. The reference scenario

Since many years in most of urban centres, a strong tendency of urban sprawl can be observed. An important drop in the number of small retail trades of the town centres is effective. Activities are growing in peripheral commercial zones along the highways and main roads. So our reference scenario, considered over a twenty years period from 1999 up to 2020, is supposed to keep the main trends noted between 1982 and 1999. Our assumption is to consider, over this period, a linear growth of the activities (number of premises). The model adds the difference between the 1999 number of premises and the one from 1982 to the one from 1999. We have assumed that the trends (concerning the number of premises, jobs and pick-ups and deliveries) of the 1982-99 period are kept according to an accurate breakdown of the activities (in 116 types).

In the town centre, note that some activities show downward trends: in this case the number of premises comes to zero. So we have had to pass these lacks of premises on to the rings 1 and 2 and to the closer activities; otherwise it would have led to an unrealistic increase in the number of jobs in 2020, compared with national economic and demographic forecasting.

Table 8: a simulation of the main parameters per ring in 2020, Lyons

2020	Number of premises	Number of deliveries	Number of jobs	Average km/trip
Town centre	46,117 (49%)	216,664 (31%)	326,497 (43%)	6.1
Ring 1	30,345 (32%)	299,838 (42%)	284,460 (38%)	8.2
Ring 2	18,206 (19%)	192,565 (27%)	145,805 (19%)	10.1
Total	**94,669 (100%)**	**709,067 (100%)**	**756,762 (100%)**	**8.1**

Urban sprawl tends to go on (see table 1) and the number of pick-ups and deliveries increase in the distant outskirts of the conurbation. Between 1999 and 2020, the average distances per trip show a smaller increase (+0.6 km) than between 1982 and 1999 (+1.2 km). The trend to this lengthening is due to urban sprawling but it is slowed down by an increase in the activity density.

Table 9: 1999-2020 evolution of pick-ups and deliveries and travelled distances, according to the types of vehicle

1999-2020 evolution	Light commercial vehicles (< 3.5 t)	Rigid lorries	Articulated vehicles	Average
% of pick-ups and deliveries	+13%	+12%	+1%	+11%
% of travelled distances	+25%	+22%	+18%	+21%

The total number of pick-ups and deliveries increases, essentially light commercial vehicles and rigid lorries. The lengthening of travelled distances is twice more important than the number of pick-ups and deliveries. In the case of articulated vehicles, the trend is more noticeable because they work in the less dense and distant zones of the conurbation.

The following figures 4 and 5 show the outputs resulting from our first simulation between 1999 and 2020:

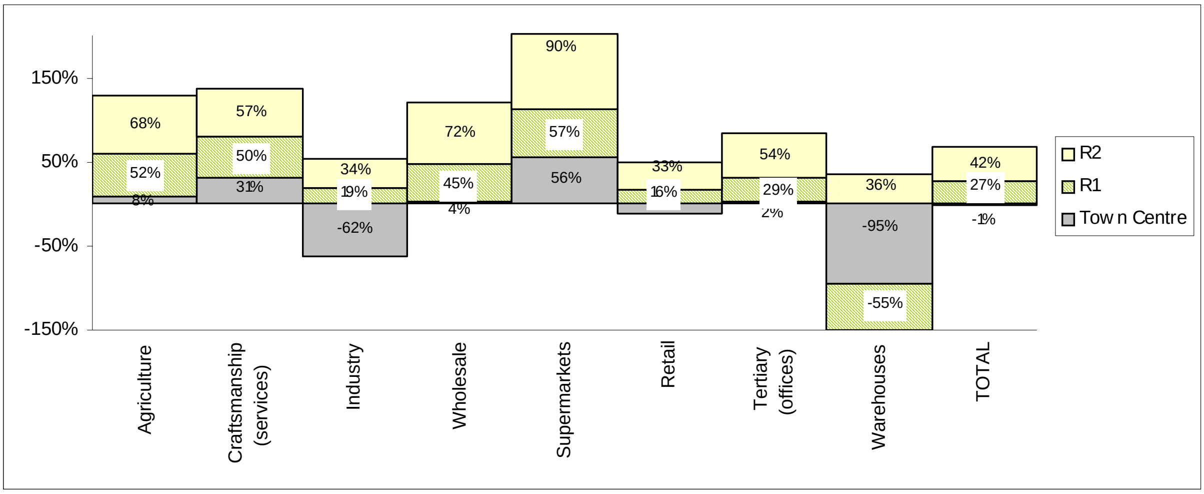

Figure 5: simulation of the evolution of employment between 1999 and 2020

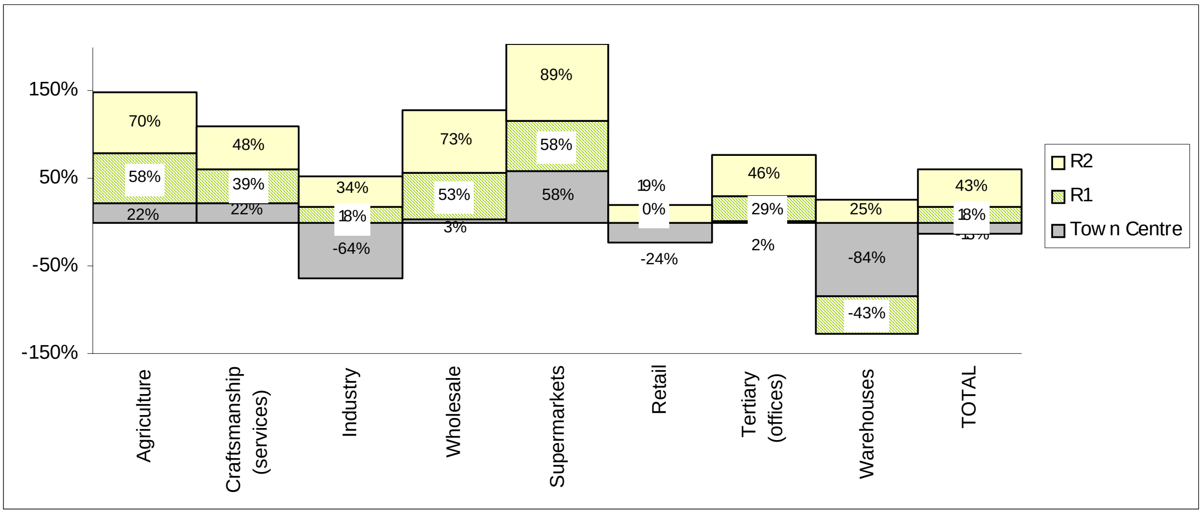

Figure 6: simulation of the evolution of pick-ups and deliveries between 1999 and 2020

Our assumptions lead to the following results: the positive trends between 1999 and 2020 have levelled off and the negative gaps (especially industry and warehouses) have widened comparing to the 82-99 period. During this period, heavy industry and logistics platforms were set up beyond the reference area.

3.4. Impacts of urban density and activity relocation

From this reference scenario, we built a few simulations - somewhat typical -, in order to estimate their impact on the change of the expected trends, notably the average travelled distances of the commercial vehicles.

Using the Freturb model, two parameters involve substantial changes: the activity type and the activity location. Remember that the model can't give an account of the logistic changes that occurred in each activity between 1982 and 1999.

Analysing the consequences of a significant return of commercial trades in the town centres may be considered according to two scenarios, as follows.

3.4.1. Return of retail trade to town centre

This 2020 scenario simulates the following trends:

- - the drain stopping of small retail shops in the town centre: the number of premises of 1999 is kept;
- - the building stopping of hypermarkets (> 2,500 m²) in the rings 1 and 2: hypermarkets are converted into supermarkets and the latter into small retail shops. According to this assumption, the premises which are not built in the ring 2 are allocated to the ring 1. The same is done between the ring 1 and the town centre.

To that purpose, changes in the assignment of some premises are carried out in the different areas of the city (from the outskirts towards the central zones; from less dense zones towards more dense zones).

Small retail shops or supermarkets are generated by the model in place of the hypermarkets to come all over the scenario's period, according to the total weight delivered by the different types of shop as follows in the table 10:

Table 10: substitution assumptions between the different types of shops

	Average weight of delivered goods per premises	**Equivalence**
Hypermarket (> 2,500 m²)	464 tonnes per week	9 supermarkets
Supermarket (< 400 m² and > 2,500 m²)	53 tonnes per week	37 retail shops
Department store	39 tonnes per week	27 retail shops

This scenario suppose that the behaviours of the inhabitants are similar to those of 1999 regarding private car using. It is relevant only if the settlement tends to a sprawling stabilisation.

Table 11: breakdown of the private cars in household purchasing trips

	Supermarkets	**Hypermarkets**	**Small retail shops**
Reference scenario	11%	26%	63%
Scenario 341	13%	15%	71%
1999	9%	18%	73%

The results of the scenario 341 are closer to the 1999 data, especially for small retail shops. As the latter are more numerous in the town centre, private car trips are simultaneously shorter.

Comparing to the reference scenario, the scenario 341 shows:

- an increase in the number of household purchasing trips (+3.6%), that is 18,000 trips per day;
- a slight decrease in the number of private car purchasing trips (+0.8%), that is 3,500 trips per day;

- a significant decrease in the private car distances (+6.3%), that is 115,000 km per day

3.4.2. Return of wholesale trade and light industry to town centre

The above assumption is now enlarged from retailers to wholesale trade and not polluting industries (producer and intermediate goods industry (small items) and consumer goods industry).

In the town centre and according to the reference scenario, the growth rate of these industries is negative while it is positive in the two rings. For that reason, in the town centre, the number of light industry premises of 1999 is kept. The remaining growth between 1999 and 2020 is allotted to the rings 1 and 2 (by relocation from a zone to one another), according to the significance of these industries in each of them.

In the town centre, the number of wholesale premises of 1999 is kept. An average growth rate (2 %, got from the growth rate of each zone between 1999 and 2020) is used to calculate the number of premises in rings 1 and 2 in 2020.

Table 12: a comparison between the different scenarios (34)

Scenario	Total travelled kilometres per week	Number of pick-ups and deliveries per week	Average km/trip for light commercial vehicles (< 3.5 t)	Average km/trip for rigid lorries	Average km/trip for articulated vehicles	Average km/trip (all types of vehicle)
Reference 2020	5,729,000	709,000	6.6	7.9	16.3	8.1
Scenario 341	5,726,000	714,000	6.5	7.8	16.3	8.0
Scenario 342	5,332,000	709,000	6.1	7.3	15.1	7.5
1999	4,754,000	637,000	5.9	7.2	14.9	7.5

The first of the above scenarios, aiming at keeping the small retail trade activity at the 1999 level in the town centre, have no impact on either the total travelled kilometres per week or the average travelled distances per vehicle types. A significant increase in the number of pick-ups and deliveries towards more small retail shops can be observed. On the contrary, this scenario involves a rather significant decrease in the private car travelled distances carried out by the consumers on the occasion of their purchase.

It is noticeable that the second scenario leads to use more light and small commercial vehicles and to keep an average travelled distance per delivery around 7.5 kilometres, which is similar to the 1999 one.

3.5. Changes in the urban logistics structure

3.5.1. Urban distribution centres (UDC) without co-operation

This 2020 scenario is built in the following way: a few platforms, consisting in wholesale premises, warehouses or depots, initially distributed around the main interchanges (see figure 7: first drawing) are relocated in more central zones (see figure 7: second drawing), to serve these urban central areas. Note that the provisioning mode of the UDC may be implemented by means of railway installations.

Various recent French studies seem to suggest that, in the best case, only around 20 % of the delivered weights in the central zones are capable of passing through a UDC. It implicates essentially the small retail shops and the services activity. In the contrary frozen food, perishable goods and voluminous goods don't usually pass through UDC.

In our case, these 20 % of weights amount to the capacity of 70 warehouses. So the implementation of the simulation consists in relocating 70 peripheral platforms in the town centre and not far from it. Note that the total flows are not changed and these flows concern the only central zones of the conurbation. Besides, the urban logistic chains of delivery are not modified.

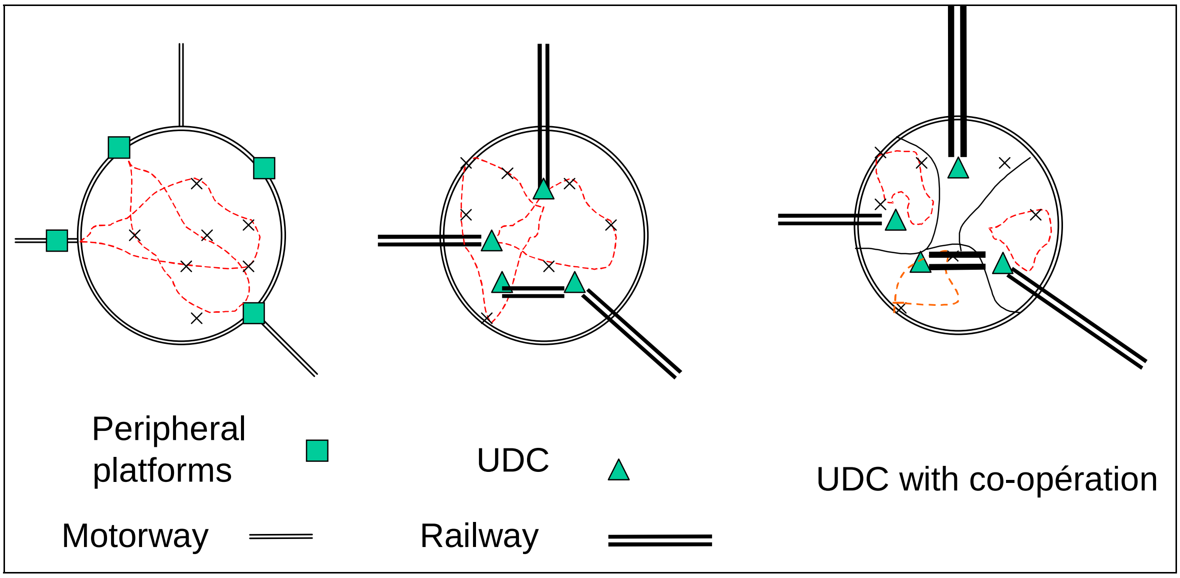

Figure 7: urban distribution centres without and with co-operation

3.5.2. Urban distribution centres with co-operation

Compared with the previous scenario, this one is built as follows: the platforms are relocated in more central zones, in such way that each of these platforms have a commercial influence without overlap (see figure 7: third drawing). In this case, beyond the relocation of the platforms, the transport operators have to co-operate, what requires a strong will from them and the local authorities.

Central zones are partitioned, in such way that the direct trips and the rounds generated from each platform are restricted to their own geographical commercial influence area. In this case, the simulation consists in estimating the delivered flows (all in all, these flows are similar to those of the previous scenario) according to 7 commercial areas defined on the central zone of Lyons conurbation. This division into sectors results in a mechanical decrease in the travelled distances. For this scenario, the model is implemented on each commercial area. Note that the remaining 80 % flows (not passing through the UDC) are managed independently (without co-operation) by the concerned operators.

The impact of the first of the two last scenarios (351: UDC without co-operation) has not a significant impact on the total travelled kilometres and on the average travelled distances per vehicle types. In the contrary, the last scenario (352: UDC with co-operation) leads to similar average travelled distances per vehicle types, compared with 1999. Obviously, to be appropriately implemented, this scenario requires a strong will from local and national authorities; but in the end it shows well what could be a credible sustainable development of the city.

The scenario 351 (the relocation of UDC) allows a very small decrease in the travelled distances (- 1% compared with 1999).

The scenario 352 (relocation of UDC with co-operation) is more attractive: the saving reaches 384,000 km (11% compared with 1999).

In the scenario 352, average distances per vehicle types are similar to those of 1999, while they showed a 8% increase in the reference scenario.

Table 13: a comparison between the different scenarios (35)

Scenario	Total travelled kilometres per week	Number of pick-ups and deliveries per week	Average km/trip for light commercial vehicles (< 3.5 t)	Average km/trip for rigid lorries	Average km/trip for articulated vehicles	Average km/trip (all types of vehicle)
Reference 2020	5,729,000	709,000	6.6	7.9	16.3	8.1
Scenario 351	5,694,000	709,000	6.5	7.8	16.2	8.0
Scenario 352	5,345,000	709,000	5.9	7.4	15.8	7.5
1999	4,754,000	637,000	5.9	7.2	14.9	7.5

4. Conclusion

In order to estimate impacts of relocation measures, it is important to take into account:

- - private car household purchasing trips which represent the most part of the kilometres dedicated to the urban supplying;
- - beyond the relocation of the platforms, the transport operators have to co-operate, what requires a strong will from them and the local authorities;
- Several other scenarios can be considered. At the moment, directly related to our investigations, we focus on:
- - a more thorough examination of urban logistics structure changes by considering logistic sites lighter than urban distribution centres, located in the town centre. Instead of relocating the peripheral platforms, each of them are reassigned to one zone of the town centre. The commercial influence of each place is rather small, so as to optimise the length of trips, with positive environmental impacts;
- - the impacts of share changes in operating modes (hire or reward and own account operators). It is important to leave aside not flexible activities in relation to own account transport (perishable goods, cold chain, …). We consider changes towards on hire or reward transport only for the flexible activities (Patier, D., 2004);
- - the ongoing technological developments concerning the use of specific urban vehicles (carrying capacity of 5 t) and the use of clean urban vehicle. The implementation of the environmental module of the Freturb model enables to produce interesting results (Ségalou, E., Ambrosini, C., Routhier, J.L., 2003);
- - the impacts of the substitution of a number household purchasing trips for doorstep deliveries;

Besides we are working at an improvement of the Freturb model, because time series are not available to run it. It is the reason why new surveys are about to be undertaken in order to bring up to date the results of previous surveys (which are almost eight years old), so as to check a permanence in the time of previously detected invariants used in the model.

References

Ambrosini, C., Routhier, J.L., 2004. Methods and results of surveys carried out in the field of urban freight transport: an international comparison, Transport Reviews, 24 (1) 57-77, January 2004.

Dufour, J.G., Patier, D., 1997. Introduction to the discussion based on the experience of the French experimental and research programme, ECMT Round table 109, Freight transport and the city, Paris, 11th-12th December 1997, pp. 29-99.

French urban freight transport web site: http://www.transports-marchandises-en-ville.org/

Patier, D., Routhier, J.L., Segalou E., Gerardin Conseil, 2000. Diagnostic du transport de marchandises dans une agglomération, METL ed., avril, 89 p.

Patier, D., 2004. The part of the own account transport in the urban logistics, The 10th World Conference on Transport Research, 4th-8th July 2004, Istanbul, Turkey, 19 p.

Routhier, J.L., 2000. Un outil de simulation des effets des politiques urbaines sur le transport de marchandises en ville, in Patier, D. (Ed.), L'intégration des marchandises dans le système des déplacements urbains, Actes des 13èmes Entretiens Jacques Cartier, 4-6 octobre 2000, Montréal, Canada, LET, coll. Études et Recherches, n°15, pp. 145-167.

Routhier, J.L., Segalou E., Durand, S., 2001. Mesurer l'impact du transport de marchandises en ville - le modèle de simulation FRETURB (version 1), METL ed., ADEME, oct., 104 p.

Segalou, E., Ambrosini, C., Routhier, J.L., 2004. The environmental assessment of urban goods movement, in: E. Taniguchi and R.G. Thompson (eds.), Logistic systems for sustainable cities, Proceedings of the third international Conference on City Logistics, Madeira, Portugal, 25-27 June 2003, Elsevier, pp. 207-220.