URBAN GOODS MOVEMENT ANALYSIS AS A TOOL FOR URBAN PLANNING

Mathieu Gardrat, Laboratoire d'Economie des Transports, ISH - 14 Avenue Berthelot, 69007 Lyon - France

ABSTRACT

This paper aims at understanding the influence of urban structures changes on urban goods movements, through a case study of an urban planning project. This case is based on the study of a large urban project that started in Lyon in 2005 called "Confluence". By analysing the economic and urban goods structure in 1999 and 2012, the influence of the deep changes in the urban fabric on urban goods are showed and quantified. Spatial changes are also taken into account as some businesses and establishments were relocated during this period of time and the bases of a reflection on environmental impacts of these relocations are set-up. The future trends are also analyzed through a scenario for the year 2025.

Keywords: urban goods movement, policy assessment, land use, road occupancy

INTRODUCTION

Since several years, urban planning has become a major stake for the sustainable development of cities. Each decision taken for urban development has heavy repercussions on the urban system and must respect the coherence regarding each component of this system (for example land use, transport, economic development, social equity…). As a component of this system, urban goods transport is a potential leverage for functional, environmental, and social stakes of the city. By ignoring freight transport in the urban planning process, possible risks and negative effects appear: degraded accessibility for goods resulting in less attractive urban spaces, economical decay of dense areas of the city.

In this context, urban goods transport needs efficient simulation tools to understand the influence of urban goods movements (UGM) on the city and the influence of policies on the UGM. This paper aims to put this idea in the perspective of urban projects planning, and how building scenarios around the urban goods movements is a way to enhance the decision making process. Simulating scenarios is a key to understand the influence of urban goods transport policies on the urban system.

As mentioned before, the urban goods transportation is one of the subjects decision makers have to take into account in the planning process. As they lack knowledge on this particular subject (Dablanc, 2007), decision makers tend to underestimate the importance of urban

goods movements on their territory. Planning the construction of new urban districts is an extremely complex task, which requires heavy diagnosis and forecasting in order to make the right choices in terms of sustainable urban planning.

Through the example of “La Confluence” neighborhood in Lyon (in progress since 2005 and including a shopping center, administrations, apartments…), this paper proposes to build a method of urban goods diagnosis for new urban district development; the main question being how urban goods modeling and simulation can help urban planners in their decisions. From the Freturb model (Routhier and Toilier, 2007, Bonnafous et al, 2013) this methodology will help understanding the future needs of every actor (such as shops, residents, services or even industry) in urban projects regarding goods transport. This approach is a way to acquire knowledge and understand the stakes, constraints of every actor of the city concerned by the urban goods movements (Boudouin and Morel, 2002).



Figure 1 : la « Confluence » area in Lyon (within the red perimeter)

By building several scenarios in terms of urban planning, the target is to understand the mechanisms and impacts of heavy urban projects on goods movements and implementing solutions linked to regulation, land-use and logistics including distribution centers, parking lots…. By applying a systemic view of the subject, this work will also take into account the major constraints of the urban system (Ambrosini and Routhier, 2004).This paper will include the comparison between the present situation of the chosen example (i.e. “La Confluence”) and the scenarios build through the previous steps of this method.

In conclusion we propose to work on corrective solutions that can be implemented to get as close as possible to the scenarios built previously, and start a reflection on the efficiency these corrective procedures.

BACKGROUND ISSUES

Urban goods movement planning and policy is an ancient issue; indeed, the first writings concerning access regulation date from Julius Caesar (Quak, 2008). However, we observe still nowadays a lack of public authorities to include urban goods movement (UGM) into urban plans (Patier, 2001). Public intervention on urban goods regulation and planning is still today limited to manage emergencies or to understand urban goods flows. Although several European countries have developed a local, regional or national legislation that includes in some cases the urban goods traffic flow planning and management as a priority (Zunder and Ibañez, 2004), the practical applications of that principle is very variable, and depends on the implication of local authorities and their capacity to understand and use the existing methods and tools for urban goods transport planning.

Since the early 1990's, several studies deal with logistics planning and policy issues (Ruske, 1994; Taniguchi et al., 2001; Ambrosini and Routhier, 2004; Rosini, 2005; Dablanc, 2007; Bestufs, 2009; Ville et al., 2012). From those studies, we can define the main elements that seem to be important in the relations between urban goods movement and urban planning: the location of the different economic activities in an urban area, the commercial supply strategies and public policies, the logistics and organisational aspects of urban supply, and the role of the new technologies. Beyond these features, two dimensions have now to be favoured, namely sustainability and assessment associated with the decisions and measures taken by the public authorities. That is why we present briefly hereafter some recent studies focussed on these points in order to get a general idea about the concepts and the capabilities of the methods implemented.

Taniguchi and Van Der Heijden (2000) have it in mind to elaborate an evaluation methodology for city logistics, implementing a dynamic traffic simulation model with optimal routing and scheduling. The evaluation of city logistics initiatives is done on a test network. A set of assumptions constitutes the reference situation (first phase), before introducing advanced routing and scheduling systems, in order to measure the gains in CO2 emissions. In a second phase, various types of cooperative freight transport systems are introduced (e.g. building and operating a common depot or cooperation in carrying goods by common pickup/delivery trucks). In a third phase, a simulation is made to account for the effects of controlling load factor. All these scenarios are effective, showing a decrease in CO2 emissions and in total costs of freight carriers. A later paper (Taniguchi and Kakimoto, 2004) consists in applying the above model (improved with time windows) to the effects of e-commerce on urban freight transport. It appears that introducing e-commerce (B2C) may lead to more traffic and so have negative impacts on the environment, unless e-commerce is widely used by the end-consumers. However, cooperative practices in home delivery companies may lead to reduced costs and NOx emissions. Thompson and Hassall (2006) underline the need for implementing urban freight transport-oriented methodologies in order

to improve road freight projects. In fact, they consider that a number of freight specific issues are overlooked in traditional cost benefit analysis. For this purpose, they propose an evaluation methodology based on three phases: identification of goals and objectives; determination of criteria; and construction of evaluation matrices. Several goals and objectives, which are often emphasized in other studies, are associated to performance measures such as travel times or loading/unloading times, speeds, etc. In the end, a set of qualitative criteria (e.g. benefit) is combined with a set of ordinal categories (e.g. no effect, slightly increased, substantially increased …) in order to assess the expected effects of some measure or other.

Behrends et al. (2008) tackle the issue of the sustainability in urban freight transport from an actor's perspective. An actor-based model, inspired by Sjöstedt (1994), is presented, showing many actors (shippers, carriers, public authorities) and three main poles (vehicles, goods, infrastructure) which interact in such a way that they generate traffic flows and transport operations. However, it is important to underline that specific flows, as shopping trips made by households, building and demolition traffic, as well as waste collection… are excluded. The above perspective is resumed in Lindholm (2010) from the local authorities' point of view. The framework model is systems-oriented and is organised around four basic elements: facilities (in which the activities take place), goods (transported to and from the facilities), vehicles and infrastructure. Several subsystems result from interactions between the above elements, such as accessibility (between facilities and goods), transport (between goods and vehicles), traffic (between vehicles and infrastructure) and land use (between facilities and infrastructure).

Ruesch et al. (2012) account for the Swiss national research programme about sustainable development in Switzerland's cities, as well as its transport networks, in order to maintain equilibrium between the preservation of natural resources, favourable economic conditions and a high quality of life. Main objectives consist in analysing freight logistics activities and freight flow patterns on one hand, interrelation between freight transport and socio-economic structure of Swiss conurbations on the other hand; setting up an indicator scheme for evaluation of measures and monitoring for urban and regional freight transport; developing a measures-impact model for the estimation of effects; developing and evaluate sustainable freight logistics and transport strategies.

Filippi et al. (2010), Russo and Comi (2010) and Nuzzolo et al. (2012) propose a methodology to assess policy choices in terms of urban goods movement, addressed to public authorities but taking into account the different stakeholders of urban logistics. Via a demand estimation model, different scenarios can be simulated and assessed, in terms of road occupancy, greenhouse gas emissions and air pollution. Such models although theoretically able to simulate urban logistics policies, remain complex and theoretical and only small-size zones (mainly the inner center of Rome) are shown as possible examples. Although the authors insist on the fact other simulation tools are not able to assess the impact of public policies in terms of urban goods movements, we observe several examples, mainly in practice, of policy assessment via transport models.

The main four operational tools are Wiver (Sonntag, 1985), now as part of the VISUM software, Freturb (Routhier and Aubert, 1999), VENUS (Janssen and Vollmer, 2005) and City Goods (Gentile and Vigo, 2006). Wiver has been developed in the 80's by IVU Traffic, requested by the Senate of Berlin (Sonntag, 1985). It has been applied to several German cities, to Bruxelles, Madrid and Rome metropolitan areas for urban plan assessments (Meimbresse and Sonntag, 2001), and has also been used in Berlin and Madrid for assessing the suitability of urban consolidation centres (Sonntag and Tullius, 2001). Now it has been integrated into VISEVA, which is part of the VISUM software (Lohse, 2004). Also in Germany, the IVV Aachen company included a "goods and special transports" model in their urban transport planning software VENUS (Janssen and Vollmer, 2005). This model is also used in practice, but is less known of the scientific community. The French model, FRETURB, has been requested by the French Ministery of Transport under the "Urban Goods Movement National Program", and developed by the Laboratory of Transport Economics (Routhier and Aubert, 1999). The methodology is developed in Routhier and Toilier (2007); Gonzalez-Feliu et al. (2012) and Bonnafous et al. (2013), and a complete synthesis of the stakes and isses relarted to its development can be found in Routhier et al. (2013). It is nowadays used by more than 20 French cities for their urban plans, and used by the French Regional Technical Centers of Land Use, as well as by specialised consulting companies and research centers for public decision support. The Italian model, City Goods (Gentile and Vigo, 2006, 2013) has been requested by the Emilia Romagna Region and developed by The Universities of Bologna and Rome "Sapienza". With respect to other models, it is propriety of the Emilia Romagna Region, and is deployed in several regional and local transport services. It has been used in the urban transport plans of several cities in the region, and proposed to other Italian cities.

Observing all tools and studies, we can say that methods are nowadays available but their implementation to practical issues remains few developed. Most applications are related to commercial zones and city centres, or to middle and long-terms assessment of policies (Gonzalez-Feliu et al., 2010) but several models offer the possibility to be applied to other cases, like the Lyon Confluence, where an important transformation has been chosen (before, the zone was related to wholesaling and related industrial and distribution activity, and in late 90's the city council decided to delocalize those activities and convert the zone into a residential-commercial-business zone).

CONTEXT AND METHOD

Historically (before 2005) the Confluence was a wholesale area mainly characterized by the presence of the "Marché d'Intérêt National" (MIN) a wholesale market zone concentrating the majority of food and flowers distributors of the Lyon urban area. This zone was hence highly generative in terms of urban goods movements. It is important to note that few shops and residents were installed in this zone which was almost exclusively reserved to wholesale activity.

In 2005 however, the market zone was declassified to become next a residential zone, planned in two phases, the first (terminated at the beginning of 2012) including residential

buildings, and a large shopping mall, the second phase (supposedly finished in 2025) being mainly dedicated to residential units. The wholesale market was then outsourced during the beginning of the project to the city of Corbas, 10 kilometers away from its previous location.

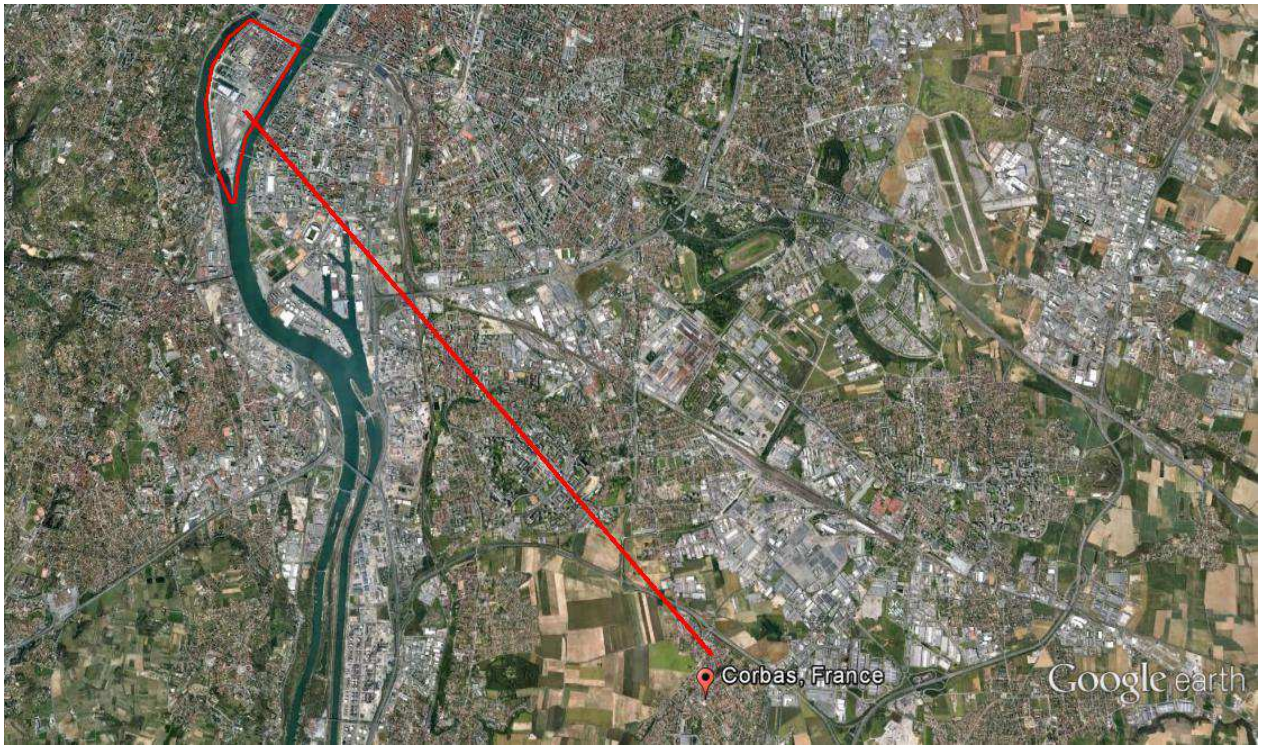


Figure 2 : Relocation of the « Marché d'Interêt National from the « Confluence » to Corbas

The original site of the MIN could welcome more than 120 establishments, specialized in various wholesaling activities (vegetables, meat, fish and flowers mainly), and was linked to a railway terminal and an urban motorway (Flaconnet, 1967; Gouat, 1991). The new wholesale market of Corbas can now welcome around 80 establishments, which is slightly smaller than the previous one, but is more adapted to heavier road traffic (proximity to the motorway and large access roads), though there is no railway access (Perrier, 2009).

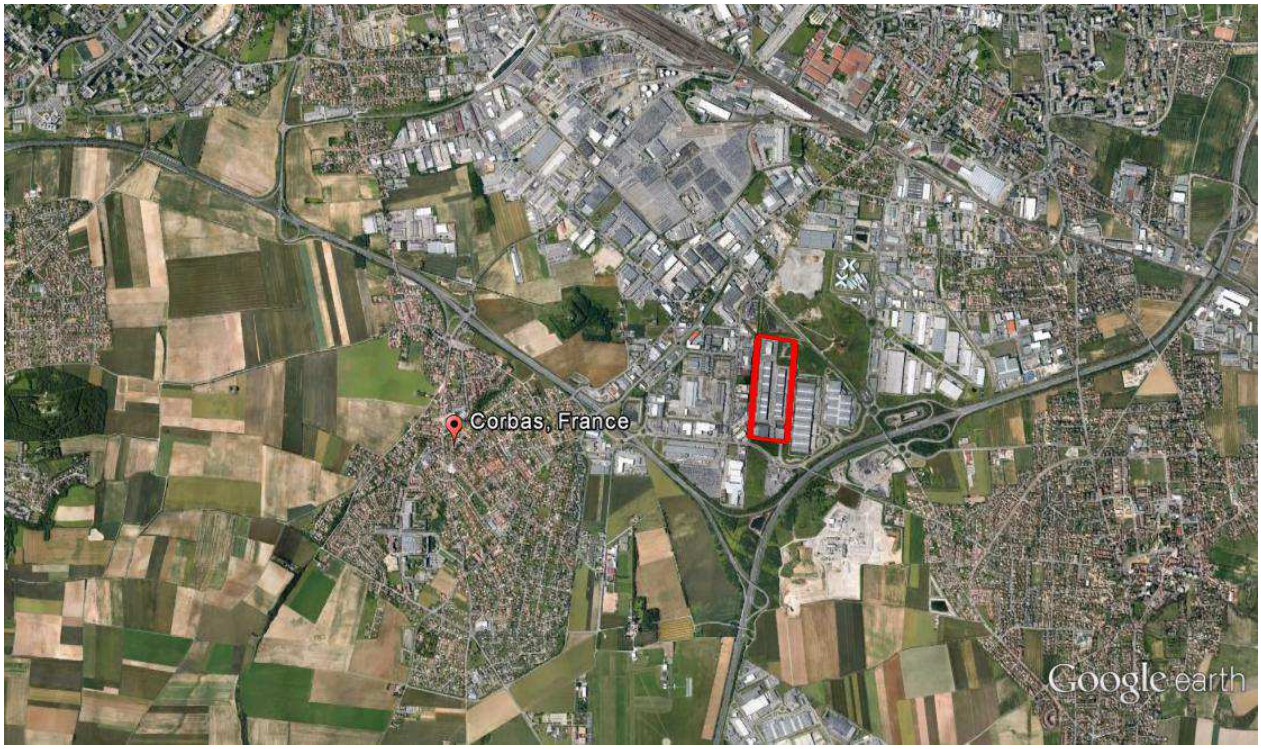


Figure 3 : the new « Marché d'Interêt National » in Corbas

By studying the evolution of the Confluence between 1999 and 2012 we can notice that the economic structure of the Confluence area profoundly changed during this period. As the MIN occupied a large portion of the neighborhood, the implantation of other types of activities was limited to the northern part of the area. Starting from the reorganization of the area the southern part of the Confluence was opened to residential infrastructures and shops (a shopping mall was also opened), thus increasing the global number of establishments (mainly small shops, services and offices) from approximately 990 to 1570 establishments. We can in fact notice that the structure of the area, evolved from a particular form of wholesale area to a regular urban framework. The next tables and figures were produced thanks to the Freturb model and the SIRENE[1] file produced by the INSEE[2].

The FRETURB model was calibrated through heavy surveys on urban goods movements, carried out on three French urban areas between 1994 and 1997 (Patier & Routhier, 2008, Ambrosini & al., 2010), allows in particular to realize a diagnosis of the urban goods flows at several scales of a city or urban area. These surveys showed that homogeneous statistical strata of activities had similar behaviours in terms of urban goods transport whatever the urban area they were implanted in. A new wave of surveys is presently carried-out to verify if these behaviours did not change significantly in the last 20 years. The FRETURB model uses the ratios that were defined by the surveys with a marginal adaptation to the geographical characteristics of the area of study in order to define the distances generated and the delivery behaviours according to the urban environment.

[1] Censorial databases of each town's economic activities and establishments
[2] The INSEE is the national institute for statistics and economic studies in France

The FRETURB model needs two main inputs: the SIRENE file which is a censorial database of the area of studies' economic activities, and a zoning file which divides the area of study into zones that are described by basic geographic data such as the population, the surface of the area, the distance to the centre of the zone and the activities implanted inside the zone.

By crossing both economical (type of activity, number of employees) and the zoning geographical data (such as population, surface of the area, and distance from the center of the conurbation), the FRETURB model is able to estimate the number of movements generated by each establishment.

Hence, through the simple processing of a register of French establishments produced by the INSEE (national institute for statistics and economic studies) and on the localization of these establishments in a relevant zoning, the FRETURB is able to give a main output which is the number of goods movements: the term movement being defined as a delivery and/or a pick-up operated by one vehicle in one establishment. Moreover the model can estimate other indicators:

- Kilometers traveled in the urban area,
- number of parking hours on public road network,
- Origin - destination of the movements for each zone,

FORECASTING ANALYSIS

We will compare the urban goods movements at several periods of the neighborhood, namely 1999, 2012 and a scenario will be built for 2025. This approach will help understanding the evolutions of urban goods movements inside an urban area (Gonzalez-Feliu et al, 2012).

The main hypothesis defined between 1999, 2012 and 2025, is that the complete change in the urban economic structure of the area of study will have a large impact on the urban goods distribution structure and behavior, but also in terms of generated distances. Larger impact on road occupancy and longer distances are expected between the two first scenarios. Between 1999 and 2012, actual data were gathered in order to use the Freturb model. For 2025, a scenario was build according to forecasts especially built for the purpose of this paper, but also thanks to programmed elements of the Confluence project.

In order to understand these changes, several approaches were defined: first a basic analysis of urban goods movements only for the Confluence between 1999, 2012, and also 2025 is carried-out to show the evolution of urban goods movements in the area; and secondly, through the analysis of the relocation of certain types of activity (namely wholesales and transports), the global impact of the project in terms of generated distances was estimated.

Deep changes between 1999 and 2012

We will now analyze the results of the simulations of 1999 and 2012. The number of movements due to wholesale companies dropped from 71% during the period. The changes in economic structure also changed the parking and delivery behaviors inside the district, drastically changing from heavy types of transports involved in the deliveries of wholesalers, to smaller vehicles used in the deliveries of shops of modest sizes. The remaining wholesaling establishments are the smallest (the average number of employees per establishments for the wholesale activity goes from 8 to 4).

Type of activity	Number of movements	Number of establishments	Number of employees	Less than 3,5T vehicles	Medium load vehicles	Articulated vehicles	Receptions	Expeditions
Agriculture	1,4	1	1	0,8	0,4	0,2	0,8	0,6
Services-artisans	1053,7	249	967	755,9	266,6	31,3	717,5	336,2
Wholesale	4955,6	134	865	1230,6	2218,9	1506,1	1528,8	3426,7
Transports-storage	638,9	13	64	90,3	233,1	315,5	207,1	431,8
Supermarkets	15,8	1	14	4,4	5,8	5,5	14,5	1,3
Industry	520,9	56	327	244,8	223,6	52,5	276,1	244,8
Small shops	1529,3	192	1324	1092,2	412	25,1	1347,7	181,6
Offices-tertiary	591,5	343	3655	425,6	153,7	12,1	418,9	172,6
Total	9307	989	7218	3844,5	3514,1	1948,4	4511,4	4795,7

Table 1 : Structure of urban goods movements per week in 1999 in the Confluence, with a precision regarding the type of vehicles or reception and expeditions

This table sums up the structure of urban goods movements and of the economic activity. The movements are indicated in movements per week. It describes for each type of activity the number of movements per week, the number of establishments of each category of activity, the number of employees for each type of activity, the number of movements by types of vehicles per week, and the number of receptions and expeditions per week.

The urban goods movements in 1999 were mainly due to the wholesale market (the MIN) and the other establishments attracted by it, representing more than a half of the movements for this area (4900 movements out of 9300), and the next more important point being the small shops (1500 movements, 16%).

Type of activity	Number of movements	Number of establishments	Number of employees	Less than 3,5T vehicles	Medium load vehicles	Articulated vehicles	Receptions	Expeditions
Agriculture	9,3	5	9	5,2	2,7	1,4	5,2	4,2
Services-artisans	2448,3	467	1827	1640,7	747,7	60	1867,6	580,7
Wholesale	1424	51	227	488	687,1	249	455,7	968,2
Transports-storage	563,9	6	100	79,8	203,4	280,7	220,5	343,4

Supermarkets	310,2	5	242	86,4	153,1	70,7	281,3	29
Industry	549,8	55	612	271,9	211,4	66,5	319,4	230,4
Small shops	2417,6	322	1973	1640,1	718,2	59,3	2034	383,6
Offices-tertiary	735,1	660	2587	566,8	153	15,3	528,4	206,8
Total	8458,3	1571	7577	4779	2876,5	802,9	5712,1	2746,2

Table 2 : Structure of urban goods movements per week in 2012 in the Confluence, with a precision regarding the type of vehicles or reception and expeditions

The structure of movements in 2012 is completely different as the MIN disappeared, letting other types of activities taking its place. These activities are corresponding to the ones we can expect from a classic urban area with more shops, supermarkets, services, and offices. The particularity of the previous urban layout is thus erased (though some wholesale establishments remain, these are the smaller ones).

It is interesting to note that the goods movements are balanced in 1999, as the share of expeditions and receptions is almost balanced (4500 expeditions against 4800 receptions). Whereas this balance in 2012 is mainly oriented towards reception with 33% of the movements being expeditions (this trend is typical in urban areas, as the city usually consumes more than it produces). This is mainly due to the relocation of the MIN, which structure of flows is extremely consolidated at the reception of the goods (mainly articulated vehicles), the distribution of goods being performed by smaller (thus more numerous) vehicles.

The situation is however completely different in 2012 where most of the wholesaling activity of the area was outsourced far from the center of the city. The nature of the activity delivered, influenced the nature of the vehicles used to deliver the area. The high increase of small shops (+53%), offices (+24%) and services (+132%) deeply changed the structure of flows and urban movements of goods inside the area. The use of vehicles lighter than 3.5T, changed the practices in terms of parking usage, resulting in higher rates of double-line parking inside the area.

Hence the number of hours in parking on the public network in 2012 is far higher than in 1999 (+ 35% in terms of double line parking), although the increase in terms of goods movements is only of 10%. This trend can be explained by two causes. Firstly, though wholesaling activity is highly generative in terms of urban goods movements, the loading/unloading is performed inside private infrastructures especially designed for heavy transports. Thus, the majority of movements (approximately 53%) are made in conditions suited for heavy lorries operations (quays, maneuvering alleys, etc.) in a private area, thus lightly impacting the public road network. Secondly the number of deliveries performed by less than 3.5t vehicles increased drastically in ten years, and this type of deliveries are usually performed on the public road network due to the type of activities delivered (artisans, small shops mainly). The next table summarizes the number of hours parked for delivery reasons in 1999 and 2012, for each type of vehicle and parking situations.

	Parking hours in 1999	Parking hours in 2012	Difference
Less than 3,5t double line	461,3	701,0	239,7
Medium lorry double line	236,7	281,9	45,3
Articulated double line	171,1	195,4	24,3
Less than 3,5t private parking	975,2	634,9	-340,3
Medium lorry private parking	500,3	255,4	-245,0
Articulated private parking	361,7	177,0	-184,7
Less than 3,5t forbidden	136,6	134,0	-2,6
Medium lorry forbidden	70,1	53,9	-16,2
Articulated forbidden	50,7	37,4	-13,3
Less than 3,5t authorized	292,5	360,3	67,8
Medium lorry authorized	150,1	144,9	-5,2
Articulated authorized	108,5	100,4	-8,0

Table 3 : Number of hours of parking per week by type in 2012 and 1999

Scenarios for 2025

The trend defined between 1999 and 2012 will follow its course in 2025 according to the urban plans and forecasts build through the use of FRETURB and of the scenarios defined in the project. In order to model precisely the future economic structure of the area of study, the SIMETAB model (Gardrat et al, 2013) model was used to simulate what would be the number and type of establishments. This model is built around a refined urban typology that allows the definition of heavy trends in terms of urban economic structure, calibrated around key indicators such as the population, the employment, the density, etc. This is why the program defined in the urban planning project of the confluence was also taken into account to render more precisely the future reality. The results of this simulation give an increase for supermarkets, services, offices and small shops. The first scenario implies no change in other type of activities (industry, wholesales and transports). According to the FRETURB simulation, the global number of movements of the Confluence area will increase from 8458 to 10334 movements per week.

Type of activity	Number of movements	Number of establishments	Number of employees	Less than 3,5T vehicles	Medium load vehicles	Articulated vehicles	Receptions	Expeditions
Agriculture	9.3	5	9	5.2	2.7	1.4	5.2	4.2
Services-artisans	3208.7	614	2389	2147.3	982.8	78.8	2449.4	759.3
Wholesale	1424.0	51	227	488.0	687.1	249.0	455.7	968.2
Transports-storage	563.9	6	100	79.8	203.4	280.7	220.5	343.4
Supermarkets	413.1	7	287	119.8	201.0	92.2	372.5	40.6
Industry	549.8	55	612	271.9	211.4	66.5	319.4	230.4
Small shops	3206.1	426	2630	2167.7	959.3	79.0	2695.7	510.4
Offices-tertiary	959.8	871	3416	741.6	198.0	20.2	692.1	267.9
Total	10334.7	2035	9671	6021.3	3445.7	867.8	7210.5	3124.4

Table 4 : Structure of urban goods movements per week in 2025 in the Confluence for scenario 1, with a precision regarding the type of vehicles or reception and expeditions

Being essentially performed for small shops and services, the number of movements performed by the smallest vehicles will know the highest augmentation. This kind of traffic will impact the parking behavior in the same way that it did between 1999 and 2012, with usually more double line parking.

Another possible scenario is the replacement of highly generative activities in terms of movements, by more urban and population oriented (inhabitants and consumer) activities.

Type of activity	Number of movements	Number of establishments	Number of employees	Less than 3,5T vehicles	Medium load vehicles	Articulated vehicles	Receptions	Expeditions
Agriculture	5	3	5	3	1	1	3	2
Services-artisans	3385	648	2555	2265	1036	84	2582	803
Wholesale	90	5	23	43	40	7	31	59
Transports-storage	80	1	30	21	31	27	47	33
Supermarkets	413	7	287	120	201	92	373	41
Industry	23	5	18	12	9	2	15	8
Small shops	3367	448	2731	2287	998	83	2832	535
Offices-tertiary	1001	916	3545	774	206	21	723	278
Total	8364	2033	9195	5525	2522	317	6605	1759

Table 5: Structure of urban goods movements per week in 2025 in the Confluence for scenario 2, with a precision regarding the type of vehicles or reception and expeditions

In this scenario the industry, transport and wholesale activities leave the Confluence to make place to small shops, artisans, and tertiary activities. In this case the number of movements stays at the same level as in 2012, though its structure changes to favor smaller vehicles

deliveries, which characterizes small activities. As for the previous scenario smaller vehicles tend to generate more double-line parking, the number of double-line parking hours should at least be as high as in 2012 (701 hours of less than 3.5T parking hours per week), which confirmed by the following table.

	Scenario 1	Scenario 2
Less than 3,5t double line	891,5	735,5
Medium lorry double line	332,0	200,1
Articulated double line	218,8	100,4
Less than 3,5t private parking	807,6	666,2
Medium lorry private parking	300,7	181,3
Articulated private parking	198,2	90,9
Less than 3,5t forbidden	170,5	140,6
Medium lorry forbidden	63,5	38,3
Articulated forbidden	41,8	19,2
Less than 3,5t authorized	458,2	378,0
Medium lorry authorized	170,6	102,9
Articulated authorized	112,5	51,6

Table 6: Comparison of number of parking hours between scenario 1 and 2

We can see by comparing both scenarios that the delivery behaviour is drastically different. The number of movements decreases between scenarios 1 and 2 because of the departure of industry, wholesales and transport companies that tend to generate more movements than other types of activities. This fact also implies a change in the deliveries, especially for heavier vehicles.

In consequence, if no measures are taken, the double line parking will remain predominant in the structure of parking behaviors, thus deteriorating the quality of traffic within the zone. Adapted parking capacities or innovative organizational measures (use of urban logistics spaces, transport capacity pooling…), should be implemented to limit the impact of deliveries on the public road network thus improving safety and life quality in the area.

But the impact of the reorganization of the Confluence is not only measurable at a micro-scale. By analyzing the impact of the relocation of the wholesale market from the Confluence to the city of Corbas, we will try to explain the effects of such a measure on the urban goods movements.

MACRO-INFLUENCE OF THE CONFLUENCE PROJECT

We will now study the influence of the delocalization of the wholesale market (from the city center to the outer periphery) at a macro level. The particularity of this kind of activity is that it is essentially linked to delivering the city center. Hence the main hypothesis is that the

number of generated kilometers is higher due to the structure of the delivery rounds forced to penetrate the city center.

In order to offer a better comparison of the influence of this outsourcing, it is fundamental to isolate the geographical areas and the activities concerned by the structural changes of the goods movements' activities. We will carry out a sectorial analysis (in this case concerning the wholesale activity) and a geographical analysis by isolating the Confluence zone and the Corbas zone from the rest of the Lyon conurbation.

The wholesale activity increased by 69% in the zone of Corbas causing the number of movements for the wholesale activity to increase in the town of Corbas by a factor of two.

Type of activity	Number of movements	Number of establishments	Number of employees	Less than 3,5T vehicles	Medium load vehicles	Articulated vehicles	Receptions	Expeditions
Agriculture	41,4	28	41	23,1	11,9	6,3	22,9	18,5
Services-artisans	1235,3	289	1038	889,1	310,5	35,7	904,0	331,2
Wholesale	4779,6	105	1621	1652,3	2270,2	857,2	1659,5	3120,1
Transports-storage	9296,8	77	1608	1715,4	3447,9	4133,6	4276,9	5019,9
Supermarkets	77,4	5	145	21,8	28,4	27,2	71,0	6,4
Industry	3249,5	157	2997	1539,1	1307,6	402,8	1653,9	1595,6
Small shops	1042,5	128	580	807,3	214,3	20,9	833,1	209,3
Offices-tertiary	266,1	205	1454	209,9	51,4	4,7	191,0	75,1
Total	19988,5	994,0	9483,1	6857,9	7642,3	5488,3	9612,4	10376,1

Table 5 : Structure of urban goods movements per week in 1999 in Corbas

The majority of movements in the town of Corbas were mainly due to the transport and storage activity. This area is lowly populated and the available space favors the implantation of logistics and transport activity.

Type of activity	Number of movements	Number of establishments	Number of employees	Less than 3,5T vehicles	Medium load vehicles	Articulated vehicles	Receptions	Expeditions
Agriculture	54,4	33	59	30,4	15,7	8,3	28,6	25,9
Services-artisans	2848,1	647	2136	1990,5	773,5	84,2	2165,6	682,5
Wholesale	9894,4	170	2362	3028,4	4487,2	2378,8	3404,1	6490,2
Transports-storage	5539,9	39	982	718,1	1985,8	2836,0	2113,3	3426,6
Supermarkets	118,0	5	159	33,2	43,3	41,5	108,3	9,7
Industry	2495,5	179	2574	1272,7	928,4	294,5	1407,4	1088,2
Small shops	1688,4	210	953	1260,9	390,2	37,3	1340,1	348,3
Offices-tertiary	758,4	568	4838	587,2	157,6	13,7	549,8	208,6
Total	23397,2	1851,0	14063,4	8921,4	8781,7	5694,2	11117,3	12279,9

Table 6 : Structure of urban goods movements per week in 2012 in Corbas

The global number of movements increases in 10 years, but the structure also changes, the logistics activity weighing less than in 1999 to profit the wholesaling activity. We can indeed see that the number of establishments linked to the wholesale activity increases globally inside the area of study. However the new location of the wholesale market is not absorbing the totality of the number of wholesale establishments. Indeed, we can make the hypothesis that the location behavior changed in the last ten years, and it is possible that a portion of the wholesale establishments located in the Confluence in 1999, chose to relocate elsewhere than the new MIN location. This can hence be considered as a dispersion of the wholesale activity.

Another important point that can explain the impact of the relocation of the MIN is the analysis of the kilometers generated in 1999 and in 2012. The next table describes the changes in terms of generated distances between these two periods for the zones of Corbas and Confluence for the wholesaling activity only.

	1999	2012
Number of movements (per week)	9735.18	11318.38
Number of kilometers (per week)	121415.7	166337.5
Kilometers by movement	12.4	14.6

Table 7 : Kilometers and movements produced (per week) by the wholesale activity in the zones of Confluence and Corbas

The number of kilometers generated increased by 16% from 1999 to 2012 in the studied zone, as the number of movements increased by only 36%. In fact by analyzing the indicator of distance intensity, which is the number of kilometers generated for one movement, we can see that this intensity grew from an average of 14.5 kilometers for each movement in 1999 to

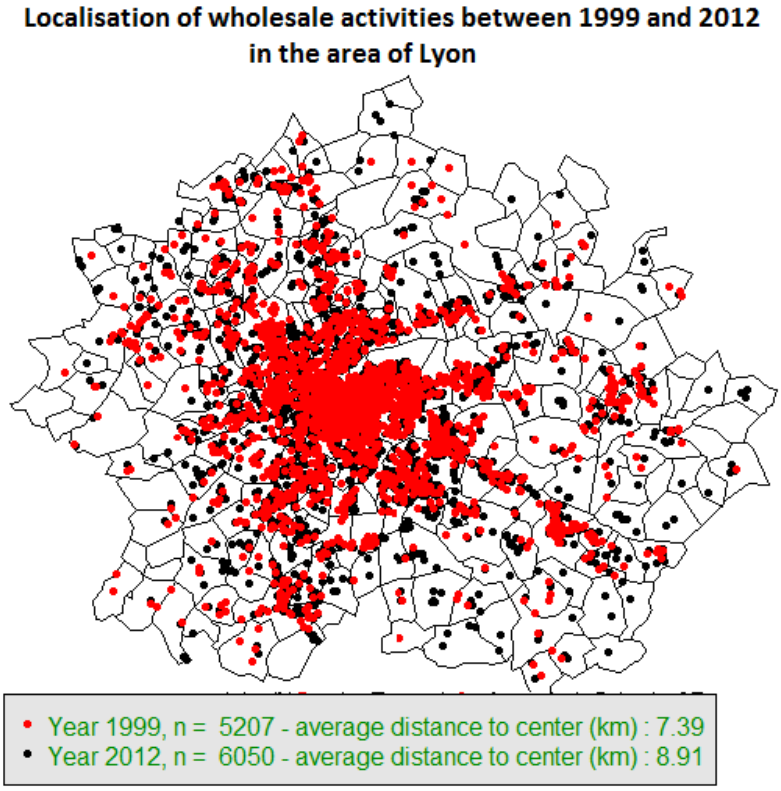
15.5 kilometers in 2012. This indicator contains all the movements and generated kilometers for all the activity of the studied zone. Only by taking into account the wholesale activity, this intensity is of 12.4 kilometers per movement in 1999 to 14.6 in 2012, the difference is hence deeper. This difference is even more obvious, when we do the same analysis but by comparing the wholesale activity in the Confluence 1999 at the time when the MIN was still in activity, and in the Corbas in 2012 after the relocation of the wholesale market.

	1999 (Confluence)	2012 (Corbas)
Number of movements (per week)	4955.55	9894.39
Number of kilometers (per week)	54248.54	144608.9
Kilometers by movement	10.9	14.6

Table 8 : Kilometers and movements produced (per week) by the wholesale activity in the zones of Confluence in 1999 and Corbas in 2012

Through this approach, the difference of the kilometric intensity for a movement is almost of 4 kilometers. The hypothesis considering that the distances generated due to the relocation of the MIN increased is thus verified.

However, it is hard to know exactly which establishments moved away from the MIN to the wholesale market of Corbas as their identification characteristics changed in time: this is due to the methodology used in the SIRENE file construction and it is reasonable to think that some establishments disappeared and other were created. Indeed, it is possible that a few of the largest wholesalers of the Confluence did not go to the wholesale market of Corbas and chose instead their own site, according to their own economic advantages (proximity of their clients, real-estate opportunity…). It also possible that some establishments that are now in the wholesale market of Corbas came from elsewhere as the Confluence. One hypothesis is however certain: wholesale and storage activities are pushed away from dense urban areas (Gonzales-Feliu et al 2010).



As we can see in the previous map, the average distance to the center of the Lyon conurbation of the wholesale activity has increased by approximately 1.5 kilometers (from 7.39 to 8.91 kilometers), the number of establishments of this type slowly leaving the central city of Lyon. There were 1865 wholesales establishments in 1999 in the city of Lyon and this number dropped in 2012 at 1592. Combined with a general increasing number of wholesales establishments in the conurbation (from 5207 to 6050), the localization of this type of activity seems to expand outside the dense areas. Wholesales activities being essentially meant to supply the city center, this changes in location can deeply influence the transport of goods. Hence the relocation of the wholesale market can just be seen as a part of a larger movement.

CONCLUSION

This work illustrated the deep changes in terms of urban goods movements that accompany large urban planning projects. The economic structure of a city or a smaller geographical zone has large effects on the structure of the urban goods movements as we can see in the first part. The knowledge of this part is fundamental if the urban planners want to monitor all the changes due to large projects, and adapt their solutions for the future (i.e. park places for deliveries, logistics areas, etc.).

As seen in the first part of this paper, urban goods transport policies should be used as a lever for economic, functional, environmental and social stakes. The urban goods diagnosis is a necessary input for a complete urban system diagnosis and to feed the decision making process according to the components of the urban environment such as personal or public transports, economic development, residential areas, etc.

Hence, the urban planning process should include an assessment of the evolutions of the activities in the urban goods transport field. As it was proven in France for the urban goods transport surveys, each activity implies a different behaviour in terms of deliveries. This fact should indeed be considered for urban projects, and the changes in terms of economic structures within cities should also be monitored in terms of urban goods movements. The forecasting analysis presented in this paper should help in the construction of a method to evaluate the implications in terms of urban goods transport when it comes to large urban projects.

Even though the results found in this paper are widely related to the particularities of the area of study and also to the specificities of the model used, the approach is still transferrable. We know that each type of activity as its own behaviour in terms of urban goods movements (Patier, Routhier 2008), and that other urban variables constraint can influence these behaviours. Thus, by combining data on activities (location, type, number) it is possible to understand the mechanisms of goods transports hidden behind the changes of urban structures, and feed the decision making process for urban planning.

Through the results produced in this paper and the background considerations, it seems that we can start to list important variables that explain the urban goods transport for a diagnosis.

- The location, size, type of urban activity
- The urban configuration
- The regulations
- The level of transport optimization
- The use of new technologies
- Other exogenous variables, such as the energy price, macro-economic trends, etc.

The limit of the approach resides in the incapacity to take into account innovative practices and technologies for future, and in lesser way present situations. But this kind of diagnosis can serve as an input for prospective in new trends in urban goods movements.

We have also noticed that influence of urban projects on urban goods movements is far larger than the zone of the projects themselves. The impact can be measured on the entire urban area, as seen in part two, through the example of the relocation of the MIN. Hence, not only the type of activities but also their locations imply deep changes in the urban goods transports structure.

The increase of the number of kilometers generated by the MIN has a negative impact in terms of environmental footprint. CO2 and NOx emissions are higher due to greater distances performed by the vehicles delivering the city center or the vehicles coming from the city to pick-up their goods. Hence, the presence of logistics activity close to the center of

cities might be considered as a positive layout in terms of generated distances, as it was in 1999 Lyon.

Moreover, this measure is particularly illustrative of the urban and logistics sprawl (Dablanc, Rakotonarivo, 2010) that has been going on for many years. Though the new project of Confluence is integrated in a densification scheme of the Lyon urban area, the relocation of the MIN (very demanding in terms of consumed space) to a remote place, brings the question of the preservation of logistics spaces within the urban framework as a support of for the life of the citizens.

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