Urban goods movement (UGM) analysis as a tool for urban planning

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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 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.

1. Evolution of urban goods movements between 1999 and 2025 in the Confluence

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 (Gonzales-feliu et al, 2012).

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.

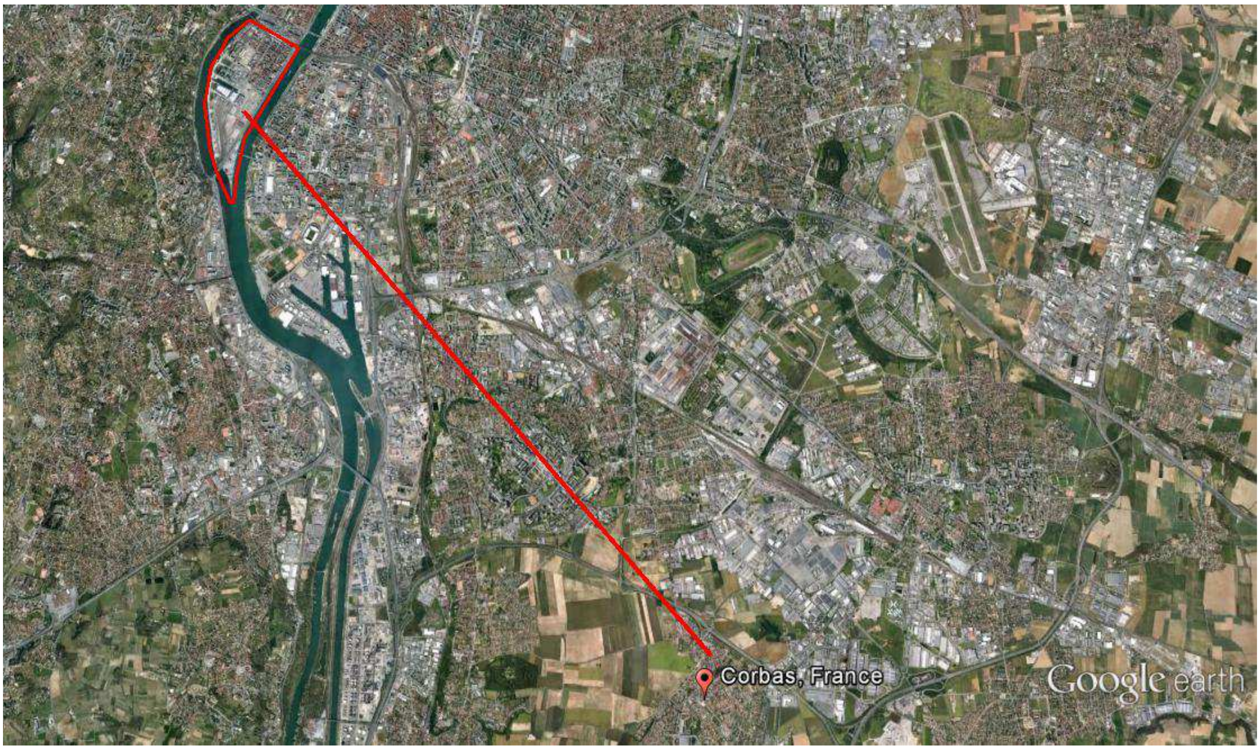

Figure 2 : Relocation of the « Marché d'Interêt National from the « Confluence » to Corbas

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 establishements, 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).

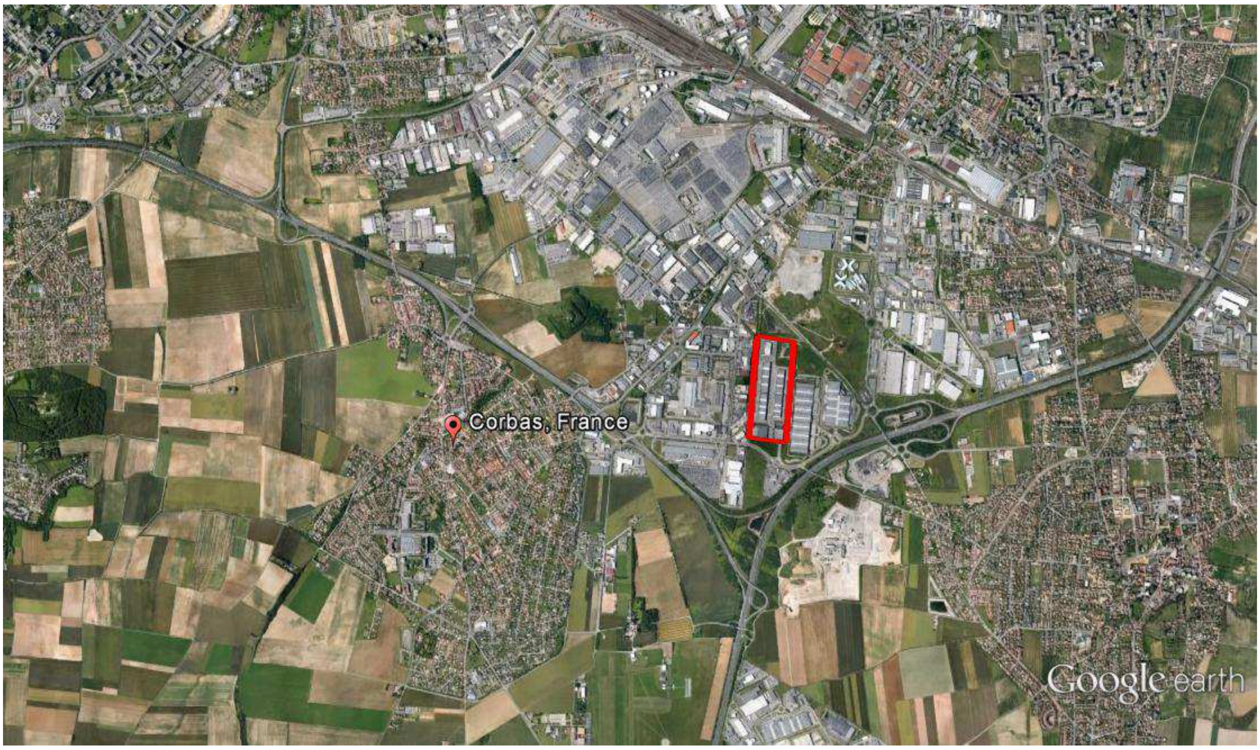

Figure 3 : the new « Marché d'Interêt National » in Corbas

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 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. 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® software allows to calculate the following elements of diagnosis:

- Number of deliveries and pick-ups per week in every zone of the urban area
- Kilometers traveled in the urban area,
- number of parking hours on public road network,
- Origin - destination of the routes for each zone,

[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

1.1.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

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

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 50% (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, although with almost identical number of goods movements. 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 doubleline	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

1.2. A scenario 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. According to the Freturb simulation, the global number of movements of the Confluence area will increase from 8500 to 10500 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

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.

In consequence, iff 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.

2. 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 which establishments moved away from the MIN to the wholesale market of Corbas and what are the mechanisms behind the location of this type of activity. 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).

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.).

But the 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.

The increase of the number of kilometers generated by the MIN has a negative impact in terms of environmental footprint. CO_2 and NO_x 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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