Financing urban logistics projects. From public utility to public-private partnerships

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Abstract Urban goods movement and urban logistics started to be defined as a scientific discipline 20 years ago, where several actions in research, development, policy and deployment were started to be coordinated. However, most of the innovations and projects presented in that field are stopped or reduced because of a common constraint that becomes its worst enemy: the financing mechanisms. Although many studies deal with urban logistics, only a few of them show the difficulties at financing, but without entering in detail on the financing mechanisms. This chapter aims to present the main financing issues in urban logistics. First, the main categories of funding strategies that can be applied to urban logistics are presented, focusing on public-private interactions and collaborations. After that, a scenario assessment using a cost benefit analysis framework shows the different interests and issues of each category of stakeholders, and the main advantages and limits of each category of investment and financing strategies. Then, the fields of urban logistics that seem the most adapted to public-private collaboration in terms of financing are identified and commented. As a conclusion, guidelines for researchers and practitioners to take into account financing issues in urban logistics decision support are proposed.

Keywords: urban logistics, finance, public-private partnerships, cost-benefit analysis

1. Introduction

Planning and management issues in terms of urban goods are not something new. The first documented proof of the interest of public authorities on regulating the traffic flows for urban supply is found in the Ancient Rome (Quak, 2008). Indeed, the oldest known urban freight transport restriction dates from the first century BC: pickups and deliveries were banned from the ancient city of Rome during the day by an edict attributed to Julius Caesar (i.e. the 'Lex Iulia Municipalis'), based on references in conserved letters of Cicero to a comprehensive law of Caesar that deals with municipal affairs (Smith, 1875). However, it is not the only ancient example of urban logistics interest by public authorities: several researches in history and archaeology show the importance of urban goods management to feed big cities like London or Paris (Britnell, 1995). Also the Islamic medieval cities accorded a particular importance to urban goods distribution (Boone et al., 1990). Moreover, the economic context in the late medieval period had a direct impact on the urban consumption, then on the flows of goods in urban zones, having an indirect impact on employment. This lack of planning concerning the supply of cities is one of the consequences of what is called the "medieval decline" (Bailey, 1996).

Focusing on recent and contemporaneous event, the integration and development of urban goods strategies passes through different stages. After the 2nd World war (1944-1960), Europe and Japan are on a reconstruction period. Although delivering primary materials is an important, it is seen as an emergency case by public authorities that make big economic efforts on rebuilding cities and primary infrastructures. With the development of the industry during the Cold War (mainly in the U.S.A., Europe and Japan) and the popularization of private cars, the period between 1960-1980 is characterised by two related phenomena (Routhier, 2001): City expansion and need of understanding personal mobility. The aims of local authorities and even several countries' governmental offices are focused on expanding urban areas and creating core infrastructures to incite internal mobility (of both people and goods). However, local economies remain important and cities start to be populated resulting on a constant increase of cities' supply flows.

It is why between 1980 and 1990 the first congestion problems start to be observed. Urban goods trips co-habit with personal trips, and the first conflicts are in general solved by punctual interventions or market regulations (Gonzalez-Feliu, 2008). It is during the 1990-2005 period that the main concepts of urban logistics will be developed. The notion of Urban Goods Movement is introduced by Ogden (1992) and extended by Ambrosini and Routhier (2004). Several coordinated actions take place in different countries during those years (mainly in Germany, France, Japan, The Netherlands), supported by the research community (Taniguchi and Thompson, 1999; 2001; 2004; 2006; 2008; 2010; 2012; Maccharis and Melo, 2010). Public authorities being the most active during that period, the private stakeholders start to strongly being implicated in urban logistics projects since 2004, mainly in France, Germany and the Netherlands.

However, we observe that after almost 20 years of coordinated urban logistics researches and studies, most innovations and projects are stopped or reduced because of a common constraint that becomes its worst enemy: the financing mechanisms. Although many studies deal with urban logistics, most of them are related to regulation, optimization and management issues, and only a little set show the difficulties at financing, without entering in detail on the financing mechanisms.

For this reason, and to support this field in urban logistics research, this chapter proposes to present the main financing issues in urban logistics. First, the three categories of funding strategies common to infrastructure investment are presented and applied to urban logistics, focusing on public-private interactions and collaborations. Moreover, several examples are presented to illustrate those concepts. Then, an example is presented to show the different interests and issues of each category of stakeholders, and show the main advantages and limits of each category of investment and financing strategies. To do this, an example of deployment of delivery space booking systems is proposed, as well as a cost benefit analysis taking into account three modes of financing: an "all private", an "all public" and a "public-private partnership". After that, the fields of urban logistics that seem the most adapted to financing-based public-private collaboration are identified and commented. As a conclusion, guidelines for researchers and practitioners to take into account financing issues in urban logistics decision support are proposed.

2. Urban logistics funding strategies

In urban logistics several funding strategies can be identified. Since the variety of stakeholders is high and their interactions frequent, the financing actions can take different forms.

The first is public funding, as happens in several city's infrastructures like delivery bays or reserved lines.

For private initiatives, private funding is the most common strategy. However, public intervention is possible. We find three main forms of public intervention:

- Delegation: public authorities cover a part of the investments (or not) and give a private company the structures to make a service. Sometimes (like in public transport) they cover a part of operational costs, in other cases (like Vicenza's UCC) they cover only the investments and give free usage of the structures, but the operational costs have to be covered by the private company.
- Subsidies: subsidies are economic helps that must not be refunded back
- Public loans: this is the case of low interest credits to help the development of urban logistics systems. Those economic helps must be refunded back to the public authority.

In South-West Europe, the concept of delegation is one of the most popular when referred to the deployment of urban logistics solutions. Indeed, many operational systems derive from trials and demonstrations financed by local authorities (with the contribution of regional, national or European subsidies). The most significant cases are the UCCs of La Rochelle (France), Monte Carlo (Monaco), Ferrara, Parma, Venice Mestre and Vicenza (Italy). In all those cases, the logistics terminals and the vehicles have been funded by the public authorities (who remain the owners). Also failed projects have followed this funding strategy, like Strasbourg (France), Genova and Bologna (Italy), Regarding logistics facilities, such projects use mainly on de-used public publics like gross marketplaces, warehouses or industrial pavilions, reconverted into urban crossdocking terminals (and sometimes, like in Parma, warehouses). The vehicles are in general built in association with the public transport operator, but remain property of the city council. Once the investments are funded (in general without a real return of investment), a carrier is contracted to operate the system. This can be a consortium of existing operators (Bologna), a municipal service (Monte-Carlo, Parma, Venice Mestre), a specific society created with public funds (Vicenza), a mixed-capital company (Genova) or a public transport operator (La Rochelle).

Subsidies are in general applied in many cases. From R&D projects (like those promoted by the European Union) to public actions like those of the Emilia Romagna region in Italy, we find in several countries cases of subsidies. They cover in general the following application fields:

- Subsidies to local authorities by national or international entities to cover a part of structural and infrastructural investments (Emilia Romagna Region subsidies, European Commission projects).
- Financial support of local, regional and national governments to carries for equipping them with green vehicles.
- Technological subsidies, when dealing to the deployment of vehicle and driver support technologies.
- In some cases, social subsidies can be used to recruit fragile populations and to prepare them to urban logistics. Although some French stakeholders like La Petite Reine or Alud have promoted those practices, this field remains less developed than the others.

The case of public loans is less common. However, the French politics in terms of environment have promoted several actions where funds are not given to private carriers as subsidies but as loans that have to be refunded back. Although most actions concern industry and long haul carriers, we can find also applications regarding urban logistics, mainly related to intermodal transport in urban areas o to technological innovation to support urban goods transport.

3. Public economics re-funding strategies

Traditionally, two main families of re-funding approaches have been applied by public authorities, mainly for infrastructure investments: that of collective utility and that of users' refunding. Those two families have been seen as opposite so being in direct conflict. However, a third family of approaches that mix both precedent families have been observed in the last years, mainly in transport infrastructures (Bonnafous et al., 2006) but also in urban logistics projects (Browne et al., 2004). This family includes all mixed approaches where a part of the investments are covered (or refunded) by public authorities on the basis of collective utility and the rest must be obtained by the economic benefits of the systems, paid by its direct users or their customers. In this section we will examine all three families of approaches, illustrating them by representative examples in urban logistics.

3.1. Collective utility

By collective utility we intend the socio-economic interest that a project can bring to a society. In collective utility viewpoints, the initial investments and operational costs are paid by public authorities. The funds come from the public taxes, either local or national, and in general no refunding is allowed. In some cases, it can be asked to a private partner to invest a part (in case of PPPs) with a total refunding by public funds, although this case is less common. Collective utility is motivating the construction of free infrastructures, like national and regional public roads, public parking (with no fees) or, regarding urban logistics, delivery bays or electronic accesses to limited traffic areas. To justify public utility, a system must be proven socio-economically viable. In other works, it must prove to bring a quantifiable socio-economic benefit to the collectives of the city or country it is deployed.

The decision to invest is then conditioned to a quantifiable analysis of the balance between the used (and sometimes destroyed) resources and the created richnesses, which are advantages of different nature (economic, environmental, cultural, social, societal, etc.) directly or indirectly lead by the project (Bonnafous et al., 2006). To do this analysis, a socio-economic assessment via Cost Benefit Analysis is a valid alternative, as seen in infrastructure investment (Hayashi and Morisugi, 2000).

To make a first example related to urban logistics, we will cite the deployment of delivery bays and other free parking infrastructures for trucks in urban centres, common to several

European cities[1]. Indeed, delivery bays in city centres are in general located next to fee-based parking spaces (so no free parking zones) and their deployment imply two types of resource usage: one is that of real costs, both for its construction (signalling, painting and sometimes small civil works) or for enforcement controls (sometimes assimilated to car parking controls); the second is the lack of savings that suppose blocking private car parking economic benefits to make a delivery free parking space. To justify that resource usage, it is important to quantify the socio-economic benefits: impacts on congestion, social benefits (mainly to delivery workers and private car drivers related to the decrease of double line parking) and economic benefits for carriers (mainly related to global time savings). Because the socio-economic benefits are higher than the destroyed resources, the development of delivery bays is justified.

Another case of collective utility is that of Bologna (Italy), where the city centre has rigorous restrictions but presents also parking facilities to “clean freight transport vehicles” (Trentini et al., 2012). In that case, vehicles have to be identified (mainly by RFID) and automatic control devices are installed at the “gates” of the limited traffic zone. Those investments are not refunded back, because they are of collective utility (the decongestion of the city centre due to such controls, on both private cars and business/goods vehicles led to significant socio-economic savings). However, they have been financed by different public bodies: the city, a regional contribution and a national subsidy.

3.2. User’s refunding

The user’s refunding strategy is that of making the user (in this case the transport carriers, the retailers or the freight senders) for using the service, i.e. to pay a fee for using an urban logistics service. This strategy is mainly motivated for economic reasons and the systems in this category need to be economically viable. This is the case of German UCCs, most of them stopped when carriers found less costly delivery schemes. Indeed, in Germany, consolidation has followed an economic logic, and carriers adopting such schemes have done only because they allowed economic savings. The main example is the Postdamer Platz distribution centre of Berlin, which is still operational. Another example is that of Dresde’s cargo-tram, developed for private interests of a Volkswagen manufacturing plant. The system, which was an example of user’s refunding, stopped in 2010 because considered as less rentable that a classical truck-based delivery system due to the global economic situation.

An alternative is to use refunding mechanism applied to a larger set of individuals (urban tolls, negotiable permits, etc.) to make the less virtuous pay for the virtuous delivery system. This alternative, although envisaged for delivery space booking services, has not been adopted by the city of Bilbao (Spain) because of both cultural and legal issues.

[1] The following statements are made after a quantitative and a qualitative analyses of two delivery bay and road parking behaviour surveys (one in Bilbao, Spain and one in Lyon, France) made between 2011 and 2012 in the context of the FREILOT project. For a detailed description of the surveys and their main results, see Blanco et al. (2012)

3.3. Mixed approaches

In urban logistics, the main re-funding approaches are mixed because of a common factor of most projects: investment costs are difficult to be entirely refunded. For that reason, public authorities accept to partially finance them, then to make them operational and economically viable (for operational costs and a part of the investments). However, mixed approaches are various in nature and structure and it is not always easy to properly identify all of them. We however propose a categorisation of mixed approaches:

The most common strategy is that of a partial contribution of authorities as a subsidy. In other words, when developing urban logistics solutions, some investment costs are covered by a public subsidy. In general, those costs cover feasibility studies, part of the investments (mainly related to civil works and technological issues, including clean vehicles) and a demonstration period. In many cases, they are not refunded back (like in Genova and in several cities from the Emilia Romagna Region in Italy). In other cases, a part is refunded back but not the entire subsidy.

Another strategy is that of giving concession (with or without asking for retribution) of infrastructures and/or vehicles. Indeed, since platforms and vehicles constitute the main investment costs, public authorities can give concession of them to the service operator. In Vicenza (Italy), a specific carrier was created to operate the UCC, freely having the right to use the logistics facilities and the vehicles given by the city's authorities. The management, maintenance and other management costs are covered by the fees the system asks the transport carriers to deliver the city centre. Being compulsory to a large number of fields to use the UCC (Ville et al., 2012), the economic benefits are enough to make the operator continue managing the system, and ensures its continuity.

Also indirect subsidies are found in practice. In Paris, Chronopost developed an urban logistics space in a central part of the city (Place de la Concorde). Since the facility prices are high, the city of Paris gave a subsidy to one of the main real estate stakeholders to make reduce the price asked to Chronopost to the values seen in near periphery areas, and allow the operator have an economically viable system. The platform is still working but the indirect subsidy needs to be maintained because of the economic situation.

Concerning Private-Public Partnerships (PPPs), the most common action related to financing transport systems is that of making a mixed investment, where public funds are used to cover a part of the global costs and the rest must be funded by the private company, or vice versa. That strategy starts to be popular in urban people transport but remains quite unusual in urban logistics.

Finally we find approaches combining various strategies, like in Padova's UCC, where the facility was already owned by the operator. In that case, costs for feasibility analysis and demonstration were not refunded (as paid directly by public authorities), but vehicles were bought on the name of the public transport operator, and given free to the operator. The system is operational and economically viable (for only operational costs) since its second year. For new vehicles, subsidies have been given, but original vehicles are step by step re-bought to the public transport company in order to refund a part of the initial investments. New investments, like the increase of storage surface and the development of fresh products logistics, are funded by the operator (which is a main logistics real estate stakeholder in the area).

4. A comparison of funding strategies

In this section, we present a comparison among four funding strategies. To do this, we will follow a classic cost-benefit analysis (CBA) method after defining each scenario. All the scenarios are defined on the same basis, i.e. a deployment project arising on implementing and making operational a network of delivery space booking (DSB) systems.

4.1. A note on Cost Benefit Analysis (CBA)

Generally, a CBA method consists on listing on one side all investment and operational costs, year after year, for a given time horizon (in general 10 years for infrastructure projects, i.e. DG REGIO, 2008). Then benefits are also listed in the same time horizon. After that, for each year, benefits are confronted to costs and their difference is updated using an update rate in order to take into account the money updating year after year. Finally, an Investment Return Rate (IRR) after the project's time horizon is calculated. In order to take into account the pluri-annual time horizon, it is important to define an updating rate "a" which allows comparing two quantities of money at two different periods. Taking the value of a quantity of money V_t at time t, and V_n the value of this quantity at horizon n, they are related by the following equation: $V_t = Vn/(1+a)n$

Then, year by year, benefits are confronted to costs and their difference is updated using an update rate of 4%. Finally, an Investment Return Rate (IRR) is calculated, in a 10-year horizon.

To simulate the scenarios, we need to have a unique basis on which only parameters related to who invests would change. We assume a hypothetic city, making abstraction of the country. All simulations are then made on the same city, a virtual 2.000.000 inhabitant urban area created from real data (the details on how the virtual city is constructed and how the freight demand is forecast, see MODUM, 2011). Using the tools of evaluation in this context, i.e. generalising local effects to a city point of view, we estimate the costs and the benefits for the two main stakeholders: the city (or the collective community) and the transport carriers (or individuals).

We assume a VAT of 20% and, for each system personnel fees equal to those of employees working during the pilot implementation, operation and evaluation phases (in case of pilots in different cities, the retained costs will be précised in the corresponding section). Another important assumption concerns the time period where investments are made. Oppositely to public transport infrastructures (tramways, subways, urban-suburban trains), investments are not made in the first two years, but the systems are introduced gradually. This assumption enforces that of money availability.

The CBA will be made on a 10-year horizon, which is enough long to ensure a return of investment and enough short to not need a strong technology change or replacement during the operation period. We also assume the level of operating costs and revenues as constant over this period. The discount rate is assumed to be the French public one, i.e. 4%. This rate varies from one country to another, and can be updated (as well as personnel costs and VAT) when adapting the scenario assessment to cities of one precise country. Moreover, we define a target internal return rate (IRR) of 15% for the private company and 4% for the public entity.

Last but not least, we assume that invested money is available by each investor, so no hypotheses on how the money is obtained are made.

4.2. Context, scenario characteristics and assumptions

When assessing a scenario, for a CBA or other forecasting analyses, it is important to explain well the context and the input variables by defining all the parameters and setting the various assumptions that allow building the scenario. In this section we present the main characteristics of the scenario that will simulate the deployment of a DSB service in the virtual city as well as the assumptions that have been made.

First, we aim to make a quick synthesis of how a DSB system works. Such system is installed into a surface parking machine which is located next to the delivery space that can be booked. The user that aims to book has to be registered and have an identification card that needs to be introduced in the machine each time the vehicle is stopped on the delivery space. Two booking alternatives are proposed: either by internet (both punctual and periodical reservations are allowed) or directly on the machine is the delivery space is free. When a vehicle is stopped on the delivery bay, lights on the floor indicate if it is reserved (red) or not (green). In any case, the vehicle needs to be identified. If the delivery space was free, the vehicle automatically books the place. If not, if the introduced card corresponds to that of the reservation, the lights change colour (to green). If an unauthorised vehicle is stopped on a reserved delivery space, lights indicate it and a message is sent to the police station to inform about the irregular situation.

To build a deployment scenario under realistic commercial, tactical and operational conditions, we suppose that the solution tested in Bilbao has been further developed and can be applied to existing parking machines in order to allow the possibility to make private car parking payment (for private parking places around the DSB) and booking operations for the DSB systems on the same machine. In that way, existing machines can be used for both private parking and DSB services. We suppose that all delivery bays with the DSB technology are deployed in a central area (about 3.5 km^2). A total number of 100 DSB will be operational in 5 years, and we assume a total number of users (per year) of 1200 vehicles. We assume that one user corresponds to one vehicle and then one vehicle uses only one card. Because the cards can be lost, broken or stolen, we estimate that 15% of the users will need to replace their cards each year. The deployment trends of the system and the number of vehicles consequently using it are reported on the following table:

Table 1. Deployment trends for the chosen scenario

	Year 0	Year 1	Year 2	Year 3
Number of installed DSBs during the year	16	40	60	80
Number of vehicles using the system	0	150	450	850
Percentage of replaced cars	15%	15%	15%	15%

	Year 4	Year 5	Year 6 and after
Number of installed DSBs during the year	100	100	100
Number of vehicles using the system	1150	1250	1250
Percentage of replaced cars	15%	15%	15%

In all scenarios, we make the assumption that operational costs will not change. The details of those costs are found in Gonzalez-Feliu et al. (2013). The cost structure can be summarized as follows:

Table 2. Cost structure (in k€)

Investment costs						
Cost type	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Technologic investments	27,00	0,00	0,00	0,00	0,00	0,00
Infrastructure and civil works	40,25	60,37	50,31	50,31	50,31	0,00
Other investment costs	10,00	10,48	16,00	11,00	10,50	10,46
Total investment costs	77,25	70,85	66,31	61,31	60,81	10,46

DSB – OPERATIONAL COSTS						
Cost type	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Functional costs	0,00	40,00	40,00	40,00	40,00	40,00
Maintenance	0,00	57,90	80,56	99,44	118,32	137,20
Other operational costs	0,00	0.11	0,34	0,64	0,86	0,94
Total operational costs	0,00	98,02	120,90	140,08	159,19	178,14

To finance the system and also to make it more efficient, it is necessary to ask a fee to the users, in order to both contribute to its development and be more involved in using it as well as in defending its good usage. The following CBA (one for each scenario) will be made to find the better fee to ensure a viable system and then continuous in time.

4.3. Transport carrier benefits

Before making a CBA for each scenario, it is important to define the benefits of transport carriers to estimate the values that fees to ask to carriers can take. This value corresponds to the maximum fee transport carriers would accept to pay. To obtain this value, we need first to estimate the benefits of a DSB for a transport company. In this case, we can identify four direct benefits for a carrier:

- Fuel savings, directly translated into economic gains (money savings related to fuel consumption).
- Time savings, also directly translated into economic gains (money savings related to timetabling and working hours).

- Distance savings, indirectly translated into economic gains (money savings related to vehicle usage).
- CO2 savings, which can be related to economic gains if a Carbon Tax is assumed.

We assume that the DSB areas will be created in order to consent the loading and unloading operations for carriers that are not DSB customers, i.e., to be developed in a non-congested situation. We extrapolate the results of Bilbao's DSB evaluation with a small calibration concerning small vehicles, the category the less concerned by the system (their characteristics and delivery behaviour show the need of stopping even no place is available and the possibility to make double lines without significantly perturbing the traffic and the environment). In this context, we assume a unitary fuel and CO_2 savings per vehicle per DSB stop as follows:

Table 3. Fuel and CO_2 savings for DSB in a deployment situation

Vehicle type	Fuel savings (ml)	CO_2 savings (g)
Van	0	0
Small truck	32	82
Big truck	40	101

We make the following assumptions:

- The deployment of the DSB allow an average usage of the system, per vehicle, as follows:
    - First year (16 DSB): 5 stops/route at DSB.
    - Second year (40 DSB): 8 stops/route at DSB.
    - Third year and more: 11 stops/route at DSB.
- Savings related to double line avoiding are negligible for drivers in terms of fuel consumption and CO2 emissions. However, a speed gain related to congestion decreasing can be assumed. This gain is estimated to be about 2 km/h in average in the considered area, i.e. an average gain in route of 20 min., corresponding to a time savings of 6% with respect to total travel time.
- Fuel savings are estimated in gram, then converted into liter using an average volumetric mass for fuel of 750 g/l. Moreover, a fuel cost of 1.3 €/l is assumed (this is the current value in France, according to CNR (2012), it can be updated to the current value for each country).
- Concerning CO2, we assume a carbon tax for each transport carrier. Although the current value is 17€/ton, we aim to set it to 100 €/ton, according to the last European Considerations (French Ministery of Land Use and Transport, 2005). In this configuration, a carrier having a standard route (see Pluvinet et al., 2012, for more information about routes using DSB in Bilbao) would pay about 1175 €/truck each year (for trucks making urban distribution as those of DSB pilot). On the another hand, the direct benefits are small since the gain of CO2 and the current carbon prices give an average gain of 16 €/truck each year.

The benefit table for the transport carrier is the following:

Table 4. Benefit monetary conversion, for each savings category

Type of gain	Stakeholder	Economic gain per vehicle (€/year)
Vehicle usage	Transport operator	0 €/year
Time savings	Transport operator	350 €/year
Fuel savings	Transport operator	85 €/year
CO_2 reduction	Transport operator	15 €/year
Total savings	Transport operator	450 €/year

With these assumptions, after year 5 and that each transport carrier would have an average benefit of 450 €/vehicle each year, mainly due to the congestion reduction (which is traduced into time savings). However, it is important to take into account margins. Since the main impacts are related to time savings because of congestion reduction and traffic estimations have in general errors of 20-30%, a 25% margin seems reasonable. We set then the maximum fee that can be asked to transport carriers to 360 € per vehicle and year, including VAT.

4.4. *Collective benefits*

After defining individual benefits for transport carriers, it is important to define the collective benefits in order to estimate the interest of municipal authorities on investing on such systems. Some of those benefits derive from those of transport carriers but others have to be estimated by taking into account global traffic on the DSB influence areas. The main benefits that have been identified are:

- Time savings of drivers (both for personal or commercial trips), which can be translated into economic gains (money savings related to timetabling and working hours). However, since it is difficult to make this estimation, we assume an average cost of time according to World Bank (2005) for monetary value estimation of travel time.
- Distance savings, indirectly translated into economic gains (money savings related to vehicle usage) are as for transport carriers savings, negligible.
- CO_2 savings, which can be related to economic gains if a Carbon Tax is assumed. The estimation method is similar to that of heavy vehicles, using an estimation of the current distribution of vehicle types on the considered city and translating it to the traffic in the parts of the city where we supposed to have DSB systems operationally working.

The collective benefits table is the following:

Table 5. Collective benefit monetary conversion, for each savings category

Type of gain	Stakeholder	Overall economic gain (€/year)
Time savings	Transport operator	150 000 €/year
CO_2 reduction	Transport operator	50 000 €/year
Total savings	Transport operator	200 000 €/year

The overall benefits by year are estimated to be comparable to those of investments, so that will justify a collective utility vision.

4.5. Scenario simulation

We propose a scenario simulation on the basis of 5 scenarios of public and/or private funding of the DSB system. The scenarios are:

- S1: Investment and management costs covered by the public authority on the basis of a public utility. No fee is asked for carriers and public authority assumes all costs by using the public funding mechanisms (local tax derivation or national funds). For this reason, only socio-economic CBA is regarded for this scenario.
- S2: Investment and management costs covered by the public authority on the basis user's refunding. Public funds are only loaned for a part of investment costs then refunded back on the basis of the public funding interest rates (about 4%). For this reason, an IRR of 4% is necessary to justify a balance.
- S3: Investment and management costs covered by a private company, on the basis of public delegation of service. No financing is made by public funds, and the company needs to ensure a minimum benefit that can be translated on an IRR of at least 14%.
- S4: Investment and management costs covered by a private company, on the basis of public delegation of service, with a public subsidy that covers all investment costs for years 0 to 5. That amount is funded by a public mechanism and no IRR is asked. The company needs to ensure however an IRR of at least 10%.
- S5: Public-Private Partnership. Public authorities cover 60% of the costs (on an IRR of at least 4%) and private carrier the 40% remaining (on an IRR of at least 15%). In this case, both stakeholders get an economic return but it allows a better management (by a private carrier) and a contained fee for the transport carriers.

Table 6. Scenario simulation synthesis

Scenario	Stakeholder	Total costs	Economic IRR	Socio-economic rate	Yearly fee[2] (per vehicle)
S1	Public	1 853 428,91 €	n.a.	5.7%	0 €
S2	Public	1 853 428,91 €	4.6%	90.9%	250 €
S3	Private	1 853 428,91 €	16,2%	n.a.	280 €
S4	Public	346 974,33 €	n.a.	5.7%	0 €
	Private	1 506 454,57 €	14.3%	n.a.	220 €
S5	Public	1 112 057,34 €	4.6%	62.0%	260 €
	Private	741 371,56 €	17.6%	n.a.	

We observe from the table the main differences in terms of cost assumed by each stakeholder, in terms of internal rate of return (IRR), socio-economic rate (i.e., the theoretical

[2] Fees include a Value Added Tax (VAT) of 20%, which is a reallistic value for European countries (Gonzalez-Feliu et al., 2013).

economic benefit that should be obtained if all benefits considered in the study would be monetized) and the yearly fee that has to be asked to transport carriers (per vehicle) to reach the expected IRR. Scenario S1 defines the socio-economic issues and shows the global benefits in case of a total funding by public authorities. In the current economic context, this scenario is not viable, since at least a part of the costs (most operational costs and if possible a part of investment costs) should be refunded by the user. In that context (Scenarios 2 to 5), different possibilities are shown. The lowest fee is obtained by a system managed and financed by a private carrier with a public subsidy which cover the investment costs, representing about 18% of the total costs of the system in a 10 years operational configuration (S4). Then, a system totally financed by public funds but with a user's refunding strategy (S2) results on a similar but lightly higher fee (220 € for S4 and 250 for S2). An only privately financed system (S3) needs a fee of 280 €, almost 30% more expensive that the best case. HJowever, in S4, public authorities need to finance almost 350 000 € without any economic return of investment, whereas in S2 and S5 the invested capital can be refunded. The difference is that in S2, the total amount (more than 1.8 million €) needs to be invested, and in S5, the amount to invest is about 60% of the total (about 1.1 million €). Moreover, having a private partner guarantees a constant need of ensuring the system's efficiency and reaching in the best way the expected IRR.

5. Which urban logistics fields seem the most adapted to public-private partnerships?

From the example, we observe that PPPs can be a valid alternative to classical funding strategies. Moreover, other forms of public-private collaboration seem interesting for different types of urban logistics solutions, whereas for commercial applications or private actions they are few recommended. Furthermore, also in the case of public utility cases (mainly related to infrastructural or policy actions) the collective utility thinking dominates the other strategies. In this section we present several fields of urban logistics where public-private collaboration for funding seems a good alternative to consolidate their deployment and operability. We distinguish three categories of fields:

- Urban logistics facilities.
- Urban logistics systems based on ITS and ICT
- Resource sharing-based logistics schemes.

5.1. Urban logistics facilities

Urban consolidation centres

Urban consolidation centres (UCC) have been considered as the main example of urban logistics (Allen et al., 2007). However, most of the planned facilities are nowadays not operational (Gonzalez-Feliu et al., 2013). This lack of operability is in general related to the difficulty to maintain the system due to a sub-usage of the platform. However, we observe different cases where the systems are working.

The first category of systems is that of UCCs with a strong public intervention. Either in totally public funding cases, like Vicenza (Ville et al., 2012) or Monaco (ref.) or on private management with public subsidies, like La Rochelle (Trentini and Malhéné, 2010), the UCC remains operational or continuous because of an explicit implication of public authorities. In the first two cases, the public authorities ban the access of all freight transport vehicles (allowing however some exceptions) using public ordinances, which is at the limit of free competition (Ville et al., 2012) but has been allowed by National Juridic instances. In the second case, the support to the UCC is not only policy-based but also economic. Indeed, La Rochelle municipality has grouped three service (two for personal transport and the UCC delivery system) into a lot, and given to a private company. The deficit of the UCC is compensated by the benefits of the other two services (Trentini and Malhéné, 2010), and in the first years of the contract a yearly public subsidy was given to the management operator to make the system operational. A similar case is that of Milan, where the public transport operator used the public transport infrastructures and their service facilities and vehicles to deploy an urban delivery system. The system was stopped after the municipality retired its support, not allowing the delivery vehicles of the system going on the bus lanes (Trentini et al., 2012).

In the second category we find private-managed initiatives with public subsidy where municipalities have not been supporting the UCC outside the initial subsidy for investment and release costs. This is the case of Padova (Gonzalez-Feliu and Morana, 2010), However, this strategy is less used than the others, but when public authorities do not interfere it appears to be efficient and sustainable.

In the third category a number of UCC have been operated by private sector without any subsidies by public authority. We can find these cases in Motomachi, Yokohama, Japan and Shinjuku, Tokyo, Japan (PIARC report, 2012). The Motomachi joint delivery system using UCC started in 2004. The Motomachi Shopping Street Association (MSSA) carried out management of the system asking a nutral freight carrier to operate UCC and collect/deliver goods to about 1,300 retail shops and 500 homes in place of 20 freight carriers. The success factors were that about 95% of retails shops in the area have participated in the joint delivery systems and MSSA effectively coordinated stakeholders involved in the system. Shinjuku UCC was another successful joint delivery system using UCC which started in 1992. The system mainly collect/deliver goods to offices and retail shops in high rise buildings in Shinjuku are of Tokyo. It is very hard and costly for freight carriers to collect/deliver goods to individual office in high rise buildings with about 50-60 stories in very busy area. In addition to the congestion on streets, the bottleneck of delivering goods in such situation is the shortage of loading/unloading space and elevators dedicated for goods delivery in the buildings. They established an association named Shinjuku Matenro stuff for operating UCC near Shinjuku station. In both cases of Japan UCC has been successfully operated without any subsidies by public authority, because private associations had good business models with the excellent leadership of management as well as enough amount of goods to be delivered by UCC.

Urban consolidation terminals can be useful if the demand is well identified (Danielis et al., 2010) and a good business model is found. However, to reach operability, such systems often need public help. Instead of forcing the usage, the best approach is that of partially funding the system at its investment phase (for example providing help to by vehicles) and make an access restriction policy that helps the establishment of an UCC without forbidding the rest of operators (instead of a limiting policy, an incentive action). However, it is important to ask the UCC operator to ensure a robust business model and a good operational management follow-up in order to ensure the balance of operational costs by the service benefits.

Urban multimodal terminals

Close to UCC we find the case of urban multimodal terminals. Despite the failures of Cargo trams (Amsterdam and Dresde), the subject starts to be popular and the cities of Lyon and Paris aim to develop freight systems with trams to access the city centres (not for final deliveries but for city access from important peri-urban logistics zones). Moreover, a case of urban combined transport is that of of Samada Monoprix. In all three cases, a specialised operator (of public or private origin) is needed to run the system, but since terminals have to be constructed in the city centre, a help of public authorities is needed. However, in the case of Dresde tram and Monoprix train service, the initiative was private and related to the main customer of the system (respectively an automotive manufacturer and a grocery distribution group), and fopllows the competition rules. The public intervention is more related to indirect subsidies to make the real estate costs decrease.

A similar case is that of soft mode transport, like Chronopost (postal chariots and small electric vehicles) and La Petite Reine (electric-supported cargo cycles). In both cases, a private initiative started the system, with the goal of an operational system. To do this, a help of public authorities in terms of real estate advantages is needed. Outside of those indirect subventions, no other advantages, neither political nor financial, are given to operators.

In all those cases, the collaboration seems to take place in the form of private initiatives with the need of public subsidy strategies.

Proximity delivery points

Another interesting facility, mode related to e-commerce and proximity delivery services is that of proximity delivery points (Augereau and Dablanc, 2008; Durand and Gonzalez-Feliu, 2012). Nowadays, two types of reception points are seen: small shops acting as reception points for food and non-food parcel deliveries, which are in general private networks without public funding, and automatic delivery machines for non-food parcels, mainly located in passage points of cities (terminal public transport stations, commercial areas, etc.), which need in general a help of the land owner's to be developed. Although some public-private partnerships can be made in the first category (to use postal offices as delivery reception points, for example), the most interesting collaboration is found in the second category, where public-private partnerships can increase the competitiveness of its business models and provide benefits to both public and private stakeholders.

In Japan we have a large number of small convenience stores in urban areas which are used as proximity delivery points using e-commerce. The individual delivery of products to home with designated time windows can generate a burden for e-commerce company. A freight carrier very often has to visit customer more than one time, since no body is at home. To avoid such inefficient delivery, customers can obtain their products at a convenience store near their home, which is generally open for 24 hours. These systems are operated without any subsidies by public sector. As e-commerce and home delivery is increasing in aging society, proximity delivery points play an important role to reduce costs of home delivery.

5.2. Introduction of ITS and ICT for urban logistics

The example is a clear example that illustrates it. In addition to delivery space booking, truck-based intersection control systems, like those of Helmond, the Netherlands (Pluvinet et al., 2012) can be deployed. Both systems need the implication of cities since there is a communication between he vehicle (a login card or an on-board unit) and the infrastructure (respectively parking machines and delivery bays with a reservation system), so public authorities need to invest on it and users should also pay for the service. When a public interest is found, cities can invest higher amounts of money. For example, intersection control increases security for fire brigade, police and ambulance vehicles that need to cross lights even when they are red, decreasing the number of red light crossings. For that reason, the city of Helmond promoted the installation of almost 40 systems in key crossroads of the city. Since such technologies need to evolve and be maintained, a management company which is also a technological actor is needed. The public-private collaboration is trivial in that case.

5.3. Logistics sharing systems

Last but not least, the collaborative systems amont transport carriers seem to be a valid alternative to UCCs (Gonzalez-Feliu and Salanova, 2012) that can derive on an overall cost decrease, having important economic, environmental and social benefits (see chapter 14 of the present book). This is also the case of e-commerce distribution sharing systems (Gonzalez-Feliu et al., 2012; Wygonik and Goodchild, 2012), where synergies can be found among operators to strongly decrease overall costs of physical distribution. However, stakeholders are reticent to share (Gonzalez-Feliu and Morana, 2011), mainly for competition and confidentiality reasons. To deal with that issue, logistics networks seem a good compromise, but to develop them, a neutral partner is needed.

It is then necessary to constitute a consortium with the different operators, a neutral management company and a public authority that ensures the neutrality of the management operator and the collective utility of the system. The most suitable way to make the system work is then to involve the different partner (public and private stakeholders) at financing levels, in order to make them participate to the development (but also to the benefit sharing) of the system, ensuring a good operational management and tactical and strategic development of the logistics sharing approach.

6. Conclusion

In this chapter we have overviewed the main financing strategies in the context of urban logistics, translating the main public economics concepts from transport infrastructure planning to urban logistics deployment. After that, we have simulated several scenarios for financing a delivery space booking system that illustrate the main concepts and show, through a cost-benefit analysis, the main economic returns for both public and private stakeholders. We observe that public-private collaboration can be a good option if both parts share the risks and are disposed to share the benefits. Opposing to transport infrastructure planning (Bonnafous and Faivre d'Arcier, 2013), in urban logistics both parties can see immediate benefits of adopting a system, and PPPs can be a good alternative to share costs and risks.

However, this does not apply to all urban logistics solutions. The most suitable application fields seem to be related to infrastructures, but not to linear ones (i.e. road or railway lines) but to nodal facilities: urban consolidation centres, proximity delivery and reception points and delivery bay related systems. Furthermore, collaborative transport systems have an important potential but need a good partnership between public and private stakeholders to be efficiently deployed and ensure then their continuity.

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