URBAN DISTRIBUTION CENTERS
A MEANS TO REDUCING FREIGHT VEHICLE MILES TRAVELED

Final Report

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16. Abstract The present study examines the model of freight consolidation platforms, and urban distribution centers (UDCs) in particular, as a means to solve the last mile problem of urban freight while reducing vehicle miles traveled and associated environmental impacts. This paper attempts to identify the key characteristics that make UDCs successful and discuss under what contextual settings (e.g., institutional, policy) they work best. After an extensive review of UDC cases already implemented in other countries, the study examined three UDCs cases with potential applicability to the New York metropolitan region, discussing models and relevant features and elements that may be transferred to the New York context.			
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ABSTRACT

The present study has examined the model of freight consolidation platforms, and urban distribution centers (UDCs) in particular, as a means to solve the last mile problem of urban freight while at the same time reducing vehicle miles traveled (VMTs), associated emissions, and environmental impacts. This paper attempts to identify the key characteristics that make UDCs successful and discusses under what contextual settings (e.g., institutional, policy) they work best. After an extensive review of UDC cases already implemented in other countries, the study examined three UDCs cases with potential applicability to the New York metropolitan region, discussing models and relevant features and elements that may be transferable to the New York context.

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SUMMARY

OBJECTIVES

The purpose of the present research project was to examine the model of Urban Distribution Centers (UDCs), in an attempt to understand the key characteristics that make them successful, and under what contextual settings (e.g., institutional, financial) they work best. Three UDCs cases that have already been implemented in other countries were examined in further detail in order to discuss their potential applicability to the New York Metropolitan region.

RESEARCH APPROACH:

After an extensive literature review, the project team examined various UDCs cases that have been implemented around the world and prepared summaries for 39 UDC experiences. The key characteristics of these cases were summarized into a matrix that was used to identify the features that would be most appropriate to the New York City context. After developing a selection criteria and applying it to this matrix, the team narrowed the potential cases for further study. Representatives from these UDC experiences were contacted and the project team conducted interviews and gathered further information on three case studies. The findings from this research, including key elements of the business model and contextual features with potential applicability to the New York metropolitan region were then discussed with local stakeholders in order to gain further insights about what may be required to implement urban distribution centers to solve the last mile problem of urban freight in New York.

ANALYSES AND RESULTS

By analyzing three UDC experiences for their potential transferability to the New York context, the project team found that certain business models would likely work best in New York City than others. While some UDCs such as at Heathrow Airport have been successful by exercising monopoly power to set participating obligations, we found that initiatives by the private sector that operate with limited government support are more

likely to be transferable to the New York metropolitan context. However, to be successful and self-sustaining in the long-run, the UDC management team must have a strategic vision and an aggressive marketing campaign. By demonstrating the environmental benefits of its operation, La Petite Reine in Paris, which uses cargocycles to distribute parcels within the city center, has successfully secured a large client base to support and expand its operation both in Paris and at other cities. Nevertheless, certain key elements may be needed to sustain private initiatives in the long-run, as demonstrated by the case of the Tenjin Joint Distribution Center in Fukuoka, Japan. Although this cooperative enterprise has operated without any government support since 1978, we found that this business model may now be faltering. Initial constraints regarding limited access to the central business center and parking have been eroding, in part because of new parking policies and the short distances to be traveled in congested streets. Coupled with a lax marketing strategy, they render the Tenjin UDC today a less competitive enterprise than in previous decades.

CONCLUSIONS AND RECOMMENDATIONS

This project started a dialogue about the key elements that need to be in place for the deployment of UDCs in New York. Based on the research findings and interest by regional stakeholders, the project team recommends that NYSERDA and NYSDOT consider the formal engagement of key stakeholders to determine the feasibility of an UDC demonstration project in the NY metropolitan region.

1. INTRODUCTION

The contributions of the urban freight transport system to the economic vitality of a city are significant, spanning from the its role in connecting nodes (e.g. suppliers, retailers, end-users, etc.) in various supply chains, to retaining industrial and commercial activities and associated jobs, to strengthening the overall competitiveness of a region. However, urban freight movement does not come without costs, including externalities such as traffic congestion and/or noise and air pollution as well as private losses such as additional fuel and labor costs during stop-and-go traffic and fees or penalties accrued during legal or double-parking). Minimizing the negative impacts of delivery trips in congested urban areas while achieving seamless and reliable goods distribution is arguably a daunting task. With the increasing density of residential and economic activity typical of large cities, the distribution of goods to retailers and final consumers enters the realm of paradox, becoming both something essential as well as a growing nuisance for urban dwellers *(Anderson et al., 2005)*.

In an effort to achieve greater efficiency in urban logistics, a number of cities in Europe and Japan have implemented Urban Distribution Centers (UDCs) and Urban Consolidation Centers (UCCs) schemes, which enable the cooperation among shippers, carriers, and retailers to consolidate deliveries, thus requiring a lower number of delivery trips by trucks between a distribution center and final delivery destinations, while achieving the same throughput *(BESTUFS, 2007; Browne, et al, 2005)*. Such schemes can address the "last mile" or "final mile" problem – often the most expensive leg of a delivery journey since economies of scale diminish from the point the vehicle has left the road network *(Lewis, et al, 2010)*. This inefficiency refers to the "small order problem" with urban deliveries and collections often involving only a small number of parcels and hence vehicles operate below their maximum carrying capacity or less than full truckloads (LTL). UDCs are seen as one way to solve this inefficiency by bringing together different parties engaged in "small orders" distribution to collaborate in joint-deliveries from a common urban freight platform *(McKinnon, 1998b)*.

UDCs are relatively recent innovations in the freight industry; they have only been implemented in considerable numbers since the 1990s, essentially in European countries and Japan. These experiences show great achievements in terms of traffic and environmental parameters for many of the cases. The social benefits associated with freight consolidation schemes range from reduced congestion and air pollution (including CO_2), to improved road safety and access to parking. Depending on how the UDC is implemented there will also be private cost-savings, especially when management is able to maximize load factors, optimize vehicle routing and reduce either miles-run-empty or overall miles traveled (or both) and in general run an efficient operation. *(Lewis, et al, 2010; Thomas, 2008).*

The benefits associated with urban freight consolidation schemes could also accrue to cities in the United States if UDCs were ever implemented; however, the topic of transferability has not been adequately addressed. Since a large proportion of urban deliveries in U.S. cities are carried out without resorting to consolidation centers *(Quak, 2008),* freight shippers and carriers in the United States would need to be convinced that they would benefit from changing their current distribution practices before they are inclined to embark in UDC initiatives.

To address the transferability issue, the research team at the NYU Rudin Center carried out a number of research tasks and activities. First, the team examined various definitions and the record of existing UDC schemes. After a comprehensive literature review including close to 40 UDCs experiences that had been developed or reached operational status, the team focused on various models of Urban Distribution/Consolidation Centers (UDCs/UCCs) that have been effective in solving the "last mile" problem. This helped determine the key characteristics that make them successful, exploring under what contextual settings (e.g., institutional, financial, geographical) they are sustainable and work best to reduce vehicle miles traveled (VMT). The team then developed the appropriate criteria to assist in the selection of case studies that could potentially render lessons for the New York metropolitan context. Based on such criteria, summaries on 13 UDC experiences were prepared before selecting the three case studies deemed to be most likely to offer lessons in terms of the transferability issue.

All the information gathered made it possible to then proceed with a discussion on the potential applicability of the three models to New York City, including a consultation that culminated in a meeting involving a select group of urban freight stakeholders in the New York larger metropolitan region.

This report contains an Appendix section that includes the following:

- A discussion of the common characteristics of the UDCs leading to a preliminary assessment of elements that are essential for their successful implementation
- Abstracts of the several UDC experiences and how they conform in terms of their ability to solve the last mile problem, become self-sustaining and reduce VMTs and or delivery trips; *and*
- The description of the three brief-case studies

2. URBAN DISTRIBUTIONS CENTERS (UDCs) IN PRACTICE

Defining UDCs

The project team considered several definitions of Urban Distribution Centers (UDCs) from the existing literature on urban freight *(Visser et al. 1999; Browne et al. 2005; BESTUFS, 2007).* These definitions show slight variations according to the research objectives, policy goals behind particular initiatives, or the specific terminology used.[1] For this study, which analyzes UDCs with respect to their potential to solve the "final mile issue," and in particular to reduce Vehicle Miles Traveled (VMT), we define UDCs as follows:

[1] A good number of synonym terms are used; most prominently, "urban consolidation center" (UCC), "city logistics center," "city terminals," "freight consolidation platform", "urban trans-shipment center", and the more generic "freight platform" (see Browne et al, 2005, p.3, for a larger compendium of terms). In studies by American researchers, UDCs schemes have also been noted, as "shared-use freight terminal" (Regan and Colob, 2005) and "cooperative multi-carrier delivery" (Holguin-Veras et al, 2007).

An urban distribution center is a facility involving the trans-shipment of goods directed to urban areas, aiming to consolidate deliveries, and thus provide greater efficiency in the distribution process by increasing the truck load factor and decreasing the number of trucks used, which help mitigate urban congestion and air pollution.

Current Experiences with Urban Distribution Centers

UDCs have been studied, implemented as pilot projects, and put into practice in several European countries since the 1970s, *(Browne et al., 2005).* While the acceptance level has varied, they have a common goal – to solve last-mile delivery issues such as urban congestion, air quality, and business efficiency. Similar schemes have been implemented in a number of cities in Japan since the late 1970s, including a multi-party collaborative enterprise operating in Tenjin (Fukuoka) since 1978, after a number of carriers came together to operate from a common urban freight platform *(Nemoto, 1997).*

With the exception of the Japanese case, most of the early UDC initiatives were promoted and/or implemented in Europe, with strong government involvement and favoring multi-company schemes. The German government led the early phenomenon of the UDCs, with more than 70 cities having plans or developing platforms in the 1990s, although few were actually implemented and even fewer remain operative today *(Browne et al, 2005).* Switzerland followed the German boom in city logistics launching 5 pilot projects for multi-company UDCs. None of them are in operation today, mostly because of constrained demand, which limited the projects' profitability *(BESTUFS, 2007, p.117).* The Netherlands also experienced a wave of enthusiasm regarding UDCs. In 1989 a national freight policy identified sixteen cities as possible locations for UDCs, although few of them moved into the pilot project phase *(McKinnon, 1998a, p.2).*

In the remaining European countries, as well as in North America, Japan and Australia the multi-company UDC concept did not reach much further than sporadic studies and singular experiences, although single-company consolidation centers were common in some countries, such as Sweden and Italy *(BESTUFS, 2007).* In the UK, the subject of multi-

company urban distribution schemes was also promoted, studied, and trialed for 25 years. However, no *public* projects were launched. The UK researchers and practitioners at government agencies, industry, and academic institutions were somewhat skeptical of the *publicly owned* and operated multi-company UDC concept that flourished in continental Europe, arguing that such model was not transferable to the islands because of their particular industry structure and other relevant differences *(BESTUFS, 2007, p.117).*

In the US, the most well known case was a study conducted between 1972 and 1974 for a consolidation terminal in Columbus, Ohio. Although this feasibility study estimated that the UDC would operate with financial benefits (after allowing for the cost of the terminal), it was never implemented *(Browne et al, 2005, p.179).* Not until the early 2000s, more conceptual studies on UDCs or collaborative (integrated) urban logistics schemes were conducted in the United States (*see Regan and Colob, 2003; Holguin-Veras, 2007; Kawamura and Lu, 2007).* Nevertheless, none have yet been put into practice.

At the turn of the century, *publicly run or promoted* UDCs seemed to have lost some appeal after many projects from the early nineties could not fulfill the optimistic expectations predicted by theoretical studies *(BESTUFS, 2007, p.96).* However, in recent years a new wave of interest in UDCs schemes seems to be rising, albeit the operational concepts being tried are quite different. The newest UDCs are being implemented mainly by private actors, such as in France and Sweden or through public private partnerships, particularly in Italy and the United Kingdom, indicating that these platforms are being perceived as an interesting market for certain contexts and when they meet certain characteristics *(ADEME, 2004; BESTUFS, 2007; Civitas, 2006).*

The following section presents the main characteristics of UDC experiences, in an attempt to shed light about the most significant features of successful cases with potential relevance to the New York context. These findings are then used to develop the criteria for selecting cases for further study.

3. CHARACTERISTICS OF UDCs

The many UDC experiences (including those listed above) represent different models and implementation approaches. In order to understand the particular factors contributing to the success of UDCs in addressing the "last mile" problem (both in terms of ability to sustain operations and to reduce VMT), the study team reviewed approximately 40 experiences and summarized the key characteristics of 13 of them, which had the potential to render lessons for the US context. This exercise served to identify three case studies that presented key features with relevance to the New York City context.

The following discussion summarizes the main findings about UDCs characteristics, which are described in further detail in Appendix A. It includes elements such as leadership, economic institutional support, operational agreements, the regulatory context, services, spatial coverage, location, and transportation solutions and vehicles, among others. Some of these characteristics have been used to elaborate various UDCs classifications, and these will be duly noted.

Institutional Characteristics:

Leadership

One attribute that differentiates UDCs in their institutional dimension is the degree of public intervention, which varies from one city to another. UDC examples reviewed for this study lie in a wide spectrum. At one end is the Tenjin Joint-Distribution Center in Fukuoka (Japan), where the government's role was limited to convening potential participants, assuming that operators would be rational enough to co-operate on a voluntary basis. The UDC scheme in Kassel (Germany), where carriers cooperate to distribute from a neutral depot *(Browne et al, 2005),* and La Petite Reine in Paris represent similar cases of minimum government involvement. At the other end of the spectrum, is the UDC owned by the city of Monaco, where the government subcontracts its operation to a single forwarder while imposing strong limitations to direct deliveries not routed through its UDC. Another such example is the initiative in Leiden (Netherlands), where the local authority issues coercive binding rules

through a "distribution license" and strong disincentives such as reduced delivery schedules for non-UDC players *(BESTUFS, 2007, p.155).*

Bottom-up initiatives tend to be considered more successful than top-down cases because the involvement of shippers, carriers and retailers *during the early stages* is seen as a critical element in achieving and maintaining the level of activity necessary for at least a break-even operation *(Quak, 2008).* BESTUFS researchers also concluded that durable solutions cannot be imposed by one side, and that improvement must be sought together with all players involved; otherwise private actors could perceive the UDC scheme as unattractive, useless or unfair, thus rejecting to participate *(e.g., Quak, 2008, BESTUFS, 2007, p.155).*

Financial Support from Public Institutions

Almost every UDC experience described in the literature has enjoyed some degree of support from public institutions; in fact, many of them are not self-sustaining without such support (*see synthesis table in Appendix B; also Browne et al, 2005*). The record indicates that economic subsidies, of one form or another, may be a key element in making UDCs sustainable. Yet, most local authorities expect UDCs to become self-sustaining in the medium to long term and therefore are only willing to commit financial support during the first years of operation.

Public involvement in the financing of UDCs has usually been justified by the benefits that such schemes offer to the citizens over the traditional way where there is no coordination across carriers, shippers, and receivers. The logic dictates that: *"if the UDC creates substantial benefits for the public, it should also be actively supported by the public (BESTUFS 2007, p.158)."* One could argue that UDCs play the role of public transportation (for goods instead of passengers); hence, a new (and sometimes publicly-owned) UDC could be set up with shippers and carriers given the option to have their merchandise "travel in a common wagon." As long as such scheme alleviates some of the negative impacts of delivering goods, the trade-off is positive and would justify public subsidies to ensure that the cooperative scheme remains viable. However, researchers have surmised that:*"there is no clear, general answer to the question whether the mentioned benefits outweigh the costs. To*

complicate things, those who benefit are not necessarily those who bear the costs (BESTUFS 2007, p.158)", thus any answer would probably be case dependant.

Failed UDC experiences (such as Genoa in Italy and Zurich in Switzerland) share common features – institutional support was discontinued after the first years of operation and carriers did not become fully involved in the scheme due to doubts on the continuing backing of public institutions in the future. In fact, most of the surviving experiences have required financial support from the local governments for longer than expected, especially where UDCs represented a strong political bet (La Rochelle) or where healthy public finances made it viable (Monaco) *(ADEME, 2004a; Gerardin, 2007).*

Operational Agreements

Existing UDCs tend to be public or privately owned according to the sector from which the initiative emerged; and more blended formulas such as public private partnerships (PPPs) also exist. However, a more relevant issue for operation is how those parties involved in the UDC decide who will be accountable for costs to deliver goods from the UDC to their final destination and who would accrue any profits. The following paragraphs introduce several formulas of operation agreements identified in the literature.

UDCs privately owned and operated by a single party, either directly or by subcontracting. This scheme involves private agreements with carriers and/or retailers. Different experiences fall into this category, including:

- *Single-site "suggesting" landlord* schemes such as at shopping malls in Kent and York (UK) where the landlord offers additional storage space and services to those retailers using a common distribution platform for all deliveries *(Browne et al, 2005).* This UDC type is completely oriented to provide benefits to retailers rather than carriers, and thus the additional generated costs are passed to retailers.
- *Single site "demanding" landlord* schemes such as the retail distribution center at Heathrow Airport in London where, as a condition of the rental agreement, the concessioner (BAA) demands that retailers accept all deliveries through an UDC

located just outside the airport. This provides increased security (all packages are screened) and decreases the number of trucks operating on the airside of the terminals. Costs for the operation are passed to retailers and partly subsidized by the airport. Curiously, forwarding and shipping companies, while accrue cost-savings on avoided "last leg" delivery trips are not being charged for the service. Another example of this formula are the temporary UDCs for building materials that were set up in Stockholm and also at Heathrow airport, during construction projects *(BESTUFS, 2007)*.

- *The Dutch system of licenses*: whereas each private carrier company complying with a specific set of regulations is granted by the government an "advantageous delivering license." Each participating company enjoys longer delivery-windows to the city center, and in exchange it agrees to use clean vehicles, increase loading factors and minimize deliveries per day/week. A licensed company's depot becomes a virtual or *de facto* UDC because carriers without licenses must deliver their goods (and pay for it) to any licensed company's depot *(Browne et al, 2005)*. This scheme has been applied in the Dutch cities of Amsterdam, Groningen, Leiden, Maastricht and Utrecht, and has sometimes led to monopolistic situations that have been strongly contested by non-licensed carriers.

Private joint ventures, led by the carrier industry without involvement of any public institution. This formula is common when no single actor has sufficient power to impose agreements (as those mentioned above). Such cooperative agreements may entail setting up a new "neutral" company to operate the UDC, as in Tenjin after 1987 *(Nemoto, 1997 and Appendix C)*. In other cases such as in Cologne, Kassel, Stuttgart and Ulm (Germany) rather than setting a new company, the cooperating carries designate an independent or external carrier that has not previously deliver to the area. Finally, in Essen and Freiburg (Germany), cooperating carriers deliver to a depot owned by one of the parties. This is a more complex formula, which involves complicated compensations among the involved companies *(Browne et al, 2005)*. In all of the previous cases, the involved companies pursue their own interest rather than that of retailers; however, it has been reported that the affected retailers are

usually rather positive towards this scheme because they can appreciate less freight traffic in their streets (Browne et al, 2005).

Public private partnerships (PPP) is a more recent formula for the operation of urban distribution centers, which is common in Italy. Indeed, Genoa, Padua, Siena and Vicenza have established UDCs through joint ventures engaging local governments, chambers of commerce or akin institutions, and (usually large) forwarding firms *(Browne et al, 2005).* There are two variations for this scheme: the creation of a new *ad hoc* company whereas the involved actors become shareholders (as in Siena), or the establishment of an agreement with some existing company (as in Padua). The public institutions have usually backed the schemes by issuing advantageous regulations for the vehicles operating from the UDC.

Publicly owned UDCs. In these cases, the UDCs are owned by the local government and operated by a private company winning a public tender, as in La Rochelle (France) and Malaga (Spain) *(Browne et al, 2005).* The UDC in Monaco also fits in this scheme. In general, if the UDC cannot sustain itself through the rates it charges, the government or agencies involved absorb any deficits. With the governments playing such a predominant role, it is not surprising that these schemes comprise some of the few cases where directing goods through a UDC is mandatory for carriers. The only other mandatory scheme is the *"single site-demanding" landlord*.

Regulatory Conditions

Obligation

For the majority of existing cases, carriers use the UDCs on a voluntary basis, with the exception of a few compulsory cases outlined above. This means that most freight platforms must prove advantageous for carriers in order to remain competitive and self-sustaining. An important reason why the use of UDCs is discretionary is most countries is that their current legal framework prevents them from banning carriers making direct deliveries. For instance, in La Rochelle, it became ultimately impossible for the authorities to deny access for non-

UDC users as long as they complied with the restrictions (Quak, 2008, p.68). However, limited restrictions can be (and usually are) enforced, but not absolute bans.

Access restrictions applied to freight operations range from delivery time windows, to vehicle weight or speed limits, to requiring the use of clean vehicles or very large trucks banned from entering certain areas. These rules are the outcome of local governments trying to balance the different uses of public space, with neighbors usually asking for such measures because they experience goods delivery as a nuisance and carriers and retailers in opposition because of the hindrance it poses to their respective business. In general, the narrower the streets, the scarcer parking space, and the more congested the city center, the more likely such regulations are enforced.

The restrictions can favor Urban Distribution Centers if they either cope better with the restrictions (e.g. by using clean vehicles, or full truckloads) or if they are fully or partly exempted from the restrictions (e.g., the Dutch model). In voluntary schemes, carriers will feel more inclined to route their goods through the UDC whenever they perceive advantages for so doing. *(Quak ,2008, p.72)* has concluded that consolidation centers seem to be most feasible for historical cities with restrictive and/or inhibitive conditions for urban freight transportation.

Not surprisingly, such advantageous regulations seem to be more common in cities where the local government is more involved in the operation of the UDC, either by being its owner or by participating through a public private partnership. However, granting a special status to one or several market players is a delicate measure as it might quickly interfere with free market competition by creating monopoly or oligopoly conditions. While such concerns differ according to the cultural and political context of each city and country, some working solutions have usually been found. For example, in France, the general public law allows for some regulations to favor one operator over others when there are market deficiencies, or to address environmental or public interests (which UDCs offer easily), *(BESTUFS 2007, p.118).* Nevertheless, if the advantages for UDC vehicles are perceived to make excessively difficult the work of those who choose to keep delivering on their own, serious unrest and

criticism could arise among the carriers and discourage their necessary involvement in the system. The case of UDCs in the Netherlands is paradigmatic of such risk, where many carriers grew suspicious about the dual role of municipalities in being the regulatory authority imposing vehicle access restrictions while at the same time being fully or partly involved in running the UDCs. Coupled with other criticisms about monopoly and lack of competition, this led to a considerable scaling down of expectations for the widespread development of UDCs in the early 1990s *(McKinnon, 1998a, p.3)*.

Besides regulations, the degree of enforcement pursued by authorities should also be considered. For instance, Quak *(2008, p.67)* considers that the lack of enforcement of the regulation forbidding heavy vehicles in the city center of La Rochelle is hindering the competitive advantage of deliveries through the UDC. However, this is a factor rarely considered in the literature because of its inherent difficulty to be properly assessed.

Services, Market Coverage and Location

Services

It is difficult for a single UDC to be able to handle the wide range of goods moving in and out of an urban area, in part because of different handling and storage requirements *(Browne et al. 2005, p.5)*. In fact, most of the existing UDCs have started by distributing only parcels, as this doesn't require specialized handling. Sometimes other goods are distributed later once the UDC has proved useful, or to try to increase its output and to reduce operating deficits. Some generic limitations to the type of goods that can be consolidated in UDCs are the following:

- Perishable goods are not handled by most UDCs because they require additional infrastructure and dedicated vehicles (and additional upfront costs). Some remarkable exceptions are the Stockholm UDC serving the historic center, which can handle cold foods, and the consolidation platform at Heathrow airport (London), which has chilled and frozen facilities, and to a certain extent, La Petite Reine in France, which delivers dairy products short distances using special refrigerated cargocycles.

- The small vehicles, especially bicycles and/or electric powered, that are used in some UDCs do not allow carrying heavy or bulky goods. For instance, goods exceeding 65 lbs. cannot be handled in small vehicles without hydraulic elevators for roll cages.
- The trans-shipment of high value products is often prohibited by insurance companies.

Many UDCs have been designed to offer a range of additional services other than consolidated deliveries, such as storage and management of stock, inventory and returns. While in some cases these additional services have been conceived of as a means to improve attractiveness for retailers, sometimes such services have been offered later, as an answer to the need of the UDC operator to generate additional revenues, often necessary to break-even. A good range of supplementary services by UDCs have been described *(Browne et al, 2005),* mainly in the context of retail premises but possibly also for other types of consignees:

- One potential use is stockholding, subject to available capacity and appropriate storage conditions for the products involved. In the main, only short-term storage tends to be envisaged, providing a useful local buffer stock that can be called off quickly when needed, thus reducing delivery lead times and improving product availability and customer service.
- Inventory monitoring and information collection and analysis, linked to in-store systems, can be provided. This can increase the visibility of the supply chain, again leading to better availability and service levels, as well as reducing loss of stock.
- Product quality and quantity checking can be carried out upon consignments' arrival at the center, giving advance notice to the customer of any problems with supplies.
- Various pre-retailing activities, such as consignment unpacking, preparation of products for display and price labeling, can also be carried out at the consolidation center to reduce time and space requirements upon delivery.

- Some UDCs may be in a position to offer B2B (business-to-business) and B2C (business-to-customer) services within their catchment area, including inter-store transfers, home delivery or customer collection of products purchased in town or by mail order. In La Rochelle, direct deliveries to houses and yachts were introduced a few years after the opening of the UDC *(Gerardin, 2007, p. 13).*
- UDCs can have a role in the handling of return and recycling flows, including product returns and the coordination of waste and packaging collection for reuse or recycling, instead of individual customers having to deal with this. As regulations in this area tighten, such coordinated approaches may offer greater benefits over time.

There is often a conflict between the retailers and carriers needs and the UDC need for consolidation and running a self-sustaining operation. Retailers demand reliable delivery times and often require increased flexibility or frequency in the delivery schedule. Apart from avoiding the final miles of their delivery trips and the restrictions or congested loading bays typical of many urban locations, carriers require well-equipped and staffed UDCs that admit deliveries at more flexible times (preferably 24 hours per day and at least six days per week) *(Browne et al, 2005, p.8).* At the same time, the necessary load consolidation requirements at the UDC, may lead to fewer delivery trips to the destination and cost saving measures may result in shorter hours of operation.

One way to bridge this conflict is by *increasing the volume of goods processed at the UDC* so as to and offer improved services to both retailers and carriers. By processing higher volume of goods, the UDC can more frequently achieve higher load factors in vehicles operating from the UDC, as well as a higher revenue stream, which may provide more flexibility in extending the hours of operation. Various ways to increase volume have been discussed above, including compulsory obligations, or policies discouraging rules (certain limitations to free entry to the city center or road pricing) as well proactive marketing and partnerships with transport operators *(Danielis, R. et al, 2005).* Since each case is different, the particular circumstances and business case of individual initiatives need to be carefully evaluated on a case-by-case basis.

Targeted market areas

Browne et al. *(2005, p.17-18),* discuss three categories for UDCs according to the target market, based on their analysis of 67 UDC schemes implemented in or planned at 15 European countries, Japan, and the United States (Ohio, which was never implemented). They distinguish between special projects such as temporary UDCs set up during construction, and *UDCs on single sites with one landlord,* both discussed above. The latter one may be relevant to landlords of large buildings in New York that wish to rationalize deliveries to multiple end users (e.g., Empire State building, Grand Central Station).

UDCs serving a town/city represent most of the cases. They serve retailers who are not subject to a single landlord, with forwarding companies participating on a mostly voluntary and cooperative basis, as implemented in German cities and most recently in France. There is much variation in the geographical area served by the UDC and the number of involved carriers, UDC operators and retailers, ranging from a single commercial street or shopping mall (e.g. Bristol and Kent in UK) to a whole city (as intended by the Dutch and German experiences).

There is one paradox that deserves discussion when the spatial coverage of UDCs applies to large serving areas. On the one hand, it has been noted that enabling a single consolidation center for the distribution in a large urban area is unlikely to be attractive for many suppliers' flows due to the degree of diversion required from normal route, and may therefore negate transport savings for onward distribution *(Browne et al. 2005, p.5).* However, it is also known that in the well-studied case of Leiden (117,000 inhabitants, Netherlands), the number of customers served through the UDC was insufficient to reach the break-even volume, even after the surrounding cities were added to the working area of the UDC *(Quak, 2008, p.68).* The project opened in 1997 and stopped in 2000 because of its inability to reach the 2,000 delivered units per day estimated for break-even *(BESTUFS, 2007, p.158).* In such case, it is obvious that putting into service a second platform for consolidation would have made reaching the break-even point even more difficult to achieve.

Location

When UDCs are designed to serve a whole city, the facilities are always located in the city outskirts and close to major communication lanes. This is not only more logical but also cheaper. Some examples are Monaco, with the UDC located in the city border under a shopping mall close to the main roads *(Gerardin, 2007, p.21),* and Leiden (Netherlands), where it is located in the outer area of the city close to A4 motorway *(BESTUFS, 2007, p.128).*

However, for UDCs designed to serve only a CBD or central areas well inside the city, the facilities can be sited either in inner city or outer locations. A typical example of the first case is La Rochelle, with the UDC located by the train station and next to the historic center *(Gerardin, 2007, p.13)*. An opposite example is Bristol where the UDC is close to a strategic road network (M4 and M32) and deliveries to its client base require a 25-minute drive to the commercial district of Broadmead *(Browne et al, 2005, p. 166).*

The location of the consolidation platform has a substantial influence on the traffic it generates both upstream and downstream, and thus on its environmental performance. Choosing a smart location consequently involves certain know-how about the main goods flows delivered and collected to and from the platform. This can be properly figured out in prospective studies, but unfortunately there are many determining factors that have been usually neglected at the design stage and have later forced many UDCs to be located in sub-optimal locations which, in turn, can affect the usefulness and viability of these schemes *(Browne et al., 2005; BESTUFS, 2007).*

Land prices and concentrated local emissions due to traffic attracted by the platform make it difficult to find a suitable location. In order to reduce the roadside distribution transport mileage, the platform would preferably be located close to the city and its commercial centers (short distribution legs, longer rail leg if there is intermodal transport). On the other hand a central location usually involves high land prices and conflicts with the neighboring residential areas that are sensitive to the traffic attracted by the platform. Due to the high land costs, establishing a freight platform in the city center will generally only be possible when

public areas are provided or subsidies are obtained. Because of the traffic involved, a location in the outskirts is often preferred or even legally stipulated anyway *(e.g. in the UK, as stated in their Planning Policy Guidance Notes)*. In any case areas suitable for a future freight platform should be identified early enough and secured by land use planning measures *(BESTUFS, 2007 p.154)*.

Transportation Vehicles and Metrics

One increasingly shared characteristic of the UDCs developed from the late nineties onwards is that they have also been conceived to spearhead the introduction of cleaner vehicles in the city. Several factors could be outlined to explain this trend:

- Some UDCs have enjoyed substantial funding from EU or national policies in which experimentation and testing of new technologies is encouraged, if not a requisite.
- UDCs are usually embedded in broader sustainability policies, which most local governments would like to make as visible as possible for their citizens, and clean vehicles are quite good for this role.
- The usual involvement of local governments in the UDCs allows for higher upfront costs, which cleaner vehicles most likely contribute to increase.

Clean vehicles selected have usually included those powered by biofuel, compressed gas and electricity, as well as cargo-cycles. Some problems with the homologation of the heaviest vehicles with alternative fuels have been documented to delay the full implementation of services offered through the UDC *(Browne et al., 2005; Gerardin, 2007)*. In some instances, although the vehicles were perceived as the cleanest ones among the available technologies, they have caused setbacks. In Leiden (Netherlands), the electric vehicles used to distribute from the UDC had a maximum speed of ~17 mph, which ultimately turned out to be a major disadvantage because it hindered other traffic and it resulted in social opposition against the UDC *(Quak, 2008, p.68)*.

Clean vehicles aside, the most repeated formula for UDCs in the typical medium sized European city is to have a fleet of about 5 small vehicles and a larger one for the heaviest

deliveries. As an example, Gerardin (2007) has recorded the following fleets for some French UDCs:

- In La Rochelle, 6 electric vehicles with capacity for 1,300 pounds and one 3.5t electric truck. The homologation process for the truck took 14 months.
- In Monaco, 6 small vans (including one electric) and a 7.5-ton truck.
- In Paris (La Petite Reine), the fleet consists of 25 electric aided cargo-cycles. This is a particular case where the UDC only distributes parcels in a central neighborhood of the city.

Metrics

Improvements in terms of efficiency and livability, which are the ultimate justification for UDCs, must be measured with respect to traffic and the environment. Metrics to evaluate UDCs' benefits and costs must include the positive outputs of city logistics projects but some of these are difficult to assess. For instance, when UDCs are combined with a heavy truck ban for the inner city, this can multiply the number of small vans running in the streets if a high degree of consolidation is not achieved, which is not necessarily something good for the environment and the city's inhabitants *(Savy & Dablanc, 1995)*. Still, metrics are often lacking for many of the UDCs that have been operating worldwide; only 40% of the experiences identified in this study measured outcomes and shared results with the public. There is not a clear trend about this among the countries that have developed UDCs. Traffic and environmental metrics can be found in the following formats:

- Mileage or VMT reduction, often given in percentage rather than absolute
- Decline in the average distance between deliveries
- Reduction in the number of trips, deliveries per retailer and/or total journey time for a given period
- Increase in the load factor of vehicles, increase of delivery weight per drop
- Reduction in the number of parking operations, decrease of total delivery parking time
- Energy or fuel savings
- CO_2 emissions; sometimes pollutants with local level impacts are given too

These metrics are calculated by comparing pre- and post-UDC conditions, and thus the measured improvements are always related to the traffic diverted through the UDC. Only Nemoto *(1997)* has calculated (for Tenjin, the CBD in Fukuoka, Japan) the impact of the UDC on the whole road traffic in trunk and service roads in the area, as well as in the energy and pollution footprint of the whole city. While a reduction of roughly 8% was estimated for traffic levels in service roads within the CBD, they represented only ~1% of all traffic and environmental effects. Finally, it should also be noted that methodological information about these metrics is very scarce. Only Monaco and La Rochelle in France *(ADEME, 2004b)* and Tenjin in Japan *(Nemoto, 1997)* have such information been available.

Barriers to Implementation or UDCs Success

Taking into account that UDCs imply a significant change in delivery practices already in place, this section introduces in a general way, some of the key elements representing *barriers to change* (mainly cultural or attitudinal) as documented in the literature.

First, it should be noted that much urban freight is already consolidated at the intra-company level or by parcel carriers, so limited benefits (or even negative consequences) for trying to channel these flows through a consolidation center could limit its potential *(BESTUFS, 2007, p.106; Browne et al, 2005, p.5).* This pre-consolidation factor could show considerable variation among different types of goods and different geographical areas, but in those contexts where it happens carriers will most likely show little interest (if not resistance) to the implementations of a UDC.

Other counter arguments presented by carriers regarding additional costs, extra product handling and poorer service standards are also featured in the literature, particularly with reference to the public sector schemes that are concerned with environmental and social improvements rather than better supply chain performance. However such claims do not receive much attention because of the reluctance of carriers to disclose operational data to back them. In some of the more recent literature, particularly relating to the more "commercial" schemes in the United Kingdom and elsewhere, more attention has been paid

to the potential total supply chain benefits, as a result of greater effort being devoted to integrating the centers into the supply chain. Even then, the impacts are generally only identified towards the end of the supply chain, with little attention being devoted to effects taking place further upstream *(Browne et al. 2005, p.9)*.

The lack of willingness to co-operate is notable in those environments with fierce competition, where carriers are afraid of disclosing competitive information about order quantities, products, customers, know-how, etc, and particularly of losing customers to their competitors. In such situation, companies seek to maintain competitive advantage rather than share expertise and systems *(BESTUFS 2007, p.106)*.

Even in less stressed contexts, many forwarding/shipping companies give a higher priority to customer service and competitive advantage than to reducing transport costs; they do not want to lose the direct contact with the receiver because the act of delivering offers an opportunity for the transport company to promote its goods and/or services and to establish a customer relationship - it is the company's "business card". Carriers are also reluctant to relinquish control over the merchandise and the transport chain if the responsibility issues for the transported goods are not satisfactorily addressed *(BESTUFS 2007, p.106)*.

4. CASE STUDIES

Fully detailed case studies are provided in Appendix C. This section describes the case study selection process and provides a summary of findings for each of three cases while discussing their relevance to the New York Metropolitan context.

Case Study Selection

Most of the discussion about UDC characteristics (see Apendix A) offer important information about the key features that the Team considered to develop the criteria for selecting three case studies, which could render potential lessons for the US context and New

York City in particular. The main characteristic considered in developing the criteria focused on a number of relevant factors, including:

- *The temporary or permanent scope of the system*
- *Economic profile: whether the operation is self-sustaining or it requires subsidies*
- *The nature of the leadership for the initiative, whether public, private, public-private partnership, top-down or bottom-up*
- *The compulsory or voluntary nature of the scheme for carriers and retailers*
- *Existence of favorable regulations, which may give competitive advantage to vehicles operating from the UDC*
- *The extension of the area served by the UDC*
- *Whether the UDC scheme implies some degree of monopoly*
- *The number of participating forwarders, thus defining single-company and multi-company schemes*
- *The nature of the goods accepted at the UDC and services offered*
- *Areas served, location*
- *Vehicles used and existence of data regarding the effects of UDCs on VMT*

Our initial criteria used to select the final case studies included the following:

1. the freight platform was intended to operate permanently and not just as a pilot project
2. the UDC is "successful", i.e., it is still in operation and financially sound
3. the available sources of information provide sufficient data to measure their outcome
4. metrics are available in terms of VMT and other traffic- and environment-related parameters

Thirteen of the forty cases reviewed met the above criteria (see Appendix B). In order to narrow the scope and to select three cases that could render lessons for the institutional and policy context of the United States, additional elements were added to our criteria, such as:

5. the UDC was operated by private parties or a public private partnership
6. regulations in place provided minimal support in favor of the UDC

7. the contextual characteristics of the UDCs exhibited certain similarities to certain locations in New York City

Given the additional criteria, the team selected three cases that were privately operated, sought to be self-sustaining, did not significantly rely on favorable regulations, and had demonstrated freight VMT reductions, all elements seen as important for New York. Consistently, the following cases were selected:

- La Petite Reine in Paris; France
- Heathrow Airport Retail Consolidation Center, London, UK
- Tenjin Joint Distribution System, Fukuoka, Japan

Findings from these cases are discussed below, in relation to their potential applicability to the United States, and in particular to the New York Metropolitan region. A detailed description of each case is provided in Appendix C.

International Experiences and Its Applicability to the United States

The previous sections have exposed the vast array of factors involved in the implementation of UDCs in Europe and Japan mostly over the last two decades. For UDCs to be successful in US cities or metropolitan areas, these parameters should be examined to assess their potential transferability. To assess the prospects for UDCs being successfully implemented in the U.S. cities, it is important to understand the main similarities and differences between the context shaping UDCs in Europe and Japan and that of the United States, in particular the New York metropolitan area. Some of these are outlined below:

- The physical layout of American and European cities is often quite different; with US cities commonly lacking the typical narrow, historic center of the European cities, which is usually a crucial "hot spot" for freight traffic requiring intervention. However, older U.S. cities in the northeast still have areas where the original street grid is in place thus presenting similar conditions - Lower Manhattan's narrow streets or the new pedestrian areas in the midtown area in New York City are just a few examples.

- Certain degree of public sector involvement has often been necessary to support the implementation of existing UDCs, with the government playing a role ranging from minor to significant support. While the enforcement of clear monopoly power typified by the Monaco and Dutch cities' experiences would likely not prosper in the United States, other UDC cases initiated by private actors with minimum public support, such as La Petite Reine or Tenjin, may offer lessons to the New York City metropolitan area.In terms of the political and regulatory contexts, it has been argued that the lack of a federal freight policy in the United States (in contrast to Germany or the Netherlands) effectively transfers this responsibility to state and local governments, which may have less knowledge and resources to support innovative trials and developments *(Miodonski, 2009).* In fact, federal legislation in the late 1970s effectively deregulated the freight industry, with the Motor Carrier Act eliminating barriers to entry for the trucking industry and the Staggers Act similarly affecting railroads' operations. The first law made it easier for a multitude of trucking companies to enter the market, while making the industry more competitive. In order to compete, companies needed to run more efficient operations, and as a result freight consolidation in the United States has increased greatly since the 1970s (NRCP 2, 2002) However, consolidation and economies of scale are harder to obtain at the "last mile" of the journey, mostly because urban distribution tackles small orders. Hence, opportunities for further freight consolidation still exist at the city freight level.

- Supported by national freight policies, most European cities have attempted to rationalize urban distribution and promote consolidation by imposing certain limitations to trucks free- entry to the urban core. It is not clear that instituting new rules or changes to the freight system would be as straightforward for cities across the United States. Sometimes policy changes require coordination with regional transportation planning organizations and other parties. This means that US cities face more political challenges when attempting to rationalize the public space; nevertheless, they have the authority to pursue such measures.

- There is great degree of variation among European cities regarding types of government interventions and the public's acceptability of regulations to rationalize the use of public space (including streets). Other policy options that have been considered are: road pricing or efficiency-inducing fees to gain access to the city, developing reserved lanes to favor clean vehicles, and/or full loaded vehicles, and promoting collaborative urban freight platforms, with varying degree of government support (see above). In the United States, given the current policy climate, there is not much appetite for regulations or the use of public funding to directly subsidize UDCs but public debate on road pricing is starting to be considered, including New York. While road charges may represent added revenues in financially difficult times, the cost and benefits to all affected must be carefully assessed. One way to minimize the need for regulatory intervention is by promoting cooperative enterprises – either private or PPPs – to lead the UDCs.

- The justification for such interventions are different among various countries, with the European government and citizens more likely to accept interventions to solve environmental externalities and policy interventions in the United States likely to be motivated by the need to address traffic congestion or inefficiencies such as the lack of space for loading/unloading, and/or for parking.

- Enforcement is an issue of concern whenever regulations are applied. However, new technologies are making it easier to directly or indirectly enforce traffic rules and penalize offenders. Nevertheless, it is hard to enforce "full truckload" requirements for freight vehicles entering urban centers. Some cities in Europe provide "green labels" for vehicles operating from an UDC, and spot checks or inspections at the facility can corroborate full truckloads. While the same enforcement approaches would be available in the United States, their relevance depends on which policies are ultimately adopted.

- The structure and idiosyncrasy of the logistics industry can also explain where cooperative logistics and private initiatives are more likely to happen, although the ongoing economic globalization could result in common practices, especially among companies operating worldwide. Conceivably, companies managing UDCs such as La Petite Reine in France or London's Heathrow Airport UDC may consider establishing such operations in New York City, servicing areas with common characteristics to the European counterparts (e.g. narrow streets in Lower Manhattan or pedestrian areas elsewhere, as well as local airports).

Case Studies Findings and their Relevance to New York City

The following paragraphs summarize the key findings from the three cases studied for their potential applicability to the New York metropolitan region, including a discussion of elements that favor or present challenges to their implementation. A detailed description of these cases is presented in Appendix C.

La Petite Reine, Paris

In less than a decade, La Petite Reine has expanded its operation from a few bicycle deliveries per day in Paris to one million deliveries per year in all of France, including at least a quarter of a million parcels distributed in Paris plus additional collection services. The success of this privately-run consolidation system lies on a number of key features. First, the LPR benefits from increased access to certain restricted areas (e.g., pedestrian zones and urban core with narrow streets) through the use of narrow-body cargo-cycles and longer delivery windows as well as a low-cost operation. Second, the cargocycles can be parked almost anywhere, decreasing the time spent looking for parking and traveling from vehicle to customer. Third, while a motorized vehicle may travel faster, the cycles have an easier time navigating through congested traffic, so as long as the delivery routes remain relatively short; hence, offering certain advantages over truck deliveries – besides fuel savings or roughly 90 tons of oil equivalent and associated pollution).

LPR operation seems to be financially viable despite limited public support. Besides fees on delivery and collection services; the company sells advertising space (on side panels of the cargo bins) thus bringing additional revenue. Known as a socially and environmentally responsible company, LPR has a good marketing strategy, benefiting from several strategic alliances that ensure a good volume of merchandize processed per day. Services offered by LPR include distribution for "express" transport companies and deliveries to its own client base. At the same time, it is clear that the City of Paris' favorable (non-commercial) rental agreement on at least one of the two hubs is a significant element in ensuring the financial viability of the LPR operation. Attaining such support in New York City may not be that easy.

The LPR experience may be applicable to areas of New York City where streets are narrow and/or in pedestrian areas closed to traffic, for example in Lower Manhattan downtown area or the midtown pedestrian areas. The model of LPR has several key elements that favor its potential implementation in New York City, including:

- It is a privately owned and operated enterprise and the model may appeal to companies operating in New York or the company now running LPR
- The operation seems to be efficient and self-sustaining and LPR has been able to expand in a short time span to other locations. A good market strategy ensures a diversified client base and high-volume of goods processed at LPR.
- This socially and environmentally responsible company is attractive to diverse clients seeking to highlight their environmental friendly practices and support for local employment and training opportunities to disadvantaged groups.
- Non-polluting cargo-cycles offer flexibility to navigate congested streets, and to park in closer proximity to retail stores and other customers.

Given the limited spatial range of the operation, the main challenge would be finding an UDC location near customers and at a reasonable rental rate. LPR in Paris has benefited from favorable lease agreements. For an operation targeting Lower Manhattan, it may be possible to find facilities near the waterfront that could be re-purposed as an urban distribution center. Such re-purposing has taken place already, for example in the early 1990s, NYSDOT held a

leasehold auction for pier 40, won by a company that secured FedEx as its anchor tenant *(Brooks, 2009).*

Other concerns were presented at a stakeholders meeting held by the NYU Rudin Center for Transportation on December 14, 2010. A participant questioned whether a similar "virtual" distribution scheme is not already in place in Lower Manhattan, with carrier company trucks parking in peripheral areas and delivering packages using hand carts to retail clients located on narrow streets. While the truck effectively functions as a mobile storage area, this operation does not relieve congested streets by removing trucks or their associated pollution, still requires time spent in moving the vehicle closer to clients or finding parking (and often paying parking fees), and given the size of the handrail also demands multiple trips from the delivery person, a time consuming endeavor that increases labor costs. The challenges faced by truck deliveries, coupled with slightly favorable regulations in Paris make LPR deliveries competitive. In fact, several "express" transport companies contract with LPR for parcel deliveries to their client base in Paris' urban core and pedestrian areas. Security concerns were also raised, and a LPR representative noted that while they have not experienced major problems with thefts, the cargo-cycles are sold with ARBUS antitheft protection devices as well as GPS locators.

The ***Tenjin Joint Distribution System*** (TJDS)

This UDC has been in continuous operation since February 1978, and thus is one of the oldest freight consolidation schemes in the world. This joint distribution system was started when roughly 30 freight carriers delivering to Fukuoka's city center (Tenjin) came together to collaborate on a joint delivery system *(Taniguchi, 2002).* TJDS members started this collaborative freight platform to address increasing delivery costs, in part because of in moving through congested CBD streets full of double parked vehicles, long times finding parking, often several blocks away from customers *(Browne et al, 2005).*

While the TJDS was successful in removing vehicles from the road and thus decreasing vehicle miles traveled, given the reduced scope of the UDC, other social effects are not

significant (e.g., overall congestion, pollution) in relation to the overall city traffic *(Nemoto, 1997).* In fact, the Tenjin area is very small and the distance traveled from the UDC is short, thus the VMT reductions do not significantly impact the city as a whole. Extending both the scope and area of operations would likely improve traffic congestion, in particular on service roads. Most importantly it would increase the volume of goods processed through the TJDS – a critical issue in making any UDC sustainable.

However, a few elements now preclude the expansion of this freight consolidation system. This privately run enterprise has received no public subsidies or support of any kind and there are no favorable regulations favoring TJDS participants. On the contrary, it may be argued that recent government interventions to add parking spaces available to all trucks delivering to Tenjin have eroded the competitive edge previously enjoyed by TJDS members. In fact, from our communications with the TJDS in 2010 (through a translator) we perceived that the center is losing competitiveness (delivery tours have been cut from three to two per day), and clients, losing four members in later years. Other reasons that may partially explain the perceived decline of the system include failing to adopt new technologies (website, e-mail) or lack of strategic plans for recruiting new clients *(Harada, 2010).* Another challenge is that without parking advantages, the UDC may no longer be attractive to carriers because the distance traveled in congested streets is a short part of the delivery journey.

In conclusion, while the TJDS has worked for over three decades, this experience offers lessons about the need for UDCs to be proactive in maintaining competitiveness and increasing the volume of processed goods, in order to support a self-sufficient operation offering enhanced services to customers. This calls for certain degree of coordination with government policies in support – not against – collaborative freight platforms, as well as for proactively recruiting clients and incorporating new services and technologies to serve them better.

These lessons should be considered if this type of collaborative, multi-party freight platform were to be tried in the New York City context. There are few sectors of the local economy that may benefit from such scheme, such as carriers delivering to restaurants and grocery stores, including those originating in Bronx's Hunts Point market. When attempting to

deliver goods in Manhattan, these parties face stop-and-go traffic conditions (for much longer than Fukuoka carriers) as well as scant parking spaces. An UDC could address such problems provided it can offer advantages and cost-savings to its members, especially when they are joining on a voluntary basis.

Economies of scale can reduce the number of trips but freight consolidation requires a minimum volume of goods. One way to create volume is through partnerships. Many restaurants are now cooperating to purchase goods from common wholesalers, so the opportunity to consolidate deliveries from the same origin exists. Indeed, a representative from the Restaurant Association who participated in our stakeholder consultation noted that its members are starting to consider freight consolidation.

Other measures to obtain higher volumes of goods entering the UDC include policies that rationalize the use of public roads and lead to load consolidation. These may include the use of time windows for deliveries with longer access for full truckloads (TL) vehicles, freight-only parking spaces (with favorable rates or dedicated spaces for LT), access to reserved lanes (controlled via licenses and/or special labels), or road pricing. Full truckload vehicles (e.g., those at the UDC) could obtain licenses to benefit from these services.

While introducing any of the above measures may be a sufficient reason to motivate carriers / forwarders to change current delivery practices, some restaurant managers who prefer to personally select products at the market would be unlikely to join an UDC. However, there are many other restaurant and grocery managers who purchase directly from forwarding companies and may be inclined to participate. Further consultation and an in-depth feasibility study are required to assess the likely applicability of an experience such as the TJDS to the New York City context. Another challenge involves finding a champion or the right party to convene stakeholders.

Heathrow Airport Retail Consolidation Center

An interesting freight consolidation model worth exploring for its potential applicability to New York is that of an urban distribution center (UDC) at a single site and/or with just one landlord. There are several examples of such systems, including the retail consolidation centers at Heathrow Airport in London, and shopping malls such as Meadowhalls, Broadmead and Cargo Centre, in England (Sheffield, Bristol) *(Civitas, 2006a)* and Austria (Graz), respectively *(Civitas, 2006b)* as well as temporary construction logistic centers at Heathrow Airport's Terminal 5 and Hammarby Sjöstad in Stockholm *(Civitas, 2006b)* These cases share key characteristics that often improve their chances of being implemented because:

- Landlords can often demand that tenants use the consolidation system. Developers seeking government support (e.g., tax abatements, favorable financing) may be inclined to integrate freight consolidation centers within their developments as a way to support sustainable social practices advanced by the public sector.
- It may be easier to recover the costs of the operation by structuring fees as part of the rent or regular handling charges (e.g., according to number of packages delivered).
- UDCs may be able to obtain additional sources of revenue when operating at a single site. For example, the UDC could offer pre-retail services such as packaging, adding scanner codes or labels to the many retailers agglomerated at a single location (e.g., shopping mall, airport). This may decrease retailers' individual labor while improving the UDC's self-financing.
- When the freight consolidation targets a single site, it's often easier to plan for an optimal / single delivery route.
- Similarly, when deliveries arrive at a single site, there is a better opportunity to plan for and/or select optimal loading/unloading areas and/or times.

The Heathrow Airport retail consolidation system operating near the airport has been successful in improving and consolidating goods movements to and within the airport. Even with only 40% of potential participants using the consolidated deliveries during the first years, the system demonstrated dramatic improvements and logistic practices became more efficient. The main benefits have included a large reduction in the number of vehicles traveling within the airport, faster and more reliable deliveries, improved overall security, and customers' increased satisfaction (e.g., door-to-door service; more flexibility to schedule deliveries), as well as reductions in congestion, VMT and pollution.

While the social benefits are clearly demonstrated, a key question is whether this privately established and operated retail consolidation center would be financially self-sustaining without the support of the British Airlines Authority (BAA). Government subsidies (through BAA) played a key role in starting the center. At that time retailers were invited to join on a voluntary basis and the scheme was attractive because the BAA made a clear decision to keep fees revenue-neutral, so that retailers' costs would be compensated by savings and improved efficiency gains. Today, participation is mandatory to all retailers except a few receiving high-value merchandize. Despite the high number of participants, the UDC operated by DHL/Exel (through a series of long-term contracts) continues to receive subsidies through the BAA. A representative from DHL argued that the main challenge faced by the UDC in achieving self-financing is that parties benefiting the most from the operation, such as forwarders and carriers accruing cost-savings from not having to complete the last leg of deliveries, do not pay for the UDC services. It is not clear why BAA has not pursued revenues from shippers and carriers delivering to Heathrow Airport. One argument is that shippers have national contracts with retailers at various locations and will not change them just to accommodate Heathrow airport's special distribution set up. However, BAA has not provided information about this issue or how much funds per year are needed to subsidize the continued operation of the retail UDC at Heathrow airport.

Whereas it would be important to obtain further information to determine the viability of this experience to the New York context, the most challenging issue is whether the Port Authority of New York and New Jersey could exercise this type of monopoly power at the local

airports. Appropriately solving another challenge – where to locate the UDC – may eliminate the need to require mandatory participation at the UDC. Ideally, the facility would be sited at a considerable distance to the airport, so as to dramatically reduce vehicle miles traveled, and hence increase cost-savings in labor time and fuel spent by freight companies. Such cost-savings may be sufficient to convince these companies to hand over the last leg of their delivery tour to a properly run UDC. One may argue that the Heathrow airport's UDC, located at a short distance from the airport, cannot offer considerable savings to freight companies and thus must resort to mandatory participation.

5. CONCLUDING REMARKS

The above discussion highlights key findings and lessons from three UDC cases that may be applicable, with certain modifications, to the US context. There is another valuable source of knowledge that should also be noted here. Two attitudinal studies on carriers' likelihood to participate in UDCs have been recently developed in the United States, providing valuable complementary pictures on this topic. Focusing upstream of the urban terminals and after surveying the trucking industry in California, Regan and Colob (2005) estimated that a relatively large number of companies could be interested in shared-use facilities, especially long distance carriers and those providing service to rail terminals. Focusing downstream, Holguin-Veras et al. (2007) concluded that 15%-18% of the urban carriers would be likely users of a joint delivery system in Manhattan and Brooklyn. Companies distributing foods would be the most likely to participate; while big company size and long delivery tours would reduce such likelihood. Considering both studies together, one could argue that, for specific sectors in the carrier industry, UDCs could gather support enough in the industry as to be implemented in US cities, including the New York City metropolitan region.

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7. APPENDICES

Appendix A: CHARACTERISTICS OF UDCs

A.1. GOALS AND METRICS

Goals pursued

UDCs have been operated in widely different contexts, with particular objectives defined in each case. Browne et al. (2005, p. 4), after having analyzed more than 60 experiences in Europe, Japan and the US, concluded that UDCs typically pursue some of the following goals:

- Reducing road freight traffic levels
- Altering the type of vehicle used to deliver goods
- Reducing the environmental impacts associated with goods delivery vehicle activity
- Improving the efficiency of urban freight transport operations
- Reducing the need for goods storage and logistics activities at urban premises which could result in improved turnover

The above mentioned goals could be synthesized under the more abstract concepts of efficiency, environmental sustainability, and livability.

A distinction between public and private goals has also been suggested to describe the objectives pursued through the UDCs, as it has been shown that they can clearly benefit both sectors (REFORM, 1999, p. 9, cited in BESTUFS, 2007). For example, the public goals are to mitigate exhaust emissions, reduce the number of truck trips in the urban areas, and to stimulate economic growth in the region (creation of jobs, establishment of new enterprises, and improved supply to the industry) by enhancing the logistic infrastructure. Private benefits (applying to operators and transport companies) are mainly focused on increasing efficiency by providing suitable spaces for consolidation, bundling consignments, participating in co-operations, and generating economic gains by attracting new customers and providing additional logistic services.

The existence of both public and private benefits (as well as costs) allows for interesting synergies to happen around UDCs. Public benefits could explain why public institutions, especially local governments, have usually been strong players and often leaders in the process to build up UDC schemes, while private benefits could explain why carriers have been convinced to participate in sometimes costly cooperative schemes. However, as Quak (2008, p.71) notes, a consolidation center should be proposed when considered as a convenient solution for freight problems after a public–private debate, rather than becoming an objective in itself from the scratch Carriers, currently responsible for making deliveries in urban areas, are mostly used to do so without a consolidation center, and they have to be convinced about the reason to change the current situation in order to give the initiative a chance *(Quak, 2008, p.72).*

Metrics

In accordance with the experimental condition that accompanies many of the UDCs described in the literature, it is not surprising that the evaluations of their success are often explained in terms of "survival", with the emphasis put in a blend of factors like achieving financial self-sustainability, engaging a minimum number of carriers operating in the city, and achieving a preset goal of daily deliveries or a noticeable share of the goods distributed through the UDC.

However, improvements in terms of efficiency and livability, which are the ultimate justification for UDCs, must be measured with metrics related to traffic and the environment. These metrics are absolutely necessary to evaluate the complex balance of benefits and costs that UDCs entail, and especially to ascertain some of the supposedly positive outputs of city logistics projects that can be controversial. For instance, when UDCs are combined with a heavy truck ban for the inner city, this can multiply the number of small vans running in the streets if a high degree of consolidation is not achieved, which is not necessarily something good for the environment and the city's inhabitants *(Savy & Dablanc, 1995).* Still, metrics are lacking for many of the UDCs that have been operating worldwide; roughly 40% of the experiences identified in this study did so (or at least let metrics be known to the public). There is not a clear trend about this among the countries that have developed UDCs.

Traffic and environmental metrics can be found in the following formats:

- Mileage or VMT reduction, often given in percentage rather than absolute numbers.
- Reduction in the average distance between drops.
- Reduction in the number of trips, reduction in the number of deliveries per retailer.
- Reduction in total journey time for a given period.
- Increase in the load factor of vehicles, increase of delivery weight per drop.
- Reduction in the number of parking operations or the total delivery parking time.
- Energy or fuel savings.
- CO_2 emissions; sometimes other local pollutants are given too.

These metrics are calculated by comparing pre- and post-UDC conditions, and thus the measured improvements are always related to the traffic diverted through the UDC. Only Nemoto (1997) has calculated (for Tenjin, the CBD in Fukuoka, Japan) the impact of the UDC on the whole road traffic in trunk and service roads in the area, as well as in the energy and pollution footprint of the whole city. These global improvements were accounted around 1% for all of the traffic and environment related items; while a reduction of roughly 8% was estimated for traffic levels in service roads within the CBD.Finally, it should also be noted that methodological information about these metrics is very scarce. Only the cases of Monaco and La Rochelle in France (ADEME, 2004b) and Tenjin in Japan (Nemoto, 1997) have such information been available.

A.2 ACTORS INVOLVED

Leadership

One attribute that differentiates UDCs in their institutional dimension is the degree of public intervention, which varies from one city to another. UDC examples reviewed for this study lie in a wide spectrum which ranges from an entirely private initiative (e.g. Tenjin in Fukuoka, Japan), based on optional participation and the assumption that operators will be rational enough to co-operate, to a local authority initiative that provides quite coercive binding rules (e.g. Leiden, Netherlands) and often based on a "distribution license" with strong incentives attached to it such as reduced delivery schedules for non-UDC players (BESTUFS, 2007, p.155).

Some paradigmatic cases of surviving private initiative are the above mentioned co-operative UDC operating in Tenjin, where 27 forwarding companies associated to create a new firm responsible to serve deliveries from the UDC to the central district of Fukuoka (Nemoto, 1997); the UDC scheme of Kassel (Germany), where carriers cooperate to distribute from a neutral depot (Browne et al, 2005); La Petite Reine, in Paris a company using cargo-cycles for urban deliveries; and the UDC serving retailers inside the Heathrow airport, where the concessioner company of the airport imposes that goods be delivered to an UDC to cope with the problematic congestion of delivery trucks inside the airport (BESTUFS, 2007). For all of these cases, except the last one, neither supporting regulations nor financial aid were provided by the government.

But in most of the examples provided in the literature (Browne et al, 2005), the push for the implementation of UDCs has come from local authorities in the conventional top-down scheme (sometimes backed by national level policies; see next paragraph). That has been the general formula in countries like Netherlands, Italy and Sweden. La Rochelle in France and Monaco are also well-known cases following this script. However, some researchers (Quak, 2008) tend to consider bottom-up initiatives more successful than top-down because the involvement of shippers, carriers and retailers at early stages is a critical key to achieve and maintain the critical mass for break-even.

BESTUFS researchers also concluded from over a decade of experience with UDCs in the Netherlands that durable solutions cannot be imposed by one side, but that improvement must be sought together with all players involved; otherwise private actors could perceive the UDC scheme as unattractive, useless or unfair, thus rejecting to participate (BESTUFS, 2007, p.155).

Finally, national governments have played a secondary role only in specific contexts, basically limited to Netherlands, Germany and France. Those countries have seen national policies issued to financially help local governments to improve freight traffic in their cities, with the German and Dutch policies being more specifically aimed towards the development of UDCs (McKinnon, 1998a). But mostly national governments are not involved at all in currently operating UDCs.

Operational agreements

Existing UDCs tend to be public or privately owned according to the sector from which the initiative emerged; although more blended formulas such as private public partnerships can be also found. However a more relevant issue for operation is how those parties involved in the UDC decide who will be responsible (and get the profit) for the delivery of goods from the UDC to their final destination. The following paragraphs introduce several formulas of operation that have been used for the experiences identified in the literature:

- The first is the **single private ownership** and operation where a single company sets up and operates (directly or subcontracting) the UDC, establishing private agreements with carriers and/or retailers. However many variations fall into this category, such as:

    - *Single site "suggesting" landlord*: In the British cities of Kent and York, there are two shopping malls whose landlord offers to retailers the possibility to get their goods distributed through a distribution platform instead than directly to the stores; therefore, retailers who voluntarily agree to this scheme must indicate their providers to deliver to the platform. Retailers choose this option they perceive advantages, mostly the ability to dedicate more store space to exhibit rather than to store stocks, and also to contract additional services for the management of their stocks instead than doing this on their own with their store employees *(Browne et al, 2005)*. This is a formula completely oriented to provide benefits to retailers rather than carriers, and thus the additional generated costs are passed to retailers.

    - *Single site "demanding" landlord*: In the airport of Heathrow (London), the concessioner (the BAA company) has the ability to force all retailers in terminal #4 to get their deliveries through its UDC; only very valuable goods are exempted because of liability issues. This is a condition in the rental contract for the retail space, so retailers cannot avoid it and have to pay a fixed amount per delivery *BESTUFS, 2007)*. Such decision was adopted during the design stage of the terminal, when designers realized that it was not possible to provide enough unloading bays for freight as to avoid a level of parking congestion that could affect the operation of airplanes.

Analogous schemes were implemented in Stockholm and Heathrow airport again with temporary depots for building materials *(BESTUFS, 2007)*. In all these cases, the parties that benefit the most are the forwarding and shipping companies, as they are exempted of doing the last leg of their delivery trips while not being charged for such service.

- *The Dutch system of licenses*: in this case, the local governments grant "advantageous delivering licenses" to those carriers who comply with a specific set of regulations, including the use of clean vehicles, making a minimum number of deliveries per day/week, or achieving a minimum number of deliveries per trip (through consolidation). The licensed companies enjoy much larger time windows for deliveries in the city center, and their depots become *de facto* UDCs because those carriers who cannot get a license must deliver their goods (and pay for it) to the depots of any of the licensees (Browne et al, 2005). This scheme has been applied in the Dutch cities of Amsterdam, Groningen, Leiden, Maastricht and Utrecht, and has sometimes led to monopolistic situations that have been strongly contested by non-licensed carriers (see next section for more discussion on this issue).

- **Private joint ventures,** which are born from the carrier industry without implication of any public institution. This has been the most common formula for cooperative approaches where there is not an actor with power enough to impose agreements such as the above mentioned. These cooperative agreements have also been developed in different ways. In Tenjin (Japan), the 27 involved carriers established a new "neutral" company to operate and deliver from the UDC onwards *(Nemoto, 1997)*. These carriers pretended to avoid the over-costs posed by the congestion and the lack of parking space in the CBD; they pay a fixed amount to the neutral company for delivering to its depot. An usual agreement among volunteering carriers in some German cities (Cologne, Kassel, Stuttgart and Ulm) has also consisted of designating an independent carrier to make the final deliveries from its depot; but unlike the Tenjin case, the neutral carrier is not a new firm constituted by the participating companies, but an external firm which was not delivering in the area before.

Finally, in the German cities of Essen and Freiburg, the cooperating carriers agreed to deliver to the depot that some of them already owned; this is a more complex formula, which involves complicated compensations among the involved companies *(Browne et al, 2005).* In all of the previous cases, the involved companies pursue their own interest rather than that of retailers; however, it has been reported that the affected retailers are usually rather positive towards this scheme because they can appreciate less freight traffic in their streets *(Browne et al, 2005).*

- **Public private partnerships** (PPP) are a more recent formula of agreement for the operation of UDCs, which is happening especially in Italian cities. Genoa, Padua, Siena and Vicenza have put into work their respective UDCs by establishing ventures with the participation of local governments, chambers of commerce or institutions akin, and (usually large) forwarding firms *(Browne et al, 2005*). There are two variations for this scheme: the creation of a new *ad hoc* company of which the involved actors become shareholders (as in Siena), or the establishment of an agreement with some existing company (as in Padua). The public institutions involved in these agreements have usually backed the scheme by issuing advantageous regulations for the vehicles operating from the UDC.

- **Government owned**. Some UDCs are owned by the local government itself and/or a public agency. In such cases, UDCs may be operated by a private company winning a public tender, as in La Rochelle (France) and Malaga (Spain) *(Browne et al, 2005).* The UDC in Monaco also fits in this scheme. Obviously, if the UDC cannot sustain itself through the rates it charges, the governments or agencies involved must cope with the deficit. With the governments playing such a predominant role, it is not surprising that these schemes comprise some of the few cases where directing goods through a UDC is mandatory for carriers. The only other mandatory scheme is the single site "demanding" landlord (see next section for more discussion on this issue).

Financial support

Almost every UDC experience described in the literature has enjoyed some degree of support from public institutions; in fact, many of them are not self-sustaining (see synthesis table; also

Browne et al, 2005). This turns economic institutional support in a key element for the successful outcome of many UDC schemes. However such assumption is not always easy to bear for the involved actors; especially for those local governments who expect UDCs to become self-sustaining and therefore are only willing to commit financial support during the first years of operation.

Public involvement in the financing of UDCs has usually been justified by the benefits that such schemes offer to the citizens. The logic dictates that: *"if the UDC creates substantial benefits for the public, it should also be actively supported by the public (BESTUFS 2007, p.158)."* One could argue that UDCs play the role of public transportation for merchandise, a comparison that fits even better in those cases where a new (and sometimes public owned) company is created to distribute from the UDC. Hence, a new option is offered to shippers and carriers to cooperatively make their merchandises "travel in a common wagon", partially alleviating the negative impacts of delivering goods in a traditional scheme where no coordination across carriers, shippers, and receivers is made. If such trade-off is positively assessed, it would justify public subsidies to ensure that the cooperative scheme remains viable. However, researchers concluded that: *"there is no clear, general answer to the question whether the mentioned benefits outweigh the costs. To complicate things, those who benefit are not necessarily those who bear the costs (BESTUFS 2007, p.158)"*, thus any answer would probably be case dependant.

Institutional support for existing UDCs has typically consisted of permanent subsidies (i.e. subsidy per delivery, free depot and consolidation facility, etc.), the financing of the initial stages (research, design, marketing), and keeping an active public implication in the coordination and promotion of the scheme, but it has often also been granted by establishing supportive legal framework conditions for transport companies participating in the scheme such as those discussed in the following section (selective truck bans, extended time windows for delivery, reserved road space for parking and loading, etc.) *(BESTUFS, 2007, p.158).* A most common formula for existing UDCs has been to provide public finance in the initial stage while envisioning to achieve financial sustainability after some years of operation. Hence public backing would be progressively retreated as the system consolidates. Some documented

cases seem to have successfully followed this script, such as Kassel (Germany) and Fukuoka (Tenjin, Japan) platforms. *(BESTUFS, 2007; Nemoto, 1997).* In other cases, such as La Rochelle (France) or Bristo (UK), the public funding for the initial stages has been partially provided by EU funded demonstration projects *(ADEME, 2004a; Becker et al, 2008).*

However, some failed UDC experiences (such as Genoa in Italy and Zurich in Switzerland) share the fact that the institutional support was discontinued after the first years of operation or that the carriers did not dare to fully involve in the scheme due to doubts on the continuing backing of public institutions in the future. In fact, most of the surviving experiences have required financial support from the local governments further than expected, and this has only happened where UDCs represented a strong political bet (La Rochelle) or where healthy public finances made it viable (Monaco) *(ADEME, 2004a; Gerardin, 2007).* In the Monaco case, its atypical governance profile has added much to the initiative success, especially its political sovereignty and its comfortable financial position, the later allowing a large, permanent amount of subsidies that even surpass what the users of the UDC have to pay for deliveries *(Quak, 2008, p.67).*

A.3 REGULATORY CONDITIONS

Obligation

The majority of existing UDCs are of voluntary use for carriers. This means that such platforms must prove advantageous for carriers in order to succeed, but this common assumption has not always turned out to be true. However, a most general reason for UDCs not being compulsory is that various countries' current legal framework cannot ban carriers from making direct deliveries at all. Limited restrictions can be (and usually are) enforced, but not absolute bans. For instance, in La Rochelle, it became ultimately impossible for the authorities to deny access for non-UDC users as long as they complied with vehicle weight restrictions and time-windows for deliveries *(Quak, 2008, p.68).*

There are few cases where delivering to UDCs is absolutely compulsory for carriers. Full obligation existed in the temporary UDCs for building materials at Berlin, Heathrow airport

and Hammarby (Stockholm). For permanent UDCs, such obligation only happens in the Heathrow airport and Malaga (Spain) cases. In the Spanish case, all freight transport is banned to access the city center except the electric vehicles operating from the UDC.

It is more common to find UDCs with partially compulsory obligations, which can be established part time, meaning that free-ride deliveries are allowed within defined time windows. This is a common feature in most UDCs operating in Dutch and Italian cities. Limited obligation also takes the form of bans for vehicles not complying with certain characteristics (usually exceeding a set weight), such as happens in Monaco, La Rochelle and most Dutch cities.

Regulatory context for urban freight

Many cities apply access restrictions to freight operations such as delivery time windows, vehicle weight limits, truck bans, etc. for the inner city or certain areas. Such situation is the outcome of local governments trying to balance the different uses of the public space, with neighbors usually asking for such measures because they experience goods delivery as a nuisance and with carriers and retailers in opposition because of the hindrance it poses on their respective business. In general, the narrower the streets are, the scarcer parking space is, and the more congested the city center is, the more likely such regulations are being enforced.

However, these restrictions can favor Urban Distribution Centers if they can either cope better with these restrictions (e.g. by using appropriate vehicles) or if they are given a special status, i.e. if they are (partly) exempted from the restrictions (the Dutch model). In voluntary schemes, carriers will feel more inclined to route their goods through the UDC if they perceive valuable advantages for so doing. *(Quak, 2008, p.72)* has concluded that consolidation centers seem to be most feasible for historical cities that have restrictive and/or inhibitive conditions for urban freight transportation.

There is a good amount of cases where such privileges have been granted to UDCs *(Browne et al, 2005):*

- In Aachen (Germany), the UDC vehicles are allowed to enter pedestrian zones over a longer time window than other goods vehicles.
- In Amsterdam (Netherlands), vehicles over 7.5 ton or 9 meters long, with load factor under 80% or with emission standards worse than Euro 2 can not access the city center and must deliver to one of the logistics centers located on the periphery
- In Ferrara (Italy), clean vehicles (including those of the UDC) enjoy larger time windows for delivery and an 80% discount of the entry tariff to the Limited Traffic Zones
- In Padua (Italy), vehicles operating from the UDC are allowed 24-hour access to the city, can use bus-only lanes and have reserved loading areas.

Not surprisingly, such advantageous regulations seem to be more common in those cities where the local government is more involved in the operation of the UDC, either by being its owner or by participating through a public private partnership. There is however one contested aspect about regulations stimulating carriers to use UDCs. Granting a special status to one or several market players is delicate as it might quickly interfere with free market competition by creating monopoly or oligopoly. While the potential for such concerns to pose a real obstacle differ according to the cultural and political context in every city and country, some working solution has been usually found. As an example, in France the general public law requires, for environmental or public interest reasons (which UDCs offer easily), or market deficiencies in the private sector, to allow for some regulations to favor one operator over the others *(BESTUFS 2007, p.118)*. However, if the advantages for UDC vehicles are perceived to make excessively difficult the work of those who choose to keep delivering on their own, serious unrest and criticism could arise among the carriers and discourage their necessary involvement in the system. The case of Netherlands is paradigmatic of such risk, where many carriers grew suspicious about the dual role of municipalities in being the regulatory authority imposing vehicle access restrictions while also being fully or partly involved in running UDCs. Together with other criticism about monopoly and competition, this led to a considerable scaling down of expectations for the widespread development of UDCs in that country in the early nineties *(McKinnon, 1998a, p.3)*.

Besides regulations, the degree of enforcement pursued by authorities should also be considered. For instance, Quak *(2008, p.67*) considers that the lack of enforcement of the regulation forbidding heavy vehicles in the city center of La Rochelle is hindering the competitive advantage of deliveries through the UDC. However, this is a factor rarely considered in the literature because of its inherent difficulty to be properly assessed.

A.4 INTEGRATION WITH THE LOGISTIC NETWORKS

Most of the UDC experiences in the literature involve the commission of a new physical facility. However, in some few cases consolidation comes from arrangements between carriers who exchange goods to be delivered using their current facilities, thus creating a virtual UDC scheme; this second type has been more common in the German cities *(Browne et al, 2005)*. Some researchers, such as Quak *(2008, p.66),* prefer to distinguish between consolidation centers and horizontal cooperation (virtual UDCs), requiring for the former the use of a shared facility for transfer and bundling activities. This requirement for the physical *ad hoc* platform could explain why some known practices of horizontal cooperation are often neglected in the studies about UDCs.

UDCs are sometimes also referred to in the literature as city terminals, urban trans-shipment or urban consolidation centers. Although they can be stand-alone platforms of a single forwarder or an element in the logistic chain of huge companies, the most common setup in early UDCs however was the integration into existent logistic urban networks, intended to become central multi-company consolidation centers *(REFORM 1999, cited in BESTUFS 2007, p.100)*. For instance, most of the UDC studies in the early 1970s conducted in U.K. assumed that their particular urban area would have its own dedicated transshipment depot. But with all these studies sharing an urban or inner urban focus, with the boundaries of the area of service often defined by the client of the study, little consideration was given to the wider spatial framework within which transshipment might develop. Not surprisingly, it was commonly assumed that peripheral transshipment depots would serve only the adjacent urban area and provide a basic break-bulk/consolidation service *(McKinnon, 1998b, p.6)*.

The trend in the most recent years has been to give more consideration to the physical integration of UDCs with the regional and national logistic networks, accordingly with the increasing emphasis that the regional transport policies put in intermodality. The most advanced developments in this area are located in Germany, with at least two successful UDC initiatives that also incorporate a freight traffic center: the Nuremberg city logistics initiative (Isolde) and the Regensburg city logistics project (Reglog) *(Quak, 2008, p.68, quoted after Koehler 2004).* More recent intermodal developments can be found in Austria (Graz) and Italy (Padua) *(BESTUFS, 2007: Browne et al, 2005).*

To illustrate the complex role that UDCs play in the supply chain processes, two stories with different outcomes deserve comment in this section. First is a case of unsuccessful intended integration with larger logistic networks. Three intermodal freight centers (IFC) were developed in Berlin, with local authorities pursuing carrier cooperation for urban deliveries by bringing together different companies in one location, without any obligation. The platforms had access by rail and by barge. After some years it turned out that companies settle in the IFC; however, there is no inter-modality and no cooperation. Furthermore, the short distance traffic increased in the neighborhood of the IFCs, with neighbors obviously not pleased at all *(Quak, 2008, p.68).* Second is a case of successful unintended integration with larger networks. The strict conditions for deliveries not directed through the UDC in Monaco caused an increasing saturation of the original consolidation facility in La Fontvielle quarter. The government decided to put into work a temporary warehousing facility in the logistics area of Sant Isidore in the French city of Nice, a 20 minute drive from Monaco. This facility was also expanded soon after beginning operations to 10,000 m^2. It has been estimated that one truck delivering to Sant Isidore generates 0.45 trucks from there to the UDC in La Fontvielle *(Gerardin, 2007, p.22).*

A.5 SERVICES

It is difficult for a single center to be able to handle the wide range of goods moving in and out of an urban area, in part because of different handling and storage requirements *(Browne et al. 2005, p.5).* Therefore most of the existing UDCs have started distributing only parcels, as this

doesn't require any specialized handling. Sometimes other goods are distributed later once the UDC has proved useful, or instead as a way to try to increase its output and to reduce its operating deficit. Some generic limitations to the type of goods that can be consolidated in UDCs are the following:

- Perishable goods are not handled in most UDCs because they require additional installations and dedicated vehicles (and additional upfront costs). Some remarkable exceptions are the Stockholm UDC serving the historic center, which can handle cold foods, and the consolidation platform at Heathrow airport (London), which has chilled and frozen facilities, and to a certain extent, La Petite Reine in France, which delivers dairy products and other perishables using special cargo bikes, called "frigocycles."
- The small vehicles, especially bicycles and/or electric powered, that are used in some UDCs do not allow carrying heavy or bulky goods. For instance, goods exceeding 30 kg cannot be handled in small vehicles without hydraulic elevators for roll cages.
- The trans-shipment of high value products is often prohibited by insurance companies.

Many UDCs have been designed to offer a range of additional services other than consolidated deliveries, such as storage and management of stock, inventory and returns. While in some cases these additional services have been conceived of as a means to improve attractiveness for retailers, sometimes such services have been offered later, as an answer to the need of the UDC operator to generate additional revenues, often necessary to break-even. A good range of supplementary services by UDCs have been described *(Browne et al, 2005),* mainly in the context of retail premises but possibly also for other types of consignees:

- One potential use is stockholding, subject to available capacity and appropriate storage conditions for the products involved. In the main, only short-term storage tends to be envisaged, providing a useful local buffer stock that can be called off quickly when needed, thus reducing delivery lead times and improving product availability and customer service.

- Inventory monitoring and information collection and analysis, linked to in-store systems, can be provided. This can increase the visibility of the supply chain, again leading to better availability and service levels, as well as reducing loss of stock.
- Product quality and quantity checking can be carried out upon consignments' arrival at the centre, giving advance notice to the customer of any problems with supplies.
- Various pre-retailing activities, such as consignment unpacking, preparation of products for display and price labeling, can also be carried out at the consolidation center to reduce time and space requirements upon delivery.
- Some UDCs may be in a position to offer B2B (business-to-business) and B2C (business-to-customer) services within their catchment area, including inter-store transfers, home delivery or customer collection of products purchased in town or by mail order. In La Rochelle, direct deliveries to houses and yachts were introduced a few years after the opening of the UDC *(Gerardin, 2007, p. 13).*
- UDCs can have a role in the handling of return and recycling flows, including product returns and the coordination of waste and packaging collection for reuse or recycling, instead of individual customers having to deal with this. As regulations in this area tighten, such coordinated approaches may offer greater benefits over time.

Retailers can gain much advantage if the UDC performs an enhanced delivery service, with more flexible and reliable delivery times. Hence higher product or component availability may be achieved and, ultimately, sales volume or site productivity may be increased. Fewer deliveries to the destination may be required as a result of the load consolidation undertaken at the centre, thereby reducing the disruption and labor requirements associated with receiving multiple deliveries, leading to improvements in staff planning and productivity at delivery locations. Carriers can find their own benefit (apart from avoiding the final miles of their delivery trips) if well-equipped UDCs admit deliveries at more flexible times (potentially 24 hours per day, seven days per week), and with staff available to receive the consignment, and without the problems of delivery restrictions or congested loading bays that are found in many urban locations *(Browne et al, 2005, p.8).*

A.6. SPATIAL COVERAGE, LOCATION AND TRANSPORTATION

Spatial coverage

The extension of the area served by a UDC can vary from a single commercial street or shopping mall (such as in Bristol and Kent in the UK) to a whole city and adjacent municipalities (as intended in most Dutch and German cities). In the midrange, a most typical configuration is to serve only the dense historic centers or CBDs in the central city, where the combination of high commercial activity and limited street space make deliveries a troublesome and expensive practice. This scheme can be found virtually everywhere and particularly in those countries where strong national policies for city logistics are not known to exist, such as Italy (Genoa, Siena, Vicenza), Japan (Tokio, Tenjin), Portugal (Evora), Spain (Malaga) or Sweden (Stockholm).

There is one paradox about the spatial coverage of UDCs that deserves discussion when it applies to large serving areas. On the one hand, it has been noted that enabling a single consolidation center for the distribution in a large urban area is unlikely to be attractive for many suppliers' flows due to the degree of diversion required from normal route, and may therefore negate transport savings for onward distribution *(Browne et al. 2005, p.5)*. However, it is also known that in the well-studied case of Leiden (117,000 inhabitants, Netherlands), the number of customers served through the UDC was insufficient to reach the break-even volume, even after the surrounding cities were added to the working area of the UDC *(Quak, 2008, p.68)*. The project opened in 1997 and stopped in 2000 because of its inability to reach the 2,000 delivered units per day estimated for break-even *(BESTUFS, 2007, p.158)*. In such case, it is obvious that putting into service a second platform for consolidation would have made reaching the break-even point even more difficult to achieve. .

Location

In those schemes designed to serve a whole city, the UDC is always located in the city outskirts and close to major communication lanes. Not only it is more logical, it is also cheaper. Some examples are Monaco, with the UDC located in the city border under a

shopping mall close to the main roads *(Gerardin, 2007, p.21),* and Leiden (Netherlands), where it is located in the outer area of the city close to A4 motorway *(BESTUFS, 2007, p.128).*

However, there is not such a common rule for those schemes designed to serve only central areas well inside the city, and these UDCs can be found as well in inner as outer locations. A typical example of the first case is La Rochelle, with the UDC located in the border of the historic center, by the train station, although it was never envisioned to receive freight by train *(Gerardin, 2007, p.13).* An opposite example is Bristol, *(Browne et al, 2005, p. 166),* where the UDC is located close to a strategic road network (M4 and M32) and requires a 25 minute drive to deliver to retailers in the commercial district of Broadmead.

The location of the consolidation platform has a substantial influence on the traffic it generates both upstream and downstream, and thus on its environmental performance. Choosing a smart location consequently involves certain know-how about the main goods flows delivered and collected to and from the platform. This can be properly figured out in prospective studies, but unfortunately there are all kind of other determining factors that have been usually neglected at the design stage and have later forced many UDCs to be located in suboptimal locations which, in turn, can affect the usefulness and viability of these schemes *(Browne et al., 2005; BESTUFS, 2007).*

Land prices and concentrated local emissions through traffic attracted by the platform make it difficult to find a suitable location. In order to reduce the roadside distribution transport mileage, the platform would preferably be located close to the city and its commercial centers (short distribution legs, longer rail leg if there is intermodal transport). On the other hand a central location usually involves high land prices and conflicts with the neighboring residential areas that are sensitive to the traffic attracted by the platform. Due to the high land costs, establishing a freight platform in the city center will generally only be possible when public areas are provided or subsidies are obtained. Because of the traffic involved, a location in the outskirts is often preferred or even legally stipulated anyway (e.g. in the UK, as stated in the Planning Policy Guidance Notes). In any case areas suitable for a future freight platform

should be identified early enough and secured by land use planning measures *(BESTUFS, 2007 p.154).*

Transportation vehicles

One increasingly shared characteristic of the UDCs developed from the late nineties onwards is that they have also been conceived of as a good mean, or even the spearhead, for the introduction of cleaner vehicles in the city. Several factors could be outlined to explain this trend:

- Some UDCs have enjoyed substantial funding from EU or national policies in which experimentation and testing of new technologies is encouraged, if not a requisite.
- UDCs are usually embedded in broader sustainability policies, which most local governments would like to make as visible as possible for their citizens, and clean vehicles are quite good for this role.
- The usual involvement of local governments in the UDCs allows for higher upfront costs, which cleaner vehicles most likely contribute to increase.

The choices for clean vehicles have usually included those powered with biofuel, compressed gas and electricity, as well as cargocycles. Some problems with the homologation of the heaviest vehicles with alternative fuels have been documented to delay the full implementation of services offered through the UDC *(Browne et al., 2005; Gerardin, 2007).* The electric vehicles, although usually perceived as the cleanest ones among the available new vehicle technologies, have also been the cause of additional difficulties in some cases. In Leiden (Netherlands), the electric vehicles used to distribute from the UDC had a maximum speed of 25 km/h, which ultimately turned out to be a major disadvantage because it hindered other traffic and it resulted in social opposition against the UDC *(Quak, 2008, p.68).* In La Rochelle (France), the choice to use electric vehicles was politically dictated in the first stages of design of the UDC, and such decision has been shown to pose additional difficulties for the viability of the scheme *(Gerardin, 2007).*

Clean vehicles aside, the most repeated formula for UDCs in the typical medium sized European city is to have a fleet of about 5 small vehicles and a larger one for the heaviest deliveries. Gerardin *(2007)* has recorded the following fleets for some French UDCs:

- In La Rochelle, 6 electric vehicles with capacity for 1,300 pounds and one 3.5t electric truck. The homologation process for the truck took 14 months.
- In Monaco, 6 small vans (including one electric) and a 7,5t truck.
- In Paris (La Petite Reine), the fleet consists of 25 electric aided cargocycles. It should be noted that this is a particular case where the UDC only distributes parcels in a central neighborhood of the city.

A.7. BARRIERS TO IMPLEMENTATION OR SUCCESS

Taking into account that UDCs imply a significant change in delivery practices already in place, this section introduces some elements posing (mainly cultural or attitudinal) *barriers to change* in a general way, as documented in the literature.

First, it should be noted that much urban freight is already consolidated at the intra-company level or by parcel carriers, so limited benefits (or even negative consequences) for trying to channel these flows through a consolidation center could limit its potential *(BESTUFS, 2007, p.106; Browne et al, 2005, p.5).* This pre-consolidation factor could show considerable variation among different types of goods and different geographical areas, but in those contexts where it happens carriers will most likely show little interest (if not resistance) to the implementations of a UDC.

Carriers' counter arguments of additional costs, extra product handling and poorer service standards are also featured in the literature, particularly with reference to the public sector schemes that are concerned with environmental and social improvements rather than better supply chain performance. However such claims do not often receive much attention because of the reluctance of carriers to disclose operational data to back them. In some of the more recent literature, particularly relating to the more "commercial" schemes in the United Kingdom and elsewhere, more attention has been paid to the potential total supply chain

benefits, as a result of greater effort being devoted to integrating the centers into the supply chain. Even then, the impacts are generally only identified towards the end of the supply chain, with little attention devoted to what takes place further upstream *(Browne et al. 2005, p.9)*.

The lack of willingness to co-operate is notable in those environments with fierce competition, where carriers are afraid of disclosing competitive information about order quantities, products, customers, know-how, etc, and particularly of losing customers to their competitors. In such situation, the desire for companies is to maintain competitive advantage rather than share expertise and systems (BESTUFS 2007, p.106).

Even in not so stressed contexts, many forwarding/shipping companies give a higher priority to customer service and competitive advantage than to reduced transport costs; they do not want to lose the direct contact with the receiver because the act of delivering offers an opportunity for the transport company to promote its goods and/or services and to establish a customer relationship - it is the company's "business card". Carriers are also reluctant to relinquish control over the merchandise and the transport chain if the responsibility issues for the transported goods are not satisfactorily addressed *(BESTUFS 2007, p.106)*.

Appendix B: SELECTION OF CASE STUDIES OF UDCS

B.1. OVERVIEW OF EXISTING EXPERIENCES WORLDWIDE

By analyzing the literature on the topic, this study has identified 39 experiences of Urban Distribution Centers (UDCs) that have been developed and/or reached operational status, either in European countries or in Japan. The Table on pages 2-4 provides an overall synopsis of these experiences. Note that not all of the information fields are available for every case. The amount and richness of the available information vary considerably by case.

The following are key characteristics of UDCs that are described in the fields of the Synthesis Table (in corresponding order):

- Start date: Date when actual operations began.
- Still Operating: Whether the UDC is still operating or not, according to the latest available sources.
- Leader: The kind of institution that led the implementation.
- Operator: The relation between the operating company and the whole scheme.
- Self-sustaining: Whether the UDC has achieved economic self-sustainability according to the latest available sources.
- Obligation: Whether direct deliveries to consignees are completely banned inside the area served by the UDC and thus there is an obligation to deliver to the UDC.
- Favorable Regulations: The existence of regulations for urban freight delivery that give some competitive advantage to vehicles operating from the UDC.
- Integrated in Freight Village: The physical integration of the UDC in a freight village and/or larger logistic networks.
- Goods: The nature of the goods accepted for consolidation in the UDC facilities. Served Area: The extension of the area served by the UDC.
- Location: The physical location of the UDC.

- Clean Vehicles: Whether the vehicles distributing by the UDC use non-conventional (clean) fuels.
- VMT Metrics: The existence of data regarding the effects of the UDC scheme on VMT.

SYNTHESIS TABLE OF UDC EXPERIENCES

	Start date	Still operation	Leader	Operator	Self-sustaining	Obligation	Favorable regulations	Integrated in freight village	Goods	Area Served	Location	Clean vehicles	VMT metrics
FRANCE													
1. La Rochelle	2001	Y	Gov	Bid win	N	N	Y	N	P, F	City center	Inner	Y	Y
2. Paris	2003	Y	?	Neutral	N	N	N	N	P, F	Ctr.	Inner	Y	Y
GERMANY													
3. Aachen	1997	Y	Priv	Neutral	Y	N	Y	N	P, F	City+	?	N	N
4. Berlin-Potsdamer	1992	N, temp	Gov	Bid win	N	Y	N	N	B	Site	On-site	N	Y
5. Bremen	1994	Y	?	?	?	N	N	Y	P, F	Ctr.	Outer	Y	Y
6. Cologne	1994	N	?	Neutral	N	N	?	?	P, F	?	?	?	N
7. Essen	1997	Y	Gov	Part	?	N	?	?	P, F	City	?	?	N
8. Frankfurt	1995	Y	Priv	Neutral	N	N	?	?	P, F	City	?	?	N
9. Freiburg	1993	N	Priv	Part	Y	N	N	N	P, F, C	City	Multiple	N	Y
10. Kassel	1994	Y	Priv	Neutral	Y	N	N	N	P, F	Ctr.	?	?	Y
11. Nuremburg	1996	Y	Priv	Neutral	Y	N	N	Y	P, F	City	Outer	Y	N
12.Regensburg	1998	Y	Priv	Neutral	Y	N	?	Y	P, F	City	Outer	?	Y
13. Stuttgart	1994	N	?	Neutral	?	N	?	?	P, F	?	?	?	N
14. Ulm	1995	N	?	Neutral	?	N	?	?	P, F	?	?	?	N
15. Ferrara	2002	Y	Priv	Owner	Y	N	Y	?	P, F, C	City+	?	Y	N
16. Genoa	2003	N	Gov	Neutral	N	N	?	?	P, F	Ctr.	?	Y	?

	Start date	Still operation	Leader	Operator	Self-sustaining	Obligation	Favorable regulations	In freight village	Goods	Area Served	Location	Clean vehicles	VMT metrics
18. Siena	1999	Y	Gov	Part	N	N	Y	N	P, F	Ctr.	Multiple	Y	Y
19. Vicenza	2002	Y	Gov	Neutral	?	N	Y	?	P, F	City+	Outer	Y	N
JAPAN													
20.Tokyo-Marun.	2002	N, temp	?	?	?	N	Y	N	P, F	Ctr.	?	Y	Y
21.Fukuoka-Tenjin	1978	Y	Priv	Neutral	Y	N	?	?	P, F	Ctr.	Outer	N	Y
MONACO													
22. Monaco	1989	Y	Gov	Owner	N	N	Y	Y	P, F	City	Multiple	N	Y
NETHERLANDS													
23. Amsterdam	1996	Y	Gov	Licensed	Y	N	Y	N	P, F	City	Multiple	N	N
24. Groningen	1995	Y	Gov	Licensed	Y	N	Y	N	P, F	Ctr.	Outer	?	N
25. Leiden	1994	N	Gov	Licensed	N	N	Y	N	P, F	Ctr.	Outer	Y	N
26. Maastricht	1991	N	Gov	Licensed	Y	N	Y	N	P, F	Ctr.	Outer	?	N
27. Utrecht	1994	Y	Gov	Licensed	Y	N	Y	N	P, F, C	Ctr.	Multiple	N	N
PORTUGAL													
28. Evora	2000	Y	Priv	?	N	N	Y	N	P, F	Ctr.	Outer	Y	Y
SPAIN													
29. Malaga	2002	Y	Gov	Bid win	N	Y	N	N	P, F	Ctr.	Inner	Y	N
SWEDEN													
30.Gothenburg	1996	N	Gov	?	N	N	N	N	F	Ctr.	?	?	N
31.Stockholm-Cent.	2000	Y	Gov	Bid win	N	N	?	?	F, C	Center	?	Y	Y
SWITZERLAND													
32. Basel	1993	N	Gov	Part	N	N	?	?	P, F	Ctr.	Multiple	Y	Y

33. Zurich	1994	N	Gov	Neutral	N	N	N	N	P, F	City	Outer	N	N
UNITED KINGDOM													
34. Bluewater-Kent	2002	Y	Priv	Owner	Y	N	N	N	P, F	Site	Outer	N	N
35.Bristol-Broadmead	2004	Y	Gov	Neutral	N	N	N	N	P, F	Site	Outer	N	Y
36. Heathrow-const.	2001	N, temp	Priv	Owner	?	Y	N	N	B	Site	On-site	N	N
37. Heathrow-retail	2000	Y	Priv	Owner	Y	Y	N	N	P, F, C	Site	Outer	N	Y
38.Meadowh.-Yorks	2001	Y	Priv	Owner	Y	N	N	N	P, F	Site	On-site	N	N
39. Norwich	2007	Y	Gov	Bid win	N	N	Y	N	P, F	City	Outer	N	N

ABBREVIATIONS

In all fields: *Y* yes, *N* no.
In Still operating*: temp* means the UDC was envisioned for temporary use.
In Leader: *Gov* government, *Priv* private.
In Operator: *Owner* owner or directly appointed by owner, *Bid win* firm winning public bid, *Neutral* neutral carrier constituted or appointed by cooperating carriers, *Licensed* all carriers who comply with the requisites demanded by local governments, *Part* one or more carriers who are part of an inter-carrier agreement or PPP.
In Goods: *P* parcels, *F* foods and drinks, *C* chilled or frozen, *B* building materials.
In Served area: *City+* means the central city and adjacent municipalities, *Site* means site specific (shopping mall, building depot, etc.)

B.2. SUITABLE CASES FOR IN-DEPTH ANALYSIS

This study requires an in-depth analysis of at least three cases. To facilitate the selection process, the Study Team has developed the following criteria:

- The experience must be intended to operate permanently.
- The experience should be "successful"; this meaning that it should be still in operational status and financially sound.
- The available sources of information must provide sufficient data to measure the outcome of the experience in terms of VMT and other traffic and environment related parameters.

From the 39 cases, 13 UDCs have been found to comply with the previous criteria. A one-page summary has been developed for each of the 13 UDCs with a general description of their operational, economic, and geographical settings, as well as the availability of information and contacts. Maps and pictures of the cities are also provided whenever possible in order to improve the understanding of their geographical settings.

The following summaries also include a classification of the UDCs according to their institutional and operational characteristics, which has been elaborated after the findings of the literature review. Thus, every UDC is classified in one of the following (mutually exclusive) nine classes[1].

Single Private Ownership and Operation:

1. Single-site "suggesting" landlord
2. Single-site "demanding" landloard
3. Dutch system of license

[1] This classification has been developed in the Literature Review paper, pp. 7-8. It has also been attached at the end of this document.

Private Joint Ventures:

4. Final deliveries by newly constituted company
5. Final deliveries by pre-existing neutral operator
6. Final deliveries by some of the participating companies

Public-Private Partnerships:

7. UDC operation by newly created company
8. Agreement with company already operating in the area

Publicly Owned UDC

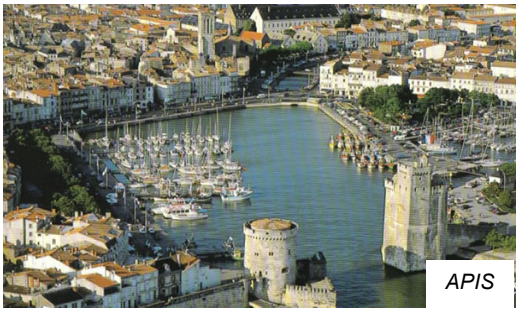
9. Operated by a private company winning a bid

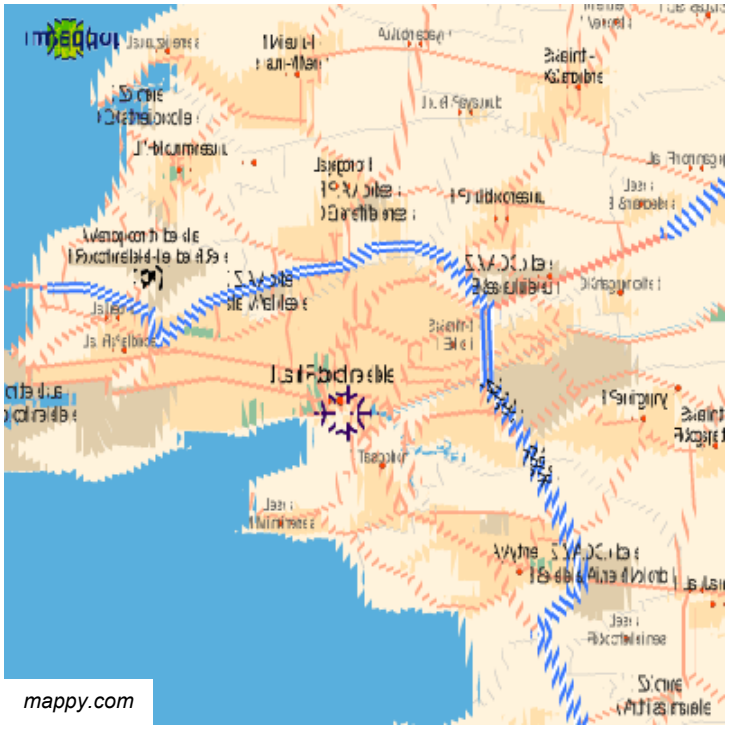
1. LA ROCHELLE - FRANCE

Start date	2001
Class	9: Publicly owned UDC.
Geography	Population: 80,000 inhabitants. The city has a historic center with narrow streets. It is an important tourist destination.
Comparing to NY	No remarkable similarities. Small city with compact central district.
Operational settings	Location: The UDC is located inside the city. Initiator: Initiative promoted by the local government. Operation: A private company operates the UDC after winning a competitive bid. Seven electric vehicles are used for deliveries but have not performed well.
Regulatory context	City center banned to vehicles over 3.5 tons except between 06:00am and 07:30am.
Economic incentives	From the outset the project has benefitted from public funding by the local government, which provides a fixed subsidy per package delivered (started at 2.08 Euro and later diminishing to 0.7 Euro), free facilities (partially equipped) and vehicles (including maintenance). Some specific funding from EU demonstration projects has also been available (ELCIDIS).
Metrics available	Energy (-48%), pollutant emissions in situ decreased because of electric vehicles. Congestion and VMT balance is unclear. There are also economic estimations of savings due to noise and accidents avoided.
*References**	Available information is very rich. The project is reported in BESTUFS workshops (1), City Logistics conferences (2), CITYPORTS report (3), CERTU reports (4). There is also available a rich report comparing the performance of La Rochelle and Monaco by the French government (5) (6).
Contacts	ADEME (Energy and Environment Agency), Poitou-Charentes delegation. Anne Chane - City Council of La Rochelle. Mathieu Aubienau – City Council of La Rochelle.

** Numbers in parentheses indicate reference numbers on page 78.*


larochellefrance.com

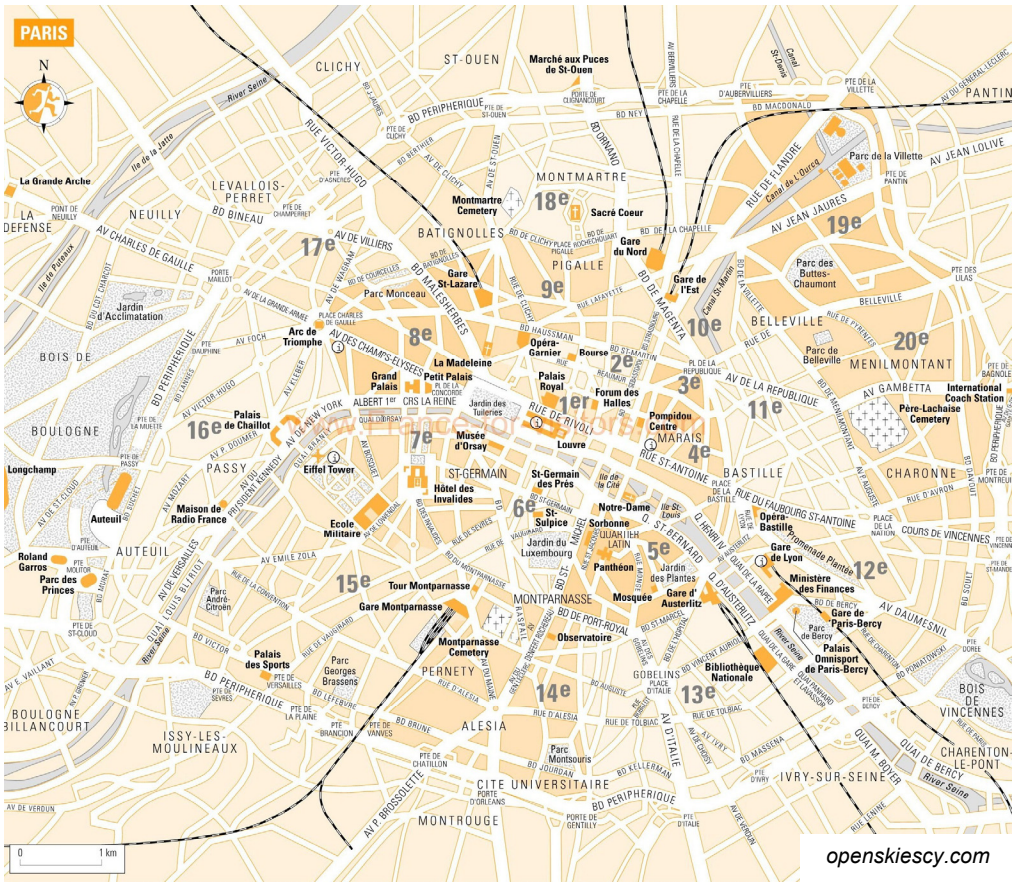

APIS


mappy.com

2. PARIS (LA PETITE REINE) - FRANCE

Start date	2003
Class	1: Single private ownership, "suggesting" landlord.
Geography	Population: 2,200,000 in the central city, 11,800,000 in the metropolitan region.
Comparing to NY	Large city, center of its economic region. The served area is dense in economic activity and tourism, with mid-size streets and large avenues.
Operational settings	Location: UDC located in the city center (by the Louvre museum), giving service to four central neighborhoods. Initiator: Private company (La Petite Reine). The experience is considered quite successful and has been transferred to other French cities (e.g., Bordeaux, Lyon, Dijon). Franchising is offered. Operation: Operated by the private company itself. Goods are delivered with electrical aided tricycles with a maximum payload of 220 lb and maximum speed of 12 mph. Targeted goods are food, flowers, parcels, and equipment and parts. Parcels represent 97% of deliveries. Business-to-consumer B2C services are also offered.
Regulatory context	There are no favorable regulations for vehicles operating from the UDC.
Economic incentives	50% of the feasibility study and 15% of the investment in vehicles has been funded by the French agency for energy and environment. The City Council provides the depot area in an underground parking at discount price. The scheme keeps operating with profits every year.
Metrics available	For the first 24 months: savings included 156,000 km (of diesel vans), 43 tons oil equivalent, 112 tons CO_2.
*References**	The main source is the CERTU report (4), City Logistics conferences (2). Other sources are cited, but they are not always available.
Contacts	http://www.lapetitereine.com/uk/contact.php

** Numbers in parentheses indicate reference numbers on page 78.*



3. BREMEN - GERMANY

Start date	1994
Class	Unclear, but most likely a Private Joint Venture (class 4, 5 or 6).
Geography	Part of the Bremen-Oldenburg metropolitan area with 2.4 million people.
Comparing to NY	Mid-size city, center of its economic region. Access to the central neighborhood is constrained by its island-like geography as in Manhattan.
Operational settings	Location: UDC located in multi-modal freight village (GVZ) outside the city. The institutional and operational arrangements of the UDC are unclear. Among its 20 clients there are some shipping companies established in the GVZ.
Regulatory context	There are not favorable regulations for vehicles delivering from the UDC.
Economic incentives	The UDC benefited from EU CIVITAS-VIVALDI (demonstration project) funding. CIVITAS was aimed to introduce gas-powered trucks for city logistics. It is not clear if it keeps operating nowadays without external funding.
Metrics available	1997 data: number of trips (-12.7%), load factor (+28%). 2005 data: VMT (-9,000 km per month), fuel (-1,100 liters of diesel per month).
*References**	The project is reported in CIVITAS-VIVALDI report (7), City Logistics presentations (8). Also in other secondary sources not readily available.
Contacts	Michael Glotz-Richter (CIVITAS site manager in Bremen)

** Numbers in parentheses indicate reference numbers on page 78.*

colon.de

openstreetmap.org

lodging-germany.net

4. KASSEL – GERMANY

Start date	1994
Class	5: Private joint venture, delivery by neutral carrier.
Geography	Located in the center of Germany, it has a population of 200,000. The city center does not have the typical space constraints of historical centers.
Comparing to NY	Kassel could compare to boroughs other than Manhattan, due to its low density, mid-size streets and spaced neighborhoods.
Operational settings	Location: Not available in the literature reviewed. Initiator: Several forwarding companies deciding to cooperate Operation: Consolidation and delivery through a single neutral carrier to the city center. The neutral carrier collects goods nightly and delivers twice daily. There were plans to create a link with the urban freight village but this was not further developed.
Regulatory context	There are not favorable regulations for vehicles operating from the UDC.
Economic incentives	The UDC operated without subsidies. The involved carriers paid the neutral carrier against an agreed price. It is not clear if the UDC was terminated in 2005 due to financial reasons.
Metrics available	Load factor (increased from 40% to 80% by volume, from 25% to 60% by weight), VMT (-40% miles to the city, -60% miles within the CBD), other logistics metrics (see CITYPORTS report).
*References**	The experience is described in BESTUFS report (9), CITYPORTS report (3), McKinnon report (10), several City Logistics conferences (11) (12) (13), and one academic paper by Taniguchi & van der Heijden (14).
Contacts	Marcel Huschebeck (BESTUFS network). Uwe Kohler (University of Kassel).

** Numbers in parentheses indicate reference numbers on page 78.*

bombardier.com

skyscrappercity.com

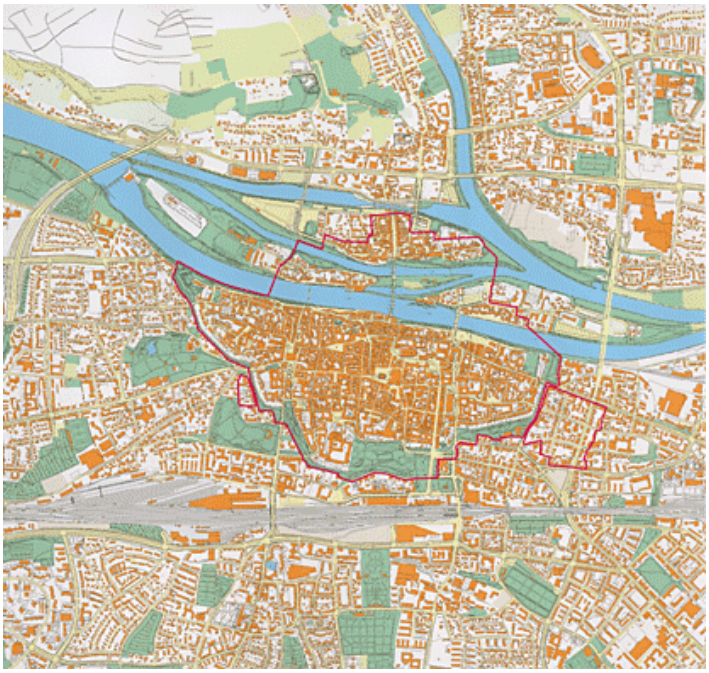
Travelpod.co

5. REGENSBURG – GERMANY

Start date	1998
Class	5: Private joint venture, delivery by neutral carrier.
Geography	The city has a population of 130,000 and is located in Bavaria, by the Danube river. It has a large medieval center which is a UNESCO World Heritage Site.
Comparing to NY	Little similarity. The city is small and its center features very narrow streets in an irregular (medieval) pattern.
Operational settings	Location: Outside the city, integrated in a Freight Village. Initiator: Known as "Reglog", the UDC started as a research project by BMW (who has factories in the city), but control of the scheme was passed to the Regensburg GVZ in 2000. The six involved companies participate on a voluntary basis. Operation: Deliveries are made by a neutral carrier to the city center and also locations around. Additional logistics services are provided: storage, collection of goods from addresses delivered to, disposal of packaging materials.
Regulatory context	There are time windows for deliveries in the city center, but it is not clear if UDC vehicles are granted extended time windows.
Economic incentives	No available information.
Metrics available	VMT (20,000 vehicle kilometers saved between 1998 and 2005).
*References**	Available information is scarce. Sources only in German.
Contacts	www.reglog.de

** Numbers in parentheses indicate reference numbers on page 78.*

leidorf.blogspot.com



regensburg.de

6. PADUA – ITALY

Start date	2004
Class	8: Public-private partnership, agreement with existing company.
Geography	The city has a population of 212,000. The metropolitan region of Padua-Venice has 1,600,000 people (Venice is 26 miles away).
Comparing to NY	Little similarity. Padua is a secondary node in the industrial corridor of Northern Italy. It has remarkable tourist activity in the center, which features the typical narrow streets of historical neighborhoods.
Operational settings	Location: Known as "Cityporto Padova", the UDC is based in the Interporto (freight village) out of the city. Initiator: It has been put into work as a public-private partnership. Operation: It is operated by one company (Interporto di Padova SpA) which is part of the PPP. 15 transport companies are delivering to the UDC.
Regulatory context	UDC vehicles are granted 24-hour access to Limited Traffic Zones in the city center, use of bus lanes and use of reserved loading areas.
Economic incentives	Public grants on total inflows have decreased from 85% in 2004 to 22% in 2007. The goal is to achieve economic self-sustainability.
Metrics available	VMT (-127,000 vehicle kilometers in 15 months, trip mileage reduced by 26%), pollutant emissions (38.4 tones CO_2 saved in 15 months). For a 5 year period, the estimated economic value of environmental benefits has been estimated to double the amount of subsidies for the project.
*References**	The project is described in the CITYPORTS report (3), BESTUFS workshops (15) (16).
Contacts	www.cityporto.it Carlo Vaghi (Universita Comerciale Luigi Bocconi)

** Numbers in parentheses indicate reference numbers on page 78.*

plone.org

Cityporto Padova

7. SIENA – ITALY

Start date	1999
Class	7: Public-private partnership, newly created company.
Geography	60,000 residential population, historic city center with narrow and steep streets, it is a relevant tourist destination.
Comparing to NY	No remarkable similarities. Small city with very tight central neighborhood.
Operational settings	Location: Two consolidation depots located just outside the city walls, one for food and one for other goods. Initiator: The project involves a public-private partnership, but the specific arrangements for the UDC are not clear, because the UDC is embedded in larger policies regarding vehicle access to the city center. Operation: The UDC company operates twelve 3.5 ton gas powered vehicles and six 3.5 ton electric vehicles.
Regulatory context	There is a pedestrian area and a Limited Traffic Zone in the historic city center. There are time windows for deliveries in the morning and afternoon. Electric vehicles are exempt from these restrictions.
Economic incentives	The UDC was established with financial aid of a demonstration project (ALIFE) – nearly 2 million Euro. Annual operating costs since the third year onwards are stabilized at 145,000 Euro aprox. The UDC has also received funding from eDRUL project from 2002 to 2005, specifically aiming to enhancing IT services.
Metrics available	Delivery trips to the city center (-37%).
*References**	Information is scarce, especially regarding to metrics. The project is described in the CITYPORTS report (3), City Logistics conferences (17) (18).
Contacts	-

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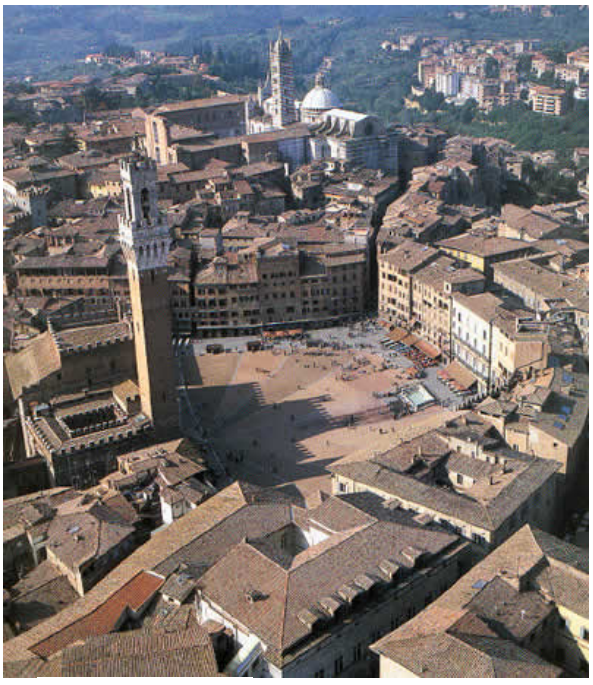

carfreeinbigd.com

siena-apartments.it

8. FUKUOKA (TENJIN) – JAPAN

Start date	1978
Class	4: Private joint venture; delivery by newly created company.
Geography	The city is located in the southernmost island of Japan and its population is 1.4 million.
Comparing to NY	Large city with industrial activity. The central area served by the UDC is dense and has relevant economic activity. Users compete for street space .
Operational settings	Location: The depot is located in the city outskirts, close to the roads connecting to mainland Japan (route to Osaka, Tokyo). Initiator: Bottom-up initiative involving 29 trucking companies. Operation: A new company was created for the final deliveries to the CBD (Tenjin district); involved forwarders contribute USD 1.6 per parcel to the scheme. Both inbound and outbound collections are made.
Regulatory context	There are not favorable regulations for vehicles operating from the UDC.
Economic incentives	The scheme is self-sustaining. It has never been granted public subsidies.
Metrics available	Operating trucks (-61%), VMT (-28%), parking operations (-72%), parking time (-17%), energy, pollutant emissions. The traffic involved represents only 5.6% of the freight traffic in the CBD.
*References**	There is a good amount of quality information. The best metrics information is provided in Nemoto's paper (19). The project is also described in BESTUFS report (9), City Logistics conferences (20).
Contacts	Eiichi Taniguchi (Kyoto University) (BESTUFS network) Sadayuki Yagi (Japan Research Institute)

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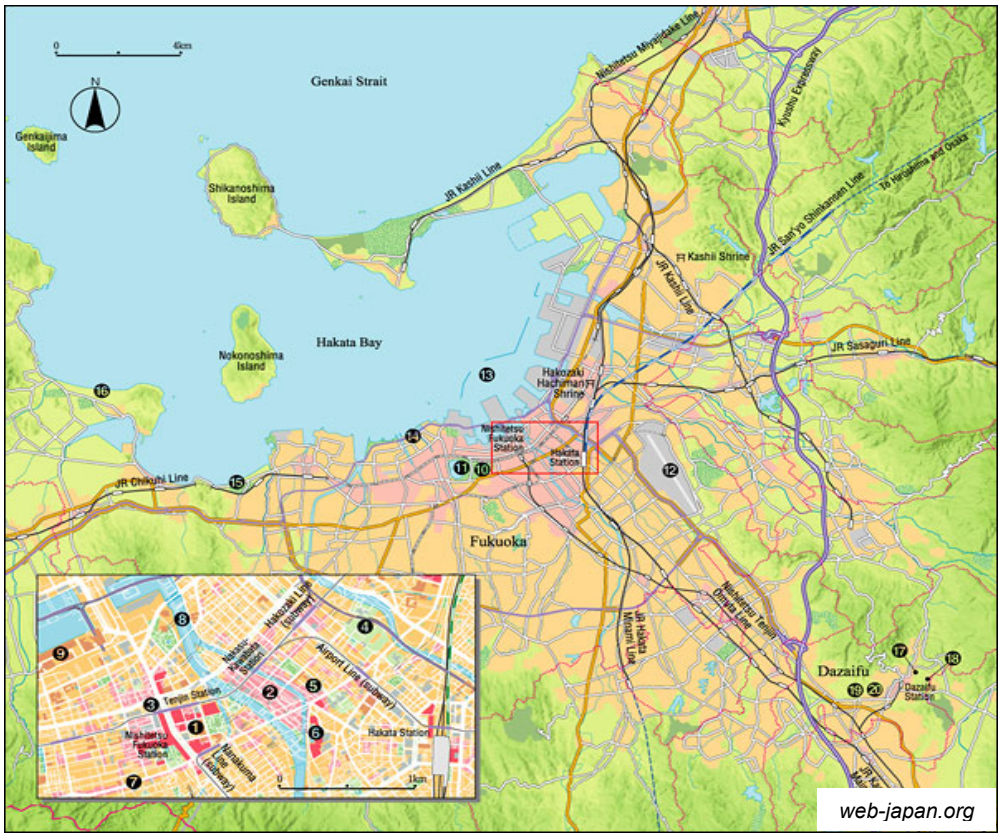

9. MONACO

Start date	1989
Class	9: Publicly owned UDC.
Geography	33,000 residential population in 2 km^2. Relevant tourism and commerce. Road access to the city is difficult, constrained by steep geography.
Comparing to NY	Although a small city, it is very dense and has relevant economic activity. Free urban space is almost non-existent and expensive. Access to the city is difficult and limited to few and often congested roads.
Operational settings	Location: At the beginning, the UDC consisted of one 1,300 m^2 depot in the Fontvieille quarter; but later another depot needed to be added in a logistics area in Nice (France), a 20 minutes drive to Monaco. Initiator: The UDC is owned by the city government. Operation: The UDC is operated by a private company (Monaco Logistique). Deliveries are made using 6.5 ton vehicles; however consignees can also choose to collect by themselves at the UDC.
Regulatory context	Vehicles over 8.5 tons are banned from delivering in the city and must transfer their loads to the UDCs. There are time windows for deliveries using vehicles under 8.5 ton.
Economic incentives	Both consolidating facilities have been provided by the government of Monaco.
Metrics available	According to a report by the French government, the Monaco UDC outperforms that in La Rochelle. A major share of the benefits is achieved in the consolidated trips between the depots in Nice and Fontvieille. For this trip, -53% VMT, -25% energy consumption. Inside Monaco, -21% VMT, -36% energy consumption. Pollutant emissions have been reduced by the same proportion as energy.
*References**	The information is good. There is a rich report comparing the performance of La Rochelle and Monaco by the French government (5) (6). The case has also been described in CERTU report (4), CITYPORTS report (3), City Logistics conferences (2) and one academic paper (14).
Contacts	-

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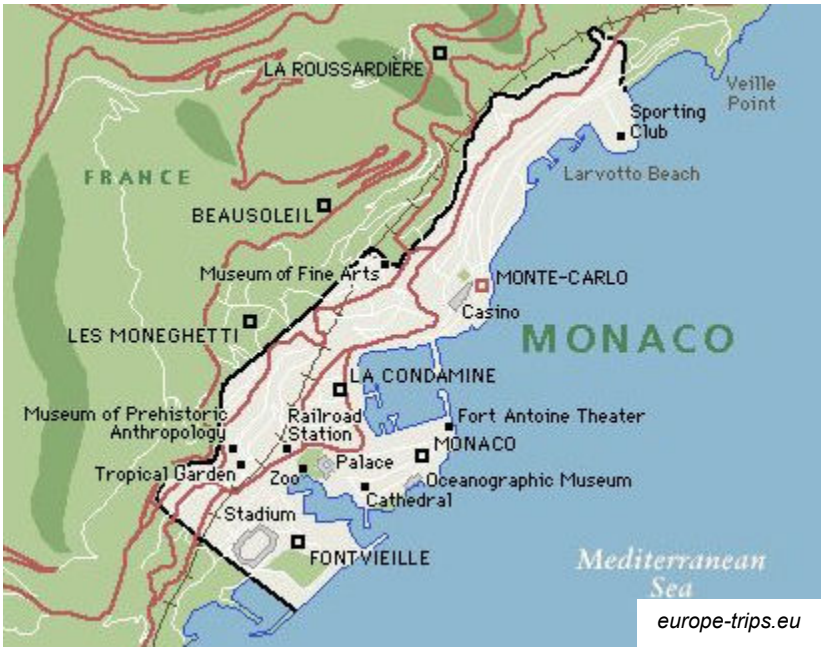

10. EVORA – PORTUGAL

Start date	2000
Class	Private joint venture (class 4, 5 or 6).
Geography	Population: 41,000. Well-preserved old town center enclosed by medieval walls. There is special concern on the impact of goods distribution on the urban environment and the historical buildings.
Comparing to NY	No remarkable similarities. Small city with very tight central neighborhood.
Operational settings	Location: City outskirts. Initiator: An association of private companies (9 shipping companies supported by a national association of freight carriers). Operation: The UDC is operated by a legal autonomous entity involving the participants.
Regulatory context	The UDC has been developed in response to a new regulation banning vehicles over 3.5 ton from the city center. For the 9 involved companies, this regulation would have implied to increase from 14 to 25 vehicles to keep delivering to the city, while with the UDC only 10 are necessary.
Economic incentives	Delivery cost is expected to be kept around 30 Euro per ton of goods delivered.
Metrics available	Expected benefits: 35% reduction in trips and CO_2 emissions. These benefits are estimated and not confirmed yet by real operational data.
*References**	Information is scarce. There is a "best practice" report by the International Road Transport Union (21). However, although the project is already implemented, the information found relates to the "project" stage.
Contacts	ANTRAM – national association of freight carriers

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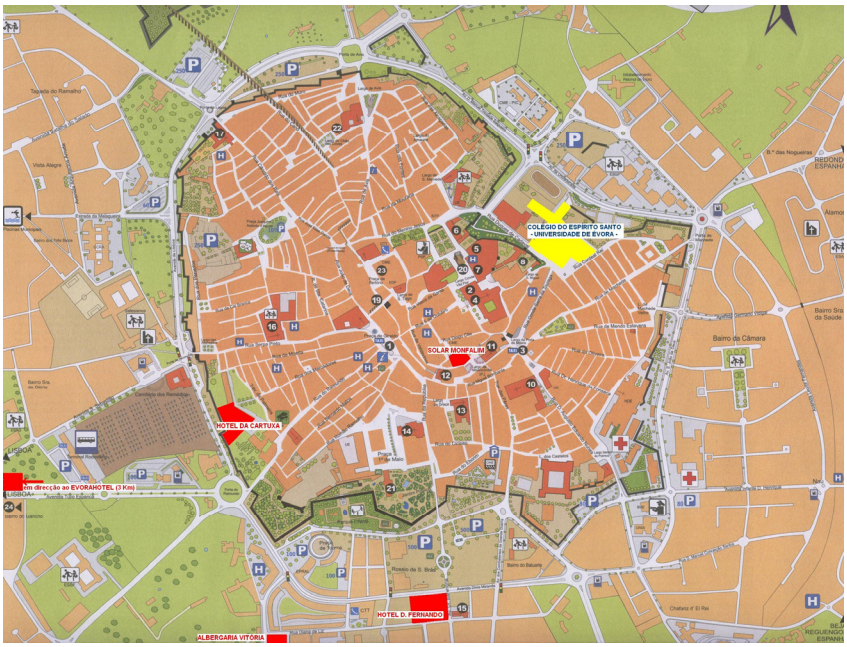
Stockphotopro.com



aprh.pt

11. STOCKHOLM (center) – SWEDEN

Start date	2000
Class	8: Public-private partnership, agreement with existing company.
Geography	Population: 830,000 in the central municipality, 2 million people in the metropolitan area. Located on a 14 island archipelago, the city has a half-completed motorway ring road and a congestion pricing scheme since August 2007.
Comparing to NY	Large city, center of its economic region. Access to the central neighborhoods is constrained by its island-like geography.
Operational settings	Location: Not available in the literature reviewed. Initiator: The UDC was started by the local Agenda 21 group, the Environment and Health Administration, and a small carrier company (Home2you) Operation: Home2you operates the UDC. Goods are delivered to restaurants (80%) and stores (20%). The UDC has cold storage facilities. By 2005 the UDC was delivering to 35 out of 100 restaurants in the old town. Deliveries are made with a biogas powered truck.
Regulatory context	Deliveries in the old town are only allowed from 6am to 11am. A one-year extension until 4pm was granted for the vehicles operating from the UDC.
Economic incentives	The experience has benefited from funding of the CIVITAS-TRENDSETTING project.
Metrics available	Estimated 17% reduction in energy consumption and pollutant emissions. VMT is expected to decrease by 65%. However the basis for these calculations is unknown.
*References**	The project is described in the CIVITAS-TRENDSETTER reports (22), which only account for the first years of operation.
Contacts	Nina Ekelund – Environment & Health Administration – Trendsetter contact.

** Numbers in parentheses indicate reference numbers on page 78.*

knowledgerush.com

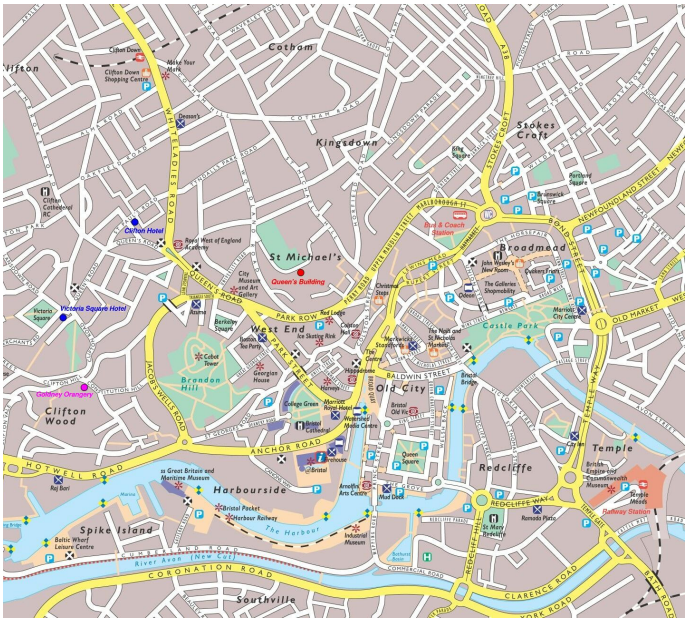
beldsico.de

12. BRISTOL (BROADMEAD) – UK

Start date	2004
Class	8: Public-private partnership, agreement with existing company.
Geography	There are 421,000 people living in the central city, 1,000,000 inhabitants in the metropolitan area.
Comparing to NY	Large city in an industrial area. Density is low but higher in the city center, thus comparable to boroughs other than Manhattan.
Operational settings	Location: The UDC is located in the city outskirts, close to strategic road network. Initiator: The experience was started through an agreement involving the city council and retailers associations. Operation: The UDC is operated by Exel (leading carrier in the UK) and serves those retailers in the Broadmead shopping area who chose to participate in the scheme; 51 retailers being served in 2005 (mostly clothing and fashion sectors). One 7.5 ton and one 17 ton diesel trucks are used for the deliveries. The UDC also offers additional logistics services to the retailers and the collection of recyclable materials.
Regulatory context	There are not favorable regulations for vehicles distributing from the UDC.
Economic incentives	The UDC has received funding from the CIVITAS-VIVALDI project. The trial was initially free for the participating retailers. It was anticipated that it would require on-going support from the city council once the European funding was over, as well as contributions from the participating retailers.
Metrics available	68% reduction in the number of trips. VMT and pollutants emissions metrics also available.
*References**	The project is described in the CIVITAS-VIVALDI reports (7), BESTUFS workshops (23). No reports were found for the post-CIVITAS phase.
Contacts	Tim Hapgood, Bristol City Council.

** Numbers in parentheses indicate reference numbers on page 78*

flickr.com



mappery.com

13. HEATHROW AIRPORT (retail) – UK

Start date	2000
Class	2: Single private ownership, "demanding" landlord.
Geography	Located west of London (population 7.5 million), Heathrow is the largest and busiest airport in the UK. It has two parallel runways and five terminals.
Comparing to NY	The UDC is serving a non-urban area. Large multi-terminal airports as JFK could be compared.
Operational settings	Location: The consolidation depot is located 2.5 km from Terminal 4. Initiator: The airport is owned and operated by BAA, the company that launched the initiative. Operation: BAA contracted Exel to operate the scheme. All goods with destination to retailers in Terminals 1-4 must be delivered to the depot (except newspapers and high value items); the depot has chilled and frozen facilities and is open 24/7. Security checks including X-ray are made at the depot. There is one "delivery team" within each terminal. Packaging and waste is also returned to the depot. The system involves 6 vehicles and an operational staff of 40.
Regulatory context	The system is entirely based in private agreements. BAA is the owner of the terminals and can force the retailers to get their deliveries through the distribution center.
Economic incentives	The scheme is self-sustaining. The charges to the retailers are not fully transparent and they likely contribute to the UDC through the lease rents for their retail premises.
Metrics available	2004 data showed 70% trip reduction and 144,000 VMT saved for that year. Economic estimations for the trial stage showed an equivalent annual saving of £245,000 in time and £53,000 in fuel for the carrier companies. Pollutant emissions savings are also available.
*References**	The experience has been documented in several sources and has even been awarded some prizes. However, due to its entirely private setting, there is little information about its economics. The experience has been described in BESTUFS reports (9) and workshops (24), and a report by the British government.
Contacts	Ian Foster, commercial manager, Exel. Julien Allen, University of Westminster.

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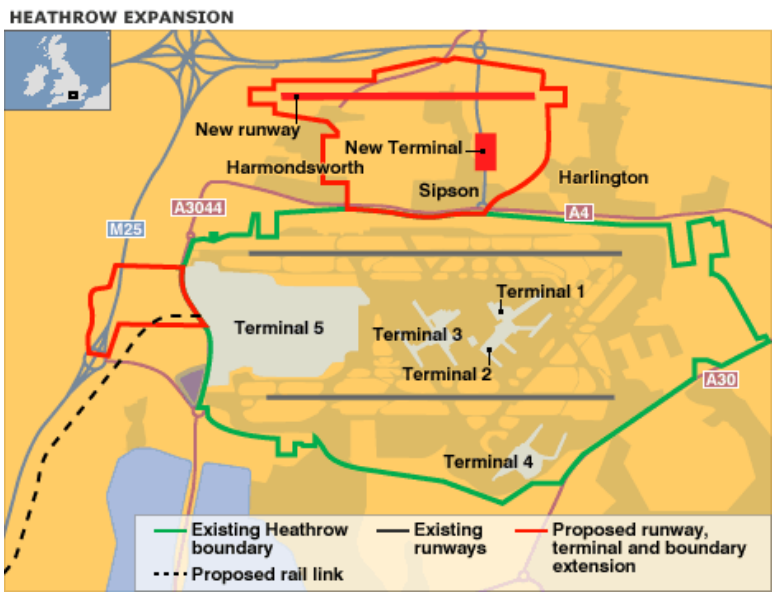
virginmedia.com



news.bbc.co.uk

B.3. SUGGESTED CASES FOR IN-DEPTH ANALYSIS

While the above mentioned cases could all be suitable for study, the information provided in their summarized description shows that big differences exist regarding their settings and available literature. For instance, there is a broad variation in terms of the size, the activity, and the geography of the cities, with some of them showing little similarity to the context in the New York area. In addition, the availability of information is quite diverse. Thus, it is clear that some of the cases can provide more valuable insights for our study than others.

Another matter to consider is the disparity in the operational settings that these experiences show. This should be understood as an opportunity rather than as a handicap; the fact that all these different models have emerged in cities with Western-like economies makes them likely suitable for the economic context of New York. Thus, rather than narrowing the selection of cases by selecting a-priori those cases depicting some type of operational settings, we find more profitable to choose the cases according to whether they represent good examples of distinct operational models.

Therefore, the Study Team suggests the following cases as the most promising candidates for further or in-depth study:

Fukuoka, Japan

This is the oldest and probably largest (in terms of companies involved) successful representation of a 100% private cooperative initiative regarding UDCs. It is also one of the largest cities where an UDC has been implemented, which has outstandingly succeeded without ever receiving neither financial nor regulatory incentives from public institutions. It also features one of the deepest analyses of its performance in terms of traffic and pollution, and it is the only non-European suitable case for study.

Heatrhow Airport, UK

This constitutes an interesting example of the private cooperative initiatives that are currently proliferating in the United Kingdom. While similar to the UDCs launched in Germany (e.g.

Kassel) during the 1990s (the so-called "German" model implying little financial or regulatory assistance from public institutions) the retail consolidation center serving the various terminals at Heathrow airport may offer important lessons that may be applicable to airports in the New York metropolitan region since they present similar characteristics and face similar challenges in terms of security and the sheer volume of merchandize sold at the terminals.

Monaco

This is the case that best represents the publicly owned UDC model. The Monaco scheme is usually referred to in the literature as "monopolistic" because it is enforced under some circumstances (weight limits, time windows), but this should be questioned because: 1) there is a competitive bid to choose the operator of the UDC scheme, and 2) many other schemes spared of the "monopolistic" label enforce similar limitations for carriers choosing to deliver directly to the consignees (i.e. La Rochelle, Padua, Stockholm). Although Monaco is one of the smallest cities among the available experiences, it features high urban density and significant economic activity. Most interestingly, the city has a difficult, constrained access from the closest motorways and a severe lack of urban space for the expansion of new activity (similar to Manhattan). It also features an interesting double facility formula which could resemble a scheme in our area, with a large depot in the New Jersey logistical area and a smaller depot in Manhattan, plus a shuttle service between the two sites. Finally, while as much information is available for both the Monaco and La Rochelle experiences, the former shows clearly superior achievements in traffic and pollution reduction.

Padua, Italy

This is the most promising representation of the public-private partnership (PPP) model among the suitable cases identified for this study. Although Bristol is a larger city than Padua where a PPP scheme has been developed, in the former case the UDC serves only a few commercial streets in the city center and its economic sustainability seems very dependent on continuous public subsidies. In Padua, the share of public subsidies in the operating costs of the UDC was reduced dramatically in the first years of operation and the scheme seems nevertheless close to being at a break-even operational status. Additionally, Padua represents

one of the few cases where the UDC is embedded within a larger Freight Village, thus providing an opportunity to learn more about the theoretical synergies derived from the integration of these facilities[2].

Paris, France

La Petite Reine in Paris is an example of a private non-cooperative scheme, although public institutions are supportive of this initiative. However, the Paris experience is most remarkable because of the different approach to distribution that has been developed, limiting service to those central neighborhoods of the city that can be reasonably served by using electric aided cargocycles. The experience seems to be very successful and has recently been duplicated by other large and medium cities in France.

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Appendix C: CASE STUDIES

C. 1. "LA PETITE REINE" IN PARIS

Background:

La Petite Reine (LPR) is one of the largest cycle-based urban distribution systems in Europe [1]. Started by Gilles Manuelle in 2001, this privately owned enterprise began operations in Paris, using just a few electrically assisted bicycles for home deliveries to retail stores' customers. Since mid-2003, the company consolidated and expanded its operations by establishing a cargo consolidation terminal in Paris' city center, with a favorable lease agreement from the city government. The main motivation for establishing this urban distribution center (UDC) was the inadequacy of using motorized vehicles (e.g., vans, trucks) to carry light parcels within the city center.

By 2007 the LPR urban distribution system had been extended to other French cities, including Bordeaux, Dijon, Rouen, and Lyon and had launched a franchise operation in Geneva [2]. Since the beginning of 2009, LPR has partnered with the ARES *(Association pour la Réinsertion Economique et Sociale)* a non-profit organization created in 1991 to promote labor re-training and job creation [3]. In 2010, LPR opened a second distribution center in Paris and is considering setting up two more hubs. This mini-case study focuses on the company's operations in Paris.

A number of transport policies introduced in France since the mid-1990s frame the LPR initiative as part of a larger political and legal effort to enhance urban logistics. In 1994 the Ministry of Transport set up a national "Urban Goods Movements" program [4], with the goal of establishing a comprehensive urban freight database that could improve policymakers' decisions. This program has supported various research projects, surveys and models [5] to improve the understanding of urban logistics and its relationship to vehicle flows and local economic development and the environment, as well as to promote and document the benefits of various experiences [6].

In 2002, the City of Paris issued a freight strategy known as the "*Plan de Déplacement de Paris*", calling to optimize the distribution of goods within the city and to minimize the negative effects associated with urban freight, including congestion, pollution, noise, and energy consumption [7]. This plan seeks to realize such objectives through a number of measures, such as promoting modal shifts (from on-road transport to rail and waterways), freight consolidation, and increased payloads per vehicle as well as clean delivery vehicles and lorry regulation [6]. Large trucks are banned from entering the city center while access by smaller trucks and other vehicles is restricted to certain hours of the day. Pedestrian areas are closed to all vehicles after 11:00am (except bicycles). The European Union has legally classified the cargocycles used by the LPR as bicycles, as long as they are electrically assisted pedalling units with a motor of no more than 250 watts travelling under the 25-km/hr speed limit [8]. Therefore, the LPR cargocycles have an advantage in terms of distributing merchandise within areas of the city that are closed to motorized vehicular traffic.

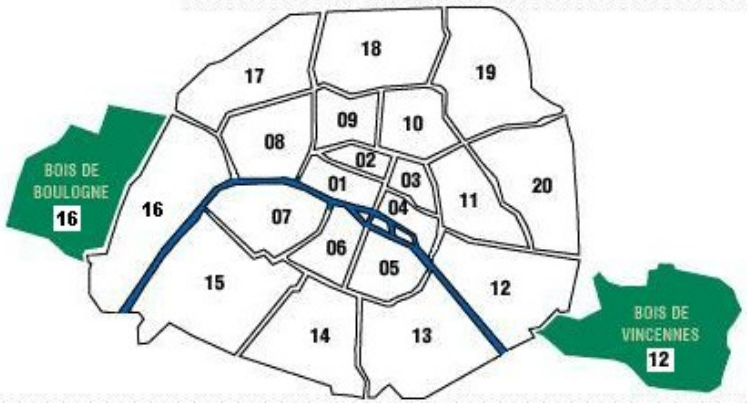
LPR's Characteristics and Operations:

Today, the LPR in Paris operates from two terminals. The first one, established in 2003, is located in close proximity to the Louvre Museum, in the city's 1st Arrondissement, on the Right Bank of the Seine. A second distribution center was opened at the beginning of 2010 on the Left Bank (6th Arrondissement). Both terminals operate from parking facilities in the urban core. Since most of the cargo is moved by cargocycles with limited travel range [8] having two centrally located hubs ensures that their service area covers most of Paris' central municipal districts (such as Arrondisements 1 to 10 as well as 13 to 16 [8] – see map below).

Paris has almost 2.5 million inhabitants and more than 27 million tourists visit the city per year. Many of the visitors seek lodging within the central districts, with a permanent population of over 350,000 residents [15]. Given the population density, the service area of the two LPR hubs exerts a considerable demand for consumer goods and hence, deliveries. Because the Paris LPR draws cargo from the entire city, its area of influence is likely broader. Figure 1, shows that the 1st and 6th Arrondissements (where the two LPR's hubs are located), are in close proximity to the commercial, business and cultural centers of Paris. The

company is now considering opening a third center on the West of Paris (Arrondissement 16) which is one of the city's wealthier neighborhoods, housing several cultural institutions, embassies, and sports arenas [16].

Figure 1: Map of Paris' municipal districts (arrondisements)



La Petit Reine's two urban distribution centers in Paris are located in arrondissement 1 and 6. Source: [16]

The terminal at the Place du Louvre (Parking St Germain l'Auxerrois) occupies 600 m^2 including 500 m^2 of warehousing space on a parking lot that had been a long-vacant car washing facility. The second terminal is located on a dedicated section of an underground parking garage in 169 bd St Germain (Parking St Germain des Prés). Both facilities may be considered urban logistic spaces and operate as transshipment platforms with no additional services offered (e.g., as pre-packaging, adding labels, etc.). Originally, as part of an implementation study conducted from 2003 to 2005 [9], the city government installed a few urban logistic boxes next to the Louvre terminal but they were never part of the LPR operation. Apparently their use was very limited and these boxes are no longer operational, although they are still used in other parking facilities [8].

While at least one of the two LPR centers is near the Seine River, there is no direct access to water vessels (or to rail) and all of the merchandize enters both facilities via road transport. However, neither hub has on-site vehicle loading docks. Parcels are brought into each distribution center by five to ten light-goods vehicles per day, and then they are manually loaded onto cargocycles, using dollies.

Some of the trucks operate as a shuttle, collecting parcels heading to the distribution center while others arrive directly from various shippers. Once at the distribution center, the parcels are sorted and consolidated according to the customers' address, and then loaded onto cargocycles, which are used to deliver to clients within the city center. As of 2009, the LPR had 20 cargocycle units in Paris and additional ones have been added since opening the Germain des Prés terminal [8].

Before 2003, the LPR in Paris run a limited operation, with 3 employees delivering purchased merchandize for retail stores' customers. Since 2010, the two facilities in Paris have 30 employees (10 in the new hub). They both operate six days per week, from 7:00am to 8:00pm and are closed on Sundays. Most of the trucks enter the terminals before the morning rush hour with few vehicles arriving before 1:00pm (always avoiding the peak traffic hours). Towards the end of the day, some trucks come to the center to collect returned merchandize or packages that could not be delivered (e.g., because of a wrong address) [8].

In 2009, the Louvre LPR center in Paris distributed approximately one quarter of a million parcels (at an average of 1,000 units daily). In all of France, the LPR operation has achieved roughly 900,000 deliveries per year. Pick-up service is not a significant activity for the LPR – only 50 packages per day or 12,000 per year were collected from the Paris service area in 2009 [8]. There are no data available yet to estimate the amount of parcels processed at the new terminal in St. Germain du Prix but this operation is targeting full-load deliveries heading to various single customers (e.g., supermarkets), including 15 such deliveries per day to a single store [8].

Since 2002, the cargocycles in Paris were used to transport a range of goods, including parcels, medicines, newspapers, flowers, food, and small equipment (e.g., cell phones) and parts. Up to a few years ago, parcels represented 97% of the deliveries [9]. Today, LPR in Paris offers three types of services: [8]

- Distribution for "express" transport companies. Companies such as Coliposte, DHL International, and TNT sub-contract with LPR to deliver to the city center,

- Deliveries to its own client base (distributed to different retail stores). Among various shippers, LPR has contracts with Sanofi Aventis (a large pharmaceutical company in France) to distribute medicines to pharmacies around the urban core, and with SFR Co. (one of the largest mobile phone operators in France) to deliver cellular phones to various stores, as well as with Danone. Other contracts include distribution of printing toner cartridges as well as newspapers.
- Deliveries to its own client base (large delivery to single establishment). This includes a contract to distribute food products to large supermarkets or "take-away food" establishments.

Vehicles: cargocycles

"La Petite Reine" ("the little queen") is an old fashion term that was used in France to identify bicycles. Cargocycles employed by the LPR are electrically assisted three-wheels bicycles equipped with a large trunk.[10] They are ideal vehicles to distribute cargo in central business districts in large central cities – they are compact, stainless steel frame and lightweight units that are easy to navigate through congested streets and/or to park in small spaces. Since they are allowed on roadways, bus or bicycle lanes at an average speed of 12.5km/hr (with maximum of 20km/hr or 12.5m/hr) the cargocycles can often travel faster than trucks during peak traffic hours and have access to areas that are inaccessible to heavy vehicles. All units have 3 gears and are equipped with an ARBUS antitheft protection device. The LPR in Paris utilizes three different cargocycle models: [13]

- The Cargocycle V1: weighing 80 kg (~175 lbs), 2.35m (7.7 ft.) long and 0.98m (3.2 ft.) wide. It can carry a load of up to 150kg (330 lbs.) or 1,400 liters (370 gallons) of cargo space. This is the model least used as it has been progressively replaced by the V2 model.
- The Cargocycle V2: weighing 100 kg (~220 lbs), 2.35m (7.7 ft.) long and 1.03m (3.2 ft.) wide can carry a load of up to 180kg (~400 lbs.) or 1,500 liters (396 gallons) of cargo space.

- The Frigocycle: weighing 120 kg (265 lbs.) 2.35m (7.7 ft.) long and 1.03m (3.2 ft.) wide can carry a load of up to 180kg (~400 lbs.) or 1,200 liters (317 gallons) of cargo space.


Cargocycle V2 [13]


Frigocycle [13]

Each cargocycles employed by LPR operates with a lithium-ion battery that may be charged at the terminal using a regular electrical outlet. It takes 5 hours to recharge each battery but since discharged units can be removed from the cargocycle and replaced with freshly powered batteries, the LPR does not need to idle cargocycles between charges [8]. Each fully charged battery supports up to 30 km of travel [11].[2]

The cargocycles' market price has been reported as £6,020 (US$9,642) per unit [12]. To pay for the first cycles, LPR obtained a line of credit from a bank specializing in "social economy lending" in part because it was difficult to find other banks that would loan to such a novel enterprise [8].

Financial Profile:

An implementation study of La Petite Reine, sponsored by CERTU, was carried out from 2003 to 2005 to improve the understanding of this enterprise's start-up phase and to draw lessons for similar endeavors. The study analyzed the costs and operating profits during the first two years of operation of LPR's Louvre center in Paris. As the following table indicates,

[2] Dirik Janin from La Petite Reine added that 30 km is the maximum the cargocycles can achieved, but with two batteries. Operating autonomy of a single battery is closer to 10km with full load of goods, but this considered to be sufficient given the distance travelled per day.

after 24 months of implementation, the operation showed positive operating earnings, despite setbacks during the third semester [9].

Table 1: Turnover and operating profits profile (2003-2005)

May 2003 to May 2005*	Turnover (€ HT)**	Operating Profit (€ HT)**
1st semester (5/03 – 11/03)	110.26 €	503 €
2nd semester (11/03 –5/04)	132,400 €	8,203 €
3rd semester (5/04 – 11/04)	138,067 €	-3,552 €
4th semester (11/04 – 5/05)	197,416 €	12,880 €

* Tthe study started in mid-May 2003
** € (HT) = euros before taxes
Source: *Bernard Gerardin (2007) CERTU*

The cost structure for LPR operation in Paris is not known in full detail. The LPR management reports that given its service-centered operation, the main cost is labor. The CERTU study noted that the share of payroll between 2003 and 2005 ranged from 80% to 90% of sales; with salaries during the third semester representing almost 90% of turnover but decreasing to 83% of total costs during the last semester when sales increased by roughly 43% and payroll obligations grew only by 30%. This improvement is attributed to productivity gains [9].

Other cost obligations include facility rental fees, which have been relatively low for the Louvre location. While the rental agreement for the second facility in Paris is not as favorable, the rental fees remain below usual commercial rates [8]. LPR management considers reasonable tender agreements for their facilities a key factor to maintaining access to the urban core. While the city government's favorable tender is the only financial support from any public entity received by this urban consolidation system, the LPR estimates that without this support, rental payments would be one of the most difficult operational costs to manage, in particular because it is difficult to afford operations in the city center when paying commercial rates [8].

Information about the rates charged for deliveries was limited in the early years of the project. It is reported that transporters/carriers (e.g., DHL, Fedex, Chronopost, Coliposte)

accepted the contract fees, while shippers such as Toner Service Co. and Canal BIO considered them to be too high relative to those charged by competitors [9]. In 2010, the LPR has a fix price schedule for each delivery address (regardless of the number of parcels) for express transporters or retailers, who are charged between 2.50 € to 3.50 € per delivery. The rate charged to shippers varies according to the weight of the parcel, with an average of is 5 € per parcel [8]. Additional revenue accrues from the sale of advertisement space on the side panels of the cargocycles [13].

The company has made a number of strategic alliances and has a respectable "social business" record, which often attracts new clients. For example, a recent partenership has been signed with Proxicity / Danone to distribute dairy products marketed within the city centre. Given that Danone advertises on the cargocycles's side panels, the dairy company gains visibility, strengthening its social commitment to support sustainable practices while also gaining access to a larger consumer market (shops and catering). To support its marketing efforts, in 2010 the LPR hired its first salesperson [8].

The regulatory framework is often seen as creating favorable conditions for the introduction of urban consolidation systems in densely populated urban centers plagued by traffic congestion. Several regulations implemented in Paris since 2002 have limited delivery operations within the various city districts. These rules constrain delivery times and the length and/or weight of trucks permitted to enter the different city districts. The lorry regulation includes the following specific rules: [7]

- 4 thresholds of surface on the ground, based on maximum vehicle size (16m², 20m², 24m² and 28m²);
- 4 time sections (7:30am –9:30am; 9:3am – 4:30pm; 4:30pm – 7:30pm; and 7:30pm – 7:30am);
- Different routes (bus lanes, red axes), and
- 8 exemptions

While cities such as London restrict lorry access to the urban core during night hours, the City of Paris's regulations prevents trucks from entering the city during most of the day,

likely reflecting Parisian's preferences for less congested streets during the business hours, when more people are using public spaces [7]. This exerts a favorable influence for the use of alternative vehicles to delivery goods in the urban core during the day. Nevertheless, some pedestrian areas are restricted to all vehicles after 11:00am.

An important consideration is whether cargocycles are acceptable vehicles for pedestrian areas. For example, LPR's model faced a significant hurdle in London where a regulation banning the use of tricycle vehicles weighing more than 60 kilograms. As noted above, \cargocycles such as those used by LPR are heavier (80 kg) [12]. While Paris has allowed the used of these vehicles in the city core, LPR's partners in London had to obtain an exemption to this rule for its cargocycles, which was granted as long as they continue to be pedaling vehicles (assisted by batteries) and travel below the speed limit of 25 km/hr [8].

Social Benefits:

There are several documented benefits, including considerable decreases in pollution and noise. The LPR consideres that their operation represents one of the best models for delivery of parcels within Paris [8]. Before the UDC implementation, the average delivery truck, weighing roughly one metric ton, was typically traveling less than 15km to deliver less than 100 kg of cargo [11]. Thus, using cargocycles and consolidating goods is considered a more efficient and effective way to complete deliveries because of increased loading factors per delivery tour and better access within the city center with little disturbance to public space users.

The LPR's website reports on the sucessful displacement of heavy trucks from the road and related VMT, emissions and noise pollution. Over the course of a twelve month period, its Paris' operation replacing heavy vehicles with cargocycles has resulted in: [13]

- Preventing close to 600,000 t-km[3] of goods from being hauled by vans.
- Generating energy savings equivalent to roughly 90 toe (tons of oil equivalent)
- Avoiding contaminant emissions, such as 84 kg PM and more than 200 T of CO_2.

[3] A t-km or ton kilometer is a unit of measurement that corresponds to the transport of one metric ton of goods over a distance of one kilometer

- Reducing noise pollution and congestion

Additional benefits ensue from the cargocycles' small footprint – they have more flexibility to travel in congested streets; hence deliveries are often faster than those made by trucks, especially during rush hour traffic. It is also easier to find parking for smaller vehicles and the cargocycle can be parked closer to the client, thus saving considerable time on the overall delivery tour [13]. It has been estimated that given these benefits, cargocycle deliveries are 10% to 20% less expensive than traditional distribution of goods using trucks or vans [14]. Finally, regardless of the vehicle used, the consolidation scheme is an efficient way to reduce the number of required trips, because parcels for several customers are combined and distributed on a single delivery tour.

Concluding Remarks

In less than a decade, La Petite Reine has expanded its operation from a few bicycle deliveries per day in Paris to one million deliveries per year in all of France, including at least a quarter of a million parcels distributed in Paris plus collection services. The success of this consolidation system lies on a number of key features. First, by using cargocycles the LPR operation benefits from increased access to certain restricted areas (e.g., pedestrian zones) as well as longer delivery windows. Second, the cargocycles can be parked almost anywhere, decreasing the time spent looking for parking and traveling from vehicle to customer. Third, while a motorized vehicle may travel faster, cargocycles have an easier time navigating through congested traffic, so as long as the delivery routes remain relatively short, this type of operation seems to offer certain advantages over truck deliveries.

LPR operation seems to be financially viable – besides fees on delivery and collection services; the company sells advertizing space (on the side of its cargocycles) thus bringing additional revenue. At the same time, it is clear that the City of Paris' favorable (non-commercial) rental agreement on at least one of the two hubs is a significant element in ensuring the financial viability of the LPR operation. Attaining such support in New York City may not be that easy.

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C.2. HEATHROW AIRPORT RETAIL CONSOLIDATION CENTER

An interesting freight consolidation model worth exploring for its potential applicability to New York is that of an urban distribution center (UCC) at a single site and/or with just one landlord. There are several examples of such systems, including the retail consolidation centers at Heathrow Airport in London, and shopping malls such as Meadowhalls, Broadmead and Cargo Centre, in England (Sheffield, Bristol) [1] and Austria (Graz), respectively [2] as well as temporary construction logistic centers at Heathrow Airport's Terminal 5 and Hammarby Sjöstad in Stockholm. [2] These cases share key characteristics that often improve their chances of being implemented because: [3]

- Landlords are sometimes in a position to demand that tenants use the consolidation system. Developers seeking government support (e.g., tax abatements, favorable financing) may be inclined to integrate freight consolidation centers within their developments as a way to support sustainable social practices advanced by the public sector.
- It may be easier to recover the costs of the operation by structuring fees as part of the rent or regular handling charges (e.g., according to number of packages delivered).
- UCCs may be able to obtain additional sources of revenue when operating at a single site. For example, the UCC could offer pre-retail services such as packaging, adding scanner codes or labels to the many retailers agglomerated at a single location (e.g., shopping mall, airport). This may decrease retailers' individual labor while improving the UCC's self-financing.
- When the freight consolidation targets a single site, it's often easier to plan for an optimal / single delivery route.
- Similarly, when deliveries arrive at a single site, there is a better opportunity to plan for and/or select optimal loading/unloading areas and/or times.

This brief case study focuses on a retail consolidation system at one of the busiest airports in the world – Heathrow Airport.

Background

The retail consolidation center at Heathrow airport was launched in 2001 when the Heathrow Airport Limited (HAL) department of the British Airport Authority (BAA) entered an agreement with a private logistics provider to operate the center on its behalf. Through this consolidation system, the BAA-HAL was responding to an increasing demand for delivery routes and loading docks due to growth in retail operations in the airports' main terminals. Another goal of setting the retail distribution system was to reduce vehicle traffic and associated emissions and to improve goods handling and waste management, in support of an overall sustainability strategy for the airport.

The infrastructure support at Terminals 1 to 4 was inadequate to respond to the growing retail business because: [4]

- Access to the terminals was constrained, with all delivery vehicles having to use a single tunnel
- Traffic congestion rendered delivery services were time consuming and/or unpredictable
- There was significant shortage loading docks, due to increased demand for deliveries by retail owners
- The number of deliveries kept increasing – at the time the initiative was launched in 2001 there were 439 supplier movements to 240 retail outlets per day.
- More congestion was anticipated given plans to develop a fifth terminal expected to add the equivalent of another 250 retail stores.

In planning for its new Terminal 5, the BAA commissioned a study of truck traffic and freight flows through Heathrow Airport. This assessment determined that establishing an off-site retail consolidation was the best way to optimize ongoing goods deliveries to terminals 1 to 4 as well as additional deliveries to the new terminal 5 [4]. Following on this recommendation, in the spring of 2000 the BAA/HAL initiated a trial off-site consolidation facility, engaging 8 retailers delivering to 40 outlets across the four terminals. Preliminary findings were encouraging, including 66% reduction in the number of deliveries to the airport, increased flexibility in terms of delivery times as well

as customer satisfaction because retailers did not have to leave travel to a central location to claim packages. The BAA/HAL then decided to implement a permanent, large-scale system to consolidate goods flows through the airport and thus invited logistic companies to compete for a 5-year operations contract. Exel (DHL) Logistics won this contract and started operations in 2001 at its Hatton Cross facility, a short distance from the airport. [5] In 2006, the consolidation center transferred to a new Prologis owned building at Park Heathrow [15], also located in close proximity to the airport. Once Terminal 5 opened in the spring of 2008, the retail consolidation center expanded to incorporate deliveries to retail stores at this terminal. While Terminal 2 closed DHL estimates that the volume of merchandise delivered to retailers has increased 5-fold [17].

Operations

Before the consolidation center started operations, terminals 1 to 4 at Heathrow airport were receiving over 49,000 supplier deliveries every year [16]. When Exel launched the off-site consolidation system at Hatton Cross in 2001 it engaged 100 of the 240 retail stores operating in terminals 1 to 4 at the time. These included several clothing and personal accessories high-end vendors, chain stores and food purveyors, among others. The agreement between BAA/HAL and Exel did not include deliveries of newspapers or high-insurance costs valuables (e.g., cash, bullion). By 2004, the center had engaged 51 businesses and was delivering to 190 out of 240 retail outlets; at this time the operation shifted from voluntary to compulsory for all retailers using terminals 1 to 4. [6] Today, the center serves 146 trading companies with deliveries to 286 shops in the four currently operating terminals (1 and 3-5) [17].

The Hatton Cross 25,000 square feet facility (2.5 km from Heathrow's terminal 4) included 3,500 square feet of chilled storage space to accommodate demand for deliveries of frozen and chilled products. In anticipation of the opening of Terminal 5, and the expected higher volume of deliveries, the BAA engaged ProLogis to design a new Consolidation Centre at Park Heathrow. At this new location since 2006, the center continues to be operated by DHL/Exel, and provides 56,288 sq ft of ambient, chilled and frozen storage to airport retailers.

The Heathrow Airport Retail Consolidation Center (HARCC) operates 24 hours, seven days a week, therefore while the regular delivery schedule had a fixed timetable (one tour of each terminal 4 times per day) the center offers retail stores increased flexibility in selecting delivery schedules.[7] By 2002, the Hatton Cross center employed roughly 20 operational and clerical staff trained to handle the different packages arriving at the center, performing security checks (e.g., running parcels through Rapiscan x-ray machines), consolidating all merchandize, driving the sealed cages to the airport and delivering them within the terminals.[10] A 2006 report indicated that the center's personnel had increased to 40 operational and clerical staff plus 6 managers.[7] In 2010, given the five-fold increase in operations the center employs 175 full time workers as well as close to 60 temporary workers employed during the high season (July, August and December). All staff undergoes background checks, is screened for security, and receives related training.

As a result of the HARCC implementation, and given increased security requirements that prevent direct deliveries to retailers, security procedures have been streamlined. All packages are screened and sealed inside roll-cages at the consolidation center, thus minimizing time spent by delivery vehicles at airport's checking points. [5] In 2004, approximately 20,000 vehicles delivered merchandize to the HC center. After being screened for security and sorted according to delivery address into sealed roll cages or pallets, approximately 1,500 cages were shuttled to the various terminals using just 5,000 vehicle trips that completed a total of 45,000 deliveries to the retail outlets.[7] The number of retail cages delivered has increased from 10,000 a month in April 2006 to approximately 50,000 on peak months or half a million cages delivered per year in 2010.

The HC center has also improved services to retail stores. The truck drivers work with two employees assigned to each of the four terminals. The later wheel the sealed cages to deliver the merchandize directly to the store (or designated stockroom).[5] Each package delivered has two manifest labels, one from the supplier and another one from the consolidation center, thus allowing retailers to easily return and/or redirect parcels to another terminal. Other value-added services provided to the retailer for additional fees

include: collection of recyclable packaging waste (e.g., plastic, cardboard, bubble wrap), temporary storage, keeping a buffer stock for on demand delivery, record-keeping, breaking down bulk merchandize to be delivered at different times, and pre-retailing (e.g., point of sale displays, as well as Palmpilot tracking of goods from receipt to delivery, among others. [5, 7]

Vehicles

At the beginning of the operation Exel was using for-hire-vehicles to deliver packages from the center to the four terminals, including four 17-ton rigid box vans and one 3.5 ton van, all having tail-lifts. [10] The company then set to build its own fleet, including three tractor trailers (2 fitted with electric fridge motors to handle chilled/frozen cargo) and three urban rear-steer 11 meters box van trailers (with tail-lifts). [5] In 2007, DHL/Exel, replaced a 7.5 tonne diesel delivery van with an equivalent electric van. BAA's CVP Incentive Fund awarded DHL Exel a grant of £17,500 towards the cost of the electric delivery van [14]. In 2009, DHL/Exel started a trial of a 9 ft chilled vehicle, manufactured by Smith Electric Vehicles.[11] All vehicles are fitted with ISOTRK tracking and driver communication systems to ensure a quick response and enhanced security.[7] Within a couple of years after starting operations, the consolidation center was using 75 percent less airport delivery vehicles than in 2001; it achieved such reductions by increasing each vehicle's load factor (to an average of 90%) all while improving on-time delivery to retail outlets (95% of the time). [9]

Evaluation: Costs and Benefits

In May 2001, Heathrow Airport Limited (HAL) signed a five-year "open-book"[4] plus fees contract with Exel for the operation of the off-site consolidation center. Under such agreement, Exel charged BAA £2 million per year as a management fee for its services. The contract has been extended and a renewal in 2009 provided DHL Supply Chain

[4] Under an open-book contract, the buyer and seller of agree on (1) which costs are remunerable and (2) the margin that the supplier can add to these costs. The project is then invoiced to the customer based on the actual costs incurred plus the agreed margin. This type of contract is often used when the true costs are not known a-priori or when the "buyer" (usually a governmental entity) wants to ensure competitive prices for those serviced by the agreement. Wikipedia; http://en.wikipedia.org/wiki/Open-book_contract

(Exel) approximately £9.8 million per year for up to 323 retail and catering outlets.[8] In addition, Exel was able to charge retailers a fee per delivered roll-cage. To maximize the number of retailers joining the consolidation system in the early 2000s, Exel had agreed with HAL that such fee would be "cost neutral." The base rate that Exel could charge to retailers was based on a study that estimated the total savings ensuing from the expected level of activity during a typical week of operations.[5] This assessment found that participants of the consolidation center saved roughly 236 hours and an equivalent of £4,715 per week (or ~ £245,000/yr.) due to increased efficiency in deliveries after the center started operations. The table below summarizes how the savings were calculated.[5]

Table 1: Savings ensuing from the UDC operation (per week)

Operation type	# of deliveries per week*	turn-around time / delivery (minutes)	# of drops	total hours	total cost/ week**
Without UDC	115	45	3	258.75	£ 5,175
With UDC	115	12	1	23	£460
			Savings per week	235.75	£ 4,715

* Comparison based on the same number of deliveries. Assumes the same # of deliveries would have taken place before the consolidation system; however, 35 fewer trips were made during this week than before implementation of the UDC.
** £s in 2002, when the calculation was made.
Source: *table developed based on information from reference [5]*

Other services offered by Exel, such as pre-retailing or storage, are charged for separately and represent additional revenue to the consolidation center. [5]

The cost neutrality structure is undermined by the uneven allocation of benefits and costs because those accruing the benefits do not pay for the consolidation system. Indeed, while the suppliers benefit from less time and money spent in delivering to the airport (e.g., avoiding tolls and labor costs by being able to use fewer and larger vehicles) the retailers are the party actually paying for the consolidation center (e.g. per cage delivered

[5] The 7-day period chosen for this analysis was the last week of January 2002, as reported in [5].

to the store). It has been argued that suppliers should pay to deliver to the center since they are accruing the benefits.[17]

As a result, the total costs of implementing and operating the HACC center have been at least partially subsidized. The BAA has received government subsidies to develop the consolidation system and BAA has and continues to pay DHL/Exel to operate the system and also pays for renting the Prologis center. Retailers pay for regular delivery services (as well as extra fees for any value-added services, including collection of recyclable packaging materials) but these fees only represent a portion of the annual costs to run the consolidation system (information about how much BAA recoups from retailers is not available). Now that the operation is compulsory the fees to be paid by retailers for regular deliveries are specified as part of the rental agreement. [12] [17].

Besides the time-savings accruing from the consolidation scheme, other benefits have been documented, including decreased vehicle congestion (most notably within the airport) due to a reduction in the number of delivery trips to the airport, and associated reduction in pollution and energy use. The BAA estimated that approximately 35 fewer trips per week were made into the airport during the first year of the consolidation center's operation. At an average of 10 miles per trip, and assuming the fuel efficiency of delivery vehicles use is 10 mpg, it is estimated that 35 gallons of diesel are saved per week, equivalent to a savings of roughly £100. [5]

Table 2: Cost savings from avoided miles & fuel ensuing from the HCC

Operation type	# of deliveries per week	miles travel on trips to airport /week*	gallons fuel consumed /week*	total cost/ week**	total cost / year
Without UDC	150	1500	150	£ 422	£ 21,963
With UDC	115	1150	115	£ 324	£ 16,838
	Savings	*350*	*35*	*£ 99*	*£ 5,125*

* assumes 10 miles per trip and fuel efficiency of 10 mpg.

** it is estimated that each gallon cost £2.815

Source: *table developed based on information from reference [5]*

It has been estimated that during the first years of operation, the consolidation system was able to reduce vehicle movements significantly, decreasing several air pollutants including more than 22 tons of CO_2 and 70 kg of carbon monoxide, roughly 200 kg of NOx and 15kg of PM per year.[13] These benefits have increased through the years, with 87,000 vehicle kilometers (vkm) saved in 2003 and 144,000 vkm in 2004 and corresponding emission reductions, including CO_2 savings of over 62 and 160 metric tons per year in 2003 and in 2004, respectively.[12]

Conclusion:

The BAA/HAL retail consolidation system operating near the Heathrow airport has been successful in improving and consolidating goods movements to and within the airport. Even with only 40% of potential participants using the consolidated deliveries during the first years, the system demonstrated dramatic improvements and logistic practices became more efficient. The main benefits of consolidation and increasing the load factor per vehicle are substantial, including a large reduction in the number of vehicles traveling within the airport, faster and more reliable deliveries, improved overall security, and customers' increased satisfaction (e.g., door-to-door service; more flexibility to schedule deliveries), as well as reductions in congestion, VMT and pollution.

While the social benefits are clearly demonstrated, a key question is whether this privately established and operated retail consolidation center would be financially self-sustaining the BAA/HAL support. Government subsidies (through BAA) are a key support in starting and continue to operate the center. At the beginning, retailers were invited to join on a voluntary basis and the scheme looked attractive because the BAA made a clear decision to keep fees revenue-neutral, so that retailers' costs would be compensated by savings and improved efficiency gains. However, while the retailers services have improved and they represent some gains (time saved often represents monetary savings) the main savings are not being passed from the suppliers to the retailers. Through the information currently available, it seems that the system is not self-financing given that the funds paid by BAA to support the operation are not 100%

recouped. Whether the BAA has the power to require the suppliers to contribute to the operation (given savings accrued to them) is still unclear, especially since most suppliers have large nationwide contracts with retail stores and are not likely to adjust them to fit airport deliveries.

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C.3. TENJIN JOINT DISTRIBUTION SYSTEM, FUKUOKA, JAPAN

Background:

In continuous operation since February 1978, the Tenjin Joint Distribution System (TJDS) is one of the oldest freight consolidation schemes in the world. This joint distribution system was started when twenty-nine freight carriers came together to collaborate on a joint delivery system. By 1994, thirty-six companies had joined the system, and at that time they formed the "Tenjin-District Joint Distribution Programme" [1]. As of 2010, the number of companies cooperating at this freight consolidation system has decreased to 32 [2].

The TJDS serves the Tenjin, the commercial business district in the city of Fukuoka. With a permanent population of more than 1.4 million people, this is the major city in Kyushu Island and one of Japan's five largest cities [3]. In close proximity to South Korea and China, Tenjin's commercial district also attracts many tourists and visitors and it's a center for information-processing and entertainment [4].

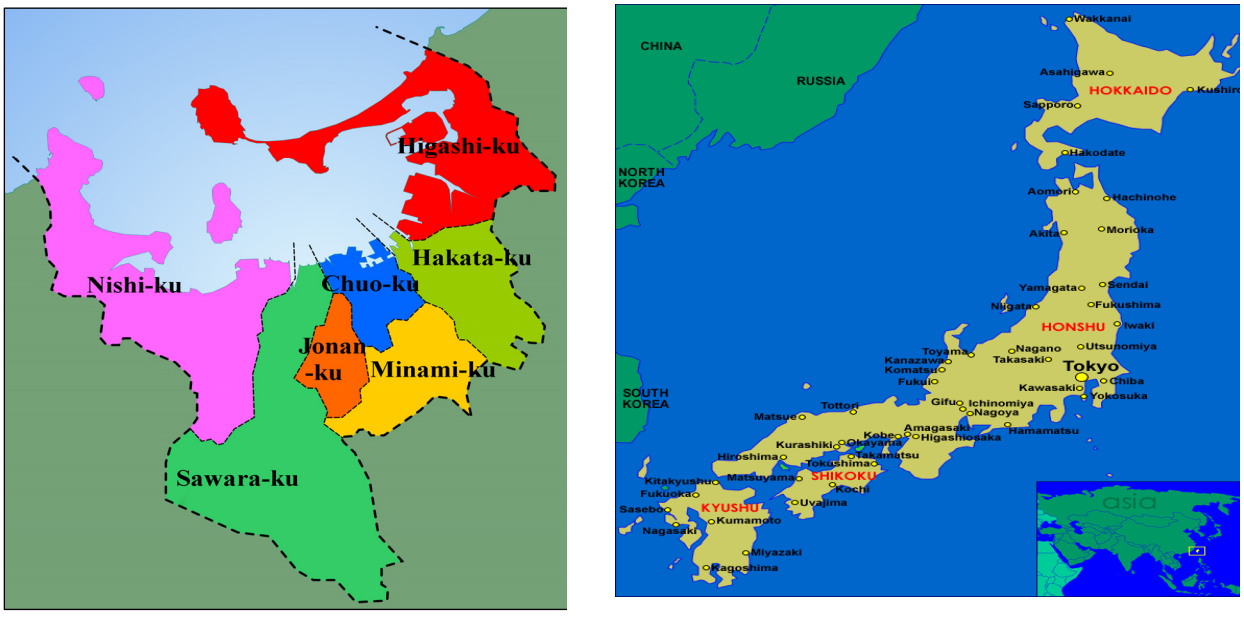

Figure 1: the map on the left, above, shows the different "wards" in Fukoka City – the Tenjin commercial district is in Chuo-ku (blue) and the joint distribution terminals are in Higashi (red). The map on the right shows the location of Fukuoka City in the north of Kyushu Island.
Source: *Japan Travel Information,* *http://www.asiaonline.com.au/japan/japan_map.gif*

The business district includes approximately 2,200 establishments within a 370,000 m^2 (36.8 ha.) area generating wholesale and retail sales valued at more than 2 Trillion Japanese Yen (~16 billion euros) per year. These businesses represent ~3% of the total establishments in Fukuoka City but generate roughly 14% of the wholesale and retail sales in the city [1].

Characteristics of the Tenjin Joint Distribution System

The initial parties involved in the joint distribution system set up the program to address several common problems they were facing when delivering cargo to Tenjin's business district, including reducing transportation costs and addressing pollution. Parking in Fukuoka was a major issue of concern, in particular for companies delivering merchandize to the Tenjin commercial district. Minimizing the time spent looking for parking or moving through streets congested with parked vehicles was likely a major factor inducing several carriers and a few shippers to join the consolidation center. It has been estimated that parking for unloading or loading merchandize represented roughly 40% of 7,500 vehicles parked on the road each day. Moreover, in-building parking in Tenjin was scant, and delivery vehicles parked for an average of 16 minutes at each location. More than two thirds of the vehicles parked in Tenjin have been classified as shipper-owned, typically with limited load capacity, thus likely requiring frequent trips. With vehicles on the road for most of the day, the extended time spent while driving on congested streets in Fukuoka resulted in costly deliveries. In addition, air pollution from vehicles exhaust-fumes during idling or stop-and-go traffic was also considered to be a problem [5].

Given the above issues, the Regional Transport Office (RTO) at Japan's Ministry of Transport brought together various parties facing the same problems and soon the cooperative distribution system was set into motion. The RTO provided a forum to discuss all transport and freight related issues and played an important role in coordinating with a large group of stakeholders, including shippers, carriers, retailers, residents and ultimately with the administrative staff involved in the system [8]. While the Tenjin joint distribution system (TJDS) started operations under the supervision of the RTO, no subsidies were provided by any public entity [1]. Due to the perceived success of the freight consolidation

experience in Tenjin the agency has embarked in plans to extend the urban distribution system to other areas, such as in Kumamoto City [7].

The TJDS is a cooperative enterprise, where each of the participating freight companies agrees to pay a charge per parcel to finance the system [6]. In 2002 the members paid 160 Japanese Yen for each parcel weighting less than 50 kilograms [7]. In 2010, companies with annual contracts pay 180 yen per package while those without contracts pay 195 yen per package [2].

There are three key elements of the Fukuoka joint distribution system, which has been characterized as an "area-wide inter-carrier consolidation system" (AIC) [5, 6]. First, the cooperating shippers / carriers deliver merchandise to the Hakozaki distribution center, a freight terminal located in the Higashi-hie ward, which is located at roughly 4 km from Tenjin and near the interchange of urban expressways as well as the Japan Railway line. At the Hakozaki terminal, all parcels are sorted and consolidated according to their final delivery address. Then, the joint distribution company's vehicles are loaded and they deliver the merchandise throughout the Tenjin business district. A decade ago, a total of 3,500 parcels per day (~90,000 per month) were being distributed between three tours (8:00am, 10:00am and 2:00pm). Each evening (starting at 4:00pm) trucks also picked up merchandise from the various businesses, at a rate of approximately 700 parcels daily (10,000 per month), and these were then delivered to a different center – the Toko terminal. All parcels arriving at this terminal were sorted and available for pick up by the different participating companies [5, 6]. Figure 2, below, provides a graphic sketch of the consolidation system in the late 1990s.

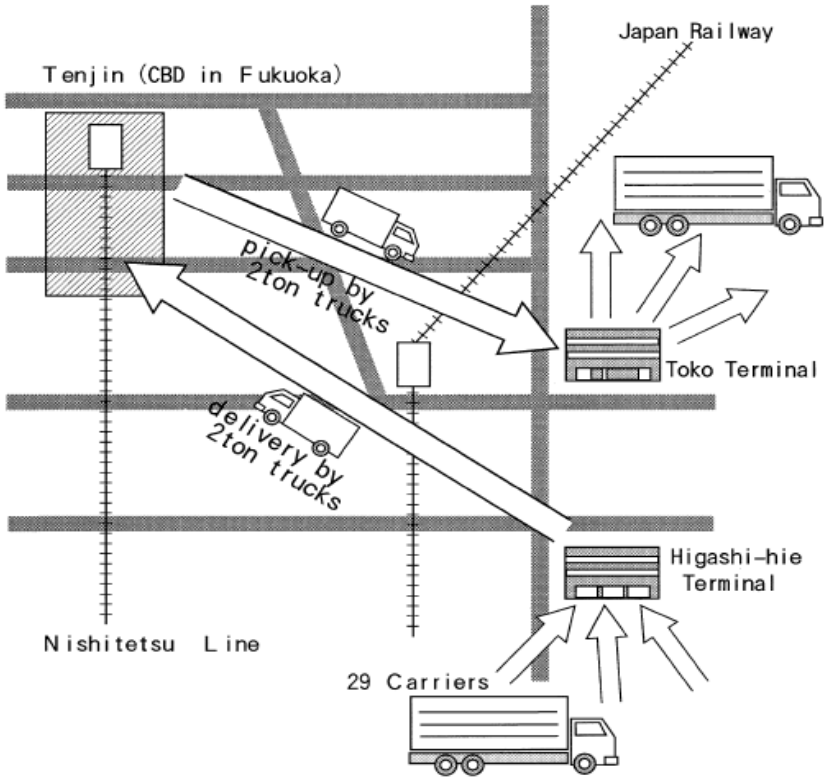

Figure 2. Sketch of the Tenjin Joint Distribution System in the City of Fukuoka, Japan
Source: *Toshinori Nemoto (1997); Op. Cit.;Transport Logistics, Vol. 1, No. 2, pp 88*

A questionnaire completed in the late 1990s by major commercial establishments in the Tenjin business district, points to some of the challenges faced by the TJDS when attempting to standardize services for its customer base, which includes mostly restaurants and retail stores [5]. The first group requires more frequent deliveries (e.g., of fresh produce) than stores. In 1997, it was reported that the frequency of shipments to restaurants was higher (3.8 deliveries per day, on average) than for retail stores (2 times per day) whilst the number of parcels per store was higher (averaging 14.3 units per day) [5]. Despite the diversity in delivery demands, overall services to various customers in the same general area were improved through co-deliveries and the higher load efficiency ensuing from consolidating parcels on a single truck.

In 2010, the TJDS no longer offers pick-up services and conducts only two rounds of deliveries are made per day, carrying between 2,500 to 3,000 packages daily [2]. The number

of clients served by the TJDS has decreased, as well as the number of members. An likely factor contributing to the decreased is the increase in delivery costs, particularly because of high parking costs. Today, 90% of the members are carriers and 10% are banks requiring deliveries. The customers they serve in 2010 include restaurants and groceries, as well as clothing, electronics, books and variety stores.

Evaluation – benefits and costs:

The success of the AIC endeavor is evaluated in relation to its associated costs to benefits, including social costs and benefits. In general, the costs of freight consolidation operation accrue to the private sector and benefits are perceived by society as a whole (ensuing by re-dressing externalities and/or from avoided "damage" costs). However, since participating logistic companies pay to drop parcels at the Tenjin AIC [9] and participate on a voluntary basis, it is important that benefits also accrue to the participants to justify the additional transshipment costs (and changes in routine) associated with joining and participating in the AIC. Thus, these "private" benefits must be at least equivalent to the costs incurred once they join the freight consolidation system.

In reviewing the cost effectiveness of the Tenjin freight consolidation system from the perspective of each individual carrier or shipper, we compare the costs incurred by each participant in this system to their own perceived benefits. First, costs are measured in terms of that the fees paid per parcel handled at the AIC, which was equivalent to ¥160 (or US$1.6) in 1978 [5] or ¥180 in 2010 [2]. We estimate that each initial participant paid, on average, approximately $66,200 per year for both delivery and pick up services. Collectively, such payments amount to close to US$2 million per year, and this represented the main revenue of the Tenjin AIC, given that it did not receive any subsidies from the public sector. The table below compares revenue/cost profile in 1978 to that of 2010, when less parcels are delivered per day and pick up services have been discontinued.

Table 1: Tenjin AIC's revenue / cost profile (1978 & 2010)

Year & (parcels/day)	Parcels delivered/yr.	Parcels picked-up/yr.	Total parcels /yr.	Revenue (US$)*	US$ per member deliveries/yr.**	US$/member-pick-up /yr.
1997 (3,500)	1,080,000	120,000	1,200,000	$1,728,000	$59,586	$6,621
2010	780000	0	780000	$1,744,526	$54,516	0
(2500-3000)	936000	0	936000	$2,093,431	$65,420	0

* The charge per parcel in 1997 was ¥160; in 2010 it is ¥180. ** 29 members in 1978 and 32 in 2010 (in the late 1990s it had increased to 36 members). Source*: [2] and [5]*

Additional potential costs have not calculated in monetary terms; they may include the participants' perceived losses from their lack of direct contact with consigners and their inability to develop new customers while delivering to regular customers. While such concerns were mentioned when the TJDS started in 1978, it is not clear whether they continue to be an issue today given that various communication and customer-oriented and market tools are available to maintain contact with current customers and/or attract new ones. Upon consultation, we found that today the center itself does not currently have a website or even an official e-mail address.

Another problem has been the need to satisfy the customers' request for frequent deliveries, which was partly addressed by setting three delivery times per day. However, in 2010 the TJDS delivers only twice a day [2]. Finally, establishing responsibility for the losses when merchandize is broken or lost may be addressed through contracts that clearly assign liability for different situations as well as through insurance policies. Nevertheless, there is no information to assess the additional costs (e.g. per parcel) associated with covering insurance policies for all merchandize handled through the AIC system.

While there are several social benefits that have been discussed by various reports, no information has been found that discusses the benefit profile from the perspective of each participating company. One report states that improved load efficiency has been a key to the success of the Tenjin consolidation system and the savings from such efficiency accrue to the TJDS members[6] (as well as to society as a whole). This has been confirmed by operation

[6] As long as the frequency of deliveries by the AIC does not jeopardize the ability of the freight companies to satisfy their own customers' demands for timely shipments. Increasing the load efficiency requires that the AIC waits for a sufficient number of parcels to load on each truck and this often results in end-users having to wait more time to receive their packages.

managers at TJDS who stated that their delivery costs are relatively cheaper than those paid by independent carriers, in part because since 1984 the TJDS has been employing trucks powered by natural gas, and the system has been able to pass on the fuel savings to the customers.

Other cost savings accrue from load consolidation. In 1997 it was estimated that the TJDS had taken 100 vehicles out of circulation per day, and as a result approximately 530 trips and 1590 vehicle-km (~988 VMT) were avoided daily. A survey determined that before its establishment, the TJDS's companies had employed 174 vehicles making 5 round trips or a total of 870 trips and traveling 2,610 vehicle-km (~1,622 VMT). By 1997 the TJDS was employing 34 vehicles, each traveling two round trips per day or an average of 15 km (~9 miles) that included approximately five stops for unloading (and loading) merchandize. This was equal to 68 vehicles, 340 trips and 1,020 vehicle-km (~634 VMT) [5].

In 2010, the TJDS employs from 20 to 24 trucks (2- and 4-ton vehicles), making trips only twice a day, each traveling a maximum of 10 vehicle-km [2]. Table 2, below provides a detailed description of most of the benefits, as estimated in 1997.

Table 2. Benefits ensuing from the TJDS

Area of impact	With TJDS	Without TJDS*	Reduction by TJD
Traffic volume	68 vehicles	174 vehicles = (3 vehicles) x (2 return trips) x (29 companies)	60.90%
	1020 vehicles-km	2610 vehicle-km = (15 km) x (174 vehicles)	
	340 trips	870 trips =(5 trips)x(174 vhcls)	
Traffic congestion along the trunk road	31,635 vehicles	32,900 vehicles (half of reduced trips use this route)	0.80%
Traffic congestion in service roads	2070 vehicle-h	2211 vehicle-h	6.80%
Traffic pollution	0.063 ppm	0.064 ppm = (all reduced trips use the intersection with the monitoring station)	0.40%
Energy	61,968 liters **	62 130 liters	0.30%

* estimated; ** the energy consumption is evaluated using the percentage to the energy consumed by all vehicles traveling within Tenjin.

Source: [5]

Nemoto reported in 1997 that besides reductions in traffic volume, there are slight to moderate improvements in traffic congestion, traffic pollution and energy consumption. In addition, there is higher overall system reliability due to decreased driver shortages, previously experienced by the freight companies.

Another report [10] indicates that by 2004 the freight consolidation scheme had achieved a decrease of 65% in the numbers of vehicles and 28% of traveled distance, as well as reductions in traffic on the main trunk road and vehicle parking times on service roads in the city center. This report showed vehicle trip reduction of 70% with CO_2 savings of 3,100 kg per week [10]. .

Additional measures have the potential to improve the competitiveness of the Tenjin joint distribution center. They include activities that increase the TJDS's revenue, such as adding services offered to customers (e.g., packaging parcels while sorting cargo) or selling advertisement space on the side of the trucks. Various cost reduction measures may also be applied, most of these centering on reducing the time spent during operations. In terms reducing the time spent looking for parking the Tenjin district has re-designated some parking spaces from passenger to freight vehicles. In 1992 "truck only" parking meters were introduced in the Tenjin commercial area; while the TJDS has no exclusive rights to them, this measure has reduced their overall delivery times. Other activity areas may be run more time efficiently if various policy alternatives are introduced. The following have been considered: requiring that buildings have loading docks, developing joint reception of cargos at each building or within each block, employing electric cargo carts to alleviate time spent to access buildings or in-building transportation [5,7].

Conclusion:

While the establishment of the Tenjin Joint Distribution System in Fukuoka was successful in removing vehicles from the road and thus reducing vehicle miles travelled, other social effects have not been significant (e.g., congestion, pollution) in relation to the overall city traffic. Extending both the scope and area of operations would likely relieve traffic congestion, in particular on service roads. However, some issues remain to be addressed because they preclude the expansion of this freight consolidation system. First, the business

model needs to be better demonstrated to the private sector, in particular private benefits that carriers may accrue by joining the TJDS. Furthermore, given that in 2010 deliveries only take place twice a day (instead of three times) and pick up deliveries have been dropped altogether, it is likely that the TJDS today is less attractive to logistic companies than when it started operating and this may explain why the number of cooperating companies has dropped from 36 in the late 1990s to 32 in 2010. The managers of the TJDS have told us that the number of deliveries has been cut because each journey has become relatively more expensive – mostly because of increased parking costs.

Furthermore, from our communications with the TJDS in 2010 (through a translator) we perceived that the center is losing competitiveness, and thus clients. The reasons remain unclear and further information is required, but the center's failure to adopt new or commonly used technologies (website, e-mail) or the lack of strategic plans for recruiting new clients (none were in place), may partially explain why this consolidation system seems to be declining. Nevertheless, we are unable to determine whether these are important factors or whether there are more fundamental issues at hand.

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