Common MicroHub Research Project
Research Scan

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Supply Chain Transportation & Logistics Center
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1. Microhub Definition

This research scan revealed a lack of an established and widely accepted definition for the concept of consolidation centers or microhubs. Many recent implementations of urban freight consolidation have focused on bundling goods close to the delivery point by creating logistical platforms in the heart of urban areas (1). These have shared a key purpose: to avoid freight vehicles traveling into urban centers with partial loads (2).

To establish definitions of micro-consolidation and its typologies, it is important to review previous efforts in the literature that have explained and evaluated urban consolidation centers and lessons that have led to the search for new alternatives. Starting in 1970s, the urban consolidation center (UCC) concept was implemented in several European cities and urban regions (3). These were mostly led by commercial enterprises with temporary or even structural support from the government to compensate for additional transshipment costs (4). Allen et. al. defined the UCC as a "logistic base located in the vicinity of the place of performing services (e.g., city centers, whole cities, or specific locations like shopping malls) where numerous enterprisers deliver goods destined for the serviced area from which consolidated deliveries as well as additional logistic and retailed services are realized"(5).

Many of these implementations failed to operate in the long term because of low throughput volumes, the inability to operate without financial support from government, and dissatisfaction with service levels (5, 6). The cost of having an additional transshipment point often prevented the facilities from being cost-effective, and they could not operate when governmental subsidies were removed (4). From a commercial perspective, experiences with publicly operated UCCs were mostly negative, and centers that have operated since 2000 are often run single-handedly by major logistics operators (5).

Although it appears that many UCCs were not successful, that does not mean that the idea of an additional transshipment point should be sidelined completely (4). Several studies have mentioned the micro-consolidation concept as a transition from the classic UCC. Learning from previous experiences, Janjevic et. al. defined micro-consolidation centers as facilities that are located closer to the delivery area and have a more limited spatial range for delivery than classic UCCs (1). Similarly, Verlinde et. al., referred to micro-consolidation centers as "alternative" additional transshipment points that downscale the scope of the consolidation initiative further than a UCC (4).

In this project, a delivery microhub (or simply a microhub) was defined as a special case of UCC with closer proximity to the delivery point and serving a smaller range of service area. A microhub is a logistics facility where goods are bundled inside the urban area boundaries, that serves a limited spatial range, and that allows a mode shift to low-emission vehicles or soft transportation modes (e.g., walking or cargo bikes) for last mile deliveries (1, 7, 8).

2. Motivation / Potential Benefits

Studies evaluating the results of microhub implementations have revealed that microhubs and the use of low-emission vehicles for last mile deliveries can offer environmental, economic, and cultural benefits. Microhubs, when paired with environmentally friendly vehicles, can lower pollutant emissions (7, 9). Public authorities in cities are moving toward policies that increase regulations on freight delivery time windows, vehicle type restrictions, and environmental zones (10). Freight systems that use microhubs to shift to cleaner modes will allow businesses to adapt to these changes. For example, the Portland Bureau of Transportation mentions establishing delivery microhubs as a long-term recommendation (11).

Microhub implementations have the potential to increase efficiency in terms of time, travel, and cost for freight companies. Studies have shown that total freight vehicle miles traveled (VMT) is reduced in areas where microhub facilities have been implemented (1, 12). Lee et. al.'s study showed that microhubs lower the total operational time for freight companies, even though they require longer travel times to complete all deliveries (7), because the service time (i.e., time to unload the vehicle and deliver the package to the receiver) is reduced and this compensates for the time lost during travel. These urban freight facilities also allow for off-hour deliveries, which can save up to 35 percent in costs because of the increased productivity of urban supply chains (13). Microhubs offer the guarantee of an available and secure unloading area close to the city center, where there is heightened competition for limited curbside space (5). Moreover, city centers usually offer cultural value and touristic attractions in the forms of historical sites, buildings, and infrastructure. And microhubs allow for cultural site preservation at city centers because they reduce the number of vehicles entering urban areas (1, 4). Finally, both traffic safety and the shopping environment improve with fewer large trucks in the city (6).

3. Conditions for Success

There are several key elements to consider when the potential success of microhub operations is evaluated.

Earlier experiences showed that multi-sectoral collaboration is necessary to obtain a working, self-sustaining facility (7). This includes government contribution, as well as scientific support through research and mediation, in the planning phase (6). A microhub operates more successfully with support from public authorities to make and enforce environmentally friendly policies (7, 6). Frequently, carriers' interest in the use of urban freight facilities is overestimated during the planning phase (14). So for multi-carrier consolidation operations, a quantified estimate of the number of potentially participating carriers is crucial at an early stage (15).

Another important aspect to consider for microhub implementations is location. The facility should serve areas in the city where delivery activities are difficult because of limited curb space for large vehicles, limited access on streets, and restricted traffic conditions (typically due to pedestrian prioritized planning) (4, 7, 8).

The microhub operations should be implemented in high-demand, high-density areas where high volumes of delivery throughput accumulate in one area (4, 16). These are necessary to first justify the need for a change in the urban freight system and to later keep microhubs sustainable and efficient during operation. Also, in cases involving multi-carrier practices, it is crucial to have strong cooperation and trust among partner carriers. To produce even more efficient results, stakeholders need to share a mindset of balancing the city's economic vitality and environment (16), build trust among partners (8), and compromise by having a neutral carrier operate joint delivery systems.

4. Microhub Models / Initiatives

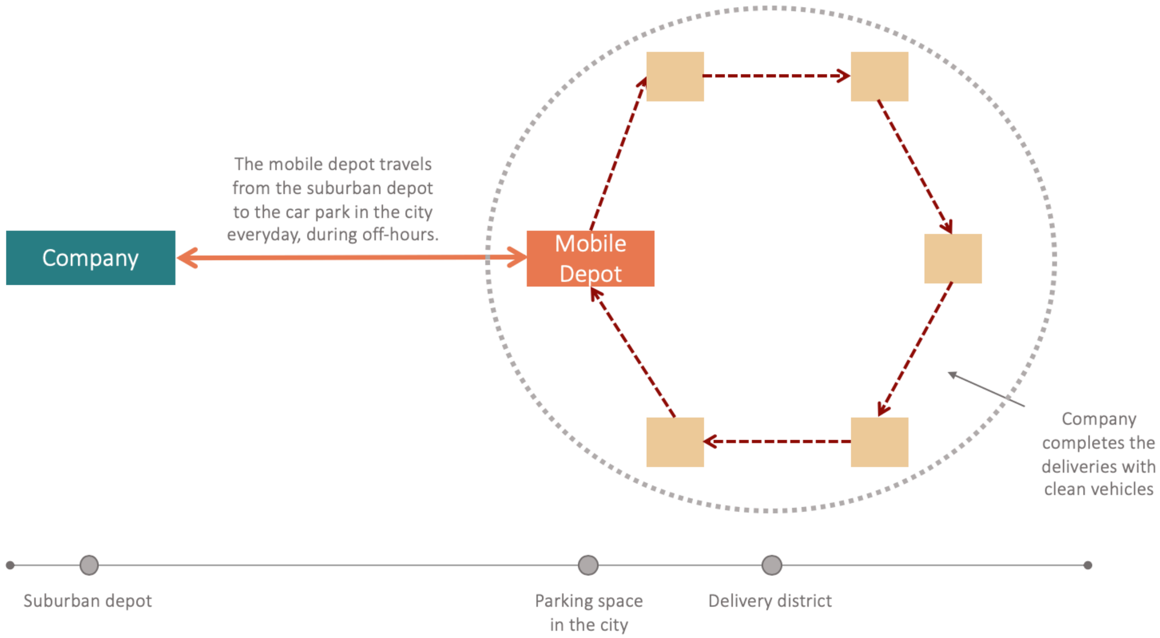
Businesses may implement a variety of operational models to integrate microhubs into their logistics and supply chain operations (7). When an operational model is chosen, a key consideration is whether the microhub will be used solely for one carrier or designed to allow a mix of multi-carrier consolidation efforts. In this section, various micro-consolidation initiatives that have been implemented in different cities across the world are described. Figures 1 to 4 illustrate logistics systems with different operational models, where dashed arrows indicate transportation via clean vehicles such as electrically assisted cargo bikes.

4.1. Single carrier consolidation

Origin-combining of urban store deliveries is the most common practice (6). Only one business is responsible for organizing this form of consolidation and only that business profits from it. Figures 1 and 2 show the delivery system and vehicle operations for the single carrier consolidation approach.

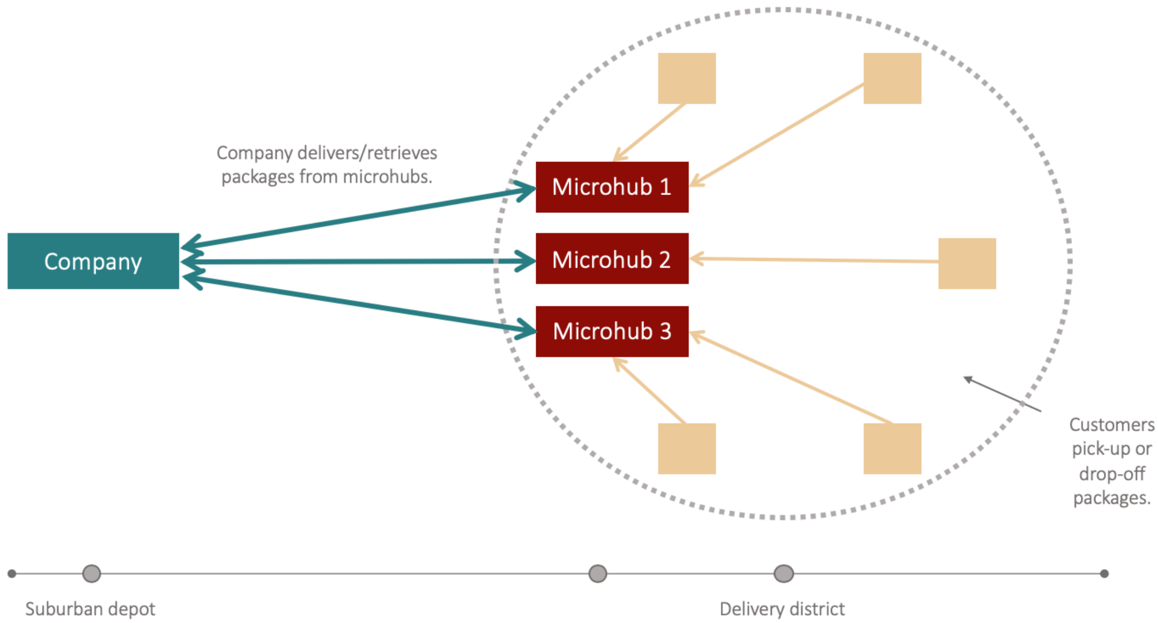
In an approach to goods consolidations, TNT Express pilot tested the innovative mobile depot concept in Brussels, an area with a high density of small shipment deliveries, for three months in 2013 (17, 18). The mobile depot was a trailer outfitted with a loading dock, a small warehousing facility, and an office. As seen in Figure 1, the consolidated transport of goods toward the urban area was performed from a suburban depot by the mobile depot during off-hours. The trailer was loaded with all inner-city deliveries for the day, it was towed to a central location in the city, and parcels were then delivered in a cyclic fashion. Delivery staff used electrically-assisted or human-powered vehicles to complete delivery rounds and returned to the mobile depot to reload and start a new round. Verlinde et. al. studied this pilot test and found a significant drop in emissions of pollutants and the number of diesel kilometers (17). Similar examples of mobile city hubs include a private green delivery service provider in Paris, Vert Chez Vous, that used a barge on the River Seine as a mobile city depot (1, 19).

Figure 1: Single carrier consolidation approach with the use of mobile depots



As another example of single-carrier consolidation practice, United Parcel Service (UPS) facilitates micro-consolidation practices with its "Access Point" implementation. UPS Access Points are affiliated retail locations (including grocery stores and gas stations) or UPS stores where customers can collect or drop off their packages. The use of access points allows customers to retrieve their packages at their desired times, and therefore it reduces failed first deliveries. UPS also installs secured locker systems at some of its Access Point locations in Europe and North America (20). Last mile deliveries are thus completed by customers, as seen in Figure 2.

Figure 2: Single carrier consolidation approach with pick-up points

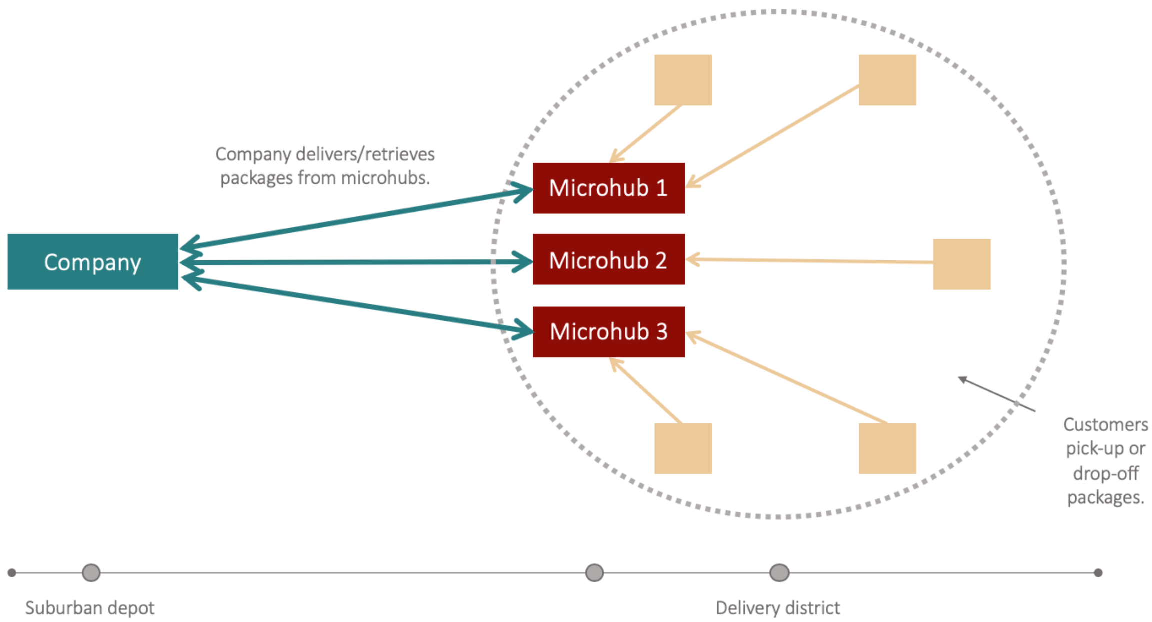


Many microhub pilot projects have taken place in Oslo, Norway, in the context of the city's progressive, environmentally friendly policies, including the elimination of the use of cars in the city center (21). Even though urban freight logistics are primarily addressed by the private sector, government is interested in the way these logistics are carried out and is often involved in the collaborative planning stages of private micro-consolidation initiatives. The Oslo City Hub, for instance, located at the Port of Oslo in the city center, started its operation in May 2019 (8). The collaboration among different stakeholders, including the Port of Oslo, Filipstad Utvikling, which rents the area from the port, and DB Schenker, made the Oslo City hub possible. The city hub is a temporary space built with portable containers and operated by the private carrier company DB Schenker. The city hub allows goods to be reloaded from larger vehicles to smaller, electric vehicles that contribute to both the company's and city's zero emissions goals.

4.2. Multi-carrier consolidation

The multi-carrier consolidation approach is more difficult to organize than a single-carrier hub because it requires cooperation among the stakeholders, and it is not always clear who will benefit financially. Figure 3 shows the logistics system for the multi-carrier consolidation approach.

Figure 3: Multi-carrier consolidation approach



Binnenstadservice (BSS) started business in April 2008 in the city of Nijmegen, the Netherlands (6). Defined as a new type of UCC, BSS's facility is located about 1.5 kilometers from the medieval city center. Unlike past urban consolidation initiatives in the Netherlands, BSS adopted a receiver-focused approach. Receivers, mostly shop owners, ask Binnenstadservice to receive their goods from carriers, store them, and then deliver them when they are needed by the shop owner. Figure 3 shows how a microhub is set up to enable the operation in the multi-carrier consolidation approach.

BSS received a governmental subsidy to support its establishment phase, which included building new stores and finding new clients. To make this extra service more preferable than the basic free-of-charge service, BSS also negotiated with carriers delivering to the city to share their cost savings. With an increasing number of receivers and stores in its network, BSS enables freight companies to reduce their number of trips into the city and therefore save costs. This service is currently established in eight cities in the Netherlands, including Rotterdam and Utrecht. Operations started in 2008 with 20 clients, mostly small and independent retailers, and increased to 98 connected stores in one year.

Van Rooijen et. al. examined the local impacts of BSS and reported that it decreased the number of trucks and truck miles traveled in the city center. As the number of BSS stores and clients increased, the truck miles traveled continued to decrease. In addition, residents faced less inconvenience caused by freight transport operating in urban centers. The inconvenience for residents was measured as the number of loading/unloading activities that each resident experienced within 100 meters of their home (6).

In Japan, since 1978, joint delivery systems have been available to increase the efficiency of urban freight operations in cities and reduce the negative impacts of urban deliveries. In 2004, an association of retail shop owners implemented a consolidation center in Yokohama, Japan, following a pilot project with financial support by the municipality (22). The facility was located 1 km from the highly congested shopping area of Motomachi Street and included 85 percent of goods delivery to the area. The Motomachi Shopping Street Association managed and financially supported the neutral carrier. The carriers were asked to transfer parcels destined to Motomachi Street to the consolidation center and to pay the neutral carrier to complete the delivery. The neutral carrier made the last mile deliveries using low emission (compressed natural gas) vehicles. Taniguchi et. al. reported that the number of trucks decreased from 100 vehicles operated by 11 companies to 29 vehicles operated by 1 company in 10 days (16, 22).

A special case of the multi-carrier consolidation approach is when several microhubs are implemented in the city and some of them allow multi-carrier consolidation. In this mixed model, some microhubs receive deliveries from multiple businesses, and all last mile deliveries are completed by a single operator. In 2009, Gnewt Cargo, the largest fully electric fleet in London, started its operation using electrically-assisted tricycles and electric vans for the company's Office Depot stores (12, 23). The public authorities in London implemented policies such as the Ultra Low Emission Zone in 2019 (ULEZ) and improved electric vehicle infrastructure (24). Because of these policies, more businesses were encouraged to use green urban freight delivery systems, and Gnewt Cargo's operations expanded. Gnewt Cargo completes deliveries to its clients such as Hermes, TNT, and retailers in the area by using micro-consolidation centers in London, some of which are shared by multiple clients (25). As seen in Figure 4, client company trucks reach city centers during off-hours by traveling to their own facilities (if they are close enough to the city) or to Gnewt Cargo's depots. The collaboration between the clients and Gnewt Cargo enables the company to use the client's facility as an additional depot, and Gnewt Cargo's electric vans are parked there at night (26). The report prepared for the Greater London Authority stated that as a result of this practice, CO_2 emissions decreased by 88 percent per parcel, and the total distance traveled for all vehicles in London decreased by 52 percent per parcel (27).

Figure 4: Mixed multi-carrier consolidation approach

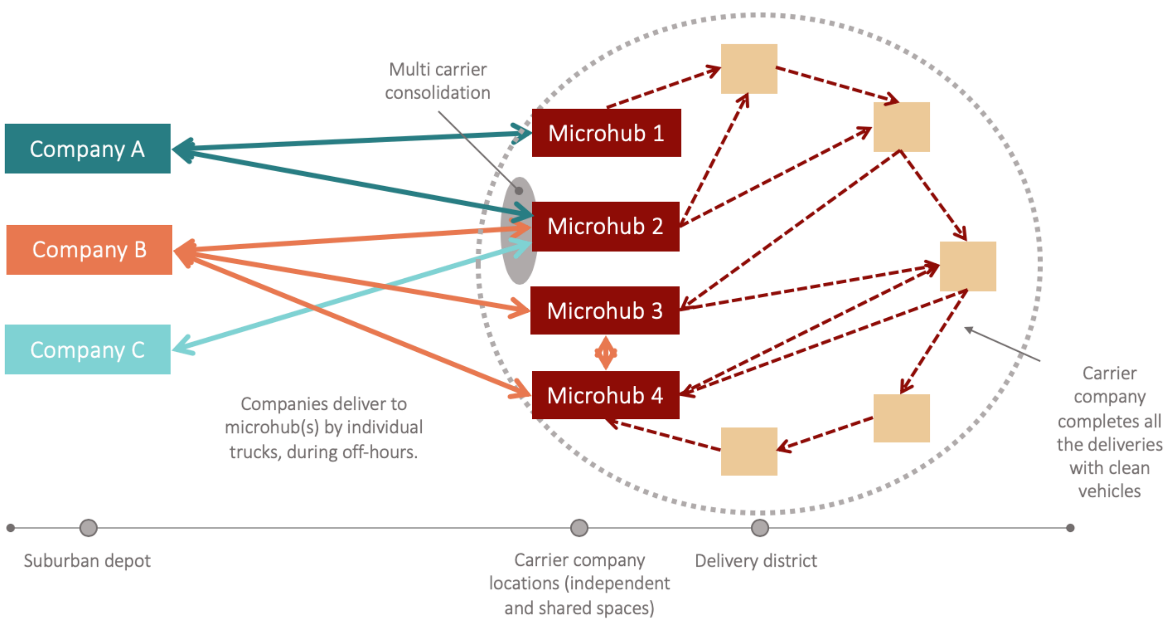


Table 1 below provides a summary of the different features of each microhub example, including the consolidation approach, the mode used for last mile delivery, different government contributions to support microhub operations, and reported results.

	NAME	LOCATION	CONSOLIDATION APPROACH	OPERATION TYPE	LAST MILE DELIVERY MODE	GOVERNMENT CONTRIBUTION	REPORTED RESULTS
1	TNT Mobile Depot	Brussels, Belgium	Single carrier (TNT)	Mobile	Electric powered tricycles	Investment cost partly covered by European Commission	•Reduced pollutant emissions (CO_2 by 24%, PM2.5 by 59%) •Reduced diesel kilometers miles traveled per stop from 1.34 km to 0.52 km
2	UPS Access Point	Several locations	Single carrier (UPS)	Fixed	Customer pick-up drop-off	-	Unknown
3	Oslo City Hub	Oslo, Norway	Single carrier (DB Schenker)	Fixed	Electric powered tricycles and vans	Contribution of multiple public agencies at planning process	Unknown
4	Binnenstad service	Nijmegen, Netherlands	Multi-carrier	Fixed	Electric powered tricycles and natural gas trucks	Government subsidy for 1 year	•Reduced number of trucks and truck miles traveled in the city •Less inconvenience for residents •Reduced CO_2 and pollutant emission by 40%
5	Motomachi Shopping Street	Yokohama, Japan	Multi-carrier	Fixed	Natural gas trucks and human powered carts	Financial support for a prior pilot project	•Reduced number of trucks
6	Gnewt Cargo	London, United Kingdom	Multi-carrier	Fixed	Electric powered tricycles and vans	Operational funding of EUR 288,000	•Reduced CO_2 emissions by 88% per parcel •Reduced total vehicle distance traveled by 52%

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