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Are Cities' Delivery Spaces in the Right Places? Mapping Truck Load/Unload Locations

Two converging trends – the rise of e-commerce and urban population growth – challenge cities facing competing uses for road, curb and alley space. The University of Washington has formed a living Urban Freight Lab to solve city logistics problems that cross private and public sector boundaries. Funding members include Costco, Nordstrom, UPS and USPS; the lab partners with the Seattle Department of Transportation. To assess the capacity of the city's truck load/unload spaces, the lab collected GIS coordinates for private truck loading bays, and combined them with public GIS layers to create a comprehensive map of the city's truck parking infrastructure.

21.1. Introduction

Two converging trends – the rise of e-commerce and urban population growth – are creating big challenges for cities. Online shoppers are learning to expect the urban freight delivery system to bring them whatever they want, wherever they want it – and within one to two hours.

City managers and policy makers were already grappling with high demand and competing uses for scarce road, curb, sidewalk and alley space. If cities do not act quickly to revamp the way they manage increasing numbers of commercial vehicles unloading goods in streets and alleys and into buildings, they will drown in a sea of double-parked trucks.

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The Supply Chain Transportation and Logistics (SCTL) Center at the University of Washington (UW) has formed a new Urban Freight Lab in partnership with the City of Seattle Department of Transportation (SDOT) to solve delivery system problems that cities and the business sector cannot handle on their own. Urban Freight Lab private sector members include retailers Costco Wholesale and Nordstrom, and delivery firms UPS and the United States Postal Service (USPS). Both private sector members and SDOT are funding the work of the Urban Freight Lab.

The core problem facing cities is that they are trying to manage their part of a sophisticated data-powered 21st-Century delivery system with tools designed for the 1800s – and they are often trying to do it alone. Consumers can order groceries, clothes and electronics with a click, but most cities only have a stripe of colored paint to manage truck parking at the curb. The Urban Freight Lab brings the private sector and city government together in applied research projects that develop advanced solutions.

21.2. Moving more goods, more quickly

Millions of people who shop online now purchase more than half of their goods online. The growth of e-commerce is putting pressure on local governments to rethink how they manage street curb parking and alley operations for trucks and other delivery vehicles. It also forces building operators to plan for the influx of online goods. A few years ago, building concierges may have received a few flower bouquets. Now many are sorting and storing groceries and other goods for hundreds of residents every week.

In the first quarter of 2016, almost 8% of total U.S. retail sales took place online. Surging growth in US online sales has averaged more than 15% year-over-year since 2010. Black Friday web sales soared by 22% from 2015 to 2016.

Online shoppers' expectations for service are also rising. Two out of three shoppers expect to be able to place an order as late as 5:00 p.m. for next-day delivery. Three out of five believe that orders placed by noon should be delivered the same day, and one out of four believe that orders placed by 4:00 p.m. or later should still be delivered on the same day.

City living and shopping is still all about location. One reason people are attracted to urban neighborhoods is because they prefer to walk more and drive less. Respondents in the 2015 National Multifamily Housing Council-Kingsley Apartment Resident Preferences Survey preferred walking to grocery stores and restaurants rather than driving by 7%. This lifestyle requires merchants to deliver goods to customers' homes, office buildings or stores close to where they live. Walkable communities rely as much on the goods delivery system as they do pedestrian infrastructure and transit services.

21.3. Establishment of a well-defined partnership

The SCTL Urban Freight Lab is a living laboratory comprised of retailers, urban truck freight carriers, technology companies supporting the transportation and logistics sector, retail/commercial and multifamily residential building developers and operators. It is organized and staffed by the SCTL Center, and limited to 10–15 companies who pay an annual membership fee to support specific research projects taken on by the Lab. The four founding members of the Urban Freight Lab: Costco, Nordstrom, USPS and UPS have dedicated senior corporate and regional executives to work with the Lab, as well as providing funding.

SDOT has entered into a long-term strategic research partnership with the SCTL Center to research and improve operations of the urban goods delivery system. The agency recently published Seattle's first Freight Master Plan, found at http://www.seattle.gov/transportation/docs/fmp/FMP_Report_2016E.pdf, which includes high-level policy recommendations and potential strategies to improve the urban goods delivery system. However, before city managers implement them, they need evidence to prove which concepts will deliver results.

Many of the Freight Master Plan's strategies focus on the management of truck parking and unloading goods in commercial vehicle load zones, other curb spaces, freight loading bays and alleys. The Urban Freight Lab's research will help SDOT to meet such needs in the center city, as it anticipates that fewer commercial vehicle on-street loading zones (CVLZs) will be available in the future as space is repurposed for bike lanes, street cars and buses. It will also be used to support the next step in SDOT's planning process: a Freight Implementation Plan with budget and operational recommendations that is expected in 2018–2019.

The SCTL Center Urban Freight Lab is designed to deliver new data-based knowledge about the effects of several truck freight parking and freight-bay action strategies proposed for implementation in the city of Seattle, before they are broadly applied.

Figure 21.1. *Second Ave. sidewalk, bike lane, CVLZ, through lanes, and bus stop in downtown Seattle. For a color version of this figure, see www.iste.co.uk/taniguchi/cities2.zip*

To ensure that project results are reported openly and objectively, SCTL researchers invited several internationally known experts to independently and critically evaluate the Urban Freight Lab's innovations in project approach, methodologies and results. The expert review panel includes representatives from the New York City Department of Transportation and the City College of New York. They were chosen for their expertise and their ability to advise the Urban Freight Lab on the national scalability of solutions tested in Seattle.

21.4. The Final 50 Feet project

The Urban Freight Lab's first research project is addressing the "Final 50 Feet" of the urban delivery system. The "Final 50 Feet" is shorthand for the last leg of the delivery process that begins when a truck stops at a city-owned curb, commercial vehicle load zone or alley, or in a privately owned building freight bay. It extends along sidewalks, and ends when the customer takes final receipt of the goods, whether that is the concierge in the lobby or the customer at their front door.

The Urban Freight Lab members have set two goals for the final 50' research project in 2017. The first is to reduce dwell time: the time a truck is parked in a load/unload space. There are both public and private benefits to reaching this goal:

– lower costs for delivery firms, and therefore, potentially lower costs for their customers;

– better utilization of public and private truck load/unload spaces will create more capacity without building additional spaces;

– less block circling as spaces turn over more quickly; and

– room for other vehicles to move through alleys – trucks can legally unload at both ends of the alley, but when they are there they can block other uses.

Figure 21.2. *Commercial vehicles parked on an alley (left) and commercial vehicle load zone on-street (right) in Seattle. For a color version of this figure, see www.iste.co.uk/taniguchi/cities2.zip*

The second priority goal is to reduce failed first deliveries. Several Urban Freight Lab members told the research team that 8-10% of first delivery attempts in urban areas fail. A study conducted in the UK reported that the rate of failed first deliveries was 12%. City residents and workers do not receive their parcels due to theft, or because they were not there to accept them.

Reducing failed first deliveries will:

– improve urban online shoppers' experiences and protect retailers' brands;

– cut business costs for the retail sector and logistics firms;

– cut crime and provide a safer environment for residents and workers;

– improve an amenity that adds value at multifamily properties – the ability to ensure that their tenants can shop online and get their order when they expect it;

– ensure that all city neighborhoods can receive online orders, not just a few; and

– lower traffic congestion in cities, as delivery trucks could make up to 10% fewer trips while still completing the same number of deliveries.

One way to cut delivery failure rates would be to place secure, common drop-off points for multiple carriers to use near transit stations or on city streets. Seattle is considering pilot testing common receptacles, such as lockers, in public locations.

Unlike government-driven strategies such as "freight villages" popularized in the EU, and schemes such as that recently proposed by researchers in the UK to have a trusted third party manage and consolidate multiple carriers' operations, the common carrier locker pilot was proposed by the private sector members of the Urban Freight Lab.

Figure 21.3. *Notices of failed first deliveries just before Christmas 2016, photo by B. Ivanov, UW. For a color version of this figure, see www.iste.co.uk/taniguchi/cities2.zip*

21.5. Getting granular

To lay the groundwork for the Final 50' research project, an SCTL data collection team collected existent and original data to locate truck load/unload spaces in all 523 blocks of Seattle's downtown (including Belltown, the commercial core, Pioneer Square and the International District), South Lake Union and Uptown Urban Centers in the fall of 2016.

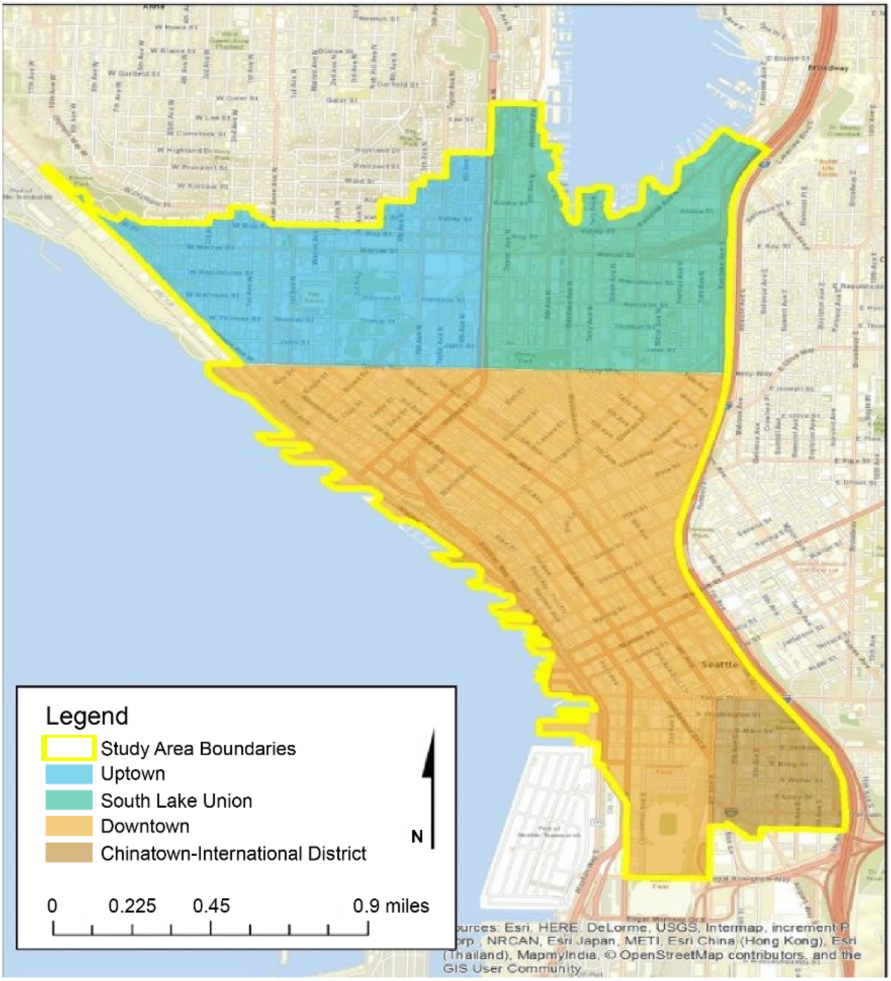

Figure 21.4. *Study area boundary and subareas in the City of Seattle. For a color version of this figure, see www.iste.co.uk/taniguchi/cities2.zip*

The following section describes the development of a simple method to capture and geocode (locate) all truck load/unload locations across large areas of the city. It includes the lessons learned in each step of the process that will be helpful to others implementing a similar data collection effort.

21.6. Mapping the city's freight delivery infrastructure

The first task in determining whether the truck load/unload spaces in the city are in the right places to serve surrounding land uses and manage competing demands, and if there is sufficient capacity to meet current and future needs, is to document the current locations and infrastructure features of all the truck load/unload spaces. While street parking was well-documented in Seattle's geospatial databases, off-street privately owned facilities such as loading docks and loading bays were not.

21.6.1. *Step 1: collect existent data*

The research team used SDOT's publicly available GIS layers of its designated curbside parking uses, as well as King County's (the county in which Seattle is located) GIS layer of Seattle's alleys, to begin developing a multi-layer map of the truck load/unload locations in the city's urban centers.

Researchers in other large cities may find that these existent data are readily available as well, making this low-cost step easily scalable at the national level. The cost comes from staff time spent collecting the data layers, and working with agency staff to clean some data points, if necessary. This could be internalized in agencies with GIS-trained staff, or purchased at a low cost from contractors if there is not a high requirement to clean the data for this purpose.

21.6.2. *Step 2: develop survey to collect freight bay and loading dock data*

In addition to geospatial data regarding on-street parking, off-street freight facilities must be mapped. To accomplish this, SCTL developed an original data collection process to collect the GIS locations and infrastructure features of all freight loading bays and loading docks in private buildings in the urban centers. SCTL's intention was to create a replicable low-cost method, so the team purchased over-the-counter tools whenever possible. The initial process has been tested and revised to overcome obstacles encountered on the ground.

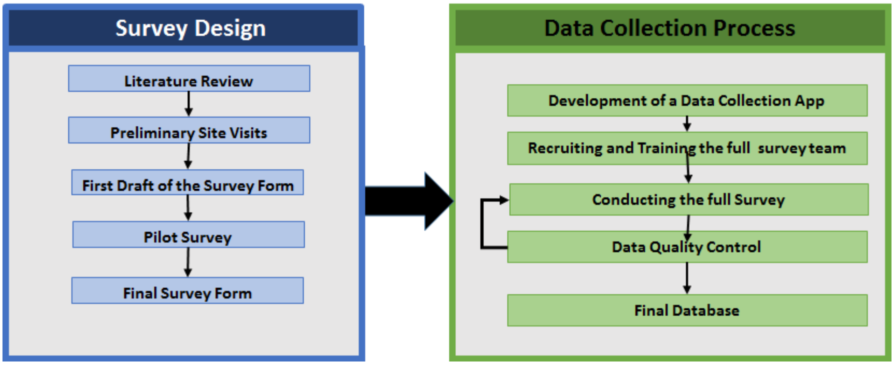

Figure 21.5. *Overview of methodology used to collect data on private freight bays and loading docks*

21.6.3. *Preliminary site visits*

The researchers first reviewed previous online reports, papers and Seattle's building codes to identify the terminology used to describe urban freight facilities and their physical features. The team also made site visits to downtown Seattle and spoke to the people working in these facilities including truck drivers, concierges at residential towers and security officers. The critical first step was to listen carefully to the process experts, who manage and work in the facilities every day. The team identified two types of private truck facilities owned and operated inside of buildings: loading bays and loading docks. A loading bay is defined as the interior building space used for unloading and loading activities and may include truck load/unload spaces, single or multiple loading docks, room to negotiate truck turns, truck entrances and exits, trash compactors and storage space for waste and recycled materials.

Loading docks are elevated platforms that truck drivers use to unload/load goods; they are typically the same height as the floor of a truck to facilitate loading and unloading. Loading docks may be exterior, flush with the building envelope or fully enclosed. They are part of a facility's service or utility infrastructure, typically providing direct access to staging areas, storage rooms and freight elevators.

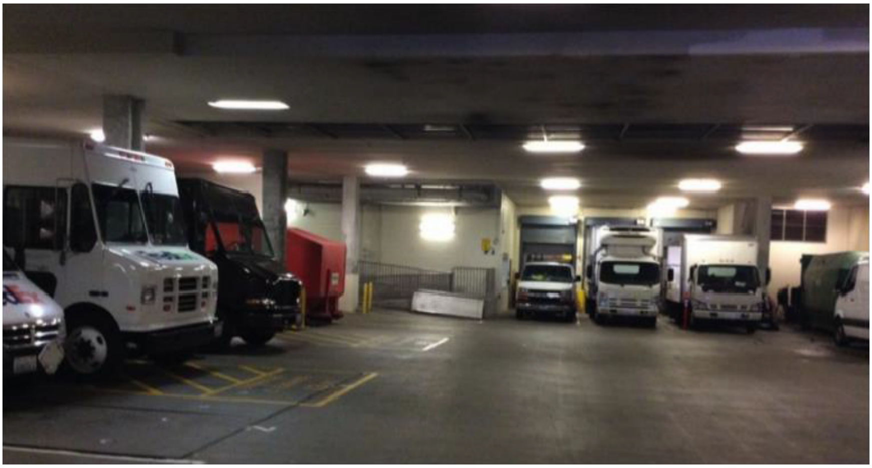

Figure 21.6. *Freight loading bay inside a Seattle building; J. Machado, UW*

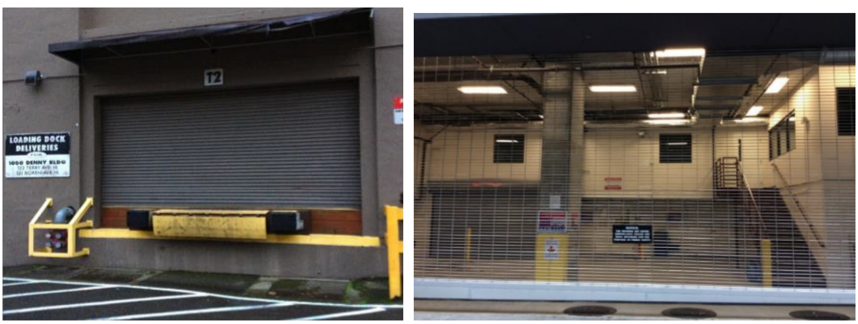

Figure 21.7. *Left to right: closed loading dock on building; secure freight loading bay; J. Machado, UW*

21.6.4. *Initial survey form and the pilot survey*

The SCTL data collection team designed and pilot tested a survey to document the key observable features of freight bays and loading docks inside of buildings, and to geocode their locations. After finalizing the instrument and developing an application for data collection, teams of SCTL graduate students (operating in pairs) tested it in downtown Seattle. The six block pilot area is shown in Figure 21.8. The data collection team used laser measurement devices bought at a local home improvement store that cost less than $150 each and completed measurements while standing on public sidewalks and in alleys.

The pilot survey proved that the team could quickly and easily measure the entrances to open freight bays on foot. It gave the project manager a clear understanding of how long it took to complete the survey per city block, so he could create a funding staffing plan and schedule for full implementation.

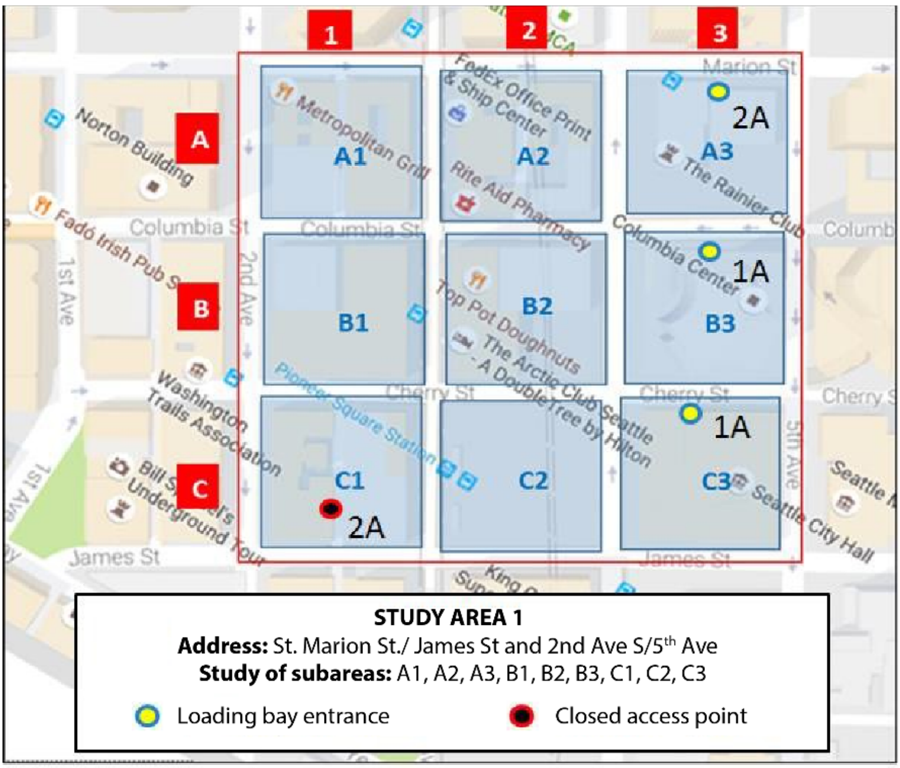

Figure 21.8. *Pilot test study area. For a color version of this figure, see www.iste.co.uk/taniguchi/cities2.zip*

The pilot survey showed that it would be difficult to collect complete data as some entrances were closed and their interior could not be observed from the public right of way.

Other features of interest such as turning radius, maximum truck size and centerline distance were not possible to measure in the field due to the complexity of the geometrical feature, the lack of knowledge or unavailability of the facility staff, or the lack of paint signs on the pavement.

The final survey form contained the following data elements:

– Survey ID

– Date and time of survey

– Photos of the facilities

– Location respective to the street:

- Alleyway (one-way or two-way?)

- Street

- Other: _____________

– Closest street name

– Door clearance and width (ft.). If dimensions were not collected, why were they not available?

– Freight facility type:

- Loading bay entrance or exit

- Loading dock

- Closed door (not observable)

- Other

– Access alignment with traffic:

- Angled to, or against, traffic

- Perpendicular

- Parallel

– Truck ingress/egress:
  - Entrance same as exit
  - Separate entrance and exit
  - Not observable
– Access maneuver:
  - Drive-in or back-in
  - Not observable
– Access security:
  - Physical barrier
  - Access code
  - Personal interaction with security guard
  - No barrier
– Total number of truck spaces
– Apron
– Dock type:
  - Adjustable or fixed
  - Not observable
  - No dock
– Dock height (ft.). If adjustable dock type, minimum and maximum height
– Additional observations

21.6.5. *Step 3: implement the survey*

21.6.5.1. *Development of a data collection app*

The team developed an application using the online platform DeviceMagic that offers cloud storage service and visualization, and an interactive and easy-to-use tool to design mobile device survey forms compatible with iOS and Android. The mobile data collection app was chosen as the data collection instrument for surveyors to gain:

– efficiency: automation of data digitization and photo collection and storage;

– flexibility: the form can be revised if surveyors encounter unforeseen infrastructure conditions that require a new data structure;

– speed;

– low cost;

– accuracy: reduce transcript errors and help reduce data lost in transit;

– quality control: almost real-time data collection monitoring and spatial visualization of completed surveys.

The researchers bought two iPad mini 2s with 32 GB and Wi-Fi and cellular option. These were purchased for the field survey for $360 each. Using the online platform on the tablets, surveyors filled out the survey form, took pictures and used the devices' GPS capability to locate facilities. The survey form supported automatic entry of GPS locations, and allowed manual input of the same coordinates supported by offline Google maps. Each pair of surveyors used one device: one measured the features while the other entered the data into the app. Surveyors also kept track of all the locations surveyed on a printed map and list for quality control purposes.

21.6.5.2. *Recruiting and training the data collection team*

The project manager hired undergraduate students of the University of Washington and trained them to conduct the survey. He provided two to three hours of training on how to use the questionnaire in the app on a tablet computer and how to use the laser device to measure physical features. As part of their training, he also personally supervised their work on city streets during the first week of the full implementation of the survey.

21.6.5.3. *Conducting the full survey, with a twist*

SDOT contracted with the SCTL Center to map alleys and private freight loading bays in three of the city's designated urban centers: Downtown Seattle, Uptown and South Lake Union (see Figure 21.4). The combined area has a regular street grid of 523 blocks.

Although they did not find technical difficulties while executing the full survey, the team quickly ran into problems due to security concerns. On the third day of data collection, they measured a freight bay under a bank building from a nearby sidewalk. The building security guard reported them to the Seattle Police Department (SPD). A police officer arrived on the scene, reviewed the UW letter they carried explaining that they were working on behalf of the city, and called various city staff to verify their story. As he could not reach the SDOT project manager, the students had to stop their work and regroup.

City police were able to contact the SDOT project manager the next day, as did a Federal Bureau of Investigation (FBI) agent responsible for homeland security. They were very reasonable, and suggested several changes that were implemented by SCTL including adding the SDOT manager's contact information to a letter on SDOT letterhead. Once informed about the project, SPD notified all building managers in the survey area in real time through the Seattle Shield program, a pre-existing information exchange for building operators and the police. SDOT also set up a new webpage at http://www.seattle.gov/transportation/thefinal50feet.htm to periodically publish information on progress made during the full survey and let the public know where the surveyors would be in upcoming weeks. The lesson learned is that before conducting an on-street survey of private buildings, it is essential to have a multilayer communications plan in place for all parties with an interest in the survey area.

21.6.5.4. *Quality control*

The quality control process included the following tasks:

– Information transfer check 1: the number of completed surveys was checked based on paper-format maps and the list filled in the field by surveyors to keep track of the number of surveyed locations.

– GPS location accuracy check 1: used offline Google Maps on tablet during data collection.

– GPS location accuracy check 2: comparison of Google Maps Street View images at GPS location and pictures collected.

– Data entry accuracy check 1: the infrastructure features were checked based on the pictures taken during the survey.

– Data entry accuracy check 2: the team collaborated with experienced UPS truck drivers who serve the study area to identify survey locations that were closed during the survey.

– GPS location and data entry accuracy check 3: The quality control process also resulted in secondary inspections at survey locations where either there was an infrastructure not yet surveyed or the surveyed infrastructure could not be located based on GPS location checks described above.

The biggest challenge with the survey process was accurately locating the freight facilities in a format that could be later transferred to SDOT. Each surveyed loading facility was located in the field using the GPS (latitude and longitude) capabilities of the survey tablet, on Google Maps on the survey tablet, and on paper maps distributed to survey teams. While applying the data quality control process, a number of location inaccuracies were identified and required manual adjustment. GPS often has problems in alleys and urban canyons due to poor line of sight with satellites, Google Maps can be inaccurate particularly in alleys, and a paper map requires user interpretation. However, when the three GPS location accuracy methods were used as a crosscheck, the team was able to verify the accuracy of the locations that were delivered to SDOT in a latitude and longitude format.

21.6.5.5. *Final database*

The researchers made a final database of the truck load/unload infrastructure identified in the study area. The final quality control check included a descriptive analysis of the data collected to check for outliers. The team also compared the data collected with the planned data structure to correctly identify missing values, thus avoiding possible confusion between the data that could not be collected in the field and the data that was not applicable in every situation.

21.7. Research results

The research team compiled GIS coordinates and infrastructure characteristics for every observable freight loading bay within buildings in three of Seattle's designated urban centers. The surveyors identified a total of 374 potential freight bays. However, over 100 of the doors were closed, so an additional expert review with a member of the Urban Freight Lab will be conducted to eliminate locations that do not currently serve truck load/unload activities. The value of recording off-street parking geospatial data is found in its ability to support capacity assessments for urban freight delivery and analyses of the true impact of modifications to any urban freight parking infrastructure.

This paper offers a practical approach to:

– identifying useful existent urban GIS data for little or no cost;

– collecting original granular urban truck data for private freight bays and loading docks;

– overlaying the existing GIS layers and a new layer to study city-wide truck parking capacity.

Urban Form Lab

Sources:
-Freight Access Points: Urban Freight Lab data collection process.
-Alleys: King County Metro Transportation Network
-Parcels: King Country GIS parcel_address layer. Office uses come from the PRESENTUSE field.
-CVLS: SDOT Curb Space Categories data. All CVLS entires from the SPACETYPE field are displayed

Figure 21.9. *Map of freight access points (freight bays and loading docks), CVLZs and alleys in a section of downtown Seattle predominantly occupied by offices. For a color version of this figure, see www.iste.co.uk/taniguchi/cities2.zip*

21.8. Conclusion

The lack of space for trucks to deliver goods in urban centers is a pressing issue.

Comprehensively mapping the city's legal truck load/unload spaces allows planners, parking managers, traffic engineers, building code development officials and researchers to analyze the network effects of reducing or altering the capacity of commercial vehicle load zones. Sensory technology could be used to monitor and/or enforce usage.

The findings of the first "Final 50 Feet: Urban Goods Movement" research project will be used to provide decision support to city officials and to private-sector firms managing scarce and expensive space in the city. By using granular data to lay out the truck load/unload space network and creative planning, we can make receiving online goods as efficient as ordering them – without clogging our streets or losing our packages.

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