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CENTENNIAL PAPERS

Standing Committee on Urban Freight Transportation (AT025)
William (Bill) Eisele, Chair

Urban Freight Transportation: Embracing the Future with Insights from the Past

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INTRODUCTION – WHAT IS URBAN FREIGHT TRANSPORTATION AND WHY IS IT IMPORTANT?

Efficient movement of people and goods is vital to the economic prosperity of any region. Reliable urban freight movement is critical to manufacturing, agriculture, retail and industry. Urban freight transportation is a field of study concerned with the collection, movement and distribution of goods in urban environments. In recent years, the field of urban freight transportation has become increasingly important given urban area population growth. Due to the complexities of the urban ecosystem, urban freight transportation is inherently linked to issues of pick-up and delivery needs (the "last mile"), curbside management, safety, emissions and air quality, urban transportation system demand and economic relationships, right-of-way limitations, and institutional challenges.

One could argue that now is the most exciting time in history to be active in the field of urban freight transportation, and the transportation industry in general. A recent report by the United Nations indicates that North America is the world's most urbanized region as 80 percent of the population lives in urban areas – and the report states that nearly 70 percent of the world population is expected to live in cities by 2050 (*1*). This information is daunting, as our urban area physical infrastructure often has limited capacity to grow and keep up, let alone be maintained. In fact, in the United States, the 2017 American Society of Civil Engineers Infrastructure Report Card gives the U.S. a "D+" grade based on infrastructure categories – a needed call to action for investment in infrastructure (*2*).

At the same time of this rapid population growth, the transportation industry is seeing tremendous change in consumer expectations, technology, and innovation and disruption. E-commerce is growing rapidly as consumers can order goods on a smartphone application and expect delivery the same day in some cases. Industries must plan and redesign supply chains and physical infrastructure to meet these consumer demands.

Meanwhile, rapid growth and innovation in potential delivery technologies in the

urban environment hold promise for freight distribution. Innovations in connected, automated, shared, and electric (CASE) vehicles are being tested for the movement of people and freight. Innovative delivery methods are being rapidly tested and deployed, including delivery robots in Washington, D.C., cargo cycles in many European cities and tests of pizza deliveries by automated vehicles and drones to name just a few. In fact, Amazon inventors are pursuing patent applications that envision a future where drones will fly from fulfillment centers that are riding trains or airships floating above cities (*3*). The innovation opportunities in the future are endless in urban freight transportation.

To be clear, these are not necessarily new, modern-day challenges or opportunities.

History can teach us lessons. Julius Caesar faced similar city life challenges in Rome in 45 BC. In fact, he banned chariot and wagon traffic into the central business district between 6 a.m. and 4 p.m., and he introduced one-way streets and off-street parking requirements (*4*). Such historical innovation tells us that our industry must continue to look at both "supply-side" and "demand-side" solutions to urban freight challenges.

It is also clear that technology will play an increasing role in the future of urban freight transportation. Equally clear is the need for engaging the right players in the conversation of the current and future urban freight challenges and solutions to the problems. All stakeholders must be engaged in this process, and this includes planners, engineers, operators, industry- representatives, elected officials, and multimodal freight representatives, to name only a few – it will take the innovation and partnership of all of us to collectively lead urban freight transportation into the next century and realize benefits for all

So. Stop. Look up from reading this. Look around. Wherever you are – the goods (and associated services) you see around you made it to you through reliable supply chains and efficient urban freight movement. Odds are, trucks delivered at least 80 percent of these goods at some point along that supply chain. It is the responsibility of all of us as transportation professionals, industry representatives, elected officials, and citizens to do our part in ensuring sustainable, safe, and efficient urban freight movement into the next century.

URBAN AREAS AND URBAN FREIGHT TRANSPORTATION EVOLUTION

Urban areas and urban freight transportation have always been explicitly linked together. Many urban areas began as trading hubs with links to ports and maritime trade. Urban areas were also centers of trade and commerce where goods were brought in from the countryside and sold to traders and wholesalers who subsequently sold goods to the urban population. Markets were usually focused on trading specific commodities, such as Smithfields Market in London, which has been trading meat for over 800 years, and Fulton Fish Market in New York City, which opened in the early nineteenth century and by the 1920's was trading 25 percent of all seafood sold in the United States (*5*).

A number of factors came together in urban areas to push these centers of logistics and freight transportation to industrial areas and away from the urban core. These included increasing land costs in central urban areas, a desire for more appropriate residential neighbors, and ill- equipped buildings suitable for more modern storage and processing operations. The development of trucks also no doubt contributed to this relocation, as facilities could be located further away from consumers. This not only applied to produce and perishables, but other industries, including manufacturing and warehousing, which also moved away from the central urban core. However, we can observe this trend reversing today as e-commerce and the desire for shorter-order lead times is seeing the development of urban warehouses located in or close to the central urban core. The case study below illustrates another modern-day trend that has its

roots back in the past.

A Reflection on Portering for the Carriage of Goods

In London, those responsible for the movement of goods by foot until the mid-19th century were termed "porters," being made members of City Companies from the late 16th century. Organized into "fellowships" by the City Corporation headed by a City Alderman, wages, prices charged, and the behavior of porters were strictly controlled (*6*). Various portering-related infrastructure began to emerge including, 1) the stands where porters waited to be procured (numbering around 100 across London by the mid-18th century, [*6,7*]), and 2) pitching places where porters could rest while carrying goods (*8*).

From 1579, the organization of portering by the City authorities resulted in four main porter groups emerging across London: 1) "Tacklehouse Porters" (portering contractors on behalf of City Companies also acting as warehousemen), 2) "Aliens' Porters" (who worked for a City officer known as the "Packer and Porter of Aliens' Goods" and provided their services to foreign traders based in the City), 3) "Street Porters" (later known as "Ticket Porters" who worked from a stand in the City or at the waterside and carried goods not allotted to other porters, and 4) "Fellowship" or "Billingsgate Porters" (responsible for coal, salt and corn) (*6*).

Work was allocated across these licensed groups depending on the type of merchant requiring portering services, the type of goods to be transported, the location at which service was needed, and the origin and destination of the goods. These criteria led to many disputes between the different groups of porters about their rights to carry various goods (*6*).

The key factor in the demise of the porter across London was the introduction of mechanized handling and transportation systems (*9*). Ironically, it is the collective impacts of the latter coupled with the exponential growth in vehicle-related congestion that is seeing the return of portering, in various guises, as an effective option for serving the last-mile.

In the same way that Tacklehouse, Aliens', Street, and Billingsgate porters waited for business allocated by their task-masters in the 16th century, similar groupings of modern-day gig-economy couriers gather outside fast-food outlets and parcel drop-off points today, awaiting job allocations via their smartphones. Walking now plays a key part in urban delivery (*10*), as it did 400 years ago with parcel van drivers in London typically walking up to 6 miles per day on a round. Many carriers are actively experimenting with the use of humans for last-mile delivery, either as fully-fledged porters or cargo cyclists using a range of self-propelled or pedal assist technologies (*11*).

On-foot delivery services were used in London during the 2012 Olympic Games when two parcel carriers put in place a team of porters to ensure delivery if road conditions became sufficiently congested. DHL worked with Jog-Post (a leaflet delivery company) to provide around 100 jogging porters to deliver packages, capable of running 5-10 miles per day at speeds that ranged from 3-8 miles per hour (*12,13*). In a similar way, Citysprint set up a network of twenty joggers and five rollerbladers in addition to its existing motorbike and cycling teams with one of the rollerbladers managing to complete a 4-mile journey from the City of London and Canary Wharf in 22 minutes (*14,15*).

In New York's lower Manhattan financial district, DHL purportedly opened a 1,200 square foot 'walking courier' and package drop-off facility employing approximately a dozen 'foot couriers' as opposed to vehicle drivers who would deliver packages across five zip codes within Manhattan (*16,17*).

As carriers experiment with pavement droids and drones for last-mile delivery (*18*) it is possible that we are on the cusp of a similar advancement in technology, akin to the

mechanization that saw the demise of the original London porters and the carriage of freight by humans. Given the difficulties in interfacing between the curbside and consignee, which may necessitate negotiating stairs, doors, lifts and security cordons, the use of humans for delivery will likely continue for the foreseeable future.

URBAN FREIGHT TRANSPORTATION TODAY

Current Issues

Nationwide in 2015, about 56 tons of goods per person were moved by the freight system (*19*). Without regular freight deliveries, hospitals could face supply shortages within hours, motor fuel stations would run out of fuel in one or two days, significant shortages of perishable food would occur in three days (sooner in locations like nursing homes), and clean drinking water could be unavailable in as little as two weeks. Garbage would also start to pile up in two or three days (*20*). Addressing these human needs on a daily basis requires freight to flow smoothly in cities across the country; for example, New York City Department of Transportation estimates that 97,000 trucks cross New York City boundaries each day, and 25,000 trucks move to and from Manhattan alone (*21*)

Yet freight has negative impacts. Nationally, in 2016, large truck crashes resulted in the deaths of 637 cyclists and pedestrians, 2,642 passenger-vehicle occupants, and 660 large truck occupants; the total of 3,986 fatalities is a 17 percent increase over 2010 (*22*). Truck emissions are a significant source of air pollution and a threat to public health; work to clean up emissions can only be phased in slowly over time (*23*). Trucks are sometimes noisy, contributing to transportation noise pollution estimated as high as 80 decibels along transportation corridors in cities (*24*). In addition, trucks contribute to and are negatively affected by the truck freight bottlenecks that plague many cities (*25*). Even the roads themselves are negatively impacted by freight – it has been clear since early pavement experiments were conducted that truck axle loads have a disproportionate impact on pavement life (*26*). Finally, the increases in e-commerce could increase freight trips relative to population, adding to the concerns above, though the e- commerce effects so far on truck trip volumes and offset passenger car volumes are in fact not clear (*27*).

Because of the negative impacts, communities are sometimes unresponsive to freight needs. Freight facilities are often regarded as locally unwanted land uses. Warehouses and distribution facilities serving urban centers can be difficult to site without long journeys to distant suburbs. Parking for trucks is likewise often relegated to distant locations, sometimes far beyond the urban area. Communities sometimes restrict overnight deliveries, leaving truckers to travel during congested peak periods from distant truck parking locations to their morning deliveries. Where deliveries take place, loading docks are often undersized when they are available, and alternative loading zones or alleys are often inadequate. Truck routes designed to inform truckers about safe and appropriate routes are sometimes discontinuous. So overall, perhaps partially because of the negative impacts of freight, communities are sometimes unresponsive to freight needs as cities and the freight industry develop and change.

Current Research and Emerging Practices

As a result of recent freight system research, emerging urban freight practices are beginning to address the issues above. First, understanding “last mile” and “last 50 feet” issues are leading to better practices in freight operations and urban design. Such practices include alleys and backage roads to separate freight activity from arterial traffic; improved design and operations

for loading docks; improved and better-located truck parking facilities; and improved separation of trucks from other vehicles, particularly non-motorized traffic. Likewise, newly emerging delivery management practices hold the promise of facilitating more efficient freight movement while reducing roadway congestion. These practices include programs of facilitating overnight deliveries, centralized shipping and receiving points, consolidated residential deliveries, better-managed loading zones, and facilitating bicycle- and pedestrian-friendly delivery, particularly for "the last 50 feet" where some urban freight faces the greatest barriers (*28*).

Second, urban freight practices are being influenced by advances in technology and data management. Real-time information systems are helping to communicate important information to drivers, addressing efficiency, safety, and the environment. Specific technology strategies include real-time truck parking availability data, low-clearance detection and alerts, clean-truck programs, electric vehicles, and truck design improvements (*29*). In addition, obtaining reliable telematics data to monitor vehicle activity has not only facilitated better operations on the part of carriers, but also, when purchased for use by state DOTs and regional planning agencies, has led to improved processes of identifying and addressing freight bottlenecks (*30*).

Third, freight and logistics clusters, such as large ports, airports, intermodal facilities, or border crossings are highly concentrated areas of freight generation and flow. These hubs share some of the same "last mile" issues with associated congestion in dense metropolitan areas, and generate particularly high volumes of freight activities that may pass through an urban core to markets outside the region. Emerging practices relating to these clusters involve basic geometric strategies, but also pricing strategies at ports, road pricing, dedicated truck lanes, multimodal connectivity (e.g., increased rail capacity, elimination of at-grade rail crossings, barge movement improved truck routing and permitting procedures), equipment management, and border crossings (*31*).

Research Gaps

A better understanding of basic characteristics is needed regarding freight activity. More importantly, research is needed to better understand truck routing processes and patterns, particularly in the last mile. This research will help shippers, receivers, carriers, and public stakeholders determine whether any proposals brought forward to resolve urban freight issues are likely to be effective.

WHAT DOES THE FUTURE HOLD FOR URBAN FREIGHT TRANSPORTATION?

Later Today

It is hard to predict what the future holds for the freight system considering that the system has already entered the digitalized and virtual world, which is constantly innovating. However, it is foreseeable that later today, we will continue to address the same issues such as congestion, environmental impacts, safety, and the consumption of resources. We will have access to better tools and more information, and will have taken important steps in knowledge; though at the same time, the efficiencies achieved throughout the supply chains and distribution systems will exacerbate the pressures at the final end of the system, that is, on urban freight transportation. With most of the population living in urban areas, the rate of consumption will significantly grow, resulting in orders-of-magnitude increases in the amount of freight that we will have to distribute to even more decentralized locations.

Tomorrow

The urban freight transportation system will continue to change and adapt, bringing with it new challenges for the sustainability of urban environments. The system of tomorrow will take advantage of the promises of today; that is, we will have an automated system, using zero emission vehicles and equipment, and facilitated by the shared economy and mobility advancements (*32*). One particular characteristic of the system, early tomorrow, is that it will potentially look similar to the current system, where the focus had been to "automate" the operations, movements, and transactions. Whilst automation is already part of the freight system, from robots and automated processes inside manufacturing and distribution center facilities to automated port terminals, tomorrow we will have extended it to the final distribution process.

It is not yet clear when and how the automated vehicles will be ready; for instance, the International Transport Forum has developed contrasting scenarios for the roll-out and adoption of trucks on long-distance routes and in urban areas (*33*). Moreover, automation in the last-mile may involve unmanned and autonomous vehicles such as pods, drones, or other innovations, which are different from the traditional freight vehicles. At a lower scale, for example, some companies of today (Marble and Yelp) have conducted trials in San Francisco to deliver pizza using autonomous pods (*34*); there is a system of robots delivering food on the Berkeley campus (*35*); Amazon launched a fully-electric delivery system moving along sidewalks in Snohomish County, Washington to deliver packages to doorsteps (*36*); and Ocado, an online grocer in London, has trialed autonomous vehicles to send groceries to customers from a nearby distribution center (*37*).

These systems are innovative, though they still require the presence of the receiver of the cargo for the final transaction, which is at the root of the inefficiencies in current urban freight systems. Other companies are working on integrating different technologies to tackle this limitation. All in all, tomorrow we will have overcome this and other inefficient processes such as access to the curbside, access to buildings/stores/residences, type and activities conducted during the final transaction, information exchanges, and the supporting systems needed to run and maintain our vehicles and equipment, among others.

There will be a transition period between later today and tomorrow when we fully understand the importance of consumer behavior to foster a change in the way we conduct urban freight transportation operations. The population at large will also come to the realization that the rate of consumption, and the convenience brought about by the efficiencies of our supply chains are not sustainable. Consequently, the public sector, the private sector, and the civic society will start to make changes throughout the system. We may slow down the system before we pick up the pace again, until we strike a balance.

Later, the system of tomorrow will in some way become a fully-connected and fully-automated system as we harness the power of big data, the internet of things, and other technological advancements. There will be a fundamental change at some point tomorrow, when a large part of the system will become a push system. This connected and automated system will be intelligent enough to move the right products, in the right quantities, to the right destinations, at the appropriate time. While there may be some level of uncertainty, a wide range of products that we consume today are very predictable and the information transfer will be highly reliable. Even today, advancements such as the use of Blockchain in supply chains are changing the transparency and information flow, with examples of companies such as Walmart, Unilever, Nestle, Tyson, and Dole already using it to track the flow of products, and for economic transactions (*38*).

By this time tomorrow, the urban form will have also shifted with a particular emphasis on open spaces, green living, and we will achieve a sustainable growth in active transportation, under a highly-dense setup. All of this requires changes in the urban freight transportation system to be compatible with the desired lifestyles of the new generations.

The Day after Tomorrow

The next day, the freight system as we know it today, will be there no more. We will have access to goods and services, in the same way that water and electricity come to our homes, with no visible infrastructure. The day will come when we can enjoy our cities just as we visit Disney World, where all the stores have products in the shelves, the restaurants have fresh food, the trash disappears, and all the rides work with no apparent supporting freight and service systems. There will be another layer of the city beneath us, where all the pieces move, making all these possible.

THE TRANSPORTATION RESEARCH BOARD'S URBAN FREIGHT COMMITTEE – ITS HISTORY, ROLE AND RELEVANCE

As the above sections illustrate, the potential research opportunities for making effective changes in the way freight moves in our urban areas and mitigating freight's impacts upon residents and communities is significant, and also very exciting. The narrative above illustrates how urban freight transportation has evolved and will continue to evolve over time.

As a program unit of the National Academies of Sciences, Engineering and Medicine, the Transportation Research Board (TRB) promotes innovation and progress in transportation through research. The Technical Activities Division of TRB includes over 200 volunteer committees covering all aspects of transportation. The Urban Freight Transportation Committee (AT025) has focused on the issues discussed in this paper since its creation in the 1970s. This section of the paper describes the history of the Urban Freight Transportation Committee with historical context on the "hot topics" of each decade.

1970s

The original name of the Transportation Research Board's current Urban Freight Transportation Committee (AT025) was the Urban Goods Movement Committee when it was formed in 1975. The first Chairman of the committee was Arnim Meyburg, Professor of Civil & Environmental Engineering at Cornell University.

Freight transportation planning in urban areas was not common at that time except in a few large urban areas. A noteworthy study of that time dealt with freight delivery problems in the Garment District of New York City. During the same time period, a few research studies examined the feasibility of establishing freight consolidation terminals in urban areas to reduce truck traffic in downtown areas. Incorporating freight movements in urban travel demand modeling also was a topic of interest at that time.

1980s

Beginning in 1981, the committee chairman was the late Richard Staley. Dick Staley was an economist who had worked for the American Trucking Associations before becoming a consultant. During these 12 years of Dick Staley's and Arun Chatterjee's tenure, the committee experienced an increased participation by the private sector in committee activities. Siro DeGasperis of United Parcel Service was a long-time member of the committee who provided

considerable help.

During this time, new federal guidelines enhanced the role of Metropolitan Planning Organizations (MPOs) in urban transportation planning and also emphasized transportation systems management (TSM). The committee regularly sponsored sessions at TRB Annual Meetings and those included topics of interest to metropolitan planning organizations (MPOs). Low-cost and easy-to-implement strategies to improve freight delivery were topics of interest at this time. Also of interest was land use planning for freight activities as well as curbside loading/unloading of delivery vehicles.

1990s

A noteworthy accomplishment of this period was the awarding of TRB's Pyke Johnson Award at the 1991 TRB Annual Meeting to a paper authored by Lance Grenzeback, a member of the committee. The paper, titled "Urban Freeway Gridlock Study: Decreasing the Effects of Large Trucks on Peak-Period Urban Freeway Congestion," was reviewed by the committee and recommended for the award, which is given annually for the outstanding paper published in the field of transportation systems planning and administration. The paper was co-authroed by William Reilly, Paul Roberts, and Joseph Stowers.

Following Arun Chatterjee's term of six years, the committee was led by Noreen Roberts of the California Department of Transportation. During Noreen's six-year tenure as chair, the scope of involvement of the committee was broadened.

2000s

During the six-year term of Susie Lahsene of the Port of Portland, Oregon, the committee began to have more interaction with other freight-related committees. The Urban Fright Transportation committee began to hold mid-year meetings with other freight committees and jointly organized technical sessions at TRB Annual Meetings. The interest of committee members now included such topics as economic development, and access to freight terminals including seaports and rail-truck intermodal terminals. Another issue that was examined by the committee was how to get active participation of freight transportation companies such as trucking firms and railroad companies in the transportation planning process.

In 2005, Mr. Joseph Bryan led the committee to a variety of new activities. Joe had worked for the trucking industry before working as a consultant. The interaction with other freight-related committees continued during his tenure, and he was also successful in getting increased private sector as well as international participation. The committee meetings during TRB Annual Meetings included excellent presentations from speakers from other countries.

2010s

The first time a staff member from a Municipal Planning Organization (MPO) led the committee was 2011 when Ted Dahlburg of the Delaware Valley Regional Planning commission became the chair.

E-commerce, complete streets, global urbanization, the USDOT FAST Act, and other factors thrust urban freight transportation research into increased prominence during this period. As a result, the committee experienced strong interest and participation, a steady growth in the number of original research papers submitted for committee review, and broad support to organize numerous paper, poster, and jointly sponsored sessions and workshops (e.g., at Freight Day) at the TRB Annual Meeting.

Committee activities were organized into seven functional areas (Communications, Triennial Strategic Plan, Research, Sessions, Resources, Membership, and Recognition). Under this framework, the committee enjoyed excellent leadership and support from functional area coordinators, committee Members and Friends, committee officers, Emeritus Members, the TRB Freight Systems Group, and TRB staff.

Research problem statements prepared by the committee during facilitated breakout sessions held during the TRB Annual Meeting were selected for funding by TRB and reflected various aspects of urban freight research, including:

- National Cooperative Freight Research Program, Project 49: Understanding and Using New Data Sources to Address Urban and Metropolitan Freight Challenges
- National Cooperative Highway Research Program, Project 08-106: Metropolitan Freight Transportation: Implementing Effective Strategies
- National Cooperative Highway Research Program, Project 15-62: Design and Access Management Guidelines for Truck Routes

Additional committee highlights included preparing an *Urban Freight Bibliography*, contributing to the American Planning Association *Policy Guide on Freight*, supporting the METRANS International Urban Freight Conferences in Long Beach, California and the Volvo Research and Education Foundation (VREF) Conferences on Urban Freight in Gothenburg, Sweden, updating the *Urban Freight Distribution* entry in Wikipedia, and conducting a 2016 Midyear Committee Meeting in Philadelphia.

In April 2017, William (Bill) Eisele of the Texas A&M Transportation Institute (TTI) became the 8th Urban Freight Transportation Committee Chair. Under Bill's leadership, the committee continues building upon the initiatives of prior chairs, and has been especially active in engaging the larger international community in the membership and identification of research needs. As one example, the committee has supported peer exchanges with the European Commission (EC) and FHWA to facilitate the US-EC Urban Freight Twinning Initiative.

The committee also ensures the active engagement in participation by younger members, has been focused on implementing the latest committee Triennial Strategic Plan, and has maintained a goal of putting the "R" in TRB by focusing on the identification and development of research needs to advance the study of urban freight transportation challenges.

The committee is actively engaging industry partners and other collaborators to better understand practical challenges, industry innovation and research needs. During the 2018 TRB Annual Meeting, the committee heard a presentation from Mr. Tom Madrecki of UPS, and at the 2019 TRB Annual Meeting, Ms. Tamiko Burnell of FHWA discussed the US-EC Urban Freight Twinning Initiative with the committee.

During the 2019 TRB Annual Meeting, the committee was recognized with a Blue Ribbon Award (Honorable Mention) in the category of Leadership (Contributing to Improving the Management and Operation of TRB Committees) for "engaging a passionate global membership and disseminating urban freight innovation to stakeholders."

The Future

The Urban Freight Transportation Committee is recognized as a global forum for urban freight transportation researchers, institutions and practitioners. As more of the world's population lives in urban areas, the need to continue research and conduct insight into

evolving urban freight transportation dynamics will only increase. E-commerce and other freight-related market interventions present some exciting challenges, which will no doubt feature in future research papers, and speaker and poster sessions at TRB Annual Meetings. The committee's collective membership (including committee friends) will continue at the forefront of research into what has proven to be an exciting transportation field of study with many challenges and research opportunities for decades to come.

ACKNOWLEGMENTS

The development of this paper was led by Mr. Joseph Dack (HDR) with contributions from Mr. Joe Bryan (WSP), Dr. Arun Chatterjee (University of Tennessee), Dr. Tom Cherrett (University of Southampton), Mr. Ted Dahlburg (Retired – Delaware Valley Regional Planning Commission), Dr. William Eisele (Texas A&M Transportation Institute), Dr. Miguel Jaller (University of California, Davis), Ms. Katie Kirk (Cambridge Systematics, Inc.), and Mr. Tom Murtha (Chicago Metropolitan Agency for Planning).

The authors also would like to acknowledge all members and friends of the TRB Urban Freight Transportation Committee for their invaluable contributions to the committee and the urban freight transportation industry. The full membership of the committee is included on the following page.

More information about the committee can be found here: https://urbanfreight.tti.tamu.edu/.

TRB Urban Freight Transportation Committee Membership (As of March 2019)

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