Working Title:
The state of freight in Complete Streets: A text-mining analysis of existing U.S. policy

ABSTRACT
Complete Streets policies are intended to support multimodal street systems, yet freight is often underrepresented relative to pedestrians, bicyclists, and transit. As e-commerce and urban goods movement continue to grow, understanding how freight is addressed in policy is increasingly important. This study evaluates the representation and definition of freight within 206 U.S. Complete Streets policies using a mixed-methods approach combining text mining and qualitative content analysis. Policies were assessed based on the frequency of freight-related terminology relative to other road user groups, and a subset of policies with higher keyword densities were selected for qualitative review. The analysis focuses on how freight is defined and described as a user group within policy language. Results indicate that freight is referenced significantly less than other modes and, when included, is typically described in broad or generalized terms that don't differentiate between different freight activities or operational needs. These findings highlight a gap in how freight is conceptualized within Complete Streets frameworks and suggest the need for more defined and actionable definitions to support effective multimodal transportation planning and design.

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Keywords: Complete streets, freight, policy analysis, text-mining
Word count: 2989 words, 2 figures

INTRODUCTION
Over the past 20 years, Complete Streets approaches and policies have been adopted in over 1700 municipalities across the US, at the federal, state, and municipal levels [1], [2], [3]. The Bipartisan Infrastructure Law of 2021 defines Complete Streets standards or policies as those that "ensure the safe and adequate accommodation of all users of the transportation system, including pedestrians, bicyclists, public transportation users, children, older individuals, individuals with disabilities, motorists, and freight vehicles [3], [4]. At its core, Complete Streets represents a paradigm shift in transportation network and roadway planning and design, prescribing a context-sensitive approach that accommodates the needs and ensures the safety of all road users, with an emphasis on the most vulnerable ones.

Positive outcomes have been documented as a result of Complete Streets adoption, updating policies and directing infrastructure investments aimed at improving pedestrian and bicyclist safety levels [5], [6], [7], [8]. Within the Complete Streets framework, however, freight needs have often been overlooked, despite being commonly referenced in Complete Streets as a road user [9], [10]. Previous analyses have sought to analyze the 'completeness' or thoroughness of Complete Streets policies and projects [1], [6], [7], [8], identifying all available dimensions of coverage across Complete Streets policy. These analyses typically omit freight, however. Design features, such as narrower lanes, tighter curb radii, and smaller crossing widths, which improve safety outcomes for pedestrians and bicyclists, are at direct odds with the wider space and turning requirements for heavy, freight vehicles [9], [11], [12], [13]. Overlooking freight activities and driver behaviors can also result in more physical and

psychological challenges for last-mile operations [9], [13]. Given the rise of e-commerce and urban activity and the increased exposure that truck and delivery drivers are already prone to due to their job requirements, a lack of inclusion in meaningfully designed safety features can lead to negative health outcomes [13], [14], [15], [16]. These trends have led to an intensified competition for limited curb space, contributing to operational conflicts between freight vehicles and other road users at the curbside, particularly in dense, mixed-use environments [17], [18]. A lack of meaningful planning or design of loading or curbside infrastructure or integration with other road user infrastructure (e.g., loading zones adjacent to bike lanes) has been associated with negative environmental and safety outcomes [9]. As a result, there is a growing need to ensure that multimodal transportation policies, such as Complete Streets, account for freight-related activities in their planning and design guidance materials or project requirements.

This study seeks to systematically assess the extent to which freight has been integrated into existing Complete Streets policies. Specifically, the research addresses two primary questions: (1) to what extent is freight represented in Complete Streets policies relative to other road user groups, and (2) how is freight incorporated into policy language in terms of actionable planning and design guidance. This paper presents a mixed-methods approach using a sample of U.S. Complete Streets policies. A text-mining procedure is used to first quantify the relative frequency of freight-related content for each policy, counting the number of freight-related keywords present in each policy. These keywords refer to freight generally (e.g., freight, carrier, commercial goods), freight modes (e.g., truck, heavy duty), or freight activities (e.g., loading, goods delivery), while avoiding general terms that could be flagged and refer to other non-freight items (e.g., “delivery” could refer to capital project delivery; “commercial” could refer to land use, etc.). Policies were then classified based on freight keyword density, and a subset of higher-density policies were selected for qualitative review. Through this approach, the study aims to characterize the presence and depth of freight definition and description across Complete Streets policy.

METHODOLOGY

This paper adopted a 4-step methodology to analyze the state of freight in Complete Streets policies. In step 1, an initial review of policy documents were gathered and reviewed to document freight-related keywords. In step 2, further policy documents were sourced using stakeholder engagement and industry expert interviews. In step 3, a text-analysis was conducted across all sampled policy documents. In step 4, subsequent policy documents that were identified as having high levels of freight-related content were qualitatively analyzed.

An initial review of policies was conducted to assemble a catalogue of terminology used to describe road users, particularly freight. Areas where freight is currently planned for or described at length and existing research literature (e.g., Cities: Seattle, WA; New York City, NY; Portland, OR; MPOs: New Jersey Transportation Planning Authority, NJ; Delaware Valley Regional Planning Commission, PA; Other sources: National Cooperative Highway/Freight Research Program; NACTO; ITE) were reviewed to gain an initial understanding of the terms used to describe freight generally, the modes used, and activities

performed during freight operations. Additional municipalities or sources of information were identified and reviewed based on internal research team outreach efforts, recommendations, and expert interviews. Smart Growth America's "Best Complete Streets Policies" reports were also reviewed for 2025, 2023, and 2018, and policies identified in each report were scanned for freight terminology as well. Freight-specific terminology identified in this initial scan includes: freight, commerce, truck, loading, carrier, goods movement, heavy vehicle, commercial vehicle, haul, delivery vehicle, commercial goods [vehicle], goods delivery, delivery van, commercial van. In addition to previously reviewed policies, an additional catalogue of 200 policy documents was provided to the research team from Smart Growth America, containing Complete Streets policies that had been released or updated between 2019 and 2023. Policies reviewed range from legislative policies, adopted by a legislatively elected body or other voter-approved process, to non-legislative policies adopted at the discretion of municipalities' internal goals or values. Legislative policies include resolutions, ordinances or laws, policy [statements], executive orders, or tax ordinances; Non-legislative policies include near, medium- and long-range transportation or comprehensive plans, design manuals or guides, and internal policies [19]. This combined set of policies led to a catalogue of 250+ policy documents ready for review.

A text-mining algorithm was developed in the R programming language and used to perform a keyword search across the Complete Streets policies. The "pdftools" and "stringr" packages were used to read and convert policy documents into text strings that could be scanned and read via R, assuming text in the PDF was readable. The algorithm used the previously mentioned freight terminology to identify and count the instances of freight keywords mentioned across all policies. The algorithm also scans for other road user keywords (e.g., pedestrian, bicycle or bicyclist, transit, car) for the purposes of future comparison against freight keyword mention. The number of words, characters, and pages of each policy document was recorded for the purposes of normalization when comparing documents to one another. Of the 250+ assembled Complete Streets policy documents identified in preliminary review, the list was refined down to 206 policy documents that were ultimately readable by the R algorithm. An illustration of policies that were text-mined is shown in **Figure 1**. The results of this text-mining analysis influenced the locations where policies were further analyzed using qualitative review.

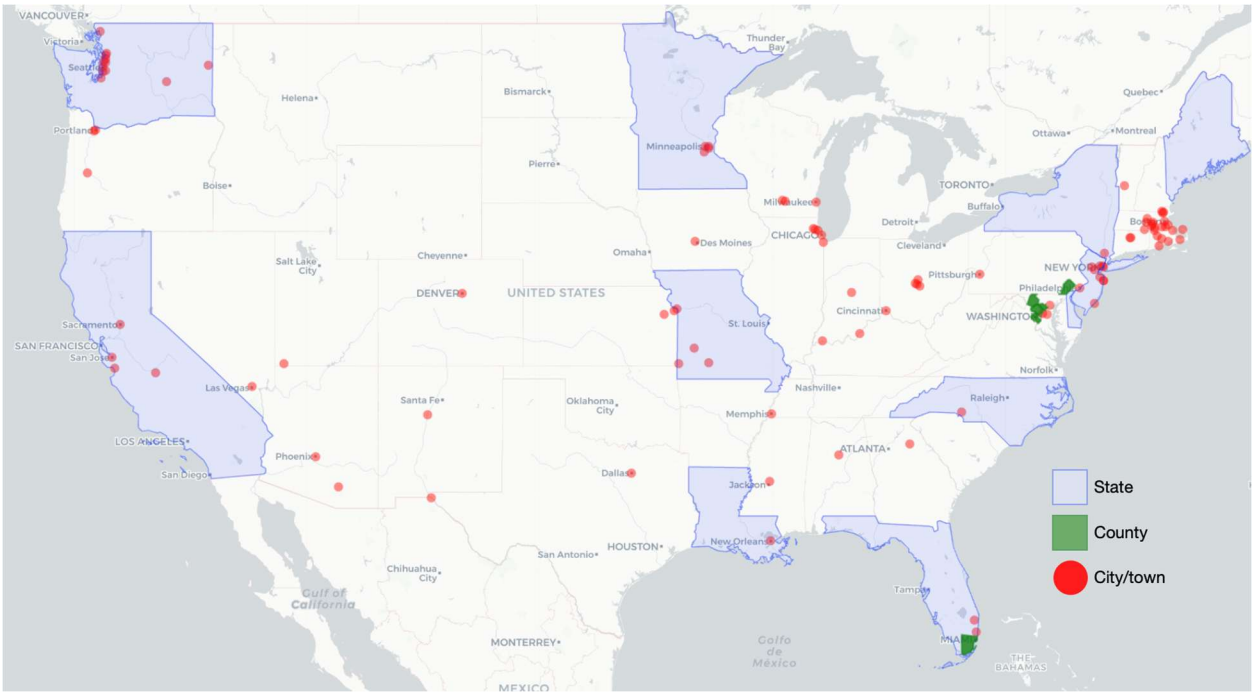

Figure 1. Complete Streets policies text-mined, by municipality type

Selected locations for subsequent qualitative review included the following jurisdictions:
Cities: Seattle, WA; Portland, OR; New York City, NY; Newark, NJ; Minneapolis, MN; Denver, CO; Milwaukee, WI; Chicago, IL; Philadelphia, PA; Pittsburgh, PA.
Metropolitan Planning Organizations (MPOs): Delaware Valley Regional Planning Commission (DVRPC); Mid-America Regional Council (MARC); Puget Sound Regional Council (PSRC); Community Planning Association of Southwest Idaho (COMPASS); New Jersey Transportation Planning Association (NJTPA).
States: Washington, Minnesota, New York, New Jersey, California, Delaware, Florida.

Policies were identified for subsequent qualitative review using a keyword density classification scheme. Using results from the text-mining analysis for all 206 readable policy documents, keyword densities were calculated for each document as the frequency of freight-related keywords. This density was normalized by the document length (number of pages), producing a standardized measure of freight mention level across all policy documents. Pages and number of words were both used as normalization fields and demonstrated no meaningful difference, so the number of pages was used for analysis. Threshold values for the keyword density classification scheme were selected using summary statistics and policy documents were separated into three categories: (1) no mention (density = 0), (2) low mention ($0 < \text{density} \leq 1.2$), and (3) high mention (density > 1.2). The no mention level threshold represents policies that do not reference freight at all. Low-mention-level policies are those that mention freight anecdotally or in passing. High-mention-level policies capture all policies that have substantial freight content relative to their length or size. Summary statistics revealed that freight keyword density is highly concentrated near low or zero values, and a small number of policies show higher densities of freight keywords. The median density is low (0.25), and the interquartile range is concentrated near the lower end of the distribution, indicating that most policies include minimal

freight-related content. Several high-value outliers are also observed, representing policies with substantial freight related content. Qualitative analysis consisted of reviewing high mention policies and focused on identifying and understanding where freight is mentioned within policy, how freight is described in terms of its operational activities, potential modes of transport, needs or importance for consideration in planning and design, to generally understand how freight is described as a road user in Complete Streets policy. Analysis also consisted of comparing and contrasting differences between different policies, highlighting differences in discussion for different levels of governance (e.g., cities, MPOs or county-level, and states). No- and Low-mention policies were passively analyzed in the process of gaining keyword terminology but were not qualitatively analyzed in the same manner as the high mention policies.

RESULTS

Preliminary text-mining results indicated that freight is rarely included in Complete Streets policies. Shown in **Figure 2**, of the 206 policies that were scanned via text-mining, 48 policies fell into the "no mention" level, 141 policies fell into the "low mention" level, and 17 policies fell into the "high mention" level. This result aligns with the existing gap in research literature around analyzing the completeness of Complete Streets both in policies and project practice, showing how freight is not generally included in Complete Streets schemes.

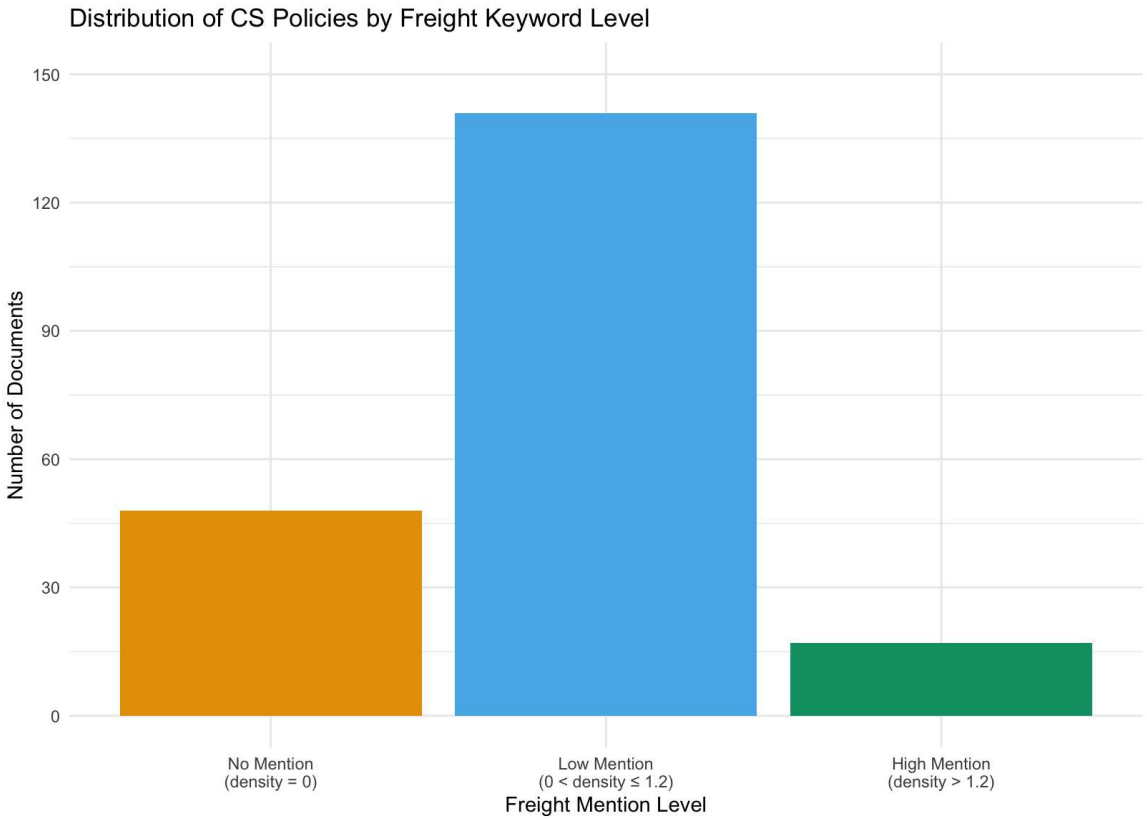

Figure 2. Distribution of CS policies by freight keyword mention level

Across the 206 policy documents reviewed, freight-related terminology appears less frequently than references to other road user groups. As shown in **Figure 3**, the distribution of freight keyword density is highly concentrated near zero, with many policies containing minimal or no freight-related content. In contrast, keyword densities for pedestrians, bicyclists, and transit users exhibit broader distributions, indicating that they are more frequently mentioned and discussed in greater detail throughout Complete Streets policy. These results quantitatively demonstrate results from previous research around Complete Streets policies and projects, as Complete Streets are thought to be synonymous with active road transportation planning and design. This also would explain why automobiles (private cars/transportation) and freight would appear much less frequently. This pattern ultimately suggests that freight, although occasionally included in Complete Streets policy, is typically referenced in a limited, anecdotal capacity compared to other road user modes.

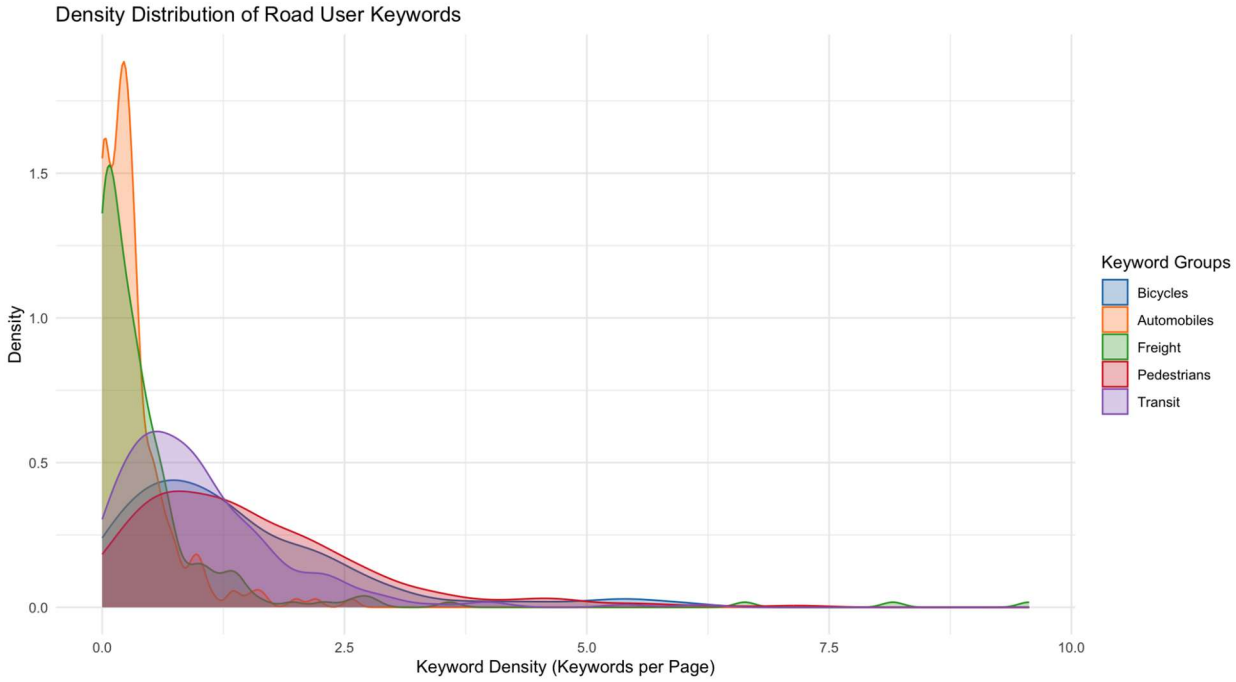

Figure 3. Density distribution of road user keywords

As previously stated, freight is not universally incorporated into most Complete Streets policies. Freight itself is often recognized as being vital to the local or state economy, and many jurisdictions with updated or recent Complete Streets policies point to the rise of home deliveries and e-commerce as a reason to design for freight in more contexts (than simply industrial or high activity commercial areas). Across “low mention” level policies, freight is referenced anecdotally or in general terms, where instances of freight being mentioned occur simply in the recognition that Complete Streets is for pedestrians, bicyclists, transit users, cars, and freight, leading to a lack of distinction or description of freight modes and activities on the street. When mentioned, there is heterogeneity in how freight is

defined in Complete Streets policies, with terms such as freight, haulers, trucks, commercial vehicles, movers of goods, and vans used to describe the modes and activities. The type of jurisdiction (e.g., state department of transportation, metropolitan planning organization, city transportation department) influences the scale of the freight mode discussed within its policy documents. For example, state departments of transportation often refer to larger, heavy-duty freight traffic as it relates to state or country-wide economic or port-related activities, whereas cities tend to refer to smaller-sized freight modes, such as delivery vans or trucks. The names and definitions given to freight and its modes may vary among Complete Streets materials for a single jurisdiction. For example, the Minnesota State Department of Transportation (MnDOT) uses the term "commercial trucks drivers" in its Complete Streets Policy, "trucks" in its Complete Streets Project Transportation Hierarchy Tool, and "freight vehicles" in its Complete Streets Handbook. When "freight" is used in Complete Streets policy, jurisdictions use it to refer to larger heavy-duty tractor trailers and or regional long-haul goods movement activity. Terms such as "commercial" or "delivery vehicle" are used in smaller geographic contexts where it's implied that smaller vehicles are used for last-mile delivery purposes. Minneapolis, MN presents a unique distinction in its modal framework from its policy, separating and distinguishing that they should prioritize "providing access for smaller freight vehicles" over "operating large freight vehicles" in its Complete Streets. This is also demonstrated in Minneapolis' Complete Streets website, where it names "freight" and "delivery" as separate items as use cases for a street or road, with "freight" referring to the movement of goods, typically with large vehicles, and delivery referring to same-day or home-based delivery services with smaller vehicles. Freight as a road user is often grouped with private automobiles, despite them being operationally different and having different infrastructure requirements.

CONCLUSIONS

This study has a few limitations. First, the analysis is based on a sample of Complete Streets policies that is mostly composed of those updated or published between 2019-2023 and may not be representative of policies that weren't updated or published within those timelines. As a result, it is possible that policies outside of that range may be more robust or contain nuanced definitions or treatments for freight. Second, the text-mining approach relies on keywords that were selected because of initial policy screening, which may not fully capture all the relevant terminology used across all policy documents. Variations in language, phrasing, or context could lead to an underestimation or misclassification of freight-related content.

This study examined how freight is represented and defined within a sample of Complete Streets policies across the United States. While Complete Streets frameworks emphasize accommodating all road users, with updated definitions or listings of user groups including "freight" or "goods movement vehicles" as a potential road user, findings indicate that freight is both less frequently referenced and less clearly defined than other road user groups. Quantitative analysis shows that freight-related terminology appears less consistently compared to pedestrians, bicyclists, transit users, and even automobiles, despite less keyword terminology being used to scan for other road user groups. Qualitative review further reinforced this finding, showing that when freight is included, it's described in general or abstract terms, without a clear differentiation or description of freight activities, potential

modes, or operational characteristics. This lack of specificity has implications for practice. The definition of user groups within policy serves as a foundation for subsequent planning and design decisions: actionable or aspirational performance measures are adopted to meet the needs of certain road users (e.g., add a certain number of curb ramps, adding a certain number of linear feet of bike lanes, reducing fatal or serious roadway injuries through VisionZero programs) [citation for ped/bike]; updating design materials to meet said performance measures or better accommodate road users (e.g., adopting active transportation design guidelines, updating standards for protected bike lane design, updating transit stop designs). As a result, freight considerations may be inconsistently or inadequately integrated into Complete Streets policy and implementation, despite being recognized as being vital to local economies and as a road user group at the federal level. These findings suggest a need for more precise and comprehensive definitions of freight within Complete Streets policies. Future policy development could benefit from explicitly distinguishing between different types of freight activities to help in considering different operational needs. Further distinctions of available freight modes could also help in this regard. Freight needs could be linked to design and planning considerations that don't sacrifice the needs of other road users. By strengthening how freight is conceptualized at the policy level, practitioners may be better equipped to incorporate and accommodate goods movement needs into multimodal street systems while balancing the safety and operational needs of other road users.

ACKNOWLEDGEMENT

This work was undertaken as part of the research project NCHRP (National Cooperative Highway Research Program) 08-176 Balancing Freight and Goods Delivery Needs in Designing Complete Streets. The authors wish to acknowledge industry experts and stakeholders interviewed, along with Smart Growth America for providing access to their database of policy documents.

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