



STRENGTHENING MOBILITY AND REVOLUTIONIZING TRANSPORTATION (SMART) GRANT PROGRAM

EVALUATION PLAN

Title: Seattle SMART Grant Digital Commercial Vehicle Permit Project

Recipient Name: City of Seattle Department of Transportation

Fiscal year of award: 2023

Period of Performance: September 1, 2023 – March 1, 2025

Organizations preparing Plan: Seattle Department of Transportation, University of Washington Urban Freight Lab

Date Evaluation Plan Submitted: 12/15/2023



PART 1 OF 4 – Introduction and Project Overview

Provide a description of your project, including:

- A. The real-world issues and challenges that would be addressed with at-scale implementation.
- B. The technology(ies) being deployed. Please reference the following categories in your description of the specific deployments (as applicable): coordinated automation, connected vehicles, intelligent sensor-based infrastructure, systems integration, commerce delivery and logistics, innovative aviation technology, smart grid, and smart technology traffic signals.
- C. The goals and desired outcomes for at-scale implementation. Please reference the following program benefit areas (as applicable): safety and reliability, resiliency, equity and access, climate, partnerships, and integration.
- D. Any other information that may be relevant.

In April 2023, the Seattle Department of Transportation (SDOT) was awarded a US DOT SMART grant for the project, "Seattle SMART Grant Digital Commercial Vehicle Permit Project," that will advance work to provide reliable, modernized access for commercial delivery vehicles at the curb using a collaborative, data-driven approach.

Online shopping and home delivery have transformed our transportation networks, and the impacts are felt most intensely in dense, urbanized areas like Seattle's neighborhood business districts. This has numerous consequences: vehicles circling, trucks idling, safety challenges from vehicles unloading in travel lanes, and failed deliveries for small businesses and residents. However, SDOT does not have a scalable way to monitor curbspace usage at a citywide level to design effective policies and technology. Having a data-driven and scalable approach to curbspace management for urban goods delivery is a critical lever to enable Seattle to achieve our climate, safety, and economic development goals. These include the adopted City Transportation Electrification Blueprint goal that 30% of all deliveries will be completed with zero emissions vehicles by 2030, and our Vision Zero goal to eliminate traffic-related deaths and serious injuries by 2030.

Our Stage 1 project will provide learnings and build our foundation for at-scale, citywide deployment of new technologies and associated curbspace management policy. Each layer of our project will help us progress towards outcomes achieved in Stage 2. To accomplish our goals and address the challenges above, we are:

- 1. Engaging with local businesses and urban freight companies to understand challenges and build a foundation of trust.
- 2. Prototyping a digital Commercial Vehicle Permit (CVP) and digital curb management monitoring tools to modernize and scale within the larger curb management ecosystem.
- 3. Collaborating with a national cohort of cities led by the Open Mobility Foundation (OMF) implementing the Curb Data Specification



SDOT is uniquely positioned to deliver a successful Stage 1 project focusing on commercial vehicle curb access and utilization given our existing commercial vehicle permit program and on-going leadership in data-driven curbside management, especially in the areas of paid parking and mobile payments. Specifically, our Stage 1 project will make significant advances in the SMART goals of equity and access, partnerships, and integration. The project will also build the foundation for dramatic improvements in safety, reliability, and climate in Stage 2. Our goal is that our Stage 1 learnings will allow us to not only scale a digital commercial vehicle permit to citywide adoption in Stage 2, but also scale digital permits and curb monitoring technology to many other areas and users of the curb. Examples of other SDOT Curb permits include either existing or a new permit for curb use for food-app delivery vehicles, at truck zones, building service vehicles, weight-based permits, and emission-based permits. If expanded to these permits and all parts of the city, the future stage could entail 1000's of permitted zones or issued permits covering Seattle (84 square miles).

SDOT will deploy various technologies to help us address the above list of issues and challenges and they fall under the SMART Grant Commerce Delivery and Logistics category. The technologies SDOT intends to use are:

National open-source data standards

- SDOT will be developing all digital tools for our CVP and V2I based on the Curb Data Specification (CDS) stewarded by the OMF.
- For the Stage 1 SMART project area, SDOT will be creating a digital inventory of curb regulations standardized in the CDS format.
- All curb utilization data collected during the project period will be stored in CDS format, and all digital communications between the CVP and V2I will also be done via application programming interfaces (API) defined in CDS.

Vehicle-to-curb infrastructure (V2I)

- Final V2I technology for the SMART project is to be determined and subject to competitive procurement. However, SDOT anticipates possible technologies intended to digitally match unique vehicles to specific commercial vehicle load zones (CVLZ). This may include magnetometer sensors, infrared, Bluetooth, RFID, GPS, or cameras utilizing AI edge computing.

Describe the proof-of-concept or prototype to be assessed in Stage 1.

The proposed SMART grant project will be located in the Belltown and Denny Triangle neighborhood business districts in north downtown Seattle (approximately 0.5 square miles). SDOT recently completed a US Department of Energy (DOE) project with the University of Washington Urban Freight Lab (UFL) and has an ongoing vehicle detection sensor research project with the Pacific Northwest National Lab (PNNL) located here. Land use patterns include dense residential, commercial, and office development that includes Amazon headquarters and significant employment from major high-tech companies. Belltown hosts many social service providers and income-restricted affordable housing but is not a Historically



Disadvantaged Community (HDN). The area is served by frequent bus transit and several major bicycle corridors. The neighborhoods are home to many restaurants and nightlife venues dependent upon regular goods deliveries. The area has 150 dedicated CVLZs that vehicles with a CVP can use to access.

In partnership with SDOT's research partner at the UFL, we will identify 2-3 evaluation "sub-areas" where we will deploy the V2I technology for testing. The number of CVLZs we install V2I technology is still undetermined, but we anticipate approx. 20-30 CVLZs. The data collected from the V2I CVLZs will be paired with qualitative outreach to local businesses and freight carriers to help develop a new data-driven commercial vehicle policy and permit program.

In partnership with the OMF and an as-of-yet procured transportation technology company, we will create a digital curb inventory in CDS of the entire project area. We will also use CDS to build and manage data collected from the V2I technology. We intend to evaluate if using CDS will help SDOT better manage its curbspace.

If Stage 1 is successful, SDOT intends to implement a citywide digital CVP program using V2I technology built on a CDS framework.

For the Stage 1 proof-of-concept, summarize the project evaluation process including list of project stakeholders:

SDOT will lead a team of public sector, academic, consultant, and private vendors to implement and evaluate a digital commercial vehicle permit program.

Project Stakeholder List:

- A. SDOT
 - i. Project Lead
 - ii. Management and oversight
 - iii. Technology oversight
 - iv. Evaluation
- B. University of Washington Urban Freight Lab (UFL)
 - i. Lead research partner
 - ii. Data collection design, data analysis, and evaluation support
- C. Open Mobility Foundation (OMF)
 - i. Lead development of CDS based on SMART project findings
 - ii. Facilitate cohort of SMART grant awarded cities using CDS
 - iii. Help develop data-driven curb management policy facilitated by CDS
- D. Project Consultant (TBD)
 - i. Assist SDOT with Project Management
 - ii. Strategic Communications
 - iii. Data Collection and V2I technology evaluation



The evaluation will be led by the SDOT team with strong support from our partners at UFL and our consultant.

Evaluation Task	Evaluation Task Team	Expected Delivery Date
Create baseline conditions, maps, and data collection plan	UFL	Q4 2023 – Q1 2024
Develop stakeholder strategic engagement plan	Consultant	Q1 2024
Procure technology services such as data management (to develop CDS) and a type of vehicle-to-curb digital infrastructure (V2I) to implement digital permit program	SDOT, UFL	Q1 2024
Implement stakeholder communications strategic engagement plan	Consultant, UFL	Q2-Q4 2024
Finalize baseline conditions analysis	UFL	Q2 2024
Finalize Curb Data Specification (CDS) digital curb inventory	SDOT	Q3 2024
V2I prototype installed and operational	SDOT, Consultant	Q2-Q3 2024
CVLZ policy scenario research results and recommendations	UFL	Q4 2024
Deliver V2I technology assessment	Consultant, UFL	Q4 2024
Final Report Complete	Consultant, UFL, SDOT	Q1 2025



PART 2 OF 4 – Project Goals and Objectives for At Scale Implementation

Part 2 of the Evaluation Plan should focus on your expectations for at scale-implementation of the project (Stage 2). By starting with the goals of the project at-scale, the evaluation of the proof-of concept or prototype can be tailored to provide informative results and actionable insights.

QUALITATIVE DESCRIPTIONS OF ANTICIPATED IMPACTS OF AT SCALE IMPLEMENTATION IN EACH FOLLOWING GOAL AREA: (CAN WRITE N/A IF NOT APPLICABLE, descriptions should indicate direction of change or level (reduce travel speeds, etc.)).

Our Stage 2 project will scale the Stage 1 prototype to a citywide system by building upon the lessons learned from Stage 1 and continuing to focus on commerce, delivery logistics, and intelligent sensor-based infrastructure. The Stage 2 citywide system will leverage CVP technology to facilitate data-driven curbside management policy decisions that will improve curbside access for commercial deliveries. In a citywide implementation of our CVP program, we anticipate achieving the following impacts by goal area:

GOAL AREAS	QUALITATIVE (or Quantitative if available) DESCRIPTION DIRECTION OF CHANGE OR LEVEL AND IMPACT TARGET
Safety and reliability: <i>Improve the safety of systems for pedestrians, bicyclists, and the broader traveling public. Improve emergency response.</i>	<ul style="list-style-type: none"> • Reduce conflicts between commercial vehicles, vulnerable road users, and other vehicles near and around the curb interface • Reduce the number of vehicles parking in travel lanes or other “unauthorized” locations
Resiliency: <i>Increase the reliability and resiliency of the transportation system, including cybersecurity and resiliency to climate change effects.</i>	<ul style="list-style-type: none"> • Improve the effectiveness of curb management policy and space allocation to better serve the traveling public with a strong focus on commercial activity
Equity and access: <i>Connect or expand access for underserved or disadvantaged populations. Improve access to jobs, education, and essential services.</i>	<ul style="list-style-type: none"> • Improve the effectiveness of curb management allocation, access, and pricing for all commercial users of the curb (small and local businesses to large carriers)
Climate: <i>Reduce congestion and/or air pollution, including greenhouse gases. Improve energy efficiency.</i>	<ul style="list-style-type: none"> • Reduce transportation-created pollutants by accelerating the transition to zero emission vehicles through curb-related policies and incentives • Reduce cruising for parking by creating a data-driven policy framework for improving curb access
Partnerships: <i>Contribute to economic competitiveness and incentivize private sector</i>	<ul style="list-style-type: none"> • Increase the level of engagement between the commercial users of the curb network in Seattle and SDOT to ensure a smooth and supported citywide rollout



<i>investments or partnerships, including technical and financial commitments on the proposed solution. Demonstrate committed leadership and capacity from the applicant, partners, and community.</i>	<ul style="list-style-type: none">• Provide city-wide curb regulation data in CDS format to support increased efficiency for curb users - including delivery service providers, and encouraging digital app development
Integration: <i>Improve integration of systems and promote connectivity of infrastructure, connected vehicles, pedestrians, bicyclists, and the broader traveling public.</i>	<ul style="list-style-type: none">• Improve systems and processes to perform ongoing monitoring of curbspace usage and compliance for commercial and other users of the curb• Scale permit digitization for commercial permit holders citywide and scale to other decal-based curbspace permit programs across the city• Improve data interoperability within SDOT's burgeoning data governance program

What are the estimated costs of the proof-of-concept or prototype carried out using the grant?

SDOT has \$1,996,000 budgeted for the Stage 1 prototype. The budget for the prototype will support our:

- Internal and consultant staff support;
- University of Washington research partners;
- Membership to the OMF collaborative;
- Data collection (sensors, cameras, intercept surveys);
- Stakeholder outreach (interviews, surveys, etc.);
- Technology installation and assessment (sensors, cameras, vehicle to infrastructure, etc.); and
- Conversion of curb inventory into CDS.

Our proof-of-concept will allow us to have a comprehensive understanding of the current commercial delivery freight system in our study area and test the viability of digital permit tools – both of which will help inform our Stage 2 project.

For a rough estimate for at-scale implementation – we will consider the following:

- Expanding from ~20-30 commercial load zones technology installations to 1,000-1,200 (60x) and would include funding for maintenance and on-going support for these systems.
- Expanding from roughly 10-20 pilot participants to ~5000 permit holders in the commercial vehicle permit program, with intent to include thousands more related service vehicle permits, and conversion of truck load zones to CVLZs if pilot proves viability for additional permit digitization.
- Expanding the area of impact from two neighborhoods covering ~0.5 square miles to citywide ~83 square miles.



- Developing and maintaining APIs of CDS compliant curb management data for public consumption and internal use that provide curb locations, regulations, pricing, and availability with support of the OMF.
- Improving staff capacity and start-up costs associated with the new program and technology integration within SDOT such as parking enforcement, data warehousing and hosting, and IT administrative requirements.
- On-going data collection and stakeholder outreach to support policy research needed to maintain a data-driven CVP program.

Based on these considerations, SDOT anticipates it will cost significantly more than the Stage 1 prototype to implement a citywide digital CVP and curb monitoring technology in a Stage 2 project. We estimate that our Stage 2 project would cost anywhere between \$15-\$20 million to implement.

Is any historical data currently available that could be used to inform project goals, performance measures, or performance targets for at-scale implementation? Provide a high-level summary of the data and how it has informed the evaluation plan. (Please organize this information by goal area.).

SDOT has access to many historical datasets that our project team intends to use to inform project goals, performance measures, and performance targets for at-scale implementation. Examples of datasets we may use are:

Goal Areas	HISTORICAL DATA AVAILABLE TO SUPPORT GOALS, PERF MEASURES AND TARGETS FOR AT-SCALE IMPLEMENTATION
Safety and reliability:	<ul style="list-style-type: none">• SDOT Vision Zero collision history• Previous UFL studies on curb use, and commercial activity at the curb
Resiliency:	<ul style="list-style-type: none">• CVLZ permit holder purchase history• Commercial Load Zone Pay-by-Phone purchase history• SDOT led curb studies (on-street and off-street)• Replica subscription to historical freight trips in Seattle
Equity and access:	<ul style="list-style-type: none">• CVLZ permit holder purchase history• Commercial Load Zone Pay-by-Phone purchase history• Belltown establishment survey completed for previous UFL – SDOT study• City of Seattle Race and Social Equity Index
Climate:	<ul style="list-style-type: none">• Past research completed in partnership with the Urban Freight lab including:<ul style="list-style-type: none">○ An inventory of on- versus off-street loading for building envelopes in downtown Seattle



	<ul style="list-style-type: none">○ A Department of Energy project that created a baseline for commercial vehicle time (and associated climate externalities) spent circling to search for parking
Partnerships:	<ul style="list-style-type: none">• History of partnership with the Urban Freight Lab and members (UPS, Amazon)• Past community engagement in Belltown to support DOE and other curb research• History of SDOT leading the Seattle Freight Advisory Board which seeks to elevate freight voices
Integration:	<ul style="list-style-type: none">• Previous SDOT curb and parking studies (on and off street)• SDOT Vision Zero collision history• CVLZ permit holder purchase history



Part 3 of 4 – Performance Measures for the Proof-of-Concept

Part 3 of the Evaluation Plan should focus on the proof-of-concept or prototype being deployed during Stage 1. One objective of evaluating the proof-of-concept or prototype is to better understand what would be realistically achievable through at-scale implementation. The evaluation findings should refine your expectations, so it is necessary to select informative performance measures.

In context of the goals described in Part 2 for at-scale implementation, complete the following table regarding evaluation questions, performance measures, and performance targets for the prototype or proof-of-concept.

Goals	Evaluation Question	Performance Measure	Performance Measure Target (Stage 1)
Overall Project Goal	Can digital permits and curb monitoring technology improve curbspace efficiency and utilization?	Rigorously assess the piloted technology(ies) to understand their scaling potential	Determine which technology and policy can scale to at-scale Stage 2 implementation
Safety and Reliability:	Can digital permits and curb monitoring technology reduce the number of vehicles parking in travel lanes or other “unauthorized” locations?	Document the number and type of unauthorized parking events	Create a baseline dataset at 2-3 different sub-areas within the study area
Resiliency	What is the vehicle detection accuracy of V2I?	Number of vehicles correctly detected in a CVLZ parking space	98% detection
Equity and access	How do small and local businesses make deliveries and utilize the curb? Which businesses have concentrated numbers of BIPOC and low-income employees?	Understand and categorize different users of the curb (carriers) and receivers (local businesses)	Perform in-depth interviews with one small, medium, and large carrier. Analyze existing permit holder composition and conduct an online survey of existing permit holders
Climate	Are there commercial vehicle parking policy and pricing scenarios SDOT can deploy via curb monitoring and digital permits to help city reduce transportation - created pollutants?	Review baseline data collection, in-depth interviews, and V2I CVP assessment	Create parking policy and pricing scenarios used to improve curb access and incentivize positive climate outcomes
Partnerships	How do (carriers) and receivers (local businesses) respond to digital permits and new commercial curb policies?	Document existing permit holder and other commercial vehicle operators feedback on how the new system could	Collect survey responses from project participants and other stakeholders to gather feedback on pilot technology and new policy scenarios



		integrate with their daily work	
Integration	Can SDOT convert its existing digital curb regulations inventory into CDS?	Understand how CDS formatted data integrates with existing SDOT curb datasets	Develop a replicable process to translate curb regulations into CDS format



Part 4 of 4 – Evaluation Methodology for the Proof-of-Concept

In Part 4 you should summarize your evaluation methodology. To assess success, you will have to compare the performance measurements to a baseline. Whether the deployments for this project are compared to a pre-deployment baseline, an alternative technology, or industry standards, the type of comparison will shape your conclusions.

Provide an overview of how the proof-of-concept or prototype will be evaluated.

SDOT plans to evaluate the Stage 1 prototype through the following efforts:

- A. Establish baseline conditions to understand existing commercial vehicle parking and payment behaviors:
 - i. Data collection study of commercial vehicle load zones and other locations with a high demand for curbside loading within study area to gather street observations on commercial vehicles parking choices (where they park) and their related parking payment behavior (whether vehicle has permit, pay-per-use or are non-compliant, park elsewhere on blockface, vehicle types)
 - ii. Document delivery carrier's practices on pricing payment
 - iii. Evaluate trends in existing CVLZ permit purchasers
 - iv. Implement strategic stakeholder communications plan to local businesses and freight carriers operating in project area to understand their current loading needs, technology competency, engagement with CVLZ permit program
- B. Develop freight parking policy pricing and technology scenarios using baseline data collection, stakeholder engagement, and data collected via V2I technology.
- C. Assess the CVP and V2I technology system to understand its scaling potential:
 - i. Document share of parking events and permit holders correctly identified by the V2I technology
 - ii. Analyze accuracy and communication potential of curb regulations inventory and data integration of V2I curb events data in CDS format
 - iii. Compare costs of implemented prototype technologies with our OMF cohort cities project technologies

Describe the methods that will be used to estimate the anticipated benefits and costs associated with at-scale implementation. Describe the type and source of baseline data that will be used.

SDOT plans to use a similar methodology for estimating the anticipated costs and benefits of an at-scale implementation as we will use for evaluating the Stage 1 prototype. Given the drastic change in scale from Stage 1 to Stage 2, there will be some changes to scope methodology and performance measures to accommodate for the change in scale. To estimate the benefits of the scaled-up CVP, we will use baseline measures from data collected during Stage 1 such as feedback from permit holders and commercial carriers in Seattle, user satisfaction with proposed technology, conversations with Seattle parking enforcement on proposed technology, and by comparing against the curb utilization data. There are also many financial costs that must be considered when comparing against the benefits of the



program. The costs associated with an at-scale implementation will be compared to the existing curb management programs (baseline costs) that SDOT maintains today such as our on-street pay station meters, mobile parking payment tool, and parking occupancy data modeling services among many others. It is important to note that at-scale evaluation methods may change as the prototype is refined during Stage 1 implementation.

Provide a brief overview of how challenges, best practices, and recommendations for future deployers will be collected across the project team throughout the duration of the project.

We will include thorough documentation of challenges, best practices, and recommendations for future deployers in our final evaluation and recommendations report. This will be accomplished by:

- A. Project management tracking by SDOT, UFL, and consultant
 - i. Challenges and learnings will be collected throughout the project – especially during the baseline and data collection phase that involves curb data collection (behaviors at the curb) and engagement with users of the permit program and delivery carriers operating in this area of Seattle
- B. Membership services provided by the OMF and SMART cohort of cities
 - i. The OMF Collaborative will capture learnings from across the cohort cities and document these for public consumption
- C. Final evaluation report produced by SDOT, UFL, and consultant
 - i. Our final evaluation will include policy recommendations and next steps for at-scale implementation of the CVP and V2I technology in Seattle

Provide a table with any relevant technical terms or acronyms and their definitions.

SDOT	Seattle Department of Transportation
UFL	University of Washington Urban Freight Lab
OMF	Open Mobility Foundation
CDS	Curb Data Specification
V2I	Vehicle-to-curb infrastructure
CVP	Digital commercial vehicle permit
CV	Commercial vehicle
CVLZ	Commercial vehicle load zone