Mobility Data Collaborative™
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DATA SHARING GLOSSARY AND METRICS FOR SHARED MICROMOBILITY

INTRODUCTION

As shared micromobility, such as dockless bikesharing and electric scooter sharing, has expanded around the world, so too have regulatory frameworks that define how these services use the public right of way. Many public agencies require operators of these services to provide access to data to support more data-driven approaches to monitoring and management, including the establishment of vehicle caps that limit the number of vehicles per operator and monitoring system utilization rates. This data is also used for long-term transportation and infrastructure planning.

Despite the burgeoning data sharing standards that describe the specific vehicle or trip data fields that shared micromobility operators are required to provide to public agencies, there are often inconsistent definitions and interpretations for the performance metrics that are used by public agencies and operators. For instance, what qualifies as a "vehicle count" towards a "vehicle cap" may have multiple definitions depending on the public agency, operator, or third-party platform auditing and analyzing data. As mobility services continue to expand and data-driven approaches to regulation are adopted, it is imperative to define consistent performance metrics that are agreed upon by multiple stakeholders, including both the public and private sector.

Data Sharing Glossary and Metrics for Shared Micromobility provides a consensus-based set of definitions for terms and metrics that are commonly used. It outlines key vehicle, trip, and geospatial definitions and metrics to reduce discrepancies in the terminology used across jurisdictions and sectors and allow public agencies to clarify policies related to shared micromobility.

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1. SCOPE

Data Sharing Glossary and Metrics for Shared Micromobility provides a set of definitions for terms and metrics commonly used to monitor and evaluate shared micromobility operating in the public right of way. There are a variety of data and sources of information that are used to manage and evaluate shared micromobility programs, including:

- vehicle and trip data;
- reported complaints and collisions;
- demographic data about users; and
- behavioral impacts of micromobility use.

This document focuses on vehicle and trip data.

This document clarifies and reduces ambiguity of terms that are commonly used to regulate and oversee shared micromobility programs. Other mobility services may be covered in future best practices.

For taxonomy specifically related to powered micromobility vehicles, please refer to SAE J3194 *Taxonomy and Classification of Powered Micromobility Vehicles*; and for taxonomy specifically related to shared- or rental-fleet operations of micromobility vehicles, please refer to SAE J3163 *Taxonomy and Definitions for Terms Related to Shared Mobility and Enabling Technologies*.

2. VEHICLE STATUS DEFINITIONS

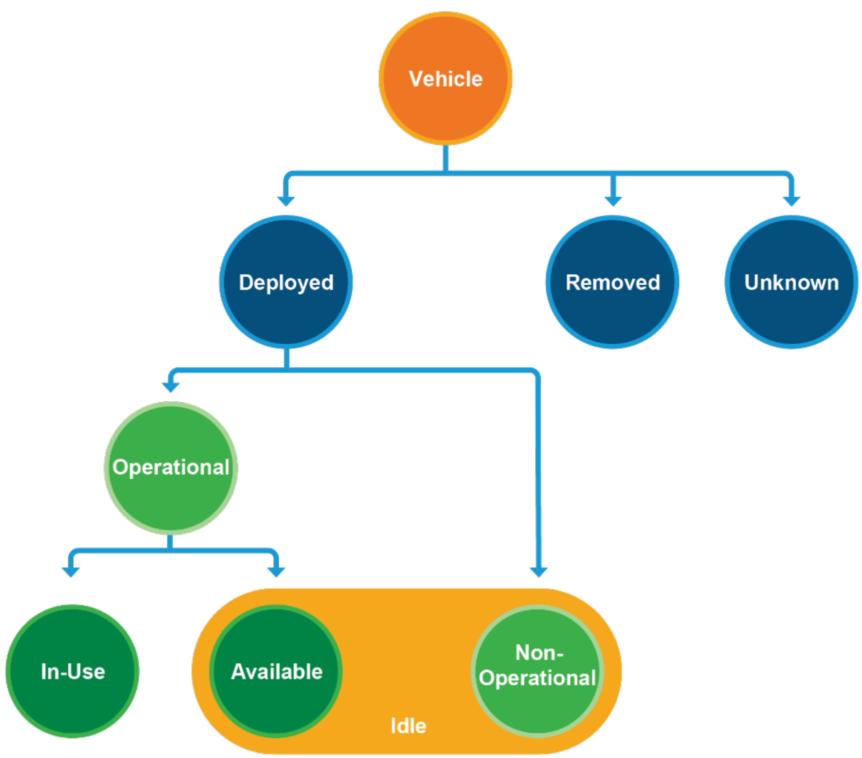

Figure 1: Overview of key vehicle status definitions

2.1 Available Vehicle

An operational vehicle that is available for use. A vehicle may not be defined as available and also in-use at the same time.

2.2 Deployed Vehicle

A vehicle that is in a specified geography and is either operational or non-operational. A vehicle may not be defined as deployed and also removed or unknown at the same time.

2.3 Fleet Vehicle

A group of more than one vehicle.

2.4 Idle Vehicle

A deployed vehicle that is either available or non-operational.

2.5 In-Use Vehicle

An operational vehicle that is either actively on a trip or is reserved for a trip and unavailable to other users. A vehicle may not be defined as in-use and also available at the same time.

2.6 Non-Operational Vehicle

A deployed vehicle that is not available for use because of a mechanical issue such as an equipment issue, insufficient battery, or other reason that it is non-operational. A vehicle may not be defined as non-operational and also operational at the same time.

2.7 Operational Vehicle

A deployed vehicle that is either available or is in-use. A vehicle may not be defined as operational and also non-operational at the same time.

2.8 Removed Vehicle

A vehicle that has been removed from being deployed in a specified geography by the operator to be recharged, repaired, rebalanced, or for some other reason and is unavailable for customer use. A vehicle may not be defined as removed and also deployed or unknown at the same time.

2.9 Unknown Vehicle

A vehicle that has been flagged as unknown by the operator because it has lost a GPS signal and/or its location cannot be determined by the operator for some other reason. A vehicle may not be defined as unknown and also deployed or removed at the same time.

2.10 Vehicle

A motorized or human-powered vehicle could include an automobile, motorcycle, (e-)bike, e-scooter, or moped that is used for transportation.

NOTE: Specific methods for counting vehicles in the public right of way are defined in Section 6.

3. TRIP DEFINITIONS

3.1 Trip

Travel of an in-use vehicle from one location to another. Failed attempts to use a vehicle and non-customer vehicle movement are not considered trips.

NOTE: If specific thresholds are used to exclude failed attempts to use a vehicle or non-customer vehicle movement, these should be clearly communicated. At a minimum, trips that have a duration of less than 10 seconds should not be considered as trips. Similarly, vehicles with a period of in-use time more than 7 hours should not be considered as having been on trips.

3.2 Trip Start

The beginning or origin of a trip.

3.3 Trip End

The end or destination of a trip.

NOTE: Specific methods and key issues regarding counting trips as in a specified geography or in the public right of way are included in Section 6.

4. GEOSPATIAL DEFINITIONS

4.1 Route

A list of waypoints ordered sequentially by time that comprise a trip, or subset of a trip along a particular path.

4.2 Service Area

The geographical area where an operator is permitted to provide service.

EXAMPLE: If an operator is allowed to operate throughout a given local jurisdiction, the service area would be the area within the local jurisdictional boundaries.

4.3 Waypoint

A specified geographical location that contains a two-dimensional coordinate, a latitude and longitude, for the precise location of a vehicle on a route at an exact time. Trip start and trip end are waypoints.

4.4 Zone

A smaller geographical area within a service area that may be associated with a policy or set of policies.

EXAMPLE: A zone may be identified as an equity zone, preferred parking zone, or other type of zone where vehicles or vehicle movements are regulated in a specific manner.

5. TIME DEFINITIONS

5.1 Available Time

The time period in which a vehicle is available. Total available time is the summation of time in all time periods in which a vehicle is available, over a specified window of time.

5.2 Deployed Time

The time period in which a vehicle is deployed. Total deployed time is the summation of time in all time periods in which a vehicle is deployed, over a specified window of time.

5.3 Idle Time

The time period in which a vehicle is idle. Total idle time is the summation of time in all time periods in which a vehicle is idle, over a specified window of time.

5.4 In-Use Time

The time period in which a vehicle is in-use. Total in-use time is the summation of time in all time periods in which a vehicle is in-use, over a specified window of time.

5.5 Non-Operational Time

The time period in which a vehicle is non-operational. Total non-operational time is the summation of time in all time periods in which a vehicle is non-operational, over a specified window of time.

5.6 Operational Time

The time period in which a vehicle is operational. Total operational time is the summation of time in all time periods in which a vehicle is operational, over a specified window of time.

6. VEHICLE-BASED PERFORMANCE METRICS

6.1 Number of Vehicle of a Specified Status

The number of vehicles of a specified status that are within a specified geography at a specific moment in time. When establishing policies to count a number of vehicles, the status of the vehicles should be defined. See Section 2.

Example available in Appendix A.

6.2 Average Number of Vehicles of a Specified Status

The average number of vehicles of a specified status that are within a specified geography over a specified time period. It is recommended that this metric be associated with the smallest latency of data available (preferably a 1-minute time unit) for aggregation.

$$avg\_veh = \frac{\sum_i^T veh_i}{T} \quad \text{(Eq. 1)}$$

Where:

avg_veh = average number of vehicles of a specified status

veh_i = number of vehicles of a specified status at i

i = sampling frequency (e.g., time units in minutes)

T = time period of interest (i.e., total number of i samples)

Example available in Appendix A.

6.3 Maximum Average Number of Vehicles of a Specific Status

The maximum average number of vehicles of a specified status in a specified geography over a specified time period. It is recommended that this metric be associated with an hourly (or longer) window of time, where the average number of vehicles of a specified status is calculated for that hour window. The maximum average number of vehicles of a specified status would therefore be the maximum of the hourly windows.

$$max\_avg\_veh = \max_{j \in S}(avg\_veh_j) \quad \text{(Eq. 2)}$$

Where:

max_avg_veh = maximum average number of vehicles of a specified status

avg_veh_j = average number of vehicles of a specified status over j

j = sampling frequency (e.g., time units in hours)

S = The set of time periods, j, to be considered (in the maximum)

NOTE: See Section 6.2 for the definition and equation for average number of vehicles.

Example available in Appendix A.

6.4 Absolute Maximum Number of Vehicles of a Specified Status

The absolute maximum number of vehicles of a specified status in a specified geography over a specified time period. It is recommended that this metric be associated with a sampling rate associated with the most frequent data latency available.

$$abs\_max\_veh = \max_{j \in S}(veh_j) \quad \text{(Eq. 3)}$$

Where:

abs_max_veh = absolute maximum number of vehicles of a specified status

veh_j = number of vehicles of a specified status at j

j = sampling frequency (e.g., time units in minutes)

S = The set of time periods, j, to be considered (in the maximum)

Example available in Appendix A.

6.5 Minimum Average Number of Vehicles of a Specified Status

The minimum average number of vehicles of a specified status in a specified geography over a specified time period. It is recommended that this metric be associated with an hourly (or longer) window of time, where the average number of vehicles of a specified status is calculated for that hour window. The minimum average number of vehicles of a specified status would therefore be the minimum of the hourly windows.

$$min\_avg\_veh = \min_{j \in S}(avg\_veh_j) \quad \text{(Eq. 4)}$$

Where:

min_avg_veh = minimum average number of vehicles of a specified status

avg_veh_j = average number of vehicles of a specified status over j

j = sampling frequency (e.g., time units in hours)

S = The set of time periods, j, to be considered (in the minimum)

NOTE: See Section 6.2 for the definition and equation for average number of vehicles.

Example available in Appendix A.

6.6 Absolute Minimum Number of Vehicles of a Specified Status

The absolute minimum number of vehicles of a specified status in a specified geography over a specified time period. It is recommended that this metric be associated with a sampling rate associated with the most frequent data latency available.

$$abs\_min\_veh = \min_{j \in S}(veh_j) \quad \text{(Eq. 5)}$$

Where:

abs_min_veh = absolute maximum number of vehicles of a specified status

veh_j = number of vehicles of a specified status at j

j = sampling frequency (e.g., time units in minutes)

S = The set of time periods, j, to be considered (in the minimum)

Example available in Appendix A.

7. TRIP-BASED PERFORMANCE METRICS

7.1 Number of Trips

The sum of the number of trips taken in a specified geography over a specified time period. For small service areas, it is particularly important that the local jurisdiction clearly determine and communicate whether the number of trips should include or exclude trips that start, end, and/or pass through (i.e., recording waypoints in) a specified geography.

7.2 Utilization Rate of Vehicles of a Specified Status

The number of trips taken by vehicles of a specified status in a specified geography over a specific period of time. It is recommended that this metric be based on the average number of vehicles of a specified status as calculated over 24-hour windows.

8. CONCLUSION

The Mobility Data Collaborative™ looks forward to supporting data-driven approaches to improving mobility through a consistent set of definitions and metrics for shared micromobility.

9. ABOUT THE MOBILITY DATA COLLABORATIVE™

The Mobility Data Collaborative™ serves as a neutral forum for cross-sector collaboration. Its goal is to convene leading mobility partners from public and private sectors to develop a framework of best practices to support effective and secure mobility data sharing.

Vision: Support the effective sharing of mobility data with public agencies to support safe, equitable, and livable streets for all.

Mission: Fostering a collaborative, cross-sectoral, and productive forum that reconciles public agencies' policy and regulatory goals with industry capabilities and consumer interests. This includes establishing a data sharing framework that provides public benefit while protecting consumer privacy.

10. CONTACT INFORMATION

To learn more about the Mobility Data Collaborative™, please visit www.mobilitydatacollaborative.org.

Contact: mobilitydatacollaborative@sae-itc.org

11. ACKNOWLEDGEMENTS

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12. REFERENCES

The following publications were referenced during the development of this document. Where appropriate, documents are cited.

Unless otherwise indicated, the latest issue of SAE publications shall apply. Available from SAE International, 400 commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J3163	Taxonomy and Definitions for Terms Related to Shared Mobility and Enabling Technologies
SAE J3194	Taxonomy and Classification of Powered Micromobility Vehicles

APPENDIX A. EXAMPLE CALCULATIONS USING PERFOMANCE METRICS

In this section, sample data and example calculations are provided to illustrate the use of Section 6.

Table A1. Sample data of operational vehicles by minute

Column A	Column B	Column C
Index	**Time**	**No. of operational vehicles**
1	7:00 AM	40
2	7:01 AM	45
3	7:02 AM	50
4	7:03 AM	55
5	7:04 AM	60
6	7:05 AM	70
7	7:06 AM	80
8	7:07 AM	90
9	7:08 AM	100
10	7:09 AM	100
11	7:10 AM	105
12	7:11 AM	105
13	7:12 AM	100
14	7:13 AM	110
15	7:14 AM	110
16	7:15 AM	110
17	7:16 AM	110
18	7:17 AM	110
19	7:18 AM	110
20	7:19 AM	110
21	7:20 AM	110
22	7:21 AM	110
23	7:22 AM	110
24	7:23 AM	110
25	7:24 AM	110
26	7:25 AM	110
27	7:26 AM	110
28	7:27 AM	110
29	7:28 AM	110
30	7:29 AM	110

Table A1. Sample data of operational vehicles by minute (continued)

Column A	Column B	Column C
Index	**Time**	**No. of operational vehicles**
31	7:30 AM	110
32	7:31 AM	110
33	7:32 AM	106
34	7:33 AM	105
35	7:34 AM	105
36	7:35 AM	105
37	7:36 AM	105
38	7:37 AM	105
39	7:38 AM	105
40	7:39 AM	105
41	7:40 AM	105
42	7:41 AM	105
43	7:42 AM	105
44	7:43 AM	105
45	7:44 AM	105
46	7:45 AM	105
47	7:46 AM	105
48	7:47 AM	105
49	7:48 AM	105
50	7:49 AM	105
51	7:50 AM	105
52	7:51 AM	105
53	7:52 AM	106
54	7:53 AM	107
55	7:54 AM	110
56	7:55 AM	110
57	7:56 AM	110
58	7:57 AM	110
59	7:58 AM	110
60	7:59 AM	110
61	8:00 AM	110
62	8:01 AM	110
63	8:02 AM	110
64	8:03 AM	110
65	8:04 AM	110

Table A1. Sample data of operational vehicles by minute (continued)

Column A	Column B	Column C
Index	**Time**	**No. of operational vehicles**
66	8:05 AM	110
67	8:06 AM	110
68	8:07 AM	110
69	8:08 AM	110
70	8:09 AM	110
71	8:10 AM	110
72	8:11 AM	110
73	8:12 AM	110
74	8:13 AM	110
75	8:14 AM	110
76	8:15 AM	110
77	8:16 AM	110
78	8:17 AM	110
79	8:18 AM	110
80	8:19 AM	110
81	8:20 AM	110
82	8:21 AM	110
83	8:22 AM	120
84	8:23 AM	121
85	8:24 AM	122
86	8:25 AM	123
87	8:26 AM	125
88	8:27 AM	128
89	8:28 AM	130
90	8:29 AM	130
91	8:30 AM	130
92	8:31 AM	130
93	8:32 AM	130
94	8:33 AM	130
95	8:34 AM	130
96	8:35 AM	130
97	8:36 AM	131
98	8:37 AM	133
99	8:38 AM	134
100	8:39 AM	135

Table A1. Sample data of operational vehicles by minute (continued)

Column A	Column B	Column C
Index	**Time**	**No. of operational vehicles**
101	8:40 AM	136
102	8:41 AM	137
103	8:42 AM	138
104	8:43 AM	140
105	8:44 AM	140
106	8:45 AM	140
107	8:46 AM	140
108	8:47 AM	140
109	8:48 AM	140
110	8:49 AM	140
111	8:50 AM	140
112	8:51 AM	140
113	8:52 AM	140
114	8:53 AM	140
115	8:54 AM	140
116	8:55 AM	140
117	8:56 AM	140
118	8:57 AM	140
119	8:58 AM	140
120	8:59 AM	140

A1. Number of Vehicles of a Specified Status in Section 6.1

Example: The number of operational vehicles at 7:00 AM.

The number of operational vehicles at 7:00 AM is 40 (C1 from Table A1).

A2. Average Number of Vehicles of a Specified Status in Section 6.2

Example: The average number of operational vehicles from 7:00 AM to 7:59 AM, using 1-minute intervals.

Using Equation 1 in Section 6.2:

$$avg\_veh = \frac{\sum_i^T veh_i}{T} \quad \text{(Eq. A1)}$$

Where:

avg_veh = average number of operational vehicles between 7:00 AM and 7:59 AM

veh_i = number of operational vehicles at i (i.e., C1, C2, ... ,C59, C60 from Table A1)

i = 1-minute sampling frequency starting at 7:00 AM

T = time period of interest is 60 minutes (i.e., 7:00 AM to 7:59 AM)

$$avg\_veh = \frac{\sum(C1, C2, \dots, C59, C60)}{60} + \frac{40 + 45 + \dots + 110 + 110}{60} = \frac{6064}{60} = 101.07 \quad \text{(Eq. A2)}$$

A3. Maximum Average Number of Vehicles of a Specified Status in Section 6.3

Example: Maximum average number of operational vehicles from 7:00 AM to 8:59 AM, using 1-minute intervals averaged over 1-hour time periods.

Using Equation 2 in Section 6.3:

$$max\_avg\_veh = \max_{j \in S}(avg\_veh_j) \quad \text{(Eq. A3)}$$

Where:

max_avg_veh = maximum average number of operational vehicles between 7:00 AM and 8:59 AM

avg_veh_j = average number of operational vehicles at j (i.e., time period 1 = average of C1, C2, ... ,C59, C60; time period 2 = average of C61, C62, … , C119, C120 from Table A1)

j = 1-hour sampling frequency starting at 7:00 AM

S = the set of time periods is 2 hours (i.e., time period 1 = 7:00 AM to 7:59 AM; time period 2 = 8:00 AM to 8:59 AM)

Step 1. Determine the average for each 1-hour time period using Equation A1.

Step 2. Take the maximum of the values using Equation A3.

$$max\_avg\_veh = max\left[\frac{\sum(C1, C2, \dots, C59, C60)}{60}, \frac{\sum(C61, C62, \dots, C119, C120)}{60}\right] = max\left[\frac{6064}{60}, \frac{7523}{60}\right] = max[101.07, 125.38] = 125.38 \quad \text{(Eq. A4)}$$

A4. Absolute Maximum Number of Vehicles of a Specified Status in Section 6.4

Example: Absolute maximum number of operational vehicles from 7:00 AM to 8:59 AM, using sampling rate of most frequent data latency available (i.e., 1 minute).

Using Equation 3 in Section 6.4:

$$abs\_max\_veh = \max_{j \in S}(veh_j) \quad \text{(Eq. A5)}$$

Where:

abs_max_veh = absolute maximum number of operational vehicles

veh_j = number of operational vehicles at j (i.e., C1, C2, … , C119, C120 from Table A1)

j = 1-minute sampling frequency starting 7:00 AM

S = The entire time period from 7:00 AM to 8:59 AM

Step 1. Find the maximum value from C1 through C120 from Table A1 using Equation A5.

$$abs\_max\_veh = max[C1, C2, \dots, C119, C120] = max[40,45, \dots, 140,140] = 140 \quad \text{(Eq. A6)}$$

A5. Minimum Average Number of Vehicles of a Specified Status in Section 6.5

Example: Minimum average number of operational vehicles from 7:00 AM to 8:59 AM, using 1-minute intervals averaged over 1-hour time periods.

Using Equation 4 in Section 6.5:

$$min\_avg\_veh = \min_{j \in S}(avg\_veh_j) \quad \text{(Eq. A7)}$$

Where:

min_avg_veh = minimum average number of operational vehicles between 7:00 AM and 8:59 AM

avg_veh_j = average number of operational vehicles at j (i.e., time period 1 = average of C1, C2, ... ,C59, C60; time period 2 = average of C61, C62, … , C119, C120 from Table A1)

j = 1-hour sampling frequency starting at 7:00 AM

S = The set of time periods is 2 hours (i.e., time period 1 = 7:00 AM to 7:59 AM; time period 2 = 8:00 AM to 8:59 AM)

Step 1. Determine the average for each 1-hour time period using Equation A1.

Step 2. Take the minimum of the values using Equation A7.

$$min\_avg\_veh = min\left[\frac{\sum(C1, C2, \ldots, C59, C60)}{60}, \frac{\sum(C61, C62, \ldots, C119, C120)}{60}\right] = min\left[\frac{6064}{60}, \frac{7523}{60}\right] = min[101.07, 125.38] = 101.07 \quad \text{(Eq. A8)}$$

A6. Absolute Minimum Number of Vehicles of a Specified Status in Section 6.6

Example: Absolute minimum number of operational vehicles from 7:00 AM to 8:59 AM, using sampling rate of most frequent data latency available (i.e., 1 minute).

Using Equation 3 in Section 6.6:

$$abs\_min\_veh = \min_{j \in S}(veh_j) \quad \text{(Eq. A9)}$$

Where:

abs_min_veh = absolute minimum number of operational vehicles

veh_j = number of operational vehicles at j (i.e., C1, C2, … , C119, C120 from Table A1)

j = 1-minute sampling frequency starting 7:00 AM

S = The entire time period from 7:00 AM to 8:59 AM

Step 1. Find the minimum value from C1 through C120 from Table A1 using Equation A9.

$$abs\_min\_veh = min[C1, C2, \ldots, C119, C120] = min[40,45, \ldots, 140,140] = 40 \quad \text{(Eq. A10)}$$