Sway Mobility and Mapless Carshare Pilot: Risk Assessment

Scope

A Sway Mobility carshare vehicle will be equipped with tele-operation technology provided and operated by Mapless AI. Each morning, a trained remote operator from Mapless will position the vehicle at a predetermined parking spot in the TIZ. In the evening, another relocation operation will be performed to deliver the carshare vehicle to a charger location inside the Bagley Mobility Hub. During all remote operation, a safety driver trained by Mapless will be sitting in the driver's seat of the carshare vehicle to supervise all tele-operated driving operations. The safety driver has full control authority over the vehicle, and their input immediately takes precedence over any input by the remote operator.

Together, the remote operator and the safety driver are trained to ensure safe vehicle operations at all times. Training includes but is not limited to:

1. Proactive communication between remote operator and safety driver,
2. Taking over manual operations by the safety driver if/when necessary,
3. Monitoring the vehicles systems with constant vigilance,
4. Providing clear and concise verbal and written feedback for team consideration.

All operation will be limited to the TIZ with all applicable road rules and signage adhered to. Vehicle speed is limited to a maximum of 35 mph, and roads with higher posted speed limits will not be included in the pilot. Both remote operator and safety driver will monitor weather conditions during operation. If adverse weather conditions, such as heavy rain or snow, are observed, no remote operation will be conducted in the TIZ. Operation may proceed in light to medium rain.

High-level risk assessment

A potential source of harm is an accident of a carshare vehicle due to collision of the vehicle with infrastructure, another traffic participant, or a vulnerable road user. To assess the risk associated with operation, the risk assessment below considers hazards, as well as their mitigations, which are implemented through system safety and operational safety. For system safety, the tele-operation system includes multiple technical measures to avoid the risk of an accident during operation. Additional operational control measures are in place to limit the exposure to accident risk further, such as the presence of a trained safety driver during all operation in the TIZ. As can be seen in the full analysis, we foresee this project's overall risk level to be low with the mitigations and operational protocols in place.

In the analysis, the probability ("P") – also referred to as likelihood ("L") – considers the frequency of a *hazardous event*, i.e., the occurrence of the listed hazard in a scenario in the TIZ

where a collision, and thus harm to humans or property, may result. Severity ("S") describes the magnitude of such an incident.

Likelihood (L) \ Severity (S)	Negligible 1	Minor 2	Moderate 3	Significant 4	Severe 5
Very likely 5	5	10	15	20	25
Likely 4	4	8	12	16	20
Possible 3	3	6	9	12	15
Unlikely 2	2	4	6	8	10
Extremely unlikely 1	1	2	3	4	5

Lastly, controllability ("C") can be regarded as a measure of how difficult the scenario is for the safety driver in the vehicle to correct. The resulting Risk Score ("R") is the product of all three factors, and used to determine follow-on risk reduction actions.

Controllability	
1	Very easily controllable
2	Easily controllable
3	Moderately controllable
4	Difficult to control
5	Not controllable

Overall Risk Scoring	
R >= 30	Unacceptable Risk - must be reduced before activity can begin
40 > R >= 30	Tolerable Risk (upper) - must be reduced if reasonably practicable within project resources
30 > R >= 18	Tolerable Risk (lower) - should be mitigated if possible to achieve with minimal additional burden
R < 18	Acceptable Risk - no further mitigation necessary
The overall Risk Level is scored by multiplying together the Probability, severity and (difficulty of) Controllability	

Figure 1: Risk matrix and action level.

Potential Risks & Mitigation *(link to sheet)*

The attached risk assessment considers hazards, as well as their mitigations, which are implemented through system safety and operational safety. Both the *Existing Mitigation Measures* (column 2), as well as the *Additional Mitigation Measures* (column 8) have been implemented in the course of development.