

R37: Applying the AcciMap approach to a fatal e-scooter crash: A safe systems approach to analyzing micromobility

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Project Team

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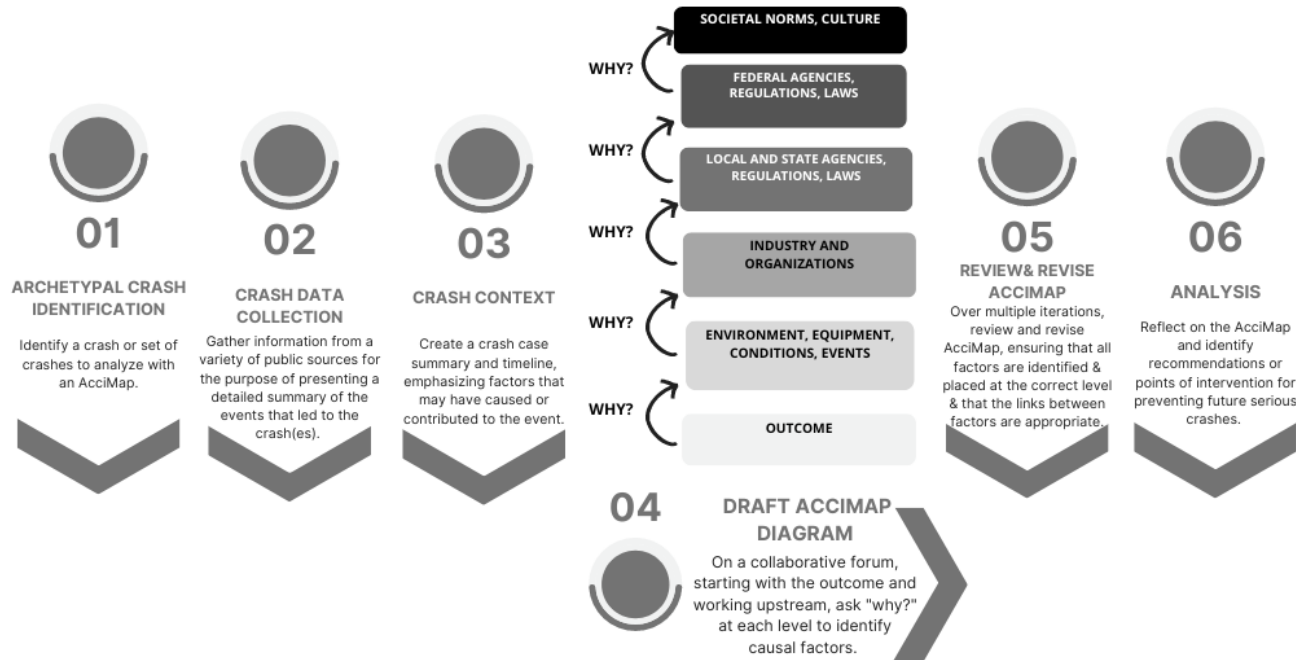
Study Objectives

1. Complete the first AcciMap analysis of a fatal e-scooter collision.
2. Assess the feasibility and usefulness of applying the AcciMap methodology using limited, publicly available data sources.
3. Develop a framework for applying the AcciMap analysis to other micromobility incidents, with practitioners, governmental officials, advocates, and other typical safety (e.g., Vision Zero) coalition members in mind.
4. Identify potential upstream and downstream interventions for preventing micromobility injuries and fatalities.

Some Common Tools for Systems Thinking

Tool	Description	Strengths	Weaknesses
STEP	The STEP method is multi-linear and focuses on decisions and actions across time in contrast to looking at them across systemic levels.	<ul style="list-style-type: none"> • Low complexity and easy to use (requires minimal training) • Does not require a large time investment • High applicability to the analysis of road traffic incidents • Useful for generating interventions/ countermeasures (but only as it relates to proximal safety factors) 	<ul style="list-style-type: none"> • Considered a multi-linear rather than a truly systemic model of safety • Limited scope and is not designed to provide insight into more complex factors/ relationships
STAMP	The STAMP method is an accident causality model that uses a control structure.	<ul style="list-style-type: none"> • Addresses all levels in the system, including societal levels • Has a formal in-built classification system • Useful for generating interventions/ countermeasures 	<ul style="list-style-type: none"> • High complexity • High reliance on subject matter experts • Can be time-consuming to generate • Assumes a hierarchical relationship between factors • More suitable to identifying technical factors over others (e.g., human factors)
FRAM	The FRAM method uses a resilience method by recognizing a range of human performance that systems need to accommodate.	<ul style="list-style-type: none"> • Addresses interactions between factors • Holistic approach • Useful for generating interventions/ countermeasures 	<ul style="list-style-type: none"> • High complexity and not simple to interpret • Low applicability to road traffic incidents • Does not cover all systems levels (especially higher levels)
AcciMap	The AcciMap method uses a graphical approach to systems mapping and sociotechnical system analysis.	<ul style="list-style-type: none"> • Facilitates a more systemic view of traffic safety consistent with the Safe System approach • Facilitates creative, expansive thinking • Facilitates cooperation, accommodates differing viewpoints and perspectives, and is suitable for larger groups • Has a low barrier to entry (i.e., does not require specialized analytic abilities) • Requires minimal resources • Has had demonstrated practical impacts 	<ul style="list-style-type: none"> • Limited application outside of the academic domain • Sufficiently capturing relationships between factors can be challenging • Does not commonly incorporate feedback between variables to capture reinforcing and balancing forces

Stages of AcciMapping



Step 1: Archetypal Case Selection

- Selected the first e-scooter fatal traffic crash in Tennessee (May 16, 2019)
 - Generated a comprehensive crash investigation
 - Generated considerable media attention
 - Fewer data privacy concerns, as compared to a nonfatal injury

Source: FARS (2023)
<https://cdan.dot.gov/query>



Step 2: Collect Data

Data sources

- Abstracted data from the following sources:
 - Media reports,
 - Crash report,
 - Fatality Analysis Reporting System (FARS),
 - And information released as part of the Nashville Department of Transportation's E-scooter Pilot Program.

Step 1: Collect Data Con.

Prepare Incident Narrative

Who:

- Vehicle #1: 2017 Black Nissan Pathfinder
- Vehicle #2: Bird Scooter

What:

- Vehicle #1 driving in the middle lane when Vehicle #2 turned right onto roadway and a collision occurred

Where:

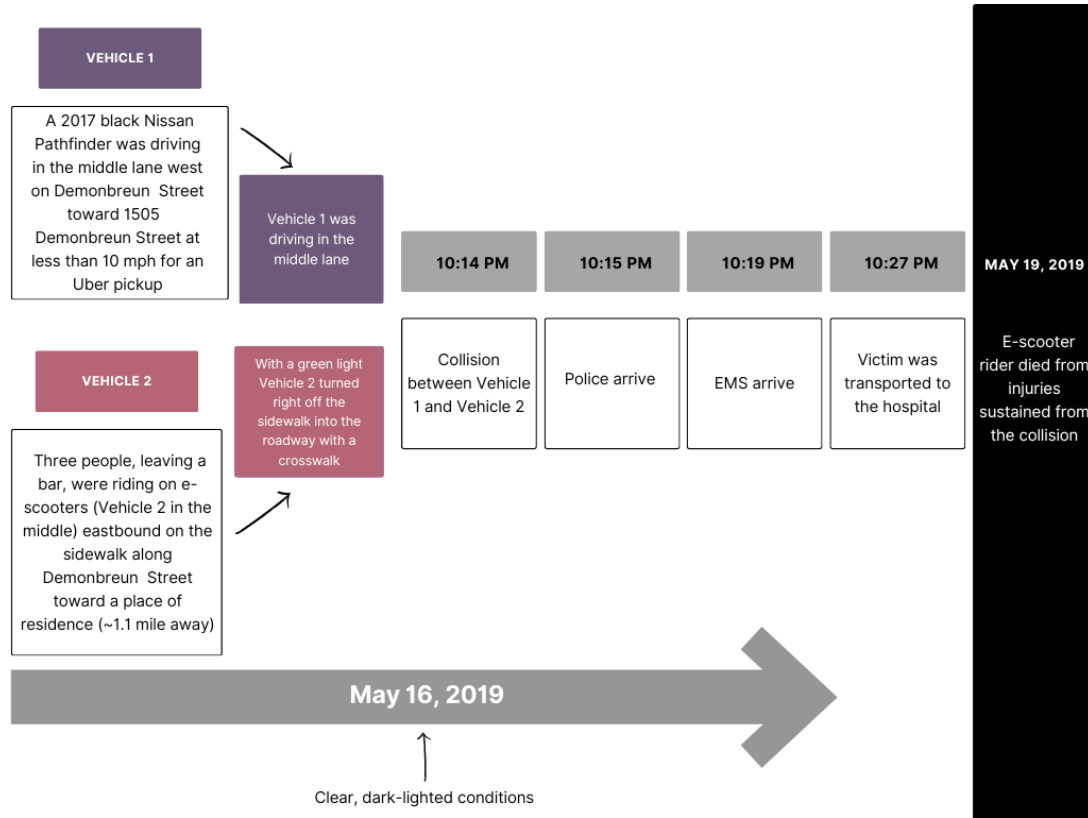
- The intersection of Demonbreun Street and 14th Avenue South in Nashville, TN

When:

- May 16, 2019, at 10:14 pm

Step 3: Establish Crash Context

Document Timeline of Events Leading to the Fatal Collision



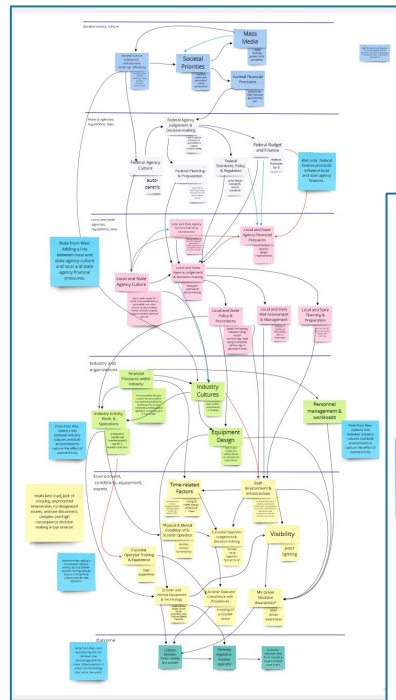
Step 3: Establish Crash Context Con.

Identify Relevant Nashville Policies at Time of Event (2019)

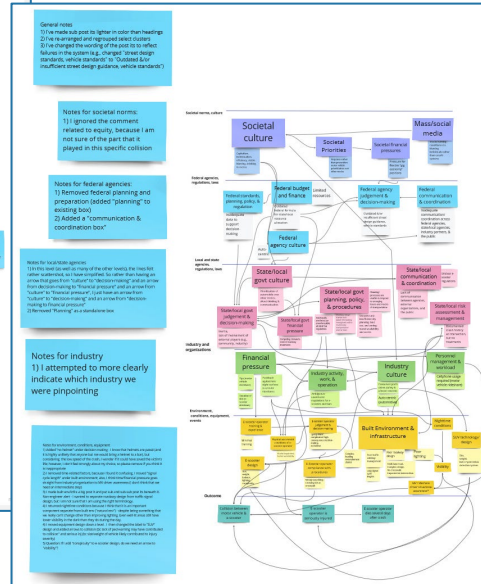
- E-scooter rideshare operators were required to limit the top motor-powered speed of their e-scooters to less than or equal to 20 miles per hour.
- E-scooters were not permitted on sidewalks in the business district and were required to yield to pedestrians when operating on sidewalks in permitted zones.
- When riding in the street, e-scooters were required to follow the rules of the road as if they were motor vehicles.
- Helmet use was not a requirement when operating an e-scooter.
- Rideshare operators were responsible for educating e-scooter users on all laws and regulations applicable to operating the device and instructing users to comply with these laws and regulations.

Step 4: Draft AcciMap, Revise, & Repeat...

- Project team met three times to draft and revise the AcciMap.
- Additional revisions were made via email.
- A total of 5 drafts were made prior to the final draft (three shown here).

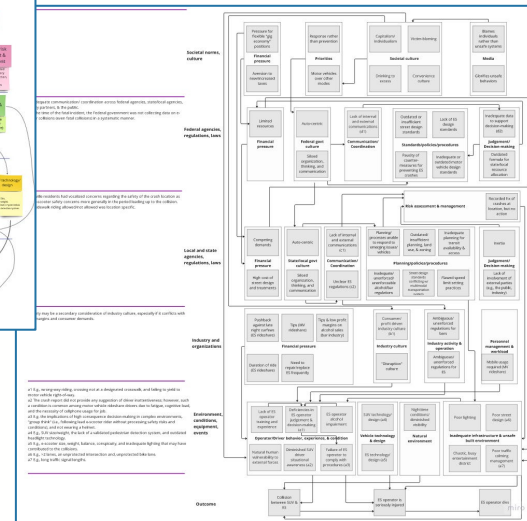


← AcciMap Version 1



← AcciMap Version 2

↓ AcciMap Version 3

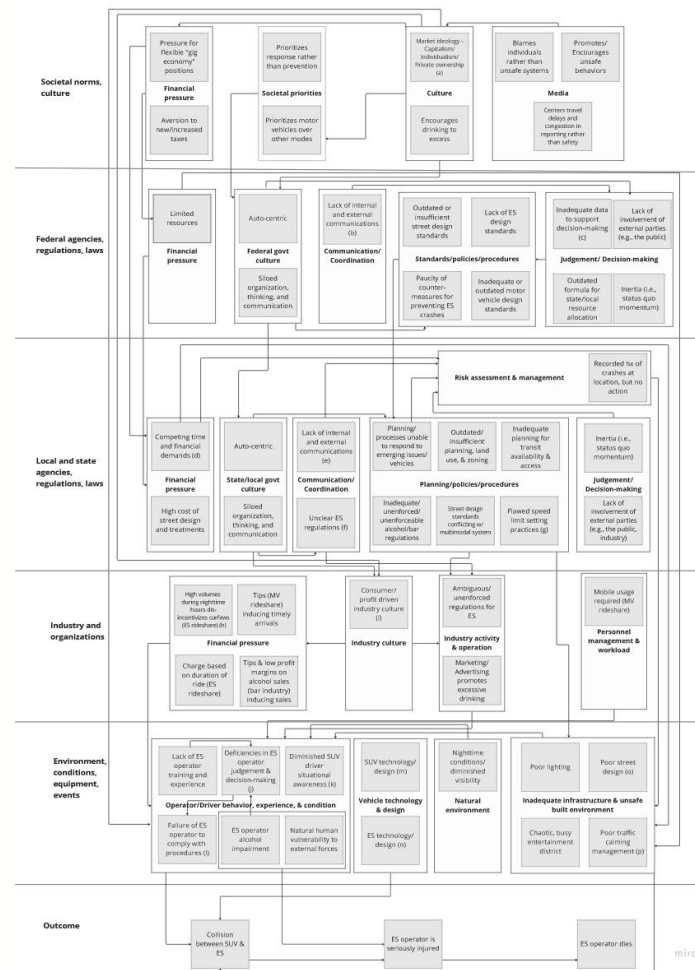


Step 5: Finalize AcciMap

Link to Board:

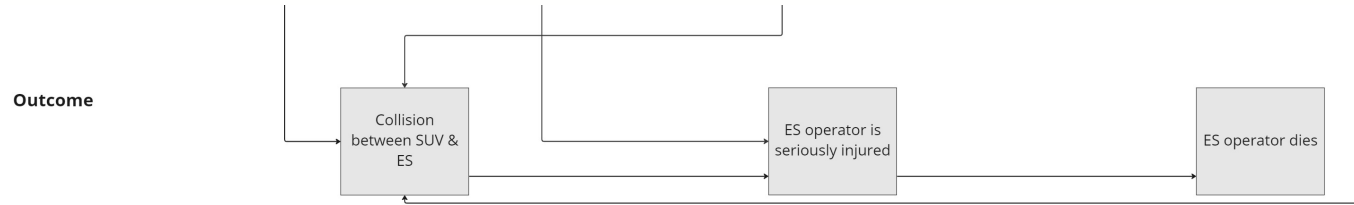
https://miro.com/app/board/uXjVPh4AfPw=/?share_link_id=839706148802

Please note that the board linked above is the best way to view the AcciMap. We zoom in on each AcciMap level in the following slides, but some of the connections between levels are then lost.



Step 6: Analyze AcciMap

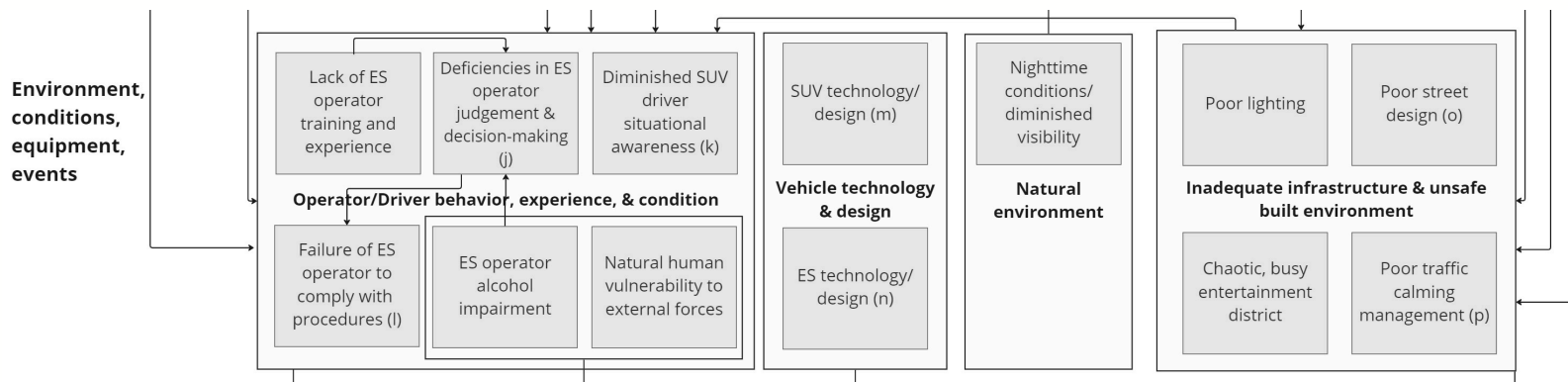
Level 1: Outcome



Abbreviations: SUV, sport utility vehicle, ES, e-scooter

Step 6: Analyze AcciMap Con.

Level 2: Environment, Conditions, Equipment, Events



Abbreviations: SUV, sport utility vehicle; ES, e-scooter

^j E.g., wrong-way riding, crossing not at a designated crosswalk, and failing to yield to motor vehicle right-of-way as potential contributors to the collision.

^k The crash report did not provide any suggestion of driver inattentiveness; however, such a condition is common among motor vehicle rideshare drivers due to fatigue, cognitive load, and the necessity of cellphone usage for job.

^l E.g., the implications of high consequence decision-making in complex environments, "group think" (i.e., following lead e-scooter rider without processing safety risks and conditions), and not wearing a helmet.

^m E.g., SUV size/weight, the lack of a validated pedestrian detection system, and outdated headlight technology as potential contributors to the collision.

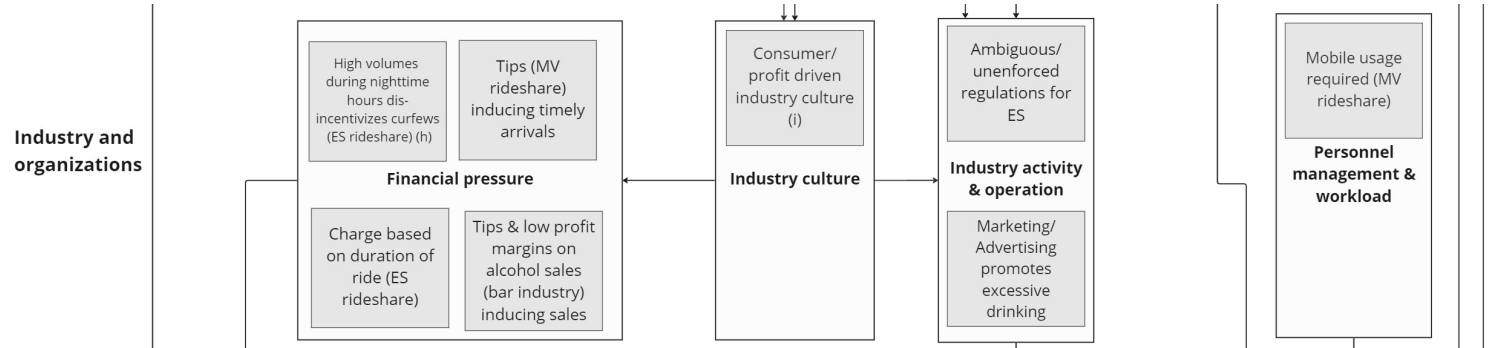
ⁿ E.g., e-scooter size, weight, balance, conspicuity, and inadequate lighting as potential contributors to the collision.

^o E.g., >2 lanes, an unprotected intersection, and unprotected bike lane as potential contributors to the collision.

^p E.g., long traffic signal lengths as a potential contributor to the collision.

Step 6: Analyze AcciMap Con.

Level 3: Industry and Organizations



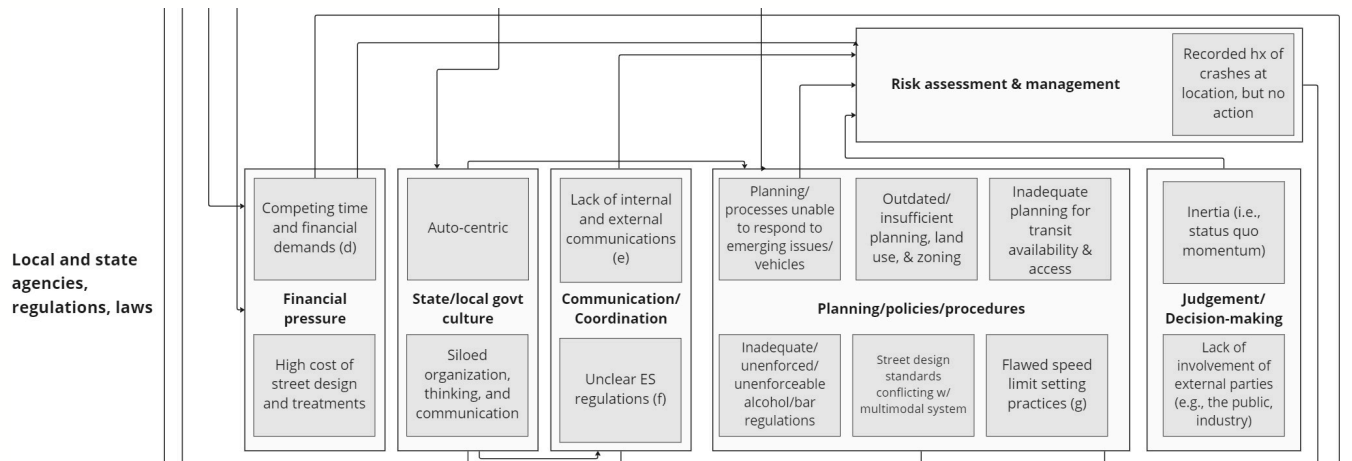
Abbreviations: ES, e-scooter; MV, motor vehicle

^h Late night curfews limiting or banning e-scooter rideshare usage are common regulatory responses to perceived deficiencies in e-scooter safety; however, late night ridership is quite high, especially in cities, such as Nashville, with large, vibrant entertainment districts. Therefore, these measures have historically been met with resistance on the part of e-scooter companies. Nashville enacted an e-scooter curfew after the fatal e-scooter collision (Gardner, 2019). <https://www.forbes.com/sites/greggardner/2019/09/16/nashville-mayor-proposed-e-scooter-ban-then-council-changed-the-rules/?sh=77b9b510ef1a>

ⁱ A consumer/profit driven industry culture may discourage safety considerations. E.g., at the time of the event, the e-scooter rideshare industry was an emerging market, with relatively high costs and low profit-margins; therefore, safety may have been a secondary consideration, especially in comparison to market expansion and economic growth (Button et al., 2020). <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7544631/>. Also, consumer demands may have contributed to SUV size/design/technology that factored into the collision.

Step 6: Analyze AcciMap Con.

Level 4: Local and State Agencies, Regulations, Laws



Abbreviations: ES, e-scooter; hx; history

^d E.g., Resource demands contributing to the inability to innovate or move outside of the "status quo" as related to roadway improvement as well as other safety strategies.

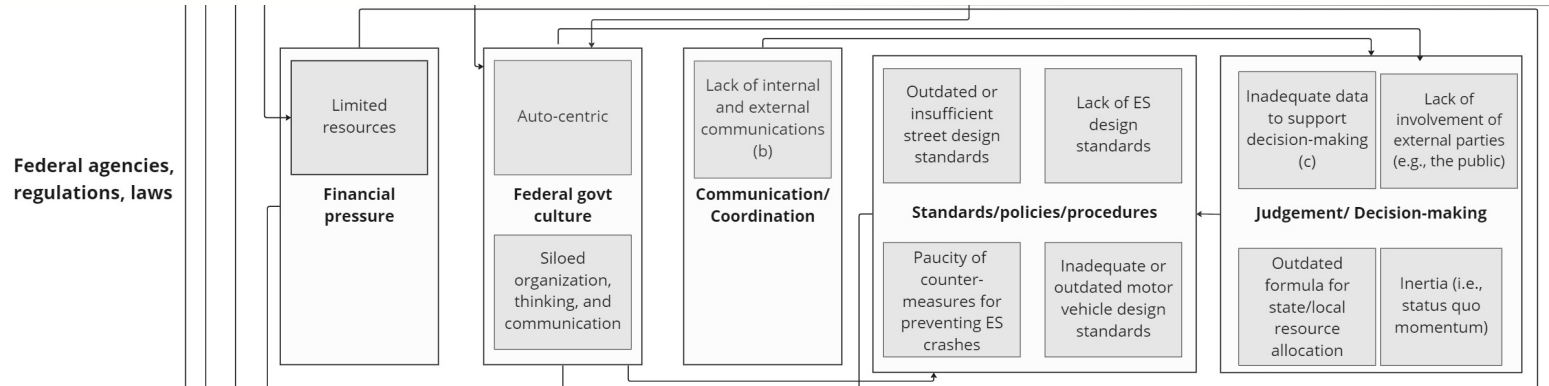
^e Nashville residents had vocalized concerns regarding the safety of the crash location as well as e-scooter safety concerns more generally in the period leading up to the collision; however, there was little action preceding the fatal collision.

^f E.g., in Nashville, at the time of the incident, whether sidewalk riding was allowed or prohibited differed by geographic location, potentially leading to operator confusion.

^g Agencies follow Manual on Uniform Traffic Control Devices (MUTCD) guidance for speed limit setting. While the MUTCD recommends a variety of data for consideration in speed limit setting, some agencies may not carefully consider the safety implications of different speed limits and may default to posting speed limits based on 85th percentile operating speeds that are well above human injury tolerance. Differences between local road ownership and legislature-established statutory speed limits also complicate speed limit setting practice (https://mutcd.fhwa.dot.gov/kno_2009r1r2r3.htm)

Step 6: Analyze AcciMap Con.

Level 5: Federal Agencies, Regulations, Laws



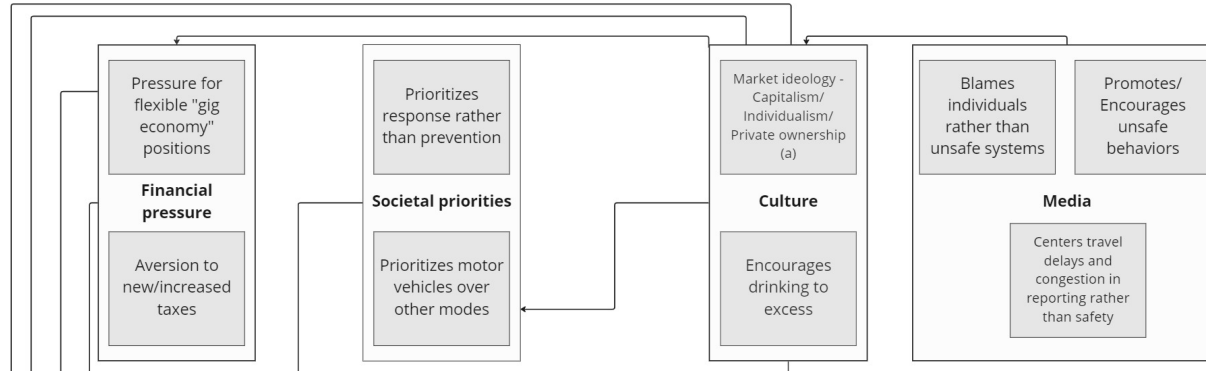
Abbreviations: ES, e-scooter

^b Inadequate communication/ coordination across federal agencies, state/local agencies, industry partners, & the public.

^c At the time of the fatal incident, the Federal government was not collecting data on e-scooter collisions (including fatal collisions) in a systematic manner.

Step 6: Analyze AcciMap Con.

Level 6: Societal Norms, Culture



^a A culture that centers the self, capitalism, and private ownership of personal vehicles is in conflict with a society that prioritizes safety and the public wellbeing over the private good.

- Hall, P. A., & Gingerich, D. W. (2004). Varieties of capitalism and institutional complementarities in the macroeconomy: an empirical analysis. Retrieved from https://pure.mpg.de/rest/items/item_1234332/component/file_1234330/content.
- Kasser, T., & Linn, S. (2016). Growing up under corporate capitalism: the problem of marketing to children, with suggestions for policy solutions. *Social Issues and Policy Review*, 10(1), 122-150. <https://spssi.onlinelibrary.wiley.com/doi/pdf/10.1111/sipr.12020>

Step 6: Analyze AcciMap Con.

Develop Possible Interventions by Considering Factors at Each Level and Links Between Factors

System Level	Actions/Interventions
Environmental, conditions, equipment, events	<ul style="list-style-type: none">• Provide alternative forms of transportation for impaired persons, including better/expanded transit options as well as non-profit or subsidized for-profit rideshare programs• Transition auto-oriented designs and operations (signals) to multimodal designs and operations• Add route detours and signage to encourage crossing at designated (safer) crossing locations• Improve lighting (e.g., adding streetlights, upgrading to LEDs)
Industry and organizations	<ul style="list-style-type: none">• Partial or full subsidization of e-scooter rideshare program by local government as a means of better integrating e-scooters into the existing transportation system, reaching underserved populations, and improving safety, while still allowing private companies to remain profitable
Local and state agencies, regulations, laws	<ul style="list-style-type: none">• Better coordination and cooperation between state and local agencies to ensure that the design and operations of a state-maintained road in an urban setting is meeting the safety needs of local residents and visitors• Reduce barriers for state and local agencies to quickly respond to changing land use patterns and emerging technologies• Collect better data on e-scooter ridership, travel patterns, and collisions• Institute more stringent safety audit processes and procedures
Federal agencies, regulations, laws	<ul style="list-style-type: none">• Adequately fund safe, multimodal infrastructural improvements• Design and retrofit guidance, standards, and processes• Update new car assessment program (NCAP) to include ratings of vehicles' VRU safety performance
Societal norms, culture	<ul style="list-style-type: none">• Develop and disseminate recommendations for framing media coverage of e-scooter incidents using a public health lens• Launch wide-scale social norms campaigns to change perceptions around binge-drinking and drinking and riding as norms as well as norms related to safe micromobility use and active travel

Conclusion

- The AcciMap approach is a useful tool for thinking about transportation incidents in a systemic manner
 - Facilitates group discussion and thinking
 - Uncovers contributory factors at different organizational levels
 - From factors involving the built environment to factors at the societal level
 - Suggests possible countermeasures for preventing similar events
- Limitations
 - Publicly available sources contain limited information for building an AcciMap (i.e., many “unknowns”)
 - Subjective
 - Replicability is unclear

Future Research Needs

- Apply the AcciMap approach to other traffic events
- Apply the AcciMap approach using a more diverse team
 - Practitioners, advocates, community members
- Demonstrate how the AcciMap approach can be incorporated into community activities (e.g., risk assessments)
- Additional testing, methods, and recommendations on how to potentially improve the reliability of the approach

Questions?

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