| | Area | Barrier |
|---|---|---|
| **Identification Issues** | Identifying the Problem | Human trust and perception of the new EAV |
| | | Loss of jobs to AEVs |
| | | Clear partner/stakeholder expectations. |
| | | Tax payer model versus Non-profit model |
| | | Current transportation flow or demand may not support development goals. |
| | | Last mile business model |
| | | EAV as last mile is only developed from transportation/innovation perspective. |
| | | There is no information on total cost of ownership (TCO), which includes power cost. |
| | | Choosing the correct last mile: Routing of last mile is personalized. Link attributes are needed (we don't know everything we need or how to value those attributes when giving route directions. |
| | gn | Vehicles (type, size, cost, AV/CV technology) |
| | | Determining timeline |
| | | Determining size and room for vehicles for last mile. |
| | | Safety implications (e.g., interaction with other road users) |

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|---|---|---|
| Community Issues | Desi | Public perception of safety and cyber security of EAVs. |
| | | There is a lack of last mile path data to make right decision (e.g., parking, traffic, incident rates) |
| | | Long term sustainability program approach |
| | | Laws that prohibit operation |
| | | Distance from transit hub to destination, especially for mobility impaired. |
| | Partner Ecosystem | Utility reluctance and business model challenges |
| | | ADA-accessibility from both the platform (i.e., hailing system) and the service (special vehicles, limited assistance with AV) |
| | | Simplicity of payment for customer |
| | | Private sector and political pressure |
| | | Institutional/contracts goals, operation |
| | | Lack of collaboration across cities/organizations/counties/states to reduce cost and design an optimal solution (i.e., politics) |
| | | Labor issues with ownership and operation of vehicles |
| | | Historic Biases (service and contracting); there is no precedent for on-street charging regulations |
| | Pilot Execution | Speed limit |
| | | Fast moving traffic makes it difficult to cross street |
| | | Need nodes/hubs, need charging, need community understanding and support |
| | | Need sensors and intuitive user experience |
| | Relations | Communication barrier between city and citizens |

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|---|---|---|
| | Community | Community buy-in (spending or new technology) |
| | | Issues with identifying "objectives" and "the problem" |
| **Routing Issues** | Last Mile for Walking, Cycling, and Wheelchairs | Unclear which areas are okay for walking or not |
| | | Weather for walkers/bikers |
| | | Personal safety of walking/biking |
| | | Sidewalk maps with pollen and/or pollution data |
| | | Lack of sidewalks and bike lanes in business parks |
| | | Integration with stop light timing |

| Last Mile |
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| Solution |
| Social campaigns, stage testing, videos, and media will all help over time to build trust. |
| Openness plus transportation developments show benefit and plan to create jobs. |
| Platform to track expectations, intentions, etc. |
| ~Governments should show openness to new ways of utilizing funding.<br>Recognize differing needs of funding partners (e.g., service area, success metrics)<br>~ Non-profits may be able to pool money from private companies. |
| Consider economic and social impacts before making changes but be open to R&D changes. |
| ~Lease, allow more flexibility in government budgets (move health money to transportation)<br>~NY Model: City gets part of profit<br>~Goal: AEVs become cheaper than mass transit<br>~Columbus model - movement of cargo |
| Find out what we need it for/who is using it and build coalitions around it: spatial planning, health/ADA, and transportation considerations. |
| |
| The end locations of Last Mile solutions need to be carefully selected (it may not be the 'shopping mall'). |
| |
| |
| ~Expand transit route<br>~Platooning<br>~Dedicated lanes<br>~Consider where shuttles are already  used and work to eliminate all personal cars and parking. |
| ~Progressive trials<br>~Simulation<br>~Closed environment testing and then open road/network testing<br>~Clear solutions and oriented definition in regard to weather |

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| ~Videos and free rides<br>~Focus on reliable service, good connections to public transport and real time info on travel |
| ~Provide incentives and tools to provide/share data between government entities as well as private companies<br>~Arch data and architecture to gather info from multiple sources and easily expand |
| Master Plan implementations |
| Lobby government to change laws (pilot execution) |
| ID a cluster of low income service providers and link to transit hub with AV. |
| |
| |
| ~Integrated payment cross modes<br>~Understand the travel demands of people during first and last mile |
| Keep everyone (across stakeholders) engaged |
| Need to be seamless to user |
| ~Get OEMs involved<br>~Address segmented regulations at different levels of government<br>~Address government procurement process |
| |
| Partner(s) required to integrate challenges |
| During pilot execution, verify that EAVs can travel the speed limit |
| ~Slow arterial speed<br>~Acceptance of convenience speed |
| ~For a cogent deployment strategy, assemble coalition of diverse stakeholders<br>~I.D. hubs, interdisciplinary and interagency (PPP) |
| ~Education/training for services<br>~Feedback loop from citizens on what works<br>~Create an app for smart phones |
| ~Invest more in community relations<br>~Surveys for issues and possible solutions<br>~Provide up front messaging with all affected communities (i.e., explain what EAV is doing/when) |

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| Need constant and ongoing education and engagement to address concerns and fear/caution about new traveling experience |
| Need to summarize these identifications. Community outreach needs to be program-wide starting with objectives and problem definition and it needs to include all tactics. |
| Show areas where you can walk with transparent signage per zoning laws |
| Provide access to other last mile options |
| Add layer with crime statistics, lighting increase, increased patrol, etc. |
| Integrate tree maps, pollination schedules, or pollution monitors |
| ~Evaluate the current zoning laws<br>~Build sidewalks/paths into solutions |
| Utilize a possible foot traffic sensor. |

| | Area | Barrier |
|---|---|---|
| Are sensors part of the solution? | Short Term | Data format & architecture- too much up front worry |
| | | Understand opportunities to mine data and picking right sensors. |
| | | Data analysis |
| | | Political engagement and capacity to implement |
| | | Siloed data needs and performance measures by different departments |
| | Long Term | How to best plan to scale up |
| Selecting Sensor Package | Short Term | Sensors have huge cost differential between types of sensors. Some sensors are $1.00 others $2,000. Need to understand the cost up front. |
| Privacy Issues | Short Term | Government: when to share data for vendor support |
| | | Data communication security |
| Community Engagement Plan | Short Term | Privacy and engagement |
| | Long Term | Metric for success: positive feedback from end-user |
| Local Procurement Process | Short Term | Vendor inclusion |
| | | Identifying the right sensor platform |
| | | Ability to upgrade/modify |
| | Long Term | V2I used in car decisions require good secure data (especially where liability and safety concerns exist such as malfunctioning sensors) |

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| **Installation Considerations** | Short Term | Roof right agreements and community engagement |
| **Data Communication & Management Plan** | Short Term | Data management |
| | | Real-time long-range wireless communication and modems overheating |
| | | Ongoing metrics/scalability |
| | Long Term | Technology compatibility across several cities/sectors |
| **Funding** | Short Term | Scaling beyond small corridors/regions- needed to be useful for broad scale solutions |
| | | Funding to install new sensors is hard to come by and it is expensive |
| | | On-going maintenance and operation costs |
| **Data Integration** | Short Term | Data integration of city deployments vs private projects |
| | | Need a better return on investment of existing infrastructure |
| **Data Validation/Data Standards** | Short Term | Regulator/acceptance or compliance |
| | | Quality of data must be known throughout sensor lifecycle |
| | | Accuracy and performance of sensor |
| | | Creating interoperable data sets |
| **End of Sensor Life** | Short Term | Normalizing data after sensor replacements |

| Sensors |
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| Solution |
| ~Get started and start with small price and build (metrics, right data, structure agile methodology- it will change iteratively as you work through.<br>~Start with most useful outcomes- build initial reporting structure and work backwards to input fields, data set, etc. |
| Robust communication process with agencies and public. |
| ~Identify ways to analyze beforehand<br>~Metric for services: positive feedback from end-user |
| The system ability to solve problems dictated by the sensors interface |
| First, establishing core goals from adapted plans, build a platform that can be additive |
| Need standards for hardware |
| |
| Make sure academia has restrictions on public access and seek government guidance |
| ~Encryption<br>~Data communication and data management |
| Need easy to communicate use to gather support and ease privacy concerns |
| Track feedback |
| ~Do not disqualify vendors by narrow specifications or communication that prevents them from bidding<br>~Need peer to peer review of use outcomes |
| Governments should help communities to deploy sensors that pave the way and facilitate future deployments |
| |
| ~Look for examples of safety assessments<br>~ASIL process or other qualification of sensors needed |

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| Need access |
| ~Avoid lawsuits and issues with sharing data (networks)<br>~Have BMPS of different models |
| ~Wired communication or longer intervals before transmission.<br>~Data communication and management |
| Dedicated capacity/project owner needs to track metrics |
| Use common standards |
| Need to create effective business models |
| Look at existing physical assets that can be used |
| |
| Memorandums of understanding, sensitivity, and improved policy. |
| |
| Testing, validation, input |
| ~Standard developed for accuracy and drift<br>~Restrict the parameters to those really needed with assumed quality |
| ~Peer-to-peer review of sensors and practical applications<br>~Have NIST or NSF vet those through GCTC process |
| ~Set common national standards for types of data<br>~Balance with strenuous standards vs standards for data communication |
| Flexible standards will be required. |