POLICY & LEGISLATION SUBCOMMITTEE

AUTOMATED TRANSPORTATION PLANNING CONSIDERATIONS

IOWA ADVISORY COUNCIL ON AUTOMATED TRANSPORTATION

IOWADOT

Iowa Advisory Council on Automated Transportation

Iowa Department of Transportation

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COOPERATIVE AUTOMATED TRANSPORTATION (CAT) PLANNING WORKING GROUP MEMBERSHIP

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1. INTRODUCTION

This document was prepared as a guide to help the planning community in Iowa prepare for the integration of Cooperative Automated Transportation (CAT) in Iowa. It is intended to give those in the planning community – including planners in the public sector, private consultants, planning commissioners, and other citizen planners – a resource to take a proactive approach to addressing the potential impacts CAT may have on our communities. This document was developed and supported by the Planning Working Group of the Iowa Advisory Council on Automated Transportation (ATC) Policy and Legislation & Subcommittee. The ATC seeks to increase roadway safety, personal mobility, and freight movement within the state of Iowa by advancing highly automated vehicle technologies. The ATC provides guidance, recommendations, and strategic oversight of automated transportation activities in the state.

The ATC is comprised of four working groups and two cross cutting working groups as shown in the figure below. The bulleted items identify the focus areas for each subcommittee.

CAT systems encompass a broad spectrum of vehicles and devices to support all modes of travel, infrastructure (physical and digital), organizations, and regulations, all of which are ever changing. While the industry is rapidly evolving, these technologies stand to have profound impacts on the built and social environments.

Included in this guide is an overview of CAT and the outlook of the industry, a discussion of the role of planning with respect to CAT, and resources for additional information. This document is intended to identify issues to consider when updating planning documents or developing projects. Practices and recommendations discussed are not required, nor are they expected to be wholly applicable in all situations.

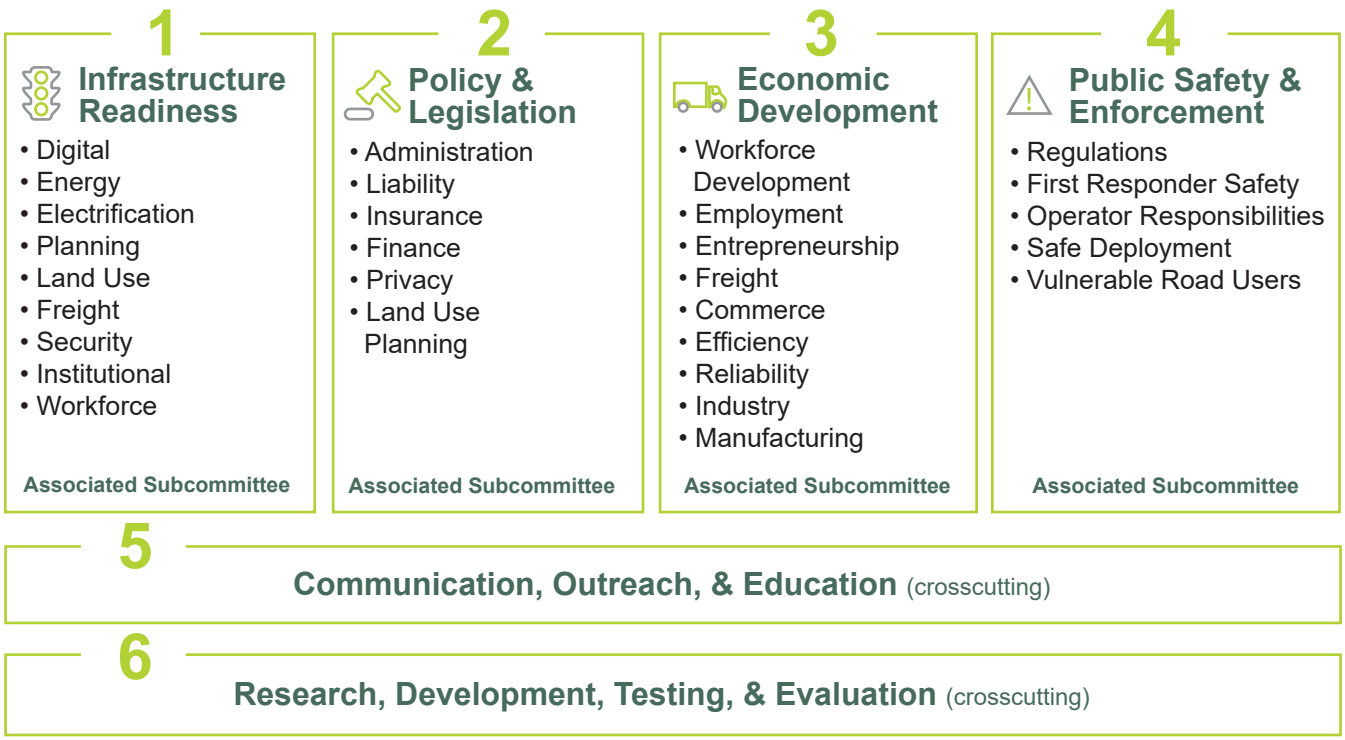


Figure 1 - CAT Overview

2. CAT OVERVIEW AND DEFINITIONS

WHAT IS CAT?

The American Association of State Highway &Transportation Officials (AASHTO) defines Cooperative Automated Transportation (CAT) as:

All modes of transportation working together to improve safety, mobility, equity, and operations efficiency through interdependent vehicle and systems automation and information exchange.

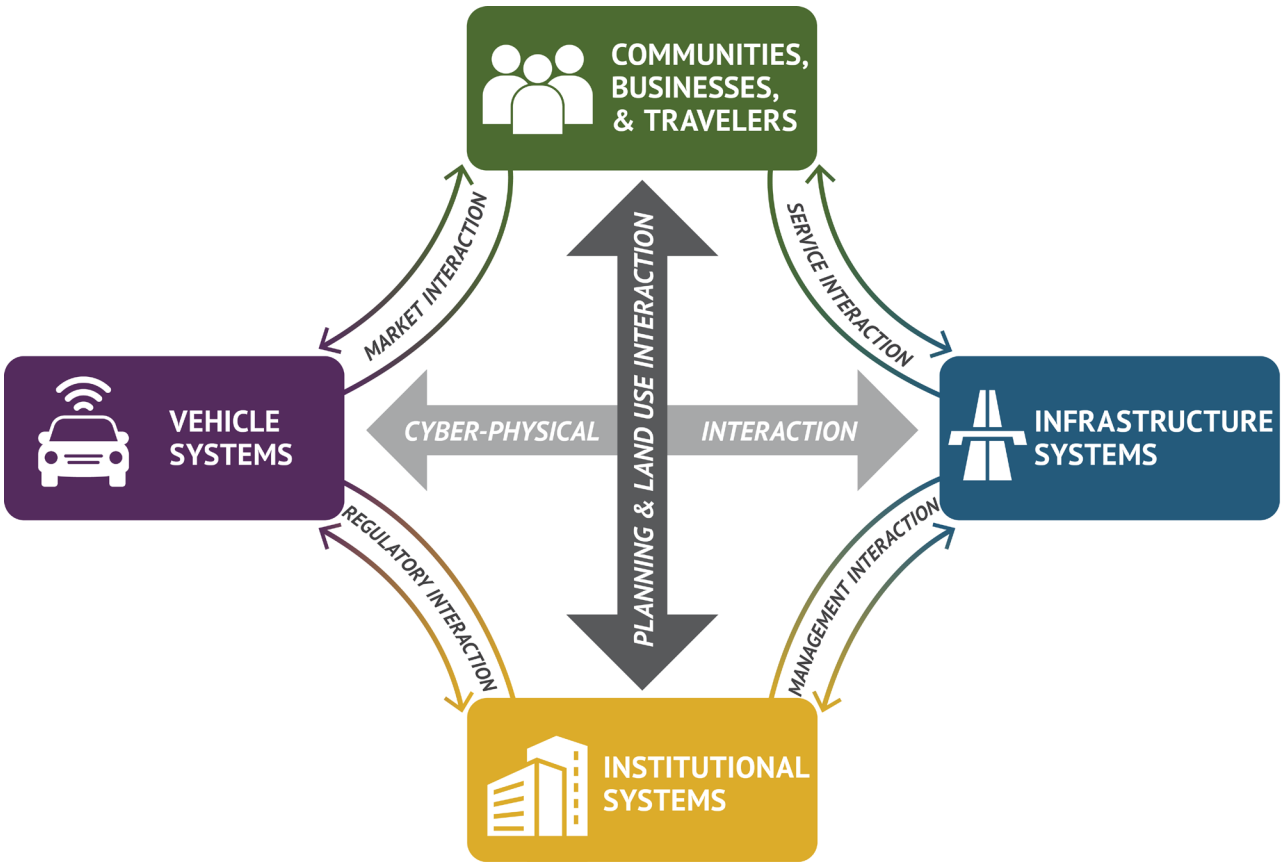
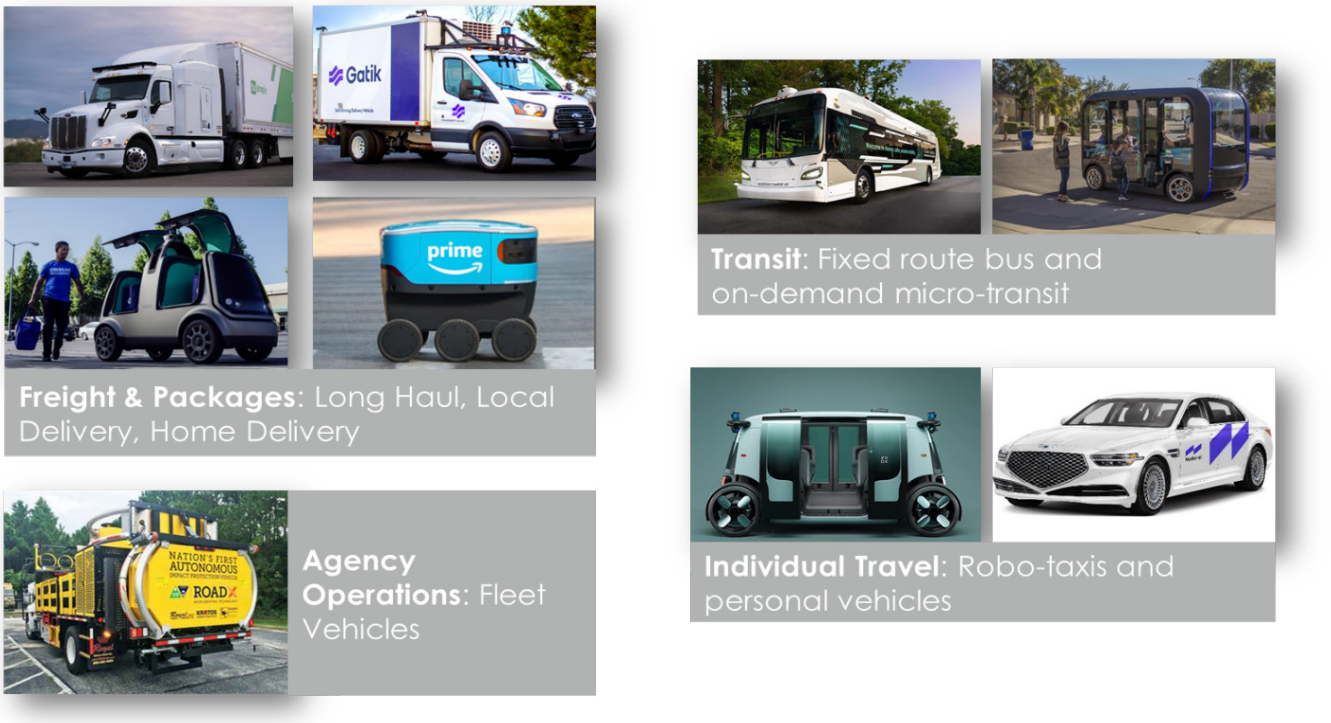


Figure 2 - CAT Systems & Users

As highlighted in the image above, it's important to realize there is more to roadway automation than enhancements to the vehicle itself. Other systems need to be enabled or upgraded/retrofitted to support one another to integrate and allow the use of these transportation modes on public roadway systems by communities, businesses, and travelers These system interactions will be critical to ensure successful deployment and the safe integration of connected and automated vehicles and infrastructure.

The Federal Highway Administration is developing guidance with additional information related to the automation use cases. As these and other resources become available, this document will be updated accordingly.
Automated transportation on public roadways is anticipated to occur within specific use cases as noted in the following images and figure..



Freight and Package Delivery	Transit	Individual Travel	Agency Operations
Automated Trucking Operations - Long-Haul Freight	Automated Fixed Route Transit (Including Low Speed Shuttles)	Passenger Vehicle Automated Driving System (Fleets)	Automated Agency Fleets
Automated Trucking Operations - Local Freight Delivery	Automated On-Demand Microtransit (Including Low Speed Shuttles)	Passenger Vehicle Automated Driving System (Privately Owned)	
Automated Home and Package Delivery			

Figure 3 - Automated Transportation Use Cases

LEVELS OF AUTOMATION

The Society of Automotive Engineers (SAE) has developed a taxonomy of vehicle automation systems illustrated in the graphic below. The taxonomy shows six levels, ranging from no automation at Level 0 to full automation at Level 5, which can be used to understand the spectrum of possibilities when discussing CAT. Broadly, SAE levels 1 and 2 are vehicle safety features known as advanced driver assistance systems (ADAS) while SAE levels 3 to 5 are known as automated driving systems (ADS).

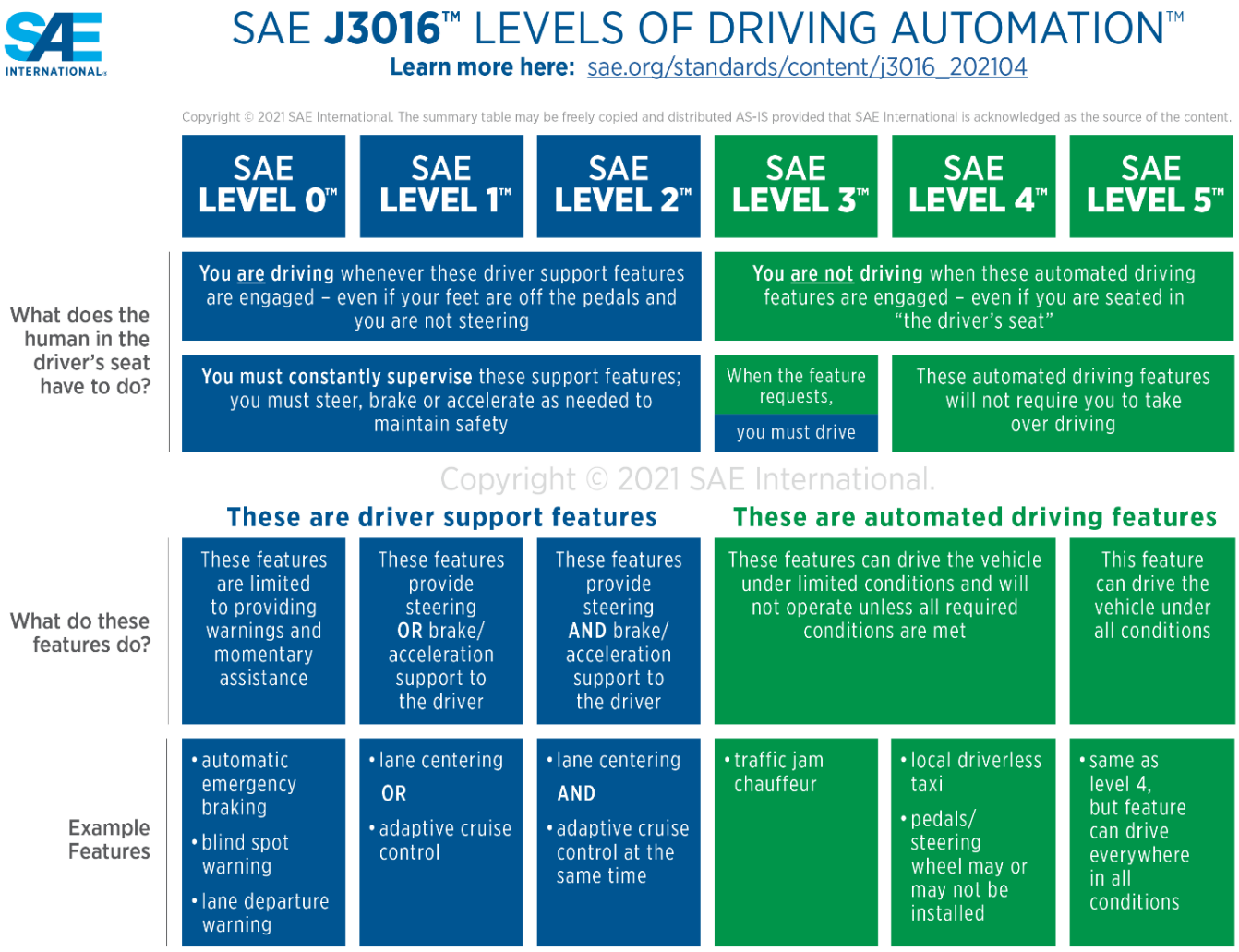


Figure 4 - Levels of Driving Automation

KEY TERMINOLOGY & CONCEPTS

- **Advanced Driver Assistance Systems (ADAS)** – systems designed to help drivers with certain driving tasks (e.g., staying in the lane, parking, avoiding crashes, reducing blind spots, and maintaining a safe headway). ADAS are designed to improve safety while reducing the workload for the driver. These systems are typically recognized as being included within SAE levels 1 or 2.

- **Automated Driving Systems (ADS)** – the hardware and software that are collectively capable of performing the entire dynamic driving task on a sustained basis, regardless of whether it is limited to a specific operation design domain. This term is used specifically to describe an SAE level 3, 4, or 5 driving automation system.

- **Operational Design Domain (ODD)** – the specific conditions (e.g., time of day, roadway functional class, weather) under which a given driving automation system or feature is designed to function

Transportation Demand Management (TDM) – as defined by the Federal Highway Administration, TDM or demand management is simply a set of strategies aimed at maximizing traveler choices, regardless of whether they drive alone, such as work location, route, time of travel and mode. In the broadest sense, demand management is defined as providing travelers with effective choices to improve travel reliability.

STAKEHOLDERS

Many companies are actively working to bring more fully automated vehicles to market. However, the auto industry and manufactures are only one of many parties involved in shepherding CAT into the mainstream. Stakeholders include, but are not limited to:

- *Original Equipment Manufacturers/Auto Industry*: Involved in developing and selling the vehicles that will have automated capabilities.
- *Automated Driving Systems (ADS) developers*: Companies that research and develop the technology for automated transportation. These may be divisions within an automotive company or may be separate companies that license or sell the technology to automakers.
- *Government*: Involved with regulation of the industry.
    - At the federal level, Congress and the US Department of Transportation work to provide oversight and develop regulations and standards (e.g., MUTCD, WZDx) in order to protect safety, emphasize security, ensure privacy and uniformity, and enhance mobility and accessibility.
    - State legislatures and departments of transportation coordinate with industry representatives, users, local and federal officials, and other states. They ensure safety and mobility of all road users of the transportation system by developing enabling policy and legislation, licensing human drivers, registering motor vehicles, enacting and enforcing traffic laws, and conducting safety inspections. They also plan, fund, build, manage, and operate transportation infrastructure.
    - Local governments are involved in enforcing traffic laws and ensuring infrastructure, land use, and ordinances are sufficient to allow for the safe use of automated technology.
- *Academic Institutions:* Involved in various aspects of research and development, ranging from infrastructure needs for automated transportation to human behavior in automated settings.
- *Users:* Individuals as well as companies/fleets who will ultimately use automated vehicles. The users' comfort level, financial means, travel needs, and overall interest in automated vehicles will heavily influence what vehicles come to mass market and when.

ANTICIPATED DEPLOYMENT TIMELINES

While some companies are beginning to identify deployment of their automated transportation technology solutions in the next 3 to 5 years (such as automated truck freight operations on access controlled Interstate facilities from on-ramp to off-ramp), specific timelines for increased market adoption and penetration aren't well known for a variety of reasons that are still evolving, including:

- Continually developing business case
- Automation is complex, especially in very active environments (e.g., urban areas)
- Dynamic research and technology innovations
- Patchwork of state policy and legislation with limited federal or national standards, policy, or legislation

The next decade is anticipated to focus on widespread adoption of ADAS for both commercial and passenger motor vehicles. ADS deployment timelines are anticipated to vary by the technology use case. Nationally, there are deployments and testing occurring for various automated transportation use cases where there are limited barriers and specific resources available including:

- Jurisdictions open to collaboration and establishing partnerships
- Flexible and enabling policy and regulations
- Temperate weather (e.g., clear conditions)
- Uniform and well-maintained infrastructure (e.g., pavement markings and signage)
- Access to skilled labor and workforce (e.g., university research centers)

An additional, in-depth technical memorandum concerning *CAT Deployment and Innovation Timelines is available upon request at:* DOT-IowaATC@iowadot.us

ANTICIPATED CHANGES – OPPORTUNITIES AND RISKS

The rise of CAT holds much promise for the improvement of the transportation system – reduced crashes, increased mobility and accessibility, and reduced emissions to name a few. However, as noted in the 2018 American Planning Association's (APA) report Planning for Autonomous Mobility (note: APA membership required), the rise of automated transportation may create new problems. These include the need for more drop-off zones, vehicle storage and/or circulation issues when vehicles are not in use, expensive new infrastructure to maintain, and perhaps even the rise of sprawl due to reduced costs of travel and vehicle ownership. Sound planning will be important to ensure that benefits are supported and potential risks are mitigated. The remainder of this document will focus on the role of planning as CAT progresses and factors for planners to consider in their work.

3. PLANNING CONSIDERATIONS

As planners work with local governments to prepare for CAT, they must consider the various planning tools at their disposal, such as comprehensive plans, site plans, and zoning codes. Planners must also consider the various functional areas in which planning is involved, including public works, engineering, community development, public safety, public health, information technology, and policy development with elected officials. They must weigh the existing needs of the public today with the technology and infrastructure needs of tomorrow. As noted previously, they must do this for a subject that has an uncertain timeline, is influenced by multiple stakeholders, and for which the technology is continually changing. The guidance that follows is intended to help provide planners with a process and framework for them to follow in assisting communities to prepare for CAT.

KEY CONSIDERATIONS

APA's Planning for Autonomous Mobility report recommends four areas of focus for planners:

1) Establish parking standards and requirements that address changing demand and need with automated vehicles (AVs)
2) Enhance transportation demand management efforts that link to a shared and automated future
3) Right-size the right-of-way to the human scale, reallocating space previously used for automobiles for alternative modes of transportation, which builds upon the complete streets movement
4) Utilize AV technology to improve transit services and extend service to underserved areas

While these are good recommendations for how our transportation systems and built environment could adapt to take advantage of AVs, there are also more strategic considerations that can be incorporated into the planning process, including the following:

- **Add "pause points" to policies and procedures to allow for CAT considerations.** These will vary by community and process, but the goal is to ensure opportunities for policies and procedures to adapt and change with technology. Pause points will allow more focused and intentional consideration of CAT at critical milestones when implementing policies and procedures.
- **Minimize throwaway or sunk costs due to future obsolescence.** Communities routinely make investments in infrastructure and systems that will last for years, even decades. This can pose a problem when considering a technology like CAT that is rapidly changing, as investments made today may soon become obsolete. Making investments in infrastructure that can be easily modified (while possibly more expensive in the short term) could have long-term benefits by allowing the infrastructure to be "future-proofed." Similarly, consideration should be given to future conditions and the ability to right-size assets, per the third APA recommendation discussed earlier.
- **Seek policies and investments that are dual benefit, supporting today's users and tomorrow's technology needs.** Many investments are initially scoped or could be modified to address multiple needs and provide a diversity of benefits. Consideration should be given to opportunities to meet current needs for human users while supporting rapidly changing technologies into the future.
- **Emphasize well-maintained infrastructure systems to support AV readiness.** Much of today's AV technology relies on sensors and cameras reading the surrounding built environment. Pavement condition, lane markings, signage, and other infrastructure that is maintained in a state of good repair will lead to better service by AVs.

- **Identify an individual to effectively champion CAT considerations within planning and other related functions.** As an emerging issue that isn't functionally integrated into most community processes, it is important to have a champion to advocate for effective consideration of CAT. An ideal individual would be someone with both broad understanding and access across a community's functional areas.
- **Consider the latest research regarding future use cases.** The four key use cases described earlier - Freight and Packages, Transit, Individual Travel, and Agency Operations - will evolve at different paces and will vary in their impact depending on the setting. Planners should focus efforts on use cases that are more likely to impact their community. (This document will be updated to provide more details on use cases as new information becomes available.)

4. ADVANCING CAT THROUGH PLANNING TOOLS

Common planning tools – such as comprehensive plans, zoning ordinances, and strategic plans– can be used to implement many of the identified planning considerations and otherwise help communities prepare for emerging technologies. The degree to which these planning tools address CAT will depend on the state of the technology at any given time, use cases the jurisdiction is likely to face, and the jurisdiction's willingness and ability to invest resources towards CAT. While it's difficult to provide planning tools that could address every unique situation, the information below is intended to provide a foundation upon which jurisdictions can start addressing CAT in their planning efforts. Each planning tool includes a discussion of baseline, medium, and high-level efforts that could be taken. Generally speaking, baseline efforts build awareness, medium efforts relate to readiness, and high efforts focus on implementation.

TOOL: LONG-RANGE TRANSPORTATION PLAN

Iowa's 9 metropolitan planning organizations (MPO) and 18 regional planning affiliations (RPA) – which collectively cover the entire geography of the state – are required to have a long-range transportation plan (LRTP) that is updated at least once every 5 years. Likewise, the Iowa Department of Transportation is required to develop its own long-range transportation plan. These plans provide a vision for the transportation system for the next 20+ years, identify anticipated funding available, and specify projects and policies intended to achieve the plans, vision and goals.

- Baseline Effort: These plans are a logical place to reference long-range, national, and/or state visions for CAT that may be available to build awareness of the issue.
- Medium Effort: National and state visions can be used to outline a more specific vision for the MPO or RPA planning area. This could be aided by citing available data and forecasting on trends related to CAT technologies and usage. Many of the previously mentioned planning considerations – such as parking and demand management considerations, infrastructure conditions, and future-proofing investments – can

be included in various policy statements. The agency should consider undertaking a scenario planning process that considers emerging technologies and potential impacts on transportation. Additional efforts include integration and/or reference to toolkits for best practices and resources on the topic.

- High Effort: The LRTP can include guidelines on the use of available funding for CAT-related projects. For example, guidelines can require certain design requirements that would support CAT as a condition of funding and/or a portion of the funds could be set aside for CAT-related projects. The plans also could identify specific projects, as well as the need for additional studies, necessary to further implement CAT.

Related Tools: Each MPO or RPA *Transportation Planning Work Program* – the organization's budget and work plan for the year – should identify CAT-related planning projects that will be undertaken to implement the LRTP. Projects included in each MPOs and RPA *Transportation Improvement Plan*, which documents projects that will be implemented using federal funding, should include projects that support any CAT-related strategies included in the LRTP.

TOOL: COMPREHENSIVE PLAN

A standard practice for many cities and counties is to maintain a comprehensive plan. Much like the LRTP, comprehensive plans identify a vision for a city or county's future and identify strategies on how to achieve that vision. They cover a variety of topics, including land use, economic development, affordable housing, environmental protection, recreation, historic preservation, and transportation and infrastructure. Comprehensive plans provide an opportunity for a local government to expand upon the CAT vision from their regional LRTP, as well as to identify how CAT might affect – and be affected by – issues such as land use and infrastructure needs.

- Baseline Effort: Show awareness of future CAT needs by referencing national, state, and/or regional CAT visions.
- Medium Effort: National, state, and regional visions can be used to outline a more local vision with respect to the likely use cases expected in the jurisdiction. All sections of the comprehensive plan – not just transportation and infrastructure – should examine how they relate to CAT and other emerging technologies to develop CAT-related goals, objectives, and strategies. Issues of equity and access with respect to CAT also should be discussed. Public engagement should also be considered at this stage, as it may help ease any implementation of the plan and subsequent changes to things like the code of ordinances after the plan has been adopted.
- High Effort: Specific initiatives to further implement CAT could be included in the comprehensive plan. Based on the visioning and assessments completed under the Medium Effort section, the comprehensive plan may call for changes to various policies, procedures, codes, planning tools, or other mechanisms used by the jurisdiction. For instance, an analysis of recent development patterns might determine the need for changes to the future land use and zoning maps to be more compatible with travel patterns should CAT become more prevalent.

Related Tools: Projects that help implement the comprehensive plan are typically included in the jurisdiction's budget and/or capital improvement program (CIP). As with the Transportation Improvement Program discussed in the previous section, the scoping process for including projects in the CIP should ensure that CAT-related elements are considered and included when reasonable. Future-proofing investments should also be a priority at this stage.

TOOL: STRATEGIC PLAN

In addition to the comprehensive plan, many communities also have strategic plans. Whereas the comprehensive plan outlines the vision for the community in general, the strategic plan focuses on the vision of the local government, as an organization, and how it can best serve the community. With respect to CAT, the strategic plan is a good place to ensure that the entire organization, including elected officials and commissions, individual departments, and employees, are aware of the community's vision for CAT. Because CAT may include various functional areas of an organization – including public works, community development, engineering, public safety, information technology, and so forth – the strategic plan is a good place to delineate responsibilities and procedures for how various departments should interact with each other on CAT-related issues.

- Baseline Effort: Include reference to CAT and/or emerging technology in the plan's vision or goals. This can help provide clarity that these are priorities to the organization. Use the strategic planning process to educate elected officials and employees about CAT.
- Medium Effort: Review the organization's procedures and policies through the lens of CAT and emerging technologies. Develop various scenarios to consider how the organization would react and which department(s) are responsible. Scenarios could be developed around the use cases most likely to impact the jurisdiction. Identify ways that the organization can adapt to CAT, which is rapidly changing and may involve different partners than the community traditionally works with. For example, this may include more short-term pilot deployments, adjusting procurement procedures to focus more on subscription models vs. long-term purchases, and engaging in public-private partnerships. Identify a staff member who can ensure coordination among the appropriate departments.
- High Effort: Make changes to policies and procedures as identified in the Median Effort section. Budget resources for employee training to stay current on technology issues, and for other data, technology, and infrastructure needs for the organization to be attractive for CAT deployment.

TOOL: CODE OF ORDINANCES/ZONING CODE/SUBDIVISION CODE

Whereas comprehensive plans outline a community's long-range vision, the code of ordinances – specifically the zoning code - is one of the key implementation steps for achieving that vision. The code sets forth the rules for how the community will grow and operate. There are numerous ways the code can be used to facilitate and regulate CAT and emerging technologies, from the location and size of things like parking lots and public right-of-way, to the siting of technology-related infrastructure within the right-of-way, to stipulating the size and scale of the built environment within which people and vehicles will move about.

Unlike the planning tools discussed previously in this document, efforts for the zoning code and subdivision code are relative to the efforts undertaken in the comprehensive plan. A community is likely to incorporate CAT and emerging technology considerations into its code only if its efforts in the comprehensive plan fall in the medium to high effort end of spectrum.

- Baseline Effort: Initial efforts should focus on assessing possible changes. At a minimum, the community should undertake an audit of the code to understand the various places where CAT-related considerations could or should be made.

- Medium Effort: Once an inventory exists of where changes could be made, the community should prioritize its efforts with the understanding that it may not be feasible to make all the desired changes at once. When prioritizing, the community should evaluate the following key considerations.
    - Necessary vs. Desired: Some changes are necessary from the outset to allow for safe CAT operation. These can include elements related to right-of-way and curb management, infrastructure needs, public safety protocols, and operator permitting. This contrasts with changes that might be beneficial to make once CAT is more operational, such as adjusting parking requirements; garage requirements; and recording of as-builts for things like curb cuts, street furniture, roadside signage, and other infrastructure features whose exact location could help with vehicle location technology. Identifying what is needed now versus what may be beneficial in the future is important.

    - Impact vs. Feasibility: There is an inherent risk-reward with many changes in terms of their impact to the community and their technical or political feasibility. For example, it may be somewhat helpful to require developments to include a certain piece of technology that facilitates vehicle-to-infrastructure communication, but that technology may be cost-prohibitive and, therefore, subject to opposition from the development community and decision-makers. Code changes could be prioritized using an impact/feasibility matrix (i.e., high impact-high feasibility, high impact-low feasibility, low impact-high feasibility, and low impact-low feasibility). For high impact efforts that are politically challenging, planners should proactively undertake public outreach efforts with elected officials, members of the development community, and the general public to collaboratively identify issues and formulate solutions.

- High Effort: All identified changes to the codes have been made and are regularly reviewed and updated as technology progresses. CAT-related elements are included in the plat and site plan review process. For new businesses or large developments, the community inquires about plans for the use of CAT to ensure the community is adequately prepared.

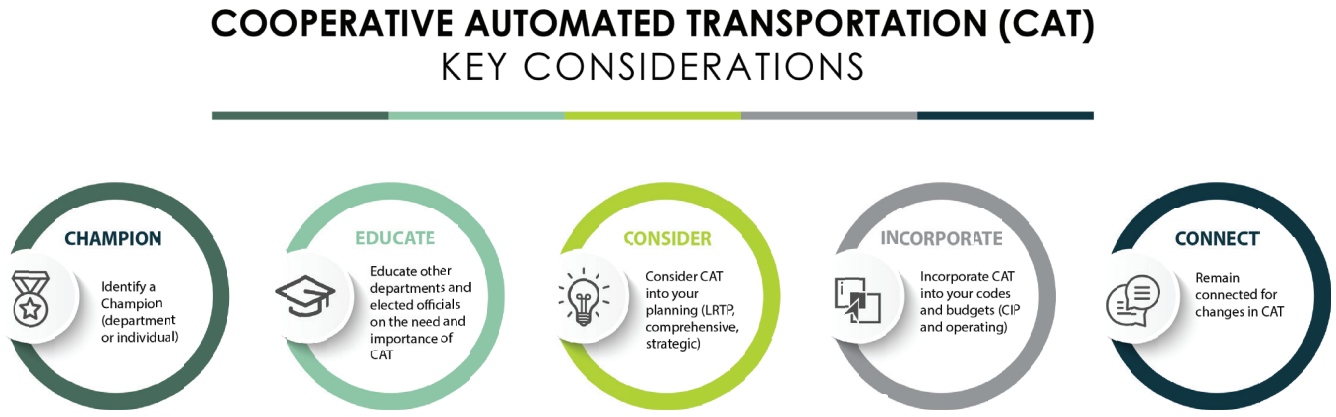
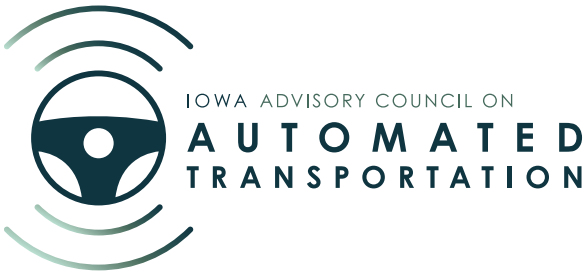


Figure 5 - CAT Systems & Users

5. CONCLUSION & NEXT STEPS

As technology continues to evolve, national guidance is published (e.g., FHWA National Roadway Integration of ADS), and new or refreshed planning tools and resources are identified, updates will be made as needed to this document to support the safe integration and deployment of automated technologies on public roadways.

The Iowa Advisory Council on Automated Transportation, Policy & Legislation Subcommittee and CAT in Planning Working Group will continue to support this resource while looking to engage the ATC Infrastructure Readiness Subcommittee as infrastructure strategies and solutions are developed and identified to support automation.



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