IOWADOT

TRANSPORTATION 4.0:

Innovative strategies for the transportation revolution

IOWA DEPARTMENT OF TRANSPORTATION

The Iowa Department of Transportation (DOT), in direct connection with Iowa Economic Development Authority (EDA), will develop and propose to the Governor and the Iowa Transportation Commission a new statewide strategy supporting economic development called Transportation 4.0.

We will target manufacturing, agriculture, and bioscience industries and challenge ourselves to implement technologies and strategies that move products and goods to market safer and more efficiently. With a focus on freight corridors, we will identify the plans and policies from our organizations that will benefit from integration, and we will partner with business stakeholders to refine our strategies and tactics.

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SUMMARY OF **CONTENTS**

The following is a compilation of one- to two-page summaries of key strategy areas that were developed in support of the Transportation 4.0 Business Plan objective. Each summary contains a brief overview of the strategy and a series of short-term (1-3 year) action items that could be implemented by Iowa DOT. Strategy areas include the following.

Artificial intelligence, machine learning, and advanced analytics (page 1)

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Advance artificial intelligence, machine learning, data analytics, data science, and economic analysis for transportation planning and operations

The fields of artificial intelligence (AI), machine learning (ML), and other advanced analytics are experiencing explosive growth and have the potential to transform industry and daily life. The scope of this initiative is to foster the development of new advanced analytics capabilities within Iowa DOT for solving transportation problems and strengthening our ability to assess and leverage new techniques. Advanced analytics is an extremely fast-changing field where vast changes in capability can occur in months. Iowa DOT must have the means to stay current with the state of the practice to make use of the potential advantages while also sorting out the hype and pitfalls. This initiative will be focused on developing Iowa DOT's ability to leverage advanced analytics, not necessarily developing the data technologies themselves.

There are several areas where advanced analytics can be used within Iowa DOT, including the following.

1. Benefit/cost and similar economic impact analyses. These are becoming increasingly necessary to illustrate the benefits of and justification for transportation improvements, especially for federal discretionary programs, and these services are frequently outsourced.
2. System operations, including incident detection, real-time warning/messaging, crash prediction, road/roadside condition monitoring, and work zone simulation.
3. Planning efforts, including corridor optimization, origin/destination and travel demand estimation, human factors research, and freight logistics.

Short-term action items

- Establish focused AI/ML/data science research partnerships with Iowa universities and initiate new research projects as part of existing university support contracts.
- Develop a plan for leveraging advanced analytics support and knowledgebase within Iowa DOT.
    - Develop a recommendation for Executive Leadership by researching how other DOTs provide staff support for advanced analytics, the pros/cons of staff support for such activities, and organizational structures that would best serve user needs.
    - Identify Iowa DOT points of contact and champions for advanced analytics.
    - Set initial guidelines for the proper use of AI (e.g., when/where it can be used, quality control, rules, liability limitation, due diligence, etc.).
- Pilot image analysis for assessing winter driving conditions, road maintenance needs, roadside asset inventories, traffic counts, etc.
- Pilot modeling new alignment/intersection design/traffic control alternatives for safety and operations considerations.
- Pilot economic/commercial development modeling using connected vehicle trip data.

Continue to advance highway planning and analysis efforts

System-level highway planning and analysis has evolved over time, and it is important to continue to advance these efforts. The system's current and forecasted use and performance are measured by multiple highway analysis tools and the outputs of those efforts have increasingly been incorporated into the State Long Range Transportation Plan (SLRTP) and project scoping tool to guide corridor-level planning. The Iowa Interstate Investment Plan (I3P) was created to help guide programming decisions for that network's stewardship and enhancement. Recently, highway system stratification has been evaluated as part of the rightsizing policy framework and could lead to additional planning and asset management efforts. These tools and plans need to continue to be advanced and incorporated into the planning, programming, and project development process.

A particular opportunity for advancement exists in the area of operations-related planning and analysis. Current long-range planning efforts may not offer the granularity needed to support the deployment of operational strategies, and project-level analysis may not adequately inform decision-making at that level.

Short-term action items

- Monitor emerging providers of connected vehicle, probe-based, and origin-destination data (e.g., Otonomo, Michelin, Streetlight, etc.) and evaluate available products for beneficial applications in Iowa.
- Evaluate opportunities to replace or supplement manual, spot data collection efforts with automated, larger-scale efforts that provide improved data coverage and insights.
- Identify opportunities for expanded use of camera analytics to identify crashes and other incidents, congestion, wrong-way drivers, and frame-based vehicle trajectories.
- Pilot uses of surrogate data/measures to provide transportation information typically derived from more traditional datasets (e.g., short-term connected vehicle data as a surrogate for multi-year crash data to identify safety concerns).
- Review the analysis structure of the system-level Infrastructure Condition Evaluation – Operations (ICE-OPS) analysis that quantifies the relative risk to the safe and reliable operation of the Primary Highway System, including both the criteria datasets and their granularity.
- Review roles and responsibilities for evaluating and purchasing emerging datasets for use by Iowa DOT staff, relative to leveraging outside services and university support.

Continue to advance resiliency and sustainability planning and improve freight transportation system resiliency

Resiliency and sustainability are increasingly important planning areas. Proactive analysis and planning efforts, including the work of the Resiliency Working Group (RWG) and Sustainability Working Group (SWG), should continue to be enhanced. Resiliency considerations should continue to be integrated into project scoping, prioritization, and design, as well as maintenance and operations, to make assets less susceptible to disruptions. Sustainability considerations should also continue to be integrated into Iowa DOT activities and project designs to help address economic, social, and environmental effects.

Priorities should include disaster response planning, reducing the vulnerability of highway infrastructure and working with partners to reduce the vulnerability of other modes and supply chains, and operational improvements to address small disruptions. More immediate opportunities for pursuing resiliency and sustainability improvements exist with the development of the Iowa Resiliency Improvement Plan (RIP) and implementation of the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) program.

Short-term action items

- Formalize the framework that has been developed and vetted by the RWG for identifying and prioritizing candidate projects for PROTECT funding and the Five-Year Program.
- Develop and document a listing of engineering countermeasures in the RIP that increase resiliency and reduce vulnerability of the transportation system.
- Conduct resiliency analyses that consider the criticality of the transportation system and its vulnerability to climate change, various natural disasters, and human disruptions based on findings and recommendations of the RIP.
- Develop standard operating procedures relating to incorporating resiliency into Iowa DOT's project development process.
- Support workforce sustainability by attracting, training, and retaining a quality workforce. This includes current efforts to incorporate Federal Emergency Management Agency (FEMA) Incident Command System Training into the Field Operations and Systems Operations Divisions.
- Develop a Sustainability Plan for the agency that includes an assessment of Iowa DOT efforts, how to further incorporate sustainability into the planning and programming process, a structured communication plan, and an initial work plan for implementation.
- Encourage or promote the use of alternative transportation modes, such as public transit for people and waterways (ports) and rail for goods, to decrease highway traffic volumes and reduce the degradation of roadway infrastructure.
- Participate in research projects to improve sustainable transportation infrastructure in Iowa (e.g., utilizing long-life pavements and recycled/sustainably sourced materials).

Continue to work with local governments, state agencies, utilities, and other stakeholders to advance energy-related planning efforts and alternative fuel infrastructure improvements in Iowa

Several recent initiatives have related to energy and alternative fuel and electric vehicles (EV), including the Iowa Energy Plan, studies related to infrastructure needs for alternative fuel vehicles, administration of the Volkswagen Settlement, and the I-80 Mid America Alternative Fuel Corridor planning study. Most recently this has also involved Iowa's efforts to implement the National Electric Vehicle Infrastructure (NEVI) Program, which provides federal funds for the strategic deployment of electric vehicle charging infrastructure.

As efforts in these areas continue to advance and funding opportunities arise, additional collaboration and coordination will be necessary to help implement the strategies identified through these initiatives and support the infrastructure environment for alternative fuel vehicles in Iowa.

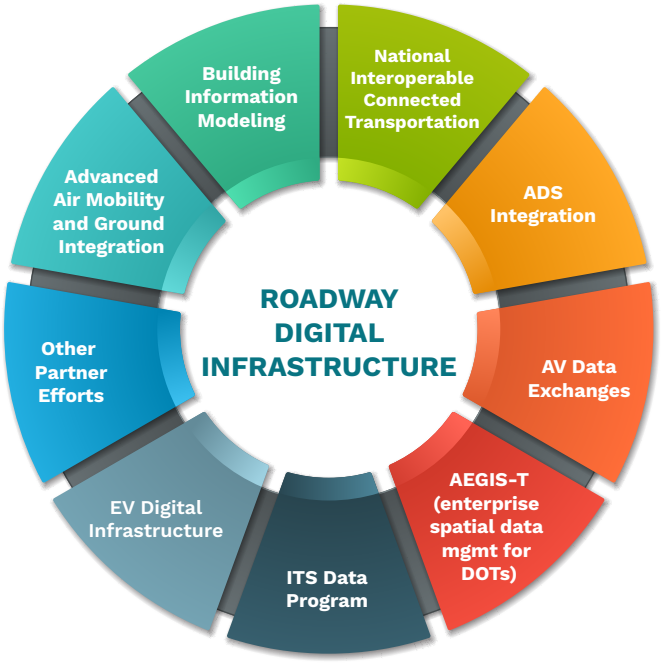
Short-term action items

- Launch Iowa's NEVI program with an initial Notice of Funding Opportunity and solicitation of funding applications.
- Install initial NEVI-compliant Direct Current Fast Charging (DCFC) sites along Iowa's Alternative Fuel Corridors, which include Interstates 29, 35, 80, and 380.
- Explore opportunities to enhance Highway Helper capabilities to support EV owners who experience unexpected rapid battery depletion and have a disabled vehicle, including working with Autobase to monitor disabled EVs in need of a charge and measure demand for portable charging systems.
- Support continued discretionary applications on behalf of Iowa's transit agencies for Federal Transit Administration's Low or No Emission Vehicle Program, which provides funding for zero-emission and low-emission transit buses and supporting facilities.
- Transition portions of Iowa DOT's fleet to low or no emission vehicles, such as hybrid electric or vehicles that utilize alternative and renewable fuels, and continue implementing the Governor's Executive Order No. 5 that requires new contracts for state vehicles with diesel engines to be B20 biodiesel compliant.
- Partner with Iowa EDA to build off existing efforts, such as the regional hydrogen hub proposal, to enable Iowa freight to pilot and utilize hydrogen fueled vehicles.

Support roadway digital infrastructure and seek dual-benefit investments

The evolution of Iowa DOT's role from infrastructure builder to operator, maintainer, and service provider creates a need to communicate with diverse digital devices. Iowa DOT has expertise in building physical infrastructure systems and now needs to integrate rapidly evolving digital infrastructure (DI) systems. This will allow the creation of insights to enable safer, more efficient transportation system management. Each new digital technology asset generates its own valuable transportation system data. Without a strategy for integration, additional data silos will develop. Additionally, investments should seek dual benefits where appropriate, considering current needs for human users while supporting rapidly changing technologies into the future (i.e., "future-proofing"). Ongoing efforts in related areas include the following.

- Building Information Modeling (BIM): Iowa DOT is working to implement digital delivery and digital twinning. Intelligent Transportation Systems
- (ITS)/Transportation Systems Management and Operations (TSMO) Program Activities: Iowa DOT is working to expand and enhance ITS infrastructure that supports DI in the areas of: installing camera, sensor, and fiber expansions along key interstate corridors and metropolitan areas; evaluating the need for ramp metering and dynamic shoulder use (DSU); and deploying queue detection and warning systems and color dynamic message signs (DMS).



Source: National Roadway Digital Infrastructure Strategy

- Automated vehicle (AV) Data Exchanges and Integrations: Iowa DOT and partners at Iowa State University are engaged with the Work Zone Data Exchange (WZDx), while Iowa DOT staff are also monitoring pooled fund research to determine use of geographic information systems (GIS) and linear referencing systems (LRS) to support DI system integration.

Short-term action items

- Continue working with industry and public partners to develop and integrate guidelines for uniformity in design and maintenance of traffic control devices (TCD) that support Automated Driving Systems (ADS) operations.
- Continue expansion of the fiber network in Iowa DOT ROW to support the ITS/TSMO programs.
- Prioritize flexible or changeable physical and digital infrastructure concepts around lane usage (e.g., dynamic shoulder use), roadside elements (e.g., cameras, DMS), and barriers.
- Expand the video analytics pilot statewide for use by the Traffic Management Center (TMC).
- Expand and enhance Iowa DOT's pavement marking data collection activities.
- Expand Iowa DOT's pavement marking program on Interstate roadways, using 6" markings, brighter contrast, and more durable marking materials.
- Update the TSMO Cooperative Automated Transportation (CAT) service layer plan to address dynamic changes related to DI and identify dual benefit opportunities.

Ensure that the highest and best use of Iowa DOT ROW is considered

As Iowa's demographic and economic landscape evolves, the transportation system will evolve with it. The multimodal transportation system as it exists today has developed over many decades and reflects the progression of population and employment growth, travel patterns, and advances in transportation to this point. The decisions made today regarding transportation investments need to be done with the social, economic, and technological patterns of the future in mind, and that may not necessarily equate to a highway network that looks the same as today. When portions of Iowa DOT ROW are no longer needed, they are sold and placed back into private ownership and use. The highest and best use of Iowa DOT-owned right-of-way (ROW) should be considered when the highway system expands or contracts, and when current needs or likely future conditions provide opportunities to utilize ROW for congruent uses that do not interfere with the transportation use of the property, such as the production or transportation of energy.

Short-term action items

- Continue to identify, refine, and geospatially locate historic property owned by Iowa DOT across the state.
- Develop criteria for which disposal of property and re-conversion to private ownership should be considered. Apply the disposal criteria to existing property boundaries and evaluate the results.
- Develop criteria for consideration of ROW that may also have potential congruent uses that will not interfere with the transportation use of the property. Apply these criteria to existing property boundaries and other data and evaluate the results.
- Pilot the development of a solar array installation on Iowa DOT ROW, leveraging the site suitability analysis previously conducted by ESRI to help identify candidate locations.

Enhance planning and asset management practices for the freight network by utilizing designs and treatments that are compatible with significant freight movements, and support superload route identification and enhancement

Enhancing freight mobility is a top priority of Iowa DOT. Whether goods are moving by road, rail, water, or aviation, Iowa businesses and consumers rely on a transportation system that allows freight to move in a safe and efficient manner. The State Freight Plan provides a vision for multimodal freight transportation and positions the state to be competitive in the global marketplace by ensuring critical connections to national freight systems become and remain efficient.

Investments targeted for facilities that handle significant freight traffic, including oversize/overweight vehicles (OSOW), should incorporate designs compatible with these types of freight movements, and avoid improvements that unintentionally create new obstructions to freight movement such as restrictive roundabouts, overhead structures, and limited turn radii. Emphasis should be placed on the highway portion of the Iowa Multimodal Freight Network (IMFN). In addition, future routing and access control decisions and processes should consider those facilities that are most compatible with freight movement.

With increasing numbers and evolving types of OSOW loads anticipated, it will be particularly important to identify ideal routes for these movements, including superloads (currently defined as any loads heavier than 156,000 lbs., taller than 16 ft., and/or wider than 16 ft.), and enhance the infrastructure accordingly.

Port of Blencoe in Monona County. *The port is a barge loading and unloading terminal on the Missouri River, serving as a gateway to world markets. June 15, 2023*

Short-term action items

- Identify superload routes based on immediate economic development opportunities and complete necessary infrastructure upgrades needed to support these loads.
- Use historical permits (iAPS) to identify the OSOW truck routes, high clearance routes, superload routes, and wind tower corridors. Consider targeted geometric design improvements for these routes as appropriate to ensure the movement of goods is efficient.
- Create a program to gather manufacturers' perspectives on Iowa's transportation system, taking into consideration similar work by MnDOT (MnDOT Manufacturers' Perspectives on Minnesota's Transportation System).
    - Interview Iowa businesses to gain feedback and better understand their specific freight transportation requirements.
    - Identify low-cost/high-value opportunities to provide a more responsive transportation system focusing on infrastructure, maintenance, communication, and permitting and policy.
- Review and potentially update the dimensions that define high clearance routes, wind tower routes, and overweight routes, as the current standards may be outdated and no longer appropriate.
- Expand on the freight design considerations noted in the State Freight Plan and develop design guidance for these freight corridors, especially those that are part of the IMFN.
- Assist communities with first mile/last mile design guidance at targeted transload facilities, large manufacturers, ports, and railyards. Review economic development grants to update and improve opportunities.
- Update the Statewide Truck Parking Study (part of the 2020 Iowa Rest Area Management Implementation Plan) analysis and recommendations to include OSOW parking needs on major routes. This could include allocating spaces at each location with planned expansions to accommodate larger loads.
- Incorporate OSOW and superload corridor considerations into work zone planning to avoid multiple restrictions for larger loads at a single time (e.g., restricting all border crossings in an area or blocking both directions out of a manufacturing plant).

Support the development and adoption of emerging freight technologies to increase safety and efficiency

Emerging technologies such as automation, autonomous vehicles, unmanned aircraft systems (e.g., drones), blockchain, and others have the potential to be transformative for freight industries by increasing safety and efficiencies, enhancing supply chains, and disrupting business models. These types of opportunities should be explored and supported so industries can address various challenges such as consumer acceptance and expectations, increased competition, rising labor costs, and labor availability. As opportunities arise, activities could be coordinated in consultation with both the Iowa Advisory Council on Automated Transportation (ATC) and the Iowa Freight Advisory Council (FAC).

More immediate opportunities involve making the data and information that DOTs already have more accessible and useful to commercial drivers and the traveling public.

Short-term action items

- Task the ATC and FAC with developing a strategy for enabling corridors for higher levels of automation (i.e., "lighting up" the Interstates) and implementing recommendations from *NCHRP 20-24(138): Collective and Individual Actions for State DOTs Envisioning and Realizing the Next Era of America's Transportation Infrastructure – Phase I*.
- Pursue grant opportunities to create a connected freight ecosystem and supporting transportation data environment (see HARVEST Iowa SMART Grant application) to provide real time or near real time information directly to commercial drivers.
- Expand the Truck Parking Information Management System (TPIMS) technology to every public rest area in the state.
- Expand state funding program eligibility to include teleoperation and other emerging technologies.
- Explore opportunities to deploy height and width detection equipment around work zones and bridges to reduce crashes from oversize loads.
- Expand the use of automated route and bridge analysis technology for the issuance of oversize/overweight permits.
- Explore the use of Uncrewed Aircraft Systems (UAS) in crash investigation and analysis.

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