Innovative Data Processing: AI/ML and Algorithms Driving Efficiency in Operational and Safety Projects

April 2025

AtkinsRéalis

Why Automation Matters

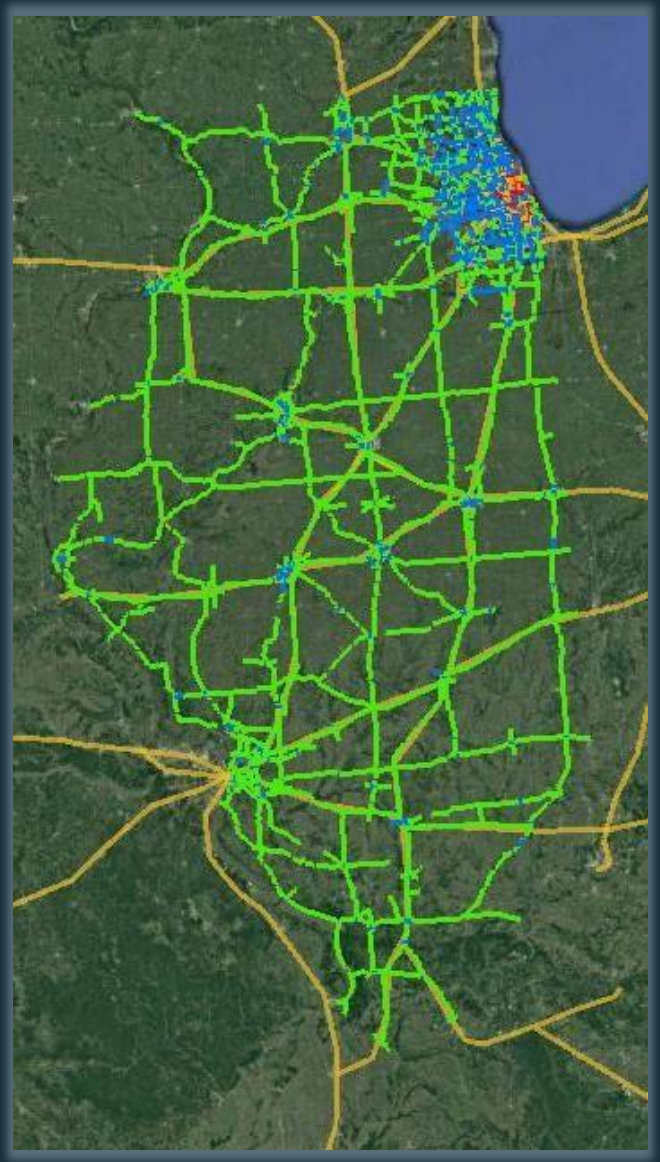
- Surge in data from sensors, geospatial tools, and open datasets is growing fast | 3V’s of big data (Volume, Velocity, Variety)
- Complexity overwhelms manual processing
- Automation unlocks efficiency and insight
- Goal: Transforming raw data into actionable insights for operational and safety projects.

Presentation Roadmap

- Tools and algorithms to process big data
- Five real-world case studies
  - Statewide TT Reliability - HERE and PostgreSQL
  - Machine learning for Crash Reports
  - Python workflows for ARCGIS and roadway data
  - Python workflow for Statewide crash data assembly
  - AI/ML-driven image data collection
- Strategies for implementation

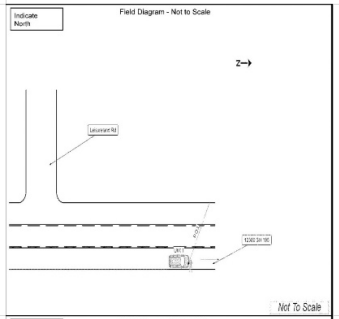
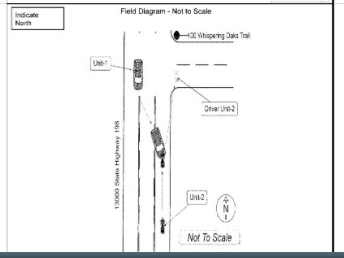
Case Study 1 – Statewide Travel Time Reliability Analysis

- Project: IDOT Statewide TSMO Plan
- Input: 2017-2019 HERE data. 16B records.
- System: Most IDOT and ISTHA roadways plus some local roads (15K+ miles)
- Tools: HERE and HPMS, Postgres GIS for spatial analysis.
- Method: Calculated TT reliability metrics, which in combination with User Delay Costs were used to identify candidate locations for TSMO Improvements
- Outcomes: Identified congestion hotspots.



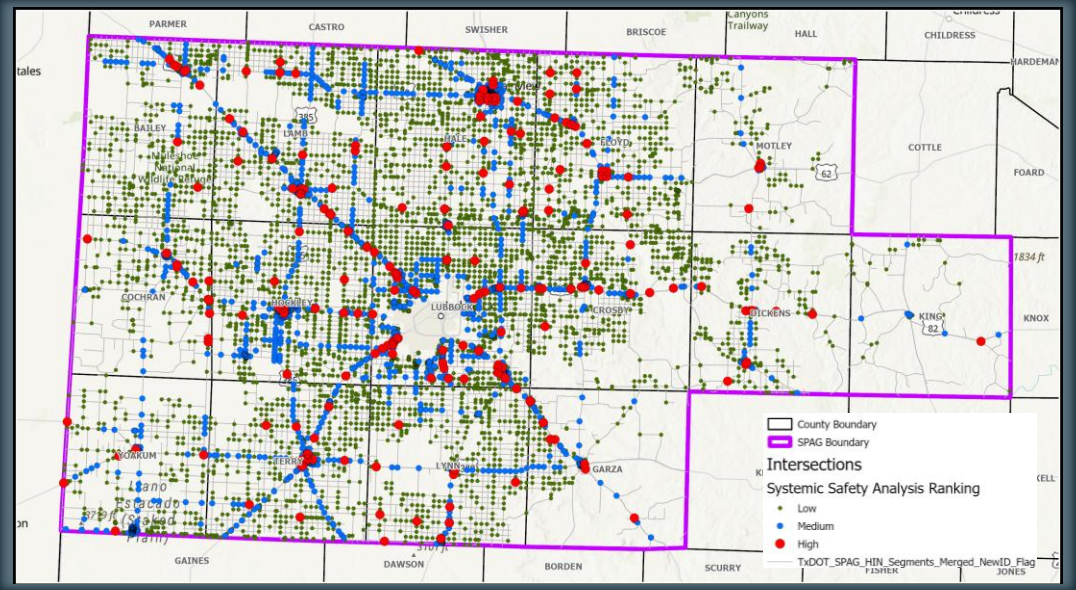
Case Study 2 – Crash Reports Interpretation

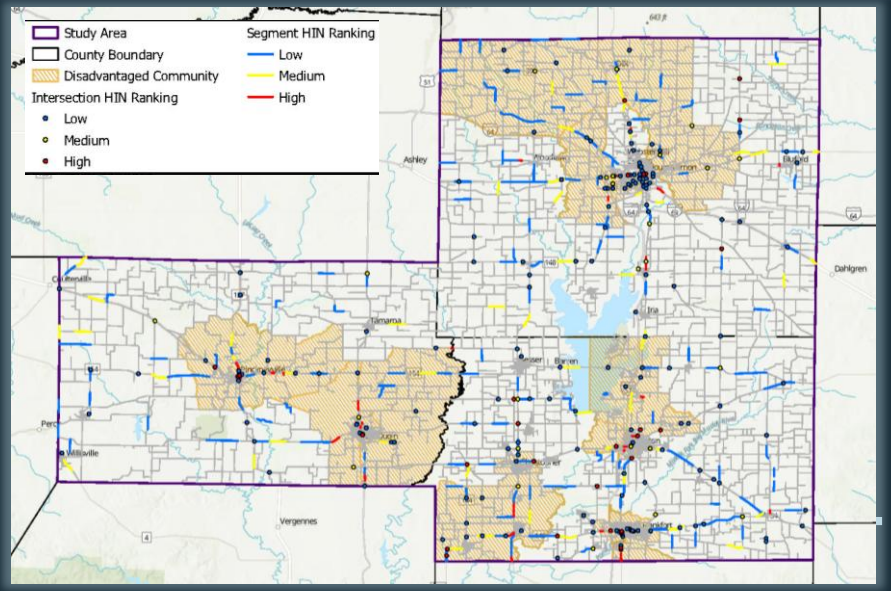
- Project: Various, TxDOT
- Input: Police crash reports inconsistencies, Direction of travel
- Tools: ML/Python workflow identifies Crash ID, interprets police narrative, assign direction of travel.
- Outcomes: Assist data preparation step by addressing inconsistencies.

	A	B	C	D	E	F	G	H
1	Crash ID	TXDOT ID_Unit	TXDOT ID	Unit#	Narrative	Direction_4	Direction_8	Crash Diagram
2	2023598449	19908875.1	19908875	1	Unit 2 was standing on the side of the northbound lane wearing dark clothing. Unit 1 was traveling northbound when he stuck Unit 2 of Health ambulance #957 witnessed the incident and responded and began caregiving. Unit 2 driver and Unit 1 was flown to hospitals in Tyler . Witness Houston 903-821-5521 1 Witness Smith 903-340-7782 . Unit 1 Davis 430-302-7641	NB	NB	
3	2023569999	19880425.1	19880425	1	Unit-1 was traveling southbound in the 13000 block of Highway 198 Unit-2 was traveling southbound in the 13100 block of Highway 198 Unit-1 began to make a left turn into a private driveway. The driver of Unit-1 advised he did not see Unit-2 coming. Is Unit-1 entered the path Unit-2 . Unit-2 could not avoid the collision Impact resulted in the rider of Unit-2 being ejected from the motorcycle and both front airbags being deployed in Unit-1 The Investigating Officer could not locate liability insurance for either vehicle involved in the collision. The driver of Unit-2 was injured and was transported by Air Ambulance	SB	SB	

Case Study 3 – Geospatial Workflow

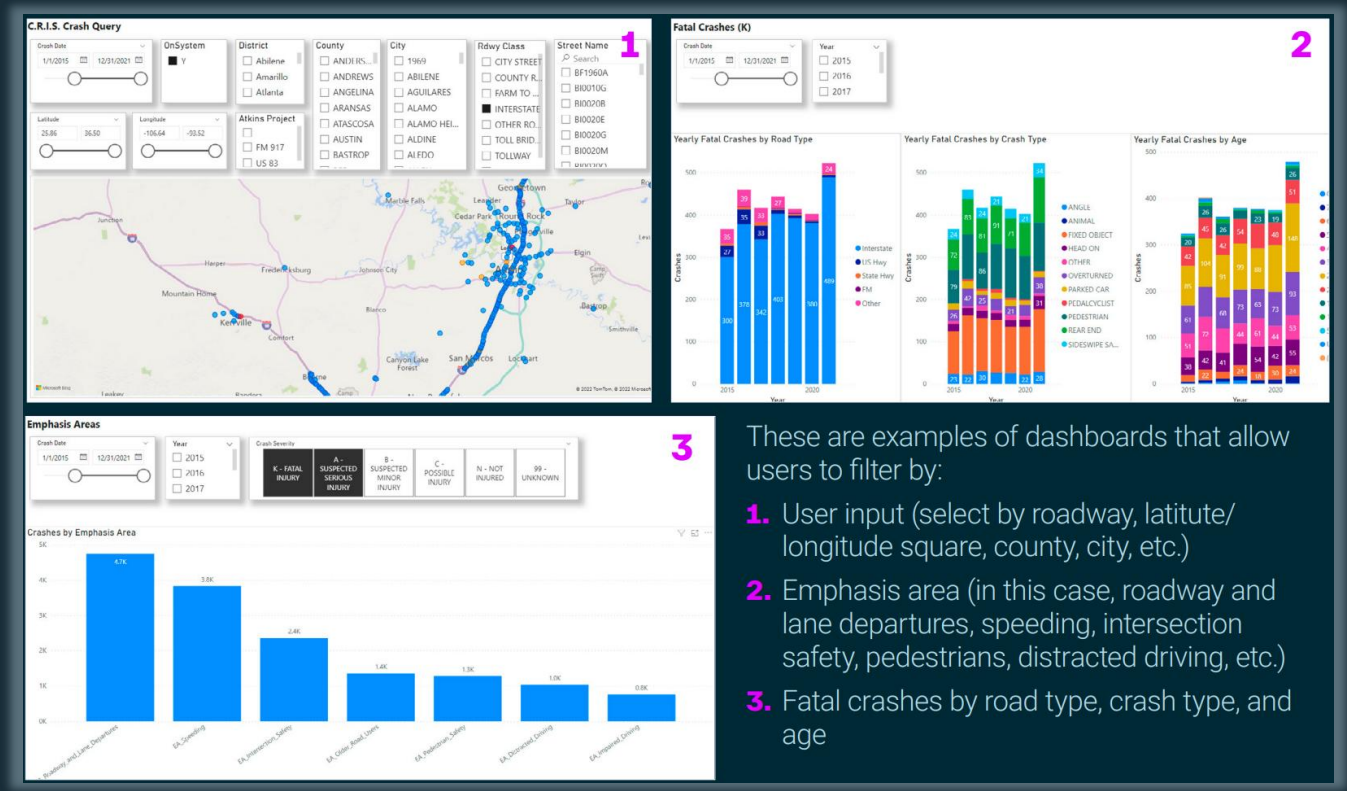
- Project: Various site-specific, corridor, and regional studies
- Input: ARCGIS + OpenStreetMap / NAVTEQ / NMPRDS /HPMS
- Tools: Python scripts streamline aggregation.
- Method:
  - Extracted roadway variables from multiple data source.
  - Created crosswalks between roadway and intersection layers
- Outcomes: Enhanced roadway layers. Developed intersection layers from scratch





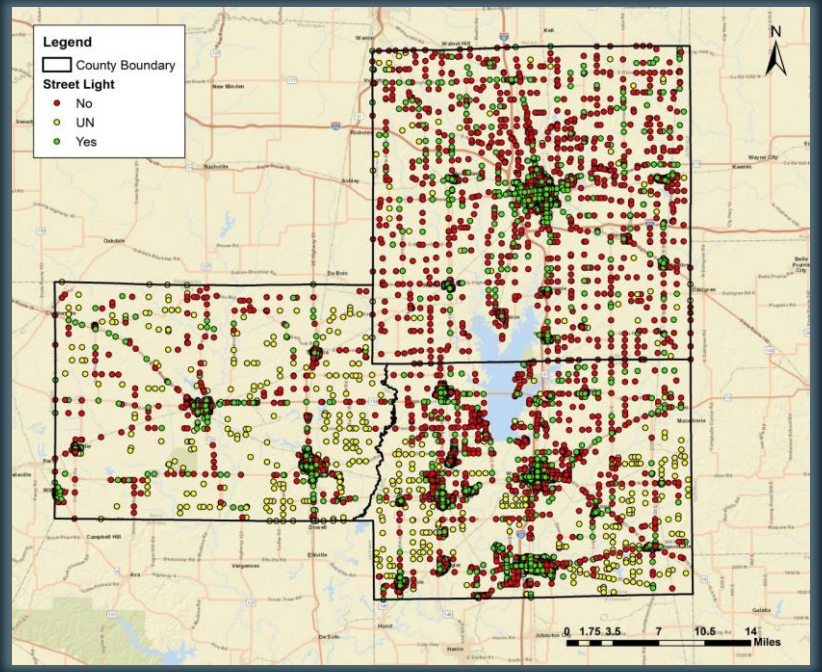
Case Study 4 – Statewide Crash Data Process

- Project: Statewide Crash data dashboard (2012-2023)
- Input: Assembled 6 million+ crash, person, unit records
- Method: Automated Python workflow for data integration
- Outcomes: Enabled large-scale analysis for safety and planning



Case Study 5 – AI– Driven Data Collection

- Project: Automates attribute collection using machine vision and crowd-sourced data.
- Input: Google Street View images (12K intersections, 48K images).
- Tools: Python, Spyder IDE, CUDA for GPU acceleration
- Method: Real-time detection with high accuracy. Processes images in milliseconds.
- Outcomes: Enabled large-scale data collection to enhance analysis for safety and planning

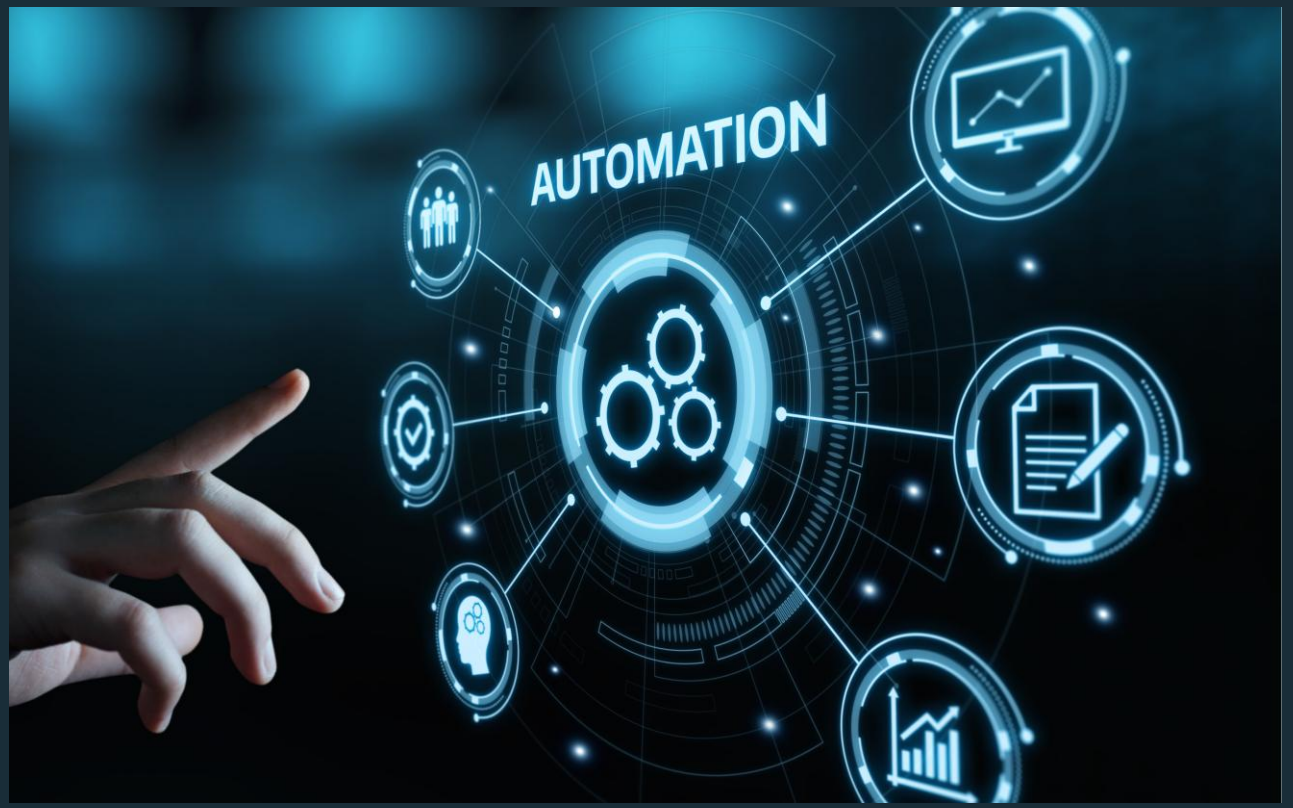


Benefits of Automation

- Streamlined workflows through reduced manual effort and minimize human error.
- Enhanced decision-making with faster, data-driven insights.
- Shifted focus to analysis and solution development.

Strategies for Implementation

- Use modular tools (e.g., Python, PostgreSQL), or other open-source technologies for flexibility.
- Integrate AI/ML incrementally based on project needs.
- Prioritize data quality and validation in automated workflows.
- Iterate and improve – Automation is a journey, not a one-time fix



Conclusions

- Recap: Automation and algorithms transform complex data into actionable outcomes.

- Takeaway: Leveraging these tools is key to tackling big data challenges effectively.

Dante Perez-Bravo, PE, PTOE, RSP1

Dante.perez-bravo@atkinsrealis.com

AtkinsRéalis