

Technical Approach

The Pavement Surface Evaluation and Rating (PASER) analysis system utilizes advanced Artificial Intelligence (AI) and geo-referenced imagery to extract the pavement conditions and quantify them in accordance with the (PASER) manuals (asphalt, concrete, brick/block, sealed, and unimproved).

Transconomy collects the right-of-way imagery using off-the-shelf Go-Pro high-resolution cameras mounted on the front of a vehicle. Our models can then use the images to extract pavement distress and assign a PASER rating for the segment. An example of the GoPro setup is shown below. It is a simple, effective way to capture data at highway speeds. It should be noted that Transconomy can utilize any geo-referenced imagery provided; it does not have to be GoPro imagery.

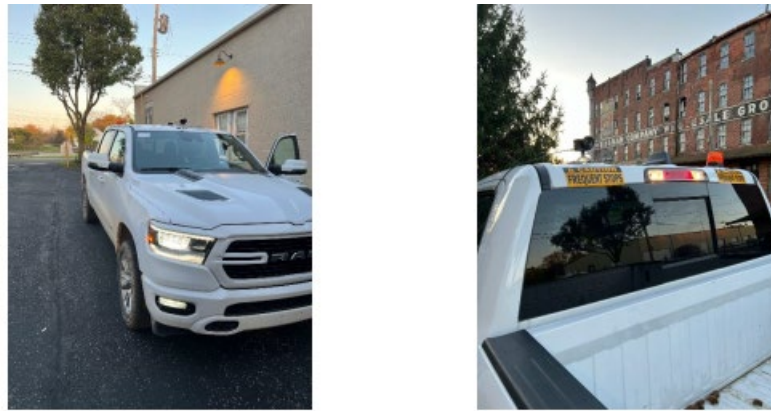
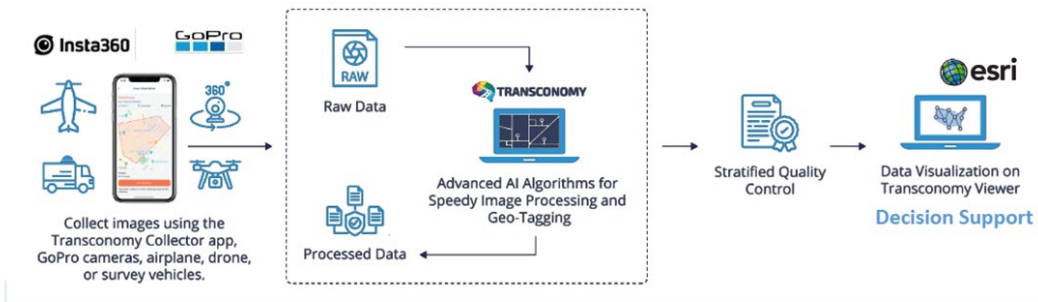


Figure 1 - GoPro's mounted on data collection vehicle.

The required inventory will be created by processing the right-of-way roadway images. A detailed description of Transconomy's Roadmap processing engine and the use of AI models is provided, below. Transconomy automatically anonymizes the images so that license plates and faces are blurred.

The solution is an AI-based technology platform, that processes digital images to extract the existing pavement surface conditions and quantify them in terms of a PASER based scoring assessment. A model of this process is shown below.



Transconomy Roadmap
Service as a Software

Figure 2 Transconomy Roadmap Workflow

AI refers to the simulation of human intelligence in machines that are programmed to think and learn like humans. For Transportation Asset Management this translates to using a collection of off-the shelf AI models to discern assets within overhead (satellite and airplane), drone, and right-of-way imagery. A commonly used model (but not exclusively used) is a YOLO (You Only Look Once) object detection model. It is a popular deep learning architecture that is specifically designed for real-time object detection in images and videos. YOLO models excel in detecting and localizing multiple objects within an image in a single pass.

The use of AI models to perform this process is becoming exceedingly more commonplace in the industry. AI models are advancing at a rapid pace, and it is now possible to perform the distress takeoffs using this technology. The process used by Transconomy to develop an AI model is illustrated in the following figure.

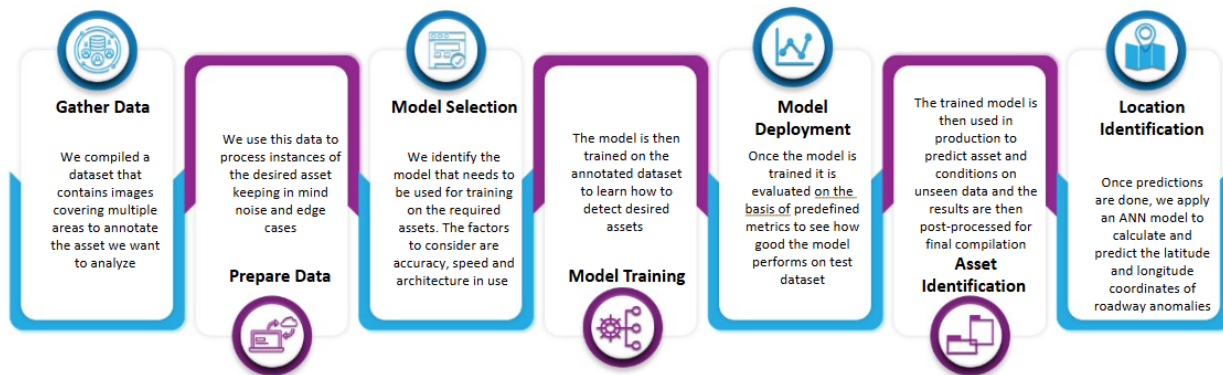


Figure 3 – Generalized AI Model Development Process

The collected images are processed on Transconomy Roadmap, using Transconomy’s latest AI models. The extracted pavement condition data will be processed using the PASER rating system and will be validated and verified by Transconomy’s data extraction team.

The resultant data is delivered in several formats. This includes a CSV file to import into the database of choice, a geodatabase file for import into ERSI GIS, and a KML file for viewing in Google Earth. We also provide Transconomy Roadmap access, which includes a viewer for visualization of the data and associated imagery. Roadmap allows you to visualize any point or segment-based road attribute on thematic maps. Point-based attributes are shown as pins, while segment-based attributes are represented as lines on the map. Roadmap Viewer also displays the corresponding metadata and media in a separate panel by simply clicking on the attribute.

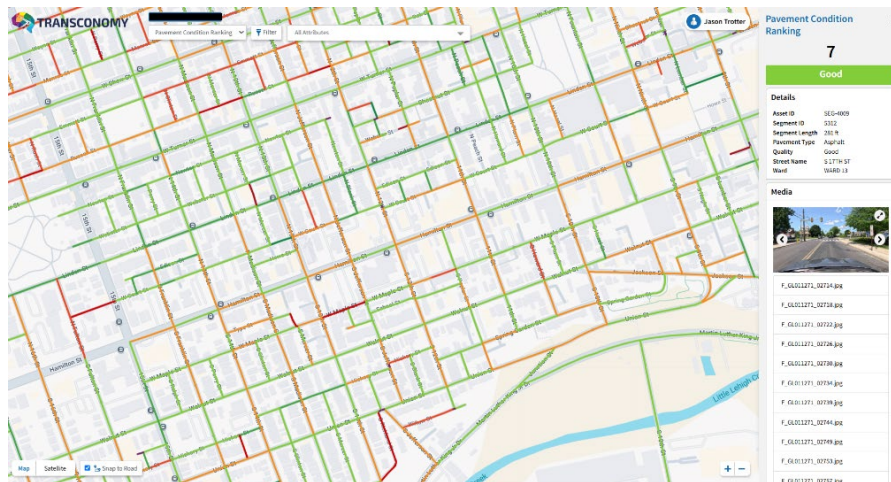


Figure 4 - Thematic Map View of PASER Ratings

Roadmap offers powerful filtering capabilities to fine-tune the search and visualize specific attributes of interest. Multiple filters can also be stacked together to quickly narrow down the search and find specific attributes. A wide range of filter options are available based on the type of attribute, including selecting a filter option from a dropdown list, specifying a filter value range, or defining a date range. Transconomy Roadmap allows for viewing at summary level for any segment, where the condition rating, information on the distresses, and the images for that segment can be viewed, as shown in the following figure.

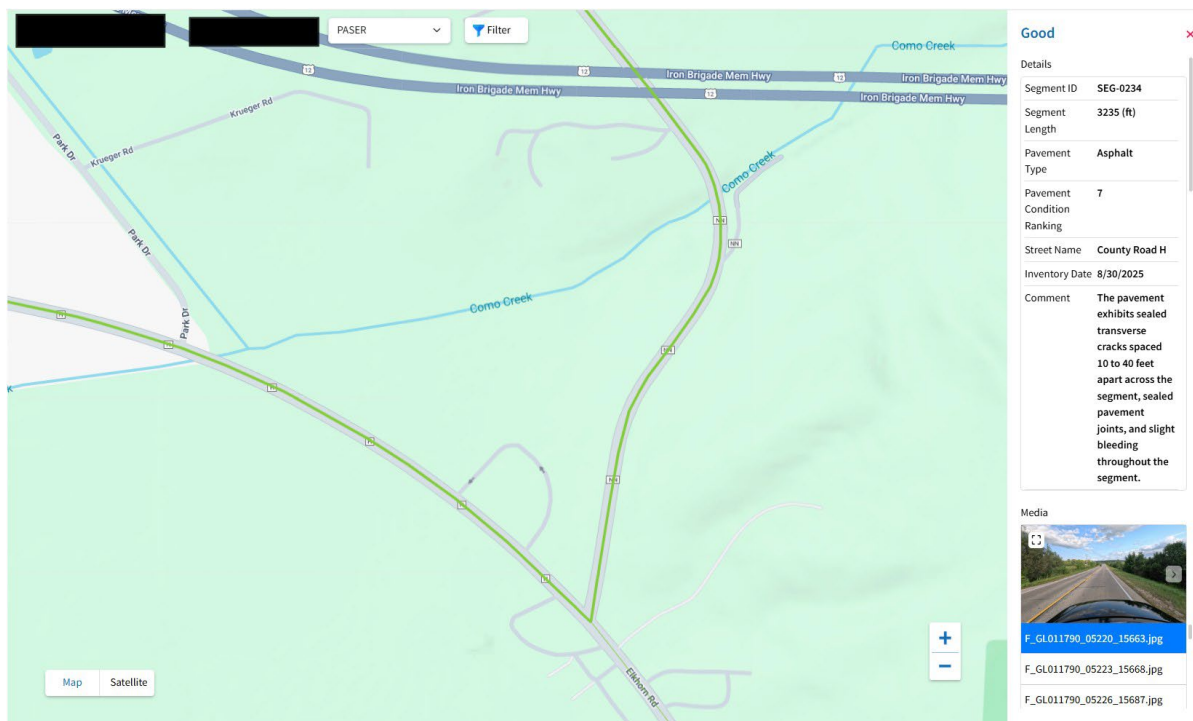


Figure 5 Transconomy Roadmap Segment View

Within Roadmap, you can launch Roadview, an immersive feature that allows users to virtually “drive” through any road within their network and detect any assets that are visible within the view.



Figure 6 - Roadview Virtual Driving View

The processed pavement evaluation would be delivered as a:

- a) Geodatabase – the geodatabase allows integration of the data into an existing GIS solution.
- b) Shapefile (KMZ) – the shapefile allows the user to use GIS tools like Google Earth to visualize the data.
- c) CSV – this format allows the data to be explored as a spreadsheet without requiring access to any GIS tools.

The final inventory of pavement condition would also be delivered in the web-based Transconomy Roadmap application, as outlined above. Within Roadmap, all pavement conditions would be identified with a corresponding image that shows the pavement in a contextual and up-close manner. The following information will be provided for the Pavement Evaluation.

- a) Each pavement section and asset will have an asset identification code associated with the pavement/individual asset.
- b) Pavement Evaluation
 - I. Segment length
 - II. PASER evaluation score (1-10)
 - III. Begin and end latitude and longitude
 - IV. Pavement type (asphalt, concrete, brick, etc.)
 - V. Street name
 - VI. Inventory Date
 - VII. PASER distress survey comments

Benefits and Efficiencies:

- Fully automated condition assessment process, providing data consistency across the network through the AI models.

- Elimination of human error. Many of these surveys are performed by inexperienced technicians or interns. AI alleviates this concern, and it performs the survey the same way every time.
- Less expensive than a manual survey.
- Faster than other types of survey methods.
- Safer than performing a manual survey, eliminating the need for crews in the field
- Automated Data Quality Control through the processing platform (image quality, project coverage, rules-based condition assessment)
- Use of standard, off-the-shelf hardware for raw data collection, such as GoPro or similar action cameras.
- No software licenses to install or maintain.
- Data formats are flexible; delivered in standard formats (CSV, Geodatabase, KMZ) and can be formatted for existing systems that may be in place by the agency, such as Enterprise GIS, Pavement Management, or Asset Management.
- Can perform asset inventory and condition survey for roadside assets as well; using a “collect once, use many times” mantra.