AI on the road: Why pavement condition inventory is such an excellent artificial intelligence (AI) use case
AI is no longer futuristic or mysterious. Nowadays, it is rapidly being adopted by traditional industries.

This is largely because innovative providers have tested AI and developed it into valuable, attainable solutions. And the business outcomes are compelling.

This eBook explains how AI is being applied to pavement condition inventory through technologies such as Vaisala's RoadAI, delivering new efficiencies and business outcomes.

### Automation and efficiency

_Everything that can be automated, will be automated._

This 30-year-old idea from Shoshana Zuboff, professor at Harvard Business School, is true across many areas of industry and society. The rule has exposed the risks in legacy road data collection processes, in which humans manually collect defect data and create pavement condition indexes (PCI) for thousands of kilometers of network. Nowadays, computer vision offers clear advantages in completing these historically laborious, time-consuming, and error-prone tasks.

<table>
<thead>
<tr>
<th></th>
<th>Traditional human assessment</th>
<th>RoadAI</th>
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<tbody>
<tr>
<td>Inspection speed</td>
<td>Drive slowly to detect and document</td>
<td>Full driving speed; inspector is free to carry out other tasks</td>
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<tr>
<td>Data availability</td>
<td>Takes weeks to get data in usable format</td>
<td>Immediate; data analyzed and shared in real time</td>
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<td>Analytics</td>
<td>Broad and nonspecific</td>
<td>Comprehensive, automated, used in short- and long-term</td>
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<tr>
<td>Personnel</td>
<td>Trained inspectors are needed</td>
<td>Non-experts can complete inspections</td>
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<tr>
<td>Process</td>
<td>Manual and seasonal</td>
<td>Automated and can be repurposed for other needs</td>
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The value of video

The Vaisala RoadAI system combines live road video with state-of-the-art analytics for carrying out road inspections. The combination of these two automated, unbiased factors gives road inspectors a trustworthy artificial assistant to support their work.

Anyone who has been in a survey vehicle doing road inspection is aware of the complexity and fast decision-making required on the road. Road traffic, even on a quiet morning, is a dangerous and complex factor that impedes people’s concentration and their ability to make a detailed analysis of pavement defects.

Video, analyzed and made useful by RoadAI, offers objective analysis of many different kinds of road stresses, categorizing and inventorying them along the inspection route.

The calculator analogy

As others have put it, RoadAI is to manual road inspection what a calculator is to an abacus. With an abacus, a user can manually complete important mathematical operations — but a calculator can do much more, and it can do it on its own, without direct user input.

Likewise, RoadAI can perform analyses at drastically higher speeds, and with a higher degree of certainty, than a human can using old tools. This results in much more effective decision-making and interventions.
Responding to in-the-field needs

In early days of RoadAI, users indicated that they wanted to make notes in real time next to video footage so they could remember certain issues that came up along their route. Vaisala solved this well-defined user problem with hands-free spoken note functionality, and now, hundreds of inspectors add notes while executing their daily routines. These notes are easy to export as text files if inspectors need to share a task with someone.

This adaptability is one of the benefits of AI-driven tools. No AI-centric tool is ever “finished” — it evolves continually to add new functionalities and improve the user experience.

Data privacy and integrity

For those who have concerns with data privacy, it is important to understand that RoadAI anonymizes visual data, and there is no possibility to have humans or vehicles captured in the video’s field of vision. Humans and license plates are automatically blacked out at the level of video storage, meaning that personally identifiable information is never actually in the system.

Improving preventive maintenance

Preventive maintenance decisions based on up-to-date, accurate information can be the key to longer-lasting asphalt. Unfortunately, maintenance organizations are often unable to conduct enough preventive maintenance because of budget constraints.

With RoadAI, users can get up-to-date data as close to the decision-making moment as possible, helping them identify and address small road problems before they become bigger, costlier ones. This is especially valuable in budget-scarce environments, where foresight into deteriorating roadways can enable more proactive, preventive repairs rather than costly, reactive ones.
Customizable for different road networks

In some locales, different road defects are emphasized in pavement planning. Because of this, the RoadAI system is customizable based on user preferences and the natural variance between different continents or countries. Clients have the option to decide what defects are relevant for them, and the system map will emphasize different defects and assess their priority accordingly.

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**Defects**

**Cracking**
- Alligator cracking
- Minor longitudinal cracking
- Moderate longitudinal cracking
- Severe longitudinal cracking
- Minor transverse cracking
- Moderate transverse cracking
- Severe transverse cracking
- Wheel track cracking

**Potholes**
- Minor pothole
- Moderate pothole
- Severe pothole

**Fretting/Ravelling**
- Severe fretting
- Moderate fretting

**Other defects**
- Settlement or subsidence
- Edge deterioration
- Bleeding

**High friction surface (UK specific)**
- High friction surface
- High friction surface deterioration

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**Fixes**

**Crack sealing**
- Longitudinal sealing
- Transverse sealing

**Patching**
- Area patching
- Spot patching

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Figure 4: Defect and fix classes detected and mapped in RoadAI.
Putting the data to use

There are two major applications of RoadAI data in daily operations:

1. Export the data to an asset management system or other corporate geographic information system (GIS) system, where it can be combined with other relevant data to inform decision-making and pavement operations.

2. Use RoadAI, as it is, in the planning phase. RoadAI is the only self-deployable survey tool combining road video recording and computer vision within the same system and price tag.

The figures to the right provide a representative look at the RoadAI user experience out-of-the-box.

Figure 5: RoadAI enables users to browse each defect type separately, or use combined pavement condition ratings that account for each defect type and the general pavement condition value.

Figure 6: RoadAI is a handy and intuitive support tool in pavement programming and operational planning.
Assessing the value of AI

The values of AI in road maintenance are easy to see and understand:

- **Efficiency and reduced workload**: With RoadAI, data can be collected on the same ride as a normally scheduled safety inspection or daily road patrol. With low-cost equipment (basically a camera or a smartphone) and automated data analysis, there is no need for a trained inspector. Data can be collected from any car.

- **Inspection speed and efficiency**: RoadAI performs defect inventory at normal highway speeds, meaning that inventory can be done much faster and with essentially zero traffic disruption.

- **Speed in data processing**: Typically, it takes weeks or even months to get inventory results from a road inspection contractor. But RoadAI processes and provides data output in less than 48 hours after each survey.

- **Objectivity and data quality**: By eliminating the reliance on human assessors, RoadAI improves objectivity and allows any inspector to gather data of the same quality.

- **Better decision-making and cost savings**: With RoadAI data, it is possible to extend the life cycle of pavement by years. By assessing and fixing defects before they become too serious — using precise, recently obtained data — users save money and time.

- **Better safety and levels of public service**: With preventive maintenance and fewer roadway disruptions, travelers have safer and more pleasant experiences on the road. This reflects positively on local agencies or departments of transportation.

Road maintenance done right: Ideal best practices using AI

1. **Right road**: Know the general condition of your network and understand where you need to focus — and where you don’t.
2. **Right funding**: Using objective data, justify and obtain sufficient funding to treat roads to save your infrastructure.
3. **Right treatment**: Make informed treatment choices to stop deterioration and restore the expected service level of the pavement.
4. **Right time**: Armed with current, valid data, complete preventive maintenance at the proper time, before defects become more expensive and more disruptive.
Hit the road.

Vaisala is ready to talk about RoadAI and how we can build your ideal solution or integration. Vaisala observation technologies are known and trusted around the globe, and they are all rooted in our 80+ years of experience and scientific research.

www.vaisala.com/RoadAI