

ACCELERATING MAINTENANCE DECISIONS WITH ACOUSTICS-FIRST MECHANICAL INSPECTIONS

How Sorama sets a new standard beyond traditional vibration sensing





TABLE OF CONTENT

3	EXECUTIVE SUMMARY
4	PREDICTIVE MAINTENANCE FOR ROTATING EQUIPMENT
5	DIFFERENT TECHNOLOGIES TO PREDICT POTENTIAL FAILURES
5	ACOUSTIC CAMERAS (REMOTE SENSORS)
6	VIBRATION SENSORS (CONTACT-BASED SENSORS)
7	STAY AHEAD WITH SORAMA'S ACOUSTIC MONITORING
11	SORAMA'S ACOUSTIC MONITORING AS A PREDICTIVE MAINTENANCE SOLUTION
12	ROI OF ACOUSTIC INSPECTIONS FOR ROTATING EQUIPMENT
13	CONCLUSION



EXECUTIVE SUMMARY

Industrial organizations strive to maximize asset availability, extend component life, and reduce maintenance costs and safety risks. Predictive maintenance plays a critical role in achieving these goals by identifying potential failures before they lead to functional breakdowns.

Sorama's acoustic cameras enable earlier fault detection than traditional condition monitoring methods by capturing ultrasonic signals generated during the earliest stages of wear. In controlled tests, Sorama's innovative mechanical inspection algorithms detected potential bearing failures 17% earlier than traditional vibration monitoring.

This earlier insight translates into lower repair costs, reduced downtime, and improved safety and reliability. As a result, Sorama's acoustic monitoring solution represents a strategic upgrade for predictive maintenance programs.

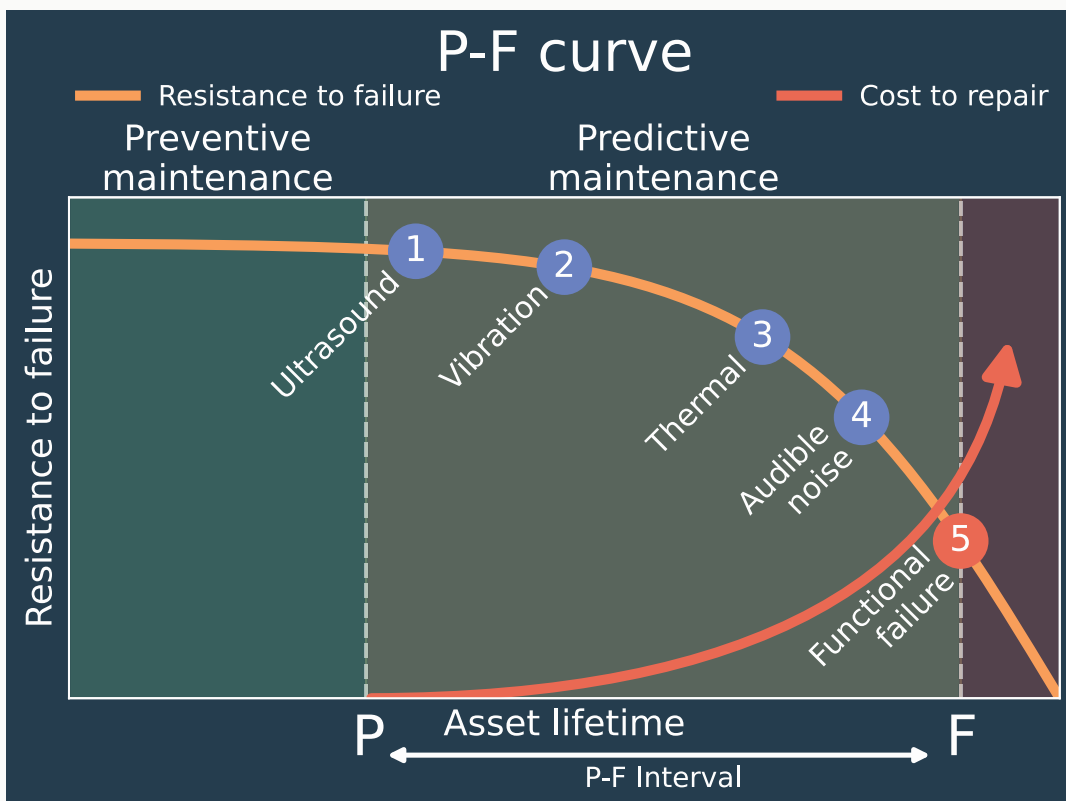
PREDICTIVE MAINTENANCE FOR ROTATING EQUIPMENT

The earlier a fault is flagged, ideally before measurable performance degradation, the more cost-effective intervention options exist. For that reason, industrial organizations that aim to increase asset availability, extend component life, and reduce maintenance cost and safety incidents depend on predictive maintenance solutions.

The P-F (Potential Failure-to-Functional Failure) curve indicates the importance of early failure detection. From the moment a potential failure can be detected (P), it is crucial to continuously assess the asset condition to prevent unscheduled downtime. From the P-F curve, it follows that ultrasound is the earliest indicator of degradation, followed by vibration- and thermal analysis¹. Audible noise can be heard when the asset is close to failure, followed by functional failure of the equipment. Sorama's innovative solutions translate the emitted ultrasound to actionable data for maintenance and reliability teams.

There is one key takeaway from the P-F curve;

Ultrasound is the earliest indicator of potential failure.



¹ Power-MI. "Rolling element bearing failure detection techniques."

DIFFERENT TECHNOLOGIES TO PREDICT POTENTIAL FAILURES

In modern industrial environments, the ability to anticipate equipment failures is critical for ensuring operational reliability and minimizing unplanned downtime. Advances in sensing technologies have enabled engineers to detect mechanical degradation with increasing precision. This section provides an overview of key technological approaches used in predictive maintenance, emphasizing their role in data-driven decision-making.

Acoustic cameras (remote sensors)

Acoustic cameras ‘see’ sound. They use an array of microphones to detect sound waves and create a visual map showing where the noise is coming from. This map is often overlaid on a normal camera image, so technicians can quickly pinpoint the sound source.

How it works:

Each microphone hears the arrival of sound waves at slightly different times. By analyzing these timing differences, the system calculates the direction of the sound source. It can even isolate one sound from background noise, amplifying what matters and suppressing the rest.

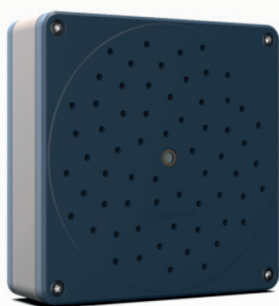
Why it matters:

Rotating equipment like bearings, pumps, electric drives, with starting degradation produce ultrasonic sounds (above 20 kHz), which humans can’t hear. Acoustic cameras are designed to detect these frequencies, ignoring the normal audible noise of a factory.

Advantages:

- Works from a distance.
- Can monitor multiple machines at once (fixed installation) or be used for spot checks (handheld devices).
- Ideal for early detection before major damage occurs.

64 sensitive microphones
capture sound
waves



High frequency
sound

Rotating machine



Vibration sensors (contact-based sensors)

Vibration sensors measure the level of vibrations in a machine. They are typically mounted directly to the equipment and continuously record the vibration levels over time or are used in periodical inspections by pushing the sensor to the machine's surface.

How it works:

Most sensors are accelerometers that detect movement in one direction. To get a full picture, three sensors are often used on each rotating part. They convert vibration signals into frequency and magnitude data, which helps identify vibration patterns and changes.

Setup:

Sensors need solid contact with the machine, using glue, magnets, or bolts.

Why it matters:

Changes in vibration often signal imbalance, misalignment, or wear. Tracking these changes helps predict when a part might fail.

Limitations:

Most sensors measure up to 10 kHz, which is good for detecting problems close to failure. But early warning signs often occur above 20 kHz, so vibration sensors may miss the earliest stages of wear.

Feature	Acoustic camera	Vibration sensor
Non-invasive	√	×
Real-time source localization	√	×
Trend analysis	√	√
Best for	Early fault detection	Medium-late stage faults
Frequency range	Audible + ultrasonic (2kHz up to 120kHz)	Up to ~10kHz
Ease of use	Simple	For advanced users
Coverage	Multiple assets	Multiple for single asset
Cost efficiency	Good for broad monitoring	Good for targeted monitoring

STAY AHEAD WITH SORAMA'S ACOUSTIC MONITORING

Early detection is non-negotiable

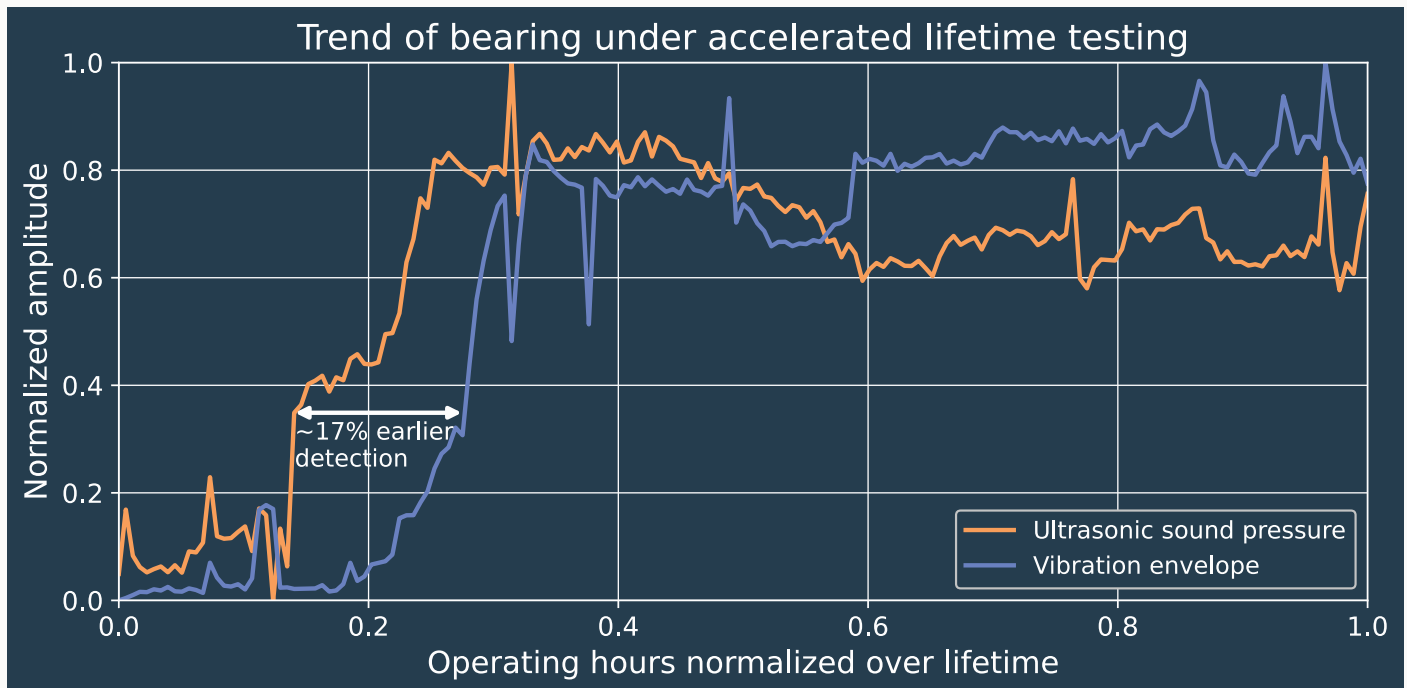
Unplanned failures are costly and disruptive. The ability to detect faults at the earliest possible stage is what separates reactive maintenance from a proactive, data-driven reliability strategy. While vibration monitoring has long been the standard, acoustic monitoring consistently identifies potential failures sooner, giving you a measurable advantage.

The test: contaminated bearing run to end-of-life

To compare acoustic and vibration monitoring, a controlled experiment was conducted:

- A bearing was deliberately contaminated to accelerate wear.
- The bearing was run until it reached end-of-life (EOL).
- Throughout its life cycle, the bearing was monitored using both vibration sensor and an acoustic camera.

The goal: To determine which method detects potential failure first.



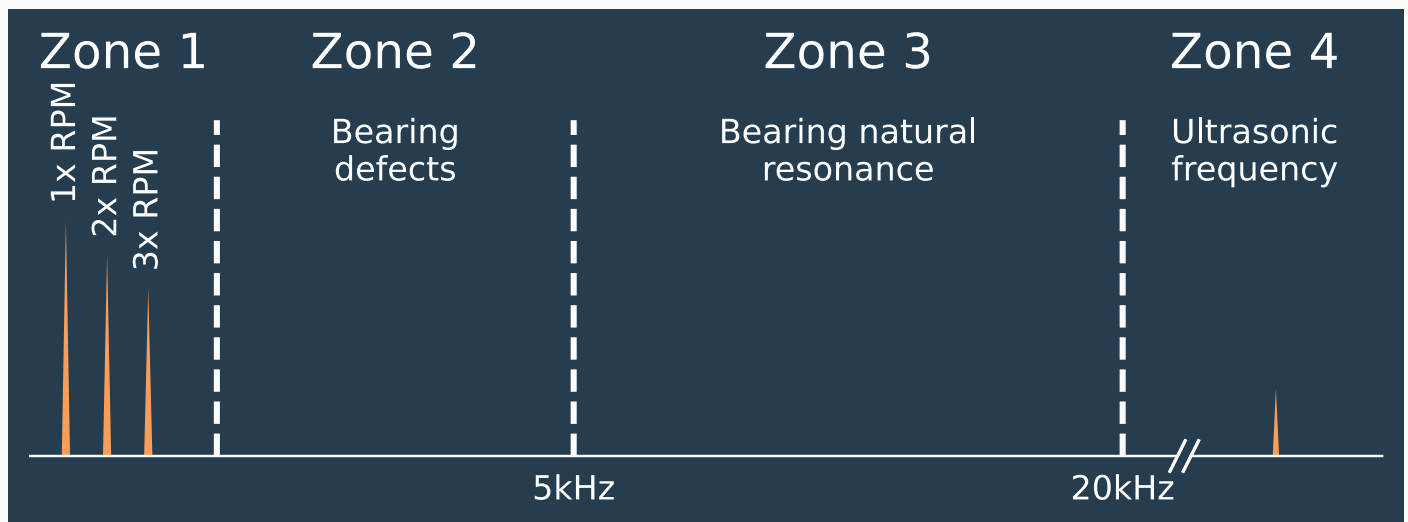
Results: Acoustic monitoring leads by 17%

The results are clear. Our findings suggest acoustic monitoring detected the onset of potential failure about 17% earlier than vibration monitoring. In practical terms, this means operators gain extra time to schedule maintenance before the situation escalates.

An interesting observation: ultrasonic sound pressure is strongest during the early stages of bearing damage. Why?

There are several stages to bearing degradation², also shown in the images below:

Stage 1: When contamination begins, the bearing surfaces create high-frequency impacts, generating ultrasonic signals (Zone 4). Those signals are the earliest indicators of a mechanical fault, which can be picked up by the array of high-sensitivity microphones deployed in the Sorama acoustic camera's.

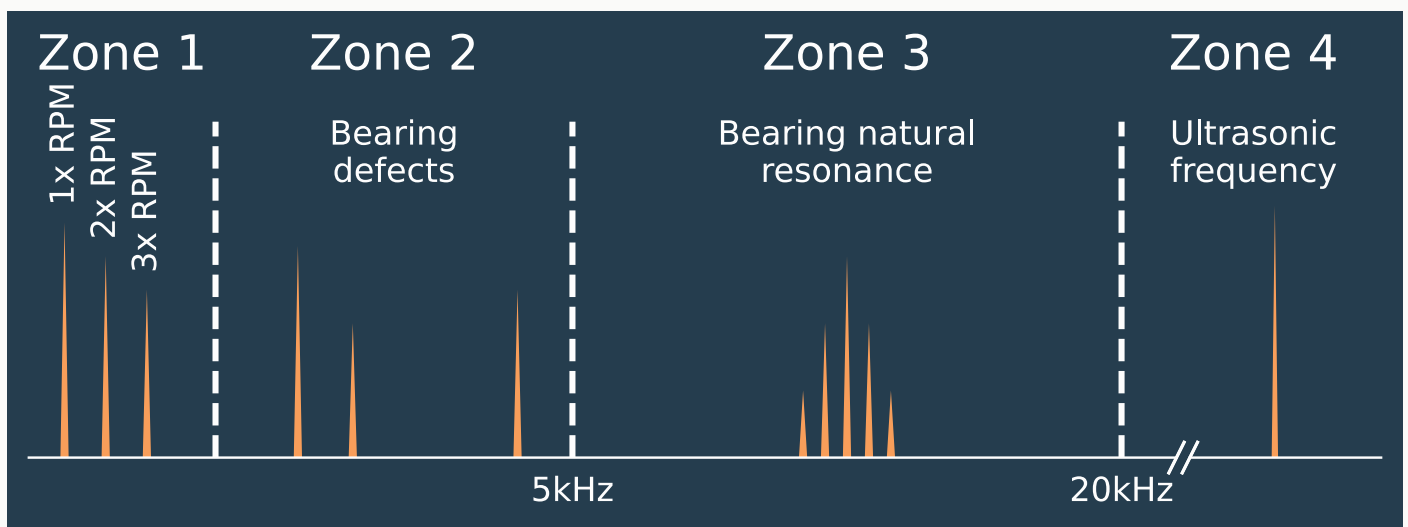


Stage 2: At some point, there is enough energy from the high-frequency impacts to excite the bearing race and cause high-frequency resonance of individual bearing components (Zone 3). The exact location of the resonance frequencies depend on the bearing geometry and loading. Small bearings and high loads result in higher resonance frequencies than large bearings and low loads. The resonance frequencies are generally well-below 20 kHz and can be picked up by both accelerometers and acoustic camera's.

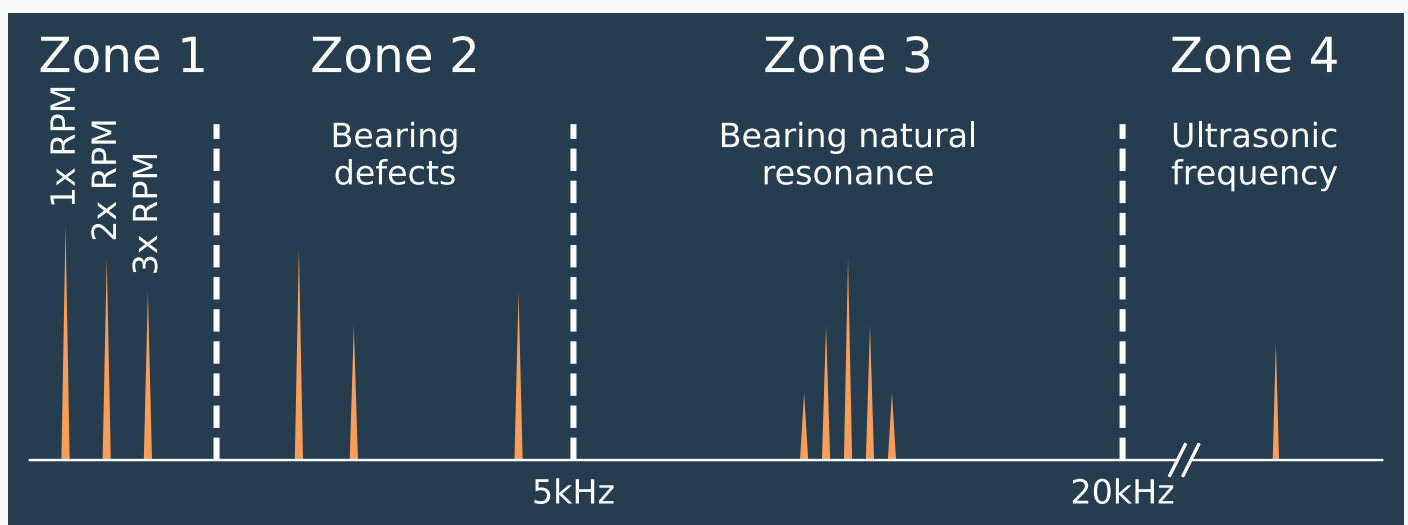


²Power-MI. "Deterioration stages."

Stage 3: As the damage progresses, surfaces become rougher, and the energy shifts to lower frequencies, at which vibration sensors usually have better signal-to-noise ratios over acoustic camera's (Zone 2). However, Sorama has developed advanced signal processing algorithms to improve the signal-to-noise ratio for those low frequencies, in which acoustic camera's typically suffer from high-background noise levels present in industrial environments. With this innovation Sorama enables diagnostic insights, which were typically preserved to vibration experts.



Stage 4: The bearing is significantly damaged, signaling imminent failure. The energy in the ultrasonic frequencies decreases, which is also seen in the experiment.



This explains why acoustic monitoring excels at detecting early-stage faults, while vibration is more stable in later stages.

Early detection of faults enables:

- Cheaper repairs preventing late-stage component replacement.
- Risk reduction, especially where failures pose safety or environmental impacts.
- Improved root-cause analysis (RCA) through better event timelines.

Additionally, acoustic cameras enable the localization of a fault as illustrated below:



SORAMA'S ACOUSTIC MONITORING AS A PREDICTIVE MAINTENANCE SOLUTION

The comparison between acoustic and vibration monitoring shows that ultrasonic sound reveals mechanical degradation at an earlier stage. In controlled tests, acoustic monitoring detected the onset of bearing failure approximately 17% earlier than vibration-based methods, extending the window for planned intervention. This early insight can be captured through non-contact, wide-frequency inspections enabled by acoustic cameras.

Sorاما CAM iV64s

Good for ad hoc or routine inspections, the Sorاما CAM iV64s is a compact, user-friendly acoustic camera that swiftly detects, localizes, and visualizes both audible and ultrasonic mechanical anomalies up to 120 kHz.



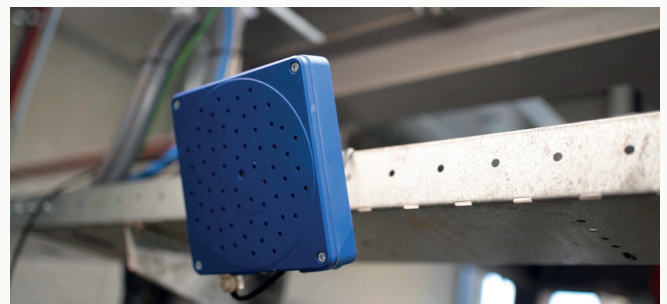
Sorاما CAM iV64Ex

The Sorاما CAM iV64Ex is ATEX and IECEx Zone 2 certified by DEKRA, giving technicians the ability to carry out mechanical inspections safely in high-risk areas. Its explosion-proof housing protects internal components without adding bulk, so teams can work confidently without sacrificing mobility or performance.



Sorاما L642 series³

The Sorاما L642 acoustic monitor is ideal for 24/7 monitoring of critical assets, either via fixed mounting or integrated with a robotic system. The Sorاما L642 delivers continuous, high resolution sound data that is ready to act on.



³ Available in regular and ATEX certified varieties.



ROI OF ACOUSTIC INSPECTIONS FOR ROTATING EQUIPMENT

In industrial environments dominated by rotating equipment, acoustic inspections deliver a strong return on investment by identifying early-stage faults, such as bearing or gear wear, before they escalate into catastrophic failures. Detecting these anomalies weeks earlier than vibration-based methods enables earlier planned interventions during scheduled downtime, avoiding emergency repairs that can cost 3–5 times more⁴.

Acoustic cameras also localize issues quickly across multiple machines without physical contact, reducing inspection time and minimizing safety risks in hazardous areas. When integrated into a layered predictive maintenance strategy, acoustic inspections typically pay for themselves within months through reduced downtime, lower spare parts consumption, and improved asset reliability.



⁴ SINGU. "PPM Maintenance — Choosing the Right Strategy for Planned Preventative Maintenance."



CONCLUSION

Predictive maintenance has become the standard for organizations that rely on rotating equipment. The ability to detect faults at the earliest possible stage directly impacts asset availability, maintenance costs, and operational safety. Traditional vibration monitoring has served as a standard for decades, but recent advancements in acoustic technology offer a clear advantage.

In controlled tests, Sorama's acoustic cameras detect potential failures up to 17% earlier than vibration sensors. Acoustic monitoring excels in identifying the first signs of wear, caused by contamination, which generate ultrasonic signals long before vibration anomalies appear.

Beyond early detection, acoustic cameras provide non-contact, wide-area coverage, reducing installation time and minimizing safety risks in hazardous environments. They enable operators to monitor multiple assets simultaneously, making them highly adaptable for both fixed and handheld inspections.

Acoustic inspections deliver a strong return on investment. By preventing unplanned failures and optimizing maintenance schedules, organizations typically recover their investment within months through reduced downtime, lower spare parts consumption, and extended asset life.

In short, acoustic monitoring is a strategic upgrade for any predictive maintenance program, offering earlier detection, safer inspections, and measurable cost savings.