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# Requirements for crossing asset management technologies

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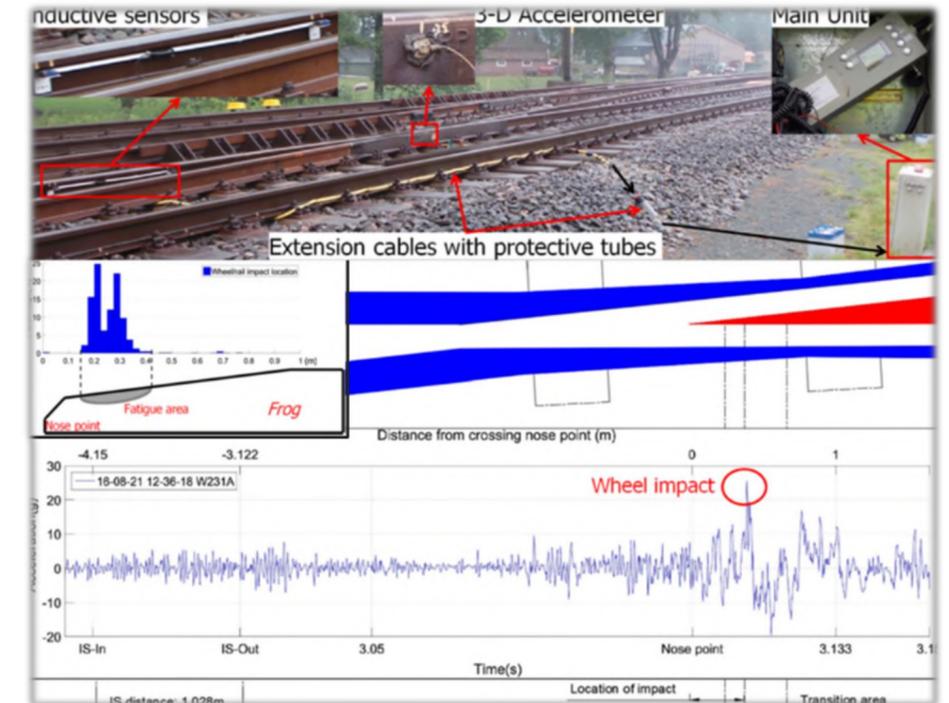
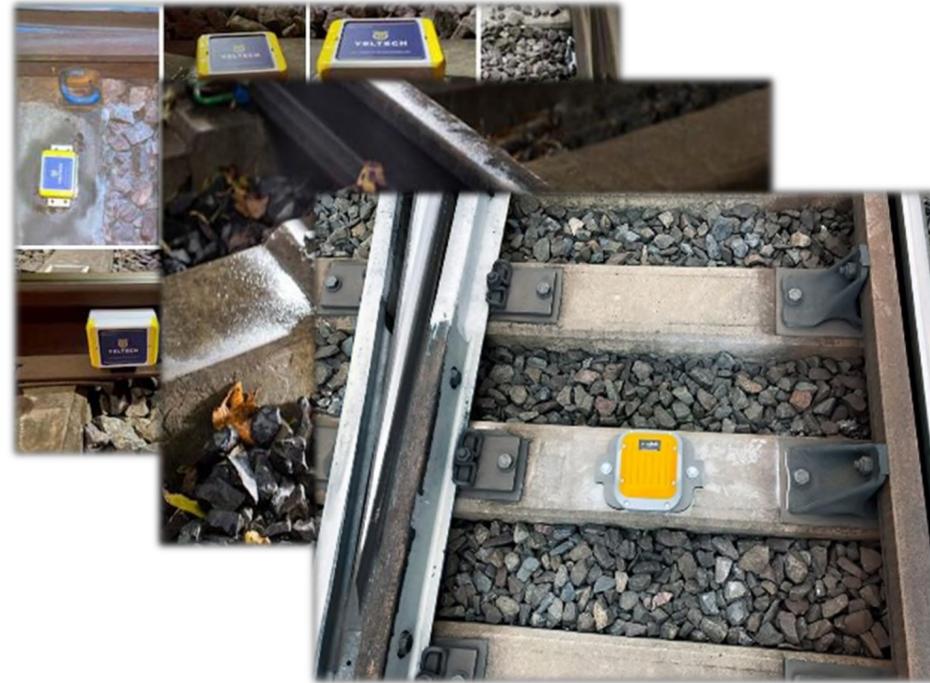
XCROSS Project – Mid-Term Public Workshop

05 February 2026

# Agenda

1. State-of-the-art of the technologies for monitoring, inspection, and repair of crossings
2. Concept of RCF preventative maintenance for crossing rails
3. Requirements of the preventative maintenance for the technologies for crossings
4. Best technologies for the preventative asset management of crossings
5. Questions

# State-of-the-art of Crossing Monitoring Technologies: Limitations & Trade-offs



## On-Board ABA Systems

- ❖ Limited to the lightweight vehicles that carry the sensors.
- ❖ Impact position is not measured
- ❖ Primarily suited for available damage detection and not for RCF prediction.

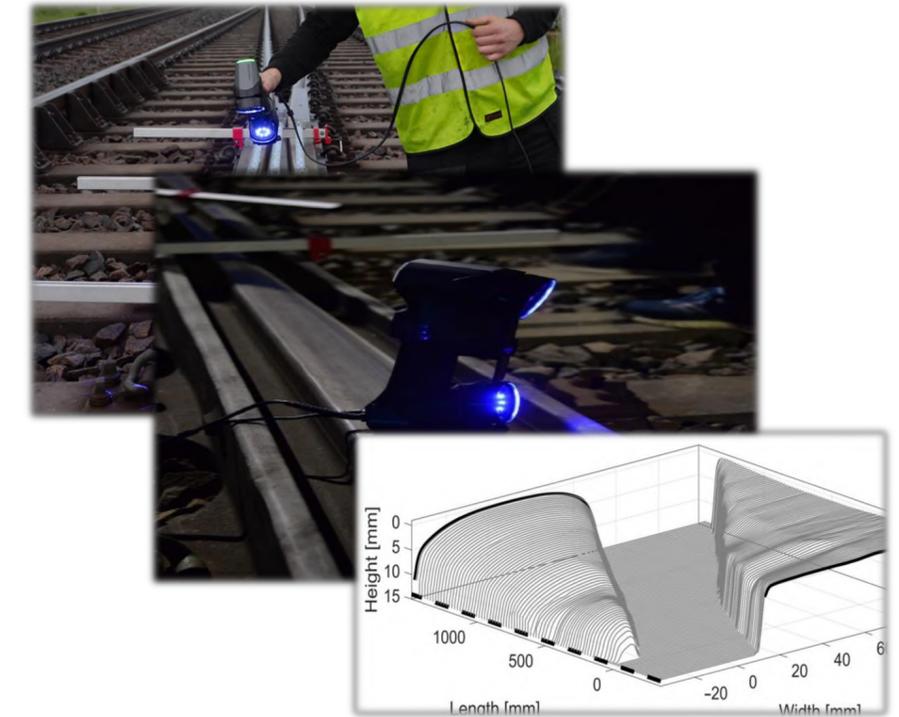
## Sleeper Vibration Monitoring

- ❖ Lower precision for specific wheel-rail impacts P1
- ❖ Impact position is not measured
- ❖ Primarily suited for available damage detection and not for RCF prediction.

## Rail Vibration and Impact Position Monitoring

- ❖ High installation and maintenance costs for permanent sensors
- ❖ Systematic errors in P1-measurement for single-sensor systems

# State-of-the-Art of Technologies for Inspection: Limitations & Trade-offs



## Manual Measurement Tools

- ❖ Utilizing gauges, profile templates, and hand tools
- ❖ Labor-intensive and low precision
- ❖ One-point (section) measurements without 3D-surface record

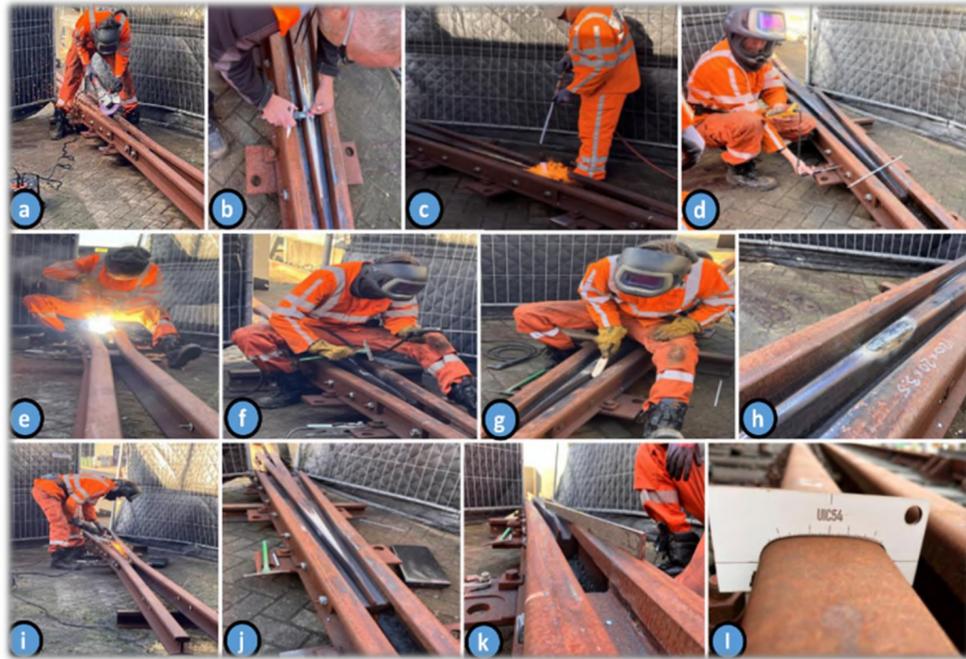
## On-Board Laser Scanning Systems

- ❖ Rail vehicles, measurement cars
- ❖ High costs of measurement devices
- ❖ Not frequent inspection timing
- ❖ Track possessions necessary

## Handheld 3D Scanning

- ❖ High accuracy, quick setup, and ease of use
- ❖ Acceptable costs of devices and good availability
- ❖ One operator is necessary, also possible without track possessions

# State-of-the-art of Technologies for Maintenance : Limitations & Trade-offs



## Manual Welding and Grinding

- ❖ Standard technology
- ❖ Quality varies with operator experience
- ❖ Simple tools like rulers provide limited control

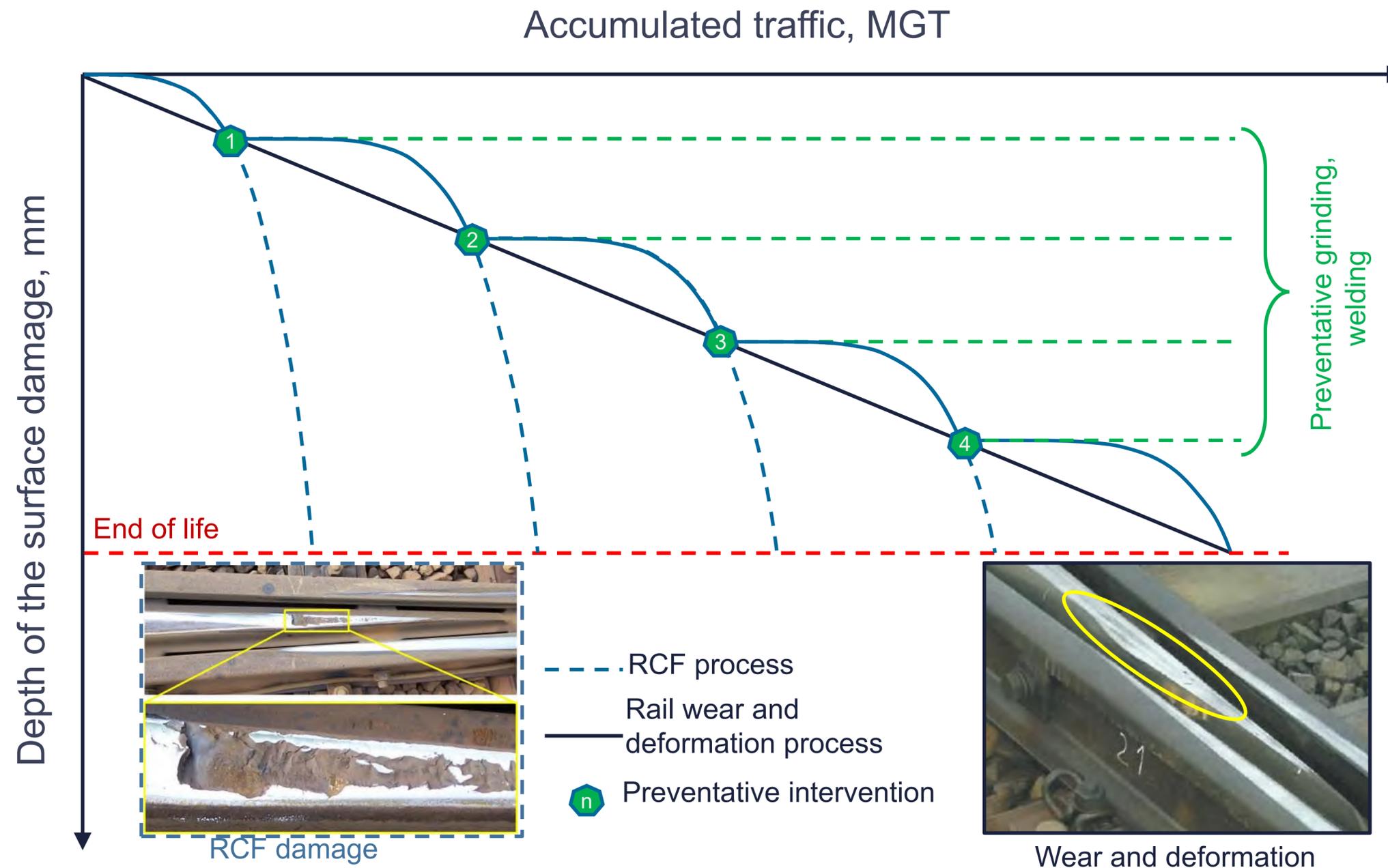
## Robotic Systems

- ❖ Consistent quality
- ❖ High investment
- ❖ Low availability
- ❖ Track possession
- ❖ Inappropriate for small preventative grinding

## AR-Guided Repair

- ❖ High accuracy, quick setup, and ease of use
- ❖ Lightweight and fast deployment
- ❖ Integrates with existing procedures
- ❖ Minimal track possession

# Concept of RCF preventative maintenance for crossing rails



(photo left after (Wei Z. , 2018), photo right after (Nicklisch & Sauer 2016))

# Requirements of the preventative maintenance for technologies applied for crossing rails

## Preventative maintenance requirements for crossing monitoring technologies

- ❖ Prediction of RCF damages before they appear
- ❖ Multi-sensor system with advanced sensors for exact P1-measurement
- ❖ Reliable impact position measurements
- ❖ Comprehensive AI-based algorithms for early detection zones with impact concentration and RCF prediction

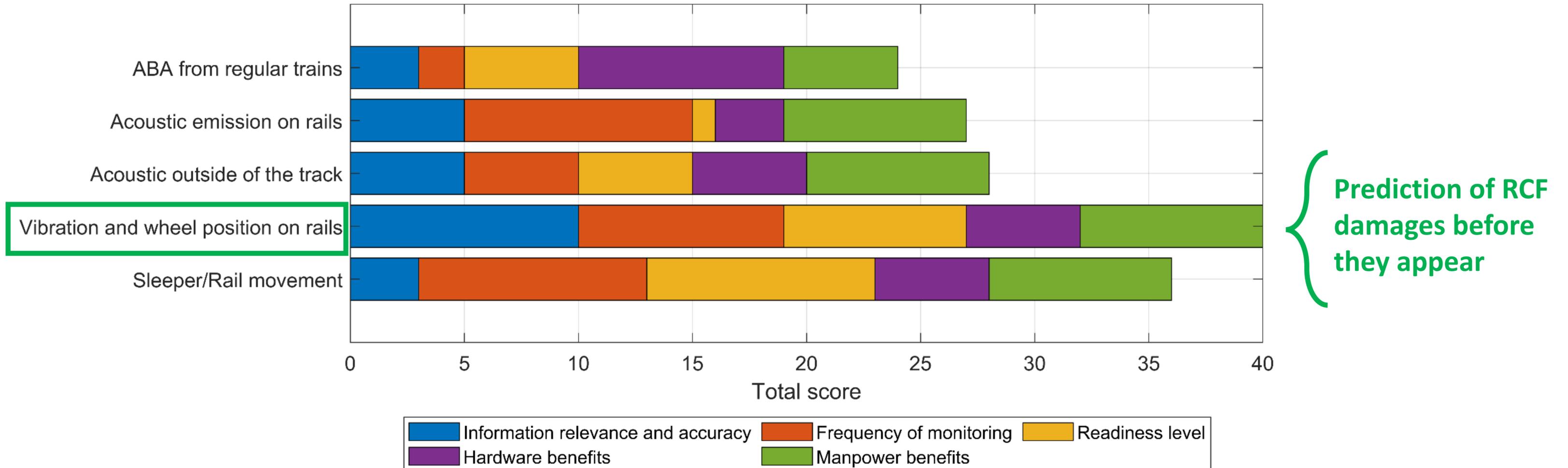
## Preventative maintenance requirements for crossing inspection technologies

- ❖ Availability for on-demand operative measurement
- ❖ Frequent and low-cost inspections
- ❖ Integration of the technology with the maintenance operations

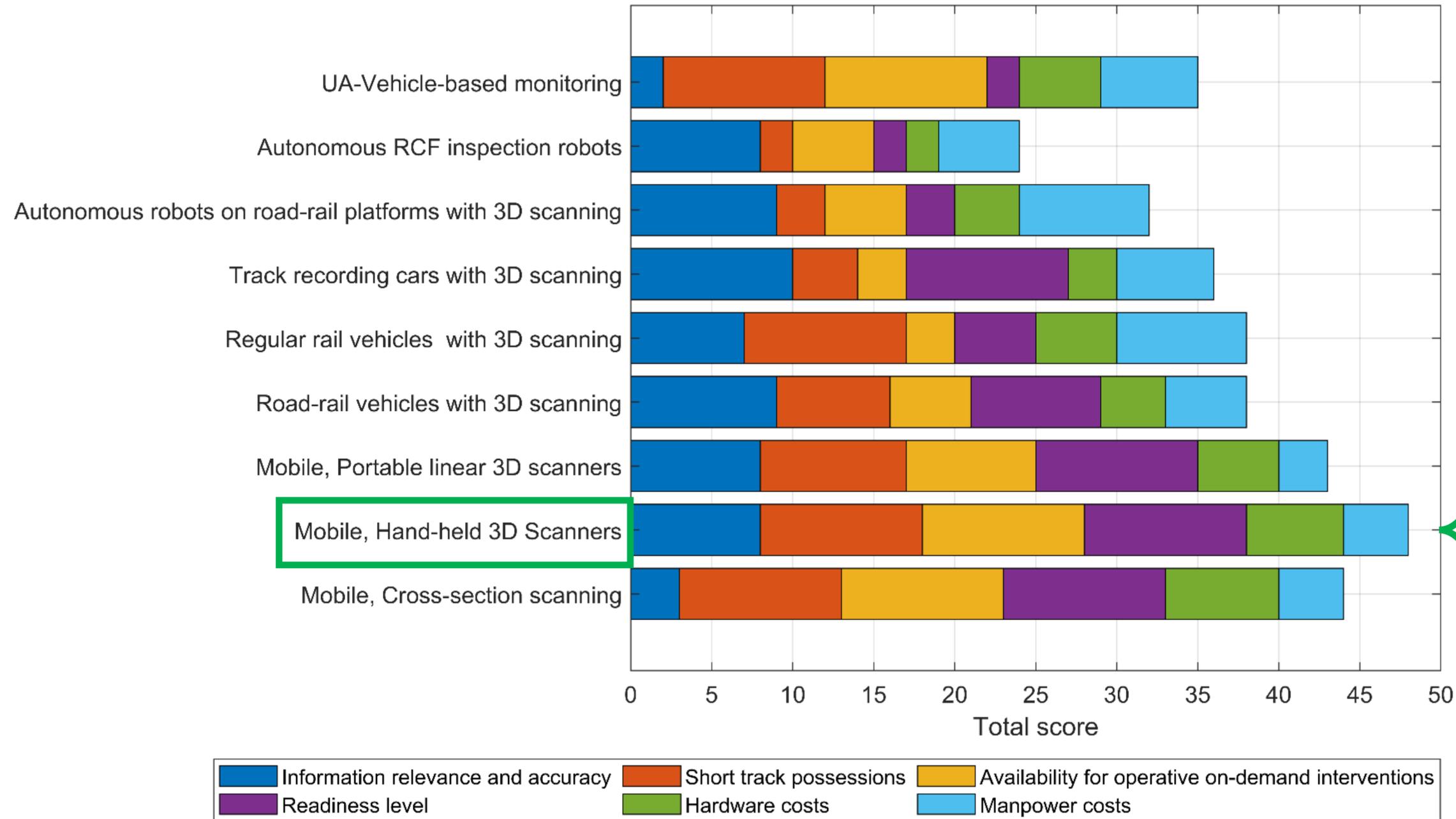
## Preventative maintenance requirements for crossing repair technologies

- ❖ High availability for on-demand operative interventions
- ❖ Integration of the technology with the maintenance operations
- ❖ Short track possessions

# Best monitoring technology for preventative asset management of crossings

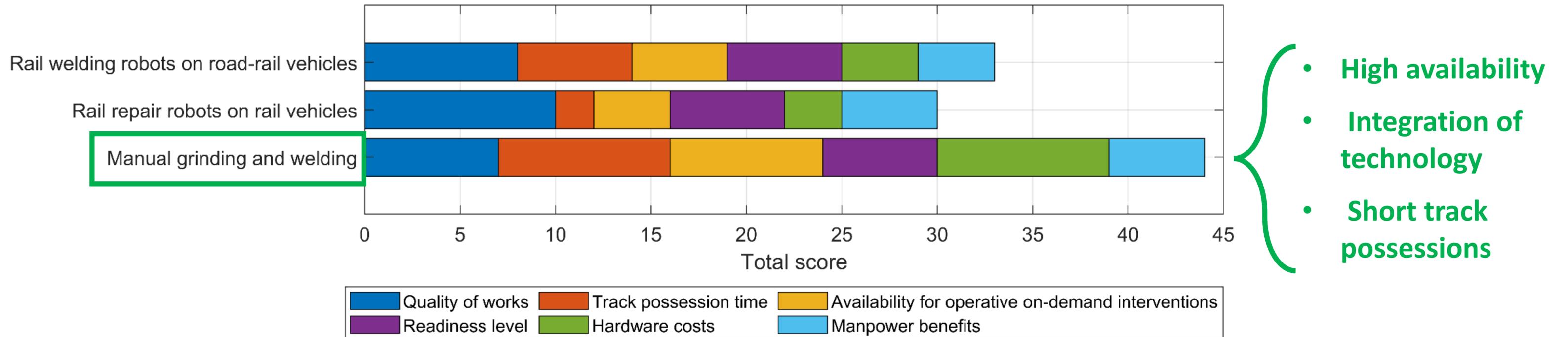


# Best inspection technology for preventative asset management of crossings



- Availability for on-demand operative measurement
- Frequent and low-cost inspections
- No track possessions

# Best repair technology for preventative asset management of crossings



**Questions?**



**Thank you**  
**for your attention**

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