Integrating Computer Vision with Operations for Highway Quality Excellence

AI On-Edge Road Quality Monitoring

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The Network

- 3.000 km
  - 23%
  - 77%
- 47% Italian Tollway Network
- 15/20 Italian regions crossed

Technologies

- 1.922 Highway Message Boards
- 5.000 Traffic Monitoring Cameras
- 1.800 km covered by Tutor System

Organization

- 9 Regional Headquarters
- 2 Central Headquarters
- 10 Traffic Control Centers

Resources

- 700 internal operational personnel
- 1.500 external operational personnel
- 1.000 operative veichles

Traffic

- > 50 Billion km travelled in 2024
- 2,5 Million daily transits

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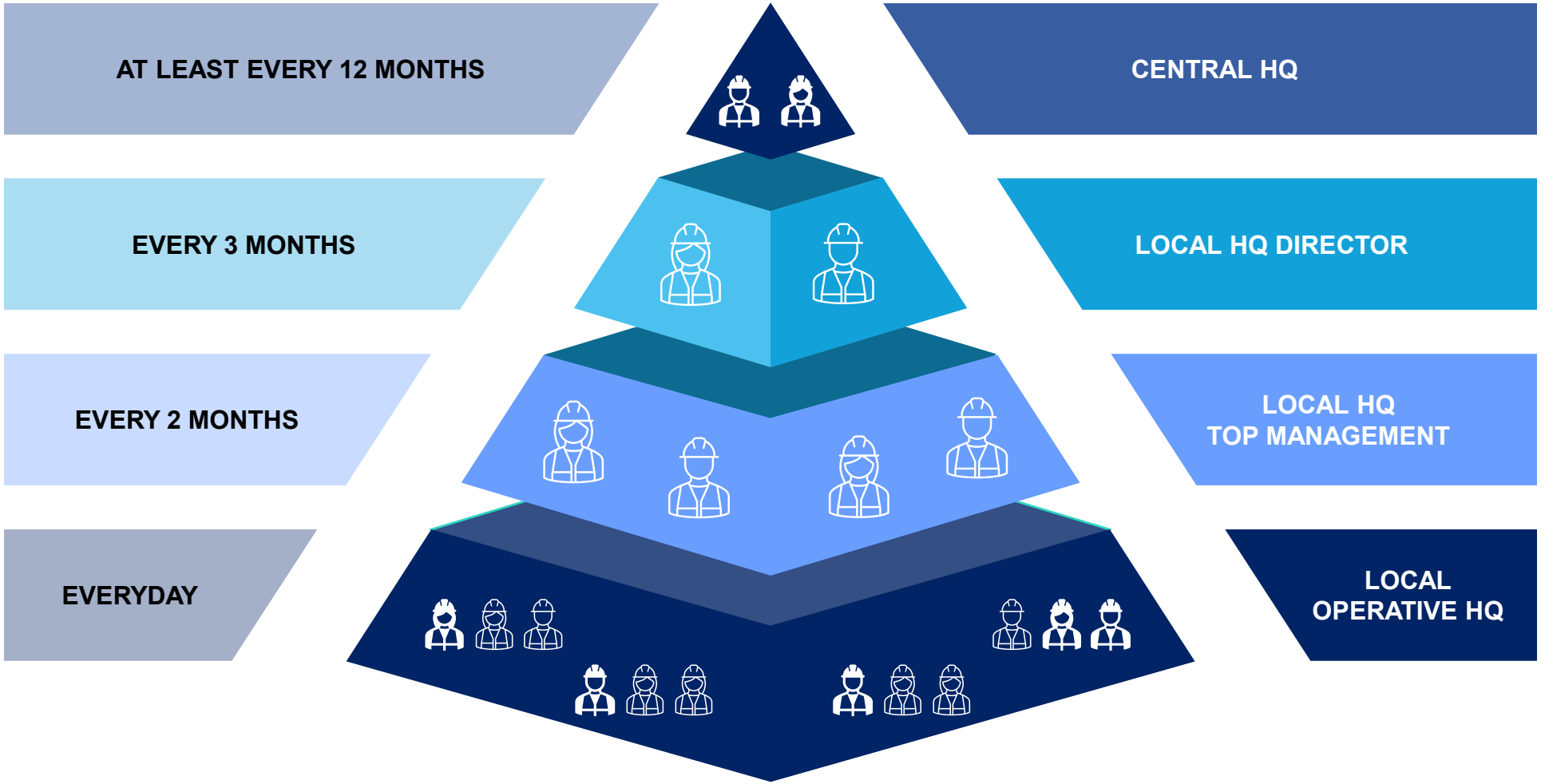
1. Highway Quality Excellence (i)

Process key figures & frequency



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1. Highway Quality Excellence (ii)

Process key activities & Digitalization

Top-Down & **Bottom-Up** Quality commitment supported by IT systems for non-conformities detection, Lifecycle management, and advanced Technology Process improvement (e.g. LLM & AI/Computer vision)

01 - Detection

+300 Non conformity-types

Detection @ field (Mobile App)
(AI/LLM detection from Speech)

Detection @ Office (Web App)

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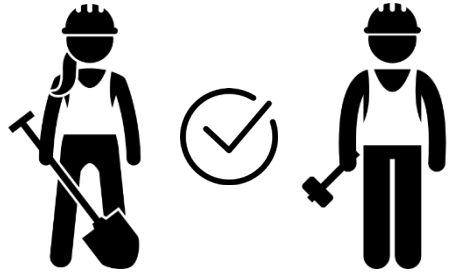
02 – Lifecycle Management

Lifecycle management system on cloud
"HQE App"
fully integrated with other systems
(+8 App Integration)

03 – Resolution

Resolution record on central system

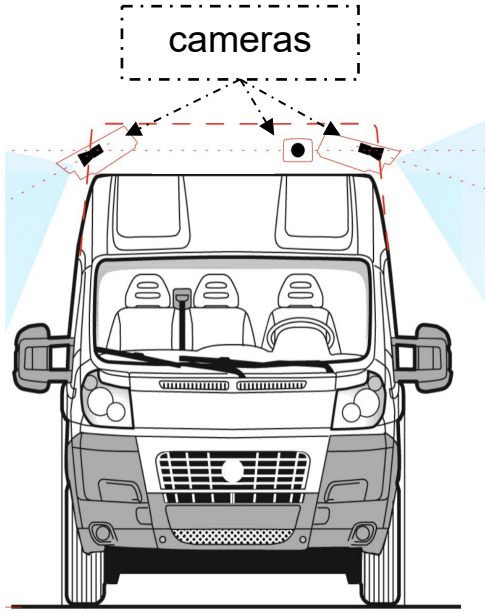


2. Advanced Detection using AI/Computer Vision (i)

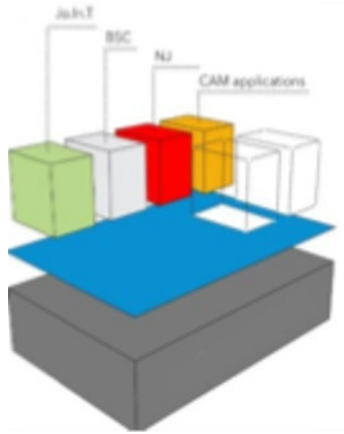
TCC – «Traveling Control Center» projects: Key components

Optimize the **detection** Activities**?** → Automatic detection with equipped **Smart Van** during **patrolling ordinary activities.**

- **On-board dedicated HW (Appliance)**
- **On-Edge** non-conformities **evaluation** with AI models on dedicated applicance (camera pictures)
- **Sends** directly non-conformities to **HQE-App**



AI model for each specific use case



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2. Advanced Detection using AI/Computer Vision (ii)

TCC – «Traveling Control Center» projects: Use Cases (in production)

AI models for specific use cases **detection** → today **3 models** in production.

(i) **Joint Quality** Detection from a **Customer** Point of View

(ii) **PPE-** Personal Protective Equipment correctly **used** in roadwork zones

(iii) **Roadwork configuration** and signals **check**

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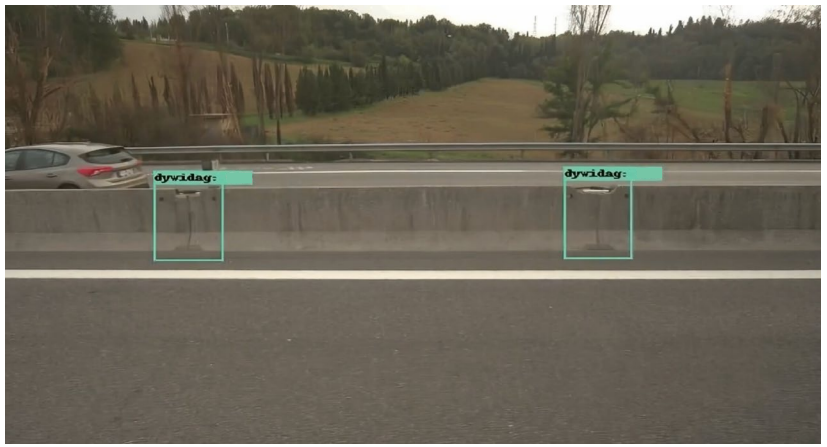
2. Advanced Detection using AI/Computer Vision (iii)

TCC – «Traveling Control Center» projects: Use Cases (validation/development)

AI models for specific use case **detection.**
Today there are **8 models** under validation/development, such as:

(iv) **New-Jersey** detection



Pavements: (v) **Potholes,** (vi) **Bumps & Sags** detection

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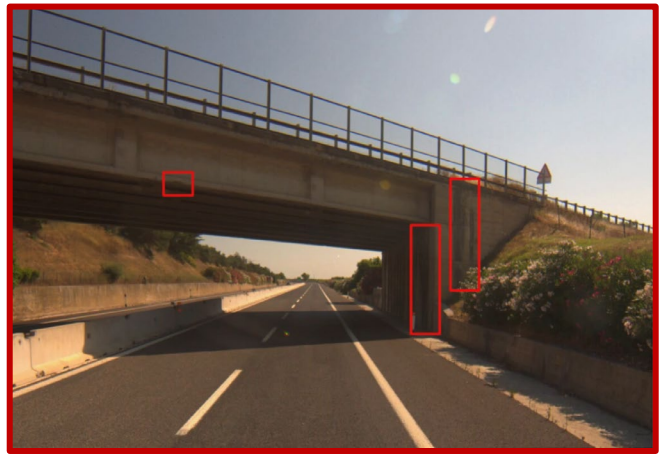
2. Advanced Detection using AI/Computer Vision (iv)

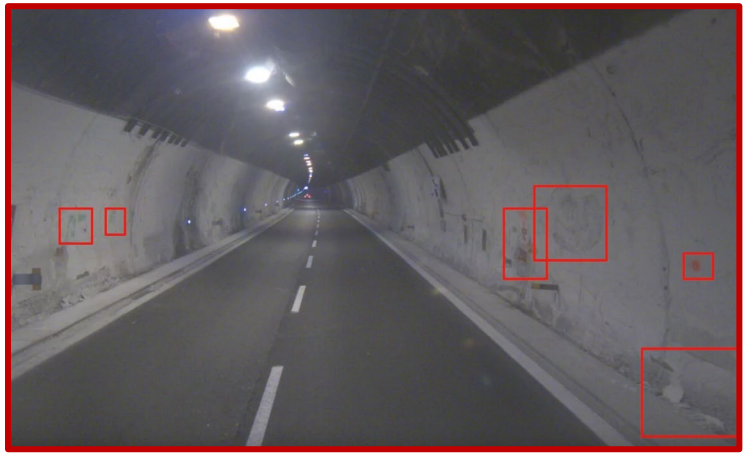
TCC – «Traveling Control Center» projects: Use Cases (validation/development)

AI models for specific use case **detection.**
Today, there are **8 models** under validation/development, such as:

(vii) **Vegetation** detection from a **Customer** Point of View

(viii) **Overpasses** & (ix) **Tunnel painting** detection from a **Customer** Point of View





Other **models** under validation/development for use cases such as:

(x) **Pavement cleanliness** & (xi) **lights counter** in **tunnels**.

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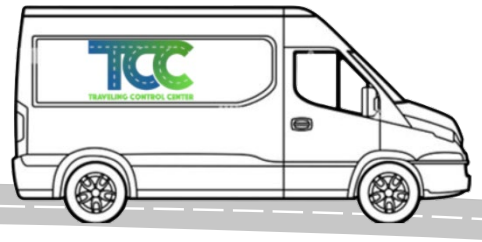
3. KPI and Next Steps

Use-cases under validation/development: **New-Jersey**, **Potholes**, **Bumps & Sags**, **Vegetation**, **Overpasses** & **Tunnel painting**, **pavement cleanliness**, and **lights counter** in tunnels.



KPI (validated)	Joint	Roadwork configuration	PPE use
Precision	80%	88%	98%

	Today	by 2026
#regional regional HQ on **HQE - App**	**2** out of **9**	**9** out of **9**
#AI models in production on ***TCC*** **Smart Van**	**3** out of **11**	**11** out of **11**
# equipped *TCC* Smart Van	**9 (1 for each Local HQ)**	

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4. Innovation & Improvements (i)

Digitalized Process & Automatic Detection: Time & Resource Optimization

<u>Time & Resource Optimization</u>:

Automated Detection: Real-time detection at 80 km/h during patrolling activities, seamless operations, no stops needed.

Smart Reporting: Automatic non-conformities logging and historical data for possible predictive improvements.

User-Friendly Interface: Touchscreen App easy to use by any operator

Efficient Issue Management:

- Instant detection and routing of non-conformities to central system
- Status tracking with planned vs. actual resolution times
- Remote verification by any operator

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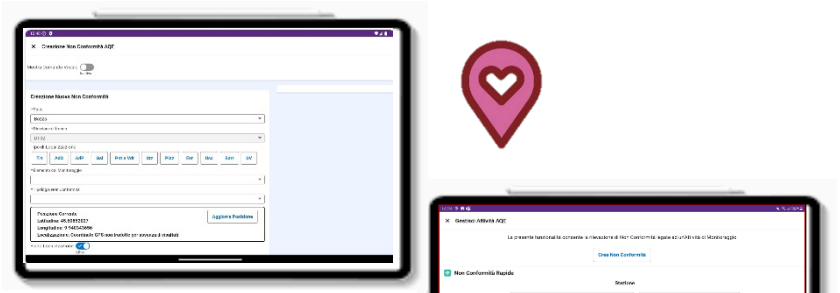
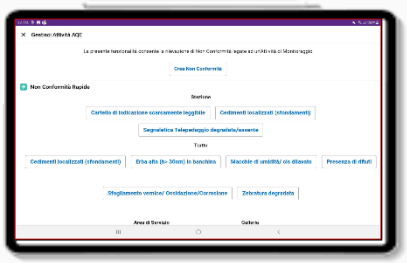
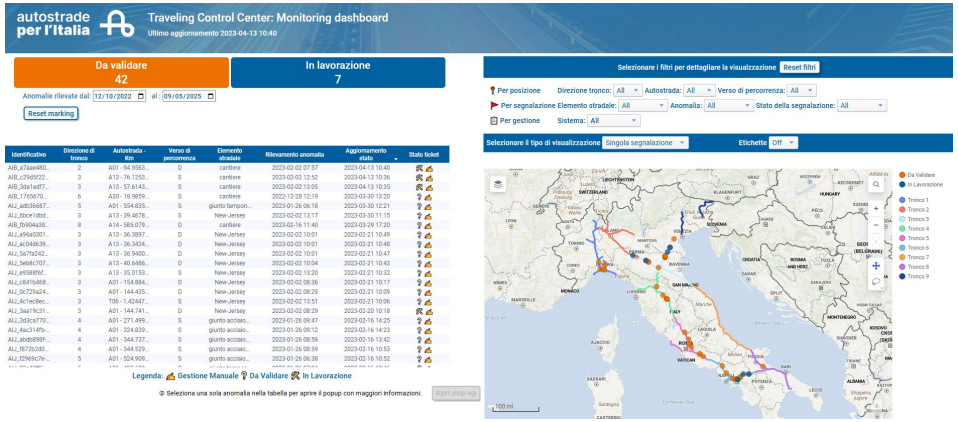
4. Innovation & Improvements (ii)

Digitalized Process & Automatic Detection: Time & Resource Optimization, Accuracy & Efficiency, Objectivity







Time & Resource Optimization:

Optimized Workflow:

- Faster resolution by reallocating saved detection time
- Reduced back-office workload via automation

Data Usage:

- Video archive for future use cases and testing
- Historical data to support continuous improvement

Accuracy & Efficiency:

- Missing issue reduction
- Localization with automatic geo-referenced non-conformities
- **Paperless** process

Objectivity:

- Model-based detection
- Non-conformity catalogue

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Gracias por su atención.

Thank you for your attention.