



Unlocking Hidden Preventive Data: BLE and Artificial Intelligence for Occupational Safety Monitoring

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Euroshnet Conference 2026 · Helsinki, Finland · May 27-28

AESIA Certified · Humanistic AI · Pre-Commercial Research

Introduction & Research Context

Occupational safety monitoring has traditionally relied on periodic manual inspections—capturing isolated snapshots that miss the continuous reality of field operations.

During active work, critical data about PPE usage, CPE positioning, and worker-equipment spatial interaction remains invisible to management and regulators.

S Digital One is an internationally patented BLE-based monitoring system that generates continuous, structured, AI-ready datasets from real field operations—making this previously hidden data visible, measurable, and actionable for the first time.

This research presents the system architecture, data quality framework, humanistic AI approach, and field validation results from a pre-commercial deployment.



Field operations under live power lines — PPE visible

Unlocking Hidden Preventive Data

Before BLE monitoring, there was no real-time record of PPE usage, CPE status, or worker spatial behaviour during field work. S Digital One makes this invisible data visible and AI-ready.

Humanistic AI Framework —AESIA Certified

- ✓ **No biometric data collected**
AI operates exclusively on BLE equipment tags — not on the person
- ✓ **Human decision support only**
Alerts and recommendations — no automated enforcement of decisions
- ✓ **Constitutional proportionality**
Suitability, necessity, and proportionality test verified (Spanish Constitutional Court)
- ✓ **Privacy by design**
GDPR compliant — legal basis in employment relationship and duty of protection
- ✓ **AESIA certified**
"Private solution of preventive AI with humanistic approach" — RD 729/2023, Art. 10(d)(g)
- ✓ **International patent protection**
Validated in 47 countries across 5 continents — EPO + PCT procedure

AESIA: Agencia Española de Supervisión de Inteligencia Artificial (Spanish AI Supervisory Agency) — EU AI Act compliance framework

Data Generation Pipeline

- 1 BLE Tag Emission**
Each tag emits unique ID every second. IP68 rated, 7gr. Battery (12 months). No fixed infrastructure.
- 2 Passive Smartphone Detection**
App runs in background—zero worker intervention. Registers GPS + tag ID + precise timestamp.
- 3 Secure Data Transmission**
Encrypted synchronous or asynchronous upload. Local persistence when offline — zero data loss.
- 4 AI & Machine Learning**
Pattern recognition. Risk prediction. Anomaly detection. Structured insights for human decision support.
- 5 Preventive Intelligence**
Geospatial risk maps. Behavioural profiling. Contractor evaluation. Evidence-based recommendations.

No cameras · No biometric sensors · No fixed antennas
Works indoors and outdoors · Zero data loss when offline

Field Validation & Results

Field-validated in real operational conditions across multiple work sites, with technical approval from the contracting organization.

- 20 Work orders
- 136 h Field operations
- 100% Data integrity
- Positive Worker feedback
- Zero Workflow interference
- 100% Validation OK



Construction site — workers with PPE across large-scale infrastructure project

Structured Dataset Quality —AESIA Certified

- ✓ **Quality** (99.7%)
Precision, consistency, reliability of records
- ✓ **Structure & Format** (AI-ready)
Normalised, labelled, ML-ready
- ✓ **Relevance** (100%)
Exclusively preventive variables
- ✓ **Volume**
Large-scale continuous processing
Scales with contracting chain depth, workforce size, and equipment count
- ✓ **Granularity**
Per-company, worker, PPE, CPE, event
Down to work order, individual PPE, CPE, and contracting chain level
- ✓ **Temporality** (±1 Sec)
Sync/async with exact timestamp
- ✓ **Representativeness** (Verified)
Faithful field activity reflection
- ✓ **Integrity** (100%)
Local persistence, zero offline loss
- ✓ **Traceability** (Full)
End-to-end movement reconstruction
- ✓ **Legality** (Compliant)
Constitutional proportionality, GDPR

International Patent Protection



Patent: Radio Frequency Based Control System for Preventing Occupational Hazards
European Patent Office (EPO) · Patent Cooperation Treaty (PCT)
Validated in 47 countries across 5 continents

Regulatory & Standards Alignment

- **EU AI Act (Reg. 2024/1689)**
Trustworthy AI with human oversight
- **LPRL Art. 14.2 & 15.4 & 17**
Permanent and continued duty of effective protection
- **RD 171/2004**
Coordination in contracting chains
- **GDPR (Reg. 2016/679)**
Proportional data collection, privacy
- **LPRL Art. 15.1**
Integration of technical evolution

Data Categories Generated

- **Work Activity Data**
Shifts, hours, breaks, timestamps
- **Work Development**
Tasks, operations, phases, work orders
- **Preventive Measures**
PPE & CPE continuous monitoring
- **Behavioural Patterns**
Worker conduct in equipment usage
- **Incident Events**
Non-compliance, breaches, violations

Conclusions

BLE continuous monitoring generates structured, AI-ready preventive datasets that were previously invisible during field operations. Combined with a certified humanistic AI approach, this enables evidence-based occupational safety decisions across the entire contracting chain, while preserving worker dignity and constitutional rights.