**REPUBLIC OF TÜRKİYE
MINISTRY OF LABOUR
AND SOCIAL SECURITY**

Digitalising Safety in Construction

Smart Tools, Safer Sites

Webinar on "Safe Work in Construction Industry"

July 29, 2025

About

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Work Experience: 13 years (in the field of OSH)

30 Slides   45 Min

Presentation Outline

1 Introduction

Why Digitalisation Matters in OSH?

2 Smart Tools in Action

What Technologies Are Shaping Site Safety?

3 Practical Insights
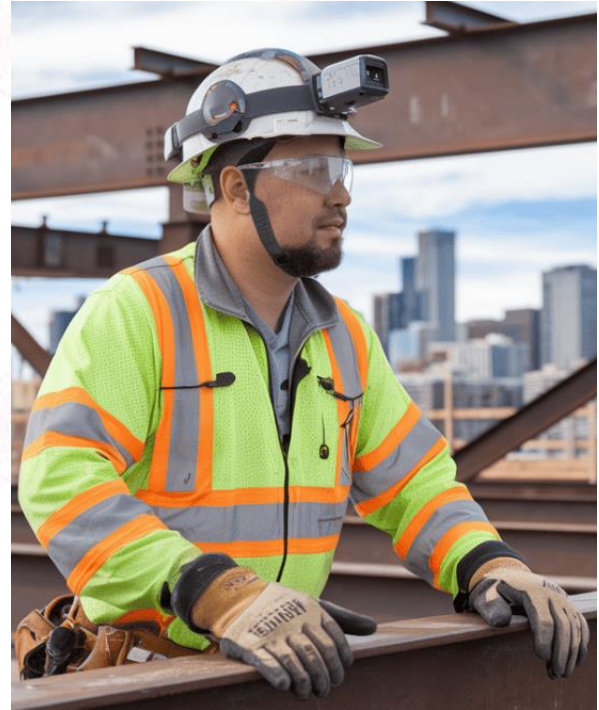
Applying Innovation on Site

4 Overcoming Barriers

What's Holding Digital Safety Back?

5 Conclusion

Embracing the Future of Digital Safety

1. What's at Stake:

Construction Safety in Numbers

International Labour Organization

🎯 The construction industry remains one of the **most dangerous** sectors globally.

🎯 **One in six** fatal accidents at work occurs on a construction site.

🎯 Each year, at least **60,000** fatal accidents occur on construction sites around the World - equivalent to one fatal accident every **10 minutes**.

🎯 The construction sector employs 6–10% of workers but accounts for **25–40% of work-related deaths** in industrialized countries.

🎯 Construction workers are **3–4 times** more likely to die from work-related accidents; in developing countries, the risk is **3–6 times** higher.

🎯 Musculoskeletal disorders are common in construction, affecting up to **30%** of workers.

Percentage of workers reporting backache in the past 12 months – **52%**

Percentage of workers reporting MSDs in the upper limbs in the past 12 months – **54%**

Percentage of workers reporting MSDs in the lower limbs in the past 12 months – **41%**

European Agency for Safety and Health at Work

2. Construction Challenges:

A Dynamic and Demanding Environment

🎯 **Growing complexity** and rising demands: projects are larger, faster

🎯 Dozens of **subcontractors**, rotating crews on-site

🎯 Constantly **changing** work zones

🎯 Tight deadlines and cost **pressure**

🎯 Simultaneous **high-risk** activities: working at heights, excavation, lifting operations

🎯 **Harsh weather** exposure: extreme heat, wind, rain

🎯 Language **barriers** and communication gaps on multinational sites

3. OSH Realities:

Gaps in Traditional Practices

🎯 **Limited real-time monitoring**: lack of capability to continuously track workers' conditions, equipment status, or environmental hazards

🎯 **Reliance on paper-based systems**: inefficient, error-prone, and slow to update

🎯 **Difficulty in data analysis and reporting**: slow manual data collection and limited ability to spot safety trends and improvement areas

🎯 **Fragmented communication**: delayed or unclear communication due to lack of integrated digital platforms, increasing risk

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4. The Global Push:

Strategic Drivers

Core benefits of Digitalisation (3V)

Visibility: real-time monitoring, transparent risk detection, smarter prioritization

Velocity: instant data flow, rapid decisions, timely alerts

Validation: trusted data, reliable insights, improved compliance

Policy frameworks

ILO Global Strategy on OSH 2024–2030,

EU Strategic Framework on Health and Safety at Work 2021-2027, EU-OSHA Foresight Reports,

UN Sustainable Development Goal 8 – Decent Work and Economic Growth

Campaigns

- Safe and healthy work in the digital age (EU-OSHA, 2023-25)

- Revolutionizing health and safety: The role of AI and digitalization at work (ILO, 2025)

Sectoral Momentum

Sectoral Insight Reports (McKinsey, ILO sectoral reports)

⚠️

The Construction industry is among the least digitized.

McKinsey Global Institute industry digitization index; 2015 or latest available data

Relatively low digitization — Relatively high digitization

● Digital leaders within relatively undigitized sectors

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Smart Solutions:

Technologies Revolutionizing OSH

1 Real-Time Monitoring and Sensing Technologies

2 Data Management and Predictive Analytics

3 Digital Communication and Training Platforms

4 Automation and Robotics

5 Digital Planning and Integration Tools

"Different tools, one purpose: smarter, safer sites."

1. Real-Time Monitoring and Sensing Technologies

Wearables (smart helmets, vests, wristbands): Track vitals (heart rate, body temp), location, and fatigue—alert if in restricted zones or heat risk.

Smart Cameras: AI-enhanced cameras detect PPE compliance, unsafe behavior and intrusion into danger zones.

Monitoring UAVs (Unmanned Aerial Vehicles): Provide aerial inspection of large sites, detect hazards in confined or high-risk areas—without endangering workers.

IoT Sensors: Embedded in scaffolds, machinery, or flooring to detect vibration, load, gas leaks, or unsafe temperature thresholds.

These sensors feed real-time data into AI-powered systems, which can detect anomalies and predict risks before incidents occur.
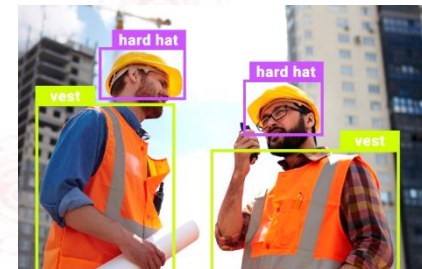
OSH Impact

1 **Early Hazard Detection and Risk Reduction**

Immediate warnings help prevent accidents like falls, collisions, and heat stress.

2 **Enhanced Worker Health Monitoring**

Vital signs tracking detects fatigue and stress before they become critical.

3 **Faster Emergency Response**

Automatic alerts with location data speed up intervention times.

4 **Data-Driven Safety Management**

Collected data enables proactive risk analysis and prevention.

5 **Improved Compliance and Reduced Human Error**

AI systems ensure PPE use and minimize mistakes, boosting overall safety.

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2. Data Management and Predictive Analytics

Centralised Platforms: Collect and unify safety data from multiple sources (wearables, sensors, inspection logs, incident reports).

Cloud-Based Dashboards: Real-time visualization of trends, hazards, compliance status, and site performance.

Predictive Analytics Tools: Use AI/ML algorithms to identify patterns and forecast future incidents or high-risk conditions.

Automated Reporting and Alerts: Instantly generate safety reports and send alerts based on pre-defined risk thresholds.

Digital Twin Technology: Create virtual models of construction sites to simulate safety scenarios and test interventions.
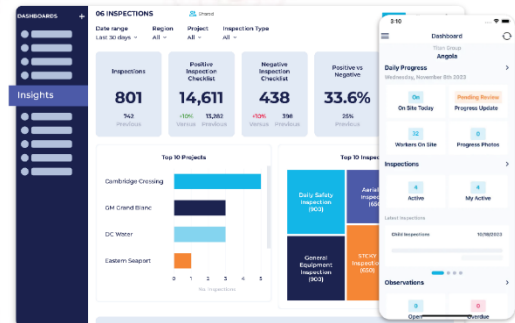
Health and Safety Dashboard with Lost Time Injury Frequency Rate

OSH Impact

1 Proactive Risk Prevention

Predictive analytics tools analyze data to foresee hazards, enabling early prevention.

2 Smarter Decision-Making

Cloud-based dashboards provide real-time site visibility, enabling safety teams to act on data insights.

3 Faster and Accurate Reporting

Automated reporting and alerts reduce delays, eliminate manual errors, and ensure consistent safety documentation.

4 Continuous Improvement

Digital platforms allow trend analysis, helping teams learn from past events and continuously refine safety strategies.

5 Better Accountability and Transparency

Data logs and automated compliance ensure clear audits and shared accountability.

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3. Digital Communication and Training Platforms

Mobile Safety and Incident Reporting Apps: Allow workers to instantly report hazards, near-misses, and safety concerns via smartphones or tablets.

VR/AR-Based Safety Training: Provide immersive, realistic training for hazardous scenarios in a controlled environment.

Microlearning Platforms: Deliver short, targeted training modules accessible anytime, anywhere—ideal for just-in-time learning.

Digital Toolbox Talks and Briefings: Enable real-time safety briefings and updates, with attendance tracking and documentation.

Gamified Multilingual Assessments: Support diverse workforces with language options and interactive learning that boosts engagement.
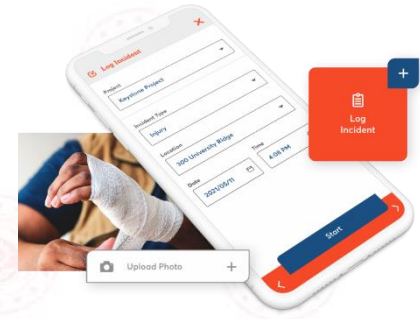
OSH Impact

1 **Proactive Risk Awareness**

VR/AR-based trainings let workers safely experience high-risk scenarios, improving hazard recognition before real exposure.

2 **Smarter Safety Decisions**

Microlearning offers brief, targeted training for smarter safety decisions on the job.

3 **Streamlined Briefings**

Digital toolbox talks ensure consistent, efficient daily briefings—reducing miscommunication and delays.

4 **Continuous Learning**

Gamified assessments and multilingual e-learning improve retention and track training effectiveness.

5 **Inclusive Communication and Accountability**

Multilingual content and mobile apps break language barriers, ensuring all workers understand safety expectations.

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4. Automation and Robotics

AI-Driven Robotics and Autonomous Machinery: AI-powered robots with vision and sensors detect hazards, adapt to environments, and perform tasks like inspections and bricklaying autonomously.

Self-operating machines like dump trucks, bulldozers use sensors, GPS, and geofencing to navigate sites and complete tasks without human control.

Robotic Systems for Hazardous Operations: Robots for hazardous environments remotely perform demolition, welding, and gas detection in confined or toxic areas.

Collaborative Robots (Cobots): Cobots assist humans with repetitive or ergonomically challenging tasks like lifting, drilling, or painting.

Wearable Exoskeletons: Exoskeletons support workers in lifting, bending, or overhead tasks to reduce physical strain.

Task-Oriented Drones: Beyond basic monitoring, these drones perform thermal imaging, mapping, targeted confined space inspections, and light material delivery in hazardous areas.

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OSH Impact

1 **Reduced Risk Exposure**

Robotic systems handle dangerous tasks remotely, minimizing human exposure to hazards.

2 **Strain-Free Operations**

Cobots reduce worker fatigue and injury risk in repetitive or heavy tasks while keeping human control.

3 **Precision Over Fatigue**

AI-driven robots and autonomous machinery perform tasks accurately, reducing errors and accidents caused by human fatigue.

4 **Powered Physical Support**

Wearables and exoskeletons ease physical strain, preventing musculoskeletal injuries during tough tasks.

5 **Safer Access**

Drones perform inspections and deliveries in risky or remote spots, keeping workers out of danger.

5. Digital Planning and Integration Tools

Building Information Modeling (BIM): Creates integrated 3D models that combine design with 4D (schedule) and 5D (cost) data to coordinate construction activities and identify design or scheduling conflicts early.

Virtual Site Layout and Scenario Testing: Digitally simulates site layout, worker movements, equipment positioning, and emergency scenarios—improving space planning and reducing on-site congestion.

Construction Sequencing and Phasing: Visualizes the order and timing of construction tasks, crew deployment, and equipment use, identifying scheduling conflicts to optimize workflow.
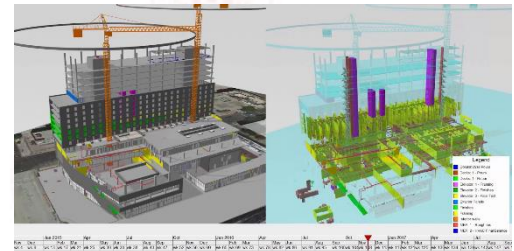
OSH Impact

1 **Early Hazard Detection**

BIM and virtual site layouts identify safety hazards and spatial conflicts early, helping prevent accidents before work begins.

2 **Improved Team Coordination**

Clear visualization of site layouts and task sequences reduces miscommunication and unsafe overlaps, keeping teams aligned.

3 **Reduced Congestion and Exposure**

Precise sequencing simulations optimize workflow timing, reducing hazardous crowding and exposure on site.

4 **Robust Safety Preparedness**

Scenario testing empowers teams to plan and rehearse emergency responses, boosting readiness and resilience.

1. Case Study — Shawmut Design & Construction (USA)

Innovation Used

AI-powered monitoring system integrated with GPS, weather data, and workforce information.

How It Works

The AI platform collects daily data—like worker activity, weather forecast, and supervision levels and flags high-risk conditions in real time, alerting safety teams about possible fall hazards, PPE issues, or unsafe areas.

OSH Impact

Enabled early risk detection, reduced fall and PPE incidents, and improved compliance across more than 150 active worksites with approximately 30,000 personnel

Source: Business Insider, "How AI is Making Construction Sites Safer",
https://www.businessinsider.com/ai-for-worker-site-safety-in-construction-2025-4
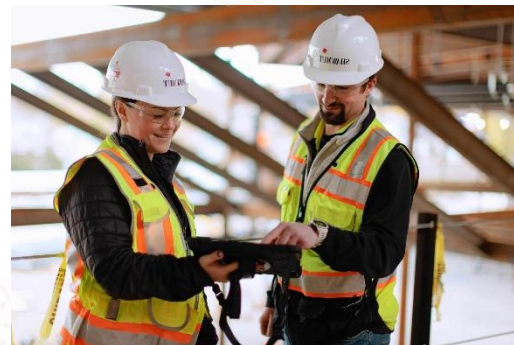
53% reduction
OSHA-recordable incidents

22% increase
Safety engagement

2. Case Study — Vinci Construction (UK)

Innovation Used

EcoSpot adjustable scaffold-mounted mortar board combined with ViSafe wearable sensors for real-time ergonomic monitoring.

How It Works

EcoSpot mortar board reduces bricklayers' bending by enabling ergonomic working height. ViSafe sensors track back-bending, muscle load, and repetitive motions in real time to compare and improve ergonomics.

OSH Impact

Reduced bending, lower-back strain, repetitive motions, and musculoskeletal issues; increased productivity—showing safety and efficiency together.

Source: DorsaVi, "Reducing Back Injuries and Costs While Improving Productivity" ,
https://dorsavi.com/reducing-back-injuries-and-costs-while-improving-productivity/

Degrees of forward bend:
● high
● low
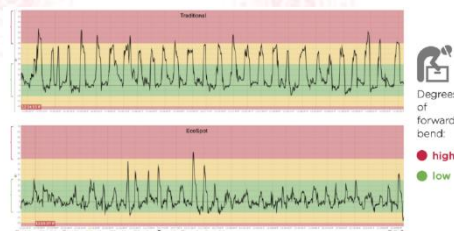
Up to 84% less strain
On low back muscles

Reduced by up to 70%
Repetition of higher risk movements

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3. Case Study — Jacar Montajes, S.L. (SPAIN)

Innovation Used

Wearable wristband sensors designed to track workers' core body temperature in real time and trigger alerts when overheating thresholds are reached.

How It Works

Construction workers wear smart wristbands that monitor core body temperature in real time. When thresholds are exceeded, the wristbands send visual, audio, and vibration alerts, prompting actions like resting, seeking shade, or hydrating.

OSH Impact

The system enabled timely alerts and proactive responses to heat stress, leading to improved worker safety during high-temperature conditions.

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Case of heatstroke

Source: EU-OSHA, "Spain: Digital Tools for Preventing Risk of Heatstroke in Construction Industry",
https://healthy-workplaces.osha.europa.eu/en/publications/spain-digital-tools-preventing-risk-heatstroke-construction-industry

4. Case Study — Obayashi Corporation (JAPAN)

Innovation Used

Obayashi's ODICT® system combines robotics, IoT, AI, and BIM to automate key construction tasks such as concrete placement, excavation, and surface finishing. Equipment like tower cranes and trucks operate autonomously or via remote control.

How It Works

The system uses 3D LiDAR and digital models to guide machines. Operators work remotely through a cyber-physical platform that enables safe, real-time task execution and route optimization.

OSH Impact

Reduced worker exposure to hazardous zones, lowered risk of falls and overexertion, and prevented fatigue-related incidents by automating dangerous tasks and enabling remote operations.

Source: Obayashi Corporation, "ODICT® Robotics for Dam Construction",
https://www.obayashi.co.jp/chronicle/130th/en/story/odict/

10%
Increased productivity

5. Case Study — Astaldi & Türkerler JV (TÜRKİYE)

Innovation Used

A radio frequency (RF)–based, computer-guided tower crane anti-collision system, designed to track 37 tower cranes and optimize crane movement on Integrated Health Campus Construction.

How It Works

The tower crane system uses radio frequency sensors and computer control to monitor crane positions in real time, alert operators of collision risks, and automatically restrict movement to prevent accidents.

OSH Impact

Reduced collision risks and worker exposure to crane hazards, lowered falling load incidents, and improved safety through real-time monitoring and automated controls.

Source: Turkish Ministry of Labour and Social Security, " Safe Construction Website ", https://guvenliinsaat.csgb.gov.tr/
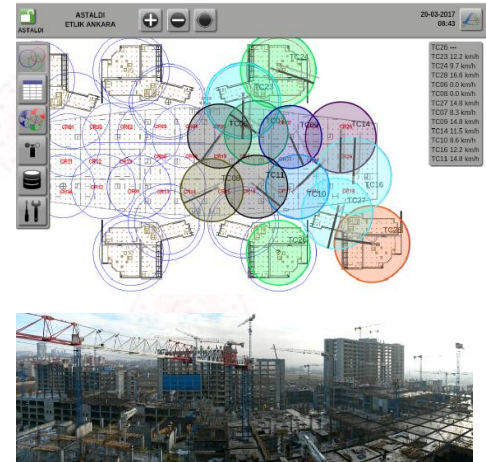
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Crane collision accident

1. Fragmented Standards and Legal Gaps

Fragmented Systems

Different vendors use incompatible data formats, software platforms, and communication protocols, making integration difficult.

No Common Safety Data Standards

Lack of standardized safety metrics and data models hinders sharing and benchmarking across sites or companies.
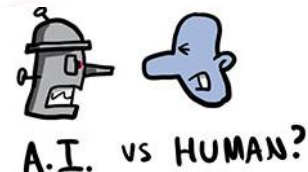
Unclear Legal Landscape

Gaps in national and international regulations—especially regarding AI decision-making, data usage rights, and accountability—create uncertainty.

Impact

This lack of alignment slows digital adoption, increases costs, and reduces trust in automated safety systems.

2. High Costs and Unequal Access

High Upfront Investment

Advanced safety tech (e.g. wearables, AI systems, digital platforms) requires significant initial costs, which many firms—especially SMEs—can't afford.

Unclear Return on Investment (ROI)

Limited evidence on long-term cost savings and safety outcomes leads to hesitation in adopting digital tools.

Unequal Access

Large firms are more likely to adopt new technologies, widening the safety and innovation gap between them and smaller contractors.

Impact

Cost barriers slow down digital transformation in OSH and risk leaving SMEs behind in adopting modern safety measures.

DRONES!

SMART PPE!

COLLABORATIVE ROBOTS!
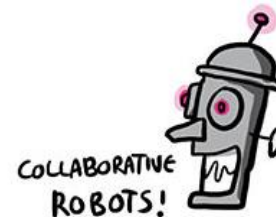
3. Limited Skills, Rising Stress

Lack of Digital Proficiency

Many workers lack the training to use or interpret digital safety systems effectively.

System Malfunctions and Complexity

Tech failures or overly complex systems cause frustration and reduce trust.

Over-Monitoring and Repetitive Tasks

Continuous surveillance, monotonous digital workflows, and alert fatigue increase stress and mental load.

Impact

Psychosocial risks rise — including anxiety, fatigue, and disengagement from safety procedures.

REQUIRES PRACTICE AND PREPARATION!

TECHNOLOGY RELIABILITY!

INFORMATION OVERLOAD FOR OSH MANAGERS!

4. Weak Adoption and Misuse

Resistance to Change

Workers and managers may mistrust automation or fear job replacement, leading to low adoption.

Poor Implementation

Lack of planning and unclear roles results in underuse or ineffective use of tools.

Shift Away from Collective Safety

Overemphasis on individual monitoring (e.g. wearables) can weaken collective protections like safe design or supervision.

Impact

Digital tools lose credibility and fail to improve safety culture when misused or poorly accepted.

5. Privacy and Security Risks

Extensive Data Collection

Widespread use of digital safety tools generates large volumes of sensitive data, raising privacy and surveillance concerns among workers and organisations.

Cybersecurity Threats

Systems are vulnerable to hacking, malware, and unauthorized access, which can compromise data integrity and disrupt safety operations.

System Failures

Technical faults or outages can lead to loss of critical safety monitoring and control functions, increasing workplace risks.

Impact

Privacy concerns and security breaches undermine trust in digital safety technologies and slow down their adoption.

DATA PRIVACY CONCERNS!

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Key Takeaways

⬥ Digital tools offer real-time insights, automation, and data-driven safety — but adoption remains limited.

⬥ The primary barriers to implementation include cost, lack of skilled personnel, regulatory ambiguities, and reluctance to adopt change.

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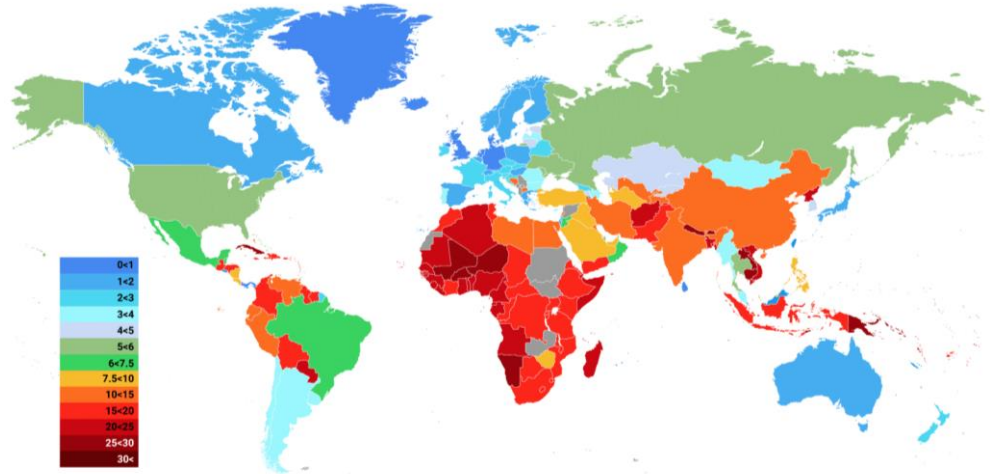
"Smart Safety is not a luxury—it's a necessity."

Global Safety Gap

⬥ Many OIC countries still experience higher fatality rates compared to global averages.

⬥ Falling behind on digital transformation may widen this gap further.

5. Conclusion: Embracing the Future of Digital Safety

Call to Action

⬥ Embrace innovation not as a threat, but as a path to protection.

⬥ Every digital step—no matter how small—can save lives on site.

⬥ Global progress in safety depends on shared learning and mutual commitment.

⬥ Equip workforce not just with tools, but with trust and training.

⬥ Develop clear strategies and roadmaps to turn innovation into lasting safety improvements.

"Technology alone doesn't save lives — action does."

Vision for the Future

⬥ Digital transformation is a real opportunity for OIC countries—when shaped by local needs, workforce realities, and proven site-tested solutions.

⬥ True progress requires more than tools—it needs training, trust, and skilled people behind systems.

⬥ The ultimate goal is not digitalisation itself, but reducing injuries and strengthening the safety culture; the way forward is practical adoption, cooperation, and measurable impact.

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Thank you very much!