### Predict & Prevent OH&S Incidents using Machine Learning, Machine Vision, IoT & Digital Twins



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# AI & ML Based, Safety, & Risk Minimisation

**MONITOR** - Monitor Real-time IoT and Machine Vision based alerts (incl. personal protective equipment, hazards and mobile equipment risk) to ensure safety compliance today. Use Digital Twins for real-time visualisation and scenario modelling.

 PREDICT – Predict OH&S incidents by creating forwardlooking machine learning-based 'Dynamic Employee Risk Profiles' to calculate an employee's chances of being involved in an incident on any upcoming day.

 INTERVENE & PREVENT – Prevent incidents by retraining, proactively removing employees from potentially dangerous situations and send live compliance alerts to employees to immediately eliminate dangerous working conditions. Real Time, Sensor Based IoT Monitoring

Machine Vision Based Monitoring

> Machine Learning Based Dynamic Employee Risk Profiles

### **Dynamic Risk Profiles**

**PREDICT** – Create forward-looking AI/ML-based 'Dynamic Employee Risk Profiles' using role type, role risk, experience, age, recent overtime, recent sick leave, near misses, recent incidents, weather, risk culture, recency of training, and many other features to accurately predict the chances of an employee being involved in an OHS incident. Simplified example below:

Machine Learning Based Dynamic **Employee Risk Profiles** 

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# Machine Vision, Monitoring & Alerts

Real-time analytics

from IoT sensors in

the environment are

used for alerts and

also stored for

advanced analytics.

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#### Real Time, Sensor Based IoT Monitoring

- Noise, Vibration, Movement, Lighting, Hydration
- Hydration, Fatigue, Inattention
- Temperature, Machine Speed, RPM, Torque, Coolant Temperature
- Chemical Detection, Air Quality, C02
- Real-time data on Recent Hours Worked, Overtime/Sick Leave, Role Risk Rating, Years of Experience





#### **Machine Vision Based Monitoring**

- Safety Equipment, PPE (Hard Hats, High Visibility Vests, Eye Protection etc), Hazardous Material Security (Locks, Unauthorised Access, Appropriate Safety Equipment), Dust, Liquid Spills, Trip Hazards, Proximity Detection, Location Awareness, Poor Mobile Equipment Practices.
- Understanding complex video events in real time (e.g. traffic flow, people movements, weather events, accidents, incidents, threats, inspections, defect reduction, tracking, environmental assessments, drone footage assessment and much more.



This is one of our consultants on CCTV being assessed for appropriate PPE, in real time, with alerts and monitoring!

# **Predictive Analytics & Optimisation**



**Predict Events Using Machine Learning & Artificial Intelligence** 

#### **Predict Incidents**

- Predict OHS Incidents by combining incident history • with environmental variables and staff activities.
- Machine-Learning-Based Dynamic Employee Risk Profiles.
- Hazard Identification.

#### **Asset Monitoring and Safety Optimisation**

- Predict catastrophic equipment failure that could lead to injury or fatality.
- Defective equipment identification.
- Determine safe asset use via statistical analysis and ulletoptimise asset safety.



# **Digital Twins**

### Real Time Visualisation & Scenario Modelling using Digital Twins

- Centralise and Collect Data (SSOT).
- Reporting and Dashboards.
- Visualise Over Maps and Building Models (2D, 3D, Model).
- Real-time, 4D model to include real-time data from systems and telemetry (i.e. APIs and IoT).
- Feedback to/from systems and telemetry for decision support around operational safety and risk.
- Complete Autonomous Operations and Risk Minimisation.

### Collect Data and Model Relationships between:

- Personal Protective
   Equipment
- Environmental Factors
- People Data
- Employee Mental Condition
- Employee Physical Condition

- Environmental Telemetry, Sensors
  - Temperature
  - Input Speed
  - Power Input
  - Vibration
- Digital Signage
- Operating Limits

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# **Risk Reduction and Safety**

We can expedite the delivery of your outcomes using IP and accelerators...

#### **Predict, Intervene & Prevent OHS Incidents**

Reduced incident frequency by identifying predictors of OH&S incidents and building a predictive model. The model combined incident history, weather, annual leave, overtime, role types and more to automatically alert employees who had that had a high risk of being involved in an incident that day. Intervention and prevention included reminders, re-training and duty changes.

#### **Monitor and Alert for PPE Compliance**

Improve PPE (Personal Protective Equipment) use and compliance by monitoring real-time CCTV feeds of high risk, PPE environments. Artificial Intelligence and Machine Learning based models were trained to be able to identify hard hats, goggles and vests, but could easily be extended to identify gloves, boots, badges and any other PPE measure. Monitoring over months showed a decline in noncompliance.

#### **Risk Culture, Safety Culture and Psychological** Wellbeing Surveys

Various surveys across various industries to identify areas of risk or concern based on questions around Risk Culture, Safety Culture/Compliance, and Phycological Health. Results allow drilling to problem departments, locations and site to focus training and remediation activates.

#### **Asset Safety**

Predict catastrophic equipment failure that could lead to injury or fatality by understanding causes of failure, likelihood of failure and predict failure events. Identify defective equipment using machine vision and IoT and determine safe asset us via statistical analysis and optimise asset safety.





# **OHS Risk & Drivers**

### Personal and Operation Risk Examples

#### Personal

- Long term health
- Weight and habit management
- Food quality
- Sleep quality
- Sedentary work
- Drug and alcohol
- Relationship stress
- Boredom
- Fatigue
- Early starts and/or late finishes (particularly after dark)
- PPE compliance
- Training

#### Operational

- Road conditions
- Wildlife on roads
- Chemical exposure
- Air quality
- Unplanned detonation and explosives
- Loading facilities
- Heights
- Confined spaces
- Remote work (and access to health services)
- Heavy vehicle operation
- Visibility
- Ground and structure stability

# **Risk Identification**

### Example of immediate causes and contributing risk factors for a manufacturing line worker...

Hazards not corrected

Safety devices not

provided

#### IMMEDIATE CAUSES

#### UNSAFE ACTS

- Protective equipment or guard provided but not used
- Hazardous method of handling (failure to watch for sharp or slippery objects and pinch points; lifting; loose grip, etc.)
- Improper tools or equipment used despite availability of proper tools
- Hazardous movement (running, stepping on or climbing over, throwing, etc.)

#### UNSAFE CONDITIONS

- · Ineffective safety device
- No safety device although one is needed
- Hazardous housekeeping (e.g., material on floor, poor piling, congested aisles)
- · Equipment, tools or machines defective
- Improper dress or apparel for job
- Improper illumination, ventilation, and so on

Ε Fall Being caught in Eruption or Slip or between explosion mechanical or Slide Burn other objects Collision Annoyance Production delays Reduced auality Spoilage RESULT Property damage Minor injury Disabling injury Fatality ۰S PHYSICAL SAFETY MENTAL CONDITION CONDITION MANAGEMENT OF WORKER OF WORKER PERFORMANCE Instruction inodequate Lack of safety awareness Extreme fatigue Rules not enforced Lack of coordination Deafness Safety not planned as Improper attitude Poor eyesight Lack of physical Slow mental reaction part of the job Infrequent employee Inattention qualification for job Hearing condition safety contacts Lack of emotional stability

Nervousness

Temperamentalism

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