Safe Work and
Return to Work Awards

Shane Webcke, Queensland Safety Ambassador

Safe Work and Return to Work Awards example entry
Category one – Best solution to an identified work health and safety issue

1. Describe the work health and safety issue and how it was identified.
When operating machinery in an essential service such as the waste management and resource recovery areas, operators are exposed to a number of uncontrollable variables such as people/plant separation but the most challenging of it all is the safety of site employees as well as pedestrians who are moving in and around landfill and transfer stations.

There is also increased regulation and compliance regulations on recycling stations including the growing need for visual inspection of recycled materials for export quality driven by the EPA - which necessitates the need for inspections of materials to be undertaken on site, thus increasing the risk of people/plant separation challenges.

Unfortunately, there have been a number of near misses, accidents and fatalities (including recent incidences reported of two men becoming trapped under landfill as well as a recent major safety breach after a member of the public was seriously hurt on a landfill site as he was struck by a loader driven by a site supervisor. (Articles can be provided for verification)

Ensuring a safe working environment between people and plant has always been a critical safety issue for any area where mobile machinery is working, and many technologies having been tried in the past. Each of these technologies have limitations.

For example, RADAR reversing systems alarm when any object is detected in the hazardous area meaning items such as curbs, materials, even objects such as beacons in a landfill setting will cause many detections per day which the operator becomes used to and complacency sets in over time.

RFID tag-based exclusion zones come with high administrative overheads to ensure the RFID tags are charged, stored and replaced over time and relies on the worker ensuring that the tag is not lost or forgotten. RFID systems also rely on a safety bubble around the vehicle which cannot be effectively modified to allow efficient exclusion zones for employees outside of these zones, and of course does not include pedestrians who would not be wearing a tag to begin with.

While traditional safety systems and pedestrian detection systems (PDS) have typically focused solely on operators or site employees, there are no systems that reliably have a dual function approach, i.e. both operator and pedestrian/site employee.

Sentinel VISION AI is a human only pedestrian detection system and uses the latest in artificial intelligence and machine learning to reliably identify a person and thus identifies and warns both operators and pedestrians or site employees that they are in the way of danger - allowing each party to rectify their behaviour and move out of harm's way before an incident occurs.

PRM Engineering Services has a long-standing presence in a wide range of heavy industries, including construction, mining, earthmoving, recycling, warehousing and demolition, and has a detailed understanding of the technologies and systems available for pedestrian safety.

Regular attendance at international & local industry trade shows (pre and post covid) have shown no equivalent system exists that recognises humans only, and more advanced technologies are increasingly in demand.

Feedback from current customers, Network contacts, Industry Bodies, Equipment Manufacturers and Safety Managers involved in the use and development of safety systems shows a strong appetite for Sentinel Vision AI as a more effective system type.

Newsletters and briefings from safety industry bodies such as Work Safe consistently show avoidable incidents - where a system with Sentinel Vision AI's capabilities was not available.

A few examples below from various websites:
Thirty deaths involved moving vehicles and heavy machinery, which were the most dangerous hazards in workplaces.
"It is unacceptable for so many deaths to involve trucks, machinery and mobile plant when the risks and how to control them are well known for these hazards," Worksafe Victoria March 2021.

Worksafe WA has serious concerns with safety in the waste recycling industry after several recent serious incidents. This second program expanded the scope of the inspections to other parts of the waste collection and recycling industry, such as plastics, e-waste, green waste, liquid waste and other materials.
"Once again, serious issues emerged – the most common ones being the safe movement of mobile plant and vehicles," Worksafe WA March 2020.

Any organisation strives for zero harm safety measures and are penalised on a number of levels should injuries and fatalities occur.

This includes the stress of employee injuries and or fatalities, legal and insurance consequences, Director's liabilities, credibility and safety ratings overall.

Queensland Government and Worksafe Queensland have been very proactive in acknowledging people in the vicinity of heavy and mobile machinery as a high risk across all applications and have shown extreme initiative and support for any development or product emerging that would minimise this risk and support a safe and zero harm work environment.

In identifying the issues and hazards and assessing all risks, PRM Engineering Services has conducted over 24 months of trials, demonstrations and consultation with major waste and recycling companies including all the top OEMS and Service providers in the Waste and Recycling arenas.

The development of Sentinel VISION AI (over three years) has been borne out of feedback and requests from a broad customer base including several tier 1 customers in recycling industries, construction, mining and rail.

Criteria 2: Explain the solution that was developed to address this issue.
Developed over three years, and utilising the latest technology in Artificial Intelligence, Sentinel VISION AI uses an AI Neural Network trained to detect only humans to determine if a person has entered the hazardous areas.

While all worksites implement administrative controls and safe work policies that enforce people plant separation, integration of an engineered control provides machine operators an immediate alert to cut through other distractions in a busy environment where people make mistakes or lose focus. By providing an engineered control for people/plant separation the PDS improves the safety of both operators and pedestrians in dynamic everchanging work environments.

This intrusion triggers in cabin and external alarms to alert both the operator of the machine and the pedestrian entering the hazardous area. This allows both parties to take action to enforce people/plant separation. The operator also commences with a preprogramed prestart checklist which is vital for safety on and off site.

Because the PDS only detects pedestrians and does not detect other obstacles within the specified zone this ensures that the operator only receives meaningful alarms. Because the PDS does not alarm when objects such as bins, posts, long grass that can occur with other

technologies the operator becomes more aware of the PDS warnings and does not tune out due to repeated alarms.

While safety system developments have typically focused solely on operators or site employees, Sentinel VISION AI has a dual operator and public monitoring approach, which works, not only to support workplace health and safety, but also behavioural change.

While operators do not want to hit inanimate objects, the focus needs to be on human safety. PRM's human –only detection system incorporates multiple cameras which are mounted to mobile machinery such as wheel loaders, excavators and even refuse trucks. The cameras are pointed at the zone operators want to detect and then these images are processed by an AI neural network that is trained using machine learning and information input algorithms. The network pulls the image out and if there is anything that looks like a person or a part of a person, an alarm will sound.

From R&D through to implementation requires a very strict process of following the hierarchy of engineering and administrative controls including hazard and risk elimination of the highest order as we are dealing with safety systems and human lives.

In consultation and on field - real time trials engineering controls were modified and customised with customer input and as per challenges of individual sites and applications. Sometimes zones had to be reconfigured and camera distances lengthened or shortened. Lighting was an issue at some sites and as machines are working in dusty conditions which could affect camera lenses, headlights on machines had to be installed and were made mandatory to use in darker conditions. Cameras and production materials were stress tested for robustness and quality controlled for all types of environments.

Administration controls included designing and installing a pre safety check list into the system, so the operator is required to sign off and be aware of surroundings before machine is started.

Instruction and operator manuals were drawn up and provided to onsite safety managers and operators. Safety Managers and Operators were involved in every step of the trial and encouraged to return feedback so systems could continue to be customised for best practice outcome.

An important point of difference was the ability for PRM Eng 's Engineering Staff to engage with their own team of Auto Electrical and Mechanical Fitting Technicians, Hydraulics and Electrical staff in order to bring a total customer solution in the way the system will interface with the machinery it is installed on, ensuring that real time challenges are addressed in the field of application and the different types of excavators, loaders, trucks and other types of mobile machinery and conditions Sentinel VISION AI has to adapt to.

PRM Eng staff have also been allocated field tablets with in -built safety and check lists documentation when installing camera systems which provides a level of administrative and quality control - pre and after installation of any system.

Some of the challenges have been around COVID border closures and PRM ENG has managed to assist with teleconferences, training videos and remote assistance. PRM Eng are continuing to seek interstate installers and have already identified two installers in different states with the ultimate aim to have national coverage.

Upscaling after 3 years of R&D into commercialism has seen a strong uptake of the system nationally and in particular in the recycling industry and the challenge has been to adapt and plan strategically for resourcing and componentry supply as well as installations and ongoing engineering development and support.

Videos and Photos uploaded.

Criteria 3: Outline the success of the solution and how it improved work health and safety.

Sentinel VISION AI has been trialed and tested over a number of months and in different applications. All challenges and learnings were reported, and customers were asked to keep daily logs of sites as well as weather /site conditions as well as issues or observations with the system. Often the customer was trialing Sentinel VISION AI along with competitor systems for best practice outcome, robustness, camera distance detection and other variables.

The following system improvements were also added after consultation with Safety Managers during the trials to fit in with their safety requirements:

- Pre-Start check to ensure that the system is working correctly (especially the cameras).
- Daily statistics for pedestrian detections to determine pedestrian behaviour over time.

Other use cases where this system have been trialed include forklifts in warehouses, applications, bulldozers and loaders in transfer station applications, excavators in construction and maintenance applications as well as standard residential waste trucks.

Over 20 systems have been trialed with various clients in multiple industries. Many of these systems have been in continuous operation installed and operational for over 12 months in harsh on-site operating conditions. The system has been proven to be reliable and resilient across all of these cases.

The operators have reported the systems are working well and providing early warning for pedestrians entering the exclusion zone where the cameras are fitted. They report the system has been detecting pedestrians consistently during this time with minimal false detections reliably throughout various work environments with only small numbers of false alarms where the alarms where triggered when there was no person in the zone.

The only failures have been a small number of cracked camera lens due to impacts with external objects. These issues are common in the refuse industry transfer station applications where impact damage from objects being crushed or pushed around occurs frequently and or are being pushed by the machine. The cameras are easily replaceable, and the current version comes fitted with an impact resistant Perspex lens and screen protector to prevent shattered or scratched lens.

Nighttime performance is very good however it does depending on the flood lighting on the machine. One machine had to be fitted with extra work lights to provide lighting at the rear in low light conditions.

Feedback from the operators using the system reported that dusty environments and rain do not impede on the system's ability to detect people provided the person is still physically visible to the camera.

Sentinel Vision AI is in a process of continual development in line with feedback from clients and keeping up with developing technologies.

Key features continue to be added and include Advanced Datalogging, Remote Access capability, Fleet Management integration, simplified hardware, and system integrability.

Some of the feedback from clients has been:

- "Eliminating the need for each pedestrian to have an RFID tag eliminates the risk of missed detections".
- "Behavioural Change Occurs Quickly and is probably the most valuable outcome - both operators and pedestrians change their behaviors around the machine".
- "The system is intuitive and easy to use".
- "The system alerted the operator of the presence of a pedestrian in cases where the operator had not yet seen the person".
- "The reliability of detection is very high - when you get an alarm it is definitely the case that there is a person in the hazardous zone".
- "Detection Distance is much better than other systems tested".

- Pre-Warning alarms give the operator and the pedestrian both the opportunity to take action, either by stopping the machine, or moving away safely".
- "The system resulted in increased awareness of the exclusion zones around heavy machinery".

Safety and culture awareness has been a huge boost for the industry and one of the NSW Landfill Safety Managers at a major Recycling Tier 1, profiled and presented on Sentinel VISION AI as a technology innovation and safety outcome at the recent landfill and transfer station conference in NSW in June 2021.

Confidence in the system has resulted in orders of over 90 units at various transfer systems nationally including Western Australia.

Uptake of the system is beginning in other industries including Rail and is starting to roll out across rail infrastructure both regionally and nationally due to the same issue of the separation of Plant/People in high-risk areas along major rail corridors.

As a small family-owned Queensland based business PRM Engineering are extremely proud of leading the way in pedestrian safety in the recycling industry and putting Queensland on the map as an innovative State which takes safety seriously.