I can see your Clearly now- the "Blind Spots" are Gone!

Are you compliant to ISO 5006 / 16001- "Earthmoving Equipment / Operators Visibility?"

LSM Technologies has been involved for some year now assisting Industry to mitigate fatalities, injuries and HPI's, associated with **Vehicle to Vehicle (V2V)**, **Vehicle to Person (V2P)** and **Vehicle to Infrastructure (V2I)** interactions utilising their **ORLACO Viewing Solutions** in accordance with the **ISO 5006 / 16001 Standards** for **Operator Visibility** made a **"recommended" (mandatory) Standard** in November 2008. **LSM Technologies** has provided numerous presentations to Industry and Safety / Health Authorities regarding the new **ISO Standards**- a few being:

- **QME Mines Inspectorate** Brisbane offices in November 2008.
- **Mine Haulage Conference** Dec 2008.
- **Quarrying Safety / Health Conference**- Townsville April 2008.
- **Quarry Safety / Health Conference**- Brisbane June 2008.
- **Queensland Mines Safety / Health Conference-** Townsville August 2008.

Also during 2009, at LSM Technologies behest, the **QME (DEEDI) Mines Inspectorate** hosted throughout Queensland, **4 x 2 day Operator Visibility / Proximity Detection and Collision Avoidance Workshops** during August and September which were well received, with an estimate of more than **500 attendees**.

The Workshops attracted enormous support, with attendees from the Mining / Quarrying and Construction Industries, not only within **Queensland** but from many other **Australian States**.

In addition, suppliers of **Visibility**, **Proximity Detection** and **Anti-collision** Technology's from **Australia**, **Europe** and **USA** also attended and provided presentations.

The Workshops brought Technology and Industry together to share knowledge, discuss needs and provide awareness, that will hopefully lead to the primary objectives of **ALARA / Zero Harm** relating to Operator Visibility (blind spots) issues that contribute and / or cause fatalities, injuries and HPI's, associated with **Vehicle to Vehicle (V2V)**, **Vehicle to Person (V2P)** and **Vehicle to Infrastructure (V2I)** interactions.

Compliance / Control Measures- ISO 5006 / 16001.

The **ISO 5006 Standard for *Earthmoving Equipment- Operators Visibility*** has been developed over nearly **20 years** and was made a full standard in 2006 and recommended (mandatory) in November 2008, after a two (2) year amnesty period.

The **ISO 5006 (and 16001)** is **specified / endorsed / enforced** internationally to mitigate "blind spot" incidents by many safety / health authorities and industries.

The ISO 5006 clearly states: *"The purpose of this International Standard is to address* **operator's visibility** *in such a manner that the operator can see around the machine (360 deg) to enable* **proper**, **effective** *and* **safe** *operation that can be quantified in objective engineering terms*.

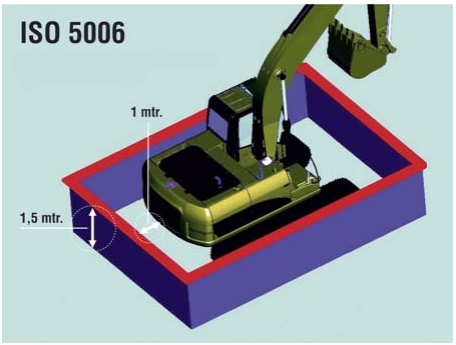

Fig 1: ISO 5006 specifies that Visibility be provided on a Boundary line of 1.0 metre / 1.5 metre height from the smallest rectangle that ncompasses the machine and on a circle of a 12.0 metre radius.

Like PPE- there is no "legislation" that requires the implementation of ISO 5006 / 16001. However, PPE is an accepted "Industry Control Measure" and if an incident occurs in a workplace then duty- of- care and regulative accountability ramifications will occur.

The ISO 5006 / 16001 for Operator Visibility is also an accepted and recommended industry control measure to eliminate fatalities, injuries and HPI's, associated with **Vehicle to Vehicle (V2V)**, **Vehicle to Person (V2P)** and **Vehicle to Infrastructure (V2I)** interactions.

A few examples are:

- British Standards- UK (BS ISO 5006).
- S.A.E. J1091 (USA).
- Safety in Mines Research Advisory Committee- COL 451 Specification- Report (South Africa).
- NIOSH / MSHA / CDC (USA).
- Mineral Resource Industry / DPI (NSW)- MDG15.
- Western Mining- WMC Specifications for Surface + EM +Surface Mobile Equipment 1999-Mirgate web site.
- Heath and Safety Executive (HSE- UK) Assessing Field of Vision for Operators of Earth Moving Machinery on Construction Sites.

The **ISO 5006 / 16001** is already adopted / adapted in many specifications for various equipment / vehicles **not only** in the Mining / Earthmoving Industry but also **Materials Handling (eg Forklifts)**, **Construction (eg Cranes)**, **Waste Vehicles**, **Transport**, etc.

Subsequently, it is clear that the ISO 5006 **/ 16001** should be one's first starting point as **"Defence #1",** so as to:

- **Mitigate 80%-90%** of such related incidents.
- Reduce the **risk of litigation / legal ramifications** of non-compliance to a "recommended" International Standards and accepted Industry Control Measure.

The following endeavours to provide the reader with some **"food for thought"** when considering their strategy in implementing technologies to mitigate safety issues associated with **Vehicle to Vehicle (V2V)**, **Vehicle to Person (V2P)** and **Vehicle to Infrastructure (V2I)** interactions- primarily caused by restricted **Operator Visibility / "Blinds Spot"** around machines / vehicles / equipment.

Major Causes and Contributors.

It is acknowledged worldwide that approximately **80%- 90%** of Fatalities, Injury and HPI's involving **V2V**, **V2P** and **V2I** interactions are a result (or a significant factor), of restricted **Operator Visibility** around vehicles / equipment- **"blind spots"**- and they occur predominately:

- At low speeds of 0- 10 kilometres / hour.
- In situations where there is close proximity.
- Primarily rearward travel.

First Step- Risk Analysis.

When considering technology to mitigate Fatalities, Injury and HPI's, associated with **V2V**, **V2P** and **V2I** interactions, there is some trepidation as to where to start and what technology should be implemented.

It is acknowledged that the first step is to complete a thorough and detailed **RA (Risk Analysis- Assessment)** in providing a solution that can meet **ALARA (As Low As Reasonably Achievable)** / **Zero Harm** objectives.

Whilst many aspects of safety involving machines and human asset interaction are common, there are some different requirements when dealing with under- ground and above- ground Mining / Earthmoving Operations.

Defences- So what technology(s) do we implement?

The following is a what we view as the lines of **"Defences"** that should be considered when endeavouring to mitigate Fatalities, Injuries and HPI's involving
associated **V2V**, **V2P** and **V2I** interactions:

Defence #1: Operator Visibility:

- Implement the **ISO 5006 / 16001** to eliminate "blind spots" with the use of "Visual Aids" such as Mirrors and CCTV Systems.
- This should mitigate more than **90%** of such incidents and so your **primary Defence technology.**
- Are stand- alone systems, require little maintenance and no separate infrastructure to support them.
- Investment is minimal.

Defence #2: Proximity Warning / Detection Systems:

- Short and Long Range Radar (RF Tagging for personnel / equipment- underground).
- These devices however, augment Defence #1 and as stipulated by the ISO 5006 (16001) are a "Hazard Detection" device and can only be used in "exceptional" circumstance in place of CCTV / "Visual Aids".
- The ISO 5006 (16001) is clear- a **"blind technology"** should not be utilised to mitigate a **"blind spot"** Operator Visibility issues.
- Hazard Detection (HD) are a good secondary devices to complement Defence #1 so as reduce Operator interaction (changing camera views) and to "prompt / warn" the Operator or to automatically initiate a camera view should an object be detected.
- One also needs to consider the risk in using such devices as a **primary** Safety defence, as they are **not** a **safety device** on their own and are classed as a **"backup up assist" (HD)** devices only.
- Hazard Detection / Proximity devices are stand- alone systems, require little maintenance and no separate infrastructure to support them.
- Investment is minimal.

Defence #3: Collision Avoidance / Awareness Systems:

- Are usually RF and / or GPS communication / positioning systems.
- These systems are primarily utilised for Fleet Management information on positioning of plant.
- Will provide management information for vehicle congestion, dedicating no- go zones (eg blast areas, overhead power lines, etc), non- compliance (contravening speed, intersection stops), mapping of haul roads, etc.
- May provide some degree of safety but only for less than **2-5% of incidents** and these situations can be mitigated better by other methods and procedures (eg high speeds / intersections- removal of light vehicles on haul roads, etc).

Fig 2: Operator visibility is not the only issue to mitigate- so is RSI neck and back injury.

- These devices / systems require costly maintenance, service support contracts for software / data / hardware updating. extensive support infrastructure and personnel to monitor / report data.
- Initial investment is high, as well as on- going servicing costs.
- Are suitable / designed for primarily HME / LV but and do not address close proximity or equipment such as Telehandlers, Forklifts, Tyre Handlers, Motivators, Drag-line / Shovel operations, Cranes, etc.
- Also consider Operator "information overload" and the associated risks of an Operator distracted by reading a screen- whilst moving.
- There is a considerable latency in attaining **real- time** information from these types of systems.
- Subjected to interference and "drop outs" by solid objects (eg workshops / buildings, etc) and other site RF communications.

Procedural / Non- Technology Mitigation- Defence #4.

Part of the initial RA is to also consider what Administrative / Non-Technology / Procedural tools could also be utilised to mitigate Fatalities, Injury and HPI's, associated with **V2V**, **V2P** and **V2I** interactions.

For example:

- Berms at intersections to stop HME from "cutting corners".
- Road rules for overtaking.
- Elimination of service vehicles and personnel from Haulage roads.
- Pedestrian berm walkways- especially in Park- up areas.
- Restriction on number of intersections- Haulage road design.
- Restrict rearward travel where possible (eg forward only into / out of workshops.
- Etc.

A combination of all these "Defences" will also need an **on- going scrutiny and evaluation** so as to achieve ALARA and meet "Zero Harm" objectives.

Quality / Robustness / Fit- for- Purpose- "Park- up"?

The Mining / Earthmoving / Construction industry is a recognised as an arduous operating environment and so one needs to ensure that they select their "Defence" Technologies carefully and that they are **"fit- for- purpose"**.

Reliability, **Durability** and **Performance** are all key criteria in selecting your technology and their importance can not be overlooked. Not just because of the high costs of maintenance / replacement but also the net effects on **Safety**, **Equipment Damage** and **Productivity**.

A significant and primary aspect to consider is- what is you **"park-up"** policy should any of your "Safety Defence Technologies" **fail**?

As an example: Should a Camera / Radar (RF Tag) / RF- GPS fail then as a Safety device / Control Measure- should the Operator "park- up" and await replacement / repairs?

The issue with not utilising quality "fit- for purpose" technologies is if they do fail then:

- **No "Park- up" policy:** Should the machine continue to operate then safety may be compromised and a high risk that an incident could occur- with substantial duty- of- care ramifications.
- **"Park- up" Policy:** Should the defence / device **fail frequently** then there will be a substantial risk of equipment damage and also loss of productivity.

The ISO 16001: Earth-moving machinery ***-Hazard detection Systems and Visual Aids -Performance Requirements and Tests,*** will assist you in the correct selection of both **Visual Aids (VA)** and **Hazard Detection (HD)** Safety / Control measures, so as they are of suitable quality and provide fit- for- purpose performance criteria.

Ensure your technology providers meet the ISO 16001 Standards and that they support their devices with **minimum 1-2 year warranties**.

A common expression: ***"There is always a cheaper alternative- as long as the end results and consequences are ignored"***

We have implemented our Safety System - What now?

Once the chosen technological (and Procedural) "Defences" are in place, one needs to then record / log data / video for analysis and validation- especially if an incident were to still occur.

Collection and recording of the amount / type of data remotely (to a base) from **Defence #3** can be completed simply without taxing bandwidth and available storage / collection (GPRS- RF- Wifi, etc) or adding additional technology Infrastructure. Defence #3 information is usually deemed "non critical" and so can be downloaded with some latency via "hot spot" download points.

Contrarily, recording of **Defence #1** and **Defence #2** would require extensive technology, network bandwidth and would overload common transfer system (GPRS, Network, Wifi, etc)- which would also have incipient latency- when considering the need to attain **real- time** storage / collection of Video Images / Radar Data.

Subsequently, a more effective solution **(Defence #1 / Defence #2),** both technically and commercially would be to implement an **End- Point "Black Box"** device mounted in the vehicle that could collect and store in "real- time" both Proximity Warning (Radar) / CCTV Imaging data and also be robust enough to survive an incident for post analysis.

More than Safety- Productivity + Damage Control.

Sometimes new Safety / Health initiatives can be met with initial resistance due to high costs. However, mitigating incidents associated with **V2V**, **V2P** and **V2I** interactions- especially resolving Operator Visibility / Blind Spots- will not only increase **Safety** but also reduce **Damage** and will enhance **Productivity**

No only is the initial investment is such Safety technologies provide an immediate return but also enormous savings in:

- **Reduction of damage:** vehicles, berms, stationary objects, buildings, Excavator / DTruck impact, etc.
- **Avoidance of obstacles:** on road that can damage vehicles and also tyres.
- **Quicker turn- around:** of vehicles- eg DTruck Fill- Dump cycles.
- **Increased** Operator **awareness** / **lower fatigue**.

Share Value / Investor Returns / Loss Productivity.

It is becoming more of a requirement (legislated in some industries already), to record, disclose and report HPI's Injuries and Fatalities- not only to Health and Safety Authorities- but also to **Investors**.

Besides the human loss, substantial costs are involved in Safety incidents with litigation, fines, compensation and loss of productivity- even permanent closure of sites / company's.

As detailed in a recent report completed by CITI **Group- Safety Spotlight June 2009:** ASX100 Companies & More- Injury and Fatalities Data Presented and Interpreted, there is a direct link to **Company's Share Value** and **Investor Returns** involving Safety and Health incidents.

Summary / Conclusion.

There is still much more to consider (Integration of various systems / devices, transfer of technology between equipment / sites (eg Contractors), redundancy, reliability, training, etc).

There are challenges in achieving ALARA / Zero Harm in Industry but they are far unsurmountable- both technically and commercially.

In Summary:

- **Risk Analysis:** Complete a thorough RA for your equipment and operations and determine technology and non- technology mitigation.
- **Defence #1:** Implement ISO 5006 Operator Visibility to mitigate more that 80- 90% of Fatalities, Injuries and HPI's associated with V2V, V2P and V2I interactions.

- **Defence #2:** Hazard Detection Devices- augment Defence #1 where applicable.
- **Defence #3:** Implement- but consider the relationship to Safety and primarily objectives for such technologies.
- **Defence #4**: Implement unconditionally- some options that willl cost less and be as (or more) effective then some technology.
- **Quality / Performance:** Ensure supplier conforms to ISO 16001, equipment is fit- for purpose" and your "park- up" policy is in place.
- **Recording Data / Video:** Consider the need for collecting / storage of data and video images- one will need to validate an incident- if it still occurs.
- **Company Value:** Not only is there a responsibility / accountability to the worker but also to the investors, in not only maximise productivity, lower costs but also the well-being of the Safety and Health of people in all industries and workplaces**.**

LSM Technologies / References.

LSM Technologies are committed to the on- going development of technologies / systems as an industry champion to continually improving our clients objectives of enhanced Safety (Health), Equipment Damage Control and Productivity.

- **Orlaco Camera Viewing Solutions:** Applications+Case Studies+Literature.
- **Operator Visibility + Proximity + Collision Avoidance**: Defence #1 + Defence #2 + Defence #3- integrated Solution.
- Are you compliant to the new ISO 5006 / 16001- Earthmoving Equipment / Operators Visibility?
- **CITI- Safety Spotlight June 2009:** ASX100 Companies & More- Injury and Fatalities Data Presented and Interpreted.

Links articles, reports, **presentations** can be downloaded by searching **"5006"** on our web site www.lsmtechnologies.com.au and reviewing the relevant news articles.