# Managing safety in the supply chain



## Contents



ebook

safety solutions .net.au

Industrial, construction & mining safe

# Sensors making road logistics safer

*Glenn Johnson*

Heavy vehicle logistics is a fact of life in the modern world, and it is not without public safety and economic risks. Modern sensor technologies present new opportunities for road management authorities to mitigate these risks by detecting safety hazards before accidents can occur.

Anyone who drives is well aware of the dangers and risks associated with heavy vehicles on the road. However, heavy haulage logistics are an economic fact of life and are important to the economy of any nation.

While accidents involving heavy vehicles tend to be a small proportion of the road accidents that occur, they can have much larger effects when they do.

The Australian Government has reported[1] that in 2014 over 1500 people in Australia were hospitalised as a result of accidents involving heavy vehicles, and 220 were killed. Over half of the fatalities involved articulated vehicles.

In a recent example from Sydney, Australia, a poorly maintained articulated truck carrying 18,000 litres of flammable liquid suffered a brake failure on a steep hill and rolled and collided with multiple cars before exploding and spilling burning fuel, killing two and severely injuring five others. Some of the liquid spilled into surrounding waterways and bushland, creating an environmental hazard. The spill covered a 1.5 km radius and the roads in the area were closed for a day.[2,3]

Even with no injuries or loss of life, if an oversized or overloaded truck enters a tunnel or gets wedged under some other structure, all road traffic in the vicinity of the incident can be stopped or delayed for many hours.

## Economic effects

Road crashes that block roads for hours or days can have a significant impact on the economy of the city in which they occur. The World Bank estimates that across the world, road crashes cost approximately 1–3% of a country's annual gross national product (GNP) each year.[4]

"These are resources that no country can afford to lose, especially those with developing economies… Governments must try to reduce these losses by providing road safety improvements and should see expenditure on road safety as an investment and not as a cost."

They go on to say that one of the ways to reduce the incidence of road crashes is to design roads to improve safety:

"The introduction of self enforcing techniques in road designs is likely to have much better short term results… Road crashes can be prevented by better planning and more safety conscious design of the road network."

## Modern sensor technologies offer a solution

In keeping with the idea of "self-enforcing road designs", modern sensor technologies can be used to assist in preventing many of the types of incidents involving trucks, or to provide additional information in the event of an incident.

Modern laser scanning technology, as well as photoelectric sensors and vision systems, can be integrated into traffic management systems to alert drivers of danger, or to divert vehicles to prevent incidents.

### Vehicle profiling

Heavy vehicles with loads that are high, or of extended length, can create a number of problems in urban environments. Over-height loads can cause expensive damage to overhead structures and tunnels, and the impact with the structure can cause the load to be dislodged from the vehicle — creating major traffic problems, including the hazardous entrapment of multiple vehicles in enclosed spaces such as tunnels.

Long vehicles can also be a hazard should they inadvertently enter areas where there isn't sufficient space for them to turn or negotiate corners.

With the use of three 2D laser scanners and a central control unit it is possible to completely profile a moving vehicle, building a 3D profile 'point cloud'. The vehicle reflects the laser beams from the scanners, and the position of the surface of the object relative to the scanners is determined by the 'time-of-flight' principle.

The first two scanners are mounted on a gantry above and to each side of the vehicle, and together record an upper contour and a side contour of the vehicle, producing a series of 2D profile sections. The third scanner is mounted above or to the side of the roadway and scans the vehicle as it approaches, returning the positions of the previously scanned 2D profile sections, enabling the central control unit to build a 3D profile of the vehicle.

For accuracy, such a scanning system requires the vehicle to move at constant speed at or below 7 km/h. The profiling system is therefore best installed at wayside checking stations or at the entrance or exit of a loading facility.

### Over-height detection

Real-time over-height detection can be used to warn or divert vehicles to avoid collisions with tunnels, bridges and other overhead structures. The way to achieve this is with a double photoelectric sensor system mounted at the maximum permissible height for the structure being approached, which will be triggered for over-height vehicles. Two spatially separated beams are necessary to help prevent false positives from birds or small objects carried by the wind that may happen to pass through the detection area.

For multi-lane scenarios, it is also possible to pair the photoelectric detector with a laser scanner to determine the lateral position of the vehicle, determining which lane it is travelling in.

Output from the over-height detection system can be used to activate traffic signals to either stop the vehicle, or to divert it to a detour to avoid colliding with the structure being protected.

### Vehicle hotspot detection

Detecting hotspots on heavy vehicles, particularly in braking systems, is important for road safety. This is especially critical for vehicles carrying flammable loads, and for avoiding vehicle fires.

Roadside detection, combining thermal imaging cameras and laser measurement scanners, can be used to detect high-risk vehicles before they enter tunnels or critical sections of road, such as steep declines where brake failure is more likely to occur. The combination of 3D data and thermal information allows vehicle parts such as wheels and exhaust to be identified at highway speed.

Because such a sensor arrangement allows individual temperature measurement for individual parts of vehicles, it is possible to have individual alarm thresholds for each part. In addition, the laser measurement scanner can also be used in the same set-up to measure other safety-related information — such as vehicle over-height detection, in a single system.

### Detecting hazardous loads

Detecting vehicles carrying hazardous loads is important in the event of an incident, particularly in tunnels. It can also be used to divert vehicles away from sections of road or tunnels where a specific hazardous load may not be permitted.

The problem of detecting hazardous loads is essentially solved using a vision system. Vehicles carrying hazardous loads are required to carry a placard indicating the type of hazardous material being carried; however, this placard may be placed in various locations on the vehicle.

The solution involves a specialised 3D profile scanner to detect the position of the placard and an infrared vision system to read the information content of the placard.

### Visual range detection

Fog, smoke and dust can cause significant visibility issues. Being able to detect visual range can have significant safety implications, making it possible to alert drivers and automatically alter speed limits based on driving conditions.

Using laser scattering technology, it is possible to measure the reflection of the laser from moisture and particles in the air and gauge how local atmospheric conditions are affecting visual range.

### Vehicle counting and classification

Road and vehicle safety can be more readily compromised as roads become congested or as the balance of the types of vehicles changes over time. Monitoring changing traffic patterns makes it possible to make changes to traffic flows, through lane management and diversions in the short term, or to help with road upgrade planning decisions in the long term.

The prevalent technology to date has been simple vehicle or axle counting through sensors placed in or on the road surface. Using modern laser scanning sensors it is possible to not only count vehicles, but also their speed and the class of vehicle, without installing sensors in the roadway. With more detailed data comes the ability to make better-informed traffic management and road planning decisions.

## Conclusion

Heavy vehicle logistics is a fact of life in the modern world and is important to a nation's economic activity. Avoiding road accidents, especially those involving heavy trucks, is therefore important to minimise risk to human life, the environment and the economy. With appropriate use of modern sensor technology, road and traffic management authorities can mitigate risks associated with oversized or overloaded vehicles, overheating brakes, speed, driving conditions and traffic density.

References


1. Department of Infrastructure and Regional Development 2015, Road Trauma Involving Heavy Vehicles-Annual Summaries, <<http://bitre.gov.au/publications/ongoing/road-trauma-involving-heavy-vehicles.aspx>>, Australian Government.
2. ABC News 2013, Toxic spill clean-up continues after fatal tanker crash at Mona Vale in Sydney's north, <<http://www.abc.net.au/news/2013-10-01/two-dead-in-fuel-tanker-crash-in-sydney27s-north/4991974>>, Australian Broadcasting Corporation.
3. ABC News 2013, Fuel tanker company Cootes, involved in fatal Mona Vale accident, accused of cutting corners on maintenance, <<http://www.abc.net.au/news/2014-02-03/cootes-accused-of-cutting-corners-on-truck-maintenance/5234052>>, Australian Broadcasting Corporation.
4. The World Bank, <<http://www.worldbank.org/transport/roads/safety.htm>>.


# Forklifts ‘face-off’ in narrow aisle

The S3000 Anti Collision safety laser scanner from SICK makes use of its own scanning range record of 7 m for a field where safety is key, but it doesn’t stop there - it is actually capable of covering a much greater scanning range of up to 15 m.

A protective field is used to safely detect oncoming forklifts in narrow-aisle applications and reduce their speed before a collision occurs. The S3000 Anti Collision can be relied on to detect a reference target on the oncoming vehicle at a distance of up to 15 m away. This means that it is possible to operate two forklifts at high speed in a single aisle, offering maximum results with a high level of system throughput. Dynamic field switching is a further function that facilitates a high degree of throughput. At the same time, the technology monitors a protective field of up 7 m to detect human presence.

As a result of spatial restrictions in the aisles, shelving systems that are accessed using industrial trucks do not always conform to a minimum distance of 0.50 m between the shelving units and the vehicle or load to be transported. Passages of this size between shelving systems are referred to as narrow aisles.

It is not possible for operators of industrial trucks in narrow aisles to avoid oncoming vehicles. In order to ensure personal safety, DIN 15185-2 requires operators to take technical and organisational action.

The ‘reliable collision protection field’ is an auxiliary function of safety laser scanners intended to prevent industrial trucks from colliding in narrow aisles. Unlike conventional safety functions that offer personal protection depending on whether a human presence is directly detected, this function detects a vehicle in the surrounding area and so, by avoiding collisions between two vehicles, indirectly prevents harm to individuals.

The high relative speed of two vehicles that are travelling towards each other makes it necessary for the collision protection field to have a large scanning range. In this case, a protective field with a scanning range of 7 m is no longer good enough. From a user perspective, the objective is to increase throughput as a result of the ability to operate two forklifts in a narrow aisle at high speed.

## Flexibility in logistics

The increased demand for personalisation of products has puts new demands on the entire supply chain. Although additional personalisation requires extra effort in terms of production and logistics, productivity and efficiency are not expected to suffer; which may sound like a contradiction in terms.

In addition, customers increasingly expect a high degree of transparency in business processes to give them maximum flexibility in terms of demand and freedom to act. Supply chains now face the same challenges both within and between the relevant factories, because logistics are everywhere, whether inside a production site or en route to the next one.

Intelligent networking of factories, as foreseen by ‘Industry 4.0’, solves both problems by creating a high degree of transparency and flexibility through new concepts of automation. There are many different dimensions within the supply chain through which logistics can exert influence.

There are five challenges that directly affect flexibility in all areas of logistics:

1. Communication
2. Track and trace
3. Flexible automation
4. Quality control
5. Safety

Safety: Autonomous machines require new safety concepts that are optimised to more flexible production methods. These include the protection of every process step along a production line to deal with man/machine interactions, which are now significantly less susceptible to planning. In all of these approaches and solutions, of course, the safety of people is a priority. However, the safety aspect must also cover an adaptive approach to the production environment, such that the safety solutions themselves are flexible and responsive. This means that complex and highly automated production lines do not need to be shut down completely just because safety cannot be guaranteed at an individual point in the process.

# Anti-collision systems

## ensure safe container-terminal operations

Container terminals operate on a 24/7 basis, so the demand on availability is extremely high. Collisions involving the boom of ship-to-shore cranes and the ships themselves pose the greatest risk in daily operations.

In order to offer its customers uninterrupted operations, DP World - one of the leading container-handling companies - has decided to equip the expansion of its Jebel Ali facility in Dubai with anti-collision systems from SICK.

Jebel Ali has been voted 'Best Seaport in the Middle East' for 19 consecutive years and is just one example of DP World's high level of service. The new Terminal 3 in Jebel Ali is to become yet another benchmark for safe and efficient operation.

Collisions involving the boom of ship-to-shore cranes and the ships themselves pose the greatest risk in daily operations. Accidents of this type account for 31% of the costs of quay crane insurance claims; they are the single largest cost item in this area. Collisions of cranes with other cranes and other equipment occur almost as frequently. In addition to the immediate damage - including damage to customers' property such as the ship or its load - collisions may also result in extended downtime of cranes and other port equipment.

Quay Cranes in Terminals 1 and 2 are today already equipped with SICK technology. All 69 cranes in the new Terminal 3 will be equipped with new SICK AOS systems for boom-collision prevention on the STS cranes and pathway-collision prevention on all the cranes. In order to maximise efficiency, the Jebel Ali facility will also use LMS511 2D laser scanners for truck/vehicle positioning and POMUX KH53 linear encoders from SICK for automated and precise positioning of the trolleys.

The AOS system uses cutting-edge LMS511 and LMS111 laser scanners. These sensors feature high-speed sampling technology and support the evaluation of multiple echoes of a single pulse. This drastically increases the accuracy and reliability of the data and allows the units to be used 24/7 in virtually any weather conditions - for example, dust in Jebel Ali or fog, rain or snow at ports elsewhere.

LMS511 and LMS111 can evaluate multiple fields, all at the same time. The AOS system comes with pre-configured fields for warning, deceleration and stop and can be adapted to customer requirements. Evaluation features include blanking of objects, reference contours, defined pixel patterns, etc. Fields can change dynamically, depending on the status of the inputs. With Flexi Soft, the AOS systems use a high-performance, modular safety controller. This allows for easy integration into the control architecture of the complete system. The controller features sophisticated, unique self-testing functions to check at any time the availability of the system regarding all configured field sets and installation position.

However, outstanding technology was not the only reason for DP World to opt for SICK. SICK was able to readily respond to DP World's requirements for a complete solution with all applicable sensor technologies, not just for individual sensors. As a global organisation, SICK is also represented in many countries. Experts from SICK based in Dubai, Sweden, China and Germany successfully liaised with DP World, the system integrator from Sweden and the main manufacturers from China and Abu Dhabi. Nabil Qayed, Director, Technical Department, DP World UAE Region, said: "24/7 availability is paramount in container-terminal operations. The anti-collision solutions from SICK play a key role in our new Jebel Ali terminal to ensure this availability and will help us to achieve new standards in efficiency and competitiveness for our customers."

# resources
## from our sponsor


**About SICK**

SICK is one of the world's leading manufacturers of sensors, safety systems and automatic identification products for factory automation, logistics automation and process automation. As a technology and market leader, SICK provides sensors and application solutions that create the perfect basis for controlling processes securely and efficiently, protecting individuals from accidents, and preventing damage to the environment.

Traffic Industry

https://www.sick.com/au/en/c/g285087

Profiling systems

https://www.sick.com/au/en/system-solutions/profiling-systems/c/g288254

Overheight detection for vehicles prior to entering a tunnel

https://www.sick.com/au/en/c/p245246

Detection of vehicles that are too high including lane detection

https://www.sick.com/au/en/c/p329710

Smoke detection for early fire detection in road tunnels

https://www.sick.com/au/en/c/p329719

another ebook from
www.safetysolutions.net.au

published by
WESTWICK-FARROW MEDIA