Improving straddle carrier safety through operational visibility and transparency

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In a typical straddle carrier operation, what procedures/methods can be put in place to move towards a zero accident policy? It goes without saying that the operator should be properly trained. But how do you make sure that it is the trained operator that is driving, and what mechanisms can you put in place to monitor and review the safe operation of the equipment. Waiting for the next accident is not an option.

Introduction

All container terminal operators recognise the benefits of improving operational welfare for their employees and on-site contractors.

It is without doubt that many have also adopted a proactive approach to operational safety, recognising not only the benefits to the welfare of the workers through a safer working environment, but also the additional benefits this will bring to the day to day operation by minimising disruptions and providing a more stable and predictable operating environment.

However, how do you achieve the implementation of best practice in a busy container terminal where the operation is spread over a wide area, and just as importantly how do you measure the effectiveness of your efforts?

In a typical straddle carrier operation, what procedures/methods can be put in place to move towards the end goal of a zero accident policy? It goes without saying that the operator of a 60+ tonne machine that is capable of carrying a load of up to 60 tonnes should be properly trained. But how do you make sure that it is the trained operator that is driving, and what mechanisms can you put in place to monitor and review the safe operation of the equipment? Waiting for the next accident is not an option.

In the following example the implementation of relatively inexpensive technology has been used as a significant step to move towards the goal of zero tolerance.

Training

After putting a training and authorisation regime in place the next step is to make sure you know who is driving. This is a relatively simple step and is already quite common throughout ports and terminals.

Restrict access

In this example a machine readable identity card access system has been utilised. There are however key features that need to be considered when implementing such systems and these are sometimes overlooked.

Centralised system

Unless you only operate one or two items of equipment or only have a similar low number of trained operators, one of the most important aspects of access control on mobile equipment is a centralised access control software application. The software application is connected to all the mobile equipment via a wireless connection and this approach provides several benefits including:

- Easy database administration for removing old or lost cards and adding new users (no need to visit every machine to update).
- The ability to set up time and equipment restrictions and easily change them as required.
- Centralised audit trail (look at who is driving now, and who drove what when).

Figure 1: Steps in a zero tolerance system

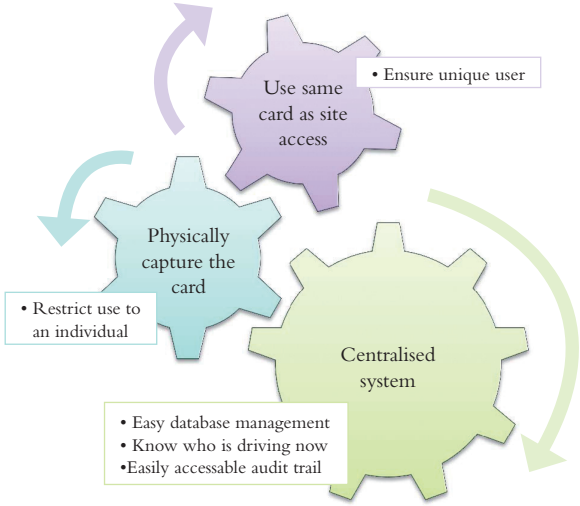

Figure 2: Access restriction considerations

Card type selection

There are also major security benefits in controlling access to the equipment by using the same ID cards that are used for general access to the site. In tandem with this is the use of a card capture system where the card must be positively inserted in a card holder whilst the machine is in operation. In the example shown in Figure 3, cards are inserted into an industrial reader with the system reading the card and recognising if the card is removed. This approach brings several benefits:

- Audit trail for site entry and machine use (eliminates working a double shift for a friend).
- Ensures ID is the operator (not just a general RFID device to start the machine).
- Equipment operation restricted without the use of a valid card.
- Once stationary the machine will not move if the card is removed (prevents leaving the machine running during shift break and a fresh operator using without a valid card).

The implementation of these types of systems will provide a terminal with a full audit trail of whom,

what, and when, and also ensures only trained approved operators use the equipment.

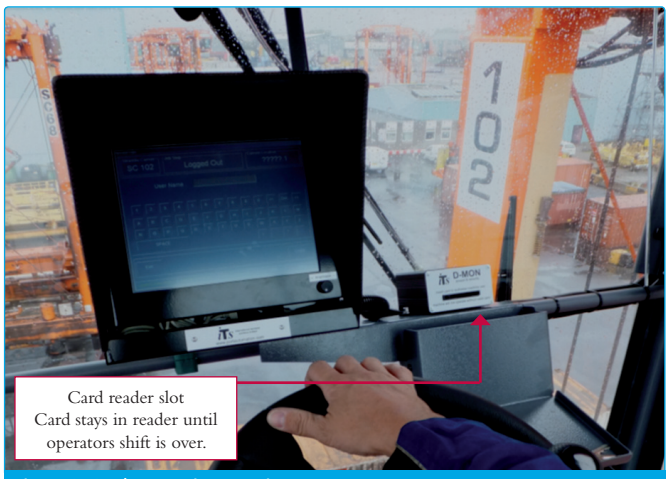

Figure 3: Card system in operation

Monitor

Monitoring of the performance and safe operation of the straddle carriers can be achieved by various methods from manual observations through to automatic monitoring. Manual observation can be expensive with relatively high labour costs and is also unreliable as it would be impractical to be sure all incidents were observed. Automatic monitoring is also perceived by some as expensive and difficult to achieve, however this is not normally the case, and the following example shows how an on-board computer can provide the basis for this.

Many straddle carriers have existing systems on board, and it is a relatively inexpensive exercise to capture this information and combine this with other key items of data provided by other sensors or systems. In this case an on-board computer is used to capture the data. The on-board computer logs information and can then make decisions based on events. The key is to network the mobile computer(s) with central servers to collect information as the straddle carrier operates and use this to create real-time status information, or use the information for post analysis.

Along with equipment status information and alerts used in maintenance and engineering, the on-board computer can also collect data related to safety events such as fire detection, emergency stop, straddle carrier stability, and many other metrics to provide key operational safety information.

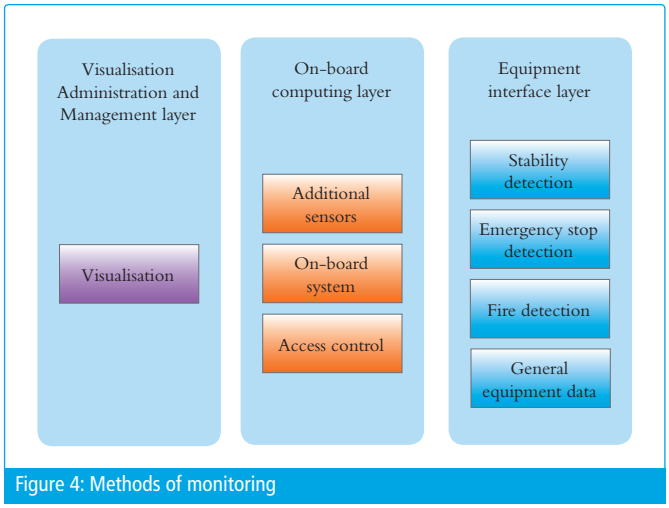

Figure 4: Methods of monitoring

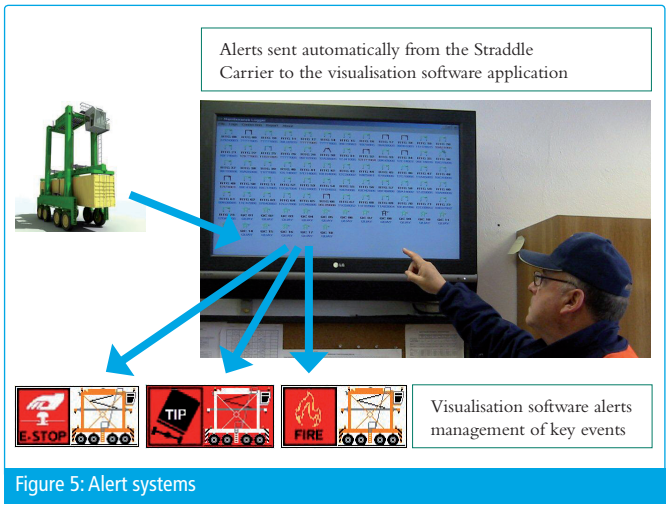

Figure 5: Alert systems

Analyse

The typical analysis and display of the informatics can be best split into two types, and as to how they are handled will depend on how time critical the information is. The first type is associated with direct monitoring and can be used to alert the supervisory management as to critical and dangerous situations. The second type is trend evaluation.

Instant critical alerts

There can be a whole host of critical and safety related alerts that can be applied to straddle carrier operations. The three we are using as examples in this white paper are engine fires, straddle carrier tipping over, and emergency stop activation. Alerting the management to these safety related events is a significant step forward in safer terminal operations. Take for example an engine fire. These are serious events with potentially disastrous consequences. As well as the operator being alerted to the fire it is important that the management also know as soon as possible to action the immediate implementation of a fire emergency plan. In many cases when the alarm sounds in the cab the operator may not be able to alert the management as he is probably evacuating the straddle carrier with some urgency. In rare cases operators have been known to ignore the warning as no flames are presently visible. From an operational management perspective the first you know about the fire

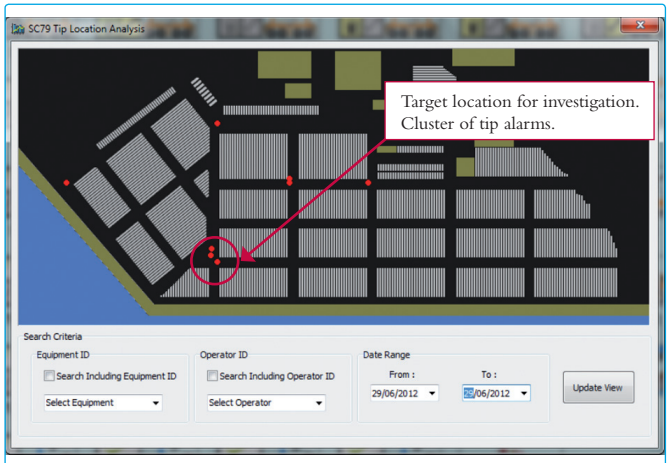

Figure 6: Screenshot of alarm locations

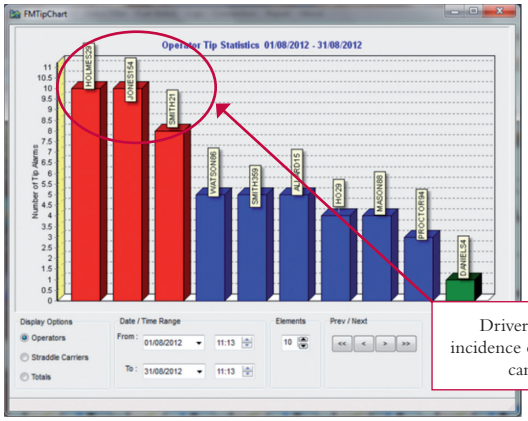

Figure 8: Screenshot of statistical breakdown

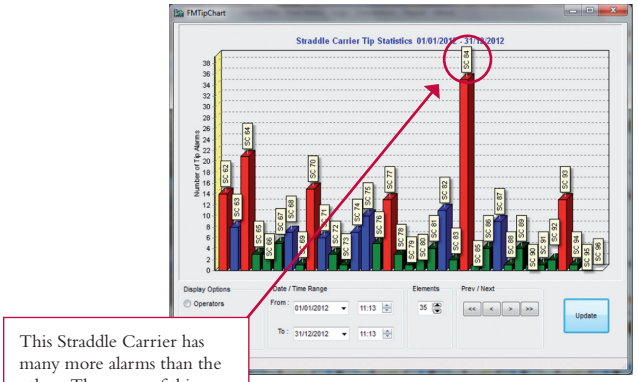

Figure 7: Screenshot showing straddle carrier alarm

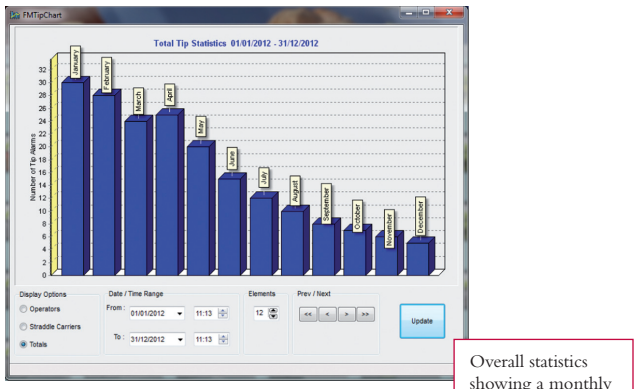

Figure 9: Screenshot of trend monitoring

shouldn't be when flames can be seen from the control tower. For engine fires and similar alarms of this type, visualisation software can instantly alert the management, as can be seen in the example in Figure 5.

Warnings are highlighted with a warning icon on a large monitor and can be accompanied by an audible alarm. The collection of these alarms within a suitable software package can also be the basis for trend analysis and subsequent corrective measures.

Trend evaluation

It is with little doubt that being alerted to potential hazards and incidents is a major benefit to the management during the on-going operation. However, to allow the management to be proactive and stop problems before they occur it is necessary to identify recurring issues that have the potential to cause future safety related events.

The use of a suitable software tool can provide key metrics and trends over time. By accurately monitoring, measuring and reporting, these tools can provide benchmarking and allow the creation of a continual improvement programme. This in turn allows the management to see the effect of improvement initiatives and training programmes.

An example of how good software tools can be utilised for proactive safety management is straddle carrier stability. Several factors contribute to straddle carrier instability such as poor yard layout, straddle carrier with inherently less stability than others, and the effect of individual operators. This allows instant visibility of the trends and provides differentiation between these various contributing factors as is demonstrated in the above example.

The yard effect

A yard layout mimic can show where the tip alarms have been activated. This allows the management to establish where road layouts, sharp bends, yard maintenance, or other circumstances should be reviewed. Figure 6 shows multiple tip alarms in specific locations, these can be viewed over different time frame options.

The straddle carrier effect

Another interesting exercise is to view the straddle carriers and benchmark them against each other to allow the management to review the stability of different types or a particular machine.

Figure 7 shows the straddle carrier tip alarm ranking.

The operator effect

As well as identifying issues regarding the yard layout and machine sensitivity, operator driving characteristics can also be a factor in safe operation of the equipment. Operator training is an essential part of modern terminal operations, however some operators adapt more quickly to the introduction of new equipment, technology or practices and the amount of training required can be difficult to determine. Figure 8 identifies operators with a high profile of repeat activation of the stability detection system.

By applying the above type of software tools to the terminal operation, trends can be identified and measured to provide Key Performance Indicators (KPIs) and subsequently allow corrective measures to be suitably targeted.

Corrective measures

Armed with quality data and with the ability to clearly identify the issues to be addressed the terminal management can take the appropriate corrective measures. This may be modifications to working practices, yard layout improvements, changes to the operator training regime, or some other action. The use of well written software tools will allow the terminal management to see the effects of the corrective measures put in place by continually monitoring and providing on-going trends.

Summary

At the beginning of this paper two questions were posed:

- How do you achieve the implementation of best practice in a busy container terminal where the operation is spread over a wide area?
- How do you measure the effectiveness of your efforts?

In this paper we have outlined how these goals can be achieved with the assistance of industry specific well written software tools connected to on-board system to harvest the correct data. The systems restrict access to the equipment to only those trained to drive it, automatically report and alert critical situations that may require the implementation of an emergency plan, measuring certain metrics to provide benchmarking to take corrective measures, and continually evaluate the measures using trend analysis tools.

ABOUT THE AUTHOR

Richard Lambert is a graduate of Production Engineering at Nottingham Trent University, England. Over 20 years experience in applying system solutions to Logistics operations specialising in maritime ports and terminals. Initially joining Morris Automation as a project manager, then leading the Ports and Terminal division of Savoye Logistics as the Solutions Director. In 2002 Richard lead a group of Port automation specialist to set up International Terminal Solutions Limited. The company specialises in turnkey automation projects for container terminals and general logistics systems, concentrating specifically on the development and implementation of systems aimed in streamlining and increasing container terminals operational efficiency.

ABOUT THE COMPANY

Working with the best known container terminals worldwide, **ITS** has an impressive list of completed projects and satisfied clients. ITS supplies G-POS, a GPS system for tracking containers and handling equipment; E-SMART an equipment status visualisation, safely, and KPI tool, and other optimisation, automated identification and security systems. With a depth of experience in integrating RFID, GPS and other technologies into business applications, ITS work with ports and terminals to explore and implement innovative new ways to use this technology to gain competitive advantage.

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