Ready for automated inspection


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Process automation in container ports and terminals is still growing with new possibilities to boost efficiency and achieve safety and environmental goals. One of the objectives of automation is to achieve complete tracking and traceability of containers inside the terminal, along with being aware of their position and physical status as they move or stack within the terminal perimeter.

One of the most demanded processes in the quest for automation is at the gate. Gate automation has proven to have a very high return of investment. It has provided terminals with a new vision of this key process, reducing access time, queues, manpower and optimising what was up until a few years ago a costly and often unreliable process.

This concept has been extended to other terminal zones, such as ship-to-shore (STS) cranes and cargo trains. For example, an increasing number of STS cranes are being fitted with cameras that capture images to be processed by an optical character recognition (OCR) system and other devices to improve operational efficiency. Trains entering or exiting a terminal area can also be processed with similar technologies to have their container load identified. The yard is now overflowing with technology for container location and identifying containers on the move, completing the circle of tracking and traceability.

So it seems that we are halfway there. However, there are still much demanded functionalities to be developed in relation to process automation in terminals. One of the most remarkable is automated container inspection.

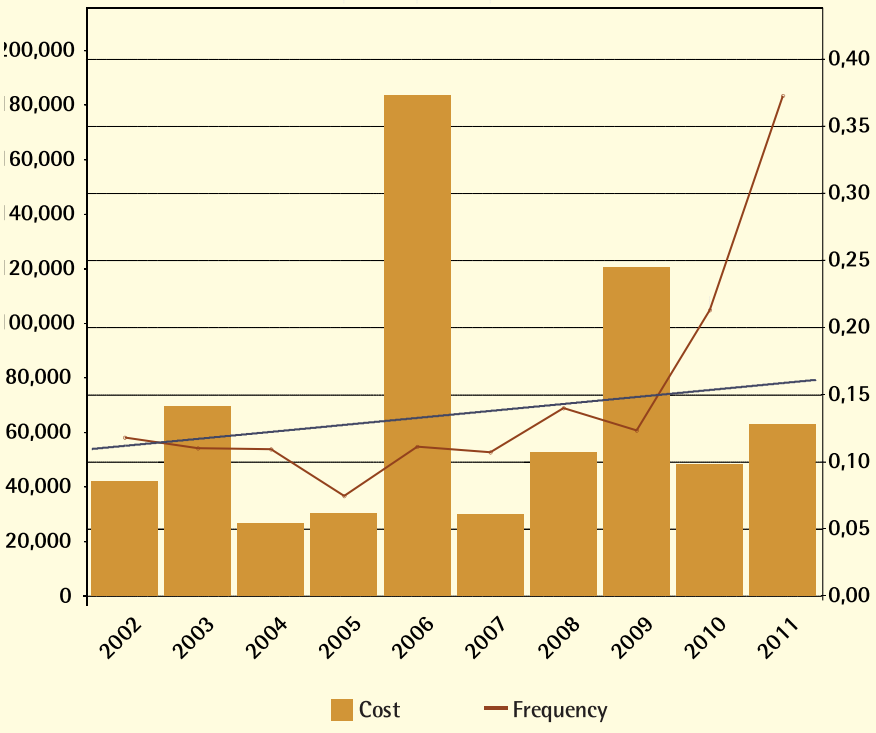


Figure 1: Swedish Club P&I Claims Analysis - average claims.

Automating container damage inspection

When the focus of terminals is set on moving containers faster and with high levels of efficiency, they must ensure that containers are not only moved in and out of the terminal quickly but also accurately and smoothly.

Today container damage liability involves a complicated sequence of procedures to distinguish responsibility and associated costs. As stated by the marine specialised insurance company Swedish Club in its 2012 P&I Claims Analysis report, the average cargo claim cost since 2009 has fallen but the frequency has risen. As a result, the total claim costs have increased. We can assume that a number of cargo claims could be avoided by terminals by detecting defective containers proactively.

If we look at the frequency and cost distributions published by Swedish Club in Figures 1, 2 & 3, the most common causes are physical damage and wet damage to the cargo. These problems could be prevented by detecting them at terminal accesses and thus resolve the

corresponding liabilities appropriately.

In response to these market requirements, Orbita has developed a new container damage inspection system, GateDMG 3D, that automatically detects and reports damages on the container structure by using 3D scanning and artificial vision techniques.

What the system does

The system is fully automated and requires no human intervention. It can detect defects in the container's structure, such as deformations and holes, indicate the location of the damage in the container and show a 3D reconstruction of the container along with associated pictures of the damaged area.

The detection process is made in real time as a container passes through the gate process, and it is independent of other automatic processes such as OCR recognition. The obtained 3D image matched with pictures of the container represents a feasible proof of damage, and it is a valid tool to settle differences between parts.

Information about container damaged areas detected and located is reported to a gate operating system such as Orbita GateOS. The system works unattended and reports back to the gate clerk with information about the location and area of damages in real time, as a truck is passing through the lane. Typically, the system can be installed within an Orbita GateOCR portal, but it can also be mounted separately or adapted to other structures.

The hardware devices are industrial class 3D scanners that provide very detailed information about the container's structure. The use of complex algorithms developed by Orbita allows for an accurate scene reproduction and real time visualisation. As an additional functionality, while the detection process is being carried out, the system is also able to classify the container in terms of shape (20ft, 40ft, twin 20ft, flats, tank).

Empty container inspection

Customs, ports and terminals need to ensure container security, which is associated to terrorism, theft and

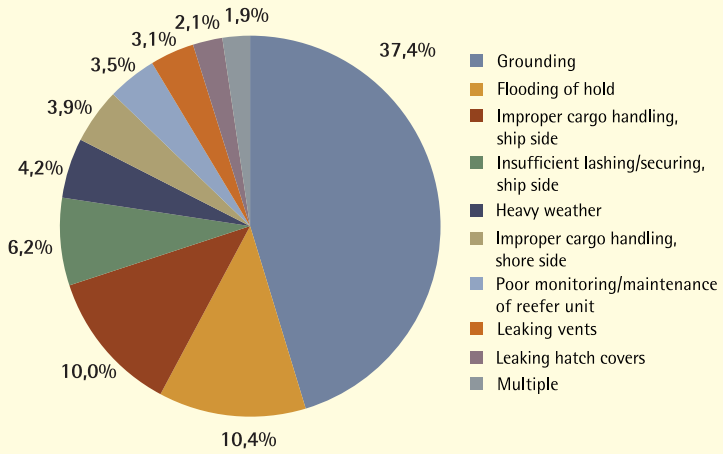


Figure 2: Swedish Club P&I Claims Analysis – cost per loss cause.

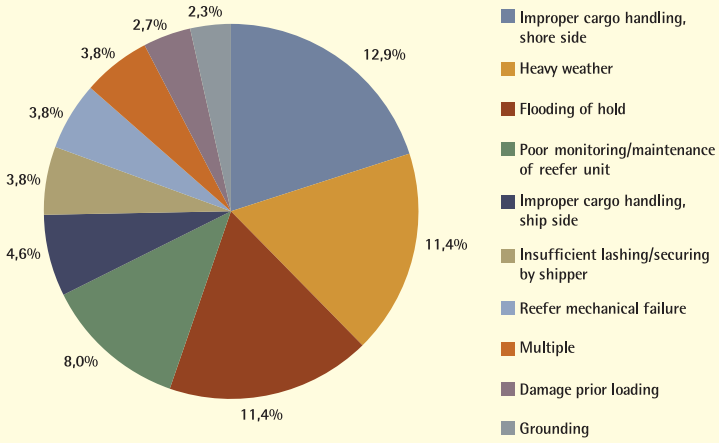
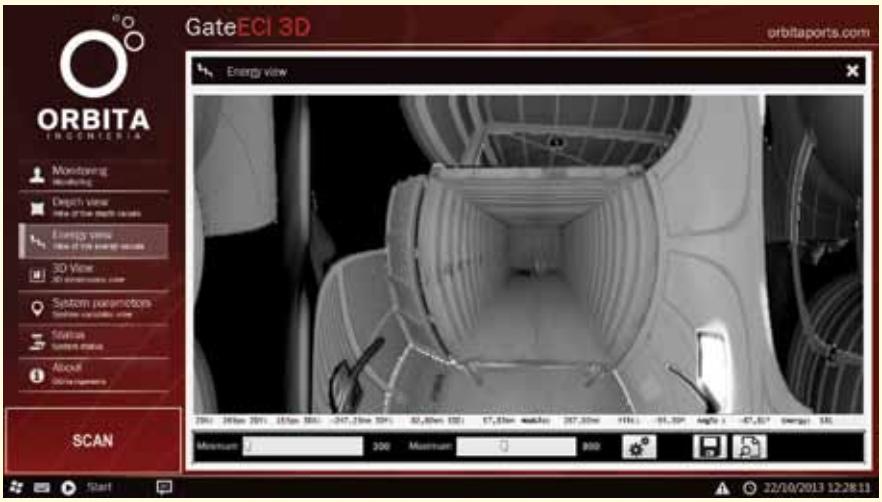


Figure 3: Swedish Club P&I Claims Analysis – frequency per loss cause.

GateDMG 3D

	FULL				EMPTY				GRAND	
MONTH	IMPORT	TREND*	EXPORT	TREND*	IMPORT	TREND*	EXPORT	TREND*	TOTAL	TREND*
Jan.	72,469	9.5%	78,185	-6.8%	22,361	-3.1%	2,3407	20.7%	196,422	2.1%
Feb.	58,915	-8.6%	79,498	-5.1%	21,515	-6.2%	17,913	8.1%	177,841	-5.3%

Figure 4: Port of Oakland TEU activity (2014).



GateECI 3D

smuggling. Consequently, since the ISPS code started to establish standard restrictions in 2004, security protocols are being adopted by container terminals around the world to control the 1,200 tonnes of hazardous materials shipments a year estimated by the US Department of Transportation. Moreover, each one of the new mega-vessels generates 18,340 twenty-foot equivalent units (TEU), meaning even more cargo is being handled at the destination terminal than ever before. Therefore, additional tools are required to have containers inspected in order to avoid unexpected goods or double walls.

According to statistical data, in February 2014 a total of 39,428 TEU of empty containers were handled in the Port of Oakland (See Figure 4). Although the number of imported empties has decreased, the trend increases by 8.1 percent for empty export containers. This data lets us observe the magnitude of the inspection issue, since 30 percent of import and a 22.5 percent of export containers are empties.

Orbita has developed an empty container inspection system to automatically detect unexpected objects or double walls inside the container.

GateECI 3D consists of a 3D scanner mounted on a mechanical positioning device. After opening the doors of the container, the system positions itself automatically and scans the interior of the container. Orbita's software processes the data in real time and is able to provide information regarding the conditions inside the container, whether there are objects in it or if the interior dimensions have been altered. Real-time data and images are sent to a gate operating system such as Orbita's GateSuite or any other third party management software.

The empty container system is the result of a continuous improvement through innovation, in order to provide ports and terminals with a solution to ease empty container inspection.

Data coming from Customs or terminals may point out specific containers to be inspected, based on pre-booking information such as goods classification, container origin or destination. With this approach, empty container inspection can be integrated into automated lanes. A higher quantity of trucks, and therefore their inspection cycle time, are distributed into as many automated lanes as there are installed.

As an additional feature, different sections of the container can be manually inspected by the user. Here the position of strange objects is highlighted to easily identify their location, while the interface displays a 3D vision of the container's interior. If it is not empty or the interior dimensions have been altered an alert is clearly shown to the clerk.

In conclusion

Automated solutions continue to be designed and developed for more efficient container processing at ports and terminals. Orbita's automated gate systems have been introduced to make container inspection easier. Since their integration they have enabled for lower inspection times, whilst providing the user with helpful registration data to support claim documentation. Furthermore, they have led to a decline in the number of claims related to damaged cargo, improved safety and security and reduced the need for human intervention within automated lanes.

About the authors

Francisco Grau Cavanillas is the business manager in charge of the ports and terminals sector at Orbita Ingenieria. He is an industrial engineer specialised in electronics and industrial automation. Over the years he has held various positions in engineering companies, yet always oriented to process automation and industrial communications. His experience and skills have been developed over more than 12 years of projects and business development in the automotive and maritime sectors. In his current role he is in charge of developing Orbita's global business in ports and terminals.

Laura Rodríguez Romo is an industrial engineer, specialised in product engineering with a master's in design management and operations, referring to areas such as management of design processes, advanced modelling systems, product development, marketing and communication strategies, logistics and operations. As a project engineer, Laura joined Orbita Ingenieria and prior to her assignment in the ports and terminals area, she worked in the mechanical engineering department. In 2013 she was appointed to her current role as project manager.

About the Organisation

Orbita Ingenieria is an engineering company specialising in process control and automation, with a significant presence in the container ports and terminals market, plus other industrial sectors such as automotive, food and beverages. Orbita's products for ports and terminals include automated processes for terminal gates and STS cranes. By dramatically improving gate, quay and yard performance as well as reducing errors in container inventory management, a rapid return on investment is assured. A modular design, plus the use of the highest quality components, allows Orbita to make maximum use of existing infrastructure and technology, minimising up-front expenditure.

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