

CONTAINER WEIGHT VERIFICATION

HOW TO ACHIEVE FAST, ACCURATE AND COMMERCIALY VIABLE SOLAS COMPLIANCE

There are now less than six months remaining before the implementation of the amended Safety of Life at Sea (SOLAS) rules requiring that any container to be loaded onto a vessel to which these regulations apply, must have its gross mass determined in advance through weighing – there are no exceptions. While the onus is upon the shipper to fulfil this obligation, the most practical location at which weighing can take place is at the ports and terminals, where lifting is a part of the existing cargo handling process. Two years ago in a previous white paper Straininstall set out the technology options, costs and opportunities for container verified gross mass (VGM) determination, as a contribution to the debate on the impending regulation. With the rules now confirmed and just months remaining before the 1 July 2016 deadline for compliance, we now offer our views on the options for fast, cost-effective and accurate compliance.

1.0 BACKGROUND – THE 2016 SOLAS AMENDMENT

In developing the new 2016 SOLAS amendment on container VGM determination, the International Maritime Organization (IMO) has kept things simple. From 1 July 2016 onwards, in order to protect the safety of ships, workers both on board and ashore involved in the handling of cargoes, and overall safety at sea, the verified gross mass of any packed container must be declared prior to stowage on board the vessel. This is not an optional requirement or an indication of best practice, but rather a legal obligation for all vessels affected by SOLAS regulations visiting any port in any IMO member state, anywhere in the world.

Two methods of container VGM determination are permitted. Method 1 requires that the pre-packed and sealed container is physically weighed using calibrated and certified equipment. Alternatively, Method 2 allows that all packages and cargo items – including pallets and other packaging materials – can be weighed separately using similarly calibrated and certified equipment, and the net summation added to the tare weight of the container to provide a gross verified packed container weight.

Whichever of these two processes are used, the estimation of container weights – as has been largely accepted practice in all parts of the world to date – is expressly forbidden under the new SOLAS amendment. There is no SOLAS prescribed time deadline for shipper's submission of the verified gross mass of each container, other than that this information must be provided in time for it to be used by the ship's master and the terminal representative in preparing the stowage plan for the vessel. Moreover, it is a requirement that container VGM data must be used in preparing the vessel's stowage plan.

WHO IS RESPONSIBLE?

If the new regulation is clear, at least in principle, on what needs to be done to achieve compliance, it is also unambiguous on who is ultimately responsible: the shipper – and in the terms of the regulation this means the person or entity named on the ocean bill of lading – must provide the verified gross mass of the containers it wishes to be shipped by the carrier. Container VGM determination can be subcontracted to a third party by the shipper, but the shipper remains responsible for regulatory compliance.

The organisation responsible for the oversight of conformance to this new SOLAS regulation is the competent authority of the jurisdiction in which the container is being prepared – for example, the Maritime & Coastguard

Agency (MCA) in the UK. Where Method 2 is being used in the UK, it should be noted that service providers carrying out container VGM determination must be accredited by the MCA.

In receiving each container's VGM determination for preparation of the vessel storage plan, the carrier does not need to verify the accuracy of the declared container gross mass, but the documentation provided by the shipper must be signed to confirm its compliance with SOLAS requirements. By this, the regulation requires that a specific, named individual is identified as having verified the accuracy of the weight provided.

While it might be tempting for port and terminal operators to breathe a sigh of relief that the shipper carries ultimate responsibility for container VGM determination under the new SOLAS rules, things are not that simple. To start with, most shippers lack the resources to implement container VGM as an integral part of their current operations. While they may carry ultimate responsibility for compliance, the implementation of certified and approved container VGM processes within the shipper's own operating environment is unlikely to be a practicable proposition for all but a few. This task will need to be sub-contracted in most cases if post 1 July 2016 shipments are to be SOLAS compliant. As such, port operators will be faced with the prospect of either turning away non-compliant consignments with the consequent disruption to both them and the carrier that this will entail, or implementing processes to enable container VGM to be determined at the terminal.

As the subsequent sections of this paper demonstrate, within the port and terminal environment container VGM determination can be implemented in a cost-effective manner offering a high degree of accuracy, which need not adversely affect existing cargo handling processes. Moreover, as the requirement for container VGM declaration is squarely upon the shipper, the technologies described herein could be considered as offering a potential additional value-added commercial revenue stream for the terminal operator. This opportunity is emphasised in the amendment to the regulation making it clear that the commercial costs of providing a VGM determination service can be passed back to the shipper, and that commercial arrangements will have to be put in place for this purpose.

2.0 CANDIDATE SOLUTIONS – WHERE TO WEIGH?

There are numerous candidate systems and technologies that are capable of delivering the required accuracy of measurement required under the new SOLAS regulations. Not all, however, are particularly practical in terms of their ability to operate as a part of the existing flow of cargo between consignor and recipient.

In our 2013 white paper we broadly segmented such solutions into indirect and direct measurement systems, and provided detailed descriptions of each. The former category is represented by weighbridge systems which record the gross weight of vehicles, while the latter is represented by the many mechanical handling devices used to move containers as part of existing port and terminal operations. These include the full range of container handling equipment, from reach stackers, RTGs and straddle carriers, and perhaps in the future even the spreader systems of ship-to-shore cranes. The following is a brief summary – for more detail see our previous white paper [ADD LINK TO WEBSITE LOCATION]. <http://www.straininstall.com/files/4414/5252/2893/>



[Taking_the_load_off_-_technology_options_costs_and_opportunities_for_the_implementation_of_container_weight_verification.pdf](#)

WEIGHBRIDGES

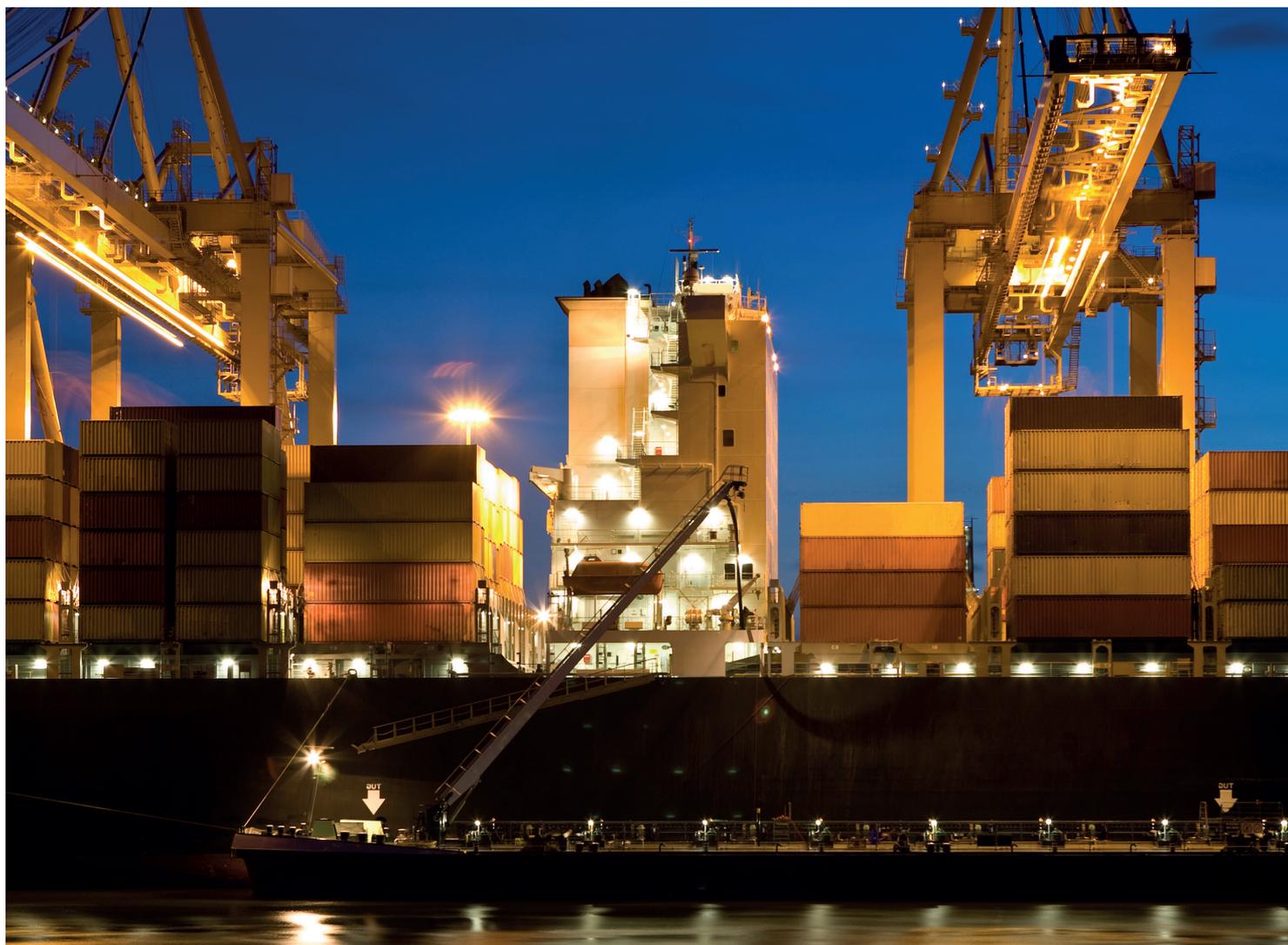
Weighbridges are proven technology for the measurement of gross vehicle weight. Unless they are required for some other aspect of cargo handling operations, they represent a significant capital investment that has no other application. Moreover, weighbridges do not in themselves deliver directly the required gross mass of the container required by SOLAS. Instead, to arrive at this figure the tare weight of the vehicle (including both the tractor and chassis/trailer as appropriate) plus the mass of any fuel in the tank, additional items carried and the driver, must all be subtracted in order to deliver an accurate container weight. The regulations do not allow for the estimation of any of these so that in most cases two weighing operations will need to be carried out in succession, respectively with and without the container loaded onto the vehicle. In addition, where a vehicle is used to convey more than one container, simply dividing the total mass – after subtracting the effective vehicle tare weight – is not acceptable under the new regulations as a means of calculating individual container weights. The

potential for this approach to container VGM to create additional bottlenecks in the port and terminal processes is therefore significant, as is the capital cost of implementation.

For some shipping operations – particularly where vehicle weights are required for other purposes and hence access to an existing weighbridge is readily available – this may provide a pragmatic if operationally complex route to SOLAS container VGM compliance. In most cases, however, an alternative based on integration of container weighing into equipment already used for container handling within the terminal is likely to be operationally less disruptive and more cost-effective.

TWIST-LOCK BASED SOLUTIONS

Solutions integrated with spreader twist-locks offer at first sight perhaps the most attractive approach to accurate container weight measurement. The need for robustness here is, however, significant. It is widely accepted that the most abused part of a crane is the spreader mechanism, which is exposed to numerous impact loads that can be significant. Any measurement solution must be sufficiently robust to withstand these repeated loading cycles and excess loads while also maintaining its calibration accuracy.



A key consideration for such a solution is whether the measurement technology is integrated within the consumable parts – the twist-locks themselves – or instead within their associated collars or other non-consumables. There are two reasons that favour the latter approach: firstly, twist-locks need to be replaced on a regular maintenance cycle, meaning that any measurement system integrated within them must be removed with the obsolete part and either replaced or reinstalled and recalibrated in the new replacement locks. The more complex and sophisticated the measurement equipment incorporated into the twist-lock, the more expensive and potentially disruptive to operations its replacement is likely to be. Secondly, twist-locks are not ideally designed for load measurement purposes, and due to the aggressive duty they are subjected to, they are susceptible to the type of damage which while acceptable for normal operations, may compromise the accuracy or calibration of any measurement systems integrated within them.

For customers wishing to implement a twist-lock based container VGM system, Strainstall recommends solutions based on durable and long-lasting strain gauge instrumented twist lock collars. This approach offers in Strainstall's opinion the best available form of twist-lock based solution in terms of cost, accuracy and long term durability. However, the company can also provide instrumented twist lock solutions where these are preferred based on the specific operational needs of the customer.

INTEGRATED LOAD PINS

Load pins offer perhaps the most well-proven, robust, cost effective and accurate means of weight measurement, and can be integrated into a wide range of port and terminal equipment. This is a mature, cost-effective and highly accurate technology that Strainstall has proven across a wide range

of industries, including many similarly demanding applications. These include, for example, the monitoring of large offshore structures, oil and gas installations, and harsh subterranean mining applications. Customers can be assured, therefore, that the technology they receive is robust and extremely well-proven against environmental conditions, shock and vibration.

Crucially for both load pin and twist-lock based implementations, Strainstall's experience has been that there is no requirement for current terminal operating procedures to be changed or extended in duration in order to be able to acquire the VGM of each container in a SOLAS compliant manner.

3.0 GENERAL REQUIREMENTS FOR IN A CONTAINER VGM SOLUTION

RETROFIT COMPATIBILITY

With the 2016 SOLAS regulations in force, it is likely that all new container handling equipment will be designed from the outset to incorporate container VGM technology. Other than for the very few new installations currently in planning, however, SOLAS compliance will need to be achieved via the installation of retro-fit solutions onto existing assets. A key consideration in selecting a technology or solution is therefore likely to be its robustness within and adaptability for straightforward installation on a wide range of operating equipment and environments, without compromising accuracy or requiring extended downtime.

Strainstall's focus upon load cell and strain gauge solutions means that the company is able to offer an extremely wide range of cost-effective systems tailored to the precise requirements of the various container handling equipment operated by each client. The company has experience



of retrofitting load cell systems into spreaders, headblocks and sheaves, enabling incorporation as a permanent feature of the container handling equipment with minimal wear. In almost all cases, no modifications to the equipment is required, and the system can be installed and tested and commissioned typically in less than two hours.

Strainstall's container VGM systems benefit from the same level of expertise that the company deploys in creating robust, high quality and cost-effective solutions for the structural monitoring and load measurement of safety and commercially critical plant and infrastructure, from petro-chemical plants to major road bridges. Key components of Strainstall VGM solutions are secured in sealed enclosures that offer ease of access for lifelong low maintenance, providing ease of integration with terminal operating systems in a wide variety of data formats.

ACCURACY AND IMPLEMENTATION DEADLINE

While the deadline for implementation of the new SOLAS regulations is fast approaching, key aspects of the required accuracy of compliant VGM systems are yet to be fully defined. This puts port and terminal operators in the very difficult position of being unable to select systems in the absence of a full specification of the precise rules that will govern their application.

Accuracy requirements are set by the competent state authority for SOLAS regulations within each jurisdiction. Three key parameters need to be defined in order for effective implementation to take place in each SOLAS state:

1. The VGM accuracy threshold required for prosecution – effectively the amount by which the declared mass of a container is allowed to vary from its measured weight before it is declared non-compliant. The accuracy of the equipment required in order to deliver the above VGM – this must clearly be a tighter limit than that prescribed for the prosecution level above
2. The process to be followed for the equipment suppliers to obtain certification of installed VGM equipment

In the case of the first of these parameters, in the UK the MCA has proposed a limit of $\pm 5\%$ as the threshold for prosecution; that is, varying by more than this tolerance from its officially declared weight. All SOLAS states are working to confirm the above requirements, and it is to be hoped that the resulting regulations will be as far as possible, universally applicable.

This is thus the nature of the dilemma facing port and terminal operators: however well-packaged, proven and easy to install, can they really risk opting for a container VGM solution now before the required accuracy parameters for their jurisdiction are determined?

Strainstall's approach to this dilemma is twofold. In the first instance, we are watching each step of the negotiations in the key markets we serve, such that we can move as quickly as possible to support our customers when the time comes. More importantly, we are ensuring that the container VGM solutions we provide in all parts of the world are specified in a manner that exceeds the likely worst case scenario in terms of accuracy and certification. In this way, customers can have confidence that our solutions will be SOLAS compliant the moment the regulations come into force.

A crucial consideration regarding the accuracy claims of candidate systems and suppliers, is whether they are expressed in terms of a percentage of the maximum load (often referred to as the percentage of Full Scale or Rated Capacity) or across the full working range of the system (often expressed as percentage of Applied Load). This is important, as an accuracy of $\pm 1\%$ of Rated Capacity for a 40 tonne system, for example, will only provide an accuracy of $\pm 400\text{kg}$ across the working range giving the potential for a 10% error when lifting a 4 tonne load. To ensure full worst case compliance with SOLAS therefore, we are ensuring that our VGM solutions are highly accurate across the full range of possible container weights and not just at high loads. As such, our customers are assured that their equipment will be compliant from the very lightest to beyond the maximum allowable weight of a loaded container.

SERVICE, CALIBRATION AND MAINTENANCE

The ability of a solution provider to deliver through life service support is crucial for ensuring long-term compliance. Occasional damage to equipment in the arduous environment of container handling systems

is an ever present risk. Load pin and strain gauge based systems are comparatively very easy to maintain in situ without the need for external technical support. For example, damaged cables can often be easily repaired by a competent site electrician – something that is far less likely to be the case with other VGM technologies. Strainstall can provide service kit and training such that this type of minor servicing and calibration operation can be carried out without the cost and risk of delays of having to commission support from the original equipment manufacturer or an external service contractor.

4.0 ACHIEVING SOLAS CONTAINER VGM COMPLIANCE – HOW STRAINSTALL CAN HELP

With the deadline for compliance with the new SOLAS container VGM regulations fast approaching, there is much for the industry and port and terminal operators to do to ensure this opportunity is realised and disruption to operations come 1 July is minimised. As outlined in the previous section, the precise nature of accuracy and certification requirements are still to be fully defined and may well vary between jurisdictions. But by taking an accuracy-led approach, focused on what we believe to be the most likely worst case scenario, Strainstall aims to enable port and terminal operators to gain a level of first mover advantage.

Why should they do this? In short, because ports and terminals are the natural environment for container VGM solutions to be implemented, as packed containers are processed as a part of normal operations. Here, there is no need to implement separate lift and drop or more complex weighbridge-based processes. As the shipper is responsible for declaring the packed container weight, this offers the very clear opportunity to provide an additional added value commercial service for the port or terminal operator.

As we have shown in this white paper, numerous solutions are available for cost-effective retrofit integration on existing assets, including the full range of container handling equipment, from reach stackers, RTGs and straddle carriers. While do not believe it will be a particularly attractive location for VGM determination – as it would clearly be too late to affect the stowage plan – it may be that in the future the technology is also integrated into the spreader systems of ship-to-shore cranes to enable in-bound checking of VGM.

A TRUSTED BRAND

Strainstall is one of very few potential suppliers of container VGM technology that can offer a truly broad range of proven technologies that have been proven across multiple industries worldwide. Its highly experienced engineers can adapt systems for retrofit in the most challenging of environments, offering unparalleled standards of accuracy in highly cost-effective bespoke solutions. Moreover, the company's extensive network and reach ensures that customers around the world are never far from support and service when it's needed to keep their business moving.

TIME IS OF THE ESSENCE

It may well be that given the delay in defining the precise accuracy and certification requirements for SOLAS compliance, that some jurisdictions ultimately decide to postpone or to taper implementation in some way. However, the IMO has previously stated that the implementation date will not be extended, so such easing of the deadline should not be counted upon.

At Strainstall, we are supporting ports and terminals who wish to select their container VGM now with technology which exceeds our opinion of the likely worst case scenario of accuracy and certification requirements. Equally, we will endeavour to support those customers who wish to defer their purchase decision until the full details of the regulations are confirmed.

While many alternative container VGM system providers and technologies are available, we believe that Strainstall's products offer the most attractive solution in meeting this new container VGM regulatory challenge. Our name and reputation is second to none in protecting and monitoring some of the most safety- and commercially-critical assets and infrastructure. By selecting Strainstall, therefore, our customers are secure in the knowledge that they are using a brand trusted throughout the world for accuracy, robustness, service and value.

ABOUT THE ORGANISATION

Strainstall, part of the James Fisher and Sons plc group, is an expert in all areas of monitoring, load measurement and sensor based technology. With engineering teams who've acquired an international reputation for work in strain gauge based technology, the company is dedicated to the acquisition and interpretation of data. Strainstall use a diverse range of strain gauges, load cells, measuring techniques and specially developed data acquisition systems to monitor and solve problems across a wide range of industries. Through continuous innovation and development, Strainstall has a range of world-class monitoring technologies that continuously monitor physical and performance parameters such as load, stress, temperature, acceleration, pressure and displacement for industries ranging from the global shipping and marine engineering sector to construction and renewable energy.

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FURTHER INFORMATION

- Strainstall's 2013 technical paper: Technology options, costs and opportunities for the implementation of container weight verification: http://www.strainstall.com/files/4414/5252/2893/Taking_the_load_off_-_technology_options_costs_and_opportunities_for_the_implementation_of_container_weight_verification.pdf
- World Shipping Council: <http://www.worldshipping.org/industry-issues/safety/cargo-weight>
- World Shipping Council concise guide to SOLAS amendment: http://www.worldshipping.org/industry-issues/safety/WSC_Summarizes_the_Basic_Elements_of_the_SOLAS_Container_Weight_Verification_Requirement_February_2015.pdf
- The SOLAS Amendment: http://www.worldshipping.org/industry-issues/safety/SOLAS_CHAPTER_VI_Regulation_2_Paragraphs_4-6.pdf
- IMO GUIDELINES REGARDING THE VERIFIED GROSS MASS OF A CONTAINER CARRYING CARGO: <http://www.imo.org/en/OurWork/Safety/Cargoes/Containers/Documents/MSC.1%20Circ.1475.pdf>
- UK Maritime and Coastguard Agency (MCA) guidance notes for the implementation of SOLAS amendment: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/436986/MGN534_Complete.pdf
- Industry coalition FAQs document: http://www.worldshipping.org/industry-issues/safety/faqs/SOLAS_VGM_Industry_FAQs_Dec_2015_US_letter_WEB.pdf
- History of IMO effort to improve container safety: http://www.worldshipping.org/History_of_IMO_Effort_to_Improve_Container_Safety_May_2014.pdf

CONTAINER WEIGHT VERIFICATION: AN OVERVIEW AT 5 MONTHS IN



It has now been a few months since the implementation of the amended Safety of Life at Sea (SOLAS) rules requiring that any container to be loaded onto a vessel to which these regulations apply, must have its gross mass determined in advance through weighing. This is a brief overview of how successfully the rules have been implemented as well as the remaining work to be done and the problems these pose.

Previously we have explored the variety of concepts and systems available to fulfil this requirement. What is apparent a few months in is that there is a place for each of these types of system somewhere in the logistics chain. We are now seeing the full spectrum in operation from shippers using both Methods 1 and 2 to provide a VGM as well as public weighbridges, third party weighing service providers using portable equipment and terminals using a further subset of options to provide a VGM by Method 1.

What has become clearer now is that the most logical place to provide this VGM purely from the SOLAS point of view, not taking into account points of view such as road transport, is that the terminal is the most convenient place to provide the service no matter where it originates, nor the means of transport nor who the shipper may be, the container will at some point pass through a terminal already equipped with container handling equipment prior to export.

On a global scale, we can see that many regions have largely embraced this and many terminals have now implemented or are implementing some means of providing a VGM.

What is also clear though, is that there are still some discrepancies in the coverage available for providing a VGM, in the tolerances adhered to by the many different states and the costs applied to the containers being weighed.

The available coverage has been affected partly by the speed of the individual states in clarifying the local requirements based on the wider SOLAS requirement. Many countries were debating this as late as July leaving little to no chance of full compliance by 1 July. Even now, several countries have implemented a grace period with what is referred to as a temporary looser tolerance, however in these cases, there is no indication of what the tolerance will be when the grace period ends and so this maintains the uncertainty and discourages terminals from investing at this time.

An important result of this uncertainty and variety of solutions is significant discrepancies in the costs that are ultimately passed to the customers. From publicly available information, we can see the costs vary from under €20 to over €120 per container weighed depending on the type of service used. It seems fair to assume that with time, these more costly solutions will come under commercial pressure to adapt.

WHAT DOES THE FUTURE HOLD?

The aspects that we can safely say will change are the end of looser tolerances through grace periods. Also, as the coverage improves and more terminals fully implement their solutions and procedures, it is likely that commercial or time pressures will squeeze some of the weighing options currently available such as the third party services that have to visit a customer site and some systems whose procedures create bottlenecks. As this happens, it seems logical to expect the discrepancies in pricing to come closer into line with each other across territories.

The important thing to remember throughout these early days is that the end goal of improving the safety of life at sea is absolutely a worthy cause and the new regulation will ultimately achieve that goal.