An operations perspective on new twistlock handling in terminals

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Introduction

What would be the impact on the container terminal industry, if containers were equipped with integrated twistlocks? A cost efficiency analysis demonstrates the significant cost savings to the industry and highlights safety, productivity and sustainability benefits.

For a long time, the handling of twistlocks (or cones) and semi-automated twistlocks (SATL’s) has been a heavy burden for the container industry. The burden consists of the operational cost to place and remove these cones in every step of the container supply chain (on the vessel, on road trucks and on trains). Moreover, the handling (coning and deconing) typically takes place in areas where dense traffic takes place, such as the apron of a container terminal, or where inherently unsafe situations take place, such as the hold of the vessel, or close to moving containers. It is therefore often a source of injuries or casualties.

The introduction of the SATL has already removed the locking and unlocking of the cones on the vessels, but still requires the manual placement and removal of the cones, and as such only addresses some of the costs, and does not address the safety issues.

Automated twistlock handling stations

There have been many efforts in developing automated twistlock handling stations (see Port Technology International editions 50-58), which could carry out this placement and removal of the twistlocks. Although various tests have been carried out, it has not led to a large-scale application. Here, various reasons can be identified, both technical and economical. To mention a few:

- Not all types of twistlocks can be handled
- When the twistlock station gets jammed, it is blocking a large area under the QC
- Ideally, the station is placed on a sill beam rather than on the ground. However, this adds a significant weight to the QC, which may have impact on the crane, and possibly reduces crane lifting capability
- The stations still have to be supplied with sufficient twistlocks
- The stations needs to be replaced every time the QC moves, even when it moves only half a meter the station is not positioned correctly
- The stations are not easily applicable to on-dock and inland rail environments
- The stations require skilled labor for maintenance
- The stations will reduce productivity in bombcart environments
- The investment required for a single station is quite high (more than $1 million), leading to a quite long return on investment

Universal Container Locking System: how it works

Another development, and the focal point of this paper, is the Universal Container Locking System (UCLS), a system that is fitted into the corner castings of a container, and fulfills the container locking and unlocking without the need to place or remove it every time a container gets handled.

The UCLS was devised on the premise that the container shipping industry needs a single, safe, easily adaptable and truly automated system for securing containers during transport across the entire container supply chain. It is designed to improve safety, productivity, environmental sustainability and profitability for shipping companies, railroads and terminal operators.

The UCLS is in the final stages of development and early stages of field testing with RMG cranes, straddle carriers, top picks and side picks are promising. The safety and economic opportunities are compelling and worthy of serious consideration by the maritime community (shipping lines and terminal operators), railroads and trucking community.

The first image in Figure 2 shows a UCLS locking unit mounted in the lower corner fitting of a standard ISO container. A UCLS actuating unit is housed in the upper corner fittings of containers as shown in the second image of Figure 1. Simple, rugged linkage connects the actuating and locking units. The linkage is protected by existing container structure and does not reduce the cargo carrying capacity of the container. When the...
twistlock of a hoisting spreader locks to the container to hoist it, the twistlock engages the UCLS actuating unit which in turn causes the UCLS locking unit to rotate to the unlocked position. The container can then be hoisted clear from its base as shown in the third image of Figure 2. When the spreader twistlock unlocks from the container, the UCLS locking unit returns to its natural, fully locked position. When a conventional twistlock (SATL or fully automatic twistlock) engages the upper corner fitting of a UCLS equipped container, the UCLS locking unit remains in its fully locked position allowing conventional containers to be stacked on UCLS containers onboard ships and in container yards exactly as they would on any other container. Other common container securing equipment such as lashing rods or bridge fittings etc. do not interfere with UCLS components.

Safety and savings

The UCLS solution will improve safety in maritime and rail container handling operations. Additionally, the trucking community will realize safer working conditions at marine and rail container terminals.

- No men aloft on ships to unlock twistlocks
- No falling twistlocks
- No maritime twistlock handlers in congested areas under gantry cranes

**Savings attributable to the UCLS solutions are:**

- Safety – reduced costs of twistlock and twistlock handling injuries
- Reduced manning
- Increased productivity – crane lifts per hour
- Loose gear replenishment
- Improved operational expense per container

Fitting 18 million containers for a global implementation requires a large, one time, upfront investment. So what are those savings, and how quickly can they be earned back?

The saving associated with reduced manning consists of the complete elimination of the twistlock handling on shore, as well as some of the twistlock handling at the ship. Lift drivers for shifting cone bins in some environments are not considered here. For a terminal of 1 million TEU, six QCs, there is a saving of approximately 50-55,000 man hours annually. In Table 1, we have listed the typical direct savings per container for a terminal of that size. Obviously, the higher the labor cost, the higher the possible savings.

The payback period for the terminal’s share in the overall investment ranges from 1.5 years in a high cost environment ($100 per man hour) to 7.7 years in a low cost environment ($20 per man hour); which are both fully acceptable for the entire industry. The estimated average global labor rate of $50 per man hour suggests an average industry payback in the range of three years.

In addition to the direct savings, we could expect that at a straddle carrier terminal, the QC productivity increases approximately 10 percent because UCLS containers convert indirect lifts (those lifts that must stop mid-hoist for twistlock handling purposes) into direct lifts (those lifts that go directly from the quay to the ship and vice versa). These savings will also be realized at terminals that load or discharge directly to street chassis. For terminals that only utilize bomb carts, the QC productivity would not increase substantially, as the impact on tractor-trailer cycle time is less than 1 percent. UCLS related savings attributable to increased productivity (direct lifts) is estimated at $1.25 per global lift.

Safety related savings and loose gear replenishment costs are not considered here, however the upside potential should be recognized.

**How to implement globally**

Worldwide, there are approximately 18 million containers. How can our industry implement the UCLS, as it offers such profound impact in terms of handling costs, and operational safety?
Here we elaborate on one of the possibilities, departing from the idea that the key stakeholders are the terminal operators. The number of injuries and lost time injury frequency will drop significantly, as one of the most dangerous jobs is eliminated from the process. As with all automation efforts, the reduction of jobs will, in a highly unionized environment, be a challenge. However, given the potential improvement in safety of members, unions should embrace the UCLS solution.

So, how can the joint terminal operators get this system implemented, overcoming the chicken and the egg problem? Let’s first look at upgrading the existing fleet of containers. Existing containers can be upgraded with UCLS components in approximately one hour in a workshop. New build containers can be manufactured today with UCLS linkage access holes in anticipation of a UCLS rollout which reduces container upgrade time by more than 50 percent. Following UCLS implementation, it is expected that installation of UCLS components will be fully incorporated into the new build process. A container visits a marine container handling facility approximately 18 times per year. Obvious locations are low cost ports where many containers are transshipped, such as Shanghai, Hong Kong, Singapore or Los Angeles/Long Beach. Shanghai sees approximately 13 million containers passing through, Singapore 8 million and Los Angeles/Long Beach approximately 7 million.

Besides introducing these dedicated locations, large repair shops could be supplied with the UCLS, so that every container passing there will also be equipped. Of course, there will be containers that only move within a limited region, as they are owned by lines that are not global operators. For these containers, a more detailed strategy has to be developed.

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Although UCLS equipped containers can be landed directly on the terminal surface (UCLS components and corner fittings have been compression tested and withstand the compressive force of eight fully loaded containers), it is anticipated that terminal operators will make use of Terminal Deck Sockets (TDS) to eliminate damage to the terminal surface (see Figure 3 for TDS images).

Type 1 TDS are flexible in that they can be put into position and picked up quickly. It is anticipated that Type 1 TDS will be used in early stages of a UCLS rollout or in areas of terminals that store containers on a temporary basis. Type 2 TDS are easily put into position and picked up with lifts or other container handling equipment and have a means of semi-permanently securing them to the underlying terminal surface.

Type 3 TDS are more substantial, with additional anchoring qualities and support under the terminal surface. Type 3 TDS may allow high density terminals to expand vertically, if necessary, with more safety. Long-term, this would be the way forward when UCLS gets implemented. The higher the stacking, the lesser TDS will be required for a certain volume.

Equipping the yard with TDS will be a large, one time exercise. However, as the following example indicates, investment in
TDS is in the best interest of the terminal operator. Given the variety of TDS and the even greater variation of terminal operations and configurations it is challenging, within the scope of this article, to quantify the cost and reward of TDS on a global scale. However, an analysis at the terminal level can shed some light. Analysis of a straddle carrier terminal showed that the terminal recently handled approximately 1.3 million vessel lifts annually. The terminal has approximately 13,800 decked 20 foot container slots. Given the estimated UCLS related savings at this terminal, the operator could expect savings per 20 foot slot in the range of $3,000 annually (assuming the terminal operator retains all UCLS savings). TDS are expected to last 20 years or more. Given that RTG/ASC environments generally have fewer grounded slots, the savings per slot in those environments is expected to be slightly greater.

Of course, as the percentage of containers with will grow steadily, the installment of TDS can also be gradual, across one or two years. For example, in early stages of a UCLS implementation, today’s TOS can be used to code and plan UCLS containers on the second tier or higher. In a one over three straddle carrier environment, the use of TDS could be postponed until the transition to UCLS containers is approximately 50 percent complete. In RTG/ASC environments, TDS can be added to terminal bays over time as UCLS containers become more and more common as demonstrated in Figure 4. The TDS are able to be used for containers without UCLS, so storage capacity should not be affected.

A secondary advantage of TDS is that they can reduce damage to terminal surfaces and the associated costs of occasional resurfacing projects caused by conventional containers (see Figure 5). Applying TDS reduces pavement maintenance significantly, also improving the availability of yard space over time.

Furthermore, upgrades for some hinterland transportation equipment (train wagons and truck chassis) will be necessary. Equipment that has fixed male chassis pins require upgrades to female ISO sockets. All upgraded equipment can handle conventional and UCLS containers during a transition period to the UCLS solution. Additionally, the rail community will realize UCLS related savings similar to the maritime community and the trucking community can likely realize indirect benefits beyond the scope of this article. All in all, it is a large investment in infrastructure, but not significant compared to the cost of fitting the scope of this article. All in all, it is a large investment in infrastructure, but not significant compared to the cost of fitting

**Business models for implementation**

Another challenge to consider is how to equitably share investment and reward of UCLS related savings. The general view of terminal operators is the UCLS solution helps operators achieve safety, productivity and economic goals. However, since the equipment (containers) belong to the shipping companies, they can do nothing until shipping companies drive implementation of the UCLS.

The general view of shipping companies is the UCLS solution will help lines achieve safety, productivity and economic goals. However, lines are generally of the opinion that terminal operators will retain all of the economic benefits. Therefore, what is needed is open, constructive dialogue between leading shipping companies and leading terminal operators potentially via conference and industry work groups.

Several high level models may be considered to spark discussion:

1. Shipping lines drive implementation and demand reduced terminal handling charges (the generally perceived traditional approach)
2. Terminal operators offer handling lines reduced terminal handling charges for UCLS equipped containers, for example:
   a. Load/discharge standard ISO containers - $200
   b. Load/discharge non-standard ISO container - $200 plus
   c. Load/discharge UCLS equipped container - $180*

   *Rates to be negotiated by shipping line and terminal operator.
3. Terminal operators jointly invest in a mutual association to fund UCLS investment in container upgrades (on behalf of, and in coordination with, shipping lines) and retain 100 percent of the ensuing savings.
4. Terminal operators and shipping lines jointly invest in a mutual association dedicated to UCLS implementation. A per lift license fee is collected to fund investment and redistributed to investors.

In order to have a few pivotal terminals mount all the UCLS devices, they need to be paid by all the terminals worldwide to share the benefits. For this, we deem that an intermediary organization of united terminal operators (they would be the joint venture partners) raise the money needed. Every terminal would pay its share based on the waterside moves it performs. The terminals executing the retrofitting process get paid from the jointly collected funds. Each terminal would need to raise approximately $10 per container handled over the quay. In addition, they would need to equip the yard with the required TDS in some form. However, these costs are small compared to the contribution to the container retrofit.

**Conclusion**

The safety benefits of the UCLS solution are clear. Economic analysis suggests a managed, timely global UCLS implementation is achievable and an attractive investment for the container shipping community as a whole. To achieve the safety and economic benefits of the UCLS requires buy in and guidance from industry leading shipping companies and terminal operators. UCLS work groups at upcoming conferences and industry organization events should be created to spark discussion about funding approaches and implementation strategies for the mutual benefit of all industry stakeholders.

**Figure 5. Impact of container grounding on pavement.**