INCREASING CONTAINER DWELL: ADDRESSING THE CHALLENGE OF HIGH YARD UTILISATION

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SOLVING CONGESTION WITH YARD OPTIMISATION

As of mid-December 2021, there were some 101 ships waiting for berth space at the Port of Los Angeles and Long Beach. What's more, the congestion being experienced on the US East Coast isn't isolated to this region. Ports around the world are reporting strong congestion issues throughout 2021 with no end in sight. In talking to several terminal operators in the Ports of Los Angeles and Long Beach, we've come to understand that many of them are operating at

over 90-95 per cent of their terminal's designed yard capacity, and some are even exceeding the design capacity, finding space wherever possible to accommodate the significant overload of inbound containers.

To help resolve the capacity issues, the City of Long Beach temporarily waived enforcement of stacking-height limits in late October 2021. This has allowed terminal operators to increase their stack heights from a maximum of two-high stacks to five-high container stacks for a 90-day period. To the public, this is likely

perceived as a positive outcome, but to the terminal operators, it brings an entirely new set of challenges and risks to manage and mitigate.

When you peel back the layers to the congestion challenge, one realises that it isn't simply about port capacity. The entire supply chain is congested. The average dwell time for inbound containers is up across the board at both maritime and intermodal facilities. In Chicago, some intermodal facilities are operating at over 120 per cent capacity primarily due to an inability to discharge import

containers in a timely fashion. Container dwell time has gone up across the board, and the impacts on terminal operations are significant. It's clear that the broader supply chain congestion is a challenge that must be addressed; however, in the short-term, maritime and intermodal terminal operators need proven solutions to help them resolve their capacity issues now. This is where optimisation, specifically yard optimisation, comes to the forefront of the conversation.

A BRIEF EDUCATIONAL DETOUR

Before we get into how yard optimisation can help terminal operators, it is very important to take a quick educational detour to understand why it can help. The correlation between stack height and rehandles has been carefully studied, documented, and tested over the past three decades. In one of the original research papers on the topic, Bernardo Castilho and Carlos Daganzo from the University of California documented their findings on the topic well. If we take the scenario in Long Beach as an example, prior to the city extending stack heights, it would be expected that a terminal would experience two rehandles to extract an import container. By increasing the stack height potential to five high, the expected rehandle rate increases to just over three moves – a 50 per cent increase in cost and a 33 per cent decrease in equipment productivity.

Simply stacking higher doesn't alleviate the issue. Firstly, you must have the equipment at hand that can stack higher. As an example, most straddle carrier yards will still be very confined due to hardware limitations. Secondly, add to this equation a highly unpredictable drayage call schedule (which results in unpredictable dwell times for containers and poor stack designs), and you have the perfect recipe for poor yard operations, unproductive equipment, and high operating costs. Expanding the yard outwards (i.e., more stacks) may result in fewer rehandles, but it comes at a comparable decrease in equipment productivity due to increased travel distances for both loaded and unloaded moves.

The only real short- and long-term solution to resolve the challenge of managing high yard utilisation is to improve the decision-making around container placement. To achieve this, Operations Research (OR) based algorithms have proven their worth for over 20 years, and more recently, Artificial Intelligence (AI) based algorithms are further enhancing the significant gains already possible. INFORM's Yard Optimizer (YO) and Machine Learning (ML) modules are proven solutions for managing the congestion challenges the supply chain is facing today.

DRIVING EFFICIENCY FOR MARITIME OPERATORS

Improving the utilisation of ship-to-shore (STS) cranes to allow for quicker turnarounds of backlogged vessels is the primary challenge for most maritime ports affected by the current congestion. INFORM's Yard Optimizer increases the productivity of equipment peripherally to the yard, such as STS cranes or rail cranes, by ensuring good yard stacks have been made prior to and during peak operations.

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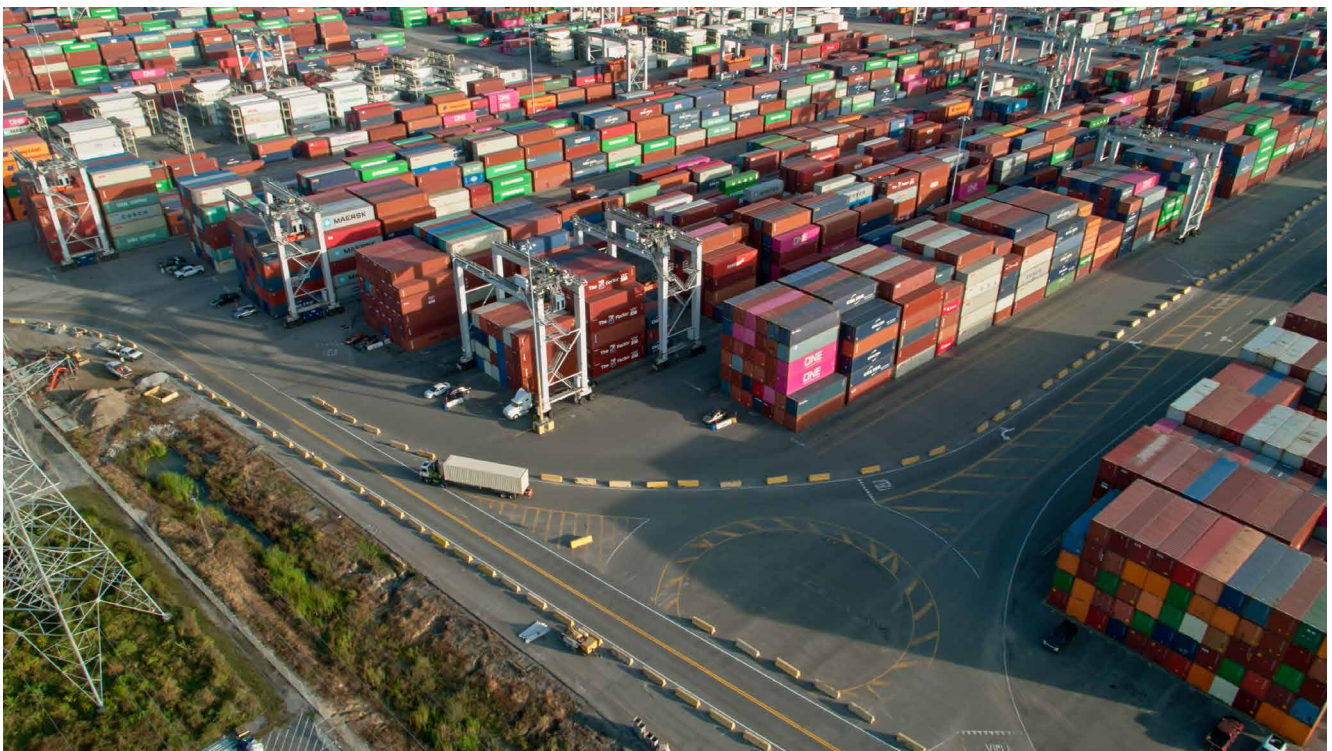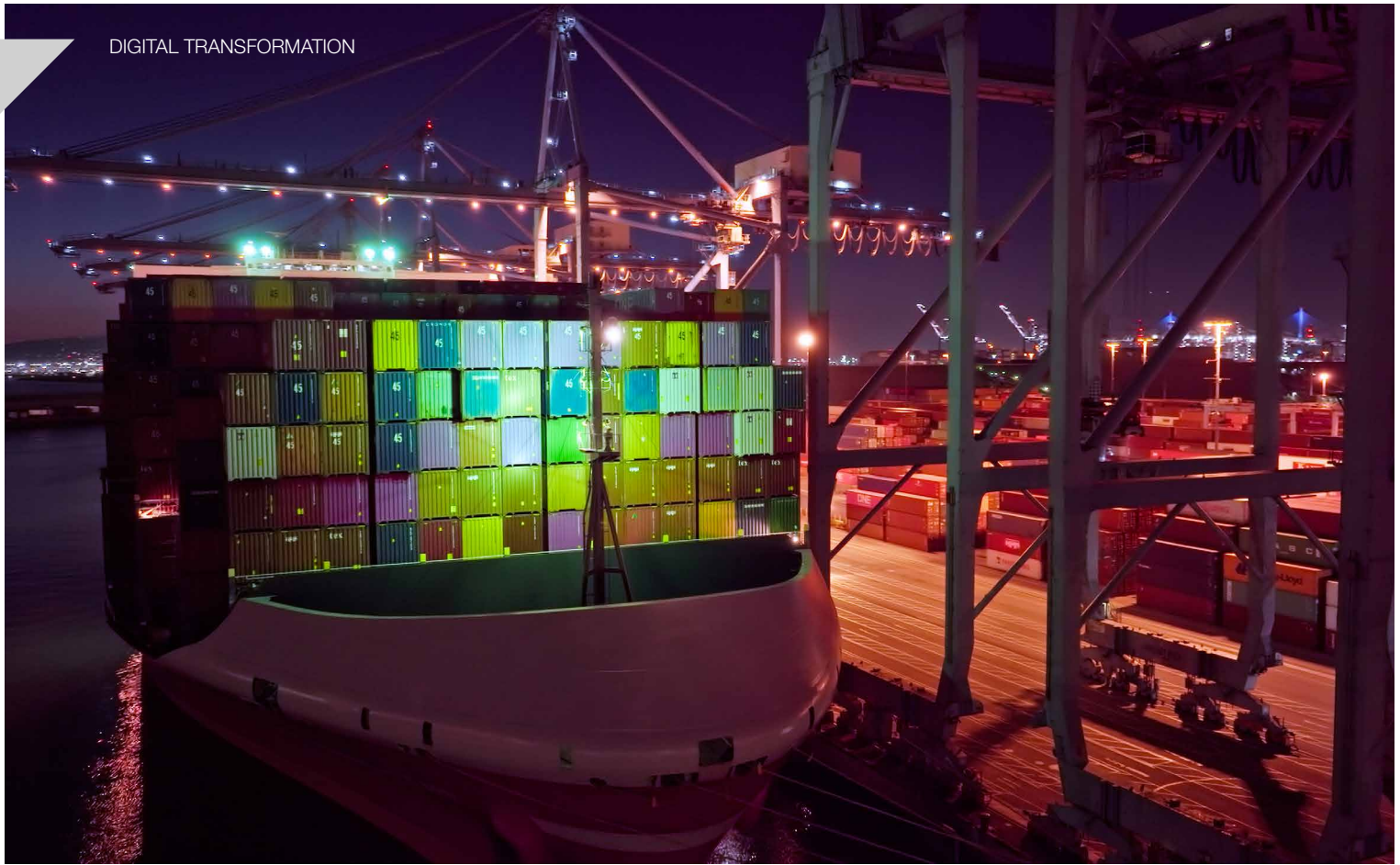
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In this way, unloading thousands of twenty-foot equivalent unit (TEU) containers from a megaship becomes an operational norm as opposed to a challenge. The Yard Optimizer does this by allowing for a seamless interchange of export containers from the yard, again from well-organised stacks, while also ingesting import containers into the yard and making real-time allocations for their best storage positions while they await their outbound journey.

In addition to the real-time operations, Yard Optimizer is equipped with a housekeeping, or grooming, function that runs during off-peak operations allowing operations to reconfigure their yards, adjusting according to the most up-to-date information. By leveraging the most current data, housekeeping is able to reposition containers during slow or idle equipment times to improve the efficiency of outbound container processes resulting in fewer subsequent rehandles, decreased equipment travel distances and time, improved equipment productivity during peak operations, as well as reduced external truck waiting times.

DRIVING EFFICIENCY FOR INTERMODAL OPERATORS

In the US market, many intermodal terminals are wheeled. However, with the cost of real estate rising and the adverse effects of 'spread-out' terminals impacting operational efficiency, the option to convert to stacked operations is becoming more common. However, even in these comparatively small facilities, how you build stacks is of the utmost importance. Smaller terminals do not equal a simpler challenge. In fact, quite the opposite. Complexity is a by-product of throughput capacity and actual throughput volume. Again, the simple rule here is that the closer you are to your design capacity in terms of volume throughput, the less productive your yard will be. As such, Yard Optimizer allows smaller intermodal facilities the same advantages of which their large maritime terminals are already taking advantage. Given INFORM's operational experience in the intermodal space, we've proven time and time again the benefits of such an optimisation tool in intermodal operations.

HOW YARD OPTIMISATION WORKS

Yard Optimizer improves the management of a terminal's yard by allocating containers to ideal yard blocks, the correct 'ends' of yard blocks (e.g., quayside or landside), and subsequently building intelligent stacks therein. This sounds simple, but in fact, the algorithms that achieve the proven outcomes are processing a great deal of information and producing a slot allocation for all containers within a terminal in real-time. Through a combination of both improved algorithms and improved computational power, planning problems that used to take days 20 years ago take milliseconds today.

The principal goal of Yard Optimizer at both maritime and intermodal terminals is to reduce unproductive and costly rehandles, and it does this extremely well, often resulting in a reduction of rehandles by a rate of 40-50 per cent. In a typical European terminal, this results in an ROI period measured in months, not years. The flow-on benefits extend to the equipment and areas connected to the terminal's yard. By way of example, Yard Optimizer can

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improve STS crane productivity, Automated Stacking Crane (ASC) productivity, as well as straddle carrier and yard vehicle productivity by reducing job completion times and idle times, especially for loaded travel, both improve overall productivity.

Let's look at the example of improving STS crane productivity. First, Yard Optimizer considers a terminal's vessel calls, berthing plan, and when known, stowage plan for individual vessels to allocate containers to ideal blocks to build smart stacks. When we consider the sheer size of many of today's maritime terminals, there is a considerable distance to be traveled from one side of the berth, let's say 'west side', to the other 'east side'. By leveraging the berth plan, Yard Optimizer will select initial storing positions in blocks nearest to the outbound mode of transport, minimising the subsequent distance a container must travel to reach its final destination. In this example, for the STS crane loading onto a deep-sea vessel.

Second, Yard Optimizer will leverage the stowage plan, specifically the weight of containers, when known to build stacks, and when not known, will build intuitively smart stacks (e.g., containers going to the same end destination will be stacked together). All these decisions are made in real-time based on the actual state of the yard and what's known. Should these variables change after a stack allocation has been made and prior to the next operational peak, Yard Optimizer's housekeeping functionality leverages the updated information to replan the yard.

Where terminals operate a fleet of mixed equipment types – such as 2-over-1 or 3-over-1 straddle carriers, Yard Optimizer considers the constraints of handling equipment when making slot allocation decisions. Furthermore, it also considers future equipment productivity when making decisions. By way of example, when assigning a storage slot for an inbound container for containers leaving on the same outbound transport, a scattered stacking approach will be taken to avoid subsequent equipment bottlenecks and decreased productivity during the loading processes.

Our Machine Learning module, which was released in 2019, was initially deployed to improve the productivity of the Yard Optimizer. In our earliest assessments, we predicted that terminal operators would benefit from a further 10 per cent reduction in rehandles (for a combined reduction total of 50-60 per cent), and we're delighted to see our customers achieving these results and more.

EXPERIENCE COUNTS

INFORM has a strong, proven track record of managing Yard Optimization in maritime and intermodal facilities stretching some two decades. Our Yard Optimizer was first deployed at HHLA in Hamburg and has been tested, refined, and improved over the past 20 years. It's since made its way across and into our Intermodal TOS product and was first deployed at the KTL Kombi-Terminal Ludwigshafen, where it has undergone further refinements to ensure a strong operational benefit for intermodal operators. In 2021, Norfolk Southern selected our Yard Optimizer to manage their stacked operations, with the first site scheduled to go live in mid-2022.

Many operators and start-ups believe solving the yard planning challenge is as simple as throwing a machine learning algorithm at the task. In reality, that only just scrapes the surface of the problem. What we've learned over 20 years of delivering yard optimisation to the maritime and intermodal terminal industry has allowed us to refine our algorithms and implementation process to ensure that operators will receive a strong ROI in the shortest timeframe possible, working from a proven solution.

What the industry desperately needs now, amongst all the congestion, is a proven solution with a quick return on investment to help them find a light to guide them through the congestion tunnel and help them build a more robust operational framework well into the future.

ABOUT THE AUTHOR
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ABOUT THE ORGANISATION
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INFORM specialises in AI and optimisation software to improve operational decision-making. Based in Aachen, Germany, the company has been in the optimisation business for 50 years and serves a wide span of logistics industries, including maritime, intermodal, and inland terminals. With a broad range of standalone and add-on software modules, INFORM's unique blend of algorithmic-based software expertise, rich industry experience, and big-world thinking delivers enormous value for their customers.
More Info: https://infrm.co/terminal