American writer Walter Lippmann once wrote, with regards to automation, “You cannot endow even the best machine with initiative.” The notion he was presenting is that robotic equipment cannot think for itself – it does what it is programmed to do. Nothing more and nothing less.

In the early 1900s, that was most certainly correct. Today, however, that line is blurring at an increasing pace as Artificial Intelligence (AI) and Operations Research (OR) based software allow their physical robotic (or manned) counterpart equipment to operate with a heightened sense of awareness of the world around them rendering automated processes more intelligent and efficient.

Within the maritime industry, automation is not a new concept. With varied successes and failures over the past two and a half decades, we have come up with solutions to many of the challenges facing automation and, of course, have many more to overcome. When we think about automation, what is the first thing that comes to mind? Rail Mounted Gantry (RMG) cranes? Sea to Shore (STS) cranes? What about autonomous ships? One would be rightly justified in any of these lines of thinking, but what about automation for rail operations?

This paper explores automation solutions available for rail or intermodal terminal operations. In doing so, it goes beyond the typical “autonomous equipment” thinking to explore how automated decision and decision-support software, such as INFORM’s Syncrotess, can address train planning, container handover, loading, discharging, and continuous improvement within rail operations while adding a degree of intelligence not yet experienced in automated rail operations.

**TRAIN LOAD PLANNING**

Gone are the days of a dispatcher sitting down and manually planning your outbound trains. This statement is harsh, perhaps, but honest. Utilising AI and OR-based algorithms, INFORM’s Syncrotess Train Load Optimizer (TLO) cuts down the time it takes to plan an outbound train from hours to minutes by automating the planning process using cutting-edge algorithms. Customers big and small, such as GCT Deltaport, DP World Vancouver, KTL, and Samskip, have placed their trust in TLO to plan their rail operations.

“INFORM’s TLO generates an optimized train load plan at the push of a button,” said Peter Newerla, Supervisor Rail Termi-
nal Operations at Samskip, “And the folks out there know if and how they have to change the pin configuration...and all move jobs are generated and sent to the reach stackers, tractors, and cranes. It’s so easy.”

RAIL SCHEDULING FOR CONTAINER HANDOVER

The handover point between rail operations and the yard is an often-overlooked opportunity for efficiency gains within rail operations. INFORM’s Syncrotess Rail Scheduler has been designed to leverage the powerful AI/OR optimization engine of Syncrotess to address this common pain point in a fully automated manner. Rail Scheduler automates the decisions of which containers to bring to the rail transfer area and at which time the transport jobs should occur. From there, it carefully selects a highly suitable transfer point to minimize loaded-crane travel distances. These transport orders are sent out to the necessary transfer vehicles via a terminal’s existing TOS, ensuring there is no additional equipment in the transfer vehicles and nothing new for drivers to learn.

“There are a lot of ingredients to the Deltaport Rail Expansion Project’s ‘cake’, but without a solid Rail Scheduler, these results would not be possible,” added Iain McChesney, Operations Superintendent at GCT Deltaport.

REAL-TIME LOADING AND DISCHARGING

In a perfect world, a train load plan would be implemented without issue, but no terminal operates in a perfect world. Instead, TLO dynamically adjusts to the real-time demands of the terminal environment adjusting the train plan in real-time to account for new containers becoming available, and previously planned containers not being available, or becoming less “attractive” for loading, as the loading process works towards one of its ultimate goals – an on-time departure.

Working to the highest standards, TLO considers all loading restrictions both during the planning phase and in real-time operations (for example, weight limitations, stacking constraints, dangerous goods, etc.). This, typically, was determined via manual inspection or by railway companies, further reducing the quantity of manual labour required to plan a train and re-work that plan to adjust to real-time demands. The planning criteria can be customised to ensure it favors an operation team’s preferred operational outcomes helping them reach their organization’s specific key performance indicators.

In addition to managing the call of containers from the yard to the handover point, Rail Scheduler has a significant impact on the overall efficiency of the real-time loading and discharge of containers from a train. It works to automatically adjust a crane’s schedule according to the job progress and the crane’s actual position to minimize travel distances and increasing efficiency of container handling. By proposing double-cycling when reasonable, crane productivity is maximized with flow on effects to the handover area and transfer equipment. In terminals with multiple rail cranes, the Rail Scheduler considers the full-picture (i.e., all handling equipment) when assigning work and dynamically splits the cranes to avoid handling delays.

Finally, Rail Scheduler automatically adjusts the workload distribution to account for planned breaks, planned maintenance, as well as unforeseen disruptions to workflows. As a crucial element driving On-time Departure success, Rail Scheduler automatically prioritizes the last several loading moves to ensure a train is ready for an on-time departure. “Many of the incoming trains are not punctual,” said KTL Managing Director Ralf Dahlinger, summing up one of the main problems his day-to-day work involves. “Even though there is a timetable that is exact down to the last minute for every train, our internal goal is to hand over 98% of all punctual, incoming trains on time. In fact, we achieve almost 100%. The rate is excellent for trains that don’t arrive on time, too. Out of the 1,000 hours of arrival delays per month, only...
“THERE ARE A LOT OF INGREDIENTS TO THE DELTAPORT RAIL EXPANSION PROJECT’S ‘CAKE’, BUT WITHOUT A SOLID RAIL SCHEDULER, THESE RESULTS WOULD NOT BE POSSIBLE.”

Iain McChesney, Operations Superintendent at GCT Deltaport

around 75 hours are left on exit – one of the main reasons for the terminal’s success.”

TWO “MINDS” ARE BETTER THAN ONE
The age-old adage that “two minds are better than one” applies to AI systems too. When both the TLO and Rail Scheduler are enabled, they improve each other’s overall performance. The TLO works in alignment with Rail Scheduler to seamlessly provide train stowage information, which in turn is used by Rail Scheduler for scheduling loading (and discharge) operations. In many instances, these two processes are run by different departments/people within a terminal. The combined efficiency of the automated solution cannot be understated.

NOT JUST FOR THE BIG PLAYERS
INFORM’s solution for automating rail operations isn’t just for the big players. In fact, most rail and intermodal terminal operations in the world are small by comparison to the sea-side operations of a maritime terminal. It’s been designed from the ground up to be deployed to medium-sized terminals and up. Recently, INFORM has also begun investing in a “lite” version of the Train Load Optimizer, TLO Solo, which will be a completely standalone, cloud-based, train load-planning resource for smaller terminals.

TERMINAL WIDE AUTOMATED DECISION-MAKING
This paper has sought to focus on the gains from automating rail processors, but the Syncrotess solution adds significant value across the terminal with a broad range of optimization solutions that set the bar for improving automated terminal efficiency. From our standout Yard Optimizer, which can significantly reduce rehandles, especially when paired with our Machine Learning Module that improves the accuracy of data when unknown by their TOS, through to the Syncrotess Vehicle Optimizer, which renders a terminal’s transport vehicle fleet (e.g., AGVs, Straddle Carriers, RTGs, RMGs, etc.) more productive, reduces empty travel, and decreases maintenance costs.

CONCLUSION
In short, automation has promised a lot over the years, and the focus has predominately been on STS and yard operations. As rail continues to play an ever-increasingly important role in the movement of goods into and out of our maritime terminals, it is time to move towards automating rail operations, and starting with the software side of the automation equation ensures that the intelligence that drives the decision-making is right before heavily investing in the “dumb” automated hardware Lippman was referring to in the early 1900s.

ABOUT THE ORGANIZATIONS
INFORM specialises in AI and optimisation software to improve operational decision making. Founded 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 huge value for their customers.

ABOUT THE AUTHORS
Dr. Eva Savelberg is Senior Vice President of INFORM’s Logistics Division. She specialises in Optimisation Software that renders a wide range of operational processes more productive, agile, and reliable. Eva is also lecturer at the University of Aachen (RWTH), where she received her PhD in mechanical Engineering in 2002. Eva has published 5 books and over 40 papers on innovation in freight transportation.

Rafael Velásquez is a Senior Consultant within INFORM’s Logistics Division. He holds a PhD in Mathematical Optimization from the Technical University of Kaiserslautern. He has worked in Optimization Projects over the last 14 years within the Research and IT sector. He joined INFORM in 2008 with focus on promoting optimization solutions in the Container Terminal industry. Since 2012 he is leading the Port Optimization projects at INFORM’s Logistic Division.

Matthew Wittemeier is responsible for Marketing at INFORM’s Logistics Division where he has become a thought-provoking contributor to many industry publications and conferences. He’s co-author of the award winning 2038: A Smart Port Story – a story about the future of technology and the social challenges it may bring. He is a member and judge at The Academy of Interactive and Visual Arts (AIVA), the senior producer and host of the buzzITtalk podcast, as well as an award-winning designer.