

Intelligent TOS plug-ins: the easy way to increase performance



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With most Terminal Operating Systems (TOS) many functions still need to be performed manually, meaning there is a reliance on supervisors to ensure processes are correctly executed. By nature, this is error prone, and depending on the training, experience and attention of the operations staff, liable to mishaps. The nature of these tasks is typically repetitive and at the same time some of the tasks require a lot of information to be executed efficiently; characteristics that make them suitable for automation.

This is exactly the space in which the Intelligent Plug-in platform comes in. Conceived and developed in close co-operation with the CIO from Global Container Terminal (GCT) New York, Rich Ceci, the platform serves as a basis

for implementing those functionalities that complement the TOS in its workings, and automate specific tasks, where otherwise regular human interaction would be required. The ideas for the plug-ins (or apps) that are developed on top of the platform mostly stem from customers.

The platform is currently linked to Navis SPARCS, and Navis N4, as the most widely used TOS in the market place. Yet even in the Navis product, gaps can be identified, where frequent user action is required. The interface between the Plug-in platform and the TOS is bi-directional in the sense that it retrieves information from the TOS and sends back instructions or updates information in real-time.

In this article, we would like to discuss several of the intelligent plug-ins. We

also discuss how they are tested by means of emulation to ensure their contribution to performance in live operations. After all, they are aimed at performance enhancement. The plug-ins that we will discuss here are used in the following:

- Intelligent reefer operation
- Chimney stack avoidance
- Automated pooling
- Dynamic RMG range setting

Intelligent reefer operation

Reefer plugging and unplugging is a time-consuming business which is subject to many rules and targets. Reefers of different kinds are more or less sensitive to the time they can stay unplugged and the potential risk of the temperature rising too much is typically high, and reefers carry

source: Wilbert Kistemaker, *Scheduling Reefer Mechanics at Container Terminals: a case study based on Global Terminal, New Jersey, USA, Tilburg University, 2014*

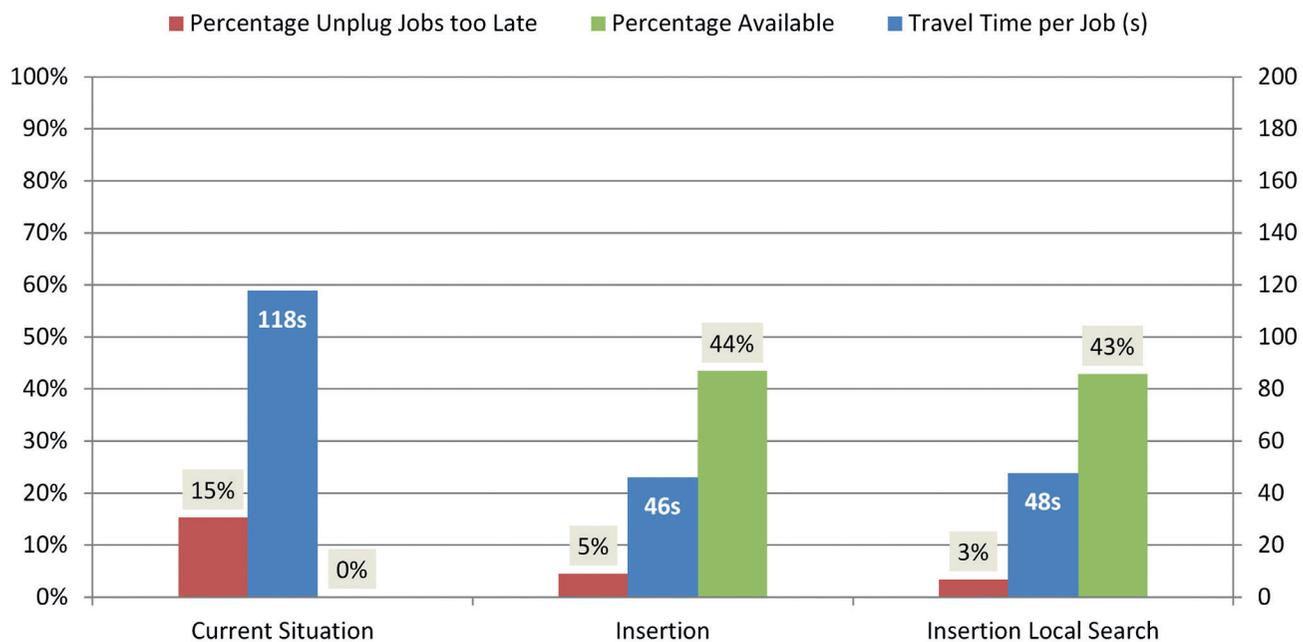


Figure 1: Results from experiment with and without reefer scheduling

valuable cargo. As reefers can be dispersed throughout the terminal – especially in perpendicular RMG terminals such as Antwerp Gateway, or Euromax – an optimised walking route that meets all plugging and unplugging requirements (timeliness) is beneficial.

Hence, we developed a plug-in that reads the reefer (un)plugging in real-time, creates an optimised schedule for X reefer mechanics, and sends it to a mobile device that mechanics carry with them. On the device, mechanics can review their jobs, and complete them. As can be seen from the graph below, the impact of efficient reefer mechanic scheduling can be significant. Without scheduling, reefer mechanics are working for almost all of the time.

Without path optimisation, the average travel time per job is long (up to 3 times longer than the optimal path), while maintaining the time a container may stay unplugged within requirements. With proper reefer job scheduling, a reefer mechanic's productivity can go up by 100%.

Chimney stack avoidance

The goal of the chimney Intelligent Plug-in is to increase safety in the yard. On terminals chimney stacks are undesired because of safety due to the risk of falling when handling other containers, as well as the risk of falling due to wind.

Here, we define a pile in the yard as a chimney (stack) when either:

- A. The difference between the pile height of the pile and the maximum pile height of the adjacent piles (in the same bay) is:
 - 2 or more
 - 3 or more (depending on user configuration)

B. In RTG terminals, the pile on the lane closest to the truck lane is already a chimney when it is higher than its adjacent inward pile

The Intelligent Plug-in will consist of 3 functionalities:

- To detect chimneys and create an overview of all chimneys to a supervisor who can then decide what he wants to do
- To prevent chimneys (as far as possible); by means of settings (in the TOS), chimneys can be avoided to a large extent. However, an RTG operator can always create a chimney overriding instructions (for instance during shifting a container, or when containers are loaded, remaining containers can form a chimney)
- To solve chimneys; the solving currently consists of a list of work instructions that still need to be activated by a supervisor, as he may want to wait until spare resources are available, or decide differently, based on the actual situation

Automated pooling

Prime Route from Navis is installed at many terminals and provides a solid basis for prime mover (terminal trucks, straddle carriers, shuttle carriers and AGV's) pooling between various points of work (POW). However, the tool requires frequent human intervention to get the maximum result. The control panel to the user (EC Console) offers ways to set priorities and limit the number of vehicles allowed per POW. As some work queues

require more equipment than others (think of long distances, twin-lift or dual cycling) an adjustment of these parameters is needed.

As this requires full and continuous attention from supervisors, as well as in-depth knowledge about how to configure the EC Console, we have developed a plug-in that automates the adjustments of parameters according to a unique situation. Based on the number of available prime movers and the type of work queues ongoing it sets for each work queue, the min-max parameters and updates push rates.

From emulation runs we can see that optimised Prime Route settings (using emulation), to automated settings through the intelligent plug-in, improves productivity by up to 1 box per hour, all other things being equal.

Dynamic RMG range setting

For terminals with two ARMG's on a single module (see Figure 3), there is a range setting inside the TOS that defines where ARMG's can take containers from and bring them to. Typically, there is a middle area inside the stack where both ARMG's can pick and drop containers.

From experience it can be seen that it is desirable to adjust these ranges based on an actual ARGM workload, which varies in time. The intelligent plug-in analyses per stack module the workload and the actual moves, then adjusts the ranges to ensure the RMG is minimising mutual hindering, as well as minimising unnecessary handling. The range settings are fed back to the N4 in real-time.

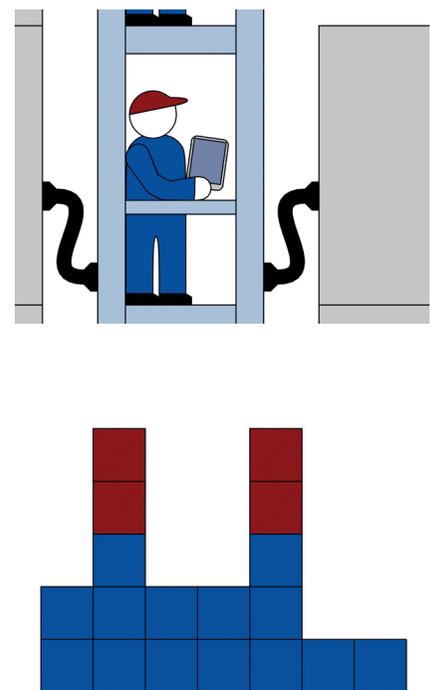
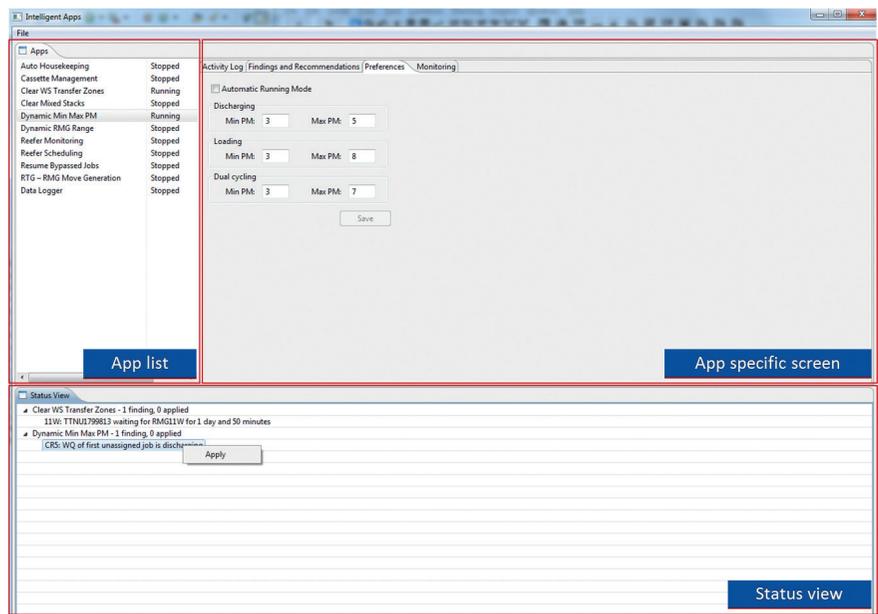


Figure 2: the configuration screen of the “automated pooling” plug-in

Figure 3: Terminals with two ARMG's on a single module



Testing

Before rolling out any of the plug-ins, the configuration is thoroughly tested through emulation. Only when the plug-ins prove to be contributing to the objectives (read: performance), they shall be tested in operation. Even then, if something unforeseen turns up, a plug-in can be stopped immediately.

Implementation

The plug-in platform is external to N4, using a client to retrieve information, and send information back. Through a central console, plug-ins can be started and stopped. All decisions are logged for eventual analysis. Most plug-ins do not have a front end as they work in the background. The configuration screen is only for administration purposes. Except for the reefer plug-in, they do not have any interaction with human operators, hence work practices can stay unchanged. The intelligence is always in the background.

Summary

In this article we described four intelligent additions to today's TOS environment. Plug-ins that strengthen the TOS in its functioning, reduce the reliance on operators, and make sure that in real-time all available information is used to make better decisions. The philosophy is that ideas for new plug-ins are welcomed. The platform that was developed underlying the plug-ins allows for quick addition of new plug-ins.

About the author

Dr Yvo Saanen is Managing Director and founder of TBA. He holds an MSc in Systems Engineering and a PhD in the design and simulation of robotised container terminals, both from the Delft University of Technology. He is also a lecturer at Erasmus University of Technology.

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About the organisation



Netherlands-based TBA is a leading international provider of consultancy and software. Its product and service portfolio concentrates on marine terminals and intermodal container and bulk terminals. Key services are terminal planning using simulation, support of complex software (TOS) implementations and TOS fine tuning using TBA's emulation tool CONTROLS, as well as the training of terminal planners. TBA is also a leader in equipment control software (ECS) for automated terminals, having supplied the Euromax in Rotterdam, CTA in Hamburg, Antwerp Gateway, and in the coming years Long Beach Container Terminal with TEAMS; TBA's Equipment Control Software. TBA's clients include all major terminal operators worldwide and many local port operators. TBA's subsidiary DBIS delivers total software solutions for bulk terminals.

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