



# TERMINAL AUTOMATION FORESEEN

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With automation being broadly implemented, this article provides a foreseen perspective about some of the key technology components the marketplace offers to terminal operators for deploying and optimising the automation (still) 'black box' solution.

The scope of the article is limited to associated software applications, mainly focusing Terminal Operating System (TOS) and Equipment Control System (ECS), and their connection to Container Handling Equipment (CHE) systems.

- Intentionally the article doesn't focus on Algorithms or People, which deserves a specific focus and a longer dissertation to avoid creating 'out-of-context' confusion.

## ROLE OF TOS

During the last few years, a clear evolution in the thinking of TOS suppliers offering is being observed, with the focus now on technology. Cloud 'hosting' and artificial intelligence (AI) are at the forefront, yet the real challenge is on the lack of traction regarding the evolution needed for terminal operators leveraging TOS to effectively move into digitalization.

Further, there is an issue on capitalising the huge investments on technology, which

so far are only creating an IT core foundation to realise business value return later.

- For terminal operators the challenge still is how TOS vendors understand requirements, as well as how other systems connect to the TOS. This process is still very 'project-to-project-driven' and non-standard; impacting simplicity, reliability and maintenance of the TOS solution component.

Terminal technology implementation is stopping being 'TOS centric' but still the methodology, practices and tools for effective integration are not available - for simplicity the article describes the challenge and need for change in some specific areas.

## WORKFLOW VISUAL MANAGEMENT

A recurring conversation is around the organisation at Terminals moving forward, for automation, but more generally applicable to leverage the potential of technology and integration of processes for empowering efficiency, safety and sustainability:

- The simplification and data-enrichment of the applications graphical interfaces (GUIs) will help to produce evolution regarding user paradigms - both for

operations planning and execution (OPS) – today, the current user interaction continues based on the monitoring of alphanumeric information. This leads to 'chasing containers' in a reactive, not proactive, way, thereby generating a stressful working environment,

- At a broader level, the number of applications for Information Technology (IT) and Maintenance Departments (MNR) is growing exponentially. For the OPS-IT-MNR organization 'triangle' to act together to resolve an exception smoothly, the different applications consuming related data from different sources will need to support the cross-functional real-time collaboration seamlessly.

## SMART FUNCTIONS AND DATA ANALYTICS

I am convinced that container terminals will leverage AI and machine learning in the future, but the reality today is we are far-away from having the necessary data - in amount and in quality - to leverage data correlation across processes to deploy deep learning capabilities that can meaningfully assist planning and executing operations:

- The overall terminal 'eco-system', not only TOS, will need to truly promote data models standardisation and open data, so customisation of applications to local environments is easier and shorter. At this stage we will start having enough data to make planning more flexible and resilient and execution more adaptable and predictable by using AI,
- The other important enabler will be on injecting the AI solution from those smart algorithms within the supporting applications to planning and execution processes and to make it in conjunction with the current organisations and profiles - making the AI part synergistic with the human component is not easy with the current set-up.

In short, TOS must empower the planning functions to drive evolution in our Industry in terms of connectivity & data, to produce simple collaboration & transparency. Broadly, TOS support to digitalization needs to really evolve into creating a data system of record and a connected eco-system approach.

## ROLE OF ECS

With Automated Terminals, ECS software is being positioned to Terminal Operators to effectively make CHE more autonomous and intelligent. But ECS products and associated services have not been conclusive so far for Terminal Operators truly framing automation blueprints, managing integration risks and minimising time-to-value.

Today the combined CHE and ECS offering has multiple and flexible possibilities, but when looking into converting the huge investment into an integrated solution the offering is not completed and adds complexity. Further the cost associated to ECS is even higher than the TOS.

## MODULARITY AND SYSTEM ARCHITECTURE

With the increasing number of system components, software applications and associated data bases; the overall system architecture needs to be structured to make the different technology layers at Terminal, and the Terminal System functional split (beyond TOS and ECS) clear for predictable design, deployment and testing:

- Some initiatives like TIC 4.0 are focusing on 'the elaboration of industry standards that will favour the development of further technological innovations for the whole sector'. On this path, Terminal Operators will need to collaborate to enable IOT or AI but also resolving the basics for the core foundation of standardising and easing automation at the system architecture level,
- The result of those initiatives will enable getting to a standard generally applicable to any configuration. Terminal operators need flexibility but

general automation standards must be enabled – as they're applied in many industries for decades, and in all sorts of processes, like batch processes, continuous and repetitive processes.

It is clear our industry needs a modular and flexible approach, but the specific layers to articulate functional splits and supporting data communications must be clearly defined. Software development can then truly follow a terms of reference and be an 'open' experience.

## CONNECTIVITY AND OPEN INTERFACES

Already from the 'early adopters' experiences in Rotterdam and Hamburg integration was spotted as the main challenge, and different technologies and practices are being utilised during the 30 years after those - to create evolution and 'repeatability':

- The required evolution will take our industry from 'one-off' integration experiences based on 'industrial communication bus' technology to having available integration platforms for connecting software services and applications (e.g. Muelsoft) - the experience and approaches by those at more complex and more real-time dependent industries will be an example for our way forward,
- As example the increasing utilisation of Enterprise Service Bus (ESB) as a integration architecture in some projects will be the norm - many times already TOS and ECS applications leveraged that architecture and associated comm methods & interfaces for their internal integration, and step-by-step the overall Terminal systems integration will follow this 'system-of-systems' approach.

In short, the role of ECS is becoming, along with TOS, the core backbone of the automation solution. CHE and ECS suppliers need to truly ease modularity, connectivity and technical support to terminal operations - it is indeed necessary at automated terminals but also for all terminals to go truly digital.

## CONCLUSIONS

With automation adoption being more and more active, the message from terminal operator needs to be positive but making sure the existing experiences and past lessons learned produce a common understanding for the design, deployment, integration and optimisation methodologies, processes and tools. Some guiding principles that the article highlighted to extend the positive message into real progress from a terminal automation industry standpoint:

- Platform(s): a platform will be understood as a cluster of business and/or operational processes that needs to be connected through data and APIs, and by default the underneath technology

will enable open data and multi-platform connected eco-system.

- Integration: normal practices in System Engineering as integration patterns and data consistency models will be consolidated in our industry, standardization on those practices and the basics for system architectures will ease integration and will reduce its risk.
- Interfaces & Data: ECS will need to 'step-in' to stay as the integration 'facilitator' and the data 'blender' at CHE level: it is a fundamental actor for creating a process digital platform to get to operational excellence together with TOS.
- Equipment Intelligence: CHEs are becoming more and more sophisticated, with the evolution of autonomous mobility more and more decisions will be taken at ECS level, which will become a catalyst to enable Terminal 'squeezing' those assets.
- Flexible Execution: the translation of dynamic & resilient planning by TOS into a flexible execution is and will be depending more and more on ECS - the development of unified user interfaces to seamlessly integrate equipment, software and people actions is key.

In particular when tackling a new green-field development or a brown-field retrofit project, the terminal operator is in front of a complex environment of terms & nomenclature, system value propositions, interfaces and integrations – and impact of those in the organisation and labour environment which in most of the cases are required to evolve from current paradigms. In this article we described some of the challenges but also traced the direction where the solutions could be found.

## ABOUT THE AUTHOR

Oscar Pernia is Director of Automation and Process Engineering for TIL, MSC's subsidiary. In his current capability he led the technical design and integration of processes, systems and workforce for TIL Automated Terminals, and pioneer the digitalization & innovation capability within TIL. Dr. Pernia had an intense career on different roles at Container Shipping – including experience at Port Authority, Shipping Line, Terminal Operator and Technology Supplier sides. He held a variety of positions managing projects focused on system engineering, process optimization, software development and applied innovation. His background is Telecommunication and Industrial Engineering, he holds a PhD on algorithms design and simulation applied to Maritime Operations.