

A DIGITALIZATION JOURNEY FOR COMPLEX PROBLEM SOLVING IN DYNAMIC ENVIRONMENTS TO ACHIEVE ILL-DEFINED GOALS



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It is not only about power. It is time, it is speed. This is one of the most famous movie quotes of Creed III, the third installment (2023) in the Creed sequence of films, and the ninth overall in the most iconic American boxing movies: the Rocky Balboa's Saga. The film sees the recently-retired boxer Adonis Creed coming face-to-face with Damian Anderson, who was his childhood best friend and a former professional boxer with a distinct aggressive fighting style. Although our protagonists always must face a supervillain through the whole epic of fights, they have characteristics, skills, and peculiarities that make them distinct: sometimes they possess a brutal strength, while others have a huge determination, a dark past, or a personal grudge among them. In essence, this remains constant yet perpetually evolves, embodying a distinctiveness akin to the operations of container terminals spread across the globe.

Container terminals are living ecosystems built over complex and large infrastructures with several parties interacting in a coordinated way to offer highly complex logistic services under strict operational planning and tight cost controls. Due to the port and shipping

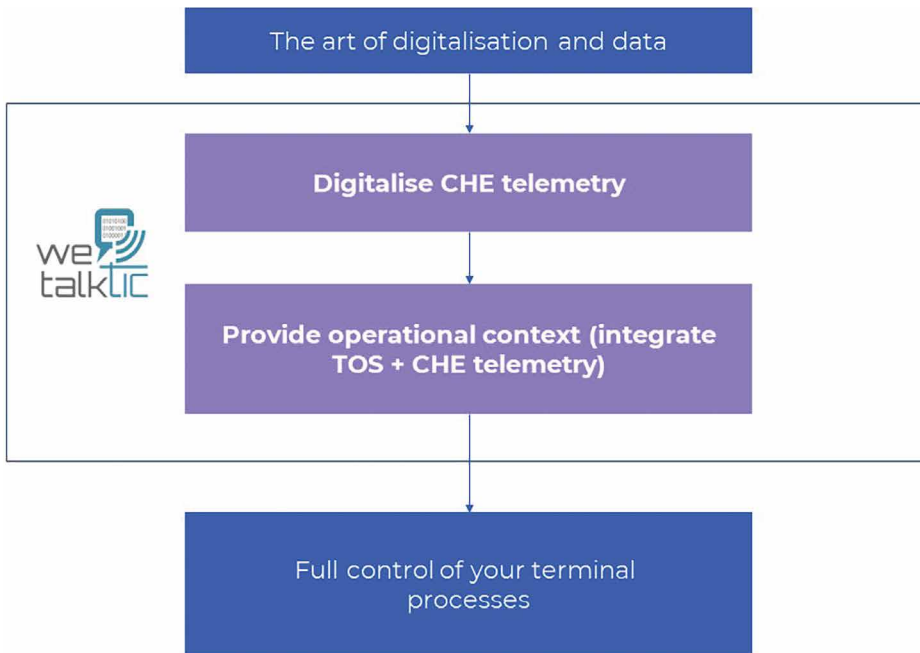
industry's competitiveness, challenging requirements, and demanding needs, operations within a container terminal must be accurately carried out to achieve high operational efficiency, while also ensuring safety, sustainability, reliability, and profitability. Port efficiency is typically characterized by maximizing terminal cargo operations productivity rates and minimizing idle time for both Container Handling Equipment and the staff involved during the end-to-end port call processes. Much has been said about the resilience, flexibility, and adaptability of global supply chains. Therefore, one of the highest priorities of logistics global groups is not only to try to improve their local needs continuously but also to standardize their operational processes and working conditions no matter the container terminal's location and core business (i.e., containers, liquid bulk, dry, etc.). CMA CGM, a leading company for the last 40 years in shipping and logistics solutions spanning the globe, is a good example of an entity that is consistently looking for innovative solutions for implementing its digitalization strategy through its two port operators, TERMINAL LINK and CMA TERMINALS.

Combined, they manage more than 50 terminals around the world, applying and endlessly developing their expertise to provide the safest, most efficient, and most sustainable cargo handling service possible.

EFFICIENCY OVER POWER, BABY!

Every container terminal has its pain points to overcome or challenges to meet but they generally share common goals which are to optimize operations, maximize revenue, and achieve long-term sustainability. Expansion or investment in new equipment can help towards these goals but other initiatives, such as standardization of business processes, can go a long way to achieving such objectives, and with a shorter lead time. Digitalization allows terminals to establish standardized practices, facilitating swift transformation of their operations; simultaneously, it fosters a shared comprehension with their clientele. This helps to shape a more efficient, resilient, and greener maritime supply chain. For that reason, terminal operators and innovation managers should look to measure real-time operational data from multiple sources of information, in particular CHE telemetry and Terminal

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Operating Systems' data (i.e., TOS). Everything from troubleshooting to long-term capital investment decisions is currently based on poor-quality data at best, and perception at worst, but tools are available to change this. Thanks to connecting equipment and systems in real time, shift leaders can rely on objective information using live heatmaps and alerts to identify bottlenecks and congestion in the yard and take the appropriate corrective actions, whilst management can use Key Performance Indicators (KPI) dashboards to assist in continuous improvement and investment programs. Besides that, digitalization requires as a first step, the need to agree on standards, terminology,

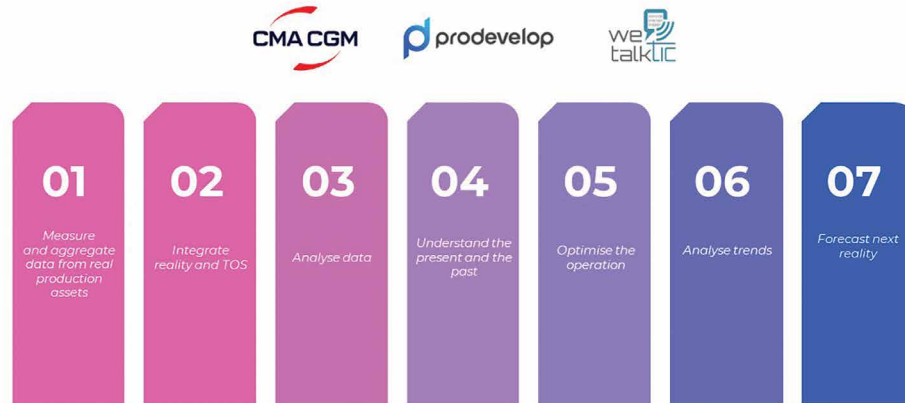
and vocabulary as a mandatory prerequisite to be able to tell a story with context enough as a baseline on which to build something solid. In other words, a business process could not be improved or optimized if an agreement between all the different stakeholders (crane manufacturers, PLC suppliers, TOS vendors, etc.) is not reached first. Promoting a mutual understanding and data sharing among all stakeholders is the only way to achieve operational efficiency. This enhances coordination, contributes to decarbonizing the supply chain, identifies potential issues in advance, reduces inefficiencies, and promotes resource reuse, eliminating the need to always start from scratch.

DO NOT RUN BEFORE YOU CAN WALK

CMA CGM in collaboration with its technological partner Prodevelop has started deploying Posidonia Terminal 4.0, an IoT, Edge Computing & Big Data platform that combines RAW data gathered in real time from the different CHE available in the yard with TOS information into a digital core foundation that precisely provides full context of the terminal's operations. One of the strengths of Posidonia Terminal 4.0 is that it is the only Big Data platform fully compliant in the market with the latest TIC4.0 version of the standard. TIC4.0 is the first process and telemetry language understandable by any type of supplier, equipment manufacturer, or computer service provider to allow seamless transmission of the information generated during terminal container handling logistics. Given the large number of different vendors, manufacturers, industrial communication protocols, and IT service providers co-existing in the same environment, interoperability is key for a fast and reliable deployment. This interoperability is granted by the TIC4.0 language and its associated data model, easing the deployment and shortening the time to go live (i.e., weeks not months). The deliverables, recommendations, and outcomes from the TIC4.0 Organization are not an option in a global industry but are mandatory to ensure the acceptance and understanding of high volumes of diverse data coming from distributed and heterogeneous sources of information.

“TIC4.0 IS THE FIRST PROCESS AND TELEMETRY LANGUAGE UNDERSTANDABLE BY ANY TYPE OF SUPPLIER, EQUIPMENT MANUFACTURER, OR COMPUTER SERVICE PROVIDER TO ALLOW SEAMLESS TRANSMISSION OF THE INFORMATION GENERATED DURING TERMINAL CONTAINER HANDLING LOGISTICS.”

A digitalisation journey for Complex Problem Solving in dynamic environments



CMA CGM's digitalization journey started eight years ago deploying IoT Gateways in the whole fleet of assets available in its container terminal located in Malta (i.e., Malta Freeport terminal, MFT). Today, the plan is already live with the setup of Posidonia Terminal 4.0 in five additional container terminals of the group (i.e., Fenix Marine Services, Total Terminal International Algeciras, Terminal des Flandres, Port of Thessaloniki, and CMA Beirut Terminal). The target goal, to be achieved by the end of 2023, is to be able to gather data in real time and merge it with the information that comes from the TOS so that managers can start analyzing data and understand the actual status of its container terminal. From this point onwards, the different responsible of the terminal will be able to optimize the different steps of the operation (thanks to the understanding of the present and past carried out), and start taking advantage of the analysis of trends which will enable them to forecast the reality and predict the near future (i.e., if - then scenarios to be proactive, rather than reactive) thanks to Machine Learning or Artificial Intelligence models. Unfortunately, there are no shortcuts in life, magic solutions, or silver bullets to improve the operational efficiency in a container

terminal. The first mandatory step is to be aware of the actual status of the terminal by measuring in real time the accuracy and performance of the most important business process (i.e., job stepping). The main element of this enterprise is the availability of an open IoT gateway, where the data collected from the PLC is translated to TIC4.0 format and published to a Big Data platform.

Container Handling Equipment is heavy machinery that has several subsystems running in real time inside, all of them managed by controllers (such as PLCs, CAN bus controllers, etc.) and provided, deployed, and maintained by different vendors and manufacturers around the world. These systems take the input directly from the machine or subsystem via sensors, transducers, or encoders, and execute the logic programmed in its internal memory. Finally, it generates useful outputs on actuators to physically control and enable the staff to manipulate the crane. Nowadays, the use of PLCs is prevailing in industrial automation over other possible solutions such as the use of computers (even industrial ones) due to the extreme requirements of these environments. PLCs are, therefore, the place where the most frequently updated data is present, and, as the measurement

of this information is directly carried out from the sensors, it is also the most realistic, accurate, and reliable representation of the actual status of the machine. The gathered and processed data is then forwarded to a message broker which persists the information in a well-known format into a Data Lake. That information is easy to exploit and manage to provide insights into levers of action which will optimize actual operation.

EXPERIENCE TELLS US: PRACTICE MAKES THE DIFFERENCE

At its genesis, nothing about an eventual innovation is new. To get started, all you need is a hunch about a real-world problem that matters; a set of parts and access to a community of people to render the problem tangible; a strategy to engage in trial and error; and an appetite to learn by being productively wrong. You learn about the problem as you bring together those people and parts. The pathway is full of choices and the potential outcomes are endless. CMA CGM, through its digitalization journey, is the engine that nurtures the conditions for innovating from a pragmatical point of view that yields impact and prepares it to produce new products, services, and even companies, while

“BY CONNECTING EQUIPMENT AND SYSTEMS IN REAL TIME, CONTAINER TERMINALS CAN LEVERAGE THE ALMOST UNLIMITED NEW COMPUTATIONAL POWER AVAILABLE TO ANALYZE BIG DATA, LEADING TO IMPROVED DECISION-MAKING, MORE AUTOMATED PROCESSES, INCREASED UTILIZATION OF CURRENT INFRASTRUCTURE, AND HIGHER OPERATING MARGINS.”

developing industrial innovations as well as fulfill both scientific and commercial goals. Such outcomes, in combination with the TIC4.0 standard, are paving the way for establishing a FAIR (i.e., findable, accessible, interoperable, and reusable) and decentralized baseline; this will in turn transform the way container terminals work and adapt quickly to the challenges, whether they relate to reducing idle time, increasing safety, or making the business more sustainable. By connecting equipment and systems in real time, container terminals can leverage the almost unlimited new computational power available to analyze Big Data, leading to improved decision-making, more automated processes, increased utilization of current infrastructure, and higher operating margins. Additionally, as more terminal operators and maritime terminal industry suppliers commit to TIC 4.0 message standardization, we will see increasing adoption across the sector simplifying communication between parties, enhancing interconnectivity, removing errors, and saving the time to go live. In conclusion, improving the efficiency of container terminal is not only about power, but time and speed too – as our famous boxer said.

ABOUT THE AUTHORS:

Ángel Martínez is a Telecom Engineer, PhD student, and Head of Products, Terminal Solutions for Prodevelop where he has the opportunity to validate new business models as well as to build solid and innovative technological ICT solutions to improve performance, user experience, and Rol of industrial partners.

Francisco Blanquer, R&D Senior Manager at CMA CGM and Chair Operations Council of the Terminal Industry Committee 4.0, is a Spanish Civil Engineer who has developed functions of innovation and development engineer in the port sector managing greenfield projects, introducing technologies, and disseminating the digital culture in their terminals. During the last six years, he has developed IoT, Big Data, Edge Computing, and decarbonization projects for CMA CGM, supporting the group's container terminals.

Ben Othman Nasser, R&D Digitalization for Terminals at CMA CGM, is a French Engineer who has worked for 11 years in the port industry managing projects related to maintenance and operation, and has introduced optimization and process efficiency culture in terminals. Since 2022, he has been working within CMA CGM to deploy Big Data & IoT for its terminal portfolio.

ABOUT THE COMPANIES:

Prodevelop is a highly specialized ICT company with a growing product portfolio to digitalize and optimize the maritime industry. Prodevelop prides itself on its ability to offer customized, flexible, and innovative solutions that are designed to meet the specific requirements of port authorities and terminals.

Present in over 160 countries through more than 400 offices, 750 warehouses, and 155,000 staff members, equipped with a modern fleet with 600 vessels, CMA CGM serves 420 of the world's 521 commercial ports and operates on more than 257 shipping lines.



The Terminal Industry Committee 4.0 (TIC4.0) initiative aims to bring together representative companies from both the Terminal Operators industry and Port Equipment Manufacturers and Suppliers to collectively work on the elaboration of standards. The TIC4.0 initiative has been endorsed by the Federation of European Private Port Companies and Terminals (FEPORT) and the Port Equipment Manufacturers Association (PEMA).