TERMINALSENSE FOR SMART PORTS
## BUSINESS INTELLIGENCE IN A CONTAINER TERMINAL

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CONTAINER TERMINALS ARE A VITAL LINK TO GLOBAL SUPPLY CHAIN

Containerised shipping has been around since the late 1960's driven by the need to efficiently move ever increasing volumes of cargo across the world. This has driven the need for container terminals to be developed to handle the specialised needs of containerised cargo handling. The container terminals facilitate seamless cargo movement between hinterland and the maritime shipping. The maritime cargo flow requires not just efficiencies of operations, engineering and labour but also need agile alignment of the port capacities to the shipping line's supply chain demands.

DIGITISED SUPPLY CHAIN USING LARGER SIZE VESSELS

Over the years, what started out as a gentle shift from general cargo ships to specialised containerised cargo ships, has accelerated
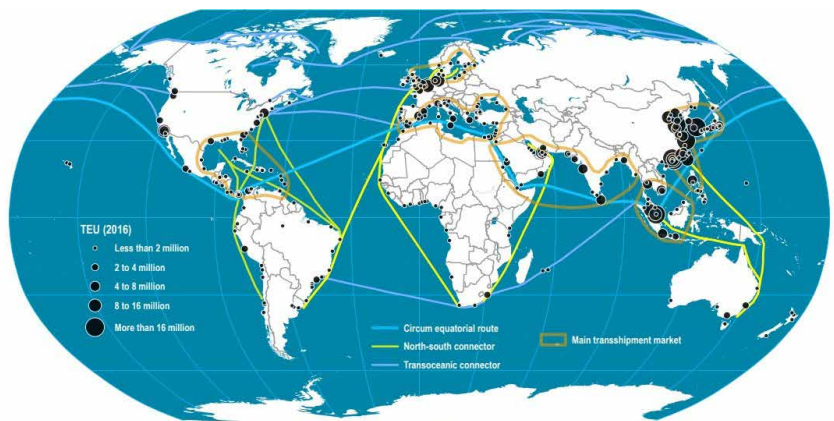
Global maritime trade network

until the bulk of what was formerly general cargo is now despatched inside standardised containers.

Container vessels began by carrying just a few hundred TEU. The latest container ships coming into service are carrying over 20,000 TEU, with even larger ones on order to be built.

The growth in ship size has been in line with the increase in worldwide trade and the necessity to move the containers in the most efficient manner between the world's markets. This has meant that the container terminals have had to continuously increase their capabilities to match the new vessels in terms of vessel size, number of containers to be handled across the quay and the minimal time which the vessel will stay 'in port' to exchange containers.

This has led to a large expenditure in dredging channels to enable the deeper drafted ships to reach the terminal, larger quay cranes to reach above and across ever larger ships, more equipment to move the containers between the quay cranes and the stacking areas. The stacking areas had to be redesigned and sometimes re-equipped to utilise the same land area more efficiently by stacking denser and higher, which in turn can lead to re-investment in new equipment to achieve these ends.

A new terminal development has the opportunity to design around a specific target requirement, but even then, might find itself having to make adjustments five to 10 years down the track as the continued evolution of trades, growth in volumes, need for transport efficiencies, and new technologies make the terminal market ever more competitive.

The costs of new terminal equipment, extra land and labour is expensive and consequently it is important to understand how the current equipment is performing and at what cost, in order to ensure further investment provides sufficient returns. For example, the cost of Quay Cranes can be up to £10 million ($14 million), horizontal transport (CHE) £400,000 ($560,000). Thus for three extra cranes and 10 extra CHE brings a bill of £34 million ($47.6 million). This is without adding in operational costs such as extra labour to drive the equipment and engineering maintenance and support requirements. Thus, it is important to understand the current operational KPI's, the Costs and Revenue leading up to such a major investment.

DAILY UNCERTAINTIES IN USING INTERDEPENDENT TERMINAL FUNCTIONS

In an established Terminal challenges are a constant threat to their viability in the marketplace. There is a constant need to ensure that the service provided meets current needs and that service levels and capacity are expanded in line with the projected and actual growth and change in the market.

Container terminals are very sophisticated operations and have stringent Service Level Agreements (SLA) to meet in order to satisfy all their customers, from Truck driver through to Vessel Operator. Delays and slow working in any part of the operation impacts the whole operation. Any allowances or the safety margins the terminal managers make can significantly increase the total cost of operations. It is essential to have tight control of every aspect of the terminal operation. It must function as a well-oiled piece of integrated machinery. There is a need to monitor trends and to ensure the terminal can be upgraded to meet these and future needs.

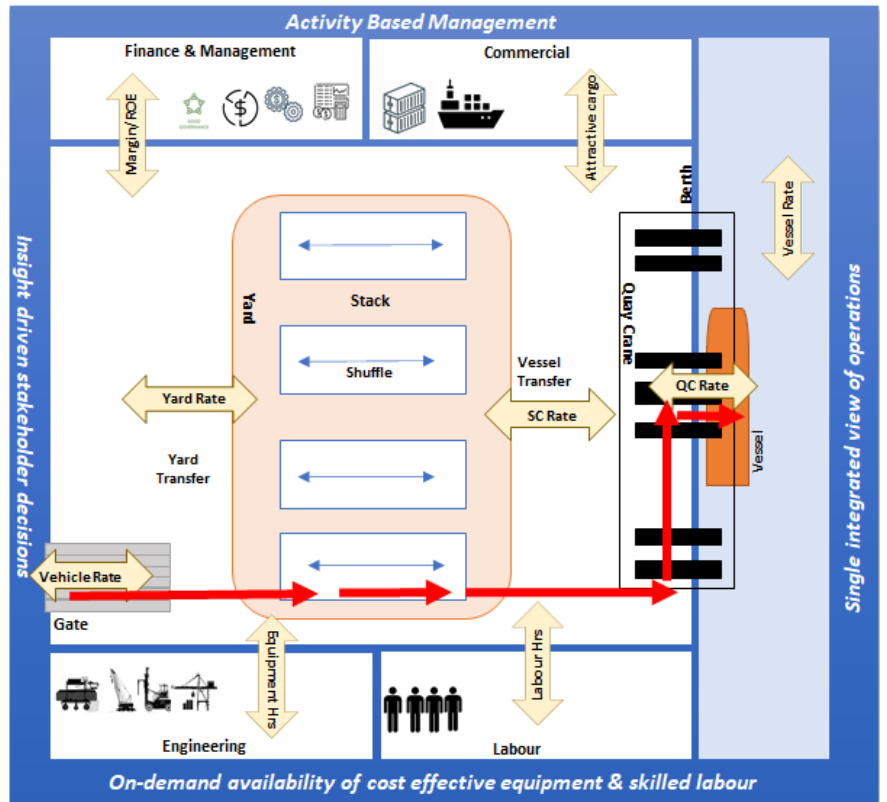## STRATEGIES FOR A SMART AND EFFICIENT TERMINAL OPERATIONS

Synchronise Terminal Operations:
Replace safety margin with insight sharing
Terminal operations include multiple support functions that must be aligned to the core operational functions. The overall port improvement requires collaborative effort across operations, engineering, labour, and commercial organisation. Any issues on equipment and labour availability will impact the overall productivity of the vessel. An issue on planning can potentially create additional requirement for equipment and labour, so increasing the overall cost of operations. As the shipside operation grows in terms of throughput and speed of load and discharge there is a knock-on effect in other areas of the terminal. Stack con-

gestion needs to be avoided, delivery and receival of containers from the landside interface has to be improved in line with the shipside operation. Truck and rail handling needs to be streamlined. The Port, as a critical link to maritime and inland logistics, needs to align operations for cargo owners by reducing the overall transit time and meeting the customer cargo commitment. The requirement for the port to align to inland and maritime logistics needs is also very dynamic. During the year, the flow and direction of cargo could significantly change due to varying market demand.

The terminal operators include additional safety margins on berth hours, equipment hours, number of straddle cranes, labour etc. Smart Ports rely on accurate information sharing across the organisation to manage operational demand and uncertainties including re-configuration for market needs. The transparency of current vessel, quay, yard, and gate activities sets a realistic expectation on marine, engineering, and labour requirements. Also, accurate information on equipment and labour availability enables operations to prioritise the activities to meet the overall customer targets. Overall transparency and collaboration and coordination on real-time insights significantly improve the alignment both within the terminal and with supply chain partners.

DIGITISE OPERATIONS FOR ALL STAKEHOLDERS
### Data to reflect operational realities
Terminals interact with stakeholders such as shipping lines, truckers, train operators, Freight Forwarders, harbour control, and Revenue and Customs, amongst many others. The diagram shows the typical information flow between Port and Stakeholders. The mode of communication is varied from mail exchanges, through EDI messaging to Port Community Systems acting as sophisticated message routing engines. As the automation integrates the stakeholders, the overall dependability of partners and stakeholders will improve and positively contribute to overall terminal efficiencies, helping to promote the long-term viability of each of the partner engagements. Smart Ports have significantly invested in automating all stakeholder touchpoints, driven by mutually agreed, and continuously improving, SLAs. The level of automation must be in step with the overall terminal efficiency. For example, terminals will have to invest in a Vehicle Booking system to manage truck appointment to balance the truck traffic in and out of terminals. The need to change cargo routing, aligning to market demand, must be streamlined in order to support smoother cargo operations at terminals.

Smart Port operating model
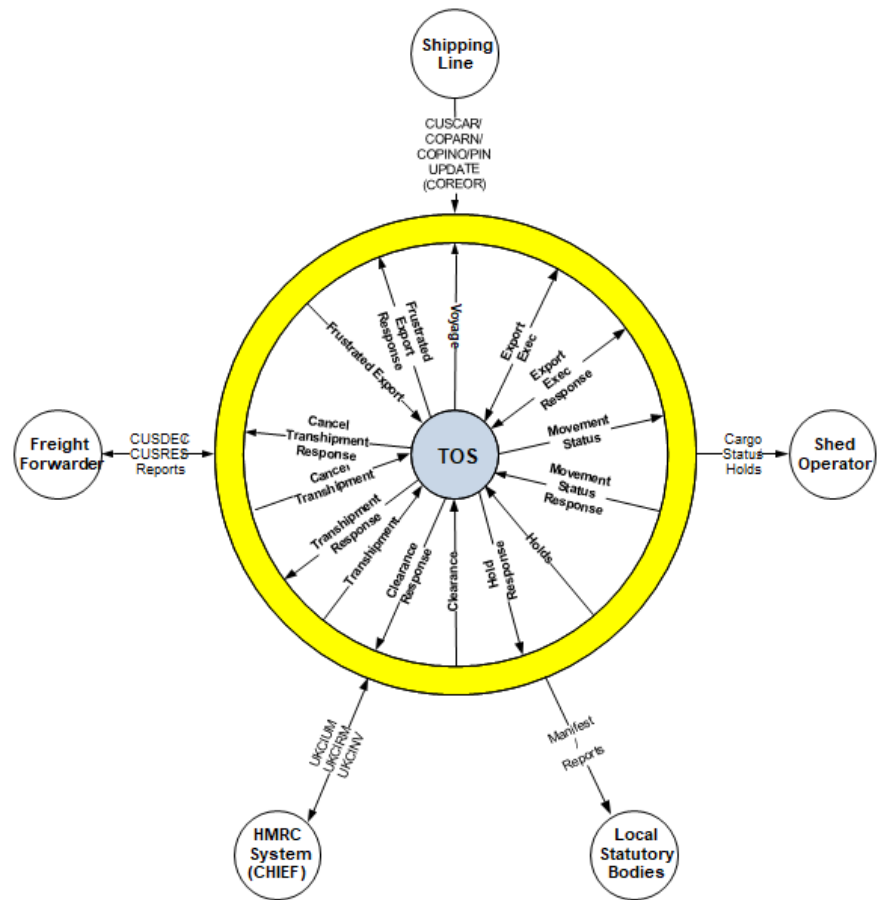
Port stakeholders and relationship

CONTINUOUS LEARNING OPERATIONS

Empowering employees for data driven decisions

Smart Ports invest in systems and technologies which empower employees to follow a path of continuous improvement of their operations. The improvement decision horizon typically ranges from real-time, or event driven to tactical and long-range planning. The control room is alerted to queues and bottlenecks, caused by delays slowing down operations, so that terminal managers can intervene early on to smooth the flow. Tactically planners typically need to decide on the number of cranes, crane hours, heavy crane choice, straddle assignment, yard allocation, stowage plan, and other such parameters. Smart Ports typically learn from their experiences so that they continuously improve their outcomes and sustain their improvements. In case of repetitive operations, the past learnings will feed into operational policies and rules for self-learning and autonomous operations.
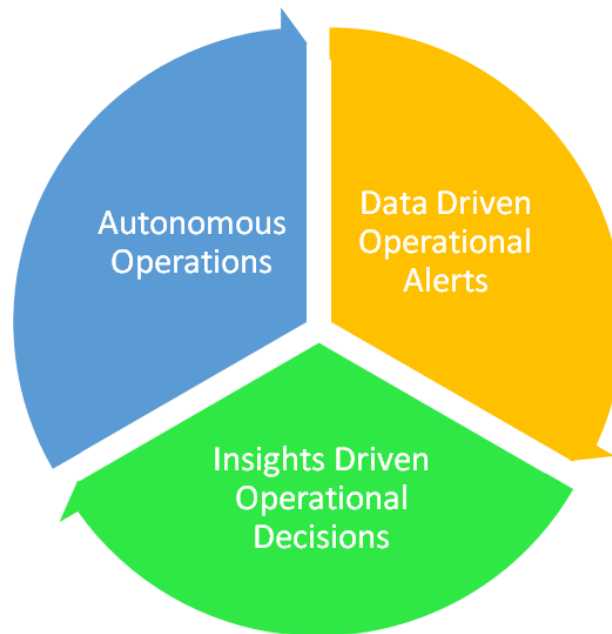
TERMINALSENSE – BUSINESS INTELLIGENCE PLATFORM FOR SMART TERMINALS

The **TerminalSense** platform suite provides essential information, which is taken from the Terminals own systems, to understand the cross-terminal performance and effectiveness and help identify actionable decision-making opportunities to improve cost efficiency and increase profit margins.

Almost all container terminals operating, over say 100,000 TEU per year, will have several computer systems to control various parts of the operation. Typically, at the centre of the physical operation is the Terminal Operating System (TOS) providing the tools to allocate and control the equipment and to record all container movements. There will be an Engineering Management System (EMS) to track equipment maintenance and repair, a Labour Management System (LMS)

to track the allocation and usage of labour, a Finance Management System (FMS) to track the costs and the charges to be made to customers. There might well be many other separate systems such as: Gate Operating System (GOS), Vehicle Booking System (VBS), Crane Operating System (COP) and Port Community System (PCS). The more a terminal develops and grows the more diverse systems it uses to help manage and run the show. This involves an investment in specialist software which is small in comparison to the capital and operational costs incurred in setting up and running a Port.

All these systems, almost as a by-product of their operational use, produce a mass of data relating to how the container terminal operates. This data is however embedded

within the different systems and so provides no single terminal level view readily.

However, Infolayer has developed **TerminalSENSE** to provide exactly this. The **TerminalSENSE** platform suite non-invasively extracts data from all the current terminal systems, at regular intervals, into its own SENSE Information Model (SIM) to create its own **TerminalSENSE** Data base. The **TerminalSENSE** modules access the SIM DB to provide extensive terminal level reports and KPI's. The data is granular down to an extremely low level allowing a large range of views of the terminal performance and operation, from the highest level down to individual transactions. **TerminalSENSE** provides the terminal executive, management team, and operations users with an integrated view of how the total business is

Port stakeholders and relationship
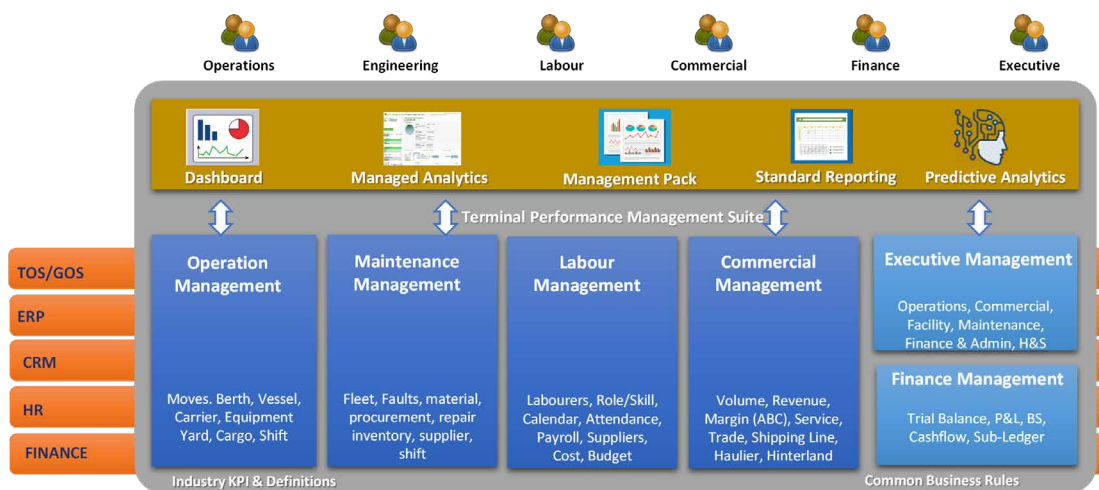
TerminalSense Performance Management Platform

performing now, and how it has performed in the past. It is then possible to carry out 'what if' scenarios on the SIM DB to determine the requirements to meet future growth and expansion plans. For a Port with multiple 'facilities' (several terminals) the product collects data for each 'facility' so that analysis at 'facility' and corporate level is possible.

These products are terminal ready, only requiring interface configuration to extract data from the terminal's own systems to populate the SIM model. Once this has been done the products can be made available to all terminal users. Access is typically controlled by user role.

The standard **TerminalSENSE** platform suite comprises the following functionally focussed modules:

- **execSENSE** – Aimed at executive management, this cross functional module provides periodic views of functional and financial performance in terms of industry standard KPI's covering vessel, container, truck, train, yard, equipment, and labour operations, which can be viewed, analysed, and drilled into.
- **opsSENSE** - Aimed at operational users, this product offers periodic views of all completed activities that have occurred to a unit, equipment, carrier, and yard. This is achieved by combining TOS, GOS, and vehicle booking information, for external and internal reporting of volume, productivity by shift, vessel service, operator splits and many others.
- **liveopsSENSE** – Provides operational users with near real time performance monitoring allowing bottlenecks and potential problems to be identified early in the operation and therefore can be rectified before they cause a serious problem. Predictions are made of performance over the next few hours, based on recent performance, for example, to predict when a vessel will finish working relative to the planned completion.
- **enggSENSE** - Aimed at engineering users, this module offers periodic views of all equipment Including fleet status, maintenance activities against operational requirements, planned vs unplanned maintenance, procurement, and stores, reporting on TOS, ERP systems
- **LaborSENSE** - Aimed at operational and labour users, reporting on labour pool, skill, availability, deployment, labour hours and costs, including shift and vessel level costing thus leading to cost-effective labour solutions for engineering and operations.
- **revSENSE** – Aimed at commercial users, this analytics module offers periodic views of operational and invoice details from TOS and billing systems, reporting on volume and productivity, revenue by period, carrier and customer service including invoice accuracy and operational reconciliation.
- **finSENSE** – Aimed at Finance users, this analytics module offers periodic views of GL information, reporting on financial accounting systems, providing trial balance, balance sheet, P&L and cash flow by period, legal entities, and account code.

Once the standard Terminal Sense platform suite is installed and information gathering proceeds this allows the implementation of Equipment Costing Systems, Advanced Resource Planning (demand versus available supply), Direct Cost and Contribution reporting, by using Activity Based Management.

KEY BENEFITS

1. Standardised Processes: Each module is optimised for functions such as Operations, Engineering, Labour, Commercial, delivering full insight requirements for a 'standard best practice' operation, integrating all relevant data sets across TOS, EMS, HR, CRM, and manual data sources. Process owners can review, refine, and document standard operating procedure across Berth Planning, Vessel and Yard Planning, and Shift Operations.
2. Insight Driven innovations: The modules empower stakeholders to review current performance enabling root cause analysis and so eliciting opportunities for functional process improvement initiatives. The initiatives can be prioritised for adoption, improving overall functional outcome.
3. Process Excellence: The repetitive standard processes can be easily rolled out across functional roles using relevant information for progress monitoring, review and autonomous coordination and collaboration, achieving consistent and sustainable improvement in process outcomes.
4. Performance Driven Winning Culture: The continuous use of information by employees to perform their day-to-day activities, and the clear and direct impact of this on productivity and efficiency improvement, breeds a performance driven culture across the organisation.
5. Improved operational reputation: A continuous and sustained improvement in operations creates a positive image of the terminal among its partners, stakeholders, and prospective employees.
6. Port of Choice for Shipping Lines: A Port with consistently high performing operations enables commercial management to leverage the port location to gain long term competitive advantage.
7. Increased Shareholder return: The cost of sales will continue to be optimised during the process improvement journey delivering attractive returns to shareholders.

ABOUT THE AUTHORS
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Maurice Winn is a Co-Founder and Chairman of Infolayer Ltd with 30+ years' experience in the Ports and Terminals business. Maurice joined with Jeyachandran (JC) Kasimani in 2014 to establish Infolayer Ltd with the aim of utilising their joint knowledge and deep domain expertise to capture and use the huge volumes of data gathered in the port industry to rationalise and improve their performance.

Jayachandran (JC) Kasimani is the Founder and CEO of Infolayer Limited and a data & insights specialist for over 20 years across Ports & Terminal, Logistics & Transportation, Manufacturing & Financial Services sectors. At Infolayer, JC is leading the Data & Insights Platform/Solution strategy & professional services delivery. JC and his team are working closely with clients to conceptualise and deliver data & insight platforms (BI in a Box) along with key accelerators to democratise both data and analytics as well as empowering their employees to increasingly rely on insight driven management decisions to drive performance and growth.