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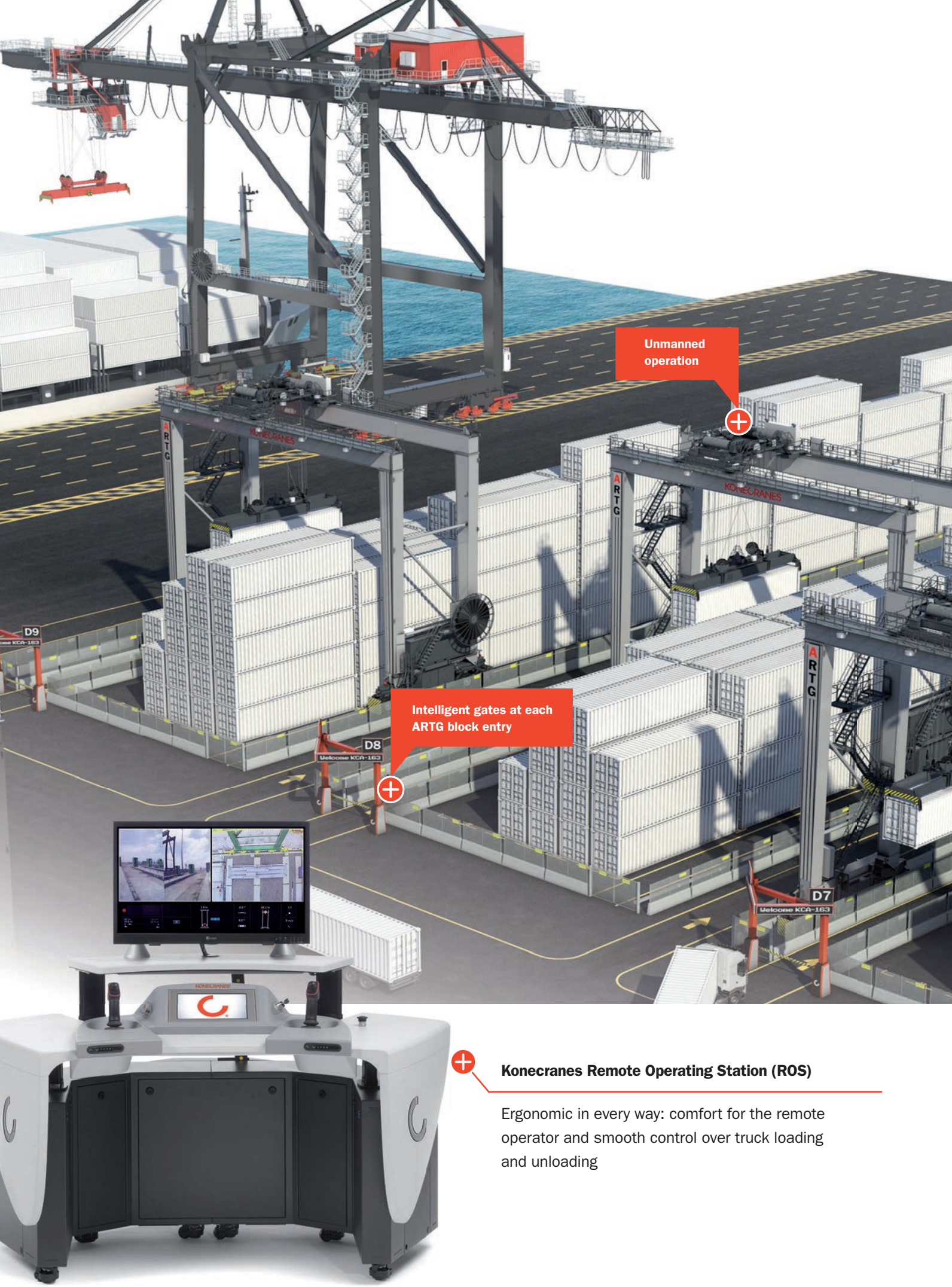

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The International Association of Ports and Harbors (IAPH) is a worldwide association of port authorities, whose principle objective is to develop and foster good relations and cooperation by promoting greater efficiency of all ports and harbors through the exchange of information about new techniques and technology, relating to port development, organisation, administration and management.
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www.coprinstitute.org

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www.dredging.org

The International Association of Dredging Companies (IADC) stands for International Association of Dredging Companies and is the global umbrella organisation for contractors in the private dredging industry. As such the IADC is dedicated to not only promoting the skills, integrity and reliability of its members, but also the dredging industry in general. IADC has over a hundred main and associated members. Together they represent the forefront of the dredging industry.
www.iadc-dredging.com

The Ports and Terminals Group (PTG) is the UK's leading ports trade association. PTG's mission is to help facilitate its members' entry into, or growth of their businesses in, overseas markets; and in doing so assist port organizations and governmental authorities worldwide to undertake port development and expansion on a build-operate-transfer or similar basis.

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From the Editor

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Welcome to the Mega-Terminals Edition, the final issue of 2015, PTI's 20th anniversary year. After the success of the recent Mega-Ports Edition, I've been looking forward to putting this issue together. This is because maintaining a consistent dialogue with ports and terminals around the world affords me and the PTI team the opportunity to familiarise ourselves with some top names in the industry and discover exactly what it is they are experiencing in an operational and macroeconomic context.

In this regard, we've had another chapter in the story of the industry since our last edition, with global trade stunting somewhat, an ominous development given the huge number of mega-ships on order. This situation may have provided the backdrop for a very interesting interview I came across recently with Brian Godsafe, Managing Director of Maersk Line UK and Ireland. In the interview Mr Godsafe stated that Maersk Line, in his region at least, would buy ships that are the most economical in the future as opposed to the biggest. Whether this is a regional decision or symbolic of a wider strategy remains to be seen, yet such a move would have big implications either way.

At PTI we believe such implications need to be discussed more fluently and instantaneously. While our audience can learn extensively from the PTI Technical Papers and keep up-to-date with the industry via our breaking online news, we have a collective aim to create a medium between the two in order for the industry to track macroeconomic developments and get a valued, concise insight into the implications of events on the shipping side.

Therefore, in 2016 PTI will bring to you an online channel which covers the major news in the shipping industry in such a way that goes that bit further than objective news coverage can, without taking the time and concentration a Technical Paper does. I have already spoken to many respected figures in the industry regarding this initiative and found a wholly positive response.

Regarding this edition, it's a pleasure for me to present Mr Frans Koch's final paper of his three part series: 'A new concept in handling mega-ships' (you can access Part I and II online at the PTI website) and I also welcome the return of Neil Davidson of Drewry; a constant source of knowledge and insight into container shipping. Dr Yvo Saanen of the ever-innovative TBA has also returned to co-author a paper with CEO of the Ports of Auckland Tony Gibson, and finally, it's great to have Rich Ceci of GCT featuring; a name various people mentioned to me as someone to speak to as soon as I began researching optimal terminal operations for this edition.

As we prepare to start an exciting 2016, there is one final piece of news from us here at PTI. We have decided to move even further into the digital realm by creating an app for your smartphone (downloadable at the Apple App Store and Google Play) and a membership function on our website. We are also looking to bring something much more visual and exciting to you in the new year with regards to our online news, so stay tuned to the PTI website.

Finally, I'd like to congratulate and thank all our partners, it's been magnificent to see them grow in 2015 and to share that journey with them.

I wish you a Merry Christmas and a Happy New Year from all at PTI.

Richard Joy
Editor

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The Pacific Ocean: the 21st century's crucible of trade

Richard Joy, *Editor,*
Port Technology International, London, United Kingdom

Despite the world's largest vessels travelling between Asia and Europe, the Pacific Ocean has surged in recent decades to become the predominant theatre of global trade, with the Asia-Pacific region the fastest growing trading area in the world. When one considers the likelihood of the implementation of the Trans-Pacific Partnership – an agreement between 12 major Pacific states which account for 40% of the global economy – and the magnitude of China's push to ensure the success of its Maritime Silk Road initiative, you see the true power of the region.

Part of China's plan is to revive historic trading links in the Pacific that have been overshadowed in recent long-term history by the predominance of trade between Europe and the US via the Atlantic Ocean. Yet while Europe – and by extension the Atlantic – had the basis of merchant power rooted in a colonialism which evolved into post-industrial capital, the rise of the Pacific has largely been due to a more modern phenomenon: hyperglobalisation.

Hyperglobalisation is the huge global shift in trade integration, conventionally thought to have occurred in the 1990s after the dissolution of communism across the globe, which freed up markets and brought powerful new growth areas to the table. This goes someway in articulating why vessel capacities have boomed by 12,600 TEU in the last twenty years, while only adding 4,870 TEU in the thirty years prior to that.

The contemporary narrative of the Pacific Ocean is very much dependent on the performance of China. The country has developed itself as a major exporter and manufacturing base, and maritime is

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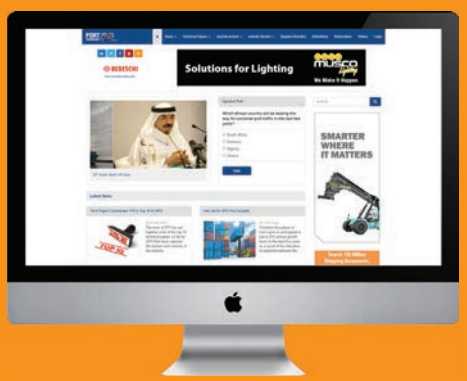

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a key area of focus for its further expansion. There is huge trade between China and the US, with the two most powerful countries in the world having what is ostensibly a cordial, if a little uncertain, political relationship.

Although the trading relationship between the US and China is one of the major factors behind the rise of the Pacific as the world's most lucrative ocean for trade, it is also of note that there is more to the story than that, with China investing more in Latin America than in Africa in recent years.

However, recent news has been bleak for the global economy with container shipping running into something of a slump. China has felt the effects of an economic crash and the Tianjin Port explosions recently, and as the new 'workshop of the world', it is part of our contemporary reality that the economic situation in China has strong ramifications globally.

As global trade growth slows and vessel capacities increase, we may well be entering an era in which the extremities of peaks and troughs are felt evermore intensely, as the economic politics of the Pacific have knock on effects on mega-ships that do not even traverse its waters. Maersk CEO Nils S. Andersen recently stated that he believed global trade is actually progressing slower than the IMF predicted. Despite ruling out a full-on crisis, he did venture to say he felt "pessimistic" about the state of world trade.

This whole situation does chime of note of wonder in that perhaps, as Drewry recently ruminated, the industry is getting the wakeup call it needs and will thereby begin to act accordingly. Perhaps this can be the impetus to begin the much-heralded collaboration talks between carriers and ports, or at least open up the potential of much closer dialogue.

The world is changing once more as the tectonic plates of the global marketplace realign, and the pace of the Pacific is now the key driver in how the world is structured.

In Brief

US Ports Set for Merry Christmas

A sterling performance has been predicted for US Ports in the month of November after the National Retail Federation (NRF) predicted that containerised imports will increase by 8.3% year on year. It has also been predicted that importers of holiday merchandise should experience little, if any, port congestion; a major issue in the 2014/15 winter. Chief Commercial Officer at Port of Long Beach Dr Noel Hacegaba recently stated that there would be no repeat of the congestion previously witnessed along the West Coast as it was simply too damaging for all parties involved the previous winter.

Melting Arctic like 'Discovering New Africa'

As Arctic Ice continues to melt, governments and the private sector are positioned to develop a whole network in the region with an abundance of untapped resources and new trade lanes. The President of Iceland recently said that the ongoing discoveries in the Arctic were akin to finding a "new Africa". The resources in the Arctic region include rare metals and minerals, oil and gas, and renewable energy sources such as geothermal and wind power. Utilising the new Arctic shipping routes would allow carriers to slash up to ten days travel time off a journey from Singapore to Rotterdam.

Vessel Pile-Up at Panama Canal

Shortly after countenancing serious delays on both the Atlantic and Pacific sides of the Panama Canal, the Panama Canal has found congestion again with a high backlog of vessels waiting to pass through the waterway, leaving ships waiting for days. According to the Panama Canal Authority, a "perfect storm" of arrivals of large, deep draft vessels alongside continued water conservation measures, fog, and maintenance work has created waiting times of up to 11 days.

Khalifa Port Launches New Facility

BRF, one of the biggest animal protein producers in the world, is announcing plans to expand its food production facility in Khalifa Industrial Zone Abu Dhabi (Kizad) – a logistics hub at Khalifa Port. The expansion of the facility was announced by Katia Abreu, Minister of Agriculture for Brazil on November 11 in the presence of the Brazilian Ambassador to the UAE, Paulo Cesar Meira de Vasconcellos and other dignitaries from the UAE and region. BRF has intensified its international expansion process in the last two years and will increase its annual production capacity in the Kizad plant from 72,000 tonnes to 100,000 tonnes by the end of 2016.

AAPA Elect New Chairman

Jim Quinn, President and CEO of the Saint John Port Authority in New Brunswick, Canada, was formally installed on November 4 as the 2015-16 chairman of the board for the American Association of Port Authorities (AAPA). As AAPA chairman, he succeeds Kristin Decas, CEO and Port Director of the Port of Hueneme. Mr Quinn accepted his new chairmanship duties at a membership meeting in Miami, Florida, during which the entire slate of 2015-16 delegation officers and board of directors were inducted as part of AAPA's 104th Annual Convention.

Transnet Plans 7 Ports in 5 Years

South African Logistics Firm Transnet is planning to launch a number of infrastructure projects at seven ports in the region, including Durban, Cape Down and Port Elizabeth, which will take place over the next five years. Phyllis Difeto, COO of Transnet National Port Authority (TNPA), said: "A total of around US$139 million will be spent over the next five years to refurbish existing repair facilities, while we will invest an estimated $909 million to more than $1 billion to create new repair facilities at the South African ports."

Global Issues

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Modern mega-terminals: a review

Dirk Visser, *Senior Shipping Consultant and Managing Editor, Dynamar, Alkmaar, the Netherlands*

When contemplating the contemporary mega-terminal what immediately springs to mind is Yangshan Deep-Water Port, the Port of Shanghai's largest terminal, which opened for business in 2005. It is built south of China's largest port on two small, partly bulldozed islands which are fixed to another via reclaimed land. The 33 kilometre, six-lane Donghai Bridge, which I had the privilege to cross ten years ago, connects Yangshan to Shanghai's Pudong New Area.

Along a nearly 6 kilometre quay with a 16 metre water depth, Yangshan boasts 64 STS container gantry cranes. The building of a 2.4 kilometre quay line at Yangshan – known as Phase Four – started earlier this year and is aimed to be completed by 2017. A fifth and last phase should take annual handling capacity to 15 million TEU by 2020.

There are many more mega-terminals in China and elsewhere in the Far East, with Singapore and PSA's four adjacent terminals as the leading facility. The 17.5 kilometre quay line with 14.6-18.0 metre water berths collates 212 quay cranes in total, providing a 37 million TEU capacity. Most notable in the case of Singapore is the new Tuas Terminal which will replace elderly berths and will ultimately look to provide a 65 million TEU capacity: now we are talking super mega-terminals.

Throughput

Size basically implies the handling of lots of boxes and this is of course true the other way around. Fourteen ports worldwide handled more than 10 million TEU in 2015, with Dalian enjoying the highest 5-year compound average growth rate.

Mega-ship ability

Emma Maersk launched in August, 2006 with a stated capacity of 11,000 TEU and was the world's first containership to break the magic boundary of 10,000 TEU. Maersk Line may have thought that through this ship it had taken a decisive lead on the competition. However, over a short period of time in 2007, and into 2008, orders were announced by other lines for around 190 very large box ships, all with a 10,000+ TEU capacity. It is at this period that the generic name of Ultra Large Container Ship was borne.

Conventional wisdom contends that by repeatedly building ships much larger than in operation at the moment of their launch, Maersk Line was the catalyst for industry overcapacity. The 7,400 TEU Regina Maersk, launched in 1996, and the Emma Maersk provoked other carriers, worried by

Port	Country	Area	5-year CAGR	2014	2013	2012
Shanghai	China	Asia, North East	7.1%	35,285,000	33,617,000	32,529,000
Singapore	Singapore	Asia, South East	5.5%	33,869,000	32,579,000	31,649,000
Shenzhen	China	Asia, North East	5.7%	24,037,000	23,278,000	22,941,000
Hong Kong	China SAR	Asia, North East	1.2%	22,300,000	22,288,000	23,126,000
Ningbo	China	Asia, North East	13.1%	19,450,000	17,327,000	16,830,000
Busan	South Korea	Asia, North East	9.3%	18,683,000	17,682,000	17,046,000
Qingdao	China	Asia, North East	10.1%	16,624,000	15,520,000	14,500,000
Guangzhou	China	Asia, North East	7.6%	16,160,000	15,309,000	14,744,000
Dubai	UAE	Middle East Gulf	6.5%	15,249,000	13,641,000	13,280,000
Tianjin	China	Asia, North East	10.0%	14,050,000	13,001,000	12,300,000
Rotterdam	Netherlands	Europe, North West	4.5%	12,298,000	11,621,000	11,866,000
Port Kelang	Malaysia	Asia, South East	8.4%	10,946,000	10,350,000	9,934,000
Kaohsiung	Taiwan	Asia, North East	4.3%	10,593,000	9,938,000	9,781,000
Dalian	China	Asia, North East	17.3%	10,128,000	9,912,000	8,064,000
Totals			**7.1%**	**259,672,000**	**246,063,000**	**238,590,000**
Growth				*6%*	*3%*	*4%*

The multi-millionaires. 5-year throughputs of ports having handled more that 10 million in 2014

the Danes' assumed lower slot costs eroding their market share, to follow suit, as market realities disappeared out of sight.

Unfazed by this observation and expecting annual 5%-8% Far East to Europe market growth, in 2011 the Danish carrier ordered twenty 18,300 TEU Triple-E vessels. Meanwhile, at this time eight carriers were operating or had on order plenty of 18,000+ TEU ships; all of them with a larger capacity than Maersk Line's leviathans.

By 2019, 103 mega-ships of 18,000-21,100 TEU will be operating along the North Europe-Far East axis [*at the time of printing], the only trade in which they will be able to achieve their superior economies of scale (when they are full). Hence it is the terminals in ports on this route that are handling these ships, and once it was thought that these would call at very few ports only, in reality, the number of roundtrip ports is not much less than it was in the early days of containerisation.

Five of the present nineteen regular North Europe-Far East container services deploy 18,000+ TEU mega-ships and make 13 to 19 calls during their roundtrip. The total number of ports per region is: North Europe 13, the Mediterranean 3, the Middle East 1, and the Far East 13 (30 in total).

All five 18,000+ TEU services call at Yantian International Container Terminal (YICT) in Shenzhen, South China; and four call twice during their Far East ports rotation. Therefore YICT, equipped with 51x24 box-wide STS container gantry cranes, handles the largest number of mega-ships.

Production

Productivity is defined as the average of the number of moves (loaded, discharged and shifted) per hour per call, calculated by dividing the total moves by the hours that the ship has been at berth. With 186 moves per hour, APM Terminals Yokohama came out as the world's 2014 number one. Furthermore, the top ten ports in the world includes no less than eight facilities in five different Chinese ports, including four in Tianjin, the North Chinese port recently hit by a devastating blast. DP World Jebel Ali is the single terminal outside the Far East in the ranking.

Mega-alliance patronage

The four alliances, comprising a total of sixteen carriers, ruling the East-West routes will be sufficiently well known, but their present East-West capacity shares are summarised in the table directly to the right.

The multi-sling services operated by the four leading alliances literally cover all relevant main ports in the Europe-Far East, Transatlantic and Transpacific trades. Hence, it requires the 18,000 TEU mega-ships operated by these alliances to define mega-terminals based on alliance patronage, which are exactly the same terminals as the ones by mega-ship ability.

An overview of the number of 18,000+ TEU ships per alliance, separate for existing and on order, is given in the next table.

Technologically advanced state

It could indeed be argued that, in addition to water-depth, connecting infrastructure, stronger quays, larger yards and other essential physical requirements, it takes the most technically / technologically advanced terminals to be considered as true mega-terminals.

April, 2006 saw the official opening of APM Terminals Rotterdam II at

Port	Calls	Country	Port	Calls	Country
Gdansk	1	Poland	Busan	4	South Korea
Aarhus	1	Denmark	Kwangyang	1	South Korea
Gothenburg	1	Sweden	Dalian	2	China North
Hamburg	2	Germany	Tianjin	2	China North
Bremerhaven	5	Germany	Qingdao	4	China North
Wilhelmshaven	1	Germany	Shanghai	7	China Central
Felixstowe	3	UK	Ningbo	5	China Central
Southampton	2	UK	Xiamen	1	China South
Rotterdam	5	Netherlands	Shenzhen (Yantian)	9	China South
Zeebrugge	2	Belgium	Hong Kong	1	China SR
Antwerp	2	Belgium	Singapore	3	Singapore
Dunkirk	1	France	Tanjung Pelepas	4	Malaysia, West
Le Havre	2	France	Port Kelang	3	Malaysia, West
Algeciras	3	Spain	Khor Fakkan	1	Arabian Sea
Tangier-Med	3	Morocco	-	-	-
Marsaxlokk	1	Malta	-	-	-

In North-South-North port order of the Eastbound Europe-Far East Trade

Overview per trade area of ports served by 18,000+ TEU Mega Large Container Ships (MLCS)

Rank	Terminal Top 10 worldwide	Port	Production
1	APM Terminals Yokohama	Yokohama	186
2	Tianjin Port Pacific International Container Terminal	Tianjin	142
3	Qingdao Qianwan ContainerTerminal	Qingdao	136
4	Tianjin Port Alliance International Container Terminal	Tianjin	136
5	DP World Jebel Ali Terminal	Dubai	131
6	Ningbo Beilun Second Container Terminal	Ningbo	129
7	Tianjin Five Containents International Container Terminal	Tianjin	124
8	Xiamen Songyu Container Terminal	Xiamen	124
9	Tianjin Port Eurasia Int. Container Terminal	Tianjin	121
10	Yantian International Container Terminal	Shenzhen	119

*data based on JOC rankings

Source: JoC

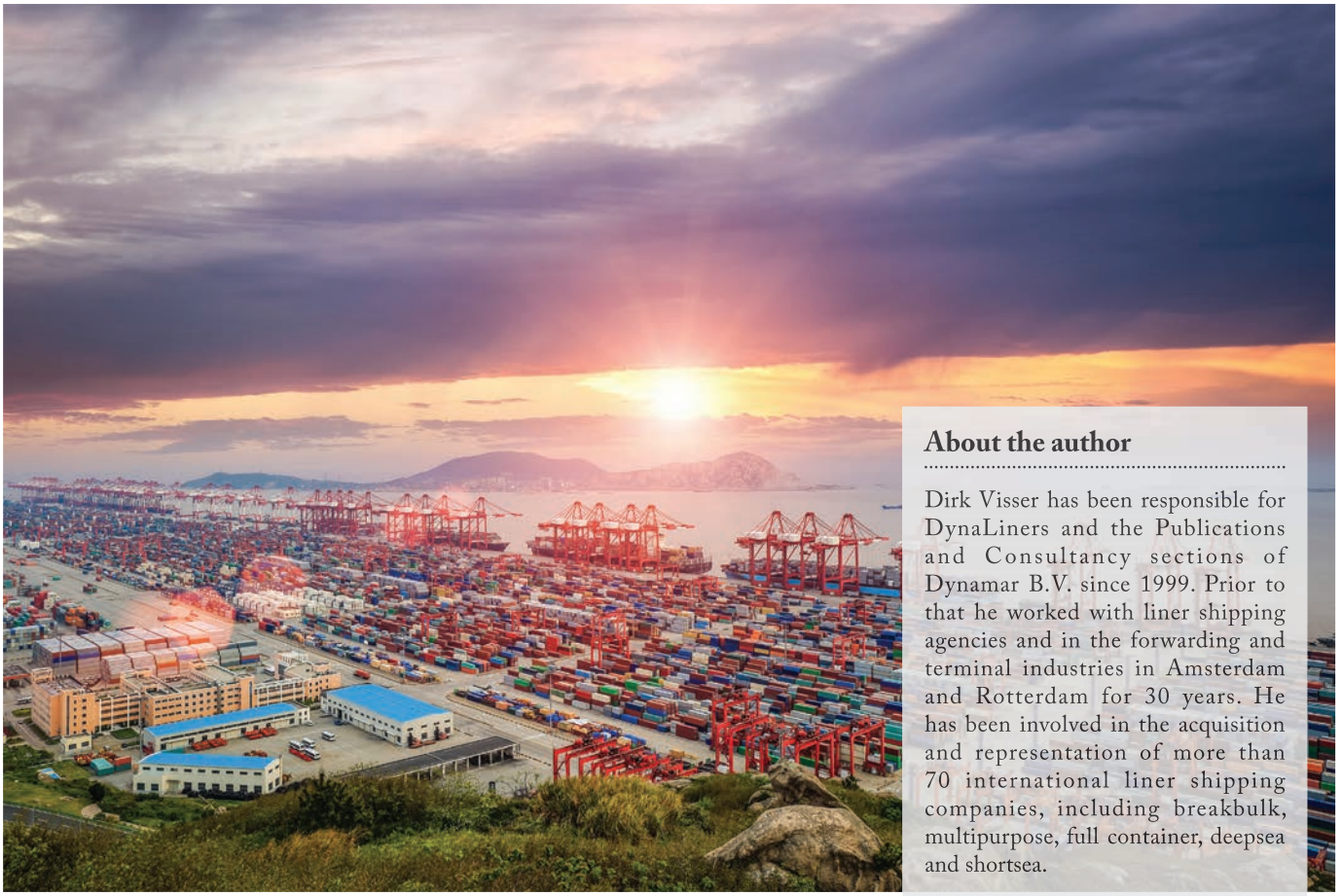
World's 10 largest terminals by 2014 productivity

Mega Large Container Ships					
Alliance	Existing	On order	Total	Ø TEU	Total TEU
2M	25	26	51	19,000	967,000
CKYHE	0	22	22	19,700	433,000
G6	0	16	16	20,500	328,000
Ocean 3	7	7	14	19,700	276,000
Total	**32**	**71**	**103**	**19,500**	**2,004,000**

MLCS per Alliance, split for existing and on order

Alliance	Capacity shares	Carriers
2M	25.5%	Maersk Line, MSC
CKYHE	26.4%	Coscon, Evergreen, Hanjin, "K" Line, Yang Ming
G6	26.1%	APL, Hapag-Lloyd, Hyundai, MOL, NYK, OOCL
Ocean 3	16.5%	China Shipping, CMA CGM, UASC
Other	5.5%	Nine different carriers

East-West Alliances, present East-West trade shares, Partners



Rotterdam's reclaimed Maasvlakte 2, and a few months later the commissioning of the DP World-operated Rotterdam World Gateway (RWG) was announced in the same area. Both terminals, which have 20 metre deep berths, are fully automated to the present max and include an exciting first in their remotely controlled STS gantry cranes.

All mega large ships are built with the North Europe-Far East trade in mind. With its high volumes, a relatively long time at sea and short time in port, this route offers the best conditions to maximise the very large ships' superior economies of scale.

The STS cranes needed to handle these ships are much taller than their predecessors, reaching a minimum 50 metres under the spreader. Therefore they are also heavier and require stronger quays.

The call size of an 18,000+ TEU ship may easily go up to 7,500 moves, equal to some 12,500 TEU. Consequently, an extra pressure weighing on terminal operators is the big ship carrier requirement to handle 6,000 moves per hour to limit port stay. The universal consent among stevedores is that a production of 3,500 moves is a more realistic maximum.

Full STS quay automation is the only means to achieve 6,000 moves per 24 hours of production in a sustainable fashion. The operator is not in a cabin on the crane but in a remote control centre. Unlike the traditional human crane-driver, a robot crane doesn't suffer from back/neck stress, fatigue or fading concentration, and can easily withstand the required faster acceleration and braking.

With remotely-controlled crane automation, APM Terminals expects to be making up to 50% more moves per hour; DP World's RWG anticipates 40 moves an hour. In both cases, it comes down to 6,000 moves per day working the ULCS's with 6 automated quay cranes and a crane intensity which the stowage plan must allow. Both facilities are still far away from this production.

Finally

As matters are, overall North Europe-Far East volumes are bound to contract by 3% this year. North America-related full containers are developing much better with estimated growths of 11% for the Transpacific trade and 13% for the Transatlantic. As these trades are not very big ship suitable, it will take a bit longer before the enormous investments in too many mega-ships and in the mega-terminals in Asia and Europe will pay out.

About the author

Dirk Visser has been responsible for DynaLiners and the Publications and Consultancy sections of Dynamar B.V. since 1999. Prior to that he worked with liner shipping agencies and in the forwarding and terminal industries in Amsterdam and Rotterdam for 30 years. He has been involved in the acquisition and representation of more than 70 international liner shipping companies, including breakbulk, multipurpose, full container, deepsea and shortsea.

About the organisation

Since 1981, Dynamar B.V. of Alkmaar, the Netherlands, has provided transport and shipping information and consultancy services for the marine, energy and financial sectors. Dynamar is today one of the world's leading container sector credit risk analysts, a major provider of analytical container shipping news and commentary, and a regular supplier of bespoke liner shipping consultancy services.

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Mega-terminal operations

PSA International

In container shipping, the idea that "big is beautiful" seems to be in vogue. Ever since the invention of the humble container in the 1950s revolutionised the face of global manufacturing, international trade flows have only grown bigger. More than 60% of seaborne trade now is containerised, with Drewry estimating that over 600 million TEU was moved worldwide in 2014.

Propelled by the strong growth in trade flows and the rise of China as the 'mega' factory of the world, containerships and terminals have also grown in size. In the last decade, the largest containerships have grown exponentially from 8,000 TEU to almost 20,000 TEU today. Shipping liners have undergone waves of consolidation, and joined forces in strong alliances to fully utilise their biggest ships. These developments have changed the landscape of the container handling industry dramatically, and influenced the shape and development of mega-terminals today.

PSA's flagship terminals

At PSA's flagship terminal in Singapore, having to think big is not new. The world's largest transhipment hub port, PSA Singapore Terminals (PSA ST), operates 57 berths over 7 terminals with a capacity of 40 million TEU annually. Its facilities at Tanjong Pagar, Keppel, Brani and Pasir Panjang operate seamlessly as one integrated container port, and handle large-scale and complex transhipment operations 24 hours a day, 365 days a year. Regularly recognised as an industry leader in port operations and management, PSA ST was voted "Best Container Terminal Asia (over 4 million TEU)" at the 2015 Asian Freight, Logistics & Supply Chain Awards. At the end of 2014, PSA ST became the first port in the world to have cumulatively handled 500 million TEU.

The sheer number of the containers that pass through PSA ST everyday means that PSA has always had an abiding fascination with technology, innovating to simplify and create competitive advantages. One example is its proprietary IT solution PORTNET®, the world's first nation-wide business-to-business port community solution. Paperless, collaborative and dynamic, the streamlined connectivity it provided the shipping and logistics community was a clear pace-setter in the port industry. Over time, the services increased, and today it connects almost 10,000 users who make over 220 million transactions a year.

Handling high volumes alone does not make a mega-terminal, however. Today's mega-terminals also have to have the expertise and capability to handle the complexity that a mega-vessel call entails. For instance, bigger ships mean the inevitable obsolescence of old terminals that do not upgrade to cater for these mega-vessels. Just to welcome today's mega-vessels alongside, ports need deeper harbours, longer and wider berths, and longer quay cranes. These mega-terminals also need ample landside facilities to ensure they can accommodate the higher peak cargo loads at each vessel call.

In Singapore, PSA is expanding with the addition of Pasir Panjang Terminal Phases 3 and 4, specifically designed to serve the next generation of mega containerships with almost 6,000 metres of quay length and water depth of up to 18 metres. When the expansion is fully operational by the end of 2017, PSA ST will be able to handle a total of 50 million TEU annually.

Another example of how PSA constantly looks ahead to ensure that its terminals are future-ready is in PSA Antwerp, at the group's second flagship terminal. A bold exercise is underway in Antwerp to move the MSC PSA European Terminal (MPET) from behind the locks to the Deurganck dock outside the locks over the course of 2015 and 2016. This will enable MPET and the port of Antwerp to become a core European gateway and transhipment hub for the 2M alliance of MSC and Maersk. When fully developed, MPET will be the largest container terminal in Europe, with a quay length of 3,550 metres and a handling capacity of 9 million TEU.

Mega-terminal technology

The larger volumes that mega-vessels carry also mean that port technology has to evolve to ensure productivity and operational service levels stay high. Port operations and planning processes have become more complex as shipping alliances grow larger, and slot sharing between ships becomes more commonplace.

In order to overcome ever-increasing constraints on space, time and labour, PSA ST is developing automation and control systems within the port in partnership with the Singaporean government. This includes intelligent planning technologies to handle the exponential increase in information flows, and a proposal to design, develop and test-bed an autonomous truck platooning system for use on Singapore's public roads. Live operational trials of automated guided vehicles (AGVs) are also currently underway at PSA ST's Pasir Panjang Terminals.

A global terminal operator

Including its flagship terminals in Singapore and Antwerp, the PSA Group today participates in over 40 terminal projects across 16 countries in Asia, Europe and the Americas. These projects – of many shapes and sizes - serve every major trade route, with links to all continents and countries, providing shipping lines with global connectivity through its network. Together, the PSA group handled 65.4 million TEU in 2014, making it the world's largest port operator by equity-weighted throughput.

In partnership with shipping lines and local governments, PSA continues to extend its presence into key growth regions around the world. Some of its greenfield projects currently under construction are located in Jakarta, Mumbai and Buenaventura (Colombia). It is also poised to capture opportunities that may arise from China's ambitious 'One Belt, One Road' economic development plan, with several of its Chinese portfolio projects positioned strategically along the maritime half of the initiative.

Its most recent foray in China is the Beibu Gulf-PSA International Container Terminal, a joint venture between Beibu Gulf Port Group, Pacific International Lines (PIL) and PSA in Qinzhou City. The joint venture terminal is PSA's first foray in the South-Western China region, one of the fastest growing economic regions in China. The region has also been earmarked by the Chinese government as a key gateway connecting the Silk Road Economic Belt and the 21st-Century Maritime Silk Road. It is positioned to support the opening up and development of the southwest and mid-south regions of China. Commencing operations in 2015, the Beibu Gulf-PSA International Container Terminal is equipped with super post-Panamax quay cranes of 23-row outreach, able to handle the biggest mega-vessels. It also establishes PSA as the first and only global terminal operator in the Guangxi-Beibu region.

Worldwide expertise

For a global terminal operator, achieving repeatable operational excellence in multiple locations every day is no easy feat. Every terminal is different: set in varying physical configurations, serving a unique set of customers and framed under local regulations and practices. Every day on average, PSA moves about 180,000 TEU worldwide with the highest efficiency and reliability.

Yet the competitive advantage that a global terminal operator like PSA brings to the table is the ability for even smaller terminals in its network to capitalise on its well-established operational franchise, multiple areas of domain specialisation and long lasting relationship with customers.

With over 40 years of experience and expertise in developing, managing, and operating container hub and gateway ports, PSA is familiar with setting the pace in the design and development of terminals for different market needs. PSA also works hard to engage all the major shipping lines regularly to meet their present and future needs, in the locations that matter to them, to provide them with the operational excellence that keep their ships on schedule.

PSA's network of terminals consistently harness the advantage of group-wide best-in-class practices and differentiating work methods, to deliver the high levels of operational excellence that its portfolio of customers and stakeholders worldwide have come to rely upon alongside.

Painting the future

Buffeted by the twin forces of globalisation and technology, the container handling industry has seen much change in the nature of cargo flows. These forces continue to shape the development of ports and terminals, as terminal operators work through the trickle-down implications of larger-than-before vessel calls on their facilities, equipment, information systems, security and even environmental sustainability. PSA will continue to find new ways to innovate and push the boundary of possibilities in the industry, alongside its customers and partners. Indeed, given the unprecedented rapid pace of change, it has become PSA's consuming priority to work with its customers and partners to co-create the best outcomes in our collective future.

About the organisation

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Following corporatisation in 1997, PSA began its internationalisation drive and transformed into a leading global port group. Today it participates in around 40 terminals in 16 countries with flagship operations in Singapore and Antwerp. As the port operator of choice in the world's gateway hubs, PSA is "The World's Port of Call".

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Terminals in northern Europe: large, mega and ultra-mega facilities


Indra Vonck, *ITMMA – University of Antwerp, Belgium; and* Professor Theo Notteboom, *Dalian Maritime University, Dalian, China; Antwerp Maritime Academy, and University of Antwerp, Belgium*

Over the past few years we have seen an increase in terminal development across the globe. The word "mega-terminal" is often used in this context. Growing trade volumes and the newest generation of ultra large ships drive the need for larger and more efficient terminals in the container industry. But how do these developments affect terminal size and port throughput?

Mega-terminals are a direct consequence of growing trade volumes and the scale increases in vessel size. The trend of maximising economies of scale in shipping is visible in almost all subsections of maritime trade but can predominantly be observed in the container business. The strong growth in the deployment of ultra-large container ships of up to 20,000 TEU is well documented. There are no signs that the number of ultra-large container ships will decrease in the coming years.

Terminals are urged to upgrade their facilities to reach unprecedented productivity levels, mainly through automation, a higher crane density, faster terminal operations and advances in yard management and onward inland transportation. At the same time, the call sizes of large vessels lead to a need for more quay space, larger stacking areas and bigger cranes that are able to reach towering stacking heights.

Terminals in northern Europe

Let's start by stating the obvious: terminals are growing in size. However, not all terminals are growing at the same rate. An analysis by ITMMA of the University of Antwerp shows that, when comparing terminal developments in the Port of Antwerp from 1890-1930 to those from 1980 until today, average terminal sizes have increased for all types of cargo. For general cargo terminals this is by a factor of 5, bulk terminals by a factor 4.5, logistics 1.7, RoRo terminals 1.7 and containers by a factor of 7.

Industrial terminals are the exception with an average decrease in size by 50%. The same trend is visible when comparing the development phase from 1950-1966 to that of 1980 to today. Only this time bulk, industrial and logistics terminals declined in surface area (by 40%, 25% and 22%, respectively) and container, Roro and general cargo terminals grew by factors of 3, 3 and 6, respectively. At present, container terminals, industrial terminals and RoRo terminals are on average the largest, followed by bulk, general cargo and logistics terminals (Figure 1).

Container terminals in northern Europe are on average the largest in size. This is a result of the wave of terminal expansion projects in major north-European ports over the past decade – such as Maasvlakte 2 (APM Terminals and Rotterdam World Gateway) and the Euromax terminal in Rotterdam, the Deurganckdock (PSA and Antwerp Gateway) in Antwerp, Port 2000 in Le Havre, Altenwerder in Hamburg, and further extensions of the terminal complex in Bremerhaven and JadeWeserport in Wilhelmshaven.

The arrival of the new generations of mega-ships played a key role in mobilising resources to realise much larger terminal complexes than before. In the mid-1990s, a new container terminal in the Hamburg-Le Havre range typically had a design capacity of 0.5 to 1 million TEU per annum. In the mid-2000s, this figure amounted to 2 to 2.5 million TEU, while the latest terminal facilities are reaching annual capacities (when fully operational) in excess of 3 to even 4 million TEU.

The growing capital needs and commercial risks have given an incentive to form more complex partnerships in view of operating the terminals. For example, DP World invested about US$750 million in Rotterdam World Gateway on Maasvlakte 2 in collaboration with four container carriers. In Antwerp, a decision was taken to move MSC's volumes (some 4.5 million TEU per year) from the right bank to the Deurganckdock, a terminal better suited for large vessels – this was in order to concentrate all future 2M network traffic on the left bank of the river. The introduction of the new coalitions and mega alliances such as 2M, O3, CKYHE and G6 are contributing to increased pressures on terminal operators to offer sufficient terminal capacity.

Throughputs

The allocated terminal area is strongly correlated to TEU throughput (Figure 2). Rotterdam, Hamburg and Bremerhaven are having a relatively high throughput for the allocated land. Note that the figures relate to 2014, so the Rotterdam data does not include the new Maasvlakte 2 terminals which opened for business in 2015. On the other hand, Antwerp and Le Havre have a somewhat lower use of the allocated land area. In Antwerp, the picture is expected to change very soon given the strong container growth in the Scheldt port (+8% in the first nine months of 2015), the ongoing move of MSC to the (now still underutilised) Deurganckdock and the associated shift in the use of the Delwaidedock on the right bank from container to non-containerised flows.

Land allocation

It would be presumptuous to assume that land allocation is the only driver for TEU throughput. Other factors are also important when discussing container volumes, such as the dock labour system, the nature of the terminal operators involved (dedicated terminal or not), the yard equipment used, the amount of

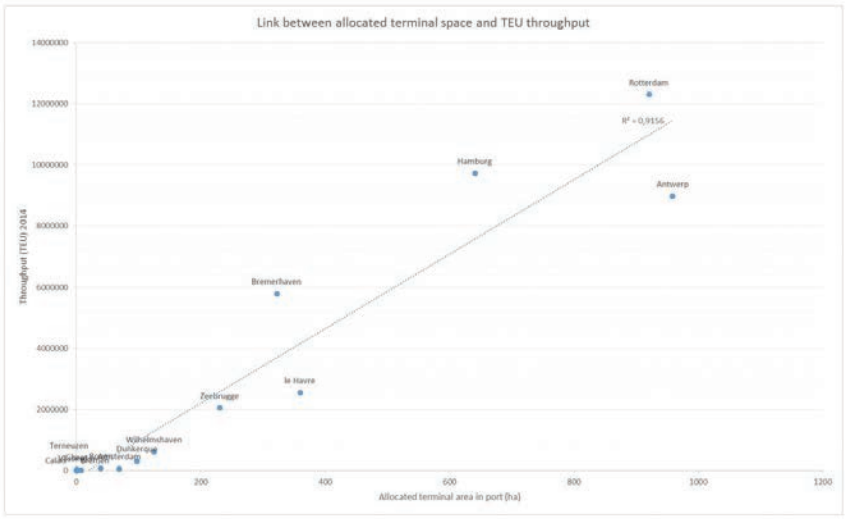

Figure 1: Terminal size distribution for all major ports in the Hamburg-Le Havre range

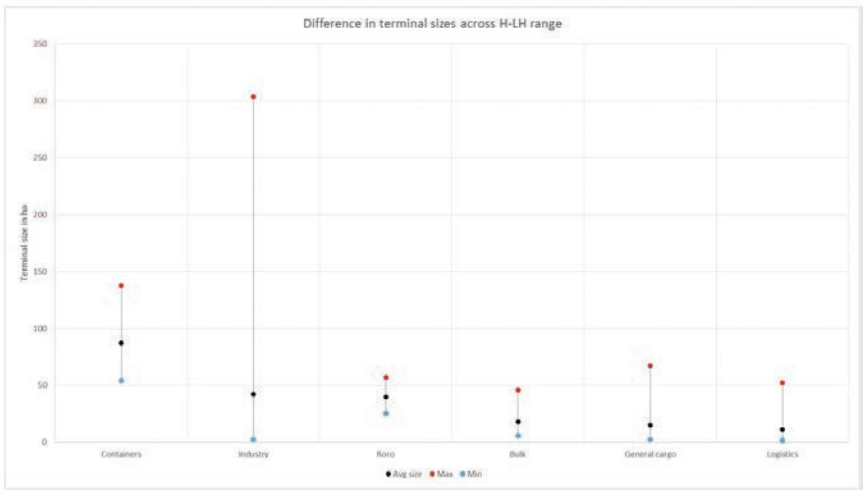

Figure 2: Relationship between terminal space and TEU throughput (2014)

automation, and so forth.

As ship size is one of the main drivers for terminal size, one could argue that terminals will reach their maximum size once ships stop growing in size. Economies of scale remain considerable and in an environment in which rates are under a continuous pressure, each penny counts. The limits of ship size largely revolve around their operations, rather than any structural constraints. The current generation of ships is already pushing the boundaries of maximum size. We also expect that terminal size will ultimately reach its limits. The added effects of liner shipping alliances, the rise of automation and the human tendency to go ever higher, bigger, better and faster are factors pushing terminals beyond mega. However, the size of mega terminals is also going to be affected by other factors:

- Firstly, further improvements in land productivity and lower dwell times due to better synchronised hub-feeder operations and intermodal connectivity will continue to increase the annual capacity per hectare of terminal land. As such, less land will be needed to offer a similar annual capacity provided the terminal operator is able to secure enough resources to make the necessary productivity leap
- Secondly, as terminals grow in size, the cost and complexity of intra-terminal container movements increases as well. Therefore, mega-terminals will increasingly be managed as a collection of adjacent sub-terminals
- Thirdly, given the commercial risks associated with mega-terminals, the ownership of these facilities is expected to become even more complex in the future
- Fourth, the growing needs in terms of berth length, yard capacity and the bundling of feeder and inland flows will lead to a further consolidation of container volumes in mega terminals. Examples include the recent closure of the Eem- and Waalhaven facilities in Rotterdam and the planned reorientation of the Delwaidedock (located behind locks) in Antwerp to non-containerised business. In extreme cases, smaller ports and terminal facilities will find it increasingly difficult to maintain a position in the large-scale container business (see the position of Amsterdam, Dunkirk and Thamesport, to name but a few)

About the author

Professor Dr Theo Notteboom is a High-End Foreign Expert / Professor at Dalian Maritime University in China, a part-time Professor at University of Antwerp and Antwerp Maritime Academy in Belgium and a visiting Professor in Shanghai and Singapore. He published widely on port and maritime economics.

Indra Vonck is a Research Associate at the University of Antwerp and the VUB (University of Brussels). He obtained Masters from the Antwerp Maritime Academy and ITMMA, University of Antwerp. He specialises in port development and inland transportation and the application of resilience and flexibility frameworks to ports.

About the organisation

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PortEconomics is a web-based initiative aimed at generating and disseminating knowledge about seaports. It is developed and empowered by the members of the PortEconomics group, who are actively involved in academic and contract research in port economics, management, and policy. Since October 2012, Port Technology International and PortEconomics have been engaged in a partnership.

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The economic contribution of ports and terminals

Willie Coetsee, *Senior Manager: Strategy, Transnet Port Terminals, South Africa*

Globalisation has resulted in the sourcing of goods from any location in the world, and this enablement has also lead to a competitive shift in the basis of a port's competitive advantage. Ports can no longer place reliance solely on their strategic geographical location or a country's endowment alone in order to maintain economic dominance; a port's ability to remain competitive today hinges on its ability to compliment and contribute to the competitive position of a country's holistic supply chain its boundaries.

This imperative requires investment in infrastructure and technology on the one hand, and cost cutting and lean operational business practices on the other, with an added commitment to play a coordinator role between different supply chain stakeholders.

South Africa

Transnet is the largest link in the South African freight logistics chain. Every day the company delivers thousands of tonnes of goods in and around South Africa through its freight network of sea ports, rail corridors and fuel pipelines. At the port, cargo is moved onto vessels for export and unloaded for import. The state-owned company introduced an investment programme three years ago that is known as the Market Demand Strategy.

The objective of this strategy is to invest about US$25 billion over a period of seven years (figure might differ depending on exchange rate fluctuations) in much needed port, rail and pipeline infrastructure in order to improve the supply chain. These committed infrastructure and equipment investments are aligned to economic cargo demand forecasts which would stimulate economic growth for the South African economy once commissioned. Two thirds of the

Document preparation	Customs clearance and inspections	Port Charges	Inland transportation and handling	Total Supply Chain Costs
$355	**$90**	$285	**$1 100**	$1 830
19.4%	**5%**	15.6%	**60%**	

Figure 1: World Bank report on South African Export Supply Chain Costs

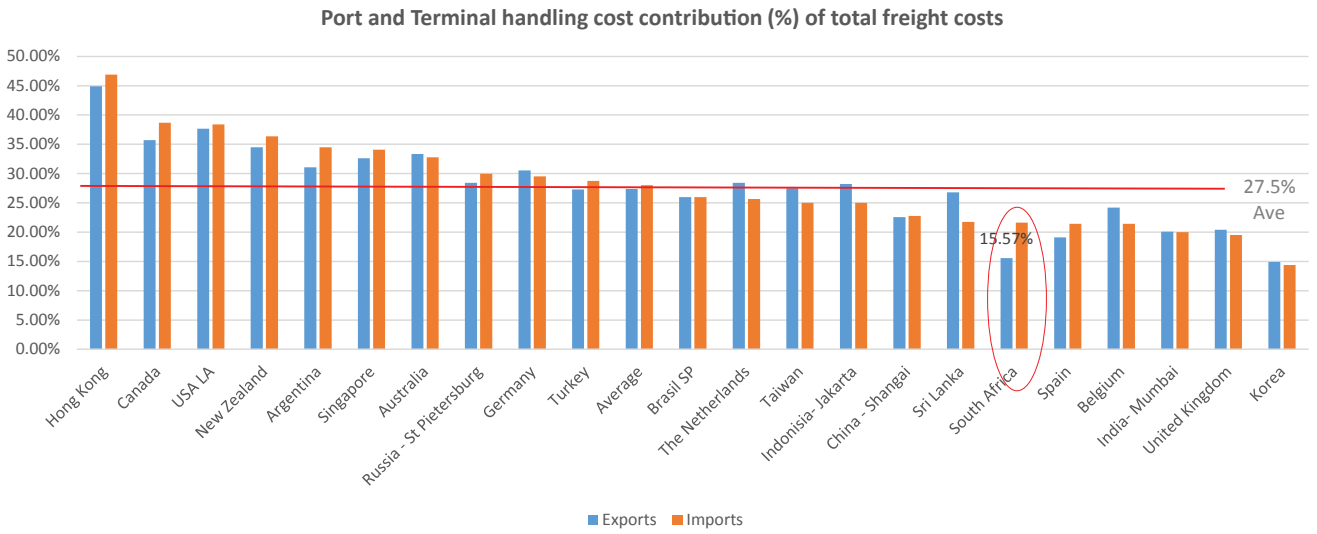

Figure 2: Port and terminal handling cost contribution (%) of supply chain costs (excluding sea transport)

funding requirements will be obtained from revenue generated by the group's operations, and the balance sourced from overseas and local sources.

Challenges with economic growth, high unemployment levels and ever increasing input cost requires the various role-players in the supply chain to investigate their individual contribution to the cost of doing business in a country.

Cost of doing business

The World Bank publishes a comprehensive report annually comparing supply chain costs for the export of a container from a country's major business hub to its major port of export. These costs are contributed by various service providers in the supply chain. Total supply chain cost includes the cost of documentation, customs and inland transport, but excludes sea transport.

According to the World Bank Report on doing business and trading across borders, South African port charges contribute a mere 15.6% of total transport chain charges as compared to the international average of 27.7% port cost contribution.

Strategic position

The cost of transport, both on land and at sea, outweighs port costs by far. Due to South Africa's geographical position at the most southern point of world trade lanes, sea transport is the most expensive contributor to total supply chain costs. Adding the sea leg from Durban to Rotterdam reduces port cost contribution to 5.5% of total supply chain cost. Shipping companies apply strategies such as slow steaming, and as the ships are getting bigger, unit costs comes down in terms of economies of scale.

Inland transport is the second biggest portion of total supply chain costs and moving traffic from road to rail will lead to an estimated reduction in inland transport costs of at least 30%.

The aid of a TOS

With the implementation of Transnet Port Terminal's (TPT) Navis TOS, manual processes and documentation have been significantly reduced. The last physical document that TPT required, the CTO, became obsolete in 2011 when all transactions with the port became electronic.

It is interesting to note that the cost of documentation levied by private sector role-players, clearing and forwarding agents, as well as shipping lines, is a bigger contributor to supply chain costs than total port costs. A port is but one of several players within the logistics supply chain and its contribution to supply chain costs are a mere fraction of the total cost of the entire supply chain.

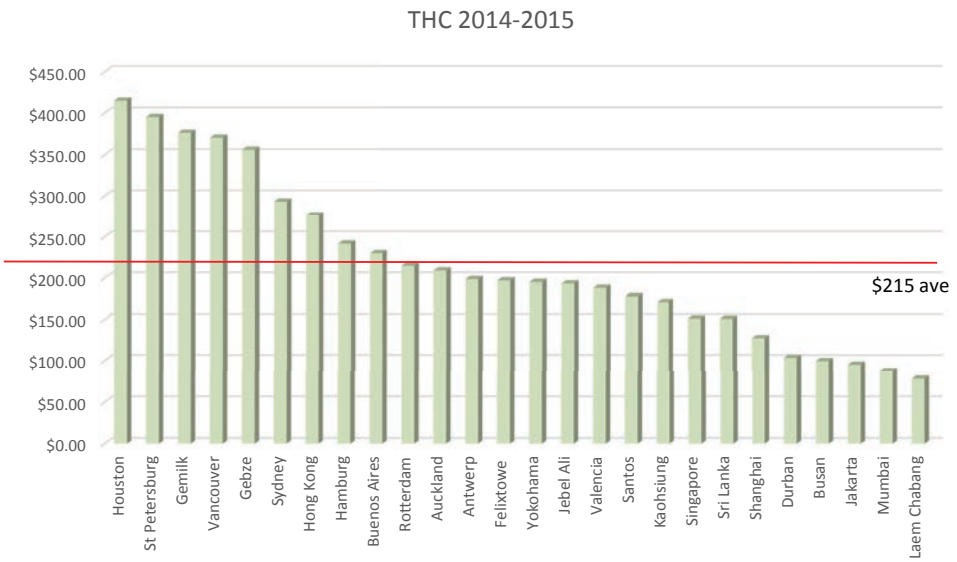

Figure 3: Container terminal handling charges. Source: Hamburg Süd

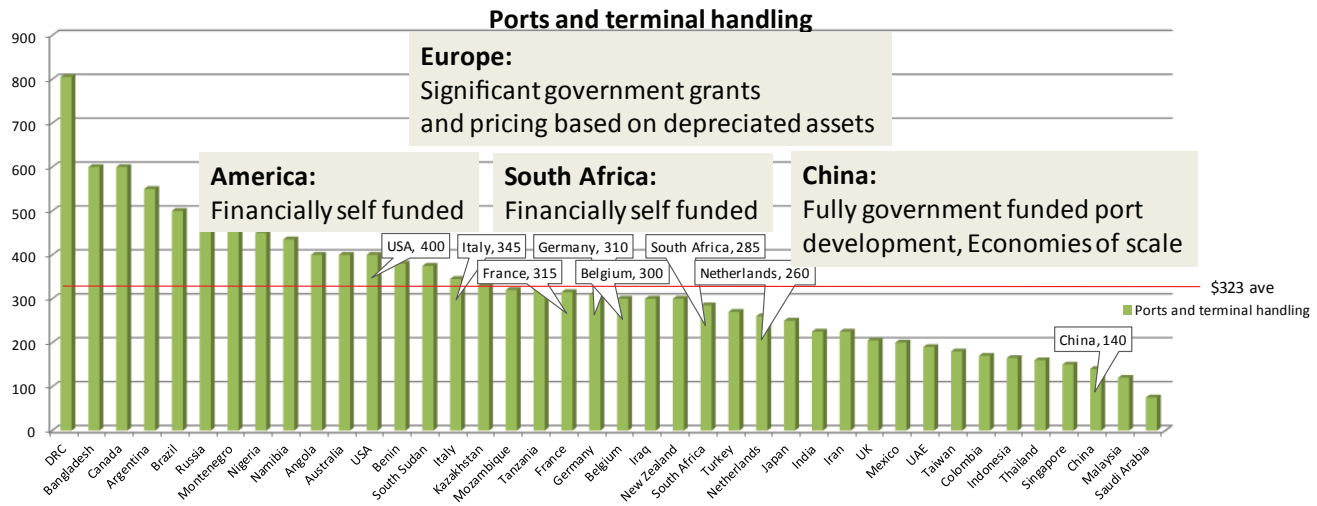

Figure 4: World Bank report on port charges as a contributor to the cost of doing business

Port charges

Cargo dues and terminal handling charges are combined to form total port costs in the World Bank report. If the port cost is split and analysed separately, South Africa's terminal handling charges are also found to be significantly lower than the total handling costs levied by other international terminal operators.

A further analysis of port charges paid by shipping lines indicate that South African ports charge far less than the majority of international terminal operators for the handling of bulk commodities.

Also of interest is the fact that in South Africa taxpayers' money isn't used to make enhancements to infrastructure or to purchase equipment. The $25 billion that is currently being spent in line with the Market Demand Strategy is funded from operations and international loans that must be repaid, unlike the situation in Asian and European countries.

A competitive landscape

The issue of connectivity needs to be considered in determining a port's cost contribution to the supply chain. South Africa is in the top quarter of countries in the world in terms of ease of doing business (positioned 43 out of 189 countries). Factors influencing port competitiveness range from location, ownership, management, labour relations, customer base and the hinterland network, to information technology connectivity.

Dwell and import handling times at ports need to be put in perspective. With port costs contributing such a small percentage to total supply chain costs, it is important to ensure that ship turnaround times are as quick as possible to allow the shipping lines to utilise slow steaming to reduce overall supply chain costs. The average time spent by the 650 containerships that called at South Africa's main container terminal, Durban Pier 2, this year has been 3.7 days.

The average time a containership spent from announcement of arrival at outer anchorage to time of berthing has been 36 hours. Ships arriving at the time when the ETA was communicated up-front to the terminal will berth on arrival, but what adds to the 36 hours is ships arriving too early or missing their berthing windows, as well as vessel delays caused by the ship waiting for connecting ships delivering transhipment cargo.

Durban Container Terminals

Durban has been rated as the most productive terminal in Africa by one of the major shipping lines calling at ports in Africa and elsewhere in the world. The average time a containership spent at berth is less than 2 days in recent months. Furthermore, it takes 42 hours to offload just under 2,000 containers at a berth productivity of 48 moves an hour, which is comparable to Antwerp's 50 moves.

On the landside, import boxes are available for collection ten minutes from landing at Pier 2, which is a straddle operation, and within 12 hours of landing at Pier 1, which runs an RTG operation. A free collection period of up to three days is allowed for import cargo, but in practice containers are dispatched in 1.8 days on average.

Electronic data interchange (EDI) and online documentation processing has streamlined this process. Trucks turn around inside the terminal within 35 minutes. A truck booking system has also been introduced recently with the aim of reducing traffic congestion outside the port gates.

About the author

Willie Coetsee heads up a talented team of individuals responsible for the corporate strategy of Transnet Port Terminals nationally and internationally. He is a seasoned executive that engages in public speaking commitments on a regular basis on the African continent. Topics covered in recent engagements include 'African seaport expansion'; 'How smart ports are making efficiency a reality'; 'How to develop a successful strategy to enable more efficient port operations'; 'Facilitating sustainable investment in Africa'; and, 'Embedding the human resource element in business strategy'.

About the organisation

Transnet Port Terminals manages sixteen cargo terminal facilities across seven South African ports with a staff complement of over 9,000. Its operations target four major market sectors; the automotive sector, containers, bulk, and break bulk; all organised according to their respective geographical regions.

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Arturo Garcia, *IT Director, Abu Dhabi Terminals, Abu Dhabi, UAE; and,*
Dr Oscar Pernia, *Senior Director of Product Strategy, Navis, California, USA*

The establishment of Khalifa Port Container Terminal (KPCT) as Abu Dhabi's main container port and first semi-automated port in the region has been a success story for its operator, Abu Dhabi Terminals (ADT). What was the journey like that helped ADT become the third fastest growing terminal and one of the most productive automated terminals in the world? What are the plans for operational improvements, expansion and increased levels of automation to promote further efficiency, sustainability and quality of service? What are the main principals driving automation?

As part of this journey, Navis played a role in providing concepts and solutions to support one of the main objectives of KPCT, and other automated mega-terminals, to realise an improved operational performance by utilising automation.

An automation journey

Since its official inauguration on December 12, 2012, KPCT has grown to support the local market with approximately 20 weekly container line services that connect Kizad (Khalifa Industrial Zone Abu Dhabi), Abu Dhabi and the wider UAE with the world markets. KPCT utilises the latest technologies and has been designed to accommodate the largest container vessels in service. The initial throughput capacity of the terminal is 2.5 million TEU, with a master plan to handle up to 15 million TEU, as and when this is required by the market.

As one of the most technologically advanced container terminals in the region, ADT has had a stellar year so far, recording a 41% increase in volumes in the first 9 months of 2015, compared to the same period in 2014, with consistently higher container moves per hour and faster truck-turn-around times. This illustrates the value of a holistic waterside and landside effort to develop and improve terminal capabilities.

ADT's operations team has consistently achieved 35 gross moves per hour (GMPH) as well as recording the shortest truck turnaround time in the region (which currently stands at 12 to 14 minutes). Recently, ADT set a new productivity record by handling 2,615 moves in just under 13 hours on the 9,365 TEU CMA CGM Thames which called at Khalifa Port in July, 2015. An operational productivity metric and record of 206 berth moves per hour (BMPH) at an average of 46.38 GMPH was also achieved. This is the first time ADT has crossed the important benchmark of 200 berth moves per hour. Achieving and maintaining these high levels of productivity is one of the key value drivers for both the shipping lines and port operators in order to maximise efficiencies and increase terminal throughput and capacity.

Automation has played a key role in the journey to attain record setting productivity through an intense technical integration effort combined with the development of ADT's operational capabilities. By fostering collaboration between different equipment and system providers, it has positioned KPCT as one of the best container terminals in the world in terms of efficiency and quality of service.

The path to systematic operations

Automation attempts to introduce planning predictability, process control and operational excellence by managing the terminal as a holistic 'system', bringing the operation as close as possible to a 'factory' environment in which operations are more predictable, while minimising the variability in processes.

This is a challenging proposition in today's environment for a few reasons:

1. Operational execution outcome variability is vastly affected by vessel conditions, the vessel stowage plan, port equipment reliability and other human factors (such as crane rates, the difference between different vessels, or different quay crane operators) which are difficult to control
2. Information accuracy: cargo information infrastructure does not always accurately provide transparency and visibility for the different stakeholders and can contain insufficient and inaccurate information for critical container parameters such as weight (e.g. container stowage differences with BAPLIE files)
3. Planning changes and trade-offs: operations are a 'live' environment where there are constant changes in both planning (e.g. vessel schedule changes or the impact of vessel completion on 'clean' yard organisation) and real-time operations (such as real-time planning changes in order to minimise a buffer's workload)

The industry needs to have a system that holistically addresses opportunities and trade-offs across the different operational areas and across the different time horizons. Only a system that includes accurate and timely information as well as holistic visibility

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CORE GOAL	MISSION	FOCUS
Timely & Accurate Data	Consistent and rich data to enable performance optimization and ability to respond to unplanned changes, while planning	Visibility
Collaboration	Alignment on stowage planning, terminal resources and performance requirements with customers	Joint Decision Making for Vessel Planning
Flexibility	Real-time transparency delivering efficiency and cost savings	Trade-Offs Driving
Operational Balance	Correlation across different operational areas and time horizons	Holistic Optimization

CORE GOAL	MISSION	FOCUS
Proactive Assessment	Framework leveraging several data sources and dependencies between decisions	Analytical Monitoring
Process Control	Fast diagnosis on congestion and bottlenecks root-causes, and quick path to resolution	Congestion Management
Move Realization	Clarity on operational goals and recommendations by systems for user actions consistency and awareness on what's coming	Adjustment & Coordination
Exceptions Handling	Toolbox to deal with the 'un-known' in order to solve problems and to minimize exceptions impact	Effective Procedures

PLANNING ⟵ ⟶ EXECUTION

and traceability can effectively assess a solution for terminal operational management.

Navis's aim is to produce a 'master system' from the N4 TOS that supports proactive and smartly driven container terminal operations and removes current limitations in terms of integration with other systems, information access and usability.

Automation moving KPCT forward

It was certainly a journey for ADT to get where they are today in terms of automation, and they are already planning for the future. Medium and long term investment plans by ADT aim to establish the next levels of innovation; KPCT will focus their efforts on managing the entire operation as a 'system'; utilising equipment, software and people to improve operational performance even further.

In general, there are two main areas of automation focus for ADT: equipment and process automation. Equipment automation has three areas: automation of quay cranes, fully automated stacking cranes including truck loading and unloading and the automation of shuttle

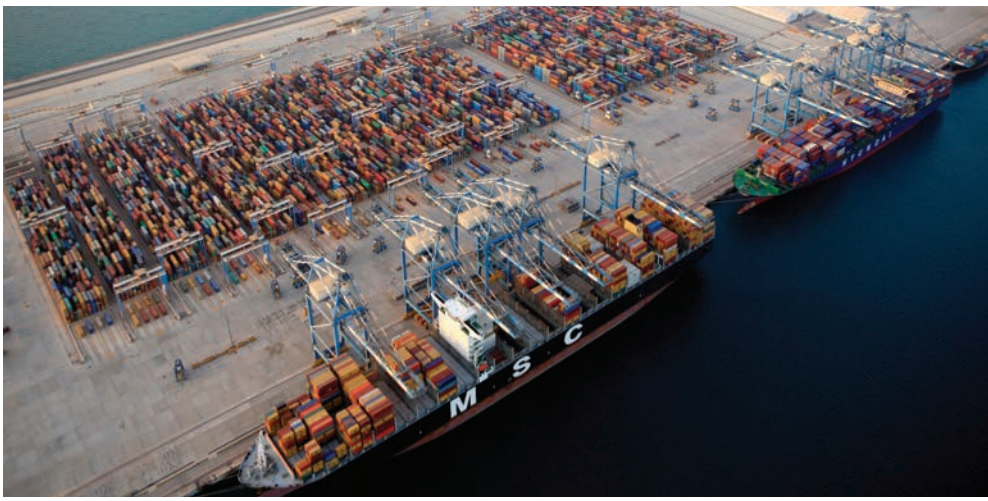
carriers at waterside. At the moment ADT believes this offers the greatest potential benefit in terms of reduced maintenance of equipment, a safer work environment and consistent, reliable productivity. With process automation, ADT is looking to further optimise operations using in-house talent and, in cooperation with their providers, by improving ADT's entire ecosystem.

ADT's corporate philosophy is based on partnership, and the operator ensures that the customer experience within Khalifa Port is one of the best, not only for stevedoring activities but also for port-centric logistics and warehousing services. ADT works very closely with a number of leading providers such as Navis to ensure it can provide the knowledge and most technically advanced solutions to their customers. ADT will no doubt expand and invest in more capabilities going forward.

Beyond the holistic approach of managing container terminals as a 'system', ADT and Navis have come together to forge some principles that could enable a 'productivity quantum leap' within automated container terminals:

1. In terms of the implementation effort to deal with the technical complexity (IT & EQ), operational teams need to stay focused on the critical areas to enable a more professional and agile approach for system integration and testing practices
2. In terms of technical implementation, consistency and repeatability, the need for 'Automation Standards' is clear. Equipment Control System (ECS) integration with TOS software, which includes methodology, processes and tools to facilitate modularity and flexibility for automated terminal is paramount
3. In terms of people, it is fundamental to develop operational and analytical capabilities as a core competency to complement technical and engineering knowledge. This is in order to better understand a whole terminal's operational infrastructure and ecosystem

All these principles are critical in improving the way a terminal delivers operational efficiency. Automation is truly the future but the realisation of its full potential requires a concentration and focus on finding the meaningful impact on operations from technical, integration and organisational perspectives. The aim is to find practical and tangible results that reinforce confidence in the value of automation as a tool to ensure operational excellence and sustainability.



About the author

Abu Dhabi Terminals' IT Director Arturo Garcia oversees the design and implementation of all automated systems and equipment at Khalifa Port Container Terminal (KPCT). As a pioneer in terminal automation and associated logistics processes, Arturo sets and delivers an ambitious IT strategy for ADT that ensures that KPCT provides a safe, high-volume and high-productivity performance. Prior to this, Arturo spent 4 years in ADT's operations department managing the Operations Control Center including network operational performance and optimising Terminal Operating Systems. Arturo brings with him over 10 years of IT and operational management experience at terminals in Europe and the Middle East.

Dr Oscar Pernia is responsible for Navis Product Strategy, with an intense focus on analysing industry driving forces regarding operational efficiency and then developing effective operational input to Navis Roadmap. Prior to his current role, he focused on terminal automation, being part of the core team designing, testing and deploying the new N4 3.0 platform. Prior to joining Navis, Oscar worked for Hanjin Shipping at TTIA (the first semi-automated terminal in Mediterranean) leading terminal implementation and optimisation for three years. Here he created a young and talented tech-team which pioneered integration and operational concepts on systems architecture and control centre organisations for automated terminals. Early in his career Oscar spent eight years in IT with Algeciras Bay Port Authority where he held a variety of positions managing projects focused on technology, process optimisation and integration.

About the organisation

Established in 2006, Abu Dhabi Terminals' (ADT) core business is to operate and manage Khalifa Port Container Terminal (KPCT), which is the region's first semi-automated and most technologically advanced container terminal. ADT's port-centric supply chain and warehousing solutions offer an optimised approach for bringing trade partners and shipping lines closer to the markets they serve.

Navis understands that as operational processes become more complex, efficiency, collaboration and productivity are essential. As a trusted technology partner, Navis offers the tools and personnel necessary to meet the requirements of a new, and ever-evolving, global supply chain. The Navis N4 terminal operating system is a platform that can integrate partner technologies, enabling terminals to optimise productivity and enhance the service delivered to its customers.

Enquiries

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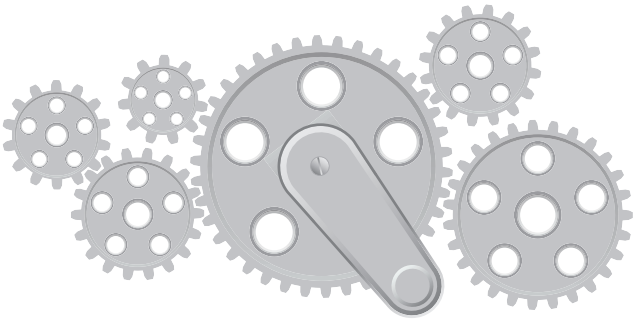
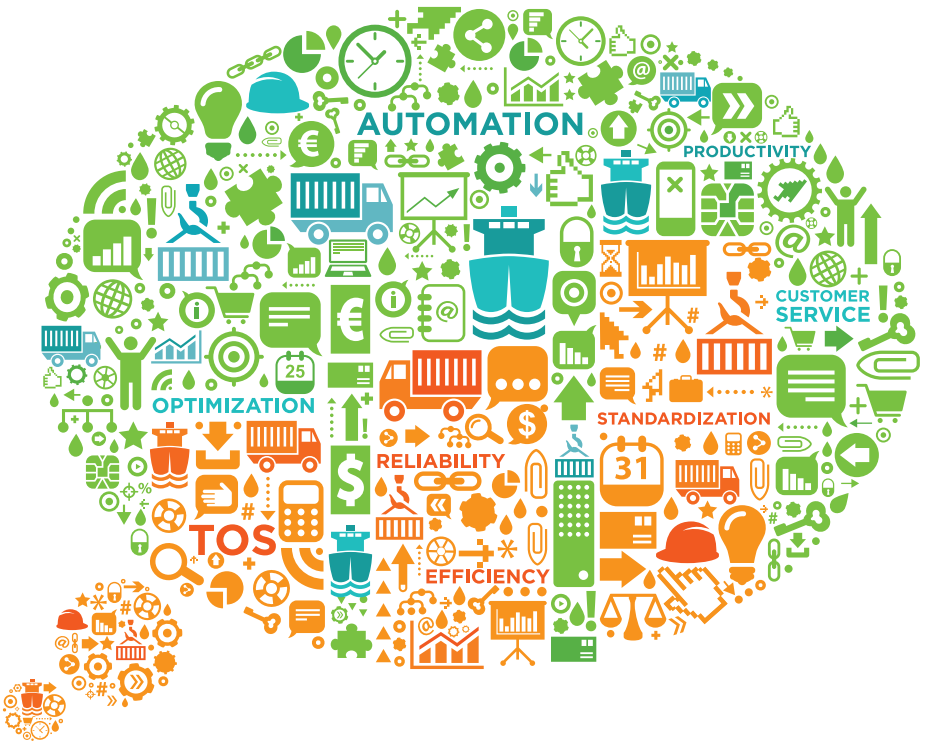


to tomorrow



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Smart Port: the key role of a Systems Integrator

Richard Butcher, *Global Head and Director: Port and Terminal Division, Wipro Technologies, Reading, UK*

This paper looks at the role of the System Integrator within the growing port and terminal market. The complex nature of this sector has left a niche for the Systems Integrator (SI) to engage the industry and deliver a cost-effective, highly efficient service.

The evolving port market

In the ever-changing port sector, large capital intensive facilities are facing major challenges with the expansion of global trade and ever greater demands from cargo owners and ocean carriers. Port executives therefore seek increasingly innovative ways to manage their facilities and introduce greater cost savings and effective solutions to drive development. Technology is a powerful force within many of today's ports and terminals seeking to implement advanced solutions that can help achieve the following goals:

- Higher productivity figures
- Reduced operational costs
- Improved levels of security
- Higher safety standards
- Increased service levels
- Improved asset utilisation

Greenfield development

The market is witnessing new capital investment in greenfield ports as the industry continues to grow and global port groups seek to develop new markets and build infrastructure to support growth regions. Other pressures being exerted on port operators are through political demand for reduced pollution levels, congestion, and associated environmental issues coupled with the limited availability of space to expand facilities. Because of this, ports are increasingly turning to automation. These factors are driving demand for the introduction of the next generation of 'Smart Port' and Global System Integrators.

Smart Port concept

The term 'Smart Port' stems from a number of key factors, these being:

- Improved IT infrastructure
- Improved data flow
- Improved safety and security
- Improved visibility
- Improved productivity
- Improved revenue generation
- Reduced operational costs

The technology road map for ports can vary significantly, with some ports more advanced than others, yet most will all have some form of IT infrastructure already in place to achieve the key Smart Port factors highlighted above. However, most ports will suffer from integration issues when looking at adopting new applications and need to define a strategic road map to adapt to continuing change.

Technology is continually evolving, and for a port IT department it becomes very difficult to assess and analyse the best of breed technology to evaluate the future technology road map, especially as IT departments tend to be limited in size and demands from their various operational departments takes up much of their time.

Smart Port building blocks

Wipro's approach is to introduce a Smart Port with a structured framework that ties key operating solutions and advanced applications together. A Smart Port must take into consideration what type of technology architecture needs to be introduced, and which applications can be slotted into this framework and provide a stable, long-term platform to grow with a port and meet industry demands.

Complex integration issues

Port and terminal IT departments face additional technological challenges as the industry changes. These are based around:

- IT 'Road Map'
- IT budgets (which need to take into account change)
- Current technology
- Current IT projects
- Technology stack requirements

As it turns out, the complexity involved in establishing a Smart Port concept lends itself well for port management to engage with leading global system integration companies.

Role of SI

SI's bring a wealth of experience and knowledge to the market, with considerable resources and strong ties with the world's leading technology partners, they bring structure to complex projects that involve integration and multi-tiered IT structures.

A System Integrator works with a client in clearly defining the solutions available, making recommendations on the changing face of technology within the market, and showing how proven technology can deliver across Smart Port frameworks.

In utilising an SI, port and terminal management is assured of an experienced resource that has profound expertise in projects that can deliver a total "turn-key" environment. The SI can be used to support and manage IT projects during the full life cycle of solutions, providing peace of mind and a strong assurance to clients.

Greenfield sites

When large scale groups seek to develop greenfield sites, an SI can be engaged

at the front end of a project and work closely with construction groups, ensuring that the necessary IT infrastructure is established. This involves such areas as:

- Total project management; ensuring that port guidelines and budgets are met and conform to business plans
- Graphical 'BIM' modelling to ensure that port infrastructure and optimal design is incorporated into port design and layout
- Ensuring that IT infrastructure is laid out and configured covering all the key areas such as fibre optics, control centres, power, lighting, and all other necessary technology infrastructure
- Defining all IT solutions and working in line with project time frames to deliver all solutions in line with a functional 'go-live' time
- Providing seamless management and resources to implement and support all IT related solutions

Totally automated terminals

A large number of container terminals are turning towards introducing fully automated facilities which involve complex control systems that run the handling and full processing of vessels, cargo and terminal equipment that take out human intervention. The benefits for facilities that have limited space for growth, higher labour costs or seek to drive even greater throughputs and productivity are manifold.

The project to run and manage every key component is very difficult when vendors only want to deliver their own areas of the project. The overall management of a project can be outsourced to a System Integrator that can run and manage the project and coordinate with the various parties, ensuring that all the deliveries are made on time and within budget.

Greater service levels

An SI seeks to deliver more than just project management and the implementation of complex applications, SI's can also deliver in the following areas:

- Provide experts that can define and integrate a port's existing technology with new solutions
- Ability to configure and define additional functionality that is missing from a selected vendor's applications, the various user interfaces can be defined, built, tested and deployed, ensuring that all port solutions are synced and deliver tangible results
- Define and deploy tangible management information applications so that data can be collected and processed from all the relevant operational systems. Therefore a port and terminal can capture and measure key performance indicators
- Design, develop, deploy and support specific bespoke developed solutions for a port. These will then be specific applications that a port or terminal will have total ownership over
- Provide full hosted solutions for a port that can be a highly cost effective method of deploying applications such as:
  - o TOS systems
  - o Port community applications
  - o Truck booking systems
  - o Centralised security and control systems
  - o Centralised ERP applications
  - o Centralised asset management solutions
  - o Centralised Business Intelligence applications

The end goal for any port or terminal is to be able to deliver and focus on its core objective to provide a high level of service, deliver greater cost savings and deliver greater profitability for its shareholders.

The role of the System Integrator is here to stay and the market can benefit. By being totally independent SI's can identify and work with every type of solution or vendor and ensure that the projects and deliverables are in line with the customer expectations.

About the author

Richard Butcher has been involved in the shipping and port sector for the past 30 years. Having consulted for a number of leading carriers as well working very closely with some of the industry's leading technology companies. Richard currently holds the role of Global Head and Director for Wipro Technologies: Port & Terminal Division. He has worked on projects all over the world and has spoken at a number of industry events and seminars on terminal automation and technology.

About the organisation

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Port Otago: integrating cloud-based asset management

Bob Smillie, *Port Management, Port Otago, Port Chalmers, New Zealand*

Port Otago's existing asset management system did not provide adequate information to support efficient maintenance planning, accurate budgeting, or effective inventory management for spare parts. So Port Otago worked with IBM Business Partner BPD Zenith to deploy MaxiCloud, a cloud-based enterprise asset management solution, and integrate it with the company's on-premise finance system.

Improved asset reporting helps extend asset life, reduce replacement costs, and facilitate safety compliance. Streamlined purchasing and inventory management save costs and increase productivity. The three key benefits are as follows:

- Saves time and costs by streamlining inventory purchasing and management
- Improves reliability and cuts maintenance costs with asset performance reporting
- Simplifies IT management with cloud-based software-as-a-service model

Port Otago Limited operates a primary deep-water, export-based container terminal at Port Chalmers in New Zealand's far south. With outstanding facilities and a committed team, Port Otago has built a customer-base that includes some of the largest manufacturing and supply organisations in the region.

Deploying a cloud-based asset management solution has helped Port Otago deliver a cohesive asset management strategy for efficient spare part inventory management and complete visibility over asset performance and maintenance needs.

BPD Zenith's expertise was vital to this deployment. MaxiCloud allowed us to take advantage of all the benefits of an enterprise-level asset management solution and put our business in a stronger, more competitive position for years to come – without the need to hire additional support resources to manage it all.

Gaps in data

Port Otago struggled with a basic asset management system which had a lack of functionality and its non-integration with other critical business systems created inefficiencies. Our asset performance data was always incomplete, with information in various locations. This made it difficult to develop any meaningful evaluation in a consistent manner.

It was also time-consuming to generate and update the reports we required, and interpreting inconclusive data was a complex and frustrating task. When predicting maintenance activities such as asset or component replacements, technical staff often had to rely on their instincts and experience to formulate lifecycle data decisions.

Port Otago also found it challenging to obtain detailed breakdowns of costs. With siloed business systems, it was often difficult to obtain adequate data on key metrics, which we needed for maintenance reports. The data we had only provided a high-level view, making our analysis unclear.

Port Otago also lacked a reliable inventory management system: for example, spare parts were not catalogued when they were purchased, which gave the business no ability to track usage or guide forward purchasing decisions. It was common to place orders for a component from a European supplier only to discover, just a few days later, that we needed additional items or different quantities from the same company. Random direct purchasing activities were widespread, increasing costs and impacting our ability to reliably plan and coordinate work activities. This was especially a problem when our work required the operation to commit to planned maintenance downtime of critical business assets.

Cloud-based solution

Following an analysis of available enterprise asset management software and potential support partners, Port Otago worked closely with IBM Business Partner BPD Zenith to deploy New Zealand's first implementation of the BPD Zenith MaxiCloud solution. The solution is based on IBM Maximo Asset Management software, running in a cloud environment.

BPD Zenith's expertise was vital to this deployment. In addition to finding a supplier, I wanted to achieve a reliable partnership model where we could work closely to drive significant change across the business through modern and aligned systems and processes. My aim was definitely a journey with a collaborative partner rather than an event with a one-time supplier.

BPD Zenith's approach and the MaxiCloud solution allowed us to take advantage of all the benefits of a widely used enterprise asset management solution to deliver high asset availability, combined with reliable and predictable performance – and best practice-focused system development opportunities. Simply, it was a strategic approach to our future – without the need to hire additional support resources to manage it.

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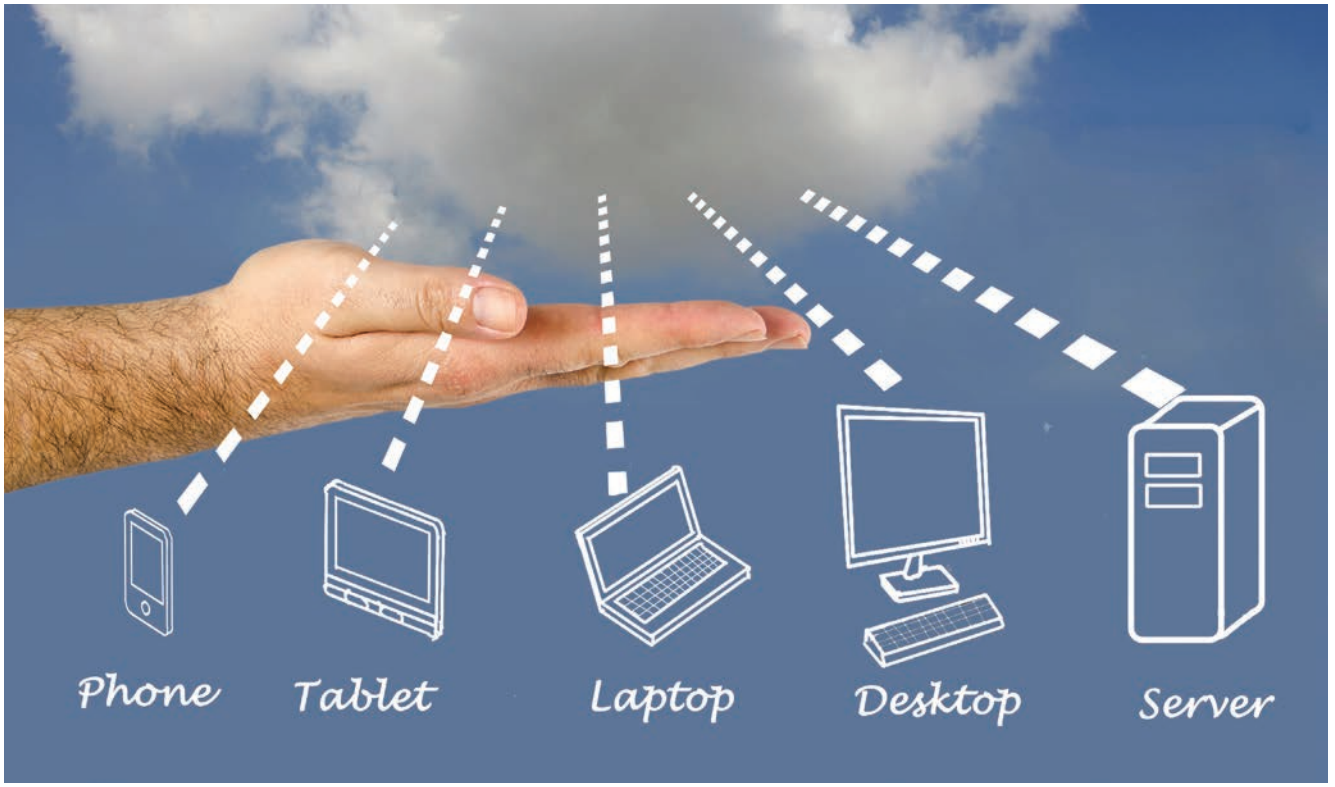

From reactive to predictive

Maximo has enabled Port Otago to make significant progress towards its goal of a modern inventory base supported by streamlined usage reporting to reduce ad hoc purchasing. We are forecasting significant cost-savings and improvements to productivity in the near future. Our maintenance crew can approach routine planned tasks with the confidence that the necessary spares are available, which is quite a change from our previous process.

The initiative has already started to reverse Port Otago's previous 'planned versus reactive maintenance' work mix – from an estimated 30% planned vs 70% reactive to 60% planned vs 40% reactive. This will result in substantial cost and organisational savings. Safety compliance has also been improved by Maximo's work order system.

Many of our assets have significant statutory maintenance requirements because they include critical lifting gear and operate within a complex mix of heavy mobile and fixed assets and people. Our planned work order documentation now include references to known area hazard warnings, colored hazard warning pictograms, detailed safe operating procedures references and attachments, as well as PPE reminders – providing our staff with total work packages and added confidence in the outcomes across the business. In the unlikely event of a failure or incident, Maximo can also quickly provide us with detailed maintenance history report data to add to an investigation.

Encouraged by these early results, Port Otago plans to develop its Maximo abilities out on the port, giving its employees access to work orders, inventory, and the raising of service requests from portable mobile tablets. Maximo gives us a range of organisational advantages, such as a greater ability to demonstrate statutory compliance, increasingly accurate visibility over critical asset behaviors, and a more predictable, efficient, and safer organisation. The increased insights about the health of our business greatly improve our strategic decision-making abilities.

About the author

Bob Smillie is a senior member of Port Otago Limited's Terminal Management Team. Bob is responsible for introducing the delivery of best practice reliability based maintenance activities, integrating business systems with a CMMS implementation, focusing on the rollout of common business processes, standard functionalities, and revised operating disciplines for critical assets. This approach includes an innovative vision that engages both employees and suppliers in maximising asset life cycle value across terminal operations, supporting the concept of sharing innovative practices and standardising equipment, processes and systems.

About the organisation

BPD Zenith is an award-winning global provider of enterprise asset management systems. BPD Zenith combines top-level accreditation in IBM Maximo software with deep expertise in a range of industries and sectors, including oil and gas, facilities management, power generation, renewables and utilities, government and transportation. To learn more, please visit bpdzenith.com

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SCADA Systems

Automation 'standards': the search for consistency and repeatability


Dr Oscar Pernia, *Senior Director of Product Strategy; and*
Elisa Rouhiainen, *Director: Partner Programs, Navis, California, USA*

The implementation of equipment and process automation has been an increasingly important topic in container terminal operations and there are important initiatives driving the market demand to concentrate on automation standardisation. With more and more automated container terminals being implemented, there is an opportunity to standardise the solutions and learn from each other.

The paper seeks to address what the current environment looks like for implementing automation at terminals, the keys to enabling a more professional and agile approach toward system integration, and the main areas that terminals need to focus on for a consistent and repeatable automation implementation in the future

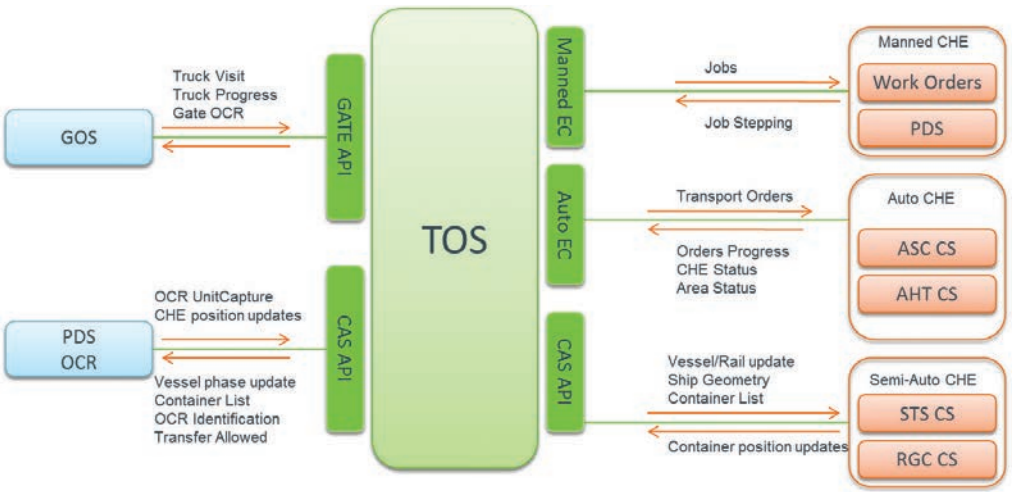
Complexity

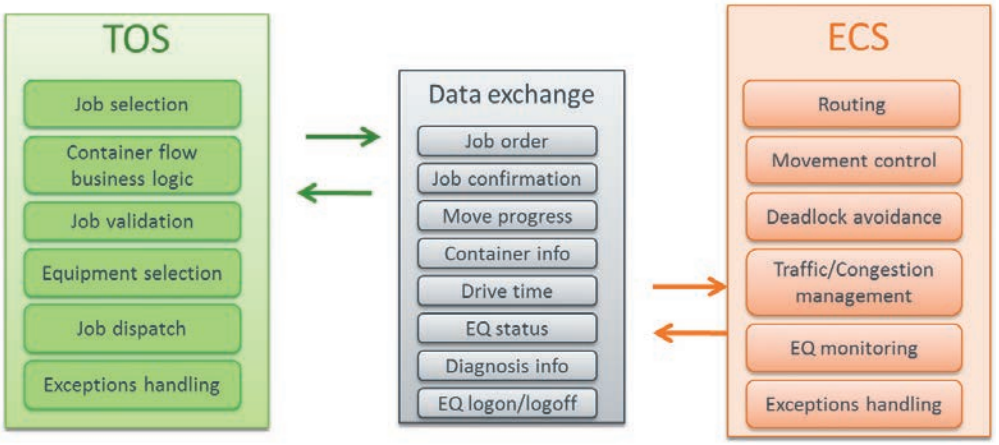
An automated terminal operation requires many different hardware and software systems to satisfy various business needs; complexity is a natural outcome. The necessary technical integration is complex and impacts equipment, systems and people. Typical projects have more than 35 interfaces that connect different software systems and pieces of equipment. In addition, automation requires time to develop the designs and concepts that need to be well defined up front and flexible enough for iterative development and tuning.

Navis terminal operating system integration with third party technologies has proven to be critical to meet go-live operational readiness. The number and variety of components involved in automation has created significant challenges to deploying a complete and integrated solution. Some of these challenges include:

- Functional specifications and interaction schemes need to be well defined in advance. The current process involves a time consuming and reactive process for software development that has led to an extended period of additional testing and solution refinement after go-live
- Generic communication channels are needed from/to TOS to/from third party technologies that are clearly defined with standardised data exchange patterns organised by equipment type
- Areas of equipment management need better definition from an operational perspective because the effort to address these areas after the go-live has impeded operational performance significantly

To mitigate the risks of going live with automation, all the components must pass through comprehensive testing during the integration process, prior to go-live. Testing should address





direct operational processes to prepare personnel for exception management with solutions. Qualified personnel should be on hand with consistent processes for testing to figure out root causes of issues and deliver agile solutions. Quality is the responsibility of the entire team.

Standard integration patterns

The terminal automation industry is striving for standards and generic integration patterns on interfaces and interactions, yet there is still a high rate of customisation and configuration that needs to take place for each project, depending on layout configuration, equipment specifications, and so forth. The industry needs to develop a clear definition for interfaces and solution modularity to handle the 'automation puzzle'. It also needs to align the processes that drive specifications, development, testing and deployment with clear criteria for go-live readiness.

From a technical integration perspective, Navis has a clear initiative to focus on standardisation when developing software and delivering services for implementing automation at terminals. Principles to consider that will help with consistency and reliability of integration include:

- The systems not only need to interface, they also need to 'understand' each other, defining clearly:
  - what, when and how the different systems communicate
  - the data involved in those communications
- Flexible and open architecture that will allow:
  - system providers to extend their product capabilities
  - better and proactive communication and interaction between systems
- A modular and de-coupled approach that will:
  - improve the testing and optimisation of the system integration
  - provide data to analyse real operational performance
  - create a long term system framework
- The equipment and operational intelligence that terminal operators are investing in for automation include TOS and Equipment Control System (ECS). These represent the 'spinal cord' of the eco-system at automated container terminals.

TOS-ECS integration

Dealing with the complexity of the system from TOS to ECS to the equipment is one of the major challenges that automated terminals need to deal with. From a technology perspective, ECS software providers are taking a step forward, but the maturity of existing solutions is not where they need to be. ECS software companies are focusing on increasing their software efforts on design, architecture, testing and deployment practices and are seeking to standardise their efforts to reduce future integration complexity and cost.

That said, progress on standardisation will be delayed by discussions on what the TOS-ECS functional split should be. Navis is focused on providing a single optimised logistics solution for both manned and automated terminals within the same technology footprint. This will serve to ease the adoption of automation and clarify the functional split and reduce the technical risk and capital investment.

The technical integration and operational interaction between TOS and ECS is fundamental. While Navis believes that ECS vendors should focus on optimising execution and coordination of equipment, there are some important aspects to consider that will enable both TOS and ECS to perform their expected functions effectively and in an integrated fashion. This will ultimately impact operational readiness and minimise the time to value, as well as enabling consistency and repeatability when implementing automated systems at container terminals.

The way forward

The following points are highlighted by Navis as the main drivers for improved automation standards:

- Interaction schemes: clear definition for interface and solution modularity. Interactions between different software applications supporting container flows need to be defined upfront and well maintained to support both the basic and exceptional container flows. These interaction schemes must be defined in a modular way to gradually and consistently allow the connection of the different terminal equipment types while commissioning equipment and preparing the terminal for operations with live equipment testing
- Accuracy of the information: system providers must find effective mechanisms to push out data from software applications. This will improve the integration, and, information congruency problems could be solved. Information from real-time planning needs to be used in a consistent way. It is crucial to keep accurate information as move-times, transfer point occupancy or drive times change
- Data Transport Technology: Even though there are different transport mechanisms and technologies that

support various communications between systems, the industry needs to promote the modern data technology and infrastructure that supports automation. While richer and more accurate data will enable real equipment intelligence, technologies providing reliability on system performance, traceability on equipment events and maintainable data consistency will be fundamental

- Optimisation: Navis opened the N4 TOS architecture to include third party software optimisers to perform algorithms as an integrated part of the TOS platform. As such, the TOS is in the best position to perform job allocations utilising a holistic view of the entire operation and leveraging the complete set of operational data and business rules to provide feedback to the planning process and an integrated approach to exception handling
- Standardisation efforts: industry standardisation efforts have been pursued recently by PEMA and they need support to improve software compatibility between TOS providers, equipment manufacturers, automation software providers and the end-users (i.e. terminal operators). Standardisation efforts must include definition not only on the technical interfaces and on the required data to be exchanged, but also on interaction schemes by equipment type and on testing processes, and alignment of processes to deliver acceptance criteria for operational integration readiness
- Integration management: a more professional and agile approach to system technical integration is needed. Project management with qualified resources that know every single interface across the implementation is required. Furthermore, collaboration between the terminal operator and multiple parties needs to have these project management counterparts involved to deploy the integrated solution

There is a good opportunity for our industry to set standardisation as a priority. If this does not happen, technical integration will continue to increase in complexity and delay the ultimate benefits of automation. The areas of focus are well known today and the benefits on getting a clear path for a standardised approach are huge and necessary for automation to be successful in this industry.

About the author

Dr Oscar Pernia is responsible for Navis Product Strategy, with an intense focus on analysing industry driving forces regarding operational efficiency and then developing effective operational input to Navis Roadmap. Prior to his current role, he focused on terminal automation, being part of the core team designing, testing and deploying the new N4 3.0 platform. Prior to joining Navis, Oscar worked for Hanjin Shipping at TTIA (the first semi-automated terminal in Mediterranean) leading terminal implementation and optimisation for three years. Here he created a young and talented tech-team which pioneered integration and operational concepts on systems architecture and control centre organisations for automated terminals. Early in his career Oscar spent eight years in IT with Algeciras Bay Port Authority where he held a variety of positions managing projects focused on technology, process optimisation and integration.

Elisa Rouhiainen joined Navis in November 2014 as Director, Partner Programs. Prior to Navis she has hold a variety of positions in Kalmar and Cargotec since 2004 ranging from product management, marketing, business development to sales management. During her career she has been based both in Finland, Singapore and India. Elisa holds Master of Science in Industrial Engineering and Management from Tampere University of Technology.

About the organisation

Navis understands that as operational processes become more complex, efficiency, collaboration and productivity are essential. As a trusted technology partner, Navis offers the tools and personnel necessary to meet the requirements of a new, and ever-evolving, global supply chain. The Navis N4 terminal operating system is a platform that can integrate partner technologies, enabling terminals to optimise productivity and enhance the service delivered to its customers.

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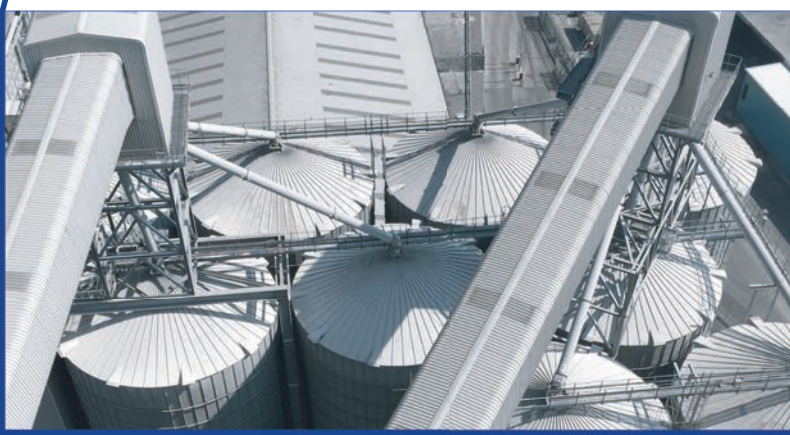

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Jebel Ali Port: Container Terminal 4

Mohammed Ali Ahmed, *Chief Operating Officer, DP World, UAE*

The problem with port operations is that development is almost always reactionary. Ports react to changes in the maritime sector, rather than spearheading them. Which is to be expected: ports have to evolve according to the needs of their customers. Try reaching too far ahead, and you just might find yourself implementing an idea for which there are no takers.

But all that is changing. Given the rapid pace at which the shipping and technology sides of the maritime industry is currently evolving, ports are finding that they need to be a lot more proactive and respond quicker to changes in customer needs, as well as predicting what their customers are likely to want five or ten years in the future.

DP World

The UAE's DP World is taking bold, proactive steps to deal with the issues highlighted above. The flagship Jebel Ali Port is on target to complete work on its mammoth 4 million TEU Container Terminal 3 by the end of 2015, and this will take the port's overall capacity to 19 million TEU.

Even before T3 is fully turned on, DP World has announced an even larger state of the art successor, Container Terminal 4 (T4), on a reclaimed island at the entrance to Jebel Ali Port. T4 will be a huge addition that will increase Jebel Ali Port's capacity by 3.1 million TEU by 2018 under Phase 1, driving the overall total to 22.1 million TEU.

As the world's largest man-made harbour, Jebel Ali is the port of choice for ocean going ships in the Middle East. But matching and exceeding client expectations is just one part of what's on offer: T4 is the grand idea that is expected to change the way ports work, and they plan on doing this through two key ways; by embracing the latest technology, and by adapting to a newer and bigger TOS.

A future vision

Terminal 4 will be equipped with semi-automated quay cranes – by now a pretty standard fare at major DP World facilities – providing operational efficiencies for customers, comfortable and safe working conditions for employees and environmental benefits for the community at large by reducing the carbon footprint.

Under Phase 1, T4 will feature a 1,200 metre long quay with an 18 metre draft, and 13 of the world's largest and most modern quay cranes, remotely operated from a sophisticated control room off the quayside. Some 35 ARMG cranes will keep order in the yard, supported by an army of ITVs (internal transfer vehicles). With a price tag of US$1.6 billion, T4 will boast a total of 110 cranes when fully completed.

At present, Jebel Ali has the capability to accommodate ten mega container ships simultaneously, and the new state-of-the-art facility at Terminal 4 will increase this number significantly.

Optimisation

Optimising technology utilisation at ports the world over has been slow. This is not surprising for a variety of reasons. The cost and logistics of revamping a port so that it is completely networked, automated, and able to track cargo in real time while keeping all the processes bug free and secure is daunting. But the need for it is real. Customers expect it.

Then there is the all too popular idea of the Internet of Things (IoT), a concept that hopes to embed physical objects with electronics, networking capabilities, and so on, and use all this embedded technology to create a giant, interconnected network of real world objects. The benefits of doing this are fairly obvious.

Imagine a port where all containers, cargo, and equipment are connected together via their own local port-wide network. This will give the port operators a direct way to not just integrate traditional non-computer based aspects of their operations with their digital systems, but also allow for real time monitoring and manipulation of these objects, leading to greatly increased operational efficiency.

This is one area where T4 is expected to break new ground. Being built from the ground up in our modern era, T4 will openly embrace the Internet of Things. The quay cranes will be semi-automated and remotely operated, and beyond that, T4 will allow for real time monitoring of other key terminal operational aspects such as tracking container locations, equipment information and KPIs.

Next generation ships

DP World plans to future proof T4 by making it ready for the new era of smart containerships. Currently, Jebel Ali is capable of handling ten mega containerships simultaneously, the only port in the Middle East with such a capability. Clearly, DP World has made sure its flagship property keeps its leadership position secure.

DP World is determined to cope with the arrival of the new capacity mega-ships across its global portfolio. Technology holds the key to this ambition. In a major breakthrough in 2013, we introduced the quad lift system for the first time in the UK at London Gateway. It's a technology DP World's engineers developed and perfected at Jebel Ali.

As DP World sees it, in the on-going search for solutions to changing customer needs, terminal operators must also proactively work to come out on top in terms of efficiency and costs. DP World's committed pipeline of developments and expansions reflect a clear intent of staying ahead of the ships.

The new terminal will reinforce Jebel Ali's role as the premier gateway serving the wider region of two billion people; from the Middle East to the Indian Subcontinent, and from East Africa to Central Asia.

The global property consultancy Knight Frank concludes in its recent UAE Industrial and Logistics Research Report that Dubai is well positioned to be a point of entry to Africa's $3 trillion economy. The additional capacity that Jebel Ali Port is building couldn't be coming at a better time.

About the author

Mohammed Ali Ahmed is an industry leader in international marine terminal operations and development, logistics and related services. His leadership, insight, vision and operational expertise has strengthened DP World's culture of service, excellence and innovation. With two decades of port and management experience, Mohammed Ali Ahmed is the Chief Operating Officer for DP World, UAE Region. Under his portfolio comes in addition to the leading Jebel Ali Port, Mina Rashid (port) and Mina Al Hamriya (port) in Dubai and the Fujairah Container Terminal on the United Arab Emirates Indian Ocean coast.

About the organisation

موانئ دبي العالمية
DP WORLD

DP World's flagship facility Jebel Ali Port is strategically located in Dubai. It provides the Middle East region with an integrated multi-modal hub offering sea, air and land connectivity, complemented by extensive logistics facilities. Jebel Ali Port plays a vital role in the UAE economy, and is a premier gateway for over 90 weekly services connecting more than 140 ports worldwide. It has market access to over 2 billion people. Expansions currently underway at the port will bring total handling capacity to 22.1 million TEU by 2018. Jebel Ali is ranked the 9th largest container port worldwide, and recognised as the world's most productive port in 2014. It has been voted "Best Seaport in the Middle East" for 21 consecutive years. DP World, UAE Region portfolio includes Jebel Ali Port, Mina Rashid Cruise Terminal and Coastal Berth, Mina Al Hamriya in Dubai city and Fujairah Container Terminal.

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GCT Bayonne: award-winning terminal operations

Rich Ceci, *Project Manager of the GCT Bayonne Expansion Project (GEP), GCT, New Jersey, USA*

Project overview

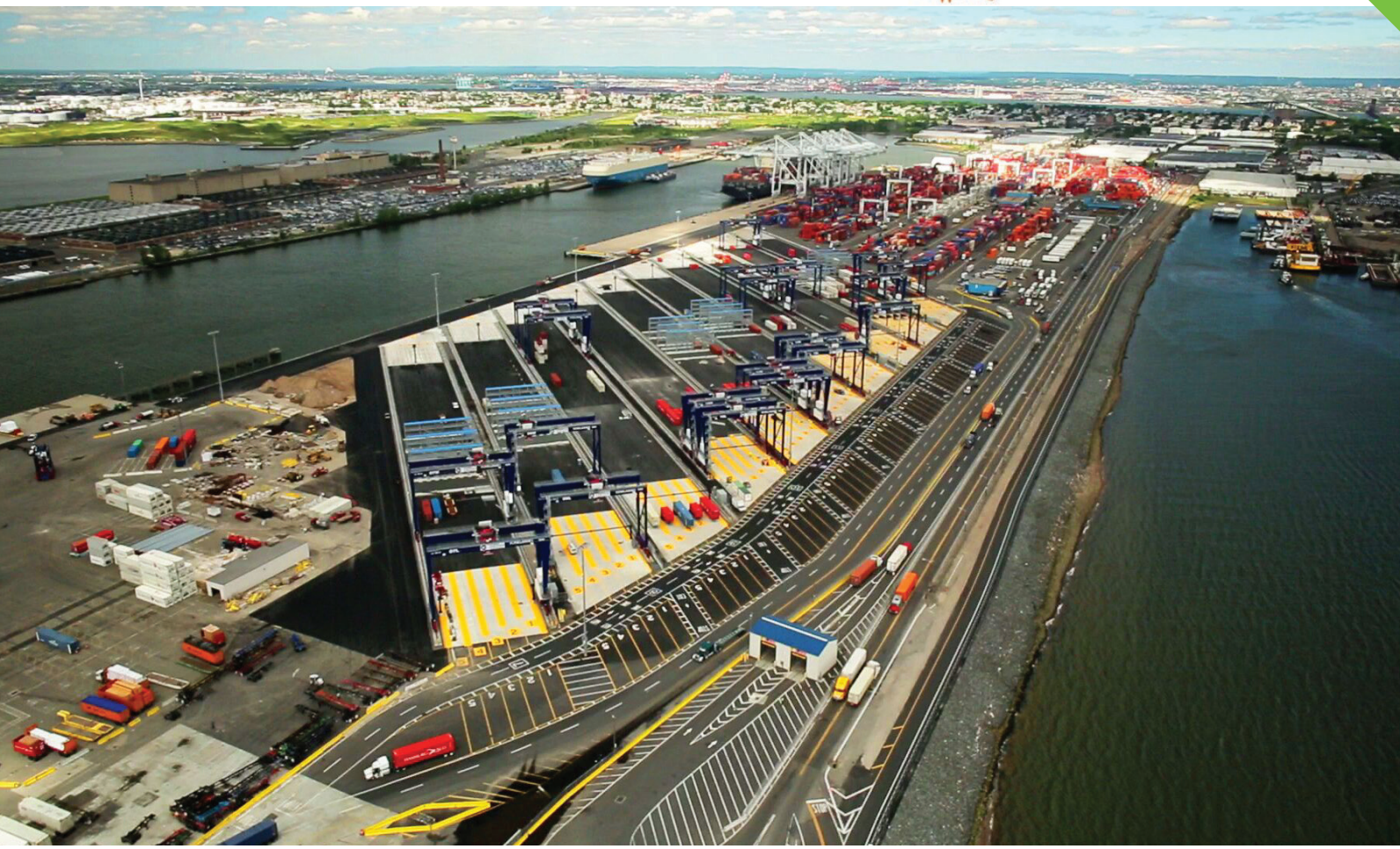
Located in one of the densest consumer markets, the GCT Bayonne Expansion Project is the first brownfield container terminal in the Western Hemisphere to be converted to semi-automation, the first terminal in North America to implement the Navis N4, the only big ship ready facility in the port of New York and New Jersey, and remains the only facility worldwide to implement an RMG and RTG terminal on the same overall footprint. The facility is a 146-acre container terminal located in the Port of New York / New Jersey.

GCT Bayonne is split between a traditional RTG operation and ten semi-automated RMG stacks. Horizontal transport between the vessel and RMGs is done by manned 1 over 1 shuttle trucks. Each of the ten stacks features two RMG cranes that operate automatically 90% of the time. The architecture allows for the separation of waterside and landside operations. Waterside operations are totally automated, while landside operations employ a remote crane operator to raise and lower containers the last ten feet to/from a chassis.

The shuttle trucks and STS cranes all employ differential GPS systems to track the movement of containers.

Technology Deployment Matrix

Technology	RMG	STS	CHE (TP,RS,MTH)	UTR	OTR	Shuttle Truck	RTG	In Portal	InGate Dispatch	Gate IN	Out Portal	Gate OUT	Driver Asst.	Yard	Reefer Racks	RMG LS	RMG WS	Rail Area	Cassette	Foreman Truck ####	Light Pole	Reefer Mechanic	Customs
OCR Reader		X						X			X							X					
Image Capture	X	X						X			X							X					
CCTV	X	X								X		X	X	X	X	X	X	X			X		
DGPS		X	X	X		X	X																
RFID Tag				X	X	X													X				
RFID Exciter			X	X			X	X	X	X	X	X		X		X		X					
RFID Reader																					X		
PLC	X	X	X	X		X	X								X	X	X	X					
Driver Display (IVP)			X	X		X	X																
TWIC Reader									X														
Ticket Printer										X		X	X										
Biometric Validation									X														
Remote Controlled Container Processing										X		X				X	X						
Collision Avoidance	X														X	X	X						
Voice Radio		X	X	X		X	X													X		X	
VOIP Communications									X	X		X	X			X							
Tablet PC		X							X					X				X		X		X	
Weigh Scales									X						X			X					
Laser	X					X									X			X					
Transponder	X																						
AEI Reader																		X					
WiFi Network		X	X				X		X	X		X	X	X	X		X	X			X		



Furthermore, all street trucks in the Port of New York and New Jersey are required to have RFID tags, these tags are part of a port security system and also support the port authority's clean truck initiative. The RFID technology is leveraged throughout the terminal to pace truck activities at various points in the process. The STS cranes consist of 6 older cranes, and two new cranes, which have all been fitted with STS optical character recognition (OCR).

GCT Bayonne makes extensive use of wireless network technology. Every light pole features an access point, RTLS receivers, as well as CCTV cameras to support security and operational needs. Each light pole is connected directly to the main network, and every terminal vehicle (RTG, UTR, top tick, shuttle truck, and pickup truck) is equipped with a wireless bridge device.

Construction on GEP began in 2010 and the expanded terminal completed its first commercial lift on June, 2014. In July 2014, the facility began processing the largest containerships calling at the US East Coast.

Technology

The on-crane network in use at GCT Bayonne is very important. We deploy ten to thirty cameras at strategic locations on our cranes. While some suppliers claim they can support this on a wireless bridge, for cranes without fibre optics in their power cables, I would strongly not recommend this approach. Once integrated, STS OCR reliability becomes a major success factor to smooth vessel operations. In systems without STS OCR, labour will almost always be deployed at the crane with a tablet device (hatch checker). When OCR is involved, the support labour will be in a remote room with cameras. The cameras approach is ok for failure rates of 2-5%, but gets very tedious if the OCR systems fail and 100% of the moves require manual image review.

During the design of the project, gate suppliers were asked to quote both STS OCR and truck OCR at the same time with the hope that a single supplier for OCR could be used. That did not work out. When the gate decision was made in 2012, there was no clear supplier that had the capability to do both. This has changed somewhat and it might now warrant revisiting this strategy on a new project. There are some significant differences between the application of gate and STS OCR. The key feature for the gate OCR was the need to perform remote damage inspection of the images. Line scan technology in the gate OCR was deemed critical, as a single continuous image of the side and top of trucks transiting the portal was important. The images must be very high quality, and we wanted to limit the number of images an inspection required (5 for containers and 2 extra for the chassis if necessary).

Some controversy exists about whether portal buildings are required. If the images are used for damage inspection, the buildings are mandatory. Without a building, glare from the sun will wash out portions of the images and it will be impossible to see all sides of the container.

In 2011, the Port of New York and New Jersey began a program to install RFID tags on all trucks. To date, over 16,000 trucks have been equipped with tags. Non-compliant trucks are turned away. GCT Bayonne adopted the RFID technology throughout the terminal and data from weigh scales in one stage is linked to another via the RFID tag presence at each stage. Trucks with missions in the RMG stacks back up into one of 50 lanes. Before a truck starts moving, the system knows whether it is in the right stack, and can queue the

work to be performed to the proper lane.

The vehicles also include a "Vehicle System", and I have debated whether to call this the "DGPS system" since that's the technology most people are concerned about. There are several choices regarding the DGPS's that are available. We wanted a solution that allowed us to assist the driver in adhering to the process and that entails in-vehicle screens which provide visual assists related to location and target containers.

At GCT Bayonne, high-definition, axis fixed, pan / tilt / zoom (PTZ) cameras were deployed. The cameras were connected to a security and camera management system. Additional cameras were also added to support operations. One area that must be covered is the transfer zones at both ends of the stacks. These views are essential for diagnosing system issues. You will never imagine the insanity that can happen in a transfer zone – cameras will save you many sleepless nights.

Future

The most important immediate future trend relates to regulating the flow of trucks to the terminal. Truck Reservation Systems, Truck Management Systems, Appointment Systems – whatever you want to call them, will happen. And in our case, it will happen very soon.

A Truck Management System will be a paradigm shift for the logistics chain and will have some implementation pain. But it will work, and in 5 years' time people will wonder how they ever operated the other (current) way. The arguments generally follow the same trend: that a Truck Management System will not fix all the problems; that the lack of a chassis is a big issue, and what happens if a big company gobbles up all the time slots?

The answers are simple: this system is not intended to fix all problems, but it will make a significant contribution to ameliorating current problems. It will not fix chassis shortage issues, but also does not hinder the solution to that problem. Companies will only be able to make appointments for work they have, such as specific containers. Limitations can also be implemented to prevent time slot hoarding. It has also been tried and works well in other countries such as Australia and New Zealand, as well as at certain US West Coast ports. Port Metro Vancouver, the home of our sister terminals GCT Vanterm and GCT Deltaport, have both been using appointments with great success since 2004-05. So we at GCT know that they can work.

Terminals have finite boundaries and deploy finite amounts of equipment. The amount of equipment is variable based on the availability of labour, which is currently in short supply in the Port of New York and New Jersey. Furthermore, competing demands to service both ships and trucks can cause issues. This is especially true when a 5,500+ move ship starts operating for 50 consecutive hours. The boxes loading and discharging must come from and go to somewhere in the yard.

If a terminal is equipped to service 250 moves in an hour (250 containers in or out of the terminal) and 500 trucks show up in the first hour, some will remain on terminal for 2 hours. That's simple mathematics. Moreover, if you get 300 trucks per hour every hour, the problem will persist all day. That is a basic scenario, but the reality is much more complicated than that.

For example, if 50 trucks arrive at the terminal for service (recall capacity is 250), there could be a real problem. If by chance the desired containers (dictated by the driver mission) are all in the same area and the equipment in that zone can only perform 12 moves per hour, then some of those trucks will be on the terminal for 4 hours.

Furthermore, equipment in other areas may go unused. To add insult to injury, most trucking companies are given work lists which may involve as many as 100 containers to drop or pickup. And it could well be that if a container from an underutilised area was chosen, instead of contending with 49 other trucks to get a specific box out of a "hot area", a driver could be out of the terminal in 15 minutes. Injecting planning and structure into the logistics chain is the next big thing.

About the author

Richard Ceci joined GCT in August 2010 as Vice President of Information Technology and subsequently assumed the additional responsibilities of Project Manager for the Global Expansion Project (GEP). Previously Rich was the Senior Director of IT at APM Terminals where he was responsible for IT in the Americas Region. In addition, he was the IT lead on the APM Terminals Virginia project which opened in August, 2007. He has over 25 years of experience delivering automation systems to the automotive industry. His involvement has ranged from the boardroom to the factory floor. After spending 10 years at Ford Motor Company in the Electronic Engine Controls Group, Rich formed his own company focused on factory automation software systems. Eventually that company was sold and merged into a Fortune 1000 Automation company where Rich stayed on as Vice President of Technology. A native of Michigan, Rich received a B.S. degree in Chemical Engineering from Wayne State University in Detroit, and also has a Master's Degree in Business Administration from the University of Michigan in Ann Arbor, Michigan.

About the organisation

GCT (Global Container Terminals Inc.) is based in Vancouver, Canada and has been making waves in the container terminal industry for over a hundred years. GCT's subsidiary, GCT Canada (formerly TSI Terminal Systems Inc.), has been operating on the West Coast since 1907 and is responsible for running both GCT Vanterm and GCT Deltaport. Beyond operating these facilities, GCT Canada has also played a major role in developing Canada's Pacific Gateway. GCT has always been committed to the growth and sustainability of the communities and ports in which it operates. With a focus on the future and our customers' ever-growing needs, GCT is implementing several unique expansion projects that will strengthen its leadership position and support the growing capacity needs of the industry.

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Modern Terminals: a journey through Hong Kong

Michael Yip, *General Manager, IT, Modern Terminals Limited, Hong Kong*

It is Modern Terminals Limited's (MTL) mission to be the preferred partner for world-class terminal and supply chain services, building global connectivity for the sustainable development of local economies, and the improvement of people's well-being. MTL is recognised as a customer-focused service provider. Our expertise in the industry, the state-of-the-art equipment we invest in, and the commitment of our people enable us to deliver a unique customer experience at the terminals we operate. Whenever you interact with us you will consistently experience the following brand promises: partnership for value, customer-driven innovation and operational excellence.

Opportunities amid challenges

The global trend of vessel oversupply has remained the main burden for the industry. Alliance driven consolidation is the industry's key focus for the deployment of mega-ships on East-West trades and the cascading of displaced vessels into smaller trades, thereby increasing vessel sizes across the board and adding a great deal of complexity in terms of customer management, inter-terminal operations and service delivery. The overall shipping market trend of the introduction of one mega vessel per week means a focus on slot costs and rate weakness have continued across recent years.

In Hong Kong, the substantial increase in barge traffic, coupled with the lack of terminal back up land and dedicated barge berths, is another trend affecting the efficiency at the Port of Hong Kong. The Pearl River Delta barge transhipment throughput at Kwai Tsing Container Terminals in Hong Kong has increased nearly 30% in the past 10 years, while the ratio of back up land area here is some 40% short of the internationally accepted standard of 25 hectares of yard area for each 400 metres of berth length.

We have been advocating for the maintenance of competitiveness at our port through the Hong Kong Container Terminal Operators Association. An industry-wide consensus has been reached to urge the Hong Kong government to provide more port backup land and berthing facilities to improve the competitiveness of Kwai Tsing Container Port. The Transport and Housing Bureau of Hong Kong government released "Proposals for Enhancing the Use of Port Back-up Land in Kwai Tsing" in June 2015, representing a positive first step in responding to changes in the shipping market, addressing the challenges faced by the port.

Continuous investment and enhancement

To navigate through the challenges, MTL has also implemented a number of measures for major achievements. In August 2014, our Hong Kong business unit implemented Navis N4, a world class terminal operating system, following the successful go-live at DaChan Bay in November 2013. This upgrade of our terminal operating system was necessary to replace aging technology and position MTL to handle the increasing complexity of mega vessels and ever larger alliances. It also ensures that our operation is running on a sustainable technology infrastructure adhering to international standards, supporting MTL's long-term growth.

Similar to Hong Kong, our DaChan Bay Terminals in the Pearl River Delta is focusing on efficiency and service delivery improvements. As well as the use of the advanced features in Navis N4, we are enhancing the external facilities and processes that support the terminal's operations, and expanding our import business into several new areas. Our Taicang International Gateway is positioned to leverage the fundamentals of strong Yangzte River Delta growth, the proximity to a large catchment area, and favourable shipper and end-user economics.

Making continuous investments in facilities and equipment helps the delivery of our brand promises. In 2015, we brought a new barge berth into service at our Hong Kong facilities and installed a new lighter crane there to enhance our quayside capabilities and customer service delivery. Terminal improvement works and the replacement of newer models of rubber-tyred gantry cranes in Hong Kong have been completed. The procurement of quay cranes for Hong Kong and DaChan Bay is underway.

MTL's groundbreaking crane training simulator installed at the end of 2014 is the first in the terminal operations industry in Hong Kong. It contributes to continuously enhancing both the safety of operations and standard of training, and allows both existing operators and new trainees to significantly enhance their skills in handling different scenarios.

Furthermore, we are driving a community approach to standardise processes and information flows that improve operational efficiency and increase the use of automation.

Corporate social responsibility

Being a good corporate citizen, MTL has embarked on the journey of delivering our Corporate Social Responsibility (CSR) programme for years. MTL's CSR policy is a compass that drives both the sustainable

development of our operations and our contributions to the well-being of the communities in which we live and work. In 2013, we took our commitment to CSR to a new level by becoming one of the region's first container terminal operators to publish a CSR report prepared in accordance with the Global Reporting Initiative (internationally recognised sustainability reporting guidelines).

We are delighted to be recognised for our efforts by becoming the first Hong Kong container terminal operator to receive the Corporate Social Responsibility Award at the Containerisation International (CI) Awards 2015, and the Web Accessibility Recognition Scheme 2015 jointly organised by the Hong Kong government and the Equal Opportunities Commission. In addition, we received the Employee Retraining Board's Manpower Developer Award Scheme in 2014.

Our cultural values mean we contribute to the Work Life Fulfillment initiative and our people take pride in being part of the company because we feel engaged and motivated to achieve – gaining satisfaction from our contribution in a trusting and supportive environment. Company Values and Leadership Challenge Workshops were fully rolled out, followed by a culture survey conducted to staff in all business units with a very high response rate (98%). This survey helps build a base for measuring cultural development and identify strengths and improvement areas for the embedding of new company cultures.

Our care for people goes beyond our companies' boundaries. In Hong Kong, we have been supporting a local secondary school in our neighbourhood with US$2 million funding, as well as volunteering through participation in Project WeCan, a programme which encourages companies and individuals to partner with Hong Kong's secondary schools in improving the overall performance of their students. At DaChan Bay, we also organised programmes to engage a wider community in environmental protection efforts, such as the drawing competition to promote a green message to the children of DaChan Bay staff, contractors, shareholders, government authorities and customers.

Occupational health and safety is the top priority at MTL. All of us at MTL assume responsibility for health and safety at work. We engage with employees, contractors and customers to increase awareness and make continuous enhancements to our health and safety approach. We also assist contractors to setup their safety management systems and conduct a review on the system in order to ensure consistent contractor quality. A series of safety programmes were organised to raise awareness among our employees and contractor staff.

Our DaChan Bay Terminals takes pride in being the world's first terminal to deploy 100% electricity-powered rubber-tyred gantry cranes (E-RTGs), which are now being used in Taicang and Hong Kong business units as well. MTL group's performance in CO2 emission reduction is seen in the decreasing trend over the recent years and our business units in Hong Kong, DaChan Bay and Taicang are ISO 14001 accredited. At DaChan Bay, LNG tractors are being deployed for cleaner air.

About the author

Michael Yip is the General Manager: Information Technology with Modern Terminals Limited. He has over 20 years of experience in IT management and consulting. He is responsible for formulating MTL's group IT strategy, as well as leading major IT transformation initiatives. He is part of MTL's Strategy Board which is responsible for formulating and driving corporate business plans and strategies.

About the organisation

Modern Terminals Limited (MTL) has been a pioneer in the growth of the container terminal industry in Hong Kong and Mainland China ever since we opened Hong Kong's first purpose-built container-handling facility in 1972. Today, we own and operate container terminals at Kwai Tsing Container Port, Hong Kong, and in our operations at DaChan Bay Terminals and Taicang International Gateway, we have built firm footholds in the Pearl River Delta (PRD) and Yangtze River Delta, respectively. We also hold equity stakes in Shekou Container Terminals and Chiwan Container Terminal, both in the PRD. MTL is building on its China base by expanding internationally through government and private sector partnerships.

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Mega-Ship Ready

"The new nature of demand is for less fragmented terminal capacity (fewer, bigger terminals needed in each port) which requires consolidation of terminals, both physically and in terms of ownership."

Neil Davidson of Drewry in 'Unprecedented challenges: tackling the biggest ships and alliances', page 64

Haifa Port is proud to conduct another historical moment for the Israeli economy

For the first time a direct line shared by the world's largest shipping companies – Maersk and MSC – is coming to Israel, as part of their massive 2M Alliance.
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Haifa Port is committed to successfully meet any challenge, and to continue to be Israel's leading port.

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HAIFA PORT

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TTI Algeciras: pioneer in transhipment automation

Maribel Grau, *Commercial Manager, TTI Algeciras, Algeciras, Spain*

During the last 25 years, transhipment has progressively grown and gained importance in an international context due to the development of a highly competitive environment. It has become an essential tool for any shipping company that intends to explore new markets and expand their business globally.

Likewise, the need to remain competitive is imposing the use of larger capacity vessels that have the tendency to call at fewer ports in order to lower transport costs and offer better conditions to increasingly demanding customers. This trend of gigantism is mainly seen in the East-West trades and specifically between Asia and Europe, most of which cross the Strait of Gibraltar, where the Spanish Port of Algeciras is located.

Thanks to an extraordinary combination of location and infrastructure, Algeciras is internationally recognised as a strategic place for hub-and-spoke and relay transhipment; allowing the connection between the main centres of production and emerging markets with growing consumer capacity.

The reliability of this connectivity is the main competitive advantage of TTI Algeciras, and this operational excellence is achieved thanks to the architecture of the terminal, a dedicated team of professionals and the introduction of automation in the terminal operations.

Infrastructure

TTI Algeciras was constructed in a greenfield site with 24-hour easy sea access (the Port of Algeciras is a natural deep-water bay opened to the Strait of Gibraltar) with no draft restrictions, which are two of the essentials for the transhipment trade.

Planned to be a 'common user' container terminal, TTI Algeciras was designed to match the needs of all companies. Its vertical layout and ship-to-shore cranes capable of handling container vessels with 24 containers wide on deck, have been indispensable in developing docks with the capacity and productivity demanded by transhipment traffic.

Automation

In 2010 the terminal became a pioneer in the introduction of automation in terminal operations in southern Europe and the Mediterranean. The objectives pursued were the improvement of productivity and the reduction of costs that would allow the terminal to fit the requirements of carriers deploying mega-ships in the Asia-Europe trades and to compete in an environment with labour costs lower than in Europe.

Innovative processes control the container yard and the gate (where human intervention has been eliminated) and are also present in the horizontal transportation of containers made by shuttle carriers and the loading and discharge operations in the quay.

The fully automated yard is controlled by a tailor-made TOS which is assisted by different functions such as yard allocation, auto house-keeping and the efficient assignment of shuttle carriers to containers. Containers are stacked in sixteen blocks perpendicular to the main quay with two last generation ASCs operating in each block (one on the seaside and the other one on the landside). The ASC on the seaside is mainly working against the quay and is supported by the ASC on the landside to boost productivity.

The whole yard is fenced preventing the entrance of workers except those authorised to do repairs or preventive maintenance of the cranes. Besides the clear increase of safety within the facility, there are also benefits for the cargo in the sense that any incidence such as non-authorised manipulation of containers has been 100% eliminated.

The TOS solution also manages all tasks related to the operations such as vessel planning, berthing and gate in real-time, while also providing management tools such as billing, reporting, gang nomination, EDI communication and e-Service, a platform of interaction among the terminal, carriers, forwarders and transport companies.

The terminal operations are designed in such way that the container is always dropped and picked up from the ground, which eliminates waiting times during the interchange of the container between the different equipments and the need of remote control of the ASC (for the last move). It also facilitates the segregation of internal traffic (shuttle carriers) and the external vehicles (trucks). The result is a well balanced workflow between the yard and the horizontal transfer of the container and the quay.

One of the main challenges for us is to achieve 100% container traceability to guarantee that the container entering the yard is the correct one. This is possible thanks to a full integration and communication among different systems that provide automated process control such as OCR (optical character recognition), LPR (license plate recognition), RTLS (real-time locating system) and DGPS (differential ground positioning system).

While discharging a container from a vessel, the container traceability is guaranteed in three steps:

- The OCR installed on the elevated lashing platform of a quay crane

takes hundreds of pictures in a few seconds with a very high accuracy, recognising the container number among other characteristics of the container

- Next the system makes a cross-check among the container number, the backreach lane of the quay crane and the shuttle carrier number assigned to pick up the unit. The terminal knows the position of the quay crane, the slot in the backreach where the container has been dropped and the shuttle carrier position thanks to the RTLS and the DGPS integrated on the shuttle carrier. The system only allows the assigned shuttle carrier to pick up the container in the correct position. Otherwise, twistlocks are blocked
- Before the container enters the yard, a final cross-check is done among shuttle carrier number, yard transfer area number and slot number. Similar verification procedures are followed for container loading and gate/rail operations

Human intervention

The semi-automation implemented by TTI Algeciras allowed the achievement of both streamlining operational costs and increasing productivity. One side mixes the savings and reliability of automation with the flexibility of human beings, securing minimum turnaround time of ocean vessels.

The control of operations is done by the terminal personnel. The operations and IT Teams monitor and trace the status and performance of systems in real-time in order to find and attend in advance to any incidence or bottleneck; ensuring that everything works with the required functionality level.

Beyond transhipment

Since 2010, the terminal has successfully managed to diversify its customer portfolio, bringing together more than twenty five shipping lines operating with regular services. Today TTI Algeciras is directly connected to more than 100 ports all around the globe and is constantly challenged on the operation of the 18,000 TEU vessels coming in every week from the Far East. Shipping lines and terminals work together to mitigate disruptions on the network (berth on arrival) and to reduce the port stay by deploying the maximum number of cranes within the highest safety environment.

The hinterland of Algeciras includes a local market of twelve million consumers and has more than 500 exporting companies seeking the best logistical solution to position their products. TTI Algeciras has also been able to enhance logistical solutions that incorporate the train in the supply chain; transforming Algeciras into an alternative gateway port for the big centres of consumption and production located in the centre of the Iberian Peninsula.

Thus, in addition to being a strategic place for transhipment, the access to import and export cargo is adding significant value to TTI Algeciras. The location helps to shorten the transit time of containers connecting Asia, Europe, America and Africa. Algeciras is actually the first port of call in the Mediterranean for many of these trades, allowing a considerable reduction of time between origin and final destination.

About the author

Ms Maribel Grau is the Commercial Manager of TTI Algeciras. She joined the project in April, 2008 right after the bid was awarded to Hanjin Shipping. Prior to joining TTI Algeciras, Maribel worked for four years in Beijing and Hong Kong as a Market Analyst and Trade Advisor in different institutions such as the BBVA bank and the Economic and Trade Offices of the Consulate General of Spain and the Delegation of the European Union to China.

About the organisation

TTI ALGECIRAS
Total Terminal International Algeciras

Total Terminal International Algeciras is the company promoted by the South Korean corporation Hanjin Shipping to build and run the Port of Algeciras Bay's second container terminal. The concession, awarded in July 2008, is located on the Phase A plot of the Isla Verde Exterior expansion area. The terminal is settled in 35 hectares with a capacity for 1.8 million TEU and two quay lines of 850 metres on the east and 550 metres on the north, with draughts of 18.5 and 17.5 metres, respectively. TTI Algeciras was the first semi-automated container terminal in the Mediterranean initiating business activity on May, 2010 with 8 quay cranes, 32 ASC and 22 Shuttle Carriers.

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Khorfakkan Container Terminal: calling all mega-ships

Daniel Wright, *KCT Terminal Manager, Gulftainer, Gulf of Oman, UAE*

Recently, all eyes were on Khorfakkan Container Terminal (KCT) as it set a new throughput record for a single vessel call of 19,561 TEU. KCT completed the record breaking call of the 'CMA CGM Jules Verne' containership in only 54.5 hours. The 396 metre long and 54 metre wide vessel was, at the time, the largest containership in the world sailing under the French flag.

KCT, as the only fully fledged operational container terminal in the UAE that is located outside the Strait of Hormuz, is a major transhipment hub for several shipping lines in the Middle East region. But regardless of its status as a major hub and its ability to handle the largest operational containerships, the sheer size of this transaction through a single call is mindboggling. KCT has since continued operations with an impressive track record of productivity and it recently completed 4,073 container moves in a single 12-hour shift.

These are not one off events in the port sector, as Gulftainer, like several other global terminal operators, had aligned its management and corporate strategy in anticipation of rapid changes in the container shipping industry. The company has invested heavily across its terminals globally and is prepared for the very large container carriers, growing dominance of shipping alliances and continuous demands of high productivity from its customers.

KCT's performance in handling CMA CGM Jules Verne was the culmination of Gulftainer's strategy of continuously evolving with the market with a long term view. With this level of forward planning in place, once the vessel was alongside, the operations team were able to execute the plan and completed the vessel 11.9 hours ahead of schedule. With this new record KCT demonstrated its ability to accommodate large container volumes and to keep pace with the increasing volumes generated.

Future container vessels

The competitiveness of ports is now defined by their ability to evolve as hubs that attract the new mega-vessels. Lines are seeking cost savings, and have identified that the most effective way to take cost out of their networks is to increase the number of paying containers on a vessel.

As a result, vessels have been growing in size at a dramatic rate, with the largest vessels today being almost three times the size of the largest vessels in the late 1990s. But it is also important that the vessels are utilised to optimal capacity. Studies have found that an 18,000 TEU vessel needs to be at least 90% utilised before it can gain sufficient economies to warrant the initial capital outlay.

This means that carriers will have to maximise liftings on each vessel, and expect their terminal vendors to handle these full loads on mega-ships at the same productivity rates as their predecessors.

Port authorities now have to develop their ports in such a way to accommodate these mega-ships in their ports by ensuring sufficient depth. Terminal operators are also feeling the strain of having to make sure that they are equipped with the latest technology and STS equipment capable of accessing 9/10 high container stowage on deck and that they do so efficiently and productively.

Mega-vessels, to stay competitive, however, must reduce the number of ports to which they call.

More containers need to be loaded and unloaded in fewer ports than before. The technological advances in equipment can now help in reducing time at the port, but terminal operators still need to make sure that the turnaround time for ships is as fast as possible, so the economies achieved at sea are not lost in the ports.

The increasing proliferation of mega-vessels therefore represents a challenge for terminal operators, who have to complete increasingly large move counts in the shortest time possible.

Investment

Classed as one of the world's most productive container terminals, KCT has completed a US$60 million investment by Gulftainer for the addition of four state-of-the-art STS cranes and twelve RTG cranes, which scaled up the terminal's capacity and competency to underline its credentials as one of the top-performing terminals in the world, as well as strengthen its position to welcome mega-ships.

The new cranes have complete PLC (programmable logic control), and feature user-friendly operator interfaces, as well as climate-controlled ergonomic operator cabs and consoles to maximise the comfort of the operators, thus boosting performance.

The addition of the new STS cranes, which are better able to cope with the giant 18,000 TEU and above vessels, has helped speed up terminal operations, and this in turn, is creating even better value for our customers.

Although the scaling up of equipment has enabled KCT to be mega-ship ready, and able to handle the latest generation of ultra large containerships (ULCS), we are currently exploring viable options for further expansion to ensure that the

terminal can accommodate the increasing volumes being witnessed year on year.

How to make it work

Khorfakkan Container Terminal has long been renowned for its high productivity levels, particularly on mainline vessels, and the terminal's management team strives relentlessly to maintain this reputation.

At KCT, we count on the support of an excellent in-house engineering team that provides outstanding equipment availability levels. We undertake regular communication with all levels of employee to apprise them of performance levels, and to reinforce expectations of all staff. It is all about team work. Meticulous pre-planning of each vessel call with input from all members of the team makes each call a little bit easier.

Managing risk

Rapid changes in the industry, along with the increasing buying power of shipping lines (through alliances), presents several commercial and financial risks to a terminal operator. Any terminal investment has a long gestation period for financial return, while over the past few years, the nature of the market in terms of both economic outlook and shipping traffic has also turned very volatile. As larger container vessels are now the new norm for both mainline and feeder services, many port operators face a conundrum to either invest now in improving their infrastructure to prepare for the new realities, or wait for the volatility to settle down.

As the figure below shows, terminal expansion happens in significant segments, which is an expensive affair, while container volume growth is staggered over this period. This means that a terminal needs to be sufficiently utilised in order to recover the investment outlay, and faces a considerable risk of being congested or underutilised.

As port demand is rather inflexible in the short-term, Gulftainer has pursued a constant dialogue with shipping lines and industry experts which assisted in aligning its long terms goals with customer expectations. The risks of overcapacity with exposure to financial burden, and under capacity which may lead to commercial failures, have been managed by the company; providing equal opportunities for both terminal operator and its customers to stay ahead of the curve.

The future

The future trend is increasingly large vessels. By 2016, vessels of 12,000+ TEU will form approximately 25% of the global carrying capacity. Therefore, both ports and terminal operators will need to continue adapting to the newer, bigger ships and further developing to handle higher and higher volumes per call.

Gulftainer sees strong growth opportunity in this, and while KCT has already established its credentials with mega-vessels, the group is focused on consolidating its operations and footprint worldwide to provide a seamless network for vessels.

About the author

Daniel Wright began his managerial career at the Royal Mail attaining the position Transport/Area Collection Manager. In 2008, Daniel moved into the port industry as a member of the Quayside Management Team at the Port of Felixstowe. Daniel joined Gulftainer as Terminal Manager at KCT in December 2012.

About the organisation

Gulftainer was launched in 1976 and is headquartered in Sharjah, where Gulftainer operates the award winning Khorfakkan and Sharjah Container Terminals. The international reputation of these terminals led to a global expansion in 2006, and Gulftainer now has terminals in Brazil, Iraq, Lebanon, Saudi Arabia and the USA, with further announcements to come soon.

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Euromax Terminal Rotterdam: evolving every day

Francois Bello, *General Manager, Euromax Terminal Rotterdam, the Netherlands*

Five years after it was opened, the Euromax Terminal Rotterdam remains one of the most modern container terminals in the world. This is because since its operational commissioning in 2010, service and performance have constantly been raised to a higher level - an ongoing process that will never stop.

Terminal characteristics

Euromax Terminal Rotterdam is situated at the northwest corner of the Maasvlakte, directly at the entrance to the port of Rotterdam. Deep-draught ultra large container ships can call at the terminal 24/7 without any restrictions. Our quay is 1.5 kilometres long, with the possibility to extend that to 4.2 kilometres in following phases. The depth along the quay is 16.8 metres; as the size of vessels increases, this can easily be further deepened to 19.6 metres.

Equipment used

On the quay, we use twelve semi-automatic ship-to-shore quay cranes with a reach of 24 containers. All twelve ship-to-shore cranes have a second trolley for further speeding up the crane cycles. That really makes a substantial difference. 96 diesel-electric AGVs - suitable for twin-carrying - transport the containers back and forth between quay and stack. Behind each quay crane there's space to position four AGVs side by side so that operations can always continue.

Hinterland modes of transport

We have four separate cranes for the handling of feeders and barges, which are divided on both sides of the 12 ship-to-shore quay cranes. Trains are handled at our on-dock rail terminal with six 750-metre long rail tracks and two cranes. Also, truck handling has been extensively automated. Truck drivers which have been properly pre-notified by their companies and can identify themselves with the fraud-proof CargoCard containing their biometric details do not need to exit their cabin to take care of the formalities. Furthermore, their containers are discharged and loaded at the stack by remote control handling from our terminal building.

Productivity

The terminal is one of the highest performers in the Hamburg - Le Havre range, and since its opening everything at the terminal has been geared to constantly further improving speed and efficiency. In recent years, we have made tremendous progress in this respect and we will unabatedly continue these efforts.

We are fully focused on the continuous implementation of new functionalities that lead to productivity improvements. Of great importance in that respect is the close collaboration with the shipping lines, since the actual productivity depends on stowage of the ship. We very regularly consult with the headquarters, the European head offices and the offices of the shipping lines in Rotterdam. That works well. Also if something requires urgent attention, we quickly contact each other. If necessary, we will drop everything to meet.

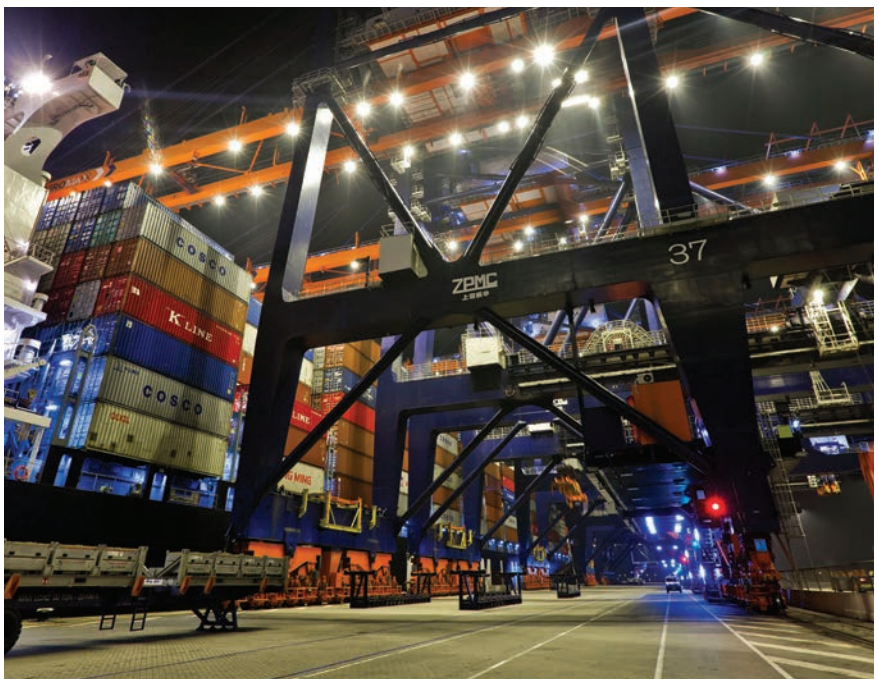
We have embedded the structural improvement of performance at the Euromax Terminal through multi-disciplinary improvement teams that, in line with the globally renowned Lean Six Sigma methodology, identify a specific point of improvement and then sink their teeth into this. In this way, many facets of the terminal - often invisible to the outside world - have been raised to an even higher level in recent years. More than 30 different projects have already been successfully completed. Thirteen such programmes are currently still underway. From improving the performance of the ARMG cranes in the stack, to optimising planning and monitoring and much more.

Three additional major projects are also currently underway at the Euromax Terminal, including further streamlining the landside handling, the phased introduction of dual cycling for simultaneously loading and discharging two containers in one crane cycle, and the implementation of Optical Character Recognition (OCR) on all quay cranes.

OCR makes it possible to fully record the number, type size, presence of seal, door direction and any damages for each container automatically. It is the next step towards the true round-the-clock deployment of equipment and achieving an optimal output. With a single crane, theoretically at the same time having two containers in the spreader, four containers on the stacker table and two in the second trolley – whilst both discharging and loading are simultaneously taking place – keeping track of everything is becoming increasingly more complex for the shore radioman. OCR can assume many of his tasks and will be primarily supportive."

Technical measures

We definitely also boost productivity through organisational measures. A recent example is the rule which we introduced in the course of 2015 that required barges to have a minimum call size of ten containers. A significant percentage of barges calling at the Euromax Terminal were carrying less. With an average switching time on the quayside of fifteen minutes between the departure of one ship and the arrival of the next, we managed to achieve double-



digit handling capacity gains by working with barge operators to adhere to stricter requirements. Although initially mixed reactions were received from the market, overall customers do understand the necessity of this measure and notice the positive effects.

Along the same lines is our approach to the amount of empties in the stack. Each shipping line has its own policies, but in general they consider it practical to have a specific number of empties available close to the deep-sea ship. Too many empties clogging up the stack however negatively impacts our productivity. This is another issue which we therefore address and discuss with shipping lines. You see, we firmly believe that putting the customer first entails much more than simply doing what is asked or letting happen what happens. What matters here is that we closely work together to achieve the best possible result, with clear benefits for all parties.

Making a difference

The Euromax Terminal has been organised in a fully process-oriented manner. The operational processes have been arranged in such a way that they do not depend on single individuals. However, quality employees and experience are still of utmost importance. We have seen a considerable influx of new staff recently and have deliberately selected some high calibre fresh graduates. This creates a good mix with the operational experience that is already present within our organisation. In that respect, we explicitly expect the recent recruits to use their fresh outsider's perspective to offer a significant contribution to further improvement projects already achieved by the organisation.

Throughout the entire organisation, many initiatives are constantly developed and re-calibrated to continually improve performance. We regularly also use what we call a 'learning ship'. Here, a supervisor and operational staff get together to evaluate the handling of a recently departed ship. What went well? What could be improved? These hands-on experiences always constitute invaluable learning opportunities.

About the author

François Bello joined Europe Container Terminals (ECT) in 2004 as an operations expert.
As of 2008 he has been responsible for the start-up and further development of Euromax Terminal Rotterdam. Prior to ECT François worked for several companies in the Port of Rotterdam all related to Maritime, Transport and Logistics services. Francois studied at the faculty of Mechanical Engineering at the Technical University of Delft and specialized himself in Shipping, Transport & Logistics Technology. He has over 15 years of experience in the field of transport and logistics both in the Netherlands as abroad.

About the organisation

ect Europe Container Terminals

ECT is a member of the Hutchison Port Holdings (HPH) Group. HPH, a subsidiary of the multinational conglomerate CK Hutchison Holdings, is the world's leading port investor, developer and operator. The HPH network of port operations comprises 319 berths in 52 ports, spanning 26 countries throughout Asia, the Middle East, Africa, Europe, the Americas and Australasia. Over the years, HPH has expanded internationally into other logistics, transportation-related businesses. These include cruise ship terminals, airport operations, distribution centres, rail services, and ship repair facilities. In 2014, the HPH port network handled a combined throughput of 82.9 million TEU worldwide.

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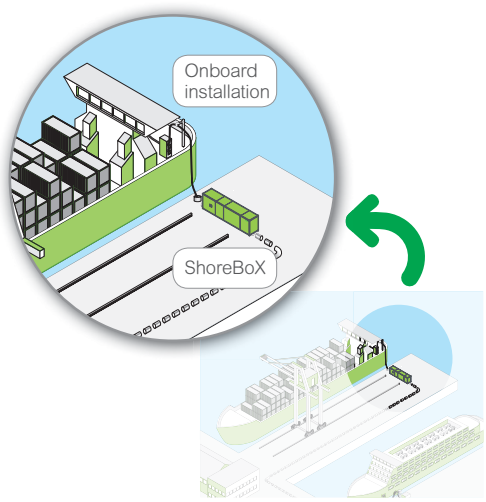

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Unprecedented challenges: tackling the biggest ships and alliances

Neil Davidson, *Senior Analyst Ports and Terminals, Drewry Maritime Research, London, UK*

The global container port and terminal industry is facing unprecedented challenges as a result of the deployment of ever larger containerships combined with the creation of larger shipping line alliances. These two interrelated factors are placing significantly greater demands on ports and terminals than ever witnessed before, and they are having far reaching consequences by driving up operating costs and capital expenditure requirements. The dynamics of these factors are illustrated in Figure 1.

Going clockwise from the top left of the graphic: bigger ships are leading to more segmentation of terminal capacity, and more rapid terminal capacity obsolescence. They are also increasing the pressure for faster port handling which in turn has implications in terms of what is needed from dockworkers. This also raises the question of the role of terminal automation. Bigger ships also mean lower frequency services and greater throughput peaks for ports and terminals to deal with.

At the same time, bigger alliances mean that the 'customer' is bigger and more complex, and there is demand for fewer, larger terminals in each port, leading to pressure to consolidate terminals. Plus, the formation of alliances and the introduction of bigger ships leads to network and port of call changes, as well as terminal customer shuffles and shake ups in each port.

For terminal operators and ports these issues are resulting in a clear trend: higher operating costs and higher capital expenditure costs. The typical EBITDA margins for the global and international terminal operators analysed by Drewry remain in a range from 20-45% and their 2014 financial results were in line with previous years. However, maintaining these margins will become increasingly challenging.

Productivity

It is well documented that bigger ships are creating pressure for higher container handling speeds and better productivity in ports, but the very nature of the larger ships results in operational challenges. The number of gantry cranes deployed per vessel cannot be increased in direct proportion to ship sizes because as Figure 2 shows, the length of vessels has not increased linearly with regard to TEU intake (they have got wider, deeper and stacked higher instead). For example, the length of the 19,200 TEU MSC Oscar is less than twice that of a first generation 1,400 TEU ship, yet its TEU capacity is nearly 14 times greater. Similarly, an 18,300 TEU Maersk Triple-E vessel is only 25%

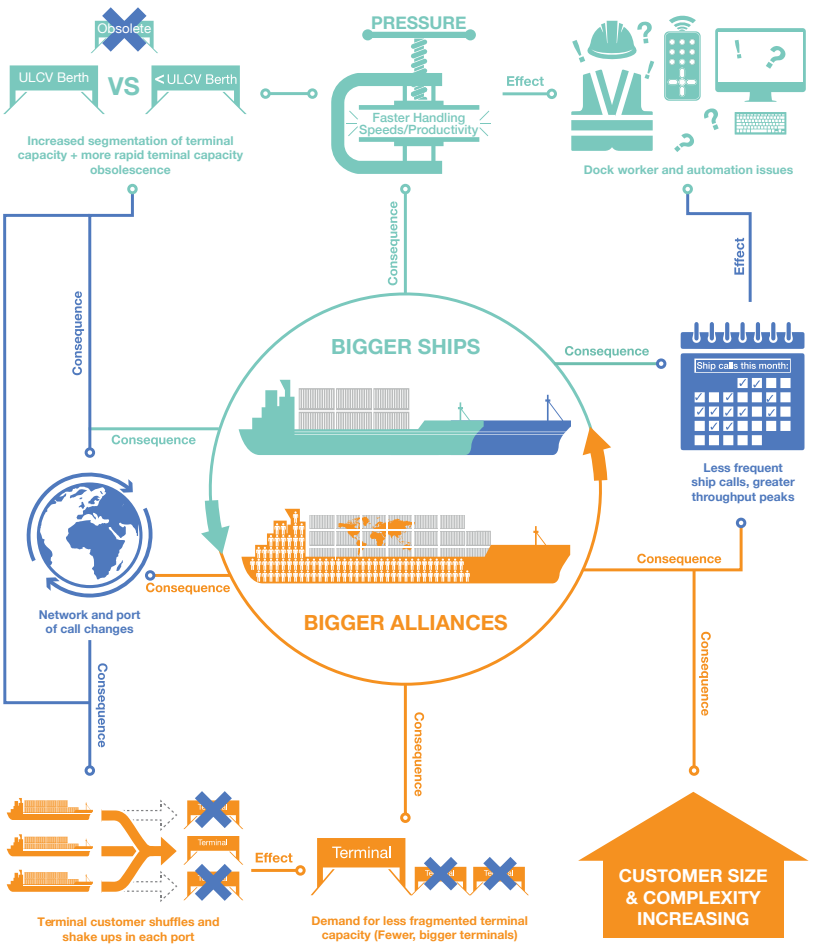


Figure 1: Key operational and commercial challenges for container ports and terminals

Source: Drewry Maritime Research

longer than the 7,400 TEU Regina Maersk class, yet carries 150% more TEU.

The largest vessels have, for the time being at least, reached a plateau of around 400 metres in length with no sign of an increase being contemplated at present. If the 400 metre barrier were breached, this could help in terms of allowing more gantry cranes to be deployed, but at the same time it would have a negative impact in terms of the requirements for infrastructure such as quay length and turning circles. It is also the case that the cost and availability of labour in some locations restricts the number of additional cranes than can be deployed on each ship.

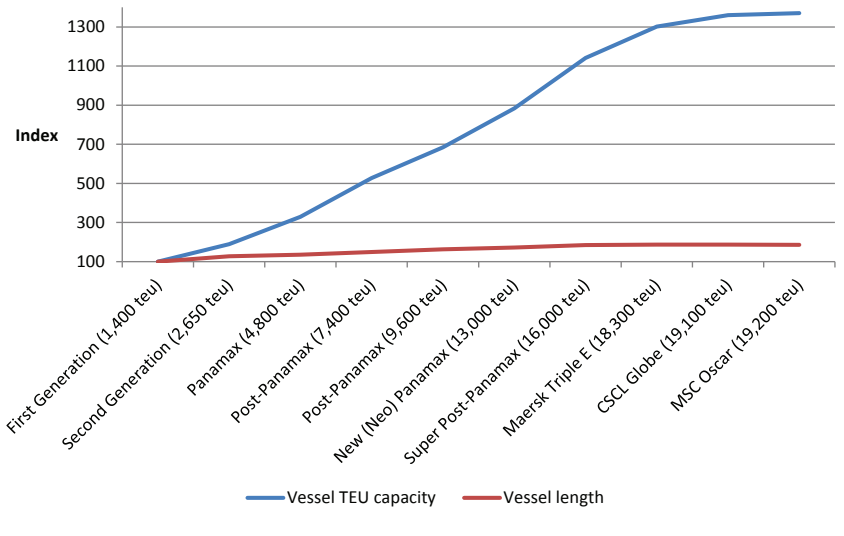
Handling ever larger ships also involves using gantry cranes which are higher and have longer outreaches, meaning that the trolley has to physically travel further per cycle between the quay and the ship's hold, making it harder to maintain the number of crane moves per hour. In mitigation, bigger ships tend to have more containers discharged and loaded to/from each hold so there is less picking and choosing, and less crane shuffles. It may also be the case that more tandem lifts and dual cycles are possible.

Is automation the solution?

Bigger ships are also resulting in reduced frequency of service and greater volume peaks for ports. This leads to inefficient use of terminal capacity and a degree of wastage because infrastructure, equipment and manning levels have to be sufficient for the peaks but are under-utilised outside of them. It also changes the requirement in terms of yard size relative to berth length. For a given berth length, a larger yard is needed to cope with the peaks. Larger yards have cost implications for terminal operators, and fundamentally, there may not always be space to expand.

Both the productivity and peaking issues create challenges in terms of dock labour requirements, especially where labour has limited flexibility and where extra resources cannot easily be obtained for the peaks. This is one of the reasons why peaking and productivity have raised the profile of terminal automation, with some observers appearing to regard it as a kind of magic bullet able to 'automatically' provide faster ship handling.

There is no doubt that automation offers many benefits, but the underlying processes must be good ones in the first place – automate a bad process and you have an automated bad process. In addition, many of the ways in which productivity can be improved are also possible with non-automated terminals, for example twin/tandem lifts, and ships stowed to allow the maximum crane deployment.



Source: Drewry Maritime Research

Figure 2: Non-linear relationship between ship length and TEU capacity (Index: First Generation vessel = 100)

The advantages of automation are certainly clear in terms of safety, reduced environmental impact, mitigating damage to equipment and cargo, and consistency of performance. It can be also argued that consistency and predictability have as much value as faster handling. Automation can also help in locations where it is difficult or expensive to deploy humans 24/7.

Automation or not, overall, it appears unlikely that any solution based simply on evolution of the original gantry crane concept (which dates back to the 1950s) can consistently deliver the 6,000 moves per day berth productivity called for by the former Maersk Line CEO Eivind Kolding in 2011. Revolutionary ideas such as APM Terminals' Fastnet crane concept are out there, but at present the economics do not stack up due to the potentially huge development and installation cost, and high risk factor. Plus, it remains doubtful that any shipping line is going to pay for Fastnet style speed of handling.

Vessel cascading and terminal obsolescence

The issue of bigger ships is not one that is restricted to ports handling the largest vessels in the world. The process of cascading vessels down to secondary trade lanes is widespread and thereby sharp increases in vessel sizes are being felt at all ports – nowhere is immune. The rate of change is also extreme, with the cycle of vessel upsizing having accelerated markedly in recent years.

Bigger ships are also leading to a greater segmentation of terminal capacity. In the past, a 'deep sea' berth could handle any vessel afloat. Today, the capability of each berth or terminal has to be broken down into a range of 'deep sea' vessel sizes, with those berths and terminals able to handle the very largest ships, fully loaded, a small and exclusive club.

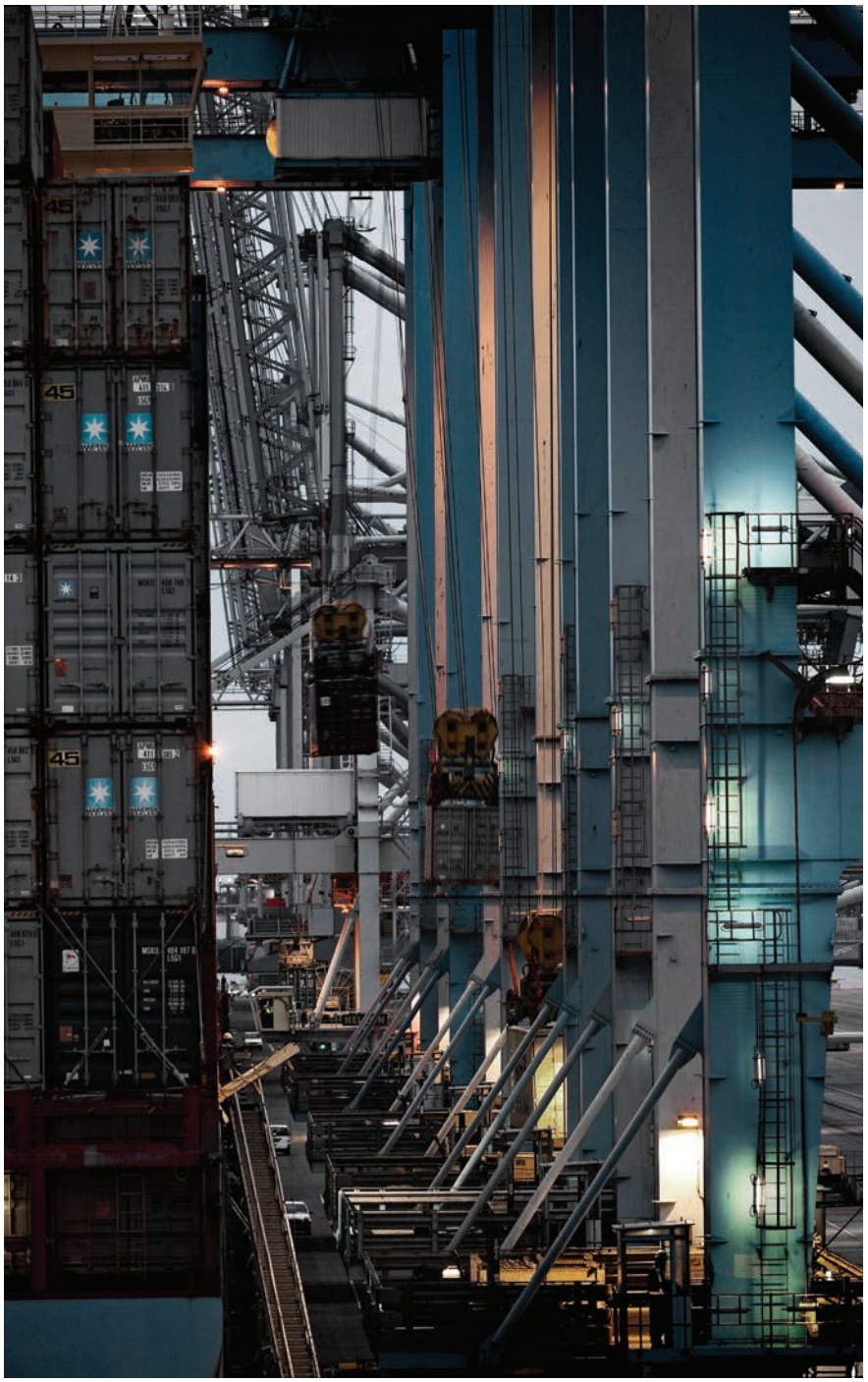
This process is in turn leading to more rapid obsolescence of modern, serviceable terminal capacity. More berths and terminals are becoming unable to serve the markets they were designed for, and are thereby falling out of the game, unable to accommodate the ever larger ships. Ports are investing in new or enhanced facilities and it is clear that in doing so, some are taking the decision to effectively make redundant good, modern facilities.

Perhaps the most significant example of this is the MSC Home Terminal in Antwerp. Located behind the (very large) locks, this modern terminal has a capacity of around five million TEU per annum, making it the largest terminal in the port. However, it is being vacated and most likely will be taken out of use for handling containers, because MSC needs a terminal outside of the locks, on the riverside, in order to accommodate the largest vessels. In conjunction with the port authority and JV partner PSA, this is being developed in the Deurganckdok.

Elsewhere, other ports and terminals have simply been forced out of the deep sea market, notably Thamesport in the UK, because it is not feasible or viable to adapt them to be able to accommodate bigger ships.

Greater customer power

Filling bigger ships with cargo requires shipping lines to form alliances and share ships. For ports and terminals, this means that the size and complexity of each customer (alliance) is increasing, along with their bargaining power. This however



is a double edged sword, because as ships and alliances get bigger, the choice of ports and terminals that can accommodate them reduces.

The new nature of demand is for less fragmented terminal capacity (fewer, bigger terminals needed in each port) which requires consolidation of terminals, both physically and in terms of ownership. However, such consolidation is complex and expensive, and may not be possible, or may take a long time to achieve.

As alliances form and bed in, they develop combined networks and ports of call. This leads to changes in port rotations and calls, and changes in terminals used within each port. The demand side of the equation is dynamic, but the terminal capacity side is, by its nature, much slower and harder to change. In addition, the alliances are not fixed forever. Take for example the proposed merger of Cosco and China Shipping. The former is in the CKYHE alliance and the latter in the O3 alliance. If the merger goes ahead, another shake up in the alliances will be inevitable and this will move the goalposts again for ports and terminals.

All these challenges may well trigger more alliances between terminals and/or between ports. At port authority level, we have already seen Seattle and Tacoma coming together to "jointly market and operate the marine terminals of both ports as a single entity". At terminal level, the concept of 'alliance' is a spectrum with, at one end, terminals in the same port simply sharing operational data, and at the other end, full scale mergers and the redevelopment of terminals taking place. The closer the coming together gets to the latter end of the spectrum, the more likely it is to encounter regulatory issues due to market power concerns.

Alongside any such terminal alliances, there is the need for more operational collaboration between terminals and shipping lines to help deal with issues such as peaking and productivity. This is perhaps the key challenge – and hope - for all players going forwards.

About the author

Neil Davidson has over 25 years experience in the port sector. He joined Drewry in 1997 and founded the company's ports practice. Neil has spoken at over 80 industry conferences, seminars and private briefing sessions worldwide and regularly contributes expert insight and analysis to the trade press and British national newspapers, as well as TV and radio.

About the organisation

Drewry

Drewry is one of the world's leading international maritime consultancy and publishing organisations. Founded in 1970, the company has over 40 years' experience within the maritime sector, employing over 90 specialists across offices in London, India, Singapore and Shanghai. The company provides research reports and consultancy services with a brand renowned for its quality. Drewry reports are sold in more than 90 countries and consultancy services are commissioned by over 70 countries..

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Terminal planning, Design and Construction

"It all started with the realisation of Maasvlakte 2, a 2,000 hectare new piece of the Netherlands that has shifted the coastline by no less than two miles…"

Managing Director of Rotterdam World Gateway Ronald Lugthart in 'Rotterdam World Gateway: seamless access to Europe', page 68

Rotterdam World Gateway: seamless access to Europe

Ronald Lugthart, *Managing Director, Rotterdam World Gateway, Rotterdam, the Netherlands*

Rotterdam World Gateway (RWG) is the newly built, highly automated and most innovative container terminal in the world. RWG provides container storage and transhipment with maximum efficiency and sets new standards in the industry when it comes to sustainability, safety and productivity. Seamless access is what RWG stands for: a seamless transit of containers from all over the world to consumers and industries in Europe and vice versa.

History

It all started with the realisation of Maasvlakte 2, a 2,000 hectare new piece of the Netherlands that has shifted the coastline by no less than two miles. Here, on this expansion of Mainport Rotterdam, the foundation has been laid for the RWG terminal. In 2007, an international consortium of four shipping lines - APL, HMM, MOL and CMA-CGM – and terminal operator DP World showed the nerve and vision to make a mega investment in Rotterdam. The consortium RWG took part in the tender for the first concession on Maasvlakte 2 and won. After signing the concession agreement with the Port of Rotterdam Authority in 2007 and five years of preparation, the actual construction started in June, 2012. Today, RWG is an indispensable part of the Port of Rotterdam, and opened its terminal officially in September, 2015.

RWG has an annual capacity of 2.35 million TEU and approximately US$760 million was invested in the terminal. Phase 1 of the terminal encompasses a total area of 108 hectares. With phase 2, another 2 million TEU can be added to this on an expansion of almost 50 hectares. The mission of RWG is to create and maintain a safe, reliable, sustainable and competitive container terminal for its customers in Europe's leading port.

Equipment and terminal process

RWG is using state-of-the-art equipment and technology in order to handle existing and future ULCS ships as efficiently as possible. The 1,150 metre deep-sea quay is home to 11 almost fully automated and remotely controlled super post-Panamax cranes. These 127 meter high cranes can reach up to 24 rows of containers and they have been provided with a double trolley system which allows containers to be unloaded from a ship onto the AGVs, or loaded from AGVs onto the ship in two steps, using equipment and time in the most efficient way.

Horizontal transportation between the quay and the yard is performed by 59 fully electric Lift-AGVs. These automated vehicles have a lifting platform by means of which they can place containers on a rack in front of the stacking modules. The result of this innovation is that the AGV process is decoupled from the stacking process. This results in higher productivity with less equipment. The AGVs will always follow the fastest and most efficient route. Within 5 to 10 minutes, an empty battery of an AGV is replaced fully automatically at the so-called Battery Exchange Stations (BES). With a new battery, an AGV can drive for further 6 to 8 hours.

Containers are stored in the stacking area that consists of 25 stacking modules with two rail mounted automated stacking cranes at each module, one landside ASC and one waterside ASC. Of these 50 ASC's, 18 are cantilever cranes (9 modules) and 32 (16 modules) are front loader cranes. The cantilever cranes are also capable of loading and unloading cargo sideways which means that, unlike the landside front loader cranes, these cranes are also able to load and unload AGVs. The cantilever stacking modules are mainly used for the storage of barge, feeder and transhipment containers. The more conventional front loader cranes are used to stack rail and road containers.

When it comes to hinterland transportation, RWG offers dedicated container handling for all modalities: barge, road and rail. At the 550 metre long dedicated barge/feeder quay, there are three fully automated and remotely controlled cranes for barges and small feeder ships. Containers are delivered to the barge cranes by the AGVs, so the entire barge process is automated.

After preannouncing all relevant information about the cargo and containers and booking a timeslot, trucks drive directly to the storage area at the terminal where they are automatically loaded or unloaded on one of the 105 available truck handling positions. Two rail cranes take care of the trains at the on-dock rail terminal, which has six tracks of 750 metres and one circuit track.

Automation

At RWG, the operational processes are more automated than at any other terminal in the world. In total, 14 unmanned ship-to-shore cranes are capable of loading and unloading ships almost fully automatically. These cranes are remotely operated, an innovation never before applied on such a scale. The horizontal transport is performed silently by the lift-AGVs. The entire terminal process is monitored 24/7 in the terminal's control room.

Applying new technologies asks for new software. Various software solutions are combined into a single highly advanced system: the TOS. This system makes sure

that the entire terminal, including all cranes and equipment, can operate almost fully automatically.

Because of the high grade automation at the terminal, RWG has introduced a pre-announcement and slot management system. All information concerning cargo and containers needs to be submitted via Portbase, the Port Community System, before any terminal visit. By having this information in advance, the terminal can run much more efficiently, and the handling of all hinterland modalities is faster and more reliable.

Together with Dutch Customs, RWG has introduced a new Customs Concept that enables RWG to scan and check containers on location without the direct interference of customs officers. In fact, the logistic process on the terminal runs independently of the customs process.

Safe and sustainable

By applying smart equipment and technology, RWG is able to reduce its carbon footprint to an absolute minimum. RWG is the greenest terminal of its kind, due to the high degree of automation and the use of fully electric cranes and vehicles. The energy that is generated from the crane cycle movements of the quay cranes is also used in other parts of the terminal. RWG is not only sustainable equipment-wise either; all buildings on the RWG terminal are energy neutral. Three-layer glass, proper insulation, the use of thermal storage and low-maintenance materials contribute to RWG being the most sustainable terminal in the world.

Container transport by rail or over inland waterways has less environmental impact than transport by road. RWG therefore aims to transport at least 65% of containers handled to and from the hinterland using this greener means of transport. No more than 35% of the containers are transported by road, meeting the strict requirements of the Rotterdam Port Authority and RWG's ambition to be the greenest terminal in the world.

Last but not least, the safety of staff and visitors is of top priority at RWG. To RWG, safety means a fail-safe design, proper staff training and taking all possible measures to prevent accidents. When it comes to safety, RWG is leading the way. Because of the high grade of automation, RWG is able to separate the operational process from human presence, keeping risks to an absolute minimum.

About the author

Ronald Lugthart was born in Rotterdam in 1967 and holds a Masters in Business Administration and Accountancy. He started his career in the port business in 1998 and has worked in several positions in the port industry (at lashing companies, empty depots and (container) terminals) in Rotterdam and abroad. He became Managing Director at RWG in 2011.

About the organisation

RWG maintains a safe, reliable, sustainable and competitive container terminal for its customers in Europe's leading transit port. Seamless access is what RWG stands for: a seamless transit of containers from all over the world to consumers and industries in Europe and vice versa. RWG is an international consortium consisting of the four globally operating shipping lines APL (Singapore), MOL (Japan), HMM (South Korea) and CMA CGM (France), and terminal operator DP World (Dubai).

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Liverpool2: a historic port city revived

David Huck, *Port Director, Peel Ports Group, Liverpool, UK*

300 years ago, Liverpool was at the forefront of international shipping and trade, with the creation of the world's first enclosed commercial wet dock. The city remained one of the world's leading ports well into the 20th century, but the advent of containerisation and new market conditions meant it was overtaken by some of its competitors.

Now, Peel Ports – port authority and operator of the Port of Liverpool – is gearing up for the opening of its new US$463m container terminal, Liverpool2. The development will make maximum use of technology and automation to more than double the port's TEU capacity on a site much smaller than the current terminal. Combined with Peel Ports' other logistical assets, including the Manchester Ship Canal and the national trimodal import centre at Port Salford, Liverpool2 will open up a new central gateway for UK trade.

Challenges

With ever-increasing vessel sizes we realised that unless we took action by 2015, 85% of the global container vessel fleet would not fit into the Port of Liverpool as the existing Royal Seaforth Terminal is accessed through a lock with a vessel capacity of 294 metres (length) x 32 metres (beam) x 11.6 metres (depth) and a channel dredge of 6.9 metres.

We therefore had to think beyond the traditional port boundary, identifying an intertidal site that could be reclaimed. This, however, would only facilitate a total terminal area of 17 hectares in phase one, much smaller than the existing terminal, and construction would have to support a 10 metre tidal range, one of the largest in the UK. We also understood that terminal productivity has a critical impact on supply chains and that port performance is a critical determinant in decision-making. So, our solution had to be able to meet the market requirements for service predictability, reliability and turnaround.

Our answer to these challenges has been the Liverpool2 terminal. This will provide Liverpool with an additional 1 million TEU capacity, help us to deal more effectively with the 26,000 annual vessel movements through the port, and deliver 'best in class' capabilities to our customers.

Management approach

For us, it has been fundamental to ensure that we are taking the right management approach. Although the physical infrastructure is essential, its performance is dependent on two other aspects of port operation: the effectiveness of the systems and processes in place, as well as the quality and training of the people managing them.

Accordingly, there are a number of priorities that have influenced our decision-making throughout and continue to guide how we deliver our services. The first is information. As far as possible, we look to improve both the quality of information that we manage and how this is shared with our customers and clients. Accurate forecasting, real-time exchange and building datasets can make a major difference to the efficiency of operations. The second is automation – something that the container terminal industry has been slow to adopt, despite the technologies being advanced, proven and capable of delivering reliable operational efficiency. The third is customer service and being 'more than ports'. We aren't just looking to differentiate ourselves on cost and efficiency. The ambition is to provide an experience that really adds value to shipping lines and our ultimate customers – the cargo owners – by offering a wider range of services supporting the whole supply chain.

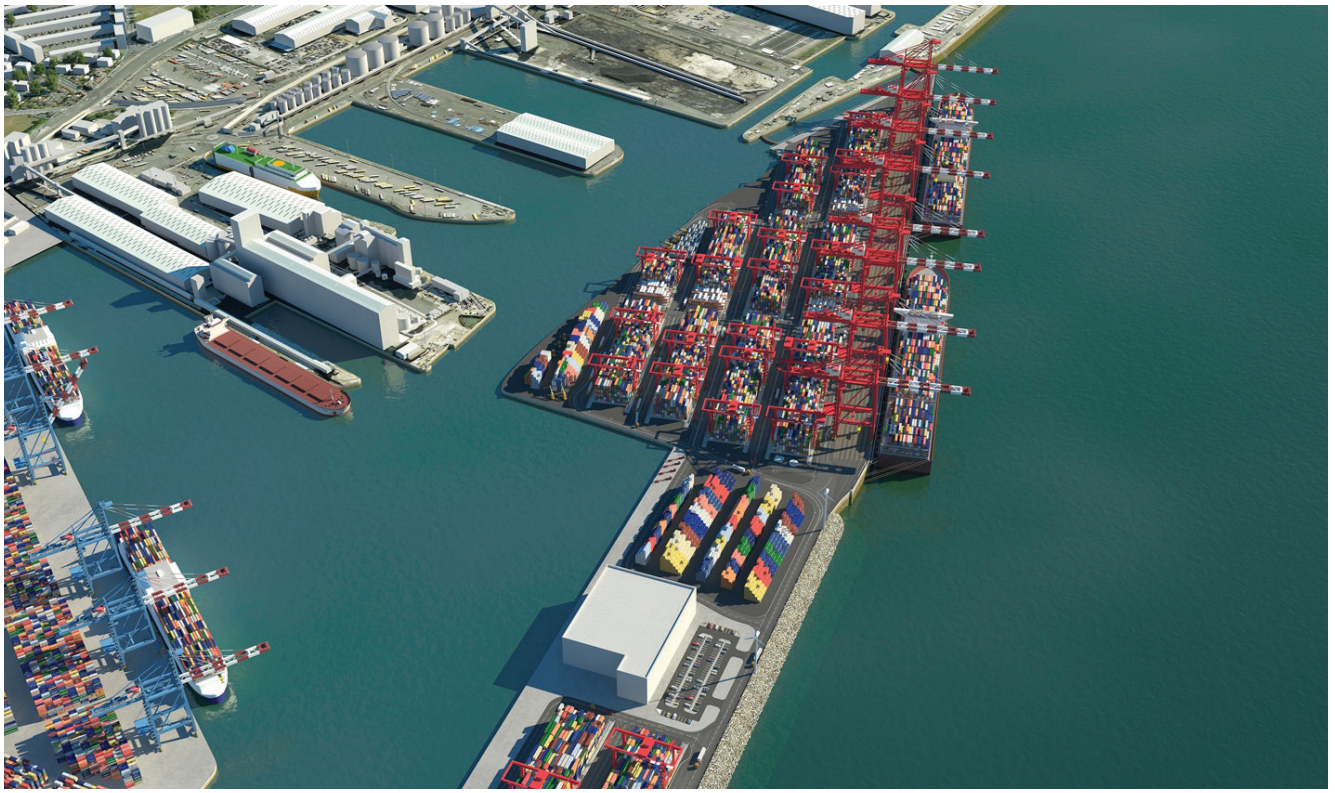
The port and shipping sectors are often considered to be traditional, hierarchical and conservative industries. We have taken steps to streamline our structure and challenge – indeed remove – some of the 'old port' mindset. We have also worked to create a more flexible workforce that can respond to changes in demand and not just respond to customer needs but to anticipate them.

The single most important action to support this has been training with a strong focus on in-job training. Where we have skills gaps, we recruit new talent, and we have implemented people development plans across the full spectrum of our intake, from apprentices to post-graduates. It will only be with the right people, culture and behaviours – managing our physical and technological assets – that we will realise the full potential of our operation.

Construction programme

For the majority of this project so far, the progress that has been made has remained hidden underwater, as we have worked to reclaim land from the sea. 296 steel piles have been driven into the seabed, allowing the infilling of 1.43 million tonnes of sand and silts taken from the Mersey estuary and deposited behind the new quay wall, up to a level of 6 metres above ordinary datum.

The piling process, which began in 2014, involved drilling from large jack-up rigs and inserting tubular piles to create a new 854 metre long quay wall. The area behind the wall has also been dredged to bed rock to allow for virgin materials to be deposited. The infilling process began in February this year with the arrival in the river Mersey of the 'Willem van Orange'



trailer suction hopper dredger. The vessel, operated by Dutch specialist Van Oord, has a handling capacity of 10,000m3 (21,000 tonnes) and took materials from a site 20 miles away from Liverpool2, with each dredging and discharge operation taking 6.5 hours from beginning to end.

The final stages of this first phase of construction has seen the installation of capping beams, with bollards and fender blocks, the installation and commissioning of five new ship-to-shore cranes, as well as other infrastructure works required for the terminal opening.

Equipment selection

Planning

Ultimately, the primary issue was to provide a predictable, repeatable, reliable and stable operation that would meet the needs of our current and future customers. The terminal needed to provide additional capacity of around 1 million TEU on a compact site, achieving over 1,500 container moves in a tidal window, allowing STS crane operations of up to 30 moves per hour in winds of up to 88kmph, and maintain existing landside service level agreements. We carried out extensive modelling over a prolonged period during the planning and design phase to ensure that we arrived at the optimum solution for our particular site.

Operating systems

A further set of considerations related to the range of interlinked IT systems required to ensure the efficient operation of the built infrastructure. We took the decision to invest in the Navis N4 terminal operation system, using Liverpool2 to drive change across the whole business, with the TOS planned to be introduced at all our container terminals enabling us to standardise our group operations. To ensure a smooth transition from SPARCS 3.7, and other in-house systems, we are rolling out N4 one terminal at a time over the next 3-4 years, beginning with the existing terminal at the Port of Liverpool and Liverpool2 itself.

Autogates

Another major element of our investment in information systems has been the introduction of Autogates to deliver faster turnaround times through a streamlined process from landside or quayside entry to exit. The fully automated system, supplied and installed by Kalmar and its partners, APS Technology Group, uses state-of-the-art identification technologies to manage gate operations, ensuring that all containers and trucks are automatically identified before entering or exiting the terminal.

Advanced OCR (optical character recognition) and line-scan camera technology (automatically detecting seal presence) link with gate operating software that seamlessly integrates to Navis N4 and our Customer Access Portal (CAP). The security process is further completed using biometric fingerprint identification to further validate driver/load identification and enhance security.

Haulier transactions are now fully integrated into the N4 system, which means more secure and efficient visits and minimal turnaround times at our terminals. This process also means that paperwork and leaving the vehicle are unnecessary, thereby increasing security, improving safety, reducing risks and saving time spent completing manual checks.

Cranes

Not surprisingly, the most visible aspect of the new terminal is the eight STS megamax cranes being supplied by ZPMC. There are an initial five quay cranes and 12 cantilever rail-mounted gantry cranes (CRMGs) for phase one, with a further 3 STS cranes and 10 CMRGs in phase two.

The new container handling equipment will be capable of handling two 380 metre vessels simultaneously, and ultimately will have a capacity of over one million TEU. The STS cranes' specification includes twin-pick, 10 high on deck air draft and outreach of 24, with safe working loads up to 85 tonnes (on hook).

The CRMGs will be single pick with a 50 tonne lift capability, and have a 13 wide container span and be able to lift 1 over 6. With semi-automated remote-controlled operation, the cranes will reduce the time taken to transfer containers from port to road or rail. They will also have the ability to operate at speeds in excess of 30mph and wind speeds of up to 88kmph.

In anticipation of their arrival we have introduced a $772,000 state-of-the-art 'virtual' training simulator on site, designed to ensure all operators are ready to manoeuvre the giant structures from day one of installation. Working closely with ABB, we have produced a customised, high-tech training simulator tailored to interactively test the abilities and skills of drivers by presenting them with realistic, operating scenarios.

The future

Our strategy has been to go as far as we can along 'the curve' of modern port operations. Liverpool2 has given us an exceptional opportunity to introduce leading-edge technology and infrastructure that will remain fit for our customers' needs for decades to come. That is not to suggest we are sitting on our laurels though. We see the scope for improvement in the continued seamless integration of our back-office operations and the overall refinement of our processes going forward.

More importantly, our vision as a company is to be very much a supply chain partner, offering port-centric logistics solutions, such as the new warehousing and distribution facility at Port Salford, that will provide a better end-to-end solution for the cargo owners that need an efficient route to the heart of the UK marketplace.

About the author

Based in Liverpool, David Huck heads up the largest operating ports cluster in the Peel Ports Group, which includes its operations in Dublin, Heysham, Liverpool and Manchester. The cluster ports collectively handle over 17,000 vessel movements and 48 million tonnes of diverse cargo per year. David has a career background including tier one manufacturing logistics and port operations management. He holds a BSc (Hons) in Industrial Engineering and an MBA in Industrial Management.

About the organisation

Peel Ports is the UK's second largest port group, owning and operating six of the UK and Ireland's most important ports. It is headquartered in Liverpool and employs around 2,750 staff. The ports handle around 70 million tonnes of cargo every year with over 35 shipping line services from 26 shipping lines calling through its network every week. It is part of the Peel Group, one of the UK's leading infrastructure, real estate and investment companies, with a portfolio ranging from airports to energy, including flagship sites such MediaCityUK, Manchester's Trafford Centre and Pinewood Studios.

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6 Different handling systems covered

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8 Different TOS covered

SPARCS / N4 / TOPS / OPUS / Cosmos / CATOS / nGen / Zodiac

10 Celebrating 10 years

First project in 2005

50 Over 50 projects

Worldwide

Victoria International Container Terminal: where technology and community interface

Anders Dømmestrup, *CEO, Victoria International Container Terminal, Melbourne, Australia*

May 2, 2014 was a significant day for the Philippine-based container terminal operator, International Container Terminal Services, Inc. (ICTSI). On this day, a 26-year contract was signed by successful tenderer ICTSI, awarding the company a deal to design, construct and operate a new international container terminal at Webb Dock East in the Port of Melbourne with a minimum annual capacity of one million TEU.

This new container terminal, known as Victoria International Container Terminal (VICT), presents ICTSI with its first commercial venture onto Australian shores and ensures that the global stevedore is officially part of the US$1.15 billion Port Capacity Project, a Victorian state government initiative to meet increasing trade volumes at Australia's largest container and automotive port.

Investing in the future

ICTSI's total capital investment to achieve the one million TEU capacity will be around US$397 million. Construction began in the third quarter of 2014 with operations due to commence in fourth quarter of 2016. The approved initial development will include a 660-metre berth with five neo-Panamax ship-to-shore (STS) gantry cranes. VICT's prime position at the mouth of the Yarra River gives it the ability to handle the new +8,000TEU vessels which shipping lines plan to use for Australian trade.

Engineered with the future in mind, VICT will introduce a full range of automated handling solutions to achieve the highest levels of safety and efficiency across operations, which are truly 24/7, for all of its users.

VICT has also worked closely with stakeholders to ensure that its construction and operations incorporate a high degree of environmentally responsible designs. This includes dimmable and near-natural terminal lighting, sustainable drainage systems for clean water run-off as well as main equipment, which runs on electricity.

Responsible development

Given Melbourne's port-city status, VICT investigated potential impacts on community stakeholders and identified sustainable design solutions. Some specific examples are:

Preventing light pollution

Potential light spill at night into the established residential suburbs of Port Melbourne and Williamstown was a concern for VICT, local councils and residents due to the strong light and resulting light spill / sky glow from traditional high-mast terminal lights. We decided to opt for a cutting-edge technology in the form of Light Emitting Plasma (LEP) luminaires. These effectively minimise light-spill and sky glow as each light source is recessed, directing light only where required for a safe working environment. Our lighting design also allows lights to be dimmed in zones when no operations are occurring, further reducing unnecessary use. This investment in a higher cost lighting system pays for itself in the long-term, through lower energy consumption and less maintenance, as well as minimising obtrusive and unnecessary lighting. A win-win situation for both terminal and community

Improving water run-off quality

Preventing pollution risk for Port Phillip Bay in terms of its water quality, marine life and beach amenity was also an important objective shared by VICT and our neighbours. For the new terminal to meet the high modern standards we felt were necessary, VICT incorporated a new drainage system into our design. Using a combination of various Stormwater Quality Improvement Devices (SQIDs) such as Stormsacks and Stormceptors to ensure over 99% removal of all Total Petroleum Hydrocarbons (TPH). The final complementing process involves landscaping with native grasses and bioswales, and swaled drainage courses with gently sloped sides filled with vegetation to remove silt and pollution from surface run-off

Efficient, sustainable operations

To achieve the most efficient terminal design for handling the Melbourne import / export market, it is essential for VICT to aim for seamless integration between its quayside and landside capabilities. The best and safest way to achieve this is through a high degree of automation. VICT is partnering with top suppliers of equipment and automation as follows:

- Cargotec (Kalmar, Navis and Bromma) for systems and yard equipment (Navis N4, Automated Stacking Cranes (ASCs), Automated Container Carriers (ACCs) and Spreaders)
- ZPMC with ABB for semi-automated Neo-Panamax STS cranes
- Camco for the automated gates

We are prepared for the large task ahead of successfully integrating VICT's operations and equipment. We already have the full system virtually live and ready for testing over the next 12 months and live physical testing will begin immediately following the first equipment delivery in March, 2016.

We have also engaged with the

various industry players to present the opportunities our automation can provide. In return, we have received valuable feedback on what they regard as being the most important service features, essential for future container terminals.

The shipping lines raised two key requirements: to be able to berth and handle +8,000 TEU vessels with 4-5 cranes; and the ability to send the high number of empty boxes that need to be evacuated, directly to the terminal from the importer devanning site.

Our current development schedule will have 5 STS cranes and 10 stacking modules ready by early 2017, and will provide capability to handle single large vessels with 4-5 cranes. The Direct Empty Return service will be provided to allow immediate export of empty TEUs, and form part of our improved Two-Way Running system with trucks. It also replaces the current double-handling of empty TEUs via off-site container storage yards for boxes intended for immediate return to Asia.

The hauliers wanted to have comprehensive 24/7 terminal access, and plan for single visits which allow a combined drop-off and pick-up of boxes (Two-Way Running system), easy access for High Productivity Freight Vehicles (HPFVs) and better use of cargo information (weight, immediate availability and customers) to make operations more seamless and efficient.

VICT is working with 1-Stop to enhance the well-known Vehicle Booking System (VBS) to better provide the tools to meet these requirements. A few examples include:

- Two-Way Running to reduce futile trips for truck operators. This system provides carriers with more choice, a few days in advance of available booking slots, allowing them ample time to co-ordinate and ensure that each vehicle's trip, both to and from the terminal, has boxes on board (laden and empties). This aligns well with the Direct Empty Return feature desired by shipping lines
- Off-Peak Slots that ease daytime traffic congestion on Melbourne's roads and allow
- carriers the option of avoiding slower daytime slots. VICT automation will provide the necessary truck handling capacity across all hours of the day
- Block-Stacking via Group Codes is a feature being established to provide more flexibility for the larger carriers by grouping large container consignments ensuring they are stacked together and, therefore, more efficiently retrieved from the terminal.
- Paperless Booking System for terminal entry and exit with paperless tickets delivered to the driver via an automatic text message to a mobile device

Cargo owners, not least exporters, wanted us to take a role in providing cost-efficient weighing services for them to comply with new SOLAS and Australian Maritime Safety Authority (AMSA) requirements for safety on-board vessels as well as streamlining services with authorities for a quicker turn-around and improving security. VICT are looking into the option to upgrade our capability in the yard, and gain the approvals to provide an accurate and cost-effective weighing service, which could be accessed by both exporters and shipping lines.

The future

VICT will deliver a state-of-the-art international container terminal to Webb Dock East towards the end of 2016 for all of its employees to work safely within and grow as professionals. VICT will aim to achieve a rating of "excellent" for our automated container terminal from the Infrastructure Sustainability Council of Australia (ISCA) for our design and build to ensure our sustainability performance exceeds regulatory standards.

We are the first container terminal in Australia to register. We will remain committed to our community, listening and responding to concerns, and connecting directly with them to promote the health, education and the well-being of young people. Finally, we will continue to engage with all our customers and industry stakeholders to gain an understanding of their needs and challenge ourselves to excel in meeting them. These important goals will serve to guide VICT as we prepare to enter the market and commence operations at the end of 2016.

About the author

Anders Dømmestrup is the Chief Executive Officer of Victoria International Container Terminal Ltd. He has spent his entire working life in container shipping and terminals and was based in Asia and the Middle East for most of his 23 year career. Prior to joining VICT, he was Chief Operating Officer of Modern Terminals Ltd with a 5.5 million TEU throughput at the Hong Kong facility and fulfilled the COO role for MTL's interest in three other Chinese terminal operations. Dømmestrup began his role as CEO of VICT in January, 2015.

About the organisation

Victoria International Container Terminal
An ICTSI Group Company

VICT was appointed by the Port of Melbourne Corporation to design, construct and operate the Port of Melbourne's new international container terminal at Webb Dock East. VICT's development will deliver a leading global standard in modern container terminal design, innovation and operations, using the best-proven technologies to deliver automated operations from gate to quayside. VICT is due to begin operations in the final quarter of 2016. VICT is owned by International Container Terminal Services, Incorporated (ICTSI), a global container terminal operator headquartered in Manila, Philippines with a portfolio of 29 terminals throughout 20 countries.

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Busan New Container Terminal: growing smartly for a big future

Peter Slootweg, *Chief Commercial Officer, BNCT, Busan, Korea*

With its first expansion completed in June of this year, Busan's newest terminal has room to grow again before reaching its full 3.5+ million TEU capacity. With a 1.8 million TEU annual volume, Busan New Container Terminal (BNCT) still has decisions to make regarding the optimisation of its equipment, processes and design to accommodate the rapid container shipping industry changes directly impacting Busan Port.

In fact, BNCT's terminal design and its phased approach to realising its full capacity are deliberate mechanisms to ensure optimisation of capital investment which, in turn, mandates improvement to the design of the terminal itself and enables BNCT to maximize its main advantages of speed and flexibility along the way.

Industry Change

Ideally located as the North East Asian transshipment hub and designed to accommodate future growth, Busan New Port is seeing the full effects of container industry vessel and call size growth as well as further customer consolidation. With all other existing terminals operating close to their full capacity, and no new terminals planned to become operational in Busan Port until 2020, BNCT has a big responsibility to keep up with the industries requirements in this market.

Mega-Ship

Since opening in 2006, New Port has seen a steady increase in volume and a more recent steep increase in size and number of mega-ship calls with Triple E class 18,000 TEU vessels calling at Busan New Port since July 2013, and MSC's 19,224 TEU Oscar choosing New Port for its maiden call earlier this year. Rapid vessel size increases in Busan's New Port are expected to continue for several reasons:

- Mega-vessel deployment will continue to increase on current and new services calling at Busan
- The majority of East-West mainline services already call Busan's New Port
- All global shipping alliances are in New Port with further expansion or consolidation likely
- New Port's terminals can easily handle vessel rows of 24 across so services planning to expand vessel sizes over 10,000 prefer New Port
- Busan Port Authority (BPA) will continue dredging works which will see 17 metres of draft ensured for all of Busan New Port and the main sea route in 2016

Terminal Design

One of the most critical advantages of BNCT's terminal design is the phased approach to its expansion because it enables BNCT to optimise its structure as well as equipment as volume grows. By phasing BNCT's expansion towards realising over 3.5 million TEU in capacity, planned investment can be adjusted as the performance of the initial layout and equipment is proven and more is known about future requirements, as well as the impact of market trends.

Big equipment for big ships

An obvious benefit of a phased expansion is the ability to upgrade equipment specifications in response to growing vessel sizes and volumes relatively quickly. As illustrated in Figure 2, BNCT started with eight already large super post-Panamax cranes of 24 rows outreach, however, for its Phase-2 (and recently completed) expansion in response to even larger size vessels, BNCT increased the height of its three newest cranes (fully commissioned in June, 2015) by 6 metres to ensure easy clearance of the tenth tier on deck. Furthermore, BNCT can easily increase its current average gross quay crane

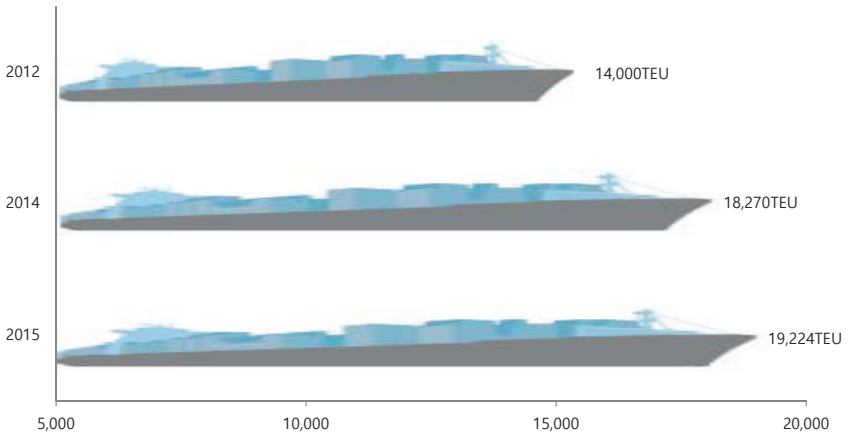
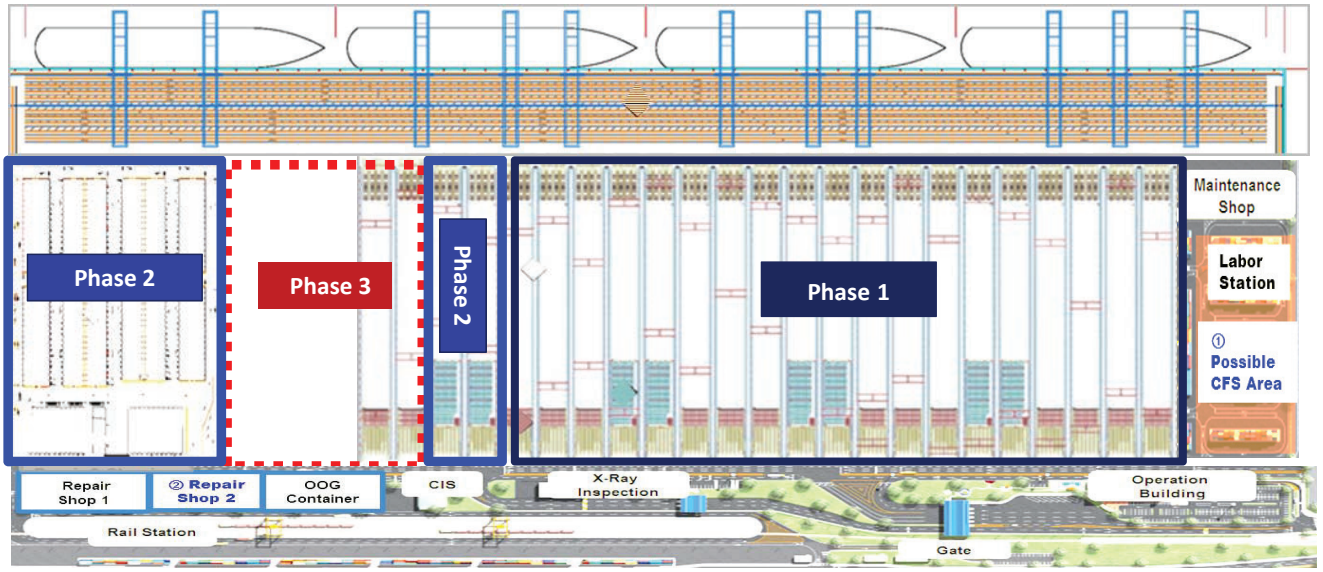


Figure 1: Increase in vessel size in New Port since 2012



	Phase 1	Phase 2	Phase 3 (Future)*
Status	1 Jan. 2012	1 June 2015	*TBD*
Total STS	8	11	14
Total ASC	38	42	52
Total SC	20	28	36
Total Yard Blocks	19	23	26
Total Handling Capacity	**1.8 mil TEU**	**2.5mil TEU**	**3.5mil TEU+**

**Adjustable depending on volume and market trend*

Figure 2: BNCT's Phased Expansion Approach

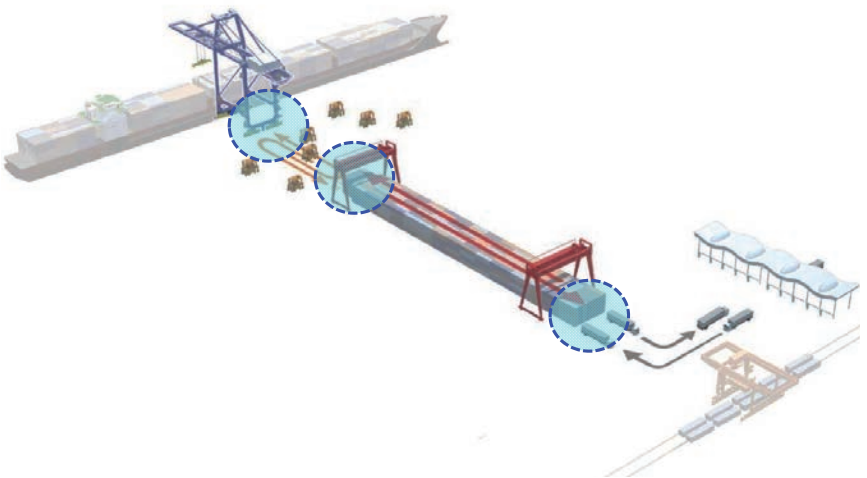


Figure 3: BNCT's Buffer Zones

productivity of 32 moves per hour with 2.5 straddle carriers per crane to 35-40 moves per hour simply by introducing additional straddle carriers.

Optimising the yard

Another benefit of BNCT's phased expansion approach, and one that could only be discovered after many months of operation, is the enhancement of our yard design. When comparing actual volume to yard utilisation levels at all operational times of the day and week, BNCT was able to decrease the number of additional yard blocks by two and associated number of automated stacking cranes (ASC's) by four for BNCT's Phase-2 expansion.

Not only did this save millions of dollars in capital investment, it also allowed BNCT to create 16,000 additional ground slots of empty yard space; a rare competitive advantage in New Port and one that will allow BNCT to improve the performance of its automated yard for discharging and loading full containers even further.

Speed and flexibility

Because of steep volume increases since BNCT's Jan 1, 2012 opening to over 1.8 million TEU annually, BNCT must constantly ensure maximum benefit of its design and resources is delivered to cope with and prepare for increased strain on capacity and equipment that larger call sizes bring. As the first perpendicular-automated yard terminal to open in Asia, BNCT is designed to accommodate mega vessels with 1,400 meter of quay, 16+ metre drafts, semi-automated yard and gates, large modern equipment and a terminal operating system to match. Though each of these design aspects are a prerequisite to be able to handle the largest vessels in the first place, it is the combination of all of these that deliver the speed and flexibility of operations needed to handle more extreme volume peaks and troughs efficiently.

Buffer Zones

Larger call sizes mean bigger fluctuations in the use of and strain on various terminal resources at different times. BNCT's design allows flexibility to efficiently handle these peaks on various terminal activities through the creation of three buffer zones depicted in Figure 3. These buffer zones mean that each piece of equipment is able to operate independently

without having to wait for the previous or next piece of transfer equipment to finish by allowing multiple containers to build up in each Buffer Zone before needing to be handled.

For example, each of our 21 yard blocks can accommodate 6 trucks wanting to deliver containers simultaneously in the land-side transfer buffer zone. BNCT's system will automatically monitor this and adjust itself to handle this peak in gate activity by pre-staging export containers in the yard instead of putting them in their final resting place, enabling a much faster transfer of containers from trucks into the yard. Similarly, the reverse is also true for handling peaks in discharge activity at the water-side transfer buffer zone, with 32 import TEUs able to be stacked at each yard block by BNCT's straddle carriers before needing to be moved by our ASC's into the yard.

Double cycling

Perhaps BNCT's biggest opportunity for vessel productivity improvement for even larger call sizes in the future and a clear advantage of it's perpendicular-automated yard structure versus other conventional truck and trailer terminals is the ability for all our equipment to double cycle at almost every stage of operations. For example, our quay cranes have the ability to load a container then immediately discharge another below deck, having the optimum impact on overall berth productivity. Theoretically, the larger the call-size the more opportunity vessel planners have to optimise stowage enabling the terminals quay cranes to load and discharge during the same cycle more often.

Traffic flow

As call sizes increase, so does the need to accommodate large in and outflows of trucks and to ensure that traffic flow is fast and uninterrupted. BNCT's automated pre-gate enables this by identifying the container before arriving at the gate by reading the trucks RFID tags. This allows separation of any containers with incorrect or missing information from the main in-flow lanes, keeping them fast and efficient. BNCT is currently reviewing additional automated technologies for even further process improvements in this area.

Also, because trucks to not have to travel far from the gate to pick up/deliver containers from/to the yard travel distance is minimised. Because pickup and delivery happens at any one of 121 transfer points, outside the yard and the main flow of traffic, constant and safe movement of trucks is ensured. BNCT's average truck turn time is well under 15 minutes.

Emulation system

The tool that enables BNCT to keep improving and adjusting along the way successfully, despite so many design, equipment and fluctuating vessel operations, is BNCT's emulation system. As volume grows and variables increase, BNCT's emulation system can record an actual vessel operation which can be played back in different scenarios by adjusting various system parameters. This allows us to identify possible parameter and system changes to make our system even more efficient and to handle ever-changing volume mixes between imports/exports, containers and transshipment.

About the author

Peter Slootweg joined BNCT, Korea's newest and Asia's first perpendicular-automated yard container terminal in Busan's, New Port, in October 2011 as Chief Commercial Officer. He led its transition from a project to an internationally-recognised and customer-focused business realising an annualised volume of 1.2 million TEU within the first year of opening on January 1, 2012. Since then Peter has gained additional positions in Korea as Chairman of the European Chamber of Commerce Korea (ECCK) Logistics & Transport Committee, and Ambassador of Korea's largest Busan-Jinhae Free Economic Zone. Peter has been in the container logistics industry since 2006. Before joining BNCT, Slootweg performed global roles with APM Terminals in The Hague and Mumbai as well as with Maersk Line in Copenhagen..

About the organisation

BNCT Co., Ltd. is an independent full-service container terminal with a capacity of 2.5 million TEU able to increase to 3.5+ million TEU in the future. As the most advanced terminal in Korea and the first perpendicular – automated yard structured terminal in Asia, BNCT can berth 3 of the world's largest container vessels simultaneously at 1,400 metres of quay with 16-17 metre water draft and the biggest and most technologically advanced equipment, terminal operating system and automation technology to match.

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Kalibaru: supporting international connectivity

Indonesia Ports Corporation

The initial plan of PT. Pelabuhan Indonesia II (Persero) (IPC) was the construction and development of the Tanjung Priok Port, however since 2010 the aim has been to create the Kalibaru Port terminals. Currently, the capacity of the Tanjung Priok Port is around 8 million TEU, and when the Kalibaru Port terminals are completed in 2018, the capacity of the port will increase by 4.5 million to 12.5 million TEU. If all goes to plan, by 2030 Tanjung Priok Port will be able to accommodate 20-22 million TEU.

The Kalibaru terminals are the newest terminals inside the Tanjung Priok Port area, with major ongoing reclamation activities taking place on the north side of the harbour to provide adequate room. Groundbreaking to begin construction of the terminal was initiated by the President of the Republic of Indonesia, Susilo Bambang Yudhoyono, in March, 2013.

Master plan

The development of Tanjung Priok Port is part of a master plan known as the 'Acceleration and Expansion of Indonesian Economic Development' (MP3EI), a government program which is planned to be in action from 2011 - 2025. One of the main aims of the Kalibaru terminals is to strengthen economic connectivity in the Asian region. Therefore, MP3EI mandated the development of Tanjung Priok Port and Kalibaru terminals with the intention of creating the main international gateway for national and international connectivity. The position is so integral to the transportation system of Indonesia and its national logistics that the new terminal is under great pressure to achieve its aims from government and industry.

Container traffic

The need for immediate action that eventually led to the creation of the Kalibaru terminals was a port capacity shortage. It was decided when this occurred that the growth of container traffic in Tanjung Priok should continue to increase at the same pace as national and global economic growth. The development of the world economy (as measured by world GDP growth) for the period 1999-2003 was at 3.3% per year, this slightly increased to 4.2% per year for the period 2004-2008. It is vital to note that the average growth of the Indonesian economy for the period 1999-2011 was at 4.5%.

The discrepancy between these figures aids in grasping the growth of cargo traffic at the port in relation to global standards. The growth of container traffic at Tanjung Priok Port in the last 10 years has been an average of 5.5% per year, with growth between 2009 and 2012 reaching an astonishing 23%. This outlines the rapid growth that needs to be supported by adequate facilities represented by the Kalibaru terminals.

The efforts toward this include the setup program, also known as the 'reconfiguration', alongside an ambitious two-pronged arrangement for an improved environmental performance.

Environmental efforts

The arrangement of the first initiative at the terminal began with the demolition of unproductive warehouses that were modified into container yard space, thereby removing inefficient and environmentally unfriendly buildings while increasing the capacity for container stacking in the yard.

Mega-ship ready

Another program that is ongoing at the terminal is the strengthening and deepening of the jetty and the berthing pool in order to serve the larger ships that are calling at the port and terminal. Bigger ships need bigger and stronger equipment, so the paving has also been strengthened in the entire container yard.

The jetty is installed with crane rails that work as a track movement support with regards to the loading and unloading of equipment. The strengthening of road and infrastructure in all areas in order to increase the surface bearing capacity that is suitable with the characteristics of heavy cargo, as well as the arrangement of gates, is regarded as the 'first line' of foundational upgrades in the port area.

To increase the capacity and productivity of Tanjung Priok, the purpose of a sizeable chunk of investment is to provide loading and unloading equipment. The specifics are outlined as follows:

- Terminal I: 2 units of mobile harbour cranes
- Terminal II: 8 units of luffing cranes, 11 units of mobile harbour cranes and 3 units of quay cranes
- Terminal III: 4 units of luffing cranes, 9 units of mobile harbour cranes and 10 units of quay cranes

The investment in equipment has been subsidised by the IPC's internal financing and equipment mobilisation collaboration with operating partners. With the additional equipment, loading and unloading capacity at each terminal will increase by two to three times, and ship waiting times will be reduced by 60 to 70%.

Productivity

The productivity rate at Tanjung Priok Port was previously around 10 box containers per hour, now it is closer to 30 box containers per hour. While the waiting period was usually four days; this has already been reduced to 1 to 1.5 days.

After the land optimisation, land reconfiguration and additional equipment as well as the building removals that had no direct relationship with port operations, Tanjung Priok port capacity has risen up to 8 million TEU.

In order to anticipate future container traffic, Tanjung Priok Port has planned additional capacity through the construction of another container terminal so congestion can be avoided.

Increasing size

Another challenge that Tanjung Priok Port has had is the limited facility to serve 6,000 TEU vessels. While ships continue the trend of ever increasing sizes in order to reduce the logistic cost per container. This situation requires special navigation channel facilities; a safe jetty and berthing pool, and the supporting equipment to serve direct call containerships with a larger size, adequate infrastructure and superstructure. This makes us prepared.

Land reconfiguration at Tanjung Priok Port has provided a proven increase in direct services to some destination ports (direct call services) by several shipping companies. The increase is caused by the container transshipment reduction to several countries in Asia. In 2012, on average, 60% to 70% of the containers at the Port of Singapore and Port of Tanjung Pelepas Malaysia were being used for transshipment, but since this has since decreased to 30-35%.

The Port of Singapore has become a favoured location for transshipment and the transfer vessels for Indonesia ports, including the Tanjung Priok Port. Based on data from the Indonesian National Shipowners Association (INSA) more than 4 million TEU of containers from and to Indonesia must go through the Port of Singapore. Total foreign exchange coming into Singapore is estimated at US$1.4 billion, the shipping revenues from Jakarta to Singapore amounted to around $350 per TEU.

This situation has come to an end with the development of the new container terminals at Tanjung Priok Port.

About the organisation

IPC
Energizing Trade. Energizing Indonesia.

Through a presidential decree issued on April, 2012, Indonesia Port Corporation II (abbreviated as IPC but better known in Indonesia as Pelindo II) was tasked to develop and operate the New Priok Port. Pelindo II is Indonesia's largest port operator.

Container Handling

In Partnership with:

Jebel Ali Port: Container Terminal 3 (T3)

Mohammed Ali Ahmed, *Chief Operating Officer, DP World, UAE*

The road to transformation is paved with technology, innovation and human enterprise. Transformation is no longer an alien word for the marine terminal industry, and for a global player like DP World it is a process that began 36 years ago when the world's largest man-made harbour emerged from the sands of Jebel Ali.

It was a technological feat unmatched then and admired since, setting new benchmarks as a container port and a commercial gateway for a region stretching from the Indian subcontinent to East Africa, the Middle East and Central Asia. The business model created by Jebel Ali as an integrated port and logistics hub is being replicated today across DP World's global portfolio, and emulated elsewhere by emerging economies.

For Dubai's port planners investing in the most sophisticated technology available was never an option. In 1972, seven years before Jebel Ali, Port Rashid launched Dubai's ambitious ports business as the region's most modern container terminal facility. Before 2015 ends, Jebel Ali's Terminal 3 (T3) will be completed and showcased as one of the most sophisticated container terminals on the planet.

A new dawn

T3, is a mammoth 4 million TEU, semi-automated terminal spread over 720,000 square metres that towers over the port's landscape. It has been built on an old general cargo and there were more than a few heavy hearts when it was decided to demolish the iconic old Control Tower as part of the development.

T3 is an automated container terminal that uses parallel stacking to the quay, fully automated ARMG's, as well as internal transfer vehicles (ITV's) for horizontal transport for container transfer from quay to stack and stack to quay. The yard's stack capacity is 103,764 TEU – designed for the mega-ships. With a draft of 17 metres and quay length of 1,862 meters, T3 can berth 10 ULCS simultaneously, a first for the region.

Automation

Automation scripts every move in the T3 facility which is equipped with 19 SPP (super post-Panamax) gantry cranes, 50 Automated RMG and RTGs, seven empty box handlers, two reach stackers, 190 tractors and 178 trailers. With so much automation, DP World chose CyberLogitec's OPUS Terminal as its TOS to run Terminal 3, a solution Jebel Ali already uses for Terminal 2, with its 29 SSTS and 60 RMG cranes.

The TOS accounts for a small portion of the total investment in a terminal but it holds the key to operational efficiency. With the latest J2EE-based open architecture, OPUS Terminal delivers high flexibility and scalability, and enables terminals to focus their efforts on increasing efficiency in yard operation, while integrating other terminal operation processes.

As a container terminal operator, DP World's biggest concerns are increasing efficiency and the visibility of operations, while minimising problems. Unexpected conditions crop up at the quayside, in the yards, at the gates and on the roads that connect its operational locations. Trivial mistakes, if not attended to immediately, stack up to costly operational hurdles in a terminal's chain of commands. As the saying goes; a chain is only as strong as its weakest link.

OPUS enables Jebel Ali's staff to focus on analysing KPI data related to overall productivity, the movement of containers, and operational efficiency at large, while the TOS takes care of the automated machinery.

In the vast yards T3 dozens of ITVs scurry around picking up container boxes, dropping them off at assigned spots and searching around for more. These automated machines are the foot soldiers of major ports in DP World's global portfolio. Preprogrammed and carefully monitored, they collectively represent artificial intelligence (AI) at work, with the computers providing data by the billions.

Big ships, cranes and data

In the 22 years since the world's first automated container handling facility opened in Rotterdam in 1993, terminal automation has scaled great heights both in terms of the technology and acceptability in an investment-sensitive industry. The shift from man to machine has seen DP World's technology allocations rise, but the yield is in the form of unprecedented operational efficiencies and economies of scale, resulting in higher productivity and profits.

In the near future, all the equipment within terminals will be communicating through a network and therefore the container flow will be optimised. Yet for DP World, automation is not a choice, but we do not forget that behind every automated operation, however extensive, there is a human hand. Ultimately, it is humans who are in charge.

To handle the ever-increasing number of boxes arriving at Jebel Ali, DP World switched to quad lift quay cranes. Today, the quad lift system is standard in major terminals across our global portfolio. As DP World's flagship, Jebel Ali has led by example. The growing sophistication at the

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quayside is matched by initiatives like gate automation, RFID tracking of containers and trucks, automated stackers and now the latest semi-automatic SPP giants controlled remotely by men and women. Automation has helped Jebel Ali crack the gender ceiling in dock-side operations, alongside better safety to workers and fewer manual errors.

T3's remotely operated quay cranes and simulated equipment with HD cameras and panoramic views deliver better accuracy of the data that is fed into the port's sophisticated systems through high bandwidth networking infrastructure. This is monitored by highly trained support staff with a commitment to embrace new technologies that increase system integrity and productivity.

The Dubai-based global marine terminal operator has focused on a set of fundamentals that have helped adapt the design to existing conditions. Over the past decade the advances made in sensor and navigation technology have made it possible to transform the movement of container handling machines at the terminals. Today the unmanned container handling machines are run by computers or are remotely operated from Jebel Ali's main operations building.

Conclusion

T3 will be the new flagship terminal and the centre of excellence for terminal automation in the DP World portfolio, setting new operational automation precedents once T3 is finally fully live and operational. When this happens the T3 container terminal, with its 19 remote-controlled quay cranes, will raise Jebel Ali Port's total annual handling capacity to 19 million TEUs by the end of 2015.

With every mechanised step, every box unit within the port complex tracked, recorded and secured, Jebel Ali's operators are using Big Data to good use. All our terminal assets such as quay cranes, yard cranes, yard tractors, trucks and even external trucks are under the radar. The virtual terminal is a reality today.

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CyberLogitec

DP World's Container Terminal 3 utilises CyberLogitec

- OPUS-Terminal TOS system
- Eagle Eye Process Automation System
- Systems provided by CyberLogitec

CyberLogitec is working on an Automated Container Handoff implementation project between manual crane and yard truck using Eagle Eye which uses DGPS and INS technologies

About the author

Mohammed Ali Ahmed is an industry leader in international marine terminal operations and development, logistics and related services. His leadership, insight, vision and operational expertise has strengthened DP World's culture of service, excellence and innovation. With two decades of port and management experience, Mohammed Ali Ahmed is the Chief Operating Officer for DP World, UAE Region. Under his portfolio comes in addition to the leading Jebel Ali Port, Mina Rashid (port) and Mina Al Hamriya (port) in Dubai and the Fujairah Container Terminal on the United Arab Emirates Indian Ocean coast.

About the organisation

موانئ دبي العالمية
DP WORLD

DP World's flagship facility Jebel Ali Port is strategically located in Dubai. It provides the Middle East region with an integrated multi-modal hub offering sea, air and land connectivity, complemented by extensive logistics facilities. Jebel Ali Port plays a vital role in the UAE economy, and is a premier gateway for over 90 weekly services connecting more than 140 ports worldwide. It has market access to over 2 billion people. Expansions currently underway at the port will bring total handling capacity to 22.1 million TEU by 2018. Jebel Ali is ranked the 9th largest container port worldwide, and recognised as the world's most productive port in 2014. It has been voted "Best Seaport in the Middle East" for 21 consecutive years. DP World, UAE Region portfolio includes Jebel Ali Port, Mina Rashid Cruise Terminal and Coastal Berth, Mina Al Hamriya in Dubai city and Fujairah Container Terminal.

Enquiries

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High performance container crane technology by Kuenz.

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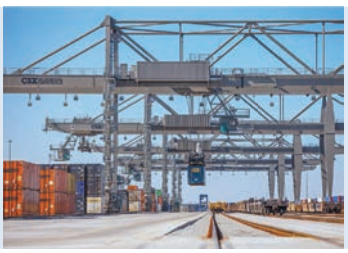

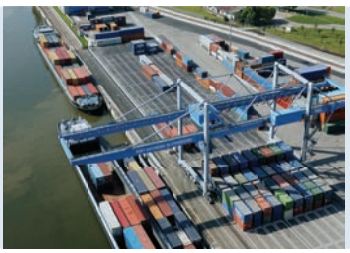

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A new concept in handling mega-ships: part III

Frans Koch, *CEO, Koch Consultancy Group, Goes, Netherlands*

In the final part of this three paper series I will focus on the main differences between the current semi and fully automated container terminal and the New Generation Integrated Container Terminal.

The general objective in designing a terminal is in principle the same for each operator, namely:

- A maximal stack capacity, maintaining utmost efficiency and flexibility in order to achieve the highest performance and service level for clients against a minimum on investment and operational costs

Despite this general objective, there is a huge variety in terminals all over the world, and almost every terminal is unique. Yet there are two main principles when designing a terminal to choose from: should the stack layout be perpendicular or parallel to the quay (see Figures 1 and 2, respectively).

Present situation

At present, for newly built fully automated terminals, a layout with a stack orientation perpendicular to the quay seems to be the standard (Figure 1). Yet how this will develop in the next few years is difficult to predict because this configuration does not bring about the revolution in terminal productivity which is often called for to handle the capacities coming from mega-ships.

Depending on stack orientation, there are principle differences in the choice of equipment, as well as the level of automation. Regarding ship-to-shore cranes, it is expected that many will be fully automated with remote control technology in the near future.

For the transport of containers from STS cranes to the stack area, it seems that people either believe in AGVs (and Lift-AGVs) or in shuttle carriers in case of perpendicular stack orientation. In the case of parallel stack orientation, it seems that there is a preference for shuttle carriers, probably as a replacement for terminal tractors.

In stack operations we see RMGs and RTGs in various models and dimensions, with differences in levels of automation. Despite the very impressive improvements in respect to the handling speed of ship-to-shore cranes over the last few years, the integral handling speed over the whole terminal process neither meets the requirements of the shipping companies on the seaside, nor the requirements of the hinterland connections on the landside.

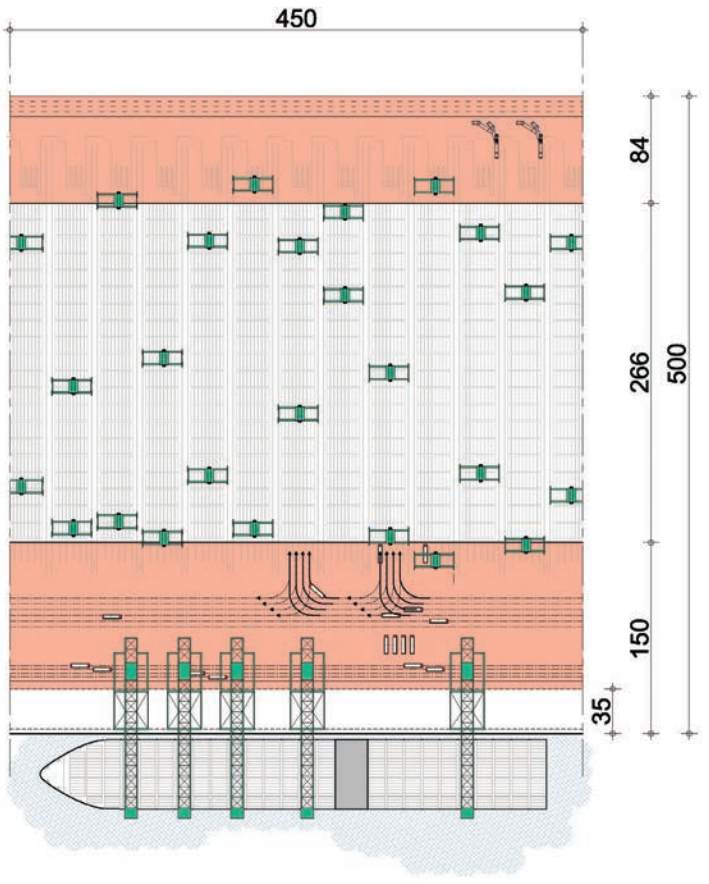

Figure 1

Terminal operators win awards if they perform 170 moves on one ship per hour during the berth-time of a ship, yet shipping companies, especially those with mega-ships, ask for 250 berth moves per hour during the total berth-time. The average berth productivity of the top ten ports in the world is approximately 108 moves per hour. There is a lot to be done.

Challenges

Present efforts, such as:

- Improving the use of automation through specific training
- Better communication and collaboration in the logistical chain
- Optimising stow and quay planning

These may be important in the long-run but are not sufficient for now. Due to the real-time information tools online customers are getting used to, receiving a parcel within 24 hours after ordering it is becoming the norm. Distribution centres which have more than 470,000 pick locations in storage are able to deliver a particular article from the warehouse to an expedition department within 30 minutes after receiving the order. Because container terminals play an important role in the supply of these distribution centres, they should be prepared to stay in line with these higher future demands.

The actual challenge should not be just

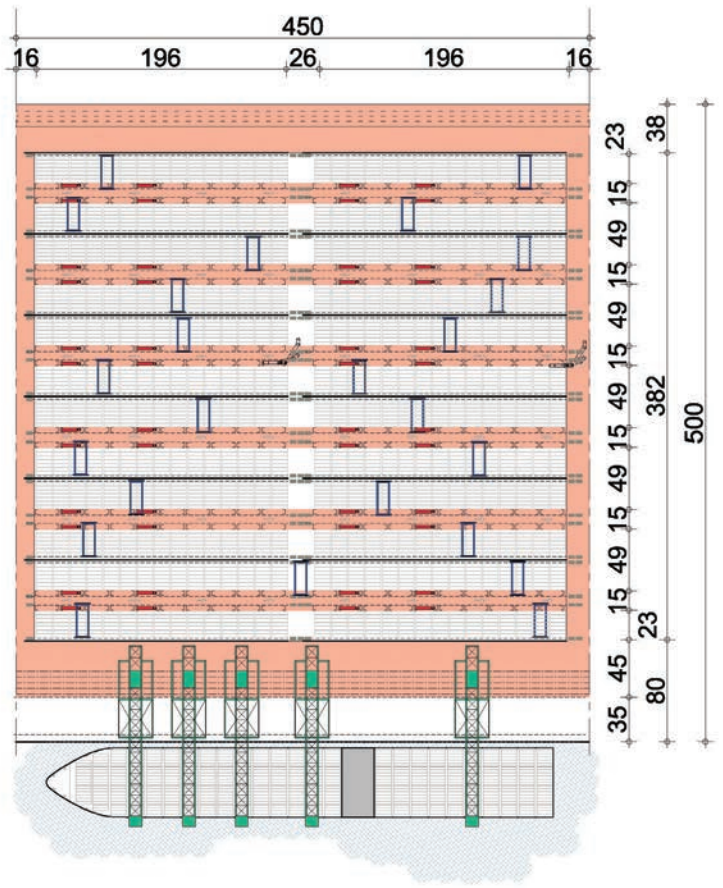

Figure 2

improving current processes by 10 or 20%, but aiming to deal with the rising demands for longer than a few years. A performance of 10,000 moves in 24 hours could become reality within a decade.

Funding

As always, the customer will pay, provided that the price is in conformity with the market and the costs due to transport and handling are in a reasonable ratio to the total price of the article in the manufacturer's opinion. Herein lies further challenges, yet this article only focuses on the differences between the current modern terminals and the NGICT-system.

Game changers

History teaches that revolution in this very capital intensive sector is often a bridge too far. This is why we put off the STS side of the NGICT-concept for a future article. To be able to profit from the current, very fast automated STS cranes, it is inevitable to realise an important change in the way containers are being transported over the yard. This is not only important for handling mega-ships because shortening the berth time for smaller vessels saves money as well, and it will place the benefits of mega-ships along the whole transport chain in a new light.

Firstly, 5 to 7 AGVs per STS crane (see Figure 1) is too many to make it possible for 5 or 6 STS cranes to perform efficiently while working adjacent to each other on one ship. The most effective solution for that problem is reducing the travel distance of the AGVs substantially.

Searching for dead-lock free zones, finding optimal sequences regarding entering, waiting, passing and leaving strategies for about 30 AGVs driving in the usual routings as shown in Figure 1 will always be a very complex and space-taxing exercise.

Using simulations, I have discovered that by using two-directional AGVs which are capable of driving in two perpendicular directions terminals could cut down on travel distances and therefore travel time by up to 50% (see Figure 4). Even using current AGVs, which could change between driving tracks in the transfer zone underneath the overhead bridge cranes (OHBCs) by parallel steering mode, this method could save a substantial amount of time.

Secondly, it is interesting to see that due to a higher stack density, the travel distance in the stack area itself will be reduced as well (see Figures 3 and 4). Thirdly, we should realise that ASCs must be faster and more flexible in job assignments than in the current configurations. The solution for this is special OHBCs which have

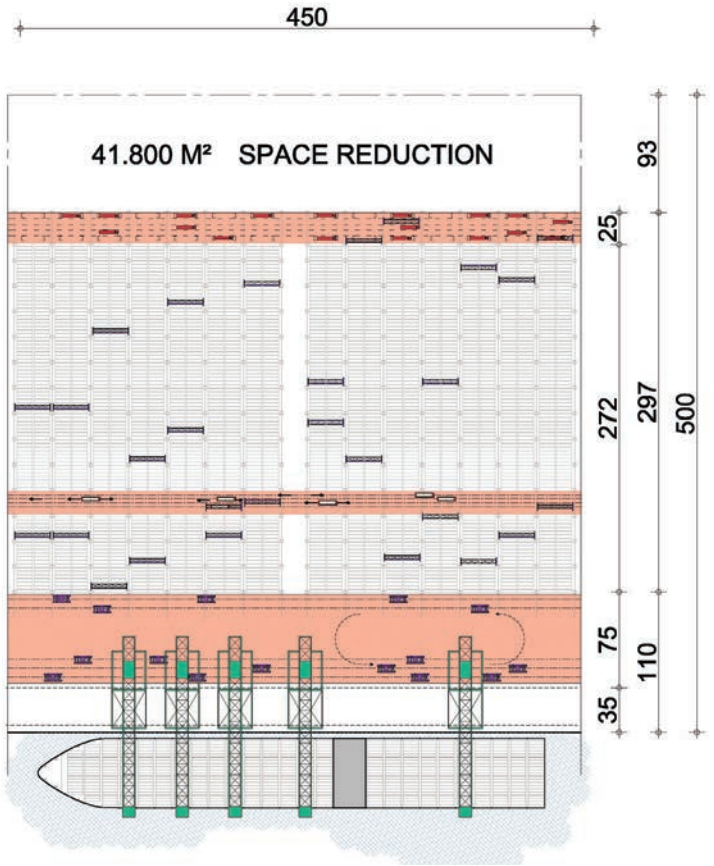

Figure 3

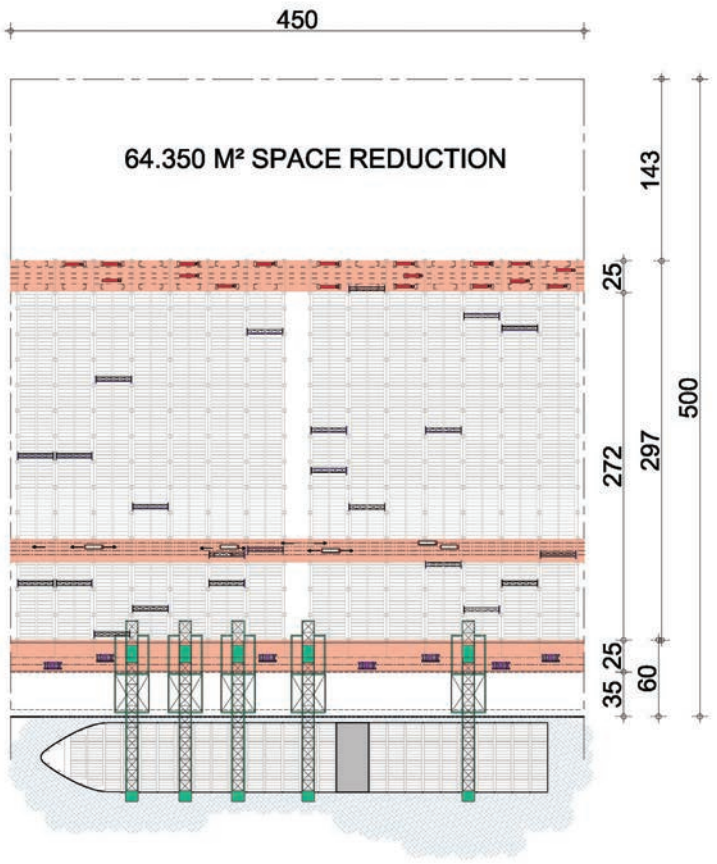

Figure 4

higher travelling speeds and pass each other in the same stack lane, making it possible to increase the number of OHBCs in one stack lane.

Depending on the length of the stack lanes, three (or even four) OHBCs in the same lane can work simultaneously without hindering each other. So it becomes possible to handle two transfer points for trucks within each stack lane at the same time (see Figure 3 and 4).

By comparing the four typical excisions of a modern terminal (Figures 1 to 4), the advantage of the NGICT concept becomes clear. In Figure 3, transport between STS cranes and stack cranes can also be done by AGVs or by SHCs, but the transfer direction under the OHBCs takes place parallel to the quay. In Figure 4, the STS cranes are able to transfer approximately 50% of the containers directly within the reach of the OHBCs which may save quite a lot of movements in relevant circumstances.

All four layouts have an equal number of STS cranes and more or less the same investment on the terminal operators account, yet the productivity potential and the operational costs are quite different.

Berth-productivity potential

Regarding the comparison between the four layouts, the difference in productivity potential regarding the berth-time can be estimated as shown in the following table (based on comparable kinematics per device and on average moves per hour by practical experience).

It is clear that the actual performance per layout can deviate from these productivity assumptions as expressed in the comparison berth-productivity table.

Integral productivity potential

For the productivity potential of a whole terminal, berth productivity is not the sole criterion. The expected future demands on the landside will also have an impact, on the stack operations in particular. Using the results from the table below, the conclusion must be that in the traditional stack configuration of Figures 1 and 2, neither the required berth productivity nor the future higher demands at the landside can be met.

The strongest link in the logistical terminal process (see Figures 3 and 4) is the OHBC. This is due to higher speeds and the ability to carry two 40 foot (or 4x20 foot) containers at the same time, and secondly because two OHBCs are able to work in the same part of the stack lane without hindering each other.

This implies that replacing, renewing or upgrading a number of STS cranes in front of a conventional yard configuration will not lead to a performance in line with higher future demands.

Conclusion

Even in combination with the current and modern automated STS cranes, implementing the NGICT-configuration in the yard will produce big advantages immediately. There are striking differences between the NGICT-layout and conventional systems. These are:

- Less surface occupation; therefore a lower investment and more environmentally friendly
- Shorter travel distances in the STS area, in the stack area itself, and in the truck area. This leads to a faster integral logistical process and lower energy consumption
- Fewer devices, higher redundancy level, and easier automation
- Higher flexibility in job assignment

Because the NGICT-configuration makes use of proven technology, there is little-to-no risk from the terminal operator's point of view. In the case of greenfield terminals and the extension of existing terminals, combined with the extension of quay length, the adoption of an NGICT-system saves money on investment, reduces operational cost and ecological footprint, and simultaneously improves performance.

A new concept in handling mega-ships: Part I featured in Port Technology International: Edition 65, February 2015
A new concept in handling mega-ships: Part II featured online at porttechnology.org

About the author

Frans Koch, founder of the Koch Consultancy Group (1994), forms together with his son Mathé, the general manager of the team of engineers and architects in the Netherlands who constitute Koch Consultancy Group. Both Frans and Mathé are both registered designers and hold a PMSE in structural engineering.

About the organisation

KOCH Consulting Group
Engineers & Architects

Koch Consultancy Group consists of Raadgevend Ingenieursburo F. Koch B.V., Allant Architecten B.V. and Koch Projectmanagement, a local multidisciplinary organisation of consultants, architects and engineers. Its portfolio concentrates on projects in favour of industry, harbour and marine structures, civil works, buildings, energy production plants and wind turbines.

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COMPARISON BERTH-PRODUCTIVITY POTENTIAL

Configuration / Figure	STS cranes: number times average moves per hour *	Lift-AGVs: number times average moves per hour	Shuttle carriers: number times average moves per hour	RMGs: number times average moves per hour	OHBCs: number times average moves per hour	Decisive devices
1	5 x 50 = 250	30 x 7 = 210	-	12,5 x 18 = 225	-	AGVs
2	5 x 50 = 250	-	25 x 8 = 200	12 x 18 = 216	-	SHCs
3	5 x 50 = 250		12 x 20 = 240	-	(13 to 26) x 25 = 325 to 520	SHCs
4	5 x 50 = 250	-	6 x 25 = 150 plus 50% direct transfer = 125	-	(13 to 26) x 25 = 325 to 520	STS cranes

* based on 6,000 moves in 24 hours

Innovation and process optimisation drive success


Dr Yvo A. Saanen, *Managing Director, TBA, Delft, the Netherlands; and,*
Tony Gibson, *Managing Director, Ports of Auckland, Auckland, New Zealand*

The Ports of Auckland operates New Zealand's largest container port. The terminals are situated in the heart of Auckland and hence have the largest consumer market in the country on their doorstep. More than 2 million people (out of 4.5 million in New Zealand) live in Auckland. Despite this relatively small population, large volumes of exports – New Zealand is one of the largest dairy exporters in the world – are handled through the Ports of Auckland (PoAL).

The main container facility of PoAL is operated on the Fergusson berth and handles just over 1 million TEU annually. On a small footprint, operated with 1 over 2 straddle carriers, with the flow being predominantly import-export, this is an everyday puzzle to achieve quality of service both on the waterside and landside.

Preparing for the future

In order to be prepared for the future, PoAL partnered with TBA in 2008 to develop a long term plan, and to keep this up-to-date as time progresses. Since then, PoAL and TBA have been working together on the 'master planning', as well as enhancing operational efficiency to make it not only the largest but also the most productive and efficient terminal in New Zealand.

Current results speak for themselves: despite the large volume growth over the last couple of years, waterside productivity has kept increasing to achieve current (net) productivities beyond 32-35 containers per hour, as well as good truck turn times. One of the concerns however is the yard occupancy, despite a relatively low dwell time.

The yard capacity problem is one of the main focus areas for the master planning exercise. As the port cannot really expand – there are some additions to the current footprint, but in the overall picture, this is quite limited – the solutions have to be sought in different directions. A first step is to implement 1 over 3 straddle carriers, and as such increase capacity by approximately 50%. Before jumping to conclusions, several solutions where thoroughly researched – various perpendicular and parallel RMG solutions have been compared by means of simulation.

One of the drawbacks of any solution with RMG's is the odd shape of the facility. RMG's lend themselves quite well for rectangular sites, and the terminal at hand is all but that. Moreover, the North berth which is currently under development makes operations from the end-serving ARMG's far from optimal. Also, parallel solutions with cantilever RMG's were discarded as the integration with straddle operations is inherently complex due to the need to avoid mixing of road trucks and straddles, as well as the interaction between CRMG's and straddles.

Decoupled semi-automated straddle operations

So, after considering various options for the yard expansion, the decision was made to intensify the straddle operations to 1 over 3, and plan for the conversion to automated straddle carriers. However, the introduction of automation is planned in 2 phases.

The first phase entails semi-automation, where the yard operation and truck operations are automated, and the service to the ship is still manual. In between

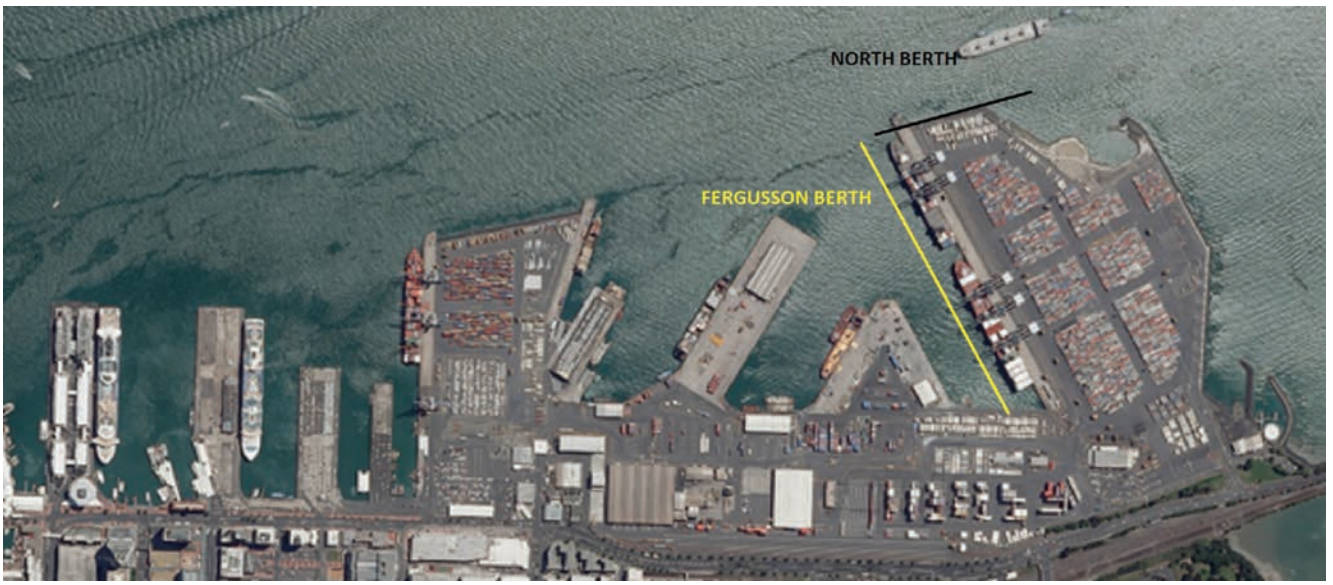

Figure 1: Overview of the Ports of Auckland

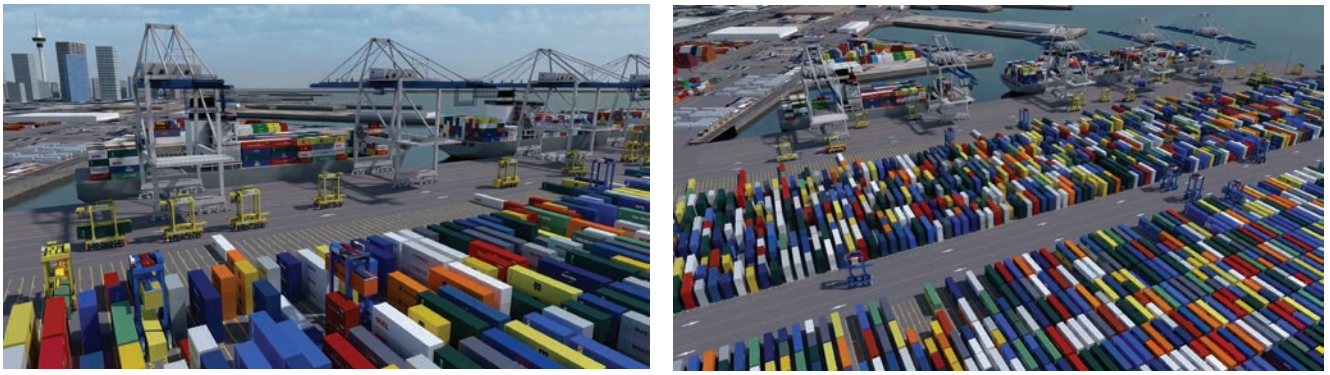

Figure 2: Screenshots from the decoupled mode of operation (yellow straddle being manual, blue straddles being 1 over 3 automated)

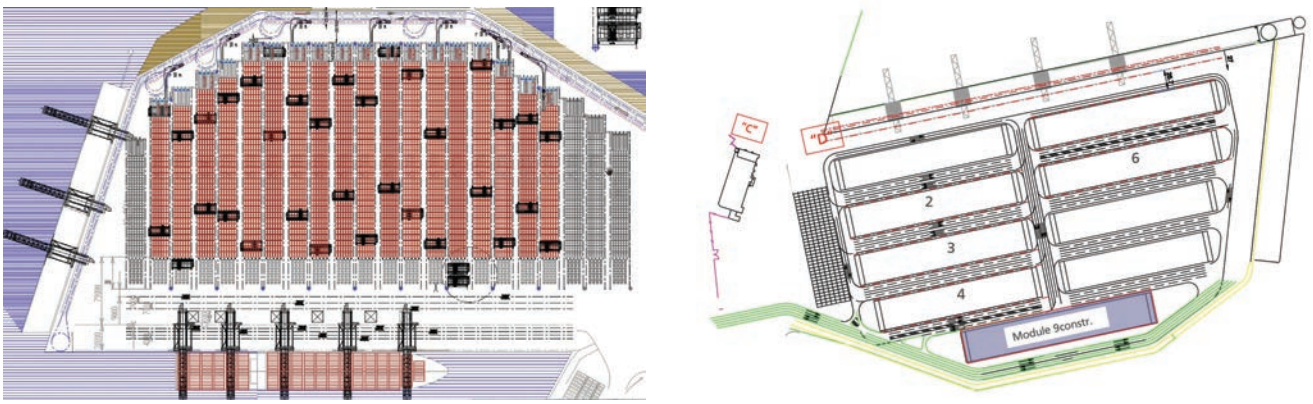

Figure 3: Initial plan for the Fergusson terminal with perpendicular ARMG's (left picture), and sketch with parallel CRMG layout (right picture)

a decoupled buffer is planned, where automated straddle carriers and manual interchange containers work in a similar fashion as end serving ARMG's and straddle carriers would do. This buffer will be 4 TEU long, and every straddle row will have its own interchange buffer. Furthermore, the yard will be 1 over 3, with automated machines, where the waterside will continue with 1 over 2 (manual) machines.

The second phase of automation would then entail the complete role out of automated machines to the vessel operation as well. This would come in a later stage. This plan comes with a number of advantages:

- The conversion to 1 over 3 straddle carriers is seamless, as there are no civil works to be performed
- The perceived safety risk of 1 over 3 operations can be avoided by only going 1 over 3 with automated machines which automatically adjust speed in case of risk of tipping
- The automation of the waterside operation – the most difficult as people under the crane remain – is deferred to Phase 2; hence there is minimal risk for a drop in performance on the waterside
- The natural staff turnover and growth of the business would align with the automation and the lesser demand for straddle drivers
- The existing fleet of 1 over 2 machines can still be used until they slowly come of age
- The area where most damage to containers and machines is incurred is automated, hence a maximum reduction of wear, tear and damage is expected
- The test phase can be performed in a small confined area, only containing a few yard rows and 1 truck interchange zone, hence minimising the capacity impact of the test phase

Optimising a novel mode of operation

The decoupled straddle model – as we call it – is a novelty. Although there are several terminals worldwide that have straddle carriers in the yard, and terminal trucks on the quay – e.g. Northport in Malaysia operates like this – an automated straddle–manual straddle operation is new in its kind. In order to ensure that the productivity targets will only be affected positively when introducing this mode of operation, PoAL asked TBA to carry out a series of simulation runs.

The level of accuracy of these simulations is such that they are very close to real operations under undisturbed circumstances, as has been proven in recent performance testing at Maasvlakte 2. The simulations were focused on the optimal yard layout, from a handling and traffic point of view – a key part in straddle operations. Three options were being considered. The options were developed because of the berth expansion project, providing the terminal with a high performance berth, with deep draught, and tandem-lift STS cranes.

In order to facilitate this berth, the buffer (indicated in yellow in, and shown in the middle layout in Figure 2) should face the berth, as a buffer (and yard) facing the existing berth (left layout in Figure 2) would make the distance to serve the North berth (berth on the right side) long. Besides the traffic around the North-West corner would become very dense, as our traffic analysis showed.

One option that was taken into consideration is the one shown in the right picture, with a buffer facing the North berth, and the yard facing the existing Fergusson berth. The automated straddles would then drive in the middle alley to the buffer on the right side, where the hand-over to the manual machines would take place.

Based on the simulation results it was decided to implement the layout with a split yard (the middle picture), as it provides the best overall performance, and especially to the new high performance berth. From the simulation, we saw net productivities of 42 containers per hour across all STS cranes, during peak operations, and 45 containers per hour

Figure 4: Three yard layout options for decoupled automated straddle operation

for the new tandem cranes. This in combination with twin-lift and tandem (twin 40') lift operation, and 3-4 straddles per STS crane (depending on the mode).

Outlook

So, from where the port is now to a fully expanded terminal with a whole new high performance berth, there is still a way to go. A way that increases the terminal's throughput capability from 1.3 million TEU today to 2.1 million TEU at full build-out, with the capability to handle 2 large (330 metre) vessels at the same time as berth productivities exceed 150 container moves per hour.

For the Ports of Auckland, this is a solid outlook for the future; staying within the boundaries, reducing the proportional need for land, and still serving the ever growing New Zealand export market while catering for the local demand for import. As a potential bonus, in the light of ever growing ships as well as cascading effects, the port could serve as a transshipment hub for New Zealand, where most transportation is done by sea due to the low density of the population. As such, fewer ports need investment in deep-water berths, higher and broader cranes, as well as the negatives of increased peaks in the yard.

About the author

Tony Gibson: Tony joined Ports of Auckland as Chief Executive Officer in early 2011. He joined the company with 30 years' experience in shipping and logistics, first with Seabridge in Wellington, and then with Nedlloyd and P&O Nedlloyd. He has worked in various Senior Management roles in Africa, Asia and Europe, including as European Director of Customer Operations, Rotterdam, before being appointed Managing Director, New Zealand and Pacific Islands in 2002. Following a take-over by Maersk, Tony served as Managing Director of Maersk, New Zealand for three years. Tony pursues his own business interests as a director and shareholder of ERoad, a road-user charge solution provider, and is Chairman of NorthTugz Limited.

Dr Yvo Saanen: Yvo is Managing Director and Founder of TBA, a leading terminal design and simulation company in the Netherlands. He is in charge of all port and terminal related projects all over the world in their planning and optimisation process of container terminals by means of simulation and emulation. In this role, he has participated in various projects, ranging from long term development, process improvement, terminal extensions and redesign of handling systems to design of greenfield terminals. Examples are the APM facility in Virginia, DPWorld's facility in Antwerp, and HPH's Euromax facility in Rotterdam. He is a Professor at the Rotterdam School of Management teaching Maritime Economics and Logistics.

About the organisation

PORTS OF AUCKLAND
TĀMAKI HERENGA WAKA

Ports of Auckland provides a full range of cutting-edge cargo-handling and logistics services at two seaports – one on the east coast adjacent to the Auckland central business district, the other on the west coast in Onehunga – and a strategically located inland port at Wiri, South Auckland. By value of trade handled, we are New Zealand's most significant port. In 2010, we handled cargo the equivalent to 13% of the country's total GDP - twice as much as any other New Zealand port.

TBA®

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, and Antwerp Gateway.

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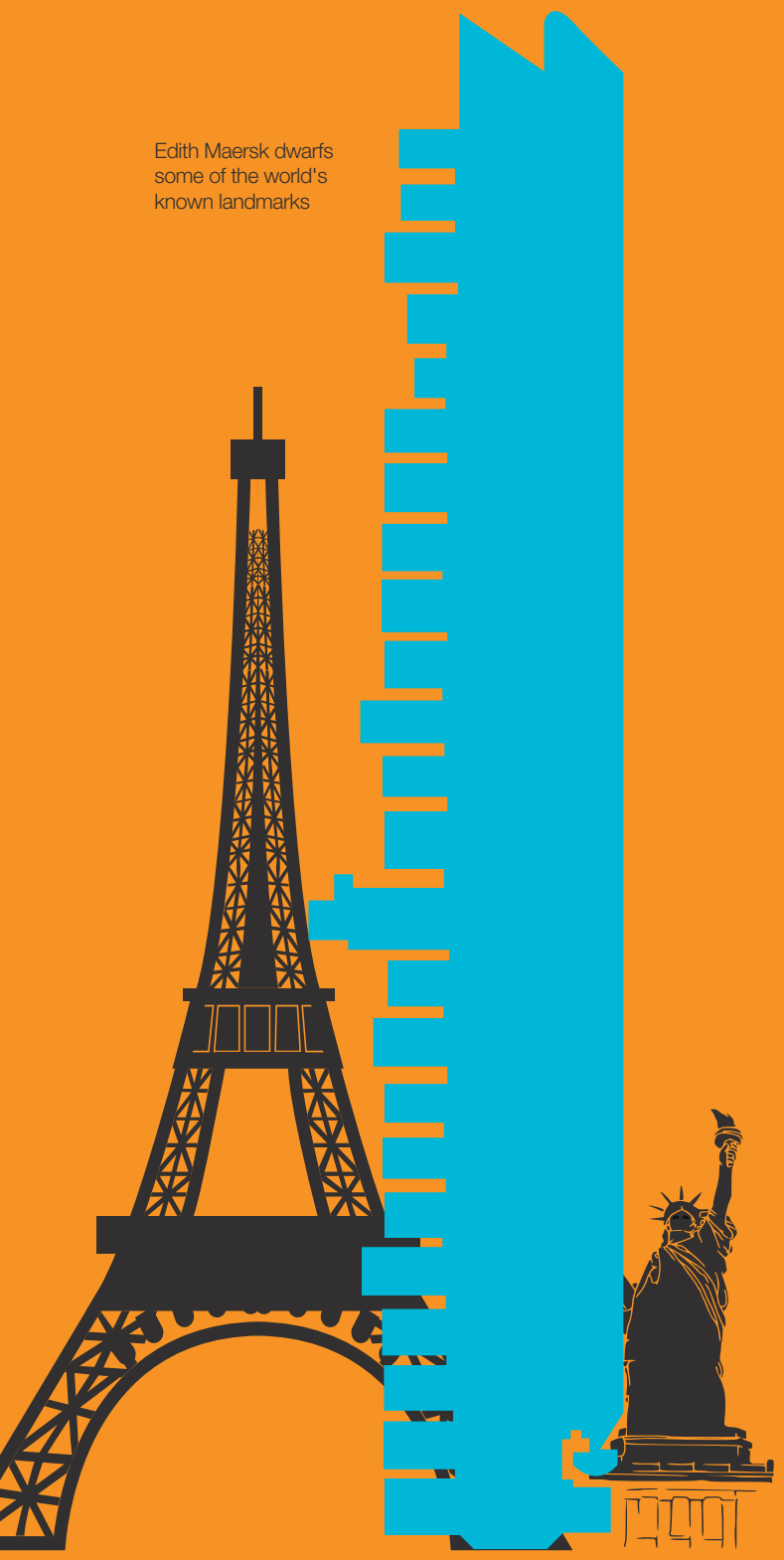

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RTG automation for every unique terminal

Thomas Gylling, Global Automation Sales,
Konecranes Port Cranes, Hyvinkää, Finland

The mega-ships are here and the pressure to accommodate them is mounting in container terminals, including terminals with manned RTG yard operations. Automation can be a long-term answer to the mega-ship question, and today, automation features can be introduced to increase the productivity of manned RTG operations. Konecranes has an increasing number of RTG customers that are exploiting automation technology to increase the productivity and safety of their manned yard operations. This article presents three of them.

Real-time RTG position

Accurate measurement of RTG position and heading in real-time is the starting-point for many automated functionalities for manned cranes, and a prerequisite for unmanned equipment automation. With these measurements online, the positions of the RTGs and their subsidiary parts, such as the steel structures and spreaders, can be tracked precisely and the location information can be recorded.

The location information in turn is used by other automation features which fully or partially automate crane motions such as gantry travel and trolley travel. This in turn enables the automation of the container handling work sequence, either to assist manned RTG operations or to carry out autonomous work cycles without human intervention. The RTG travel information can also be used to automate the transaction processes; e.g. container handovers between different pieces of handling equipment, with different degrees of asset verification. Tracking all the container moves in the terminal, and reporting them to the TOS, is a prerequisite for 100% container inventory accuracy in the TOS.

Case Study 1: DP World Yarimca, Turkey

DP World is investing strongly in its Yarimca Container Terminal in Turkey. Konecranes is delivering 18 RTG cranes to Yarimca, equipped with an array of automation features that will boost the productivity of manned RTG operations in the container yard.

Auto-steering

The Konecranes Auto-steering feature uses the information described above. It is a key performance-improving feature of the RTGs being delivered to DP World Yarimca. This feature uses two GPS antennas, located at two corners of the RTG, to deliver accurate crane position and heading measurements in real-time. The measurement start-up time is accelerated, so if there is a signal loss for any reason (due to shadows for example), the system recovers quickly. It works equally well when the RTG is moved between container blocks, during carousel motion, when the RTG is turned around for re-direction, and when the RTG is driven to and from maintenance areas.

The Auto-steering feature is the foundation for many automation features, because it provides the vital positioning and heading information. It provides pre-defined drive lanes for the RTG, and automatically steers the gantry so it stays on the defined drive lane. RTG operators call this “driving on virtual rails” since it’s very similar to driving an RMG crane. The operator’s attention is freed to concentrate more on container handling and assets circulating in the container yard.

Auto-TOS reporting

Every container move carried out by the RTG is tracked and reported to DP World Yarimca’s TOS Zodiac by the Konecranes Auto-TOS reporting feature. The Konecranes TOS interface solution allows the operator to look ahead into the work order list of each RTG. With this information, the next target slot for each RTG operator is accurately determined via the RTG’s container yard coordinates.

Auto-positioning

The Konecranes Auto-positioning feature comes into play next. It uses the target information to allow the crane to drive at full speed (gantry and trolley motions) to the target slot, and automatically decelerates the crane to an accurate stop. Again, the operator’s attention is freed to concentrate on the operating environment. In most cases, the spreader will be positioned so accurately above the target container or slot that spreader fine-positioning isn’t needed. When the load is lowered, a direct hit on the target is achieved. Load handling speed increases.

Truck Lift Prevention and Stack Collision Prevention

Some things are difficult to see from the RTG cabin. When a truck is being loaded or unloaded, it can be difficult to see if the truck is also being lifted along with the container. It can also be difficult to see when a lifted container is being moved too close to the container stack. To assist in preventing dangerous situations, the Konecranes Truck Lift Prevention and Stack Collision Prevention features are included in the DP World Yarimca RTGs. As its name says, the Truck Lift Prevention feature assists in preventing unwanted lifting of road trucks. The Stack Collision Prevention feature helps to prevent collisions inside the stack, using crane position data, spreader position data, and laser-scanned profiles of the container stack and truck.

Auto-truck guiding

The Konecranes Auto-truck guiding feature is also included in the RTGs for DP World Yarimca. This feature speeds up truck servicing and eliminates unnecessary inching of the RTGs and trucks. It provides “car wash” style signaling for trucks, guiding them accurately into position under the RTG. It guides the trucks to stop accurately in line with the container bay, since the RTG is correctly positioned -- manually or by an automation feature. The truck moves smoothly into position, in line with the containers in the stack under the active bay of the RTG. Meanwhile, the RTG operator can prepare for servicing the truck by retrieving a container from the stack for example.

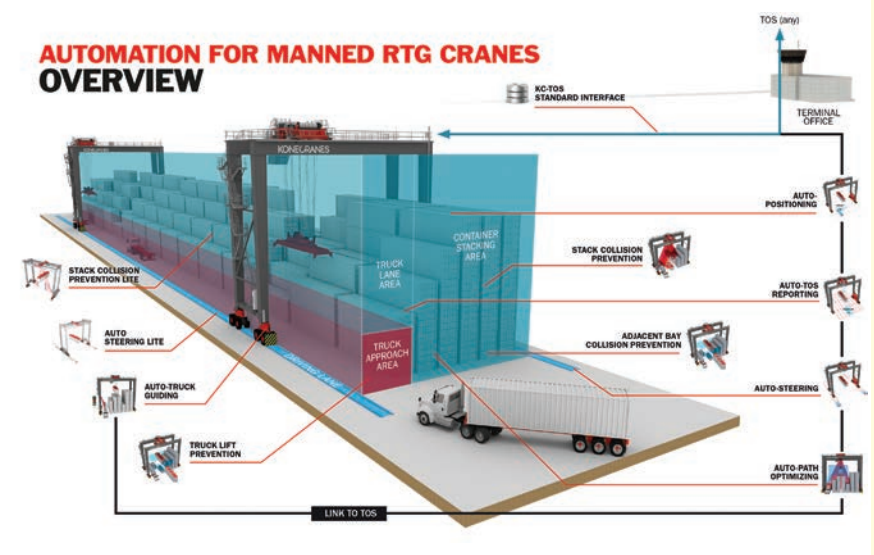

Figure 1: Konecranes provides a wide range of automation features for manned RTG yard operations. The mission is to improve performance and safety in the operating environment ‘aquarium’

Case Study 2: DCT Gdansk, Poland

DCT Gdansk is Poland’s largest and fastest-growing container facility, and the only deep-water terminal in the Baltic Sea region that receives direct ocean vessel calls from the Far East. The terminal handles Polish import and export, transshipment and transit. DCT Gdansk understands the mega-shipping era. It began for DCT, opened in May 2011, when the terminal started handling Maersk Line’s E-type class container vessels with a capacity of 15,500 TEU, the world’s largest containerships at that time.

Konecranes is delivering 15 RTG cranes to DCT Gdansk. They are high-performance, 16-wheel RTGs equipped with automation features that are similar to those described in the DP World Yarimca case. The Gdansk RTGs will also be equipped with the Auto-path Optimizer feature. This feature uses the container profile to calculate the optimal path between the current container slot and the destination container slot. This increases handling speed and reduces energy consumption: the containers’ flight paths are shortened and they are not lifted more than what is necessary for each move. The target positions are calculated based on the RTG work orders received through the standard Konecranes interface to the TOS.

The Gdansk RTG cranes will also be equipped with the Konecranes TRUCONNECT remote monitoring system, which is the Konecranes platform for the industrial internet in container handling.

Case Study 3: Luka Koper, Slovenia

Slovenia’s Port of Koper was established in 1957. It has grown steadily over the years, and now comprises 12 specialised terminals employing around 1,000 people. It has the leading container terminal in the Adriatic, handling 674,033 TEU in 2014.

Koper received its first Konecranes RTG in 2004, equipped with Auto-steering. Koper recently ordered its twentieth Konecranes RTG, equipped with the automation features Auto-TOS reporting and Auto-positioning. To ensure that their crane operators use these features to the full, an additional GUI for navigating in the yard is included in one crane for testing. It shows a block overview including crane position with spreader, work orders and next target. The crane operator clearly sees where to go next, and can initiate the next work cycle when the time is right.

Scaling automation

Luka Koper is developing its rail handling capability, which led to a recent decision to purchase two Konecranes RMGs. These cranes use the same automation feature platform described in this article, including Auto-steering. In this case, Auto-steering keeps the crane gantries in precise perpendicular alignment with the rails, and provides accurate position measurements for the Auto-positioning feature. It also paves the way for future automation features that would need very accurate equipment positioning data.

Koper’s new RTG and RMG cranes are equipped with Remote Crane Management Systems that, among other things, track and record the true energy consumed by the cranes. The energy consumption data is transferred automatically to the terminal management system for further reporting. The cranes are also equipped with special noise reduction technology.

Conclusion

Automation features are increasingly being deployed in container yards. With the proper crane design and automation technology platform, container cranes can have a built-in growth path to a higher level of automation. This helps to ensure that terminals will get the most out of their assets today and in a future where containerships keep getting bigger.

About the author

Thomas Gylling (MsC Tech) is leading Konecranes Port Cranes container handling automation sales worldwide. Prior to his current position, he held various positions at Konecranes for 11 years in the company, predominantly concentrating on the container handling industry. His areas of focus have been automation R&D and productising, project delivery, and sales and marketing. Currently he is deeply involved in the company’s first automated RTG delivery project. Mr Gylling brings energy, insight and vision to the drive for automation in the container handling industry.

About the organisation

Konecranes is a world-leading group of lifting businesses, serving a broad range of customers, including manufacturing and process industries, shipyards, ports and terminals. Regardless of your lifting needs, Konecranes is committed to providing you with lifting equipment and services that increase the value and effectiveness of your business.

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Kuenz: innovative and efficient

Kuenz offers solutions for container transfer and handling in intermodal operations – by rail, road or river. We also offer automated stacking cranes for harbour and rail yard operations, including our own custom designed and manufactured spreaders.

Due to numerous successful Kuenz installations at intermodal terminals, Kuenz is today the market leader in Europe and North America. High performance, reliability, low operating and maintenance costs, careful handling of containers and goods – in particular fragile and dangerous goods – are the main criteria for choosing the proper handling solutions we aim to offer every one of our customers.

Kuenz container cranes perform day by day in a fail-safe manner. To ensure that we maintain that level of performance well into the future, Kuenz sets value on the highest product and service quality, as well as on the highest stage of our engineering efforts. Kuenz develops, designs and manufactures all of the main components needed in container handling; the hoist, the patent-registered gantry drive, spreader and more in house, which guarantees a maximum level of safety and efficiency for the customer.

Intermodal barge cranes

Our rail mounted container gantry cranes are designed as rigid one or two-girder bridges and therefore enable a wide track width and cantilevers. The steel construction of the gantry consists of a hinged post, a fixed post, and the main girders with suspension. The hoisting rope reeving for the container hoisting gear is executed as a rigid rope-tower. This system enables swing-free travel in gantry and trolley direction, as well as with the slewing gear.

High availability

Our in house developed and supported crane management system (CMS) with integrated remote fault finding function guarantees optimised support for maintenance and operation. Systems for noise protection for night operation have also been successfully implemented. Efficient handling with Kuenz is consequently ensured.

VAN BERKEL BARGE CRANE

Aerodynamic girder

Kuenz always aims to improve its container cranes. The latest innovation that Kuenz has successfully implemented is the aerodynamic mono-girder which can be used for river port cranes, regular container cranes in intermodal facilities or stacking cranes.

This totally new design offers less wind resistance which leads to:

- Lower energy consumption (by up to 30%)
- Less and smaller sized components
- Lower wheel load (lower wear of wheels and rails)
- Lighter high-performance crane with lower impact on the infrastructure

The cf (shape coefficient of wind surface) of the aerodynamic girder is approximately 0.5 which makes it four times less than those of a conventional square box girder. This innovative technology has an impact on further crane parts such as the portal, or trolley, which is suspended. If we consider now the container crane in its whole (portal, aerodynamic girder and trolley) that means up to 50% less of the surface is exposed to the wind.

Directional travelling mechanism

Another technical feature that brings huge benefits to our customers is the directional travelling mechanism that has been successfully implemented on all of our container cranes since 2007. A wheel's lifetime is affected by:

- The crane's misalignment during travelling due to skewing forces
- The rail track and crane tolerance (rails alignment)
- Influences from the elements

The Kuenz travelling unit is automatically swivelling around a vertical pivot axle which leads to:

- Lower horizontal forces
- Optimal alignment (vertical and horizontal) to the crane's rail track even in case of irregularity
- Better transmission of forces due to arrangement of the side rollers

Technical Data:
Capacity main hoist: 37t
Capacity auxiliary hoist: 2t
Track width: 41m
Cantilever fixed column: 20m
Cantilever hinged column: 16m
Lifting height total: 18m
Lifting height over TOR: 15m
Length of crane way: 260m

Working speeds
Hoist rated load: 0-30 m/min
Hoist partial load: 0-60 m/min
Gantry drive: 0-100 m/min
Trolley drive: 0-140 m/min
Slewing: 2 rpm

Project milestones
Signing of Contract: October, 2014
Delivery: May, 2015
Handover: August, 2015

- Maintenance free mechanical technology
- Less wear, meaning a longer lifetime of wheels and rails

Travelling gear connection
This features:

- Maintenance free connection between bogies and travelling gear
- Fast and easy maintenance of connection between travelling gear and wheel
- Fast and easy disassembly even after many years of operation

The features are under Künz patent.

About the organisation

Kuenz, an Austrian based company was founded in 1932 by Hans Künz and is still a 100% family company. The company started out manufacturing tower cranes and then focused on container cranes - RMGs - mainly for intermodal terminals and river ports in the early 1970s. Kuenz is now a market leader in Europe and North America, thanks to its technical know-how, experience and high-end crane quality. With automation being more and more important nowadays, Kuenz has received large orders for automated stacking cranes in recent years. Other Kuenz's strengths are its ability to control the whole process from design, production, assembly and commissioning, as well as its dedication to provide customers with the best solutions for their terminals. Kuenz is a worldwide well-known manufacturer of hydropower plant equipment. It employs approximately 400 people; more than 25% of which are engineers.

Enquiries

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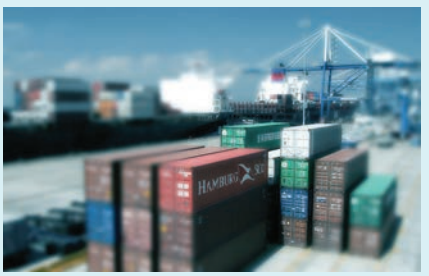

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How to go about greening terminals

Olaf Merk, *Administrator Ports and Shipping: the International Transport Forum (ITF) at the Organisation for Economic Cooperation and Development (OECD), Paris, France*

There is more and more talk about green port terminals, but what are green terminals, and is greening terminals a real development or just a gig? This article aims to tackle this question by giving an overview of practices applied in port terminals throughout the world. It finally answers the question whether mega-ships will make terminals green or not.

A green terminal

It is important from the outset to make the distinction between green terminals and green ports. In 90% of world ports, operations are conducted by private operators, with regulatory functions and infrastructure maintenance completed by a public port authority. A port operator finances the superstructure (equipment), and the port authority the infrastructure. Whereas ports can become greener by focusing on the maritime and the land transport side, terminals will have to focus on their own operations and on the equipment. So, when we talk about terminals, we actually mean port operations.

Therefore the question about what a 'green terminal' is, is foremost a question about what green operations are when practiced by terminal operators.

The greenest terminal is a terminal without activity; but this is obviously not the goal of a terminal. So talking about green terminals is not only an absolute matter, but foremost a relative matter: how can terminals have a lot of activity and at the same time be green? This is a question that is very relevant to mega-terminals. Their mega-volumes could have phenomenal negative environmental impacts for local populations; hence the need for mitigation of these impacts.

Much also depends on what kind of terminal (container, liquid bulk, dry bulk, general cargo) we are talking about, even what kind of cargo – e.g. the energy bill of a terminal with a lot of reefer containers will be higher than a container terminal with just a few of these reefer containers. Most of the energy in bulk terminals is used for pumps and belts, and also the emissions from terminal buildings differ depending on cargo and terminal characteristics.

Why green is not just a gig

It is starting to be fashionable to be a green terminal. The largest global terminal operators launched a "Go Green" campaign recently to improve their environmental performance, whilst various terminal operators market their green credentials, and terminals in emerging economies are applying more and more green practices. For example, various Chinese terminals have advanced in applying green technologies in their container terminals, such as shore power facilities and the electrification of equipment.

This can be out of noble societal intentions, but most of the time it is simply good business. Various large shippers include carbon footprint and other emissions in their criteria for procuring transport options for their products. Green terminals might in this respect have an advantage, even if emissions from terminal operations are much smaller than emissions from maritime transport or land transport. Furthermore, port authorities increasingly include environmental indicators in the bidding criteria for port terminal concessions, but there is a more direct business incentive for terminals to be green: more energy efficient equipment means savings in fuel costs.

The effects here can be substiantial, considering that energy costs can represent a considerable part of the terminal costs, and that generally around two thirds of the energy provision in container terminals comes from fossil fuels.

Greening terminals

It all starts with measurement. What are the current emissions from a terminal and what are the main emission sources; those are the key questions that need to be answered before measures should be taken. If the answers are not clear, measures might focus on emission sources that are relatively minor and not the main problems, which will make policies ineffective.

Having a baseline is necessary to measure the impacts of certain instruments or technologies. All too often, the reason why pilots are not rolled out is because the effect is not or cannot be measured. This measurement of emissions should be done based on a common methodology, so that numbers can be compared across terminals, which makes it possible to formulate benchmarks and learn from best practices. The initiative of the largest global terminal operators in harmonising their emission measurement frameworks is promising in this respect.

The next step of greening terminals is to increase energy efficiency and reduce energy use. This could imply a holistic system of smart energy management, and entail a variety of measures such as minimising shunting operations in the yard, LED lighting on container cranes, and switching off the lights at night when no activities take place. By utilising energy released when containers are lowered or the driver's cab comes to a halt, up to 25% of the energy can be fed back into the power system.

Another way of greening is using energy sources other than fossil fuels. Studies have indicated that on average around two thirds of the energy sources in container terminals come from fossil fuels, and a third from electricity. Bringing down the fossil fuel consumption in a terminal will bring down emissions, supposing that the energy sources for generating electricity are cleaner.

This implies electrification of equipment, using alternative fuels such as LNG, dual-fuel (diesel and LNG) or hybrid models (diesel/LNG plus electric).

For example, Asyaport in Turkey deploys 40 LNG-powered terminal tractors in its new container terminal. Other examples examples of equipment that could be greened include STS cranes, rubber tyred gantry cranes, reach stackers and forklifts. It is easier to invest in such equipment when starting new operations or expanding terminals, but various terminals have also invested in retro-fitting equipment.

Finally, terminals could become active in generating energy themselves. Some port terminals have become energy producers, which makes terminals less dependent on electricity grids or fossil fuels. The sources of energy generated in terminals include wind power, solar power and other energy sources. For example, half of the energy needed for the Eurogate Terminal in Hamburg is generated by its own wind power plant.

Mega-ships

Shipping lines promote the environmental benefits of mega-ships. Our research on whether they are more environmentally friendly shows that this is only partly true: around 60% of the cost savings of mega-ships are related to new ship design, the rest is related to larger ship size. These reductions in fuel consumption per transported container are theoretical if the ships are not filled, as is currently the case. If shipping lines, instead of ordering hundred 18-20,000 TEU ships, would have ordered hundred new 13,000 TEU ships, they would probably have realised more emission reductions.

But let's suppose that the larger mega-ships will eventually be filled, and will at some point be realising emission reductions, the effect on terminals will be mixed at best. These ships will create cargo peaks during a week that could translate into emission peaks. Combined with the port and terminal concentration tendencies related to mega-ships, more ship emissions could be concentrated in one place.

It is often assumed that cargo peaks related to mega-ships have contributed to port truck congestion in various ports; if this is indeed the case, any emissions reducing effects from mega-ships would be annulled on the land-side.

About the author

Olaf Merk is Administrator, Ports and Shipping, at the International Transport Forum (ITF) at the OECD. He has extensive experience in directing studies into ports, port-cities and port regulation and governance. He is the author of a number of OECD books, most notably 'The Impact of Mega-Ships' and 'The Competitiveness of Global Port-Cities'. He is a Lecturer at the Institute for Political Science in Paris. Prior to his role at the OECD, he worked for the Netherlands Ministry of Finance. He holds a Master's Degree in Political Science from the University of Amsterdam.

About the organisation

International Transport Forum

The ITF at the OECD is an intergovernmental organisation with 57 member countries. It acts as a strategic think tank for Transport Policy and organises the Annual Summit of Ministers. The next summit will take place May 18-20, 2016 in Leipzig, Germany.

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BiNY: next generation smart LED high-mast lighting

Jimmy Zhang, R&D Manager; Barry Cai, Senior Thermal Engineer; and,
Jacy Zhou, Senior Optical Engineer; BiNY, Shanghai, China

What difference will smart LED light sources plus a real-time control solution make to high-mast lighting at harbor sectors? As an overall solution provider of VLS (VeryLargeSpace®) lighting, BiNY has initiated the smart high-wattage floodlights, offering much greater control for harbour operators.

Besides the main features such as high efficiency lumen output, IP65 protection, environment-friendly components and shock absorption as is the case with most other BiNY products, BiNY's LED luminaire will go further to meet several special requirements regarding the light application on high-masts in harbour sectors.

An integrated structure

We have designed the new model in such a way that the sink itself will also work as the fixture. This structure reduces the weight of the fitting to 15 kilograms, which is actually one half of the conventional HID luminaries of 30 kilograms and above. The electronic drives to be mounted onto the back as little attachments will be easily retrofitted.

Thermal management can guarantee the reliability of high-wattage luminaires, equaling 50,000 hours at 25ºC. The excellent heat dissipation is decisive for the working of high-wattage LED luminaires.

Optical design

In light of the real situation at port and terminal sites, high-wattage LED luminaries for high-masts should have several beam angles like 5ºC, 10ºC, 15ºC, 25ºC, 30ºC, 45ºC and 60ºC. A perfect lighting array on the head-frame of high-masts should be the adoption of most wide-beam-angle fittings plus some narrow-beam-angles to satisfy illumination uniformity.

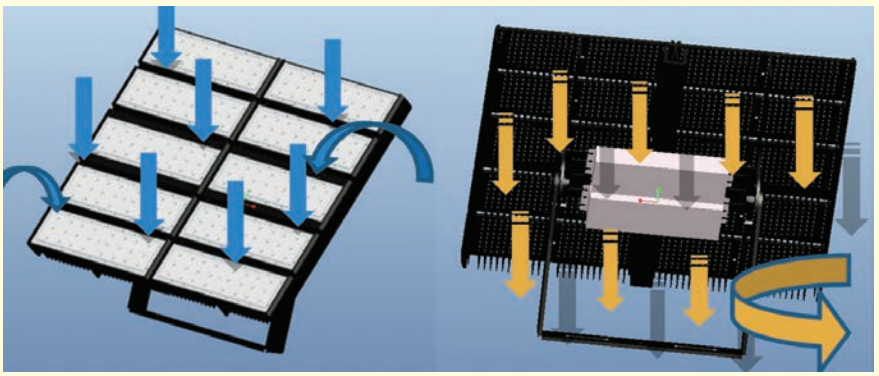
Infrared thermal radiation coating

The slim appearance requires the coating layer to serve as a perfect heat conductor as a whole. The specially designed coating will enhance the heat dissipation of the sink.

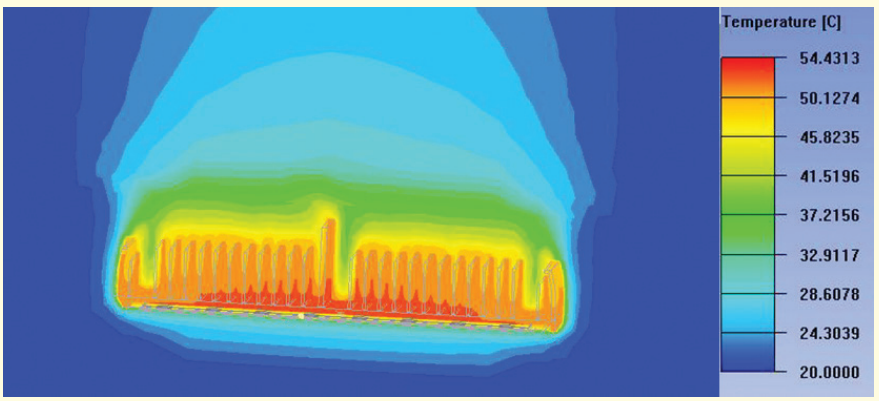
Smart-lit technology

This technology has allowed the real-time communication between each luminaire on a high-mast and operational

BiNY's 500W Smart LED Floodlight

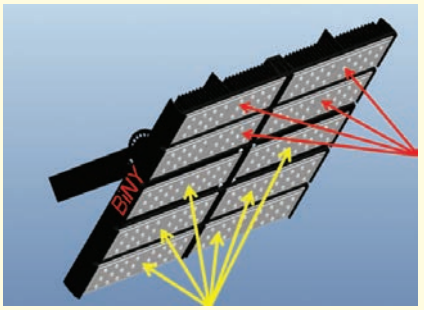


Integrated structure with light weight, strong wind resistance and simple ways of installation

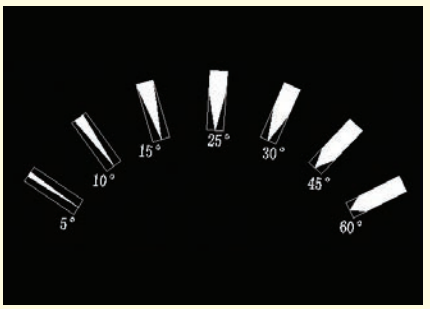


Reliable and excellent heat dissipation performance

Smart-lit technology



Optical design



administrators. Each light on the high mast alone is not only a light source, but a receiver and information collector. The smart light will connect one by one and ensure the total high mast lighting at ports and terminals becomes a VLS system.

Technical specifications

The solution will efficiently integrate every high-mast and its smart LED luminaries into the control programme so that every administrator can operate the VLS lighting freely at a distance.

Pilot project

We have been testing one unit of the 30 metre high-mast with 6,500 watts smart LED flood lights over the past three years at a car racing park in Shanghai. Our aim is to get an illumination result in lux value as well as uniformity ratio as follows:

*The distance above is the actual length from the measured point to the centre point of the high mast base

Energy conservation

We would like to take the example of Yangshan Deep Water Container Terminal Phase IV at Shanghai Port, the world's largest automated container terminal under construction, at which LED luminaires have been recommended to be used at the top of 40-metre-high lighting towers. BiNY has proposed to replace 600 more pieces of 1 kilowatt sodium vapour floodlights with 600 pieces of smart high-wattage LED floodlights.

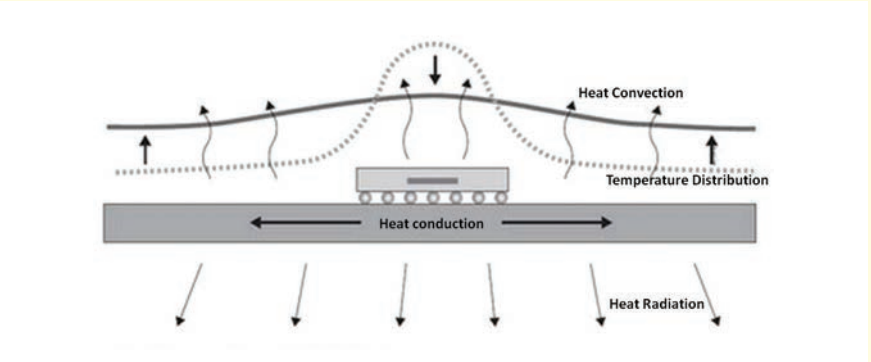
Table 2: Theoretically total input and investment recovery period for an operation period of 5 years

*Only procurement expenditure is included while labor costing and others are not covered

*The return of energy conserved by dimming during the operation of high mast lighting has not taken into consideration

Table 3: Theoretically annual energy conserved or carbon emissions reduced

*The calculation is subject to 13 hours per day and 365 days of a year. SCE denotes Standard Coal Equivalent



Infrared Thermal Radiation Coating

Category	Annualised
Light Efficiency (lm/W)	110
Color Temperature (K)	2700~6400
CRI	> 70
Lighting control (Dimmable)	0~100%
Dimensions (mm)	600 × 510 × 140
Weight (kg)	< 15
LM (50000 HOURS @ 25ºC)	70

Technical Specifications

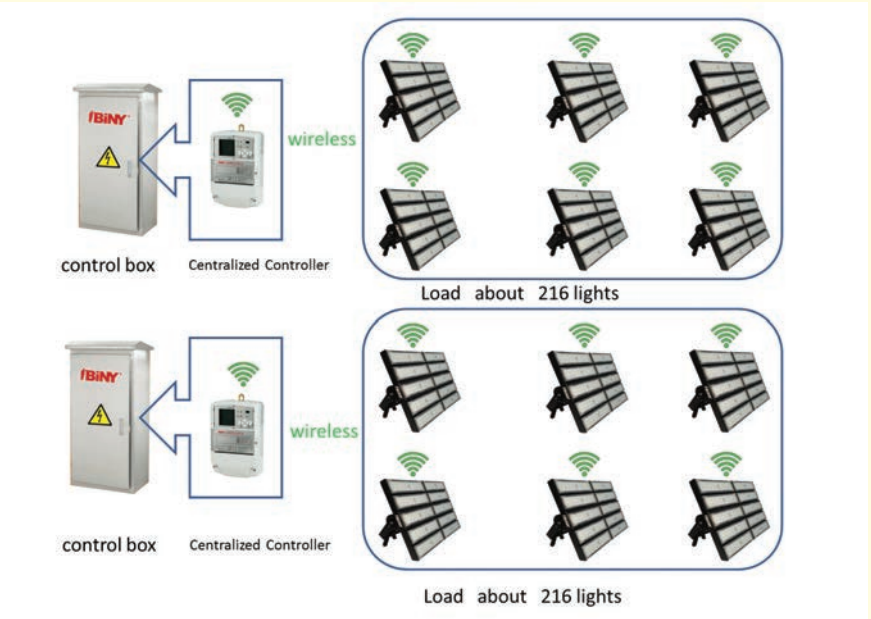


Diagram 1. BiNY's Lighting Control Part 1

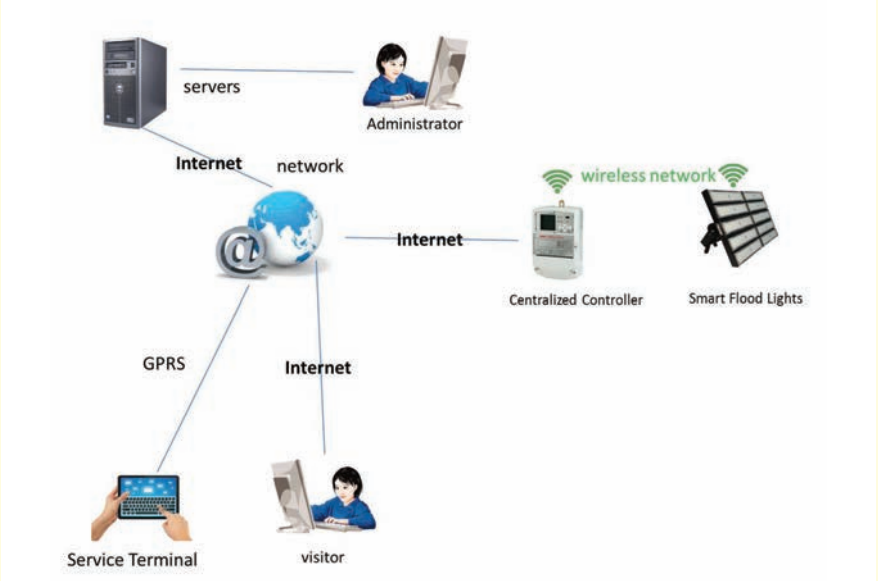
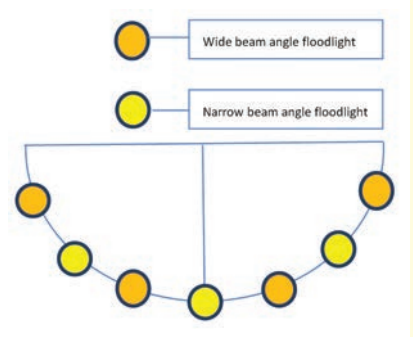
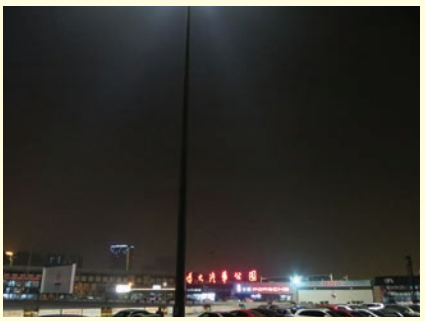


Diagram 2. BiNY's Lighting Control Part 2



Lighting array of smart LED flood light atop the mast

A High Mast at a car racing park



Illumination at night

*International standard 1 kWh saved equals the conservation of 0.3619 kgce or the reduction of 109,590kg carbon emission

The comparison outlines the great advantages of smart high-wattage LED luminaires with regards to both economy and environmental benefits.

Summary

The conditions are ripe for the utilisation of smart high-wattage LED floodlights for high masts at ports and terminals. As the leading VSL Lighting solution provider, we hope to continue our worldwide aim of providing port operators with BiNY's smart LED high-wattage floodlights and further lighting control technology.

Distance	1M	2M	3m	4M	5M	6M	7M	8M	9M
Lux	14.10	15.20	16.50	18.20	20.40	22.10	26.00	32.70	40.60
Distance	10M	20M	30m	40M	50M	60M	70M	80M	90M
Lux	46.20	47.40	39.50	24.00	16.80	12.60	10.70	8.60	7.50
Distance	100M	110M	120m	130M	140M	150M	160M	170M	180M
Lux	6.40	6.00	5.70	5.00	4.87	3.95	3.66	3.00	2.90
	Maximum	47.40	Minimum	2.90	Average	17.06		Uniformity	0.17

Table 1. Measured average lux value over three years

*The distance above is the actual length from the measured point to the center point of the high mast base.

S/N	Lighting	Initial Investment	Rehabilitation Costing within 5 years (USD)	Total Input for an Operation Period of 5 Years (USD)	Capital Saved (USD/year)	Investment Recovery Period (years)	Recovery Period of Extra Procurement on LED (years)
1	Sodium Vapor Floodlight	$1,021,248.00	$520,836.48	$1,542,084.48	/	/	/
2	Smart LED Floodlight	$1,379,000.00	$0.00	$1,379,000.00	$295,531.52	4.7	1.2

Table 2. Theoretically Total Input and Investment Recovery Period for an Operation Period of 5 Years

*Electricity tariff per unit is 0.1577 USD/kWh.

*Only procurement expenditure is included while labor costing and others are not covered.

*The return of energy conserved by dimming during the operation of high mast lighting has not taken into consideration.

Yangshan Deep Water Terminal Phase IV, Shanghai Port (October 2015).

S/N	Lighting	Electricity Consumed (kWh)	SCE* Consumed (ton)	CO2 Emissions (ton)	SCE Saved (ton)	CO2 Emissions Reduced (ton)
1	Sodium Vapor Floodlight	3,535,974.00	1,279,669.00	3,390,999.00	/	/
2	Smart LED Floodlight	1,660,750.00	601,025.43	1,592,659.25	678,643.57	1,798,339.82

Table 3. Theoretically Annual Energy Conserved or Carbon Emissions Reduced

*The calculation is subject to 13 hours per day and 365 days of a year. SCE denotes Standard Coal Equivalent.

*International standard 1 kWh saved equals the conservation of 0.3619 kgce or the reduction of 109590 kg carbon emission.

About the authors

Jimmy Zhang is a Senior Lighting Technician and has been serving in the field of LED's for 10 years. He has a sharp insight and distinctive grasp of leading-edge technology in electronic, optical, thermal and mechanical sectors.

Barry Cai is a Senior Thermal Technician majoring in Thermal Engineering. He has perfectly combined thermal management with electronics regarding the research and development of smart high-wattage LED luminaires.

Jacy Zhou is a Senior Optical Technician and takes charge of the optical design team for the next generation smart LED high-wattage luminaire with decisive contributions and unparalleled innovation.

About the organisation

BiNY is one of the leading overall solutions providers of VLS lighting and is based in Shanghai, China. It makes high-masts, next generation raising and lowering systems for high masts, smart high-wattage LED luminaries as well as specialised lighting control developed for operators of port, airport, and other VLS projects.

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Security, Surveillance and Detection

"The ingenuity of thieves has always surprised unsuspecting victims. The stakes are high and it is clear that the international supply chain is being targeted in order to fulfil trafficking of people and drugs, as well as other illegal trades."

Peregrine Storrs-Fox of TT Club in 'Mega-terminal security: the growing threat of cybercrime', page 108

Mega-terminal security: the growing threat of cybercrime

Peregrine Storrs-Fox, *Risk Management Director, TT Club, London, UK*

Container shipping is, some half century after inception, remarkably resilient and successful in operational terms. Mankind, particularly in the developed world, takes it for granted that it is possible to buy exotic fresh produce that has travelled weeks from another continent, or pick up a bargain in latest electronic gadgetry that is most likely to have been manufactured thousands of miles from the consumer.

In order to achieve such freedom of freight movement, shipping companies have had to lower their costs continually, a major consequence of which is a massive growth in containership size. By 2017 the standard size of ships on the Asia-Europe trade is likely to be nearing 20,000TEU, the so-called 'ULCCs'.

The success of the container as a means of freight transport and the increasing size of ships means port terminals are handling 'lumpier' volumes and coping with larger dimensions of ships at their berths. Of course not all trades will see the largest ships and the majority of the world's ports can't accommodate them. These leviathans will only be employed on the main east-west Asia-Europe trade. However, as shipping lines seek to gain the effects of economies of scale across all the trades in which they operate, and employ ships displaced by the ULCCs effectively, they will 'cascade' their assets on to trades with smaller volumes of cargo. Therefore all ports and terminals are likely to experience an increase in ship size (if not necessarily the largest) and the consequent increase in volume throughput per ship call.

Risk factor of growth

With this growth in business and the operational pressures that attend it comes greater exposure to criminal intent. Technological advances in terms of handling equipment and IT processing undoubtedly provide greater operational efficiencies and, to a degree, opportunities for terminal operators to mitigate their exposure to theft and fraud. Unfortunately, TT Club has also identified technological advances and increased opportunities benefiting organised criminal organisations. Invasive cyber-technology is becoming more widely available and a greater risk to legitimate trade, exposing terminals to economic and commercial damage.

The ingenuity of thieves and fraudsters has always surprised unsuspecting victims. The stakes are high and it is clear that the international supply chain, which by its nature facilitates movements across borders, is being targeted in order to fulfil trafficking of people and drugs, as well as other illegal trades such as dumping waste and intercepting valuable cargoes. Ports are necessarily a focal point for such activity.

The modern thief

The modus operandi of the modern 'cyber-thief' is now going beyond simply misleading terminals into thinking they are dealing with a legitimate company. It has been established that cyber criminals may now access and take control of operators' IT systems, extracting or manipulating valuable data.

TT Club have identified a number of incidents which at first appear to be a petty break-ins at office facilities. The damage appears minimal – nothing is physically removed. More thorough post incident investigations reveal that the 'thieves' were actually installing spyware within the IT network of the operator. More typically, criminals identify targets (generally individuals) where the system cybersecurity is inadequate, making operational executives who travel extensively particularly exposed.

The type of information being sought and extracted may be release codes for containers from terminal facilities. However, spyware can record transactions, key strokes, and even download and print documents and screen shots to an external source. In the instances discovered to date, cyber criminals have been focused on specific individual containers, taking steps to track the units through the supply chain to the destination discharge port. Once the container has arrived, the perpetrators intervene, collecting the required release data from the unsuspecting operator's IT systems, ultimately facilitating the release of the container into their custody and control. The incidents to date are thought to have been related to drug trafficking, a means of importing illegal substances through the supply chain unnoticed.

Freely accessible applications can allow criminal organisations to ring fence and pin-point individuals posting items such as tweets, photographs and location information to the internet through social media sites with mobile devices.

Whilst it appears benign, such data in the wrong hands can be very valuable and quickly affords organised criminals sufficient information to track patterns, such as at what time an individual is at work or home. The principle being that, if a criminal organisation wishes to gain information or access to a particular business by exploiting a potentially vulnerable employee, they are able to build a profile of employees who may be posting information to the internet from a particular business, department or building.

Cyber-criminals' ability to hack into email accounts and communication channels is well-established, and the risks to the terminal operator must not be

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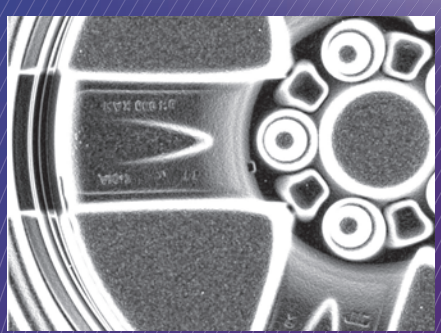

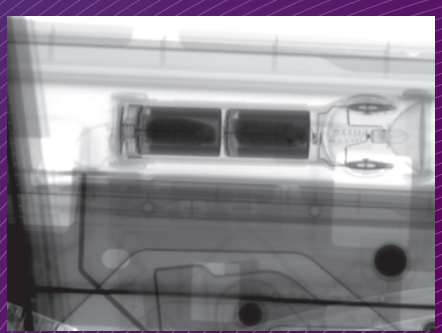

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ignored. For instance, if a driver received instructions to pick-up a container from the port terminal but subsequently is sent information, from what appears to be a known and trusted source from within their own organisation, to deliver to a different warehouse destination, would they have concern to question it? Similarly, by accessing a terminal's yard management system, a criminal organisation can achieve its ends by altering the logical versus actual container location within a terminal.

Defensive action

The ensuing losses of cybercrime can give rise to very large financial exposures, let alone the commercial and reputational damage. The increased sophistication of such 'cyber-attack' makes it challenging for operators to build effective defences. However, awareness is the first step, followed by thorough risk assessment.

Boards and managements need to articulate a clear risk culture and deliberately follow through the security process. In many cases, the human element is both the strongest and weakest link in the armoury. Education is vital to success, making individuals across all disciplines of the organisation aware of the threat and aware of the risk management policies implemented to defend an organisation from such threats.

In many ways, the source of the threat emanates from an organisation's culture. The potential for individual or contractor malfeasance may be thoroughly mitigated by others' alertness, thorough training and effective procedures (such as segregation of duties and 'whistle-blowing').

Vigilance and due diligence in day-to-day operations – the more physical side – are clearly vital, together with general security of IT installations. However, it would also be wise for operators to investigate the means of a greater degree of protection from, and detection of, hacking and spyware activity.

A well informed and transparent relationship between risk management teams and IT departments within an organisation is of paramount importance. Often there is a breakdown in cohesion between such departments, with the IT department considered merely as a service provider to the operational element of the business. Where the continued effective management of cybersecurity is concerned, both must be seamlessly aligned in order to succeed.

In terms of a real threat to a business, cybercrime is still often low on the agenda and mitigation very much in its infancy. The key risk is perceived by many as being a potential high level shut down or hacking event, however where there is a targeted effort, simple extraction of much less obvious data, such as release codes for containers at a terminal facility, can have dramatic consequences.

About the author

Peregrine read Law at Southampton University, specialising in the law of carriage and international trade. He has been with the TT Club since 1984, firstly handling claims and providing advice to all types of transport and port until the late 1990s when he was directing claims operations worldwide for the Club. Since 2002, Peregrine has led the TT Club's internal risk management framework as well as directing its loss prevention services to members. In this role he is responsible for the Club's publications and briefings on many operational issues and handbooks.

About the organisation

TT CLUB
established expertise

The TT Club is the international transport and logistics industry's leading provider of insurance and related risk management services. As a mutual insurer, the TT Club exists to provide its policyholders with benefits, which include specialist underwriting expertise, a world-wide office network providing claims management services, and first class risk management and loss prevention advice. Customers include some of the world's largest shipping lines, busiest ports, biggest freight forwarders and cargo handling terminals, to companies operating on a smaller scale but whose operations face similar risks. TT Club specialises in the insurance of Intermodal Operators, NVOCs, Freight Forwarders, Logistics Operators, Marine Terminals, Stevedores, Port Authorities and Ship Operators. The TT Club is managed by Thomas Miller.

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L-3: protecting commerce intelligently

Paul Simpson, *General Manager: Cargo Systems, L-3 Security & Detection Systems, Massachusetts, USA*

Our economic security depends on companies and individuals having access to a safe, secure and efficient global supply chain. The likelihood of disruption increases, as does the risk to economic security, when the global supply chain grows in complexity.

Cargo security professionals face the challenge of keeping their countries safe and keeping up with the demands of today's commercial expectations. These professionals are constantly challenged to improve safety and efficiency, while reducing costs. Minimising the impact on the flow of commerce continues to be a daunting goal in today's security environment.

Over the past 15 years, government and private industry have made substantial investments in cargo security infrastructure. However, most of this infrastructure remains largely unconnected. The result is a number of missed opportunities that put economic security at risk. This lack of connectivity stems from the way this infrastructure was initially purchased: each new technology and system was thought of as independent and procured to solve a specific problem. This pattern of procurement resulted in a patchwork of detection technologies and software systems from many different manufacturers, and each technology was delivered with its own software and operational concerns. Operators had to be trained on how to use the different equipment and their different interfaces, which led to a breakdown in most effectively leveraging the very systems designed to keep us safe. We put the full burden of sorting information, identifying issues, and determining the correct course of action squarely on those operators, who were clearly at a disadvantage.

Looking at the big picture

A customs organisation has to look at the bigger picture of national security. When different points of entry have different strengths and weaknesses, national oversight is put at risk. It is the duty of a customs organisation to address each weak point. Appropriate high levels of scrutiny are necessary at each entry point to ensure the safety of the country. Potential dangers that are undocumented must not be allowed to penetrate a country's borders. But we also need to be mindful of the risk of interrupting legitimate commerce.

Existing non-intrusive inspection (NII) technologies have been deployed for more than 15 years. Each NII technology has its own unique algorithms and capabilities. However, an NII technology deployed in 2005 will not provide operators with the same imaging performance as a similar NII system deployed in 2013. Resources need to be fluid and adaptable for an operation to properly respond to changing requirements, which could be due to anything from a catastrophic event to short- or medium-term traffic demands.

The networking solution

L-3 Security & Detection Systems (L-3 SDS) developed the ClearView™ software solution specifically for port, border and other security applications. ClearView allows customs and security operations to leverage their existing infrastructure, increase efficiency, lower resource costs and extend the useful life of diverse multi-vendor legacy screening systems.

The ClearView software solution is both networkable and scalable. Imagine all points of entry linked to a central command. This central command has oversight and recall capabilities. It can either assist with the decision-making process, or can serve as a pool of additional resources to be called upon to assist in image interpretation efforts when satellite locations are understaffed or running at peak hours.

ClearView ensures that all raw data collected by multiple deployed assets, regardless of the manufacturer or year, is filtered through the same industry-leading features and algorithms, as well as the same interface. This ensures that consistent, actionable information is presented to the people making critical decisions.

Instead of looking at the infrastructure as a patchwork of standalone detection technologies from multiple suppliers, we need to look at it as a series of resources in which sensors upload important data to a larger network so that trained professionals can take appropriate action in a timely manner based on the information available to them. This larger network ensures accessibility and enables efficiencies. It also connects people, providing valuable insight shared by users and supervisors or from organisation to organisation. The ClearView networking software solution brings all relevant pieces of information into the same interface so that an operator can make informed decisions.

Networking technology is essential to getting the most out of the resources already deployed. Adding either a wired or wireless connection allows data to be collected, managed and distributed. Once all the sensors are connected, the next step is to display the resulting data in a coherent and organised fashion. In a networked environment, data can be viewed on any number of devices, such as desktops, laptops, tablets or smartphones.

Using a networked solution, the power of many different sensors is available to aid

SECURE COMMERCE.
CONNECTED.

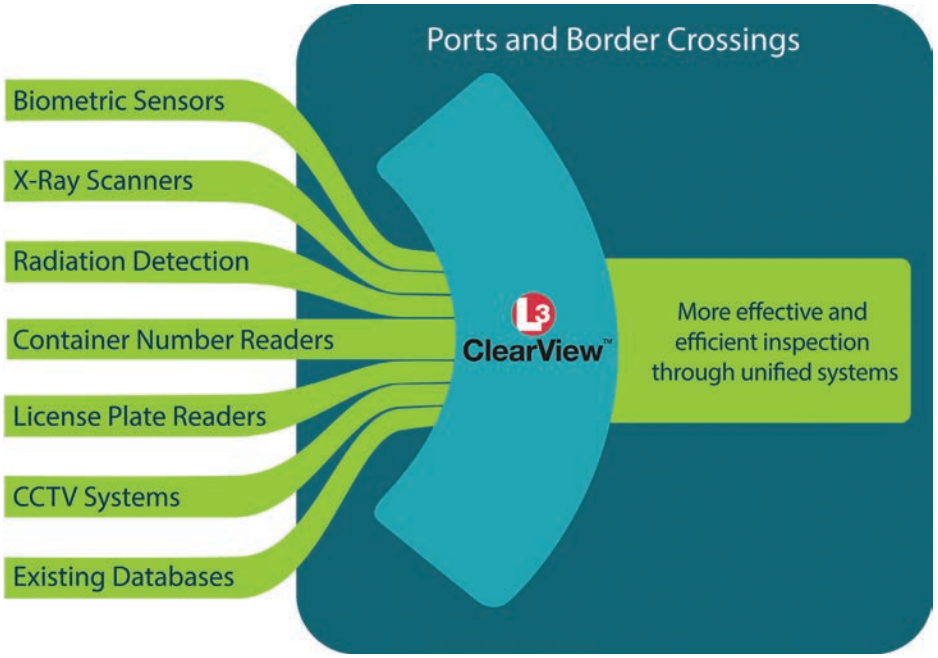
Integrate and Optimize Cargo Screening Operations With ClearView™.

L-3's ClearView software solution brings new value-added capabilities to customs and security operations, delivering maximum efficiency, lower resource costs and support for diverse multi-vendor legacy NII systems. Operating in a secure, broad enterprise network environment, ClearView seamlessly combines image analysis, system operations and data from all scanning systems onto a single, centralized display. This collaborative detection capability yields higher throughput, greater operational efficiency and increased probability of detection. Our team is ready to do for you what we're already delivering for customers globally.

For more information, please visit L-3com.com/sds.

Security & Detection Systems

L-3com.com



in inspection through a unified system. As shown in the image, ClearView connects all methods of detection and identification, leading to a streamlined, unified solution.

Benefits of networking

A networked solution drives efficiency among customs officials. When all members of the team are working with the same information, tasks get accomplished with greater effectiveness. Having a connected system lends itself to a baseline level of scrutiny, where each possible threat is treated to the same rigorous evaluation. In short, connecting all facets of the screening process gives customs operators the ability to be completely vigilant regarding potential threats, while not impeding the flow of commerce.

A flexible architecture offers a number of advantages over existing standalone inspection systems, including:

- Workload leveling – inspectors can be shared between scanning systems without having to be located at the system
- Simplified training – a common imaging workstation is used for all equipment, allowing inspectors to analyse images from any system without requiring additional vendor-specific training
- Enhanced probability of detection – ability to develop algorithms specific to the customer and for deployment enterprise-wide
- Enhanced probability of detection – allows threat intelligence to be shared between analysts at different locations
- Regional management of inspection assets – command center monitoring of usage, staffing, maintenance cycles and direct video chat over a secure network with assets located anywhere on the network
- Continuous improvement – applies Big Data techniques and metrics to improve the process and direct training
- Scalability and workload leveling – the number of inspections drives the image analyst resource requirement
- Human performance improvements – computer-based training
- Increased system availability – enterprise-wide system health monitoring

Actionable information

ClearView is a scalable platform of secure, networked applications that optimises access to information across multiple NII technologies, including cargo scanners, radiation portals, baggage scanners, hand-carry X-ray systems and CCTV equipment – all accessed from centralised command centers. ClearView enhances overall security by providing a comprehensive means to access data from multiple sensor types and locations from a single command center using a common interface.

In 2014, L-3 SDS supplied the Port of Rotterdam with a networked hardware and software solution that permits a unified and customised view of the critical information analysts need to assess cargo contents. Key to the installation was the implementation of L-3's ClearView software solution. The workflow automation software tracks container status and disposition to optimise scanning systems utilisation and analyst resources. Analysts are able to quickly view enhanced Big Data provided with any container scan taken from trucks, automated guided vehicles (AGVs) and rail cars. All incoming and outgoing cargo scan data is subject to review by analysts. Using only ClearView Enterprise software, images are displayed from any location, local and/or remote, seamlessly integrating data from multiple sensors, including those from other vendors. The benefits of this common user interface for all systems have shown greater operational efficiency, higher throughput and increased probability of detection.

About the author

Paul Simpson holds the position of Vice President and General Manager of the Cargo Solutions business at L-3 Security & Detection Systems. He has held a variety of senior positions in management and international business development in the defence, aerospace and security sectors. Mr Simpson received a Bachelor of Science degree from Heriot-Watt University in Edinburgh, Scotland.

About the organisation

Security & Detection Systems

With more than 50,000 systems deployed and supported around the globe, L-3 Security & Detection Systems (L-3 SDS) is a leading supplier of security screening solutions. For over 30 years, L-3 SDS has developed and manufactured cutting-edge products using advanced technologies that include advanced networking; 3-D computed tomography; automated, conventional and high-energy X-ray; radiation detection; active millimeter wave imaging; metal detection; and energetic trace explosives detection. Applications include the screening of people, vehicles, baggage, cargo and packages for explosives, firearms, drugs, contraband and corporate assets.

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VTS, Navigation, Mooring and Berthing

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Automatic upgrades: accommodating mega-ships


Richard Hepworth, *President, Trelleborg Marine Systems, Dubai, UAE, and;*
Francisco Esteban Lefler, *Chairman of MarCom, PIANC, Madrid, Spain*

Trelleborg's brand new Barometer Report found that 29% of those surveyed feel the industry is lagging behind when it comes to implementing upgrades to port infrastructure to accommodate increasing vessel sizes.

Trelleborg has surveyed the marine industry for its annual Barometer Report since 2010 to examine challenges, opportunities and key issues that the industry is facing, and how they evolve year to year. This year, the report takes a look back over the last five years since 2010 to see how attitudes to investment, maintenance and quality have changed over time.

The report, which calls on the views and experiences of 200 port owners, operators, contractors and consultants revealed that over half (54%) of the respondents did not think port infrastructure is adequate to keep up with the onwards logistics requirements of increased vessel sizes and their capacities.

This paper aims to ascertain whether upgrades to port infrastructure are being implemented quickly enough, and how existing technologies can be used more effectively to realise efficiency improvements.

A demanding environment

Ever growing vessel sizes bring with them a whole host of new considerations for ports, not least upgrading infrastructure to allow them to berth. Onwards logistics bring about their own set of problems: demands are growing on both the land and jetty sides.

At the same time, the economic downturn of the last few years led us to a point where the industry is suffering many and varied challenges, driven by historic underinvestment, increasingly diverse demand, increasing vessel sizes and stringent environmental regulations.

With so much to consider, ports and terminals need to look for new and innovative ways to accommodate the new breed of mega-ships, so that terminals themselves can harness and enjoy the benefits of increased throughput rather than being hamstrung by it.

Technology and collaboration play an even more crucial role than they have in the past, becoming increasingly important because of the changing economic, environmental and engineering landscape, and the role they can play in ensuring ports and terminals adapt to it.

Time for a smarter approach

Whilst respondents to the Barometer Report are split on whether current hinterland infrastructure can keep up with increased throughput, this is one area where facilities cannot afford to become complacent.

To tackle this, there needs to be a renewed focus on collaboration and communication across the whole supply chain, to enable the next round of mega-ships to bring with them the economies of scale they were intended to.

A smarter, holistic approach to new technology, as well as a more cohesive and integrated supply chain, where information is shared and made available to inform strategic decision making, will mean better port performance, and benefit stakeholders across the board.

Automated technologies

Much lauded and frequently reported, ports are looking increasingly towards automated technologies. On the land side, automated cargo handling equipment helps to ensure efficiency: processing more containers, more quickly and more consistently.

This principle should now extend to the jetty side too, the opportunity to guide vessels in, berth and dispatch them, with the assistance of automation, holds the opportunity to reduce human error and refine scheduling, ultimately increasing terminal efficiency and improving performance.

It is positive that the Barometer Report found that 75% of respondents are open to new technologies, this exhibits a willingness to adapt and improve in the industry. The industry is beginning to look forward and embrace new trends.

Data gathering

As equipment has become more intelligent, so must the way we use it and this presents a huge opportunity for the industry. You cannot optimise what you don't measure: the monitoring and analysis of existing equipment has as such become essential to competitive differentiation.

There is more data at our fingertips than ever. Training within facilities and sharing information and best practices through the supply chain is critical to creating effective operations.

Informing strategic decision making

Whilst many ports and terminals have extensive IT systems in place, they are not necessarily utilising them effectively. Data may be around, but it must be in a standardised, useful format, and ready to inform strategic decision making when it is needed.

Whilst we have the technologies available to us to gather reams of data, there is one essential ingredient that can't be overlooked – the human factor. How data is taken, analysed and actioned and what are the best practices in a new, data-driven terminal? This is where the great work that PIANC does plays such a vital role – in determining and sharing best practice.

Best practice from PIANC

PIANC brings together in its Commissions and Working Groups the best worldwide experts to share their knowledge and expertise. By means of their technical reports, PIANC provides expert guidance, state of the

art information and recommendations on good practice. Working Groups are dedicated to relevant up-to-date topics, proposed by PIANC National Sections and members.

PIANC Working Groups address present-time topics and several MarCom (Maritime Commission) Groups are related to the integration of new technologies and facing new challenges derived from the new trends in maritime transport in planning design, construction and operation of port infrastructure. Examples of topics addressed by ongoing or in formation MarCom Working Groups are: ship handling simulation dedicated to channel and harbour design, upgrade of port berths by increased dredging depth and mooring of large ships at quay walls.

Some PIANC Working Groups require port or terminal data gathering, as challenges are evolving too fast and go beyond usually available published information. A good example is Working Group 145 on Berthing Velocities and Fender Design that gathered real information on berthing velocities for new operating ships. Its outcome will be extremely relevant for the design of fender systems for new fleets. Other ongoing Working Group addressing and up-to-date issue that is performing real data collection is Working Group 159 on Renewables and Energy Efficiency for Maritime Ports and there are more examples.

Information and data collection, sharing and analysis is a fundamental tool for PIANC, fostering the generation of useful knowledge for PIANC members and Port infrastructure stakeholders in general, that results in providing tools for adapting ports to the new challenges. In a way similar to the improvements achieved by Smart Cities with Big Data, sharing and analysing data will allow significant advantages for the port community

Final Thoughts

There is a wealth of information available to port owners and operators, getting hold of it is key to competing in a new, more dynamic, automated port environment. From shipping operator to port owner to consultant to supplier, we need to develop a unified knowledge base that will drive the industry forward.

The latest Barometer Report found that the anticipated boost to budgets revealed in the 2014 is now translating into practice. We have an opportunity, through strategic purchasing, technology optimisation and engagement across the value chain to drive up standards and take a leap forward as an industry. Let's collaborate now to make sure we don't waste it.

About the author

Richard Hepworth is a Chartered Mechanical Engineer, having studied for his degree at the University of Manchester Institute of Science and Technology and now holds the position of Business Unit President for Trelleborg Marine Systems, based in Dubai. Richard has over 20 years' experience working in the offshore and marine construction industry and has held a number of roles both within Trelleborg and other large engineering companies in this sector, covering engineering, project management, sales, business development and general management.

Francisco Esteban Lefler is Master in Civil Engineering by the Polytechnic University of Madrid and Construction and Electricity Engineer by the Army Superior Polytechnic School. Now is Chairman of the Maritime Commission (MarCom) in PIANC, President of the PIANC National Section of Spain and Technical Director in FCC Construccion S.A. Francisco has 35 years' experience in the Military and Civil Administration and in the Private Consultancy and Construction Sector covering Engineering Positions, most of them directly related to Port Infrastructure and participates regularly in Courses, Congresses and Seminars as speaker.

About the organisation

Trelleborg Marine Systems designs, manufactures and installs bespoke fender systems, docking and mooring equipment, oil and gas transfer technology and vessel efficiency technology for marine environments all over the world. Trelleborg works with specifiers on a project by project basis to determine best fit solutions and supply fully integrated systems to fulfil even the most demanding specifications. Whether the project calls for equipment for a single berth, or an entire port, in-house design coupled with manufacturing and installation expertise ensures operational performance is maximised and long term maintenance is minimised – keeping whole life costs low.

PIANC is the World Association for Waterborne Transport Infrastructure. The seat of PIANC is in the General Secretariat, Graaf de Ferraris - 11th Floor - Box 3; 20, Boulevard du Roi Albert II - 1000 BRUSSELS – Belgium. PIANC is formed by national or regional governments and National Sections. PIANC provides expert guidance, recommendations and technical advice by gathering best international experts related to technical, economic and environmental aspects of waterborne transport infrastructure. This is done by means of Technical Reports and Briefs developed by International Commissions and Working Groups.

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3D visualisation: creating an optimal environment

Transas

Over the last decade we have witnessed an important evolution of Vessel Traffic Services technology, as well as related policies. Today, even the smallest ports are equipped with a Vessel Traffic Management System in order to be compliant with existing regulations and run safe and effective navigation practices.

Most of the efforts have been devoted to the development of technologies which are put behind VTS systems, including overall improvements in quality of data presentation, improvement of the radar processing technologies, the way data is distributed and exchanged, integration of the VTS with other national-scale security maritime and intelligence systems like coastal surveillance, global maritime distress safety (GMDSS), and search and rescue (SAR).

One of the recent developments introduced in the VTS technology market has been the 3D VTS application, developed to provide real-time 3-dimensional visualisation of a VTS area. 3D technology is not new in the maritime industry and already widely used in different areas, bringing a unique opportunity for an overall improvement of safety and security in maritime operations. 3D is used today for simulation of any type of maritime or port operation and is becoming fundamental. Therefore the International Maritime Organization (IMO) adopted a resolution according to which the use of simulation for some courses has become mandatory as part of the Standards of Training, Certification and Watchkeeping (STCW) requirement.

This article will demonstrate in more detail how the usage of visual 3D aids helps a VTS operator to be ready to foresee potential dangerous situations and perform more effectively in a job. Furthermore, it will demonstrate how a 3D VTS tool can be valuable in incident investigation and debriefing, as well as in training.

Behind the technology

3D VTS has been originally developed to ensure the display of the full-scale 3-dimensional view of the navigational situation in the VTS operational area. It serves as a visual aid to navigation for VTS operators or supervisors working to provide security in ports, harbours, along rivers, coasts or around offshore renewable energy and oil and gas production installations.

Once a port or an offshore platform is equipped with the VTS system it is then possible to install a 3D VTS, which comes as an additional module to the main Transas Vessel Traffic Management software. 3D VTS receives real-time data from tracking sensors such as radar or an AIS and based on the data received it is able to produce a marine traffic picture in real time.

A VTS operator is able to see the port and its operational areas in 3D using a virtual camera which can be located onboard or onshore. In addition to this, 3D VTS can display routes, zones and other objects of the traditional electronic chart. 3D VTS represents a new generation of decision support tools, providing the “extended reality” for a VTS operator.

Transas 3D VTS is based on the advanced visualisation platform Seagull 6000. It realistically simulates vessels, port areas and its infrastructure in different times of the day, with different weather conditions. A comprehensive simulation library makes it possible to have a full range of 3D scenes and vessel models. The system automatically recognises vessel type using AIS data transmitted by ship and selects the correct vessel model based on these criteria.

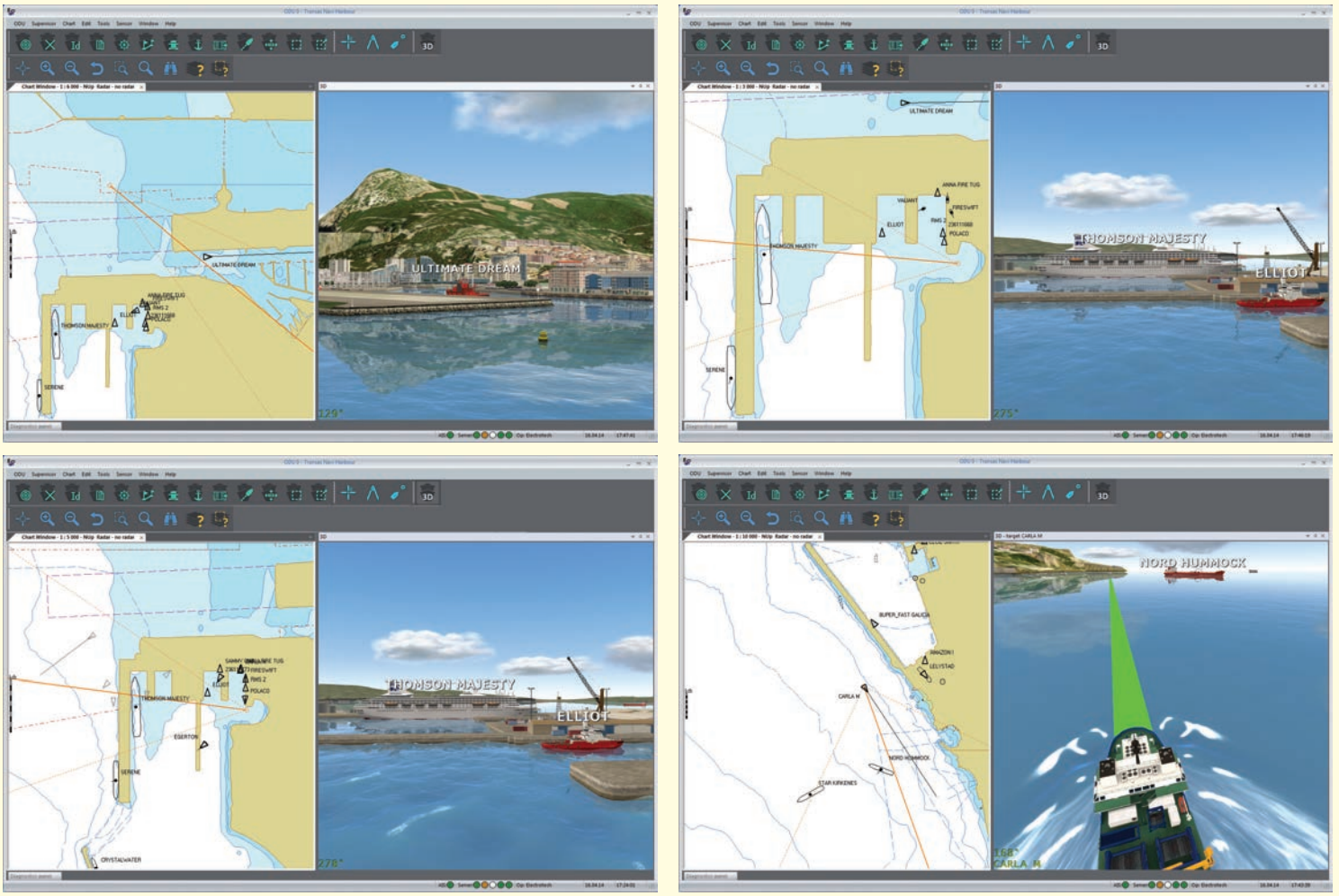
High quality of the visualisation platform enables the provision of maximum accuracy in the graphical representation of the port. Even the moving infrastructure elements are displayed in the real time mode, such as a radar antenna rotating on the top of a control tower. All this creates a realistic and highly accurate environment for a VTS operator.

Virtual shore-side support

3D VTS enhances situational awareness both from ashore and onboard perspectives, especially during pilotage operations, representing the current situation in a port using a virtual camera. This camera can be located at the different points and heights, and move in a particular direction, ensuring greater visibility.

When a vessel is entering a port, a VTS operator can attach the camera to the target and virtually assist onboard during pilotage operations. The view from the bridge will be displayed in the 3D window and will allow a VTS operator to see the overall picture of a manoeuvre as it progresses. Operators can switch between real-time weather conditions or set the weather manually with just a few clicks. It is also possible to change times (day/night/twilight). The view from the bridge will demonstrate on the simulated water the channels’ limits, the vessel heading, restricted areas and other useful navigation information.

In the Vessel Traffic Management Department at the Port of Ilyichevsk, 3D VTS is used not only for monitoring of the navigation situation in the port but also in experimental pilotages in the different weather conditions.



3D VTS is a tool of choice when it comes to analysing any incident relating to the vessel movements happening at a port. It integrates a special recording and playback feature making sure all data is recorded for debriefing. Apart from the 3D scenes, all communications between VTS operators and ship officers are recorded and can be stored for the future analysis.

As with every innovative technology, 3D VTS has several stages until it reaches a full acceptation by the VTS user. The next generations of this advanced module will be continuously improved in terms of new features. If the standard VTS software functionality, such as chart measurements, manoeuvring calculations or prediction tools, can be implemented in 3D, it can further become one of the main decision-making tools, providing a great support to standard 'chart' visualisations of the common VTS picture.

Also one possible way for product evolution could be in integration with the modern underkeel clearance calculation tools. 3D VTS would then be able to display individual no-go areas for vessels, based on the draft and the current water level. Also, an underwater camera would allow users to see real vessel clearance and the locations of underwater objects such as pipelines and cables, protecting them from anchoring vessels.

As a great performance improvement tool, 3D VTS could be developed to become a reliable and intelligent decision support system, which shouldn't only show a potentially dangerous situation, but suggest possible solutions to resolve them with displaying the results in 3D.

Conclusion

In the era of e-navigation technologies, VTS plays a vital role in ensuring streamlined vessel calls and better co-operation between on board and onshore decision-makers. The importance of 3D VTS is becoming increasingly evident as it significantly enhances VTS technology, making the marine traffic picture more accurate and more comprehensive. Real-time graphical representations of vessel movement and a variety of viewpoints allowing a VTS operator to better evaluate the navigation situation and prevent potential collision accidents is only driving the industry forward.

3D VTS provides clearer operational pictures and all in all a user-friendly environment, resulting in less stress and fatigue. 3D VTS can be considered as a significant step in improving the safety and efficiency of the navigation in the VTS operational areas.

About the organisation

Transas offers best-in-class navigation systems and integrated bridge solutions, recognised training and simulation solutions, renowned VTMS and coastal surveillance systems, fleet and port management systems, onboard and individual decision support systems for professional crew and pilots, as well as popular applications for leisure and the marine mass market. Transas operates more than 20 proprietary regional offices as well as its network of partners serving Transas customers globally.

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VTTV Terminal: the new Mediterranean energy hub

Gerrit van der Want, Project Manager,
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In November, 2014, VTT Vasiliko Ltd (VTTV) opened a US$342 million oil storage terminal for business. VTTV is a subsidiary of VTTI B.V., which is an independent provider of energy storage worldwide. The new terminal is located at the south coast of Cyprus, between Larnaca and Limasol. Its strategic location makes it the first terminal of its kind in the Eastern Mediterranean, connecting Europe and the Black Sea with markets in the Middle East and Asia.

The terminal currently comprises 28 tanks and has a capacity of 544,000 metres cubed and offers access to a deep water marine jetty with four berthing positions. The jetty can accommodate tankers from 5,000 DWT to 160,000 DWT. The terminal serves as a hub in the Eastern Mediterranean to capture the flows of middle distillates, gasoline and fuel oil. An expansion of the terminal for crude and fuel oil is currently under evaluation and would create a further capacity of 305,000 metres cubed.

Special features of the terminal

The VTTV terminal is the first terminal where the main marine operations are the responsibility of the terminal. Usually, the marine operation is the responsibility of a port authority. In this case, VTTV had to set up other entities with the purpose to provide such services in order to be better equipped, flexible and competitive. VTTV also had to develop the marine procedures for the terminal and implement these procedures in the operational handbook of the terminal, with the approval of the Cyprus Ports Authority (CPA), the regulatory body and service provider.

Another feature of this terminal is that it is an exposed jetty in an unprotected environment. The jetty stretches out in the Mediterranean Sea and the berthing positions are located at approximately 1,500 metres offshore. Consequently, arriving and moored ships are exposed to wind and waves. In case of extreme weather, vessels cannot come alongside, and moored vessels have to leave the berth. This has an impact on the operational window of the terminal. In order to find a safe balance between safety and commercial benefit, VTTV had to define clear marine operational procedures and limits.

VTTV asked MARIN to assist in setting up the marine procedures for normal operations and emergency situations. The marine procedures had to be approved by the Cyprus Ports Authority before commencing the terminal operation. Furthermore, VTTV asked to set up a training programme to familiarise pilots and tug masters with the situation at the terminal and the procedures.

Approach development nautical procedures

MARIN's Nautical Centre has provided nautical consultancy and training for more than 40 years. MARIN developed the operational procedures for many offloading facilities in exposed areas such as FPSOs. In order to develop the procedures for the VTTV terminal, MARIN carried out a marine study in close cooperation with VTTV.

During the study, VTTV and MARIN organised several workshops with personnel that would be involved in future operations. Furthermore, the CPA attended the workshops because they had to approve the final procedures. During the first workshop the marine operation was analysed and a first draft of the procedures was developed. The second workshop was carried out at a simulator.

During this workshop the proposed procedures were tested and worked out in detail. During the last workshop the final procedures were presented. The advantage of this approach was that it shortened the duration of the study and created commitment of the end-user of the terminal.

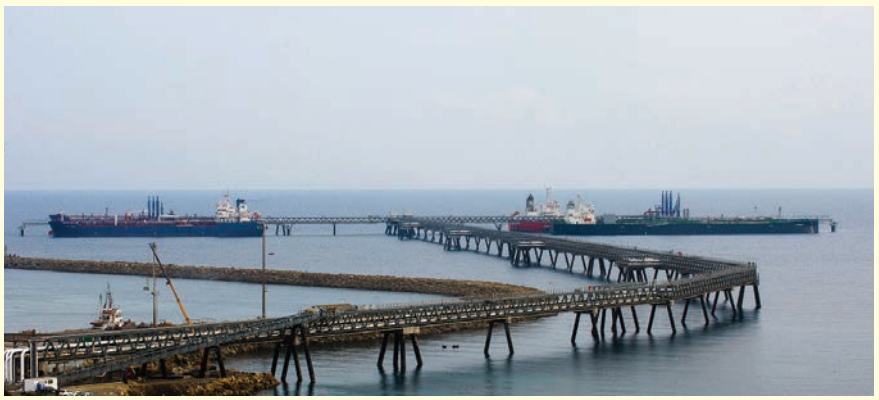
Development marine procedures

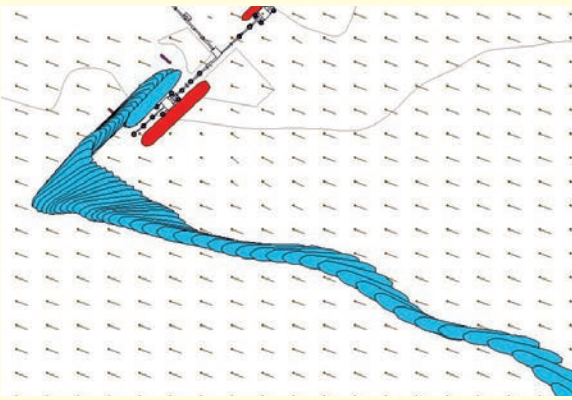
The study started with an analysis of the available data. The results of this were used as input for the first workshop. During this workshop, the following items were discussed:

- The location of the anchorage areas
- Minimum required tug boat power
- Arrival and departure manoeuvring strategy (route and speed) per berth and ship size
- Operational limits for safe arrival and departure (per berth and ship size)
- Procedures in case of an emergency at the terminal or onboard a ship
- Equipment required for a safe operation of the terminal, such as aids to navigation, weather and wave monitoring, berthing assistance tools
- The feasibility of night berthing

After the first workshop, MARIN organised a second workshop on a Real Time Ship manoeuvring simulator. A simulator is a sophisticated and efficient tool to study manoeuvring strategies, tug assistance and operational limits.

Prior to the simulations MARIN prepared a database including a 3D-model of the area and the jetty, ocean conditions (wind, wave and current) and mathematical manoeuvring models of tankers and tugs.





Top: Figure 1 VTTV Terminal; Bottom left: Figure 2 Deep water marine jetty with four vessels alongside; Bottom right: Figure 3 Track plot, showing the position of the vessel every minute

During the simulator workshop, various arrival and departure manoeuvres were executed in varying ocean conditions. Also, some night runs were carried out in order to study the feasibility to receive vessels at night.

Each run was debriefed thoroughly and MARIN also analysed each run numerically. The numerical analysis consisted of an assessment of the controllability of the vessels. The controllability is determined by the control forces applied (engine power, rudder angle and tug power). The numerical analysis gave a quantitative result on whether a manoeuvre is safe or not. The results of the briefings and the numerical analyses were used to determine the final arrival and departure manoeuvring strategy. Figure 3 presents a track plot of the final arrival strategy to one of the berths.

For a safe operation at the VTTV Terminal, it is necessary to have clear operational limits and implement them in the operational handbook. Therefore, the results of the simulations were also used to determine the maximum wind and wave conditions in which vessels can arrive or depart safely. Also, the operational limits of moored vessels were taken into account. In case of extreme weather, moored vessels should leave the jetty in time in order to avoid damage or to avoid a vessel being trapped at the jetty. The latter might be the case when the wind and wave conditions are exceeding the limits for safe tug assistance and tugs cannot assist during the departure.

Finally, the results of the simulations

Top: Figure 4 Tug assistance during simulations; Insert: Figure 5 MARIN's Full-Mission Bridge simulator (left) and tug simulator (right)

were used to determine the required number of tugs and how to use the tugs in the most efficient and safe way, especially close to the jetty. It was concluded that two ASD tugs of 80 tonnes bollard pull are sufficient to keep the vessel under control.

Training of pilots and tug captains

The study was concluded with the training of pilots and tug masters who will be deployed at the terminal. During the training tankers were controlled from MARIN's Full-Mission Bridge (FMB) simulator. The tugs were modelled as free sailing vessels and are controlled from separate tug simulators connected to the FMB.

The participants executed various approach and departure manoeuvres under various environmental conditions during day and night time. Emergency scenarios were also included in the training. The training resulted in an improvement of knowledge of the future situation and an improvement of communication between pilots and tug masters.

Opening of the terminal

Thanks to the close cooperation between VTTV, VTTI B.V and MARIN, the study resulted in clear guidelines for the marine operation of the terminal. VTTV has implemented these guidelines into their terminal procedures. The terminal opened for business in November 2014 and since then more than 100 vessels successfully called at the jetty. The official Inauguration Ceremony of the terminal took place on May 29, 2015, with the President of the Republic of Cyprus, Nicos Anastasiades.

About the author

Gerrit van der Want is working for Marin's Nautical Centre MSCN. Gerrit has a Bachelor degree in Civil Engineering from The Hague University of Applied Sciences. He is a Project Manager and coordinates nautical studies and trainings. He is a member of the International Navigation Association (PIANC)

About the organisation

MARIN, the Maritime Research Institute Netherlands, is a reliable, independent and innovative service provider for the maritime sector. MARIN provides the industry with innovative design solutions and carries out advanced hydrodynamic and nautical research for the benefit of the maritime sector as a whole. MARIN strengthens the link between academic research and market needs.

By feeding back the results of advanced research programmes into commercial projects, MARIN has created a powerful synergy with the maritime industry. Our customers include shipbuilders, fleet owners, navies, terminal operators, naval architects and offshore companies from organisations across the world.

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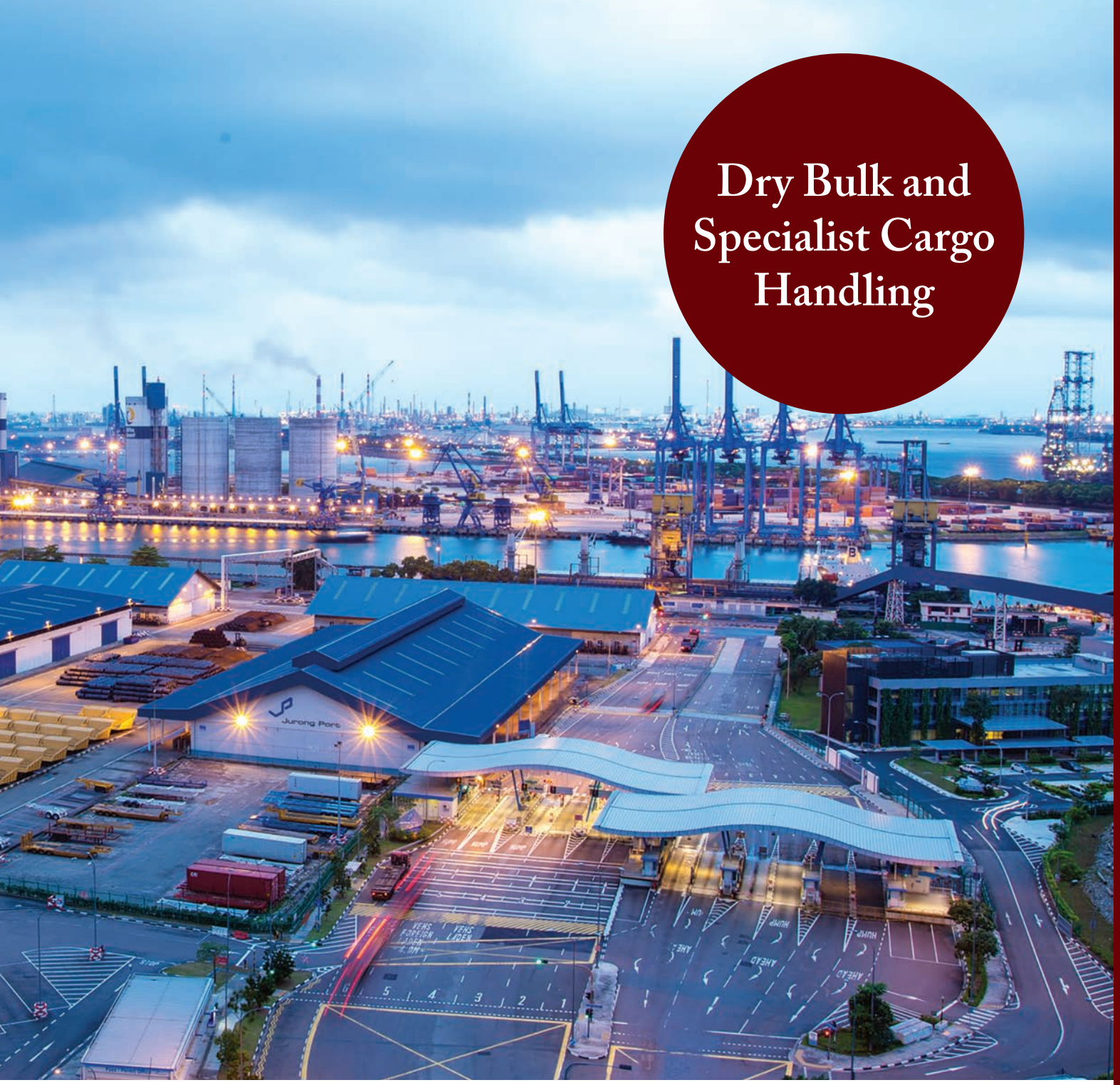

Dry Bulk and Specialist Cargo Handling

"While in the past, Jurong Port has been able to rely on pockets of innovation… we wanted to introduce a more systematic approach towards managing innovation and sustainability in our port processes and have an organisational structure that encourages and embraces such a culture."

Lee Jek Suen in 'Embedding an innovation culture', page 124

Embedding an innovation culture: the journey of Jurong Port

Lee Jek Suen, *Assistant Vice President, Strategic Planning Office, Jurong Port, Singapore*

Headquartered in Singapore, Jurong Port is a multi-purpose port operator that serves as Singapore's main breakbulk and bulk cargo gateway. Our port operating expertise includes the handling of general (breakbulk), bulk and containerised cargo, management of an offshore marine centre which serves as a one-stop dedicated facility for the retrofitting of offshore marine vessels, and operations of lighter terminals that provide vessel provisioning-at-anchor and resupply in Singaporean waters. Jurong Port is also involved in overseas joint ventures in China and Indonesia.

Jurong Port recognised that the key to the continued growth and performance of any port business is in having a strong culture of innovation within the organisation. While in the past, Jurong Port has been able to rely on pockets of innovation within the company, we wanted to introduce a more systematic approach towards managing innovation and sustainability in our port processes and have an organisation structure that encourages and embraces such a culture. The establishment of the Research & Innovation Centre at Jurong Port under the Strategic Planning Office is key to this development.

Our Innovation Journey

Embarking

In 2011, Jurong Port, together with other maritime partners in Singapore, launched the Green Port and Productivity Solutions (GPPS) Programme, which committed JP to contribute up to US$4.2 million over the next five years towards funding any port technology research, development and test-bedding projects in the areas of green port technologies and productivity solutions.

At the same time, JP has successfully tapped external funding sources such as the Maritime Innovation & Technology (MINT) Fund, intended to promote research and development, and the innovative use of technology in Singapore's maritime industry. The GPPS programme is led by the Maritime & Port Authority of Singapore. This was followed by the establishment of a Research and Innovation Centre (RIC) by Jurong Port to drive our Innovation Strategy. Within a short period of time, a charter for RIC was jointly developed with Accenture as our partner who advised us based on their cross-industry experience in introducing innovation in other leading companies. This enabled RIC to quickly build up a robust strategy and set of implementation plans that will deliver results quickly.

In the initial phase, RIC worked closely with management to identify and commit resources into several priority initiatives that will transform key business processes in (1) Bulk and Breakbulk Cargo Handling, (2) Gate Operations and (3) Customer Experience. RIC has now entered its second year of operations, and the priority initiatives have undergone an annual management review to re-establish their relevance according to the progress that has been made. Concurrently, the team has created internal publicity programmes to generate greater awareness across the company about the efforts being made in related maritime and other industries, as well as across different departments within the company, in order to reinforce a culture of innovation at Jurong Port by encouraging out-of-the-box thinking.

This two-prong approach is part of a systematic drive to ensure that innovation efforts can result in the delivery of a set of concrete programmes that are able to address the correct business and operational challenges, as well as create the correct mindset, without losing momentum. At the same time, Jurong Port wanted a lean set-up with a young team in place in order for RIC to remain nimble, receptive and dynamic. Eventually, JP wants to evolve the innovation culture towards a "top down-bottom up" organisational culture where there is a keen sense of ownership to innovate, at all levels of the company.

Enabling structures

Jurong Port identified three fundamental areas where we wanted to see greater focus: (1) productivity, (2) customer value and (3) industry benchmarking of bulk and breakbulk handling. RIC's review of our organisational structure suggested that we had to establish several enablers in order to bring about more fundamental change. Some of the key enablers that were put in place included:

1. Establishing tie-ups with external research, maritime and logistics think-tanks, as well as other innovative ports in order to provide an "outside-in" perspective. Tap on national funding that is available for innovation and productivity programmes. By being the interface between the external parties with JP, RIC ensures that such tie-ups serve JP's strategic goals
2. Establishing a dedicated operations analysis team that is able to competently perform data-mining in-house, and combine the analysis with operational competencies in order to drive productivity initiatives in various facets of cargo handling operations, vessel and berthing management etc. This ensures that knowledge is built-up within the organisation and that productivity initiatives are driven closely by operational needs rather than innovation for innovation's sake
3. Establish cross-functional teams

to ensure that more complex innovative projects are managed and delivered with the correct skill sets and within schedule. Performance in these teams become part of the individual performance appraisal process. Structurally, project leaders, project sponsors reporting to steering committees ensure that leadership emphasis and consultation remains in place. RIC participates in these cross-functional teams in order to ensure that momentum is maintained and as a member of the teams, remains accountable for delivering results.

Engagement

With the right structures in place, RIC set about to create a series of employee engagement initiatives to change the employee experience about innovation in Jurong Port. Bi-monthly Innovation Lunch and learn sharing sessions are now a regular feature at Jurong port where external guest speakers share their experience with participants in their innovation journey, and how leading organisations have encouraged collaboration in different industries. Newsletters focusing on innovation also feature segments contributed by staff and customers on innovative thinking, examples and news from the maritime and port industry. At the same time, innovation events are organised to encourage participation and reward innovative behaviour through events such as personal and operational equipment customisation and design competitions. In the next phase of engagement, it is envisaged that some of these existing programmes will have to be expanded and evolve in several ways, of which two key developments needs to be addressed:

- Widen participation to include more stakeholders from the port user community, as there is scope for innovative collaboration across the value-chain
- Refresh the corporate experience and port environment so that it incorporates the expectations and interests of the millennials, who are entering the workforce and will be the future core of the port and maritime industry

Strategy, planning and management

Besides engagement programmes, RIC has undertaken and coordinated efforts towards several priority initiatives to see how port productivity and the customer experience can be improved. After identifying the productivity and process bottlenecks or inefficiencies, a set of initiatives were rolled-out and worked through with management during steering committee meetings and leadership workshops. Some of the initiatives which are ongoing include:

- Development of a multi-year technology roadmap that maps out the various priority technologies that a leading breakbulk and bulk handling port must focus resources on over the next 5 years. Identify the "quick-win" technologies that require less customisation and commit teams to address and evaluate their suitability for rapid adoption, while less mature but interesting technologies will require the build-up of expertise and further engagement with specialised vendors. Some examples of possible port technologies in a breakbulk/bulk handling environment include specialised breakbulk handling equipment, automated guided vehicles (AGVs) and increased use of automation in bulk handling
- Collaboration with the maritime research think-tanks to conduct research that will provide deeper insight from data mining, modelling and simulation in terms of port traffic and commodity demand
- Benchmarks – review and incorporation of new or adjusted KPIs in the light of new insights derived from data-mining efforts
- Re-examination of the customer experience and touchpoints with the port given the myriad of cumulative changes in the breakbulk and bulk business, customer profile, market and port operations, and how it requires a whole-of-company response in terms of branding, commercial-orientation and marketing collaterals

Reflecting

Over a period of twelve months since the operationalisation of various initiatives, Jurong Port has successfully built up several in-house capabilities to sustain the drive towards greater innovation. At the same time, any innovation journey has to be watchful of pitfalls and challenges. The challenging outlook of the commodity cycle and global economy may test the resolve of innovators, if it increases reluctance to invest in new and innovative technologies and methods. Another pitfall is a tendency to look for innovative solutions where the inefficiencies may have resulted from more basic issues such as operator proficiency or performance. The third challenge is to manage the transitioning of an innovation from a curiosity towards widespread adoption. One perceived challenge – the lack of good ideas - which we imagined could have tripped us up, never did occur, much to our surprise.

About the author

Jek Suen heads the Strategic Planning Office which oversees the Research & Innovation Centre, Strategic Planning, and, Corporation Relations & Communications functions at Jurong Port. He has more than 10 years of experience in various roles such as port operations, business and corporate development in the industry, having started at Singapore-based Portek International in 2006. Before he joined the private sector, he served in the Singapore navy as captain of a naval vessel and was also part of the strategic planning & transformation office in the armed forces. He is a graduate of Oxford University with a degree in Philosophy, Politics & Economics (PPE) and holds a Masters from the London School of Economics (LSE).

About the organisation

Headquartered in Singapore, Jurong Port is a leading international multi-purpose port operator handling general, bulk and containerised cargo. Jurong Port began operations in 1965 as a general and bulk cargo port, serving the development needs of Singapore's Jurong industrial estate. Today, its main gateway terminal in Singapore welcomes more than 15,000 vessels each year from both the region and internationally. The main terminal has 32 berths capable of serving the varied needs of the maritime industry. Its berths, with drafts ranging from 2.2 to 15.7 metres, can accommodate vessels of up to 150,000 deadweight tonnes. Within the terminal, there are 174,000 square metres of warehouse facilities and one of the largest common-user cement terminals in the world.

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Humber International Terminal: a dry bulk powerhouse

Simon Bird, *Director, ABP Humber, Hull, UK*

The Port of Immingham sits on the south bank of the Humber Estuary and forms part of the UK's largest ports complex – and the fourth largest in Europe – which operates on the country's busiest trading gateway, a channel that sees upwards of 30,000 vessel movements every year.

The Humber is very much a working estuary, a 40-mile long expanse of water with its source at Trent Falls and its mouth opening into the North Sea between Spurn Point in East Yorkshire and Donna Nook on the Lincolnshire coast, with tributaries including the Ouse, Trent and the Hull.

The river joins northern Lincolnshire and the East Riding of Yorkshire in trading success, with the four Humber ports of Hull, Goole, Grimsby and Immingham at its centre. This quartet of state-of-the-art facilities pump US$2.2 billion into the regional economy each year, support 23,000 jobs in the area and the Port of Immingham is the powerhouse and a key driver of ABP's success on a national level.

Strategic location

Located eight miles from its sister port of Grimsby to the east, itself famous for links to fishing and food and now a well-established base for the burgeoning offshore wind industry, Immingham is the country's busiest port by tonnage, handling around 50 million tonnes of cargo each year, 20 million tonnes of which is in the form of dry bulks.

Grimsby and Immingham are also a major hub for the short sea car business. Both DFDS and Immingham Container Terminal saw significant increases in unit load traffic from Europe and the Baltic States in 2014 and this trend is continuing.

Coal, ores, grain, fertiliser, road salt and biomass all transit Immingham on a regular basis, along with crude oil, LPG, project cargos including wind turbine components, railway tracks and even the capital's Christmas tree, which comes from Norway via DFDS' Immingham terminal before making its way to Trafalgar Square in London by road. The port also handles vehicles, Ro-Ro/lo-lo and containers.

The Estuary's natural deep water channel swerves towards Immingham from just west of Grimsby. It dictated where the port and the town would be located in 1912, and it's that channel that has allowed the port to develop and grow.

Originally established to handle coal exports, it became clear in the late 1990s that additional berthing capacity was needed in Immingham due to increasing coal imports, and a new facility that would be large enough to accommodate Capesize vessels bringing in excess of 130,000 tonnes over the quayside, was proposed.

Investment for growth

Over $45 million was invested in the development and construction of Immingham's Humber International Terminal (HIT), which was officially opened in the year 2000. The new terminal added a 300 metre berth to the west of the existing Immingham Bulk Terminal, and dredged to a depth of 14.7 metres. An automated conveyor system was installed in 2005 to increase efficiency and allow imported coal a smooth journey from ship to stockyard and onward to the newly constructed rail load out facilities.

The terminal operates a traditional crane/grab system, feeding product onto the open conveyor system via hoppers, to be deposited into the terminal's dedicated stockyard by a fleet of semi-automatic stacker reclaimers. The stockyard can hold up to one million tonnes of coal at any given time and stocks are mapped via GPS to ensure that each customer's product is kept entirely separate from the next. When it's called off and fed into the automated system for transport to the end user, the system ensures the correct pile is identified and the right stock is sent on its onward journey.

By 2003 it had become clear that the country's appetite for coal was still increasing, and Immingham was in need of further dry bulk discharge and handling capacity. Humber International Terminal's second berth (HIT 2) was built at a cost of $90 million and increased HIT's total quay length by a further 220 metres – allowing HIT to handle a Capesize and a Panamax vessels at the same time, on a quay totalling 520 metres in length. By 2012 HIT had celebrated its 100 millionth tonne of cargo.

Since the construction of HIT 1 in 2000, the terminal has seen the discharge of not only coal, but also agribulks, including grain. The terminal has handled the UK's biggest ever single shipments of grain – 50,000 tonnes in 2010 and 66,000 tonnes in 2015, but it's biomass that's now seen as the future for this mega terminal.

Adapting to meet demand

As the UK's energy mix changes to reflect consumers' growing interest in renewable fuel sources, ABP has adapted to meet this need. In 2012 ABP's biggest coal customer, Drax Power Ltd, announced it would be converting three of its units to run on wood pellets following the decision to transform the UK's largest power station into Europe's largest generator of renewable electricity. ABP responded by proposing a dramatic change to its existing facilities at HIT in order to guarantee the long-term future of its most important asset.

ABP worked with Drax to plan a terminal unlike anything seen before. A projected demand for six million tonnes of North American and Canadian wood pellets per year required an innovative solution and the concept of Immingham Renewable Fuels Terminal (IRFT) was born.

Four 25,000 tonne-capacity storage silos have been built using a slip-forming process by GRAHAM Construction. The process saw the silos grow at a rate of three metres every twelve hours and these are connected to HIT 1 via a fully automated system carrying biomass from ship to silo via 1.2 kilometres of covered, over ground conveyors, and from silo to the railway network using an innovative underground conveyor belt feeding the new rail load out, designed to deliver the cargo into rail wagons which take the product straight to Drax's Selby base using the rail network. The $200 million IRFT, which at 65 metres high, dominates the skyline of the port, is the first of its kind in the world and boasts a smaller, sister facility at the port of Hull, which has been designed to handle one million tonnes of biomass per year for Drax, but which is already handling in excess of this.

IRFT: Phase 2

Phase two of IRFT, which has seen four more silos added to the four of phase one, will double the storage capacity of the terminal to 200,000 tonnes when these additional storage giants become operational. As well as providing unrivalled capacity, the system also meets exacting safety standards, with fire suppression, dust extraction and heat monitoring systems, which also extend throughout the facility onto the conveyor system to ensure the transit of this volatile material is as safe as possible. Specialist cleaners make sure the conveyors are kept free of blockages and contaminants, and industrial magnets positioned at strategic points along the conveyor's route are used to pinpoint and remove metal fragments in the product.

To complement the new infrastructure, ABP has also invested $22.7 million in two bespoke Siwertell Continuous Ship Unloaders (CSUs), which were transported up the Estuary by barge to their permanent home on the quayside at HIT 1. The two machines, which are used to discharge biomass vessels, work on the principle of the Archimedes' Screw, drawing the cargo up and onto the conveyor system at a rate of up to 2,400 tonnes per hour, which is almost three times faster than a crane and can make a huge difference to discharge rates in terms of speed and efficiency. The CSU system also reduces spillages and dust.

The HIT/IRFT terminal now boasts state-of-the-art rail loading facilities for both biomass and coal, loading trains with up to 24 x 70 tonne wagons in just 30 minutes and consistently achieving over 80% Right Time Departures from the terminal, which handles up to 36 trains per day. This performance was recognised at the 2015 Rail Freight Group Awards, with Immingham being named Business of the Year.

As if to underline the significance of this critical link in the UK's energy supply chain, HIT 1 recently handled the world's largest single shipment of biomass. Almost 60,000 tonnes of wood pellets were unloaded from the POPI S – the first time such cargo has been carried by a Panamax-class vessel. The ship was loaded at the Westview Terminal in Prince Rupert, British Columbia, before making the 34-day journey to Immingham.

About the author

Simon Bird joined ABP in the role of Director Humber, with responsibility for the ports of Grimsby, Immingham, Hull and Goole. Simon spent the previous 15 years as Chief Executive of the Bristol Port Company, delivering significant improvement in revenue and profit and expanding ports portfolio of customers. Prior to this, Simon held a number of senior roles at the Mersey Docks and Harbour Company, International Water and BAe plc.

About the organisation

ABP ASSOCIATED BRITISH PORTS

ABP is the UK's leading port operator, with a unique network of 21 ports across England, Scotland and Wales. The company's ports include Immingham, the UK's busiest port, and Southampton, the nation's second largest and Europe's most efficient container port, as well as the UK's number one for cars and cruise. The group's other activities include rail terminal operations (Hams Hall Rail Terminal), ship's agency, dredging (UK Dredging Ltd), and marine consultancy (ABPmer). Each port also offers a well-established community of port service providers. In 2014 ABP and its customers handled 94.5 million tonnes of cargo. Together with our customers, we support 84,000 jobs and contribute £5.6 billion to the UK economy every year.

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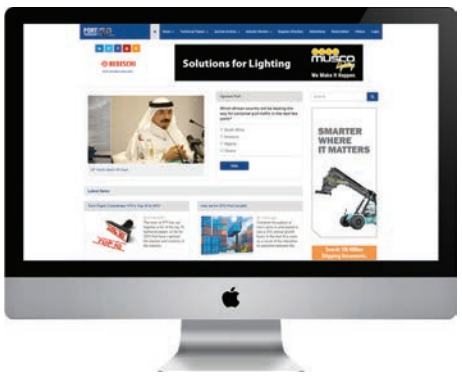

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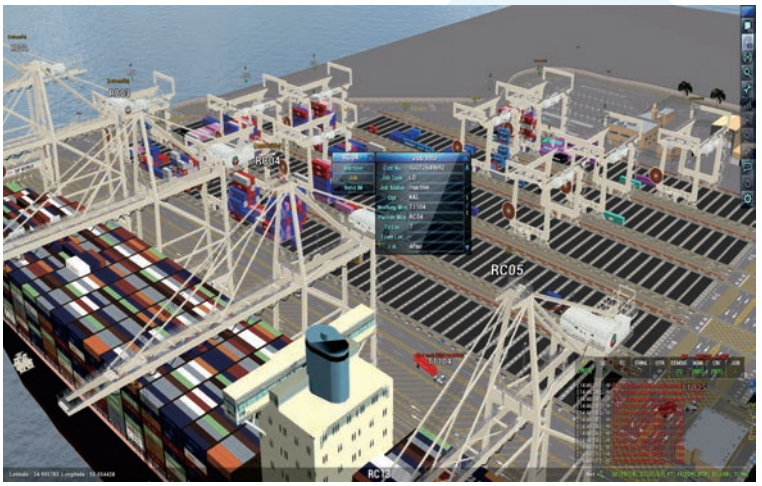



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