Floating a new container terminal concept

A radical proposal has been made for a pure transhipment terminal that, it is claimed, would be capable of turning around a complete 18,000 TEU ship (2 x 18,000 TEU) in just one day

A proposal for floating transhipment terminals to handle ≥ 18,000 TEU container ships has been published by Dr Asaf Ashar, Research Professor with the US National Ports & Waterways Institute, University of New Orleans and also an independent port consultant. The terminal, or pure transhipment port (PTP), is predicated on a transhipment share of total moves of 90% minimum, and probably at least 95%.

Dr Ashar is involved in a consulting capacity to a group considering such a scheme. The group or location has not been named, but one possibility might be somewhere in the Caribbean. A PTP presentation was also made at a special seminar in Algeciras.

The PTP concept was first proposed by Ashar in 1999 as a component of his so-called "fourth revolution" of liner shipping. This was the development of a circular service pattern focused on transhipment hubs in an equatorial round-the-world (ERTW) system.

The hubs would be located at the interstices of east-west and north-south routes of the largest containerships. Ashar estimated that the ERTW system could handle around half the volume of global east-west container trade.

However, he continues, for some time it has been clear that the ERTW system would not materialise. The 2014 expansion of the Panama Canal (NPX) - around 13,000 TEU - was supposed to be the trigger, but the trend in ship size is post-NPX and it may not stop at 18,000 TEU.

Containership generations from PanamaxMax onwards (Dr Asaf Ashar, 2012)

Category	Example	TEU	DWT	Loa x W x D	Under-below-across
PanamaxMax	Zim Savannah	5000	67,000	295 x 32.3 x 13.5	8-6-13
Post I	Rio Negro	5900	74,000	286 x 40 x 13.5	9-5-15
Post II	Maersk S	8000	105,000	347 x 42.8 x 14.5	9-6-18
Post III	New Panamax	13,000	120,000	366 x 49 x 15.2	10-6/19/20
Post IV*	Maersk E	15,000	157,000	397 x 56.4 x 15.5	10-8-22
Post IV*	Maersk EEE	18,000	165,000	400 x 59 x 15.5	10-8-23
Post V	MalaccaMax	30,000	295,000	460 x 63 x 21	12-9-25

* Maersk E and Triple-E are both classified by Post-IV as they are very similar, except that Triple-E has an extra row across and the slower speed allows for the "boxing" of the hull shape

Bi-regional focus

The "revised fourth revolution" is based not on the ERTW system, but on bi-regional shuttle services, which eliminate en route ports of call, as the core service pattern. These shuttle services have gradually been taking over from traditional multi-trade services ("pendulum" services).

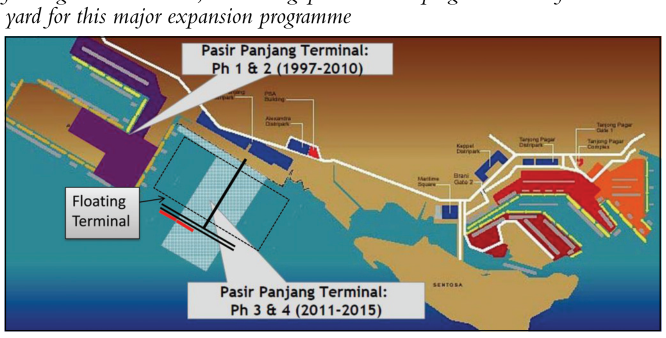
The revised revolution is still designed to exploit fully the hub and spoke system, with mainhaul ships calling only at and fully turned around at PTPs. Hence it is just as dependent as the original fourth revolution on PTPs to handle ships in the 18,000 TEU range efficiently.

Most transhipment currently takes place in terminals designed for gateway traffic. Because of the shortage of waterfront land, they are often created through costly, deep water reclamation. There is a trend towards automated yards, with a key objective being a reduction in overall land take through densification of storage capacity.

Automated terminals are not designed to handle transhipment and in reality, says Ashar, they handle it exactly like gateway traffic - in and out of the stack - so it involves double handling just like in conventional terminals.

Direct ship-to-ship moves are inconceivable, because of the difference in stowage plans and (un)loading sequencing, and in any case the dock area is used exclusively for traffic lanes and no interim buffer storage is allowed.

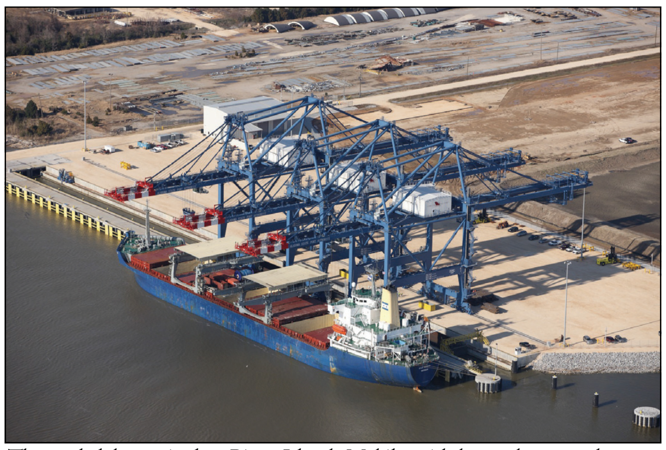
Singapore Pasir Panjang phases III and IV as envisaged by Dr Ashar as a floating PTP. However, PSA Singapore is developing more land for an ASC yard for this major expansion programme



Not so fast

On top of that, automated terminals have relatively low productivity. The yard needs to support shipside and landside operations simultaneously, dividing the yard cranes' work. This limitation is most marked in the perpendicular layout (the most popular), even with "nested" ASCs such as at CTB Hamburg. Traffic congestion in roadways between quay and yard is another problem.

"It could well be that automated terminals may eventually reach productivity averaging 300 moves a ship hour, say 7-8 cranes at 40 moves an hour," says Ashar. "However, at this productivity level, turning around an 18,000 TEU ship, as mandated by future shuttle services, would take 3-4 days, undermining the feasibility of the entire shipping system. Altogether, it seems that the present kind of automation is not applicable for PTPs." Clearly, Ashar does not believe that Maersk's "6000 moves/24 hour" challenge is feasible even at today's best-equipped and best-run terminals.



The steel slab terminal at Pinto Island, Mobile, with barges between the crane legs loaded directly from the ship, is seen by Dr Ashar as a good illustration of the PTP concept. (The barge indexer can just be made out on the left)

Floating yards

The PTP, in contrast, is tuned to the main characteristic of transhipment - moving groups of containers between ships. This cannot be performed effectively on land, says Ashar, but only on water, using barges. Hence future PTPs could be based on barges.

Figure 1 depicts a cross-section of such a PTP. Technically, says Ashar, it is relatively simple, as it is based on modifying existing equipment and operating systems. Ashar says he has referred it to port engineers and crane structural engineers and they did not think that anything was technically too difficult. Containers are trans-loaded between mother ships and barges, which are used both for storage and for transport of containers between feeder and mother ships. The key advantage of barges is their ability to move groups of containers.

The barges shown are based on the common, square-shaped Mississippi jumbo barge, with 160 (10 x 4 x 4) TEU capacity (around 2000dwt). The cranes have a rail gauge of around 50m and a barge side cantilever of 35m, sufficient for eight rows of barges, which seems sufficient to provide the required selectivity for destination.

The steel slab terminal at Pinto Island in Mobile, Alabama (*WorldCargo News*, May 2009, p57 and January 2010, p2) is described by Ashar as an excellent demonstration of the viability of the ship-to-barge direct transfer concept, except that there is need for only one barge lane there.

Barges are moved along the mother ship using an indexer (pulley) system (as also used in Mississippi River grain terminals). Once loaded, the barges are towed away from the ship and parked in a protected "fleeting area." Barges destined for the same ship are tied together and moved by one push boat.

A fleeting view

Figure 2 is based on a typical fleeting area in the Mississippi River, with barges sorted according to the hypothetical outports, in this case based on an Algeciras PTP. Containers from the mother ship are discharged onto the barges according to their destination. The barges are then towed away from the ship side to the fleeting area and parked there according to destination port. When the feeder ship arrives, the barges are towed back alongside and the containers are transloaded to the ship.

Using barges also facilitates "double cycling" one the first bay has been discharged, saving on barge movements and increasing crane productivity. A different group of barges would be positioned empty alongside the feeder ships in order to take their offgoing cargo, unless the barges are big enough to have a sufficient number of empty slots after they have been loaded by the mother ship. Ashar does say that the Mississippi barge is only an illustration; bigger barges with more container intake could also be used.

Two lifts only

In this example, the entire ship-to-ship cycle to and from barge requires only two lifts, both by the same STS cranes (assuming the berth accommodates feeder ships as well). In contrast, a land-based automated terminal requires three different pieces of equipment, and a minimum of 4-6 lifts (depending on whether AGVs or shuttle carriers are used) are needed for ship-to-ship or ship-to-barge transhipment.

Preliminary calculations, says Ashar, indicate that the cost of barges is lower than the cost of equivalent land-based storage, particularly in the case of deep water reclamations, while the operating cost is much lower due to the elimination of double handling. The main gain, however, is in lower ship cost, due to higher productivity.

Using barges facilitates tandem and triple lifts, Ashar continues, since matching containers is simple, as many containers have the same destination. Similarly, exchanging the whole ship at a single terminal simplifies ship handling, allowing deployment of more STS cranes per ship and a higher percentage of double cycling.

For example, employing nine STS cranes with tandem lifts (4 TEU) throughout the entire operation with 50% dual cycling would result in a productivity of 1620 TEU/ship hour, based on 30 moves/crane hour. In the context of the "6000/24" debate this claim is, to say the least, highly controversial on several levels.

"Gib-Sig" shuttle

Turning around 18,000 TEU (and, in the future, 30,000 TEU) ships at the floating PTP can be completed within a day, asserts Ashar. He calculates that a weekly shuttle services between Gibraltar and Singapore requires only five ships compared to 10 ships for the present services, in which the ships spend half of their rotation time calling at five or more ports in each end region ("milk run").

Likewise, a daily frequency would require 35 ships, certainly within the reach of super alliances. Similar shuttle services could also be developed in other major trades such as the transpacific, transatlantic, etc. An interesting possibility, intended to overcome the size limitation of the new Panama Canal locks, is for developing floating PTPs at both entrances, linking them and the land-based terminals with the same barges used for inter-ship transfer.

Deep thinking

Ashar makes one telling point about the PTP, and it applies to a number of other floating terminal concepts aired in *WordCargo News* over the years. Floating terminals can be located in much deeper water, as there is no need for land reclamation, and the crane rails would be supported on piles or, more likely, caissons. PTP in Algeciras and Singapore, for example, could readily be located in naturally deep water of 30m. Such depths remove the constraints on ship size. Even a massive investment like Maasvlakte II bumps on the limit at *ca.* 20m.

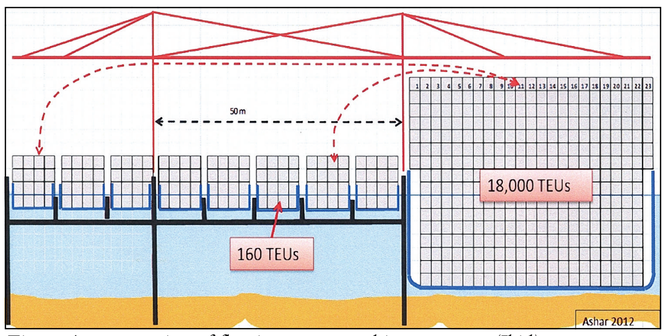


Figure 1: cross-section of floating pure transhipment port. (Ibid)

Figure 2: Notional Algeciras barge fleeting area sorted for destination. (Ibid)

The Triple-E has a nominal intake of 18,000 TEU based on 165,000dwt (*ca.* 9.1t/TEU). Professor Nico Wijnholst's malaccamax (Delft TU, 1999) has similar dimensions, but a much deeper draught, resulting in 245,000 dwt, or 24,500 TEU @ 9.1t/TEU.

With an additional 60m mid-section, says Ashar, capacity would be 28,000 TEU, and then adding an extra row on deck (25-across) brings it to around 30,000 TEU.

The limiting factor today is the Suez Canal. The Suez Canal Authority (SCA) occasionally brings out updated tables of width and acceptable draft. Currently, the maximum draught is 20.1m on no more than a 50m beam, or 12.2m draught for a beam of up to 77.5m.

Ashar says that the SCA is quite close to its target of 22m draught. Assuming a sandy bottom, 1m of underkeel clearance and relatively slow speed in the canal's calm waters, this is enough for his 30,000 TEU ship. Since 1999, when Wijnholst first proposed the 24,000 TEU malaccamax, the SCA has added 3m of depth.

Maccacamax is regarded by Ashar as marking a "new generation" and as a new "sub-species" of liner shipping centered around PTPs. These are presumed to be floating terminals as such ships will be too big for land-based ports. ▯

Dr Asaf Ashar at the Panama Canal