Revolution #4

Is the fourth revolution upon us? Are are we surfing the global grid yet? Not at the moment, says **Asaf Ashar**, who argues that the liner shipping industry first needs a breakthrough in handling technology. And there is a lot riding on the 'megaport' at Panama, too.

To date, there have been three distinct phases in the history of liner shipping. A fourth is now on the radar screen, following the recent decision to expand the Panama Canal by 2015. It will be characterised by the deployment of huge ships, the development of integrated networks and the construction of mega terminals.

The Fourth Revolution theory describes the development of liner shipping as two parallel processes.

First, there is the evolutionary phase characterised by the gradual growth in required ship and terminal/port sizes. Second, there is the revolutionary phase in which technological breakthroughs expand the overall scope of the shipping system.

The first three revolutions involved:

- Containerisation itself. This transformed the ship-to-shore link
- The development of intermodalism and full embodiment of the ship-to-rail link
- The development of transhipment services and refinement of the ship-to-ship transhipment link.

So what will the so-called fourth revolution of container shipping involve? Essentially, it will include a worldwide restructuring of service patterns, which will result in the creation of a global grid. On this basis liner shipping becomes an integrated network of east/west and north/south services, providing its customers with an unprecedented level of connectivity.

Thus a complete trip using the global grid would consist of several legs and several transhipment moves.

This revolution also includes the development of very large container terminals/ports, which are dedicated to providing transhipment services, so-called pure transhipment ports (PTP). These enable that new level of connectivity to be implemented.

This fourth revolution is unfolding and will be triggered further by the expansion of the Panama Canal.

The future primary east/west service pattern will be a cross-Panama, bi-directional (counter rotating), equatorial round the world (ERTW) route, becoming the 'ring road' of global trade. ERTW services will employ the largest and most efficient ships, with the highest service frequency, presumably daily, and with the highest slot utilisation due to the circular service pattern. ERTW services will call at a maximum of six or seven PTPs, these hubs being located at the intersections of the ERTW and principal north/south routes.

To efficiently handle the massive ship-to-ship transfers that would be required, special technologies in the container-handling equipment need to be developed and would set the PTPs apart from 'conventional' ship-to-shore ports.

The evolutionary part of the fourth revolution, the gradual growth in ship and port size, seems to have followed the predictions. However, the revolutionary part of the theory, the change in service pattern, seems to be stalled at the current time. That is, the newer and larger ships that have been replacing older and smaller vessels on the primary east/west trades have largely followed previous service patterns.

Interestingly, the main changes that have taken place involve the older tonnage, which, in several cases, has been cascaded into new secondary east/west services, with ocean carriers extending direct calls to regions and ports previously called at only by feeders.

This trend, defined as regional specialisation, is particularly evident in the transpacific. In Asia, many services are now focused on specific port regions/clusters, such as North China (Bohai Sea) and South China (Pearl river delta), while in North America there are similar clusters taking in the Pacific North West, Pacific South West and Mexico on the west coast and Gulf and east coast ports on the Atlantic seaboard.

Similar specialisation trends are occurring in other regions too, with the emergence of direct Asia/Black Sea, Asia/WCSA and Asia/ECSA links being especially significant in the past three/five years.

In the near future, direct services between Asia/Baltic Sea and North America/Baltic Sea seem likely given the rising cargo flows between these regions.

Regional specialisation has been induced by the recent consolidation that has taken place in the industry and the multitude of parallel services that has resulted from the mergers and takeovers.

The consolidation of lines also results in the accumulation of a sufficient volume of traffic to warrant direct calls at smaller, regional ports previously only served by feeders.

A companion trend on the port side is the construction of modern container terminals in smaller regional ports in anticipation of handling larger ships and more direct calls by the new regional services. This includes, in the US, Jacksonville, Mobile (Alabama), Tampa and the North Carolina port of Wilmington.

Similar trends are evident in the Baltic, Black Sea and South America, along with many Asian countries, particularly China (such as Xiamen, Fuzhou and Lianyungang).

Intriguingly, many of these new ports are designed to handle post-panamax vessels. For example, DP World, which recently secured the development and operating concession for the Peruvian port of Callao, is designing the new South Terminal for ships of 5,500TEU capacity (and even larger in the next phase).

Currently, the largest vessels serving the WCSA trades are in the 3,000TEU range. Moreover, about a third of the throughput of this terminal is expected to be generated by regional transhipment services, mainly by carriers bringing in/taking out Asian cargo.

Direct services to regional and secondary ports are bound to come at the expense of transhipment activity in the primary hubs, although no such decline has been noticed yet.

However, this trend should be taken into account by ports and terminal operating companies fostering huge expansion programmes based on transhipment and relay traffic.

This trend towards regional specialisation is a definite step back from the fourth revolution involving the development of a global shipping system based on extensive transhipment.

SHIP & PORT COSTS FOR SELECTED SERVICE PATTERNS

		(b)	(c)		(d)	
		Direct	Hub-and-spoke		Fourth revolution	
		regional	Mother	Feeder	E/W	N/S
Ship size	TEU	4 000.0	8 000.0	2 667.0	12 000.0	6 000.
Ships in string		8.0	7.0	1.0	7.0	1.0
Total rotation time	Days	56.0	49.0	7.0	49.0	7.0
One-way time	Days	28.0	25.0	4.0	25.0	4.0
Daily ship cost	USD/Day-FEU	27.6	23.9	30.0	21.9	25.4
Total ship cost	USD/FEU	773.0	585.0	105.0	537.0	89.0
Total ship cost, mother & feeder	USD/FEU	773.0		690.0		626.0
Ship cost differentials	USD/FEU	–		83.0		147.0
Port cost	USD/FEU	–		120.0		120.0
Ship & port cost differentials	USD/FEU	–		(37.0)		27.0

Sources: NPWI, USACE, Drewry and others

The expansion of the Panama Canal to accommodate more services and the use of bigger ships is now seen as the catalyst for the fourth revolution. The new canal is expected to be ready in 2015.

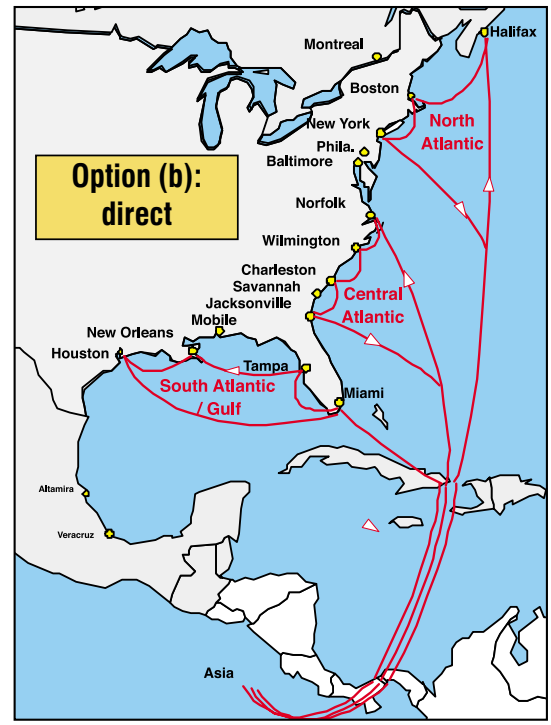
The table shows four generic possible service patterns of the AWP following the canal's expansion:

(a) Traditional – a single service that covers the entire Atlantic region.

(b) Regional specialisation – Three separate services, each focusing on a different USEC region.

(c) Hub and spoke – the same, but based on three short regional feeder loops.

(d) Global grid – based on the fourth revolution with counter-rotating ERTW services, handling both the Asian and Mediterranean trades.



The question, therefore, is whether the fourth revolution theory is simply wrong, or just facing a temporary hiccup. The situation is perhaps best illustrated by developments on the transpacific trade and especially the fast growing Asia/USEC sector. In effect this is the largest part of the market, but traditionally it was served intermodally over the west coast, although recent years have seen a rapid increase in the number of all-water Panama links (AWP).

The regional legs in service option (d) will be provided by north/south services intersecting with the ERTW operation. These will fulfil the role of serving the ECSA/US Atlantic seaboard import/export trade and will act as feeders for ERTW. The location of the hub port in Guantanamo Bay, Cuba, is only for illustrative purposes.

The table presents trip-cost calculations for these three service options. Since option (a) is generally similar to (b), no discussion of it is included here.

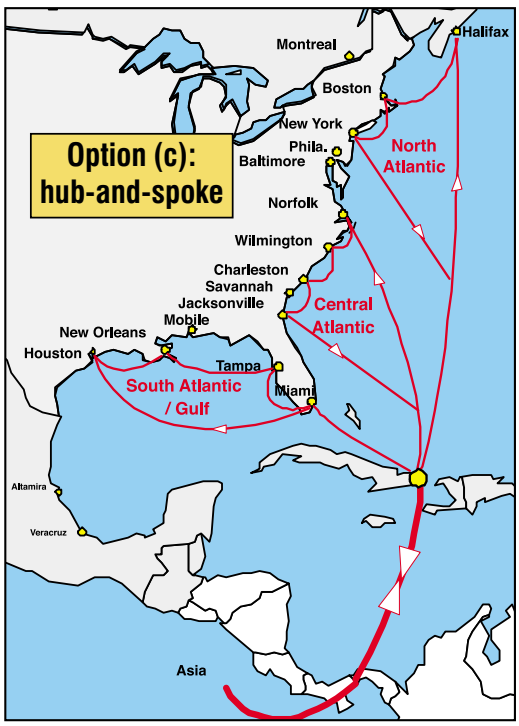
The model assumes the use of motherships of 4,000TEU for service option (b), 8,000TEU post-panamax units – currently the workhorse of the east/west trades out of Asia for (c) and new panamax (NPX) ships of 12,000TEU for (d).

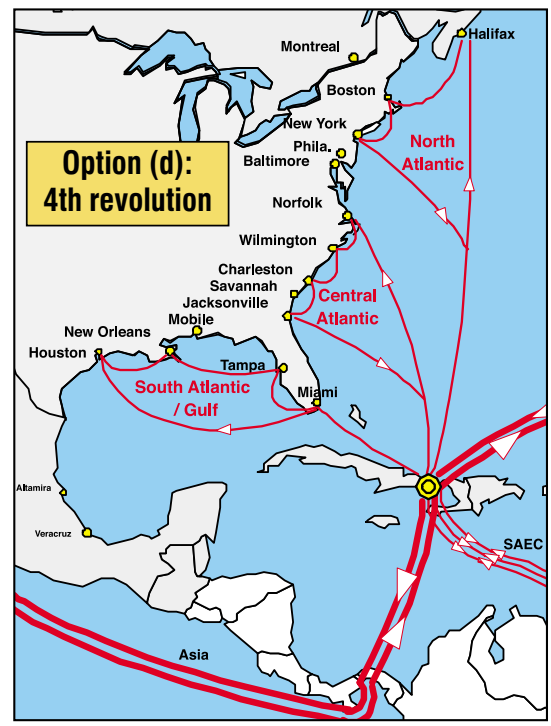
For simplicity, a 1:3 ratio was selected between the sizes of mother and feeder ships. Accordingly, the size of feederships used in (c) are 2,667TEU.

In (d), the assumption is that 2,667TEU slots of the 6,000-TEU capacity vessels deployed on the USEC/ECSA string will be used for feeding cargo to/from the ERTW operation. A further assumption is that in (d), two-thirds of the 12,000-TEU mothership's capacity is dedicated to the USEC.

To gain insight into the economics of transhipment, the ship cost calculation is based on ship production unit cost, defined as a ship's daily cost divided by its nominal capacity (USD/day-FEU). The total ship's trip cost is a multiplication of the number of days consumed by each ship for the Asia/USEC one-way trip by the respective unit costs of each ship.

The first comparison, (b) against (c),





involves panamax and post-panamax vessels, with the panamax unit following a service pattern based on direct calls by motherships at regional ports, and the post-panamax unit deployed on a hub-and-spoke pattern.

While the shorter route of the post-panamax string allows a reduction in one trunk line ship, it requires an additional feedership. Thus although the net result of this is a saving in ship costs of USD83/TEU, it is outweighed by the extra costs of transhipping containers. This is estimated at USD120/TEU for a full ship-to-ship move.

The second and more telling comparison is (b) versus (d), which involves larger mother and feeder ships deployed on ERTW and ECSA/USEC service patterns. The larger vessels result in larger ship-cost savings of USD147/FEU, and result in a total saving of USD27/FEU after taking into account the extra cost of transhipment. Such a saving is insignificant both in relative and absolute terms (equal to about 3% of the trip cost) and would not induce the fourth revolution and its associated investment in ships, ports and network integration.

While this analysis relates to the AWP service pattern, its findings can be generalised. Accordingly, there are dwindling economies of scale once any mothership of a direct service reaches 4,000TEU (or larger) and as a consequence the shift from direct to a hub-and-spoke network cannot generate the ship cost savings needed to offset higher transhipment expenses.

How, then, can the phenomenal growth in transhipment activity in recent years be explained? The main factors responsible have been:

- Lack of adequate facilities at regional ports, due to shallow draughts and/or lack of modern cargo-handling equipment.
- Insufficient level of traffic.
- Fully-utilised ship rotations, where adding another port call would require adding a ship to the string for a relatively small volume of cargo, or when adding a call would result in longer transit times making the service uncompetitive.

Some of these issues are being resolved, as witnessed by the wave of construction projects at regional ports and the proliferation of direct services to/from them. Rotation-related transhipment will only be slightly affected by the regionalisation trend, as well as the relay-based transhipment, (intersection, mother-to-mother). For example, in (b), the three regional services are likely to intersect and exchange boxes among themselves providing wider overall coverage.

A direct service using 4,000TEU panamax tonnage at 70% utilisation and calling at five regional ports, requires an average of 560TEU (4,000 x 0.7/5/1.67), or about 335 boxes (assuming two thirds of the boxes are 40-ft) per call in each direction. Many secondary ports already generate these volumes and many more are expected to join the club in the future.

The conclusion of the analysis so far is that the regionalisation trend based on direct services calling at secondary ports is likely to continue. The immediate result would be a slow-down in the growth of transhipment volumes and, perhaps, even a halt (when measured as a percentage of overall throughput).

The longer-term implication is that any transformation of the present shipping system to a network based on extensive transhipment, including that espoused by the fourth revolution, is unlikely at this point – and even after the expansion of the Panama Canal.

However, the above conclusion could be reversed if a technological breakthrough were to enhance productivity levels and cut the cost of ship-to-ship transfers. A shipping system based on large-scale transhipment would become viable if present productivity doubled to 400 moves/hour and ship-to-ship costs halved to about USD60/TEU.

The technological breakthrough is especially needed in PTPs where it should be based on their unique operating system, in which groups of boxes sharing the same origin and destination regions are transferred between ships. Breakthrough technologies could include, in ship handling, cranes lifting multiple numbers of boxes, the use of multiple cranes per ship, the use of multiple-trolleys and/or conveyors on the cranes.

Longer term, articulated ships exchanging sections dedicated to port regions could fit well with the PTP operating concept. Moreover, novel technologies that have received some attention could lead to radically different port facilities' layouts, which could lead to the development of terminals at new sites.

Excluding any major breakthrough in the technology for handling transhipment cargo, it seems that the fourth revolution in liner shipping has reached an impasse.

Accordingly, and at the risk of over-simplification, the future can be depicted along two main scenarios, respectively the 'with', and the 'without' a breakthrough in handling technology.

The 'with' scenario has been discussed in previous articles on the fourth revolution and will not be repeated here, except to note that its primary east/west services would only call at PTPs, whereby all their boxes are transhipped to north/south and/or regional feeder services for the final leg to end ports.

In contrast, the 'without' scenario will result in primary east/west services remaining basically unchanged.

Other features of the 'without' scenario include:

- The further conversion of transhipment services into direct call strings – the continuation and, perhaps, acceleration of this fledging trend, fuelled by the increasing availability of more panamax and smaller post-panamax ships cascaded from primary east/west services;
- The further regionalisation of services – future trade growth will be served by simply increasing the number of services with the same general pattern (parallel services) but with different end ports;
- The emergence of Shuttle Services – this involves shorter rotations with a smaller number of regional calls, resulting in shorter transit times and lower vessel operating costs. Examples could include a two-port four ship shuttle linking Shanghai and Los Angeles/Long Beach or via a seven-ship, Hong Kong/New York loop (via the Suez Canal);
- The rise of secondary ports – ports in this sector are being developed in anticipation of accommodating additional regional direct services and/or as substitutes for congested primary ports for handling hinterland (intermodal) boxes;
- The decline in primary ports, especially PTPs – the role of these ports will be inextricably linked to the growth in regional services (see above).

The Panama Canal, therefore, has an obvious stake in promoting the fourth revolution or any development that enhances transhipment activity and the emergence of PTPs. To this end, the Panamanian Government is involved in the development of a large PTP on its Pacific side, dubbed 'megaport'.

This megaport might have difficulties in attracting traffic in the 'without' scenario as Asian cargo for WCSA and central America, currently handled via transhipment in Panama, could be converted to direct services.

By taking advantage of regional terminals being built in Colombia, Peru, Ecuador, Chile, San Salvador and Guatemala, the service would have shorter distances, reduced transit times and lower costs, since regional ports derive most of their income from handling local boxes. As a consequence, any transhipment boxes are charged at marginal costs.

It is in Panama's best interest to explore and promote innovative cargo handling technologies for use in its PTPs. Given that the new 'megaport' development will be located on a newly-created artificial island, and hence have no site constraints, this project offers Panama a unique opportunity.

For now, though, the fourth revolution in liner shipping is in reverse.

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