A LINERGRID WHITEPAPER

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Transshipment Hub Distribution

Using LinerGrid's advanced network modelling tool, the ideal distribution of transshipment hubs within a geographical region is analyzed. The analysis shows a range of dependencies, but in all cases clearly favor a low number of larger hubs.

A LinerGrid Whitepaper

Table of Contents

Executive Summary

***Key conclusions**: For extended regions, such as for example Far East, Mediterranean or Caribbean, analysis clearly shows that networks designed around fewer, but larger, hubs are substantially more cost effective.*

For container carriers, this warrants detailed and complex network simulations balancing network efficiency against the ability for key hubs to handle substantially increased volumes – a potential saving made even more important in the light of the new larger alliances. The analysis provided herein is general in nature, but the underlying LinerGrid tool is able to capture the full complexity of any network irrespective of size.

For ports and terminals, this clearly indicate that in the future they might be able to significantly increase volumes by positioning themselves to be one of these key hubs – but equally highlights that terminals have a very real risk that they might lose significant transhipment volumes if they are not chosen to amongst the reduced number of key hubs. Again, the analysis herein is generally valid, but an individual terminal would be advised to closely analyse their own specific competitive situation to be able to position themselves for the coming competitive pressure.

Similarly, it indicates that once the dust settles over the new alliance networks the next phase for the carriers will be one of optimizing these networks with an eye to minimizing the large costs involved in the combination of vessels costs, fuel costs, terminal costs, transhipment costs and equipment repositioning costs. The only way to ensure the overall cost is reduced is to handle all of these elements as part of the same analysis – doing it for each element individually will lead to suboptimization.

This will lead to a drive for terminal consolidation within the alliances in order to reduce the total network costs. This, in turn, creates a significant competitive pressure on the alliances. Not all transshipment terminals are equally efficient and – more importantly – not all hubs have the capacity to handle multiple alliances. In some geographies, this can lead to a situation where the first alliance to consolidate volumes in a particular location not only lowers their own costs, but at the same time effectively denies the competitors the use of the same hub for consolidation purposes, and hence creates a sustainable competitive advantage for themselves.

The development of networks for liner shipping companies has become increasingly complex over the past 20 years. In the "old days" a container carrier would have a single service connecting one region of the world with another. At that point it was of paramount importance to design an efficient schedule for that one service.

However, since then a confluence of developments has changed the equation substantially. Sharply increasing vessels sizes drove the growth in transshipment operations. The emergence of efficient transshipment hubs led to the development of more complex networks and gave rise to truly global carriers. The desire for a broader product portfolio in combination with escalating vessel sizes has led to increasing sizes of key alliances.

As an example, 20 years ago the Asia-Europe trade was serviced by 23 main carriers. 2 of these operated independently, the remainder collaborated in 7 different alliances or similar structured vessel sharing agreements.

10 years ago this had been condensed into 20 carriers of which 9 operated independently and the remainder collaborated in 3 different alliances.

5 years ago, the market had further condensed into 17 carriers split on 4 alliances and 5 independent carriers.

If the mergers and acquisitions take place as announced in 2017, we will shortly be in an environment where this is reduced to 10 main carriers condensed into 3 alliances.

The task of designing a competitive network in an environment where multiple carriers need to agree on the complexities related to a network is anything but simple. Consequently, the use of powerful mathematical tools can facilitate the optimization necessary to design a network.

LinerGrid has developed a proprietary mathematical model specifically for the optimization of complex liner shipping networks. As the model can be used to analyze how to further optimize the liner shipping networks, it can also be used to analyze how network improvements will impact volume flows in the ports and terminals.

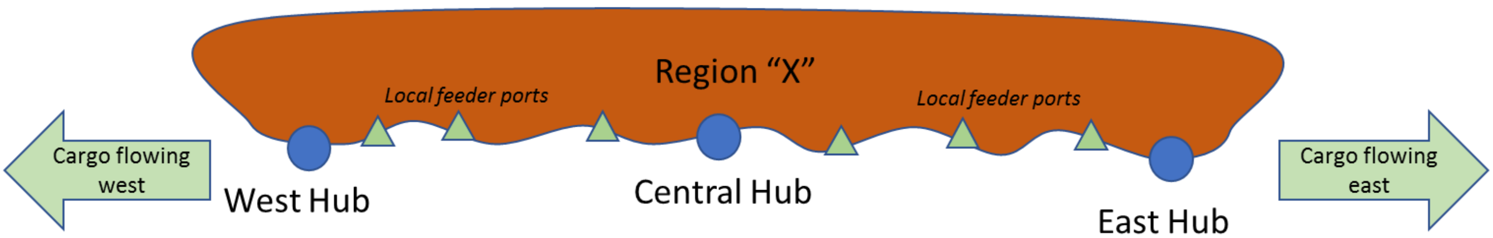
In this whitepaper we take a close look at a simple question: What is the ideal distribution of hub locations in a larger region? The answer is quite straightforward: the fewer hubs, the better. The details are not as straightforward as the magnitude of the region, oil prices etc. tend to alter the specifics, but without changing the overall conclusion.

For transshipment terminals, this becomes crucial. It shows that we should expect a general development wherein networks will gradually migrate towards designs with fewer, but larger, hubs. Whilst this is optimistic for terminals which are able to achieve this status, it equally indicates that there will be transshipment terminals which are likely to see significant reductions in volume.

The Analysis

In order to make an analysis with general validity, we have designed a simple structure as depicted in figure 1. Conceptually this could match a range of different regions such as for example the Mediterranean from Suez to Gibraltar or the Far East from the Straits of Malacca to Busan.

Figure 1: Conceptual region with local ports and hub ports



This approach ensures the analysis becomes generally valid in terms of the overall analytical conclusions, but of course detailed calculations for an individual port need to made based on more specific information.

We have developed 4 different scenarios based on the following concepts:

- Scenario 1: A balanced region where cargo flows eastbound and westbound are roughly similar
- Scenario 2: A lopsided region where westbound cargo flows exceed eastbound cargo flows
- Scenario 3: A balanced region but with a substantially longer distance from the eastern end to the western end
- Scenario 4: A balanced region but with smaller vessels and less cargo

The following baseline parameters are identical for all scenarios:

The distance from the West Hub to the East Hub is 1500nm. This is an average representation of a range of actual regions: Busan-Singapore (2425nm), Suez-Gibraltar (1975nm), Le Havre-Hamburg (650nm), Freeport-Panama (1200nm), Salalah-Bahrain (1250nm). The exception is scenario 3 where this distance is increased to 2500nm.

For each hub port we have assigned 2 feeder ports located at a distances of 250nm, for a total of 6 feeder ports.

All ports are assumed to be equally efficient, able to cater for all vessel sizes and operate at an equal cost.

Calculations have been performed at three different settings for bunker fuel prices: 200 USD/ton, 330 USD/ton and 460 USD/ton.

For scenario 1 we cater for a weekly demand flow of 60.750 FFE using 67 vessels in a network consisting of the following:

- 3 services each using 18.000 TEU vessels
- 4 services each using 14.000 TEU vessels
- 9 regional feeder vessels ranging in sizes from 900-1450 TEU

For scenario 2 we cater for a weekly demand flow of 54.250 FFE using 66 vessels in a network consisting of the following:

- 3 services each using 18.000 TEU vessels
- 2 services each using 14.000 TEU vessels
- 2 services each using 9.000 TEU vessels
- 9 regional feeder vessels ranging in sizes from 900-1450 TEU

For scenario 3 we cater for a weekly demand flow of 60.750 FFE using 73 vessels in a network consisting of the following:

- 3 services each using 18.000 TEU vessels
- 4 services each using 14.000 TEU vessels
- 9 regional feeder vessels ranging in sizes from 900-1450 TEU

For scenario 4 we cater for a weekly demand flow of 48.800 FFE using 66 vessels in a network consisting of the following:

- 3 services each using 14.000 TEU vessels
- 4 services each using 10.000 TEU vessels
- 9 regional feeder vessels ranging in sizes from 700-1170 TEU

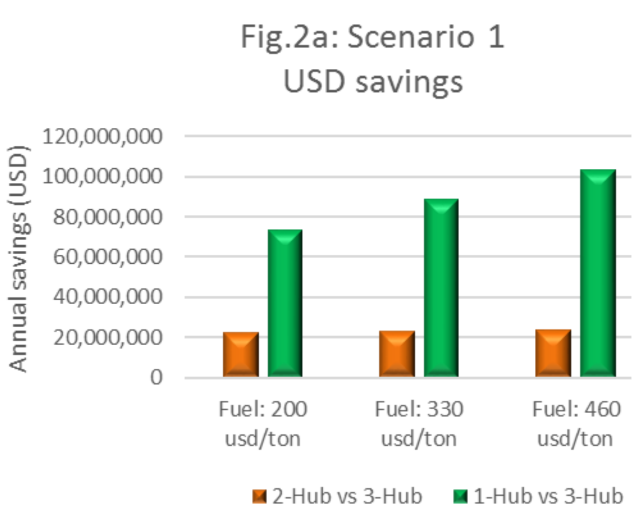
For each of the scenarios, the baseline network costs have been calculated based on usage of all 3 hubs. This includes the costs of operating the vessels in the network as well as port and terminal costs associated with both the flow of full containers and the flow of empty containers. The empty flow is based on LinerGrid's mathematical model automatically taking the optimal return flow of empties into account whenever trade imbalances are present.

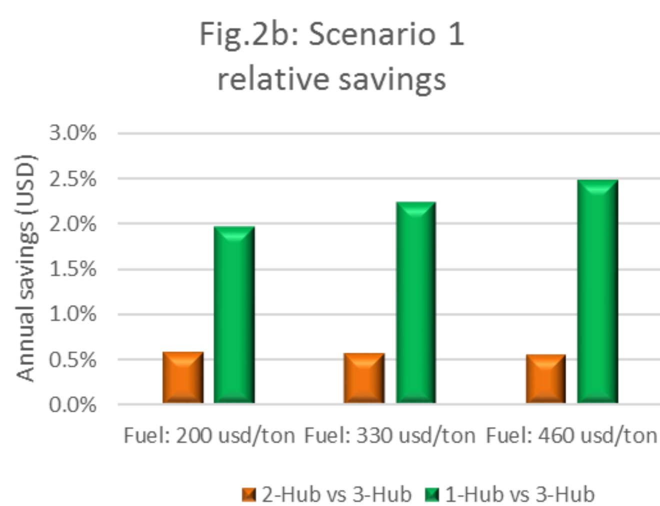
Once the baseline networks costs have been calculated, each scenario is taken through two variations. The first variation is a shift to a setup with only 2 hubs, located at either end of the region. The intention with this variation is to contemplate a conceptual setup wherein a region is primarily served through the collection of transshipment cargo at hubs at the entry/exit points of the region.

The second variation is a concentration of transshipment operations into the central hub, i.e. a pure 1-hub setup.

Scenario 1

For scenario 1 the total network cost in the baseline network varies from 3.8-4.2 billion USD annually depending on fuel costs. Of course, this calculation is contingent on assumptions pertaining to capital costs and/or TC costs for the vessels as well as the fixed and variable terminal costs etc. The actual number is not what is the most relevant in this context, and will in any case vary across individual carriers. What is, however, relevant is the change in costs when we switch to the 2-hub and 1-hub variations.





Figures 2a and 2b show the annual savings stemming from switching to the 2-hub and 1-hub variations in this scenario of a balanced region.

In this scenario we find that switching to a centralized hub set-up results in significant savings ranging from 2.0-2.5% of the total annual network costs. With the assumed standardized vessel and terminal costs, this corresponds to an annual saving of approximately 80-100 million USD.

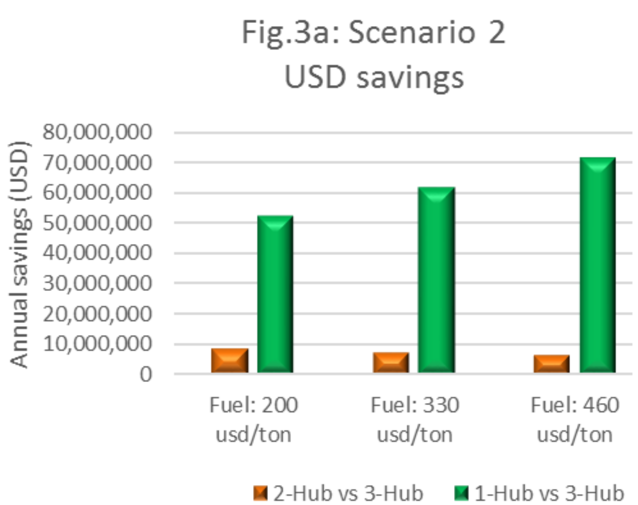
Furthermore, it is clear that the savings potential has a marked dependency on the fuel costs. The higher the fuel costs, the more benefits will be obtained by switching to a centralized network design.

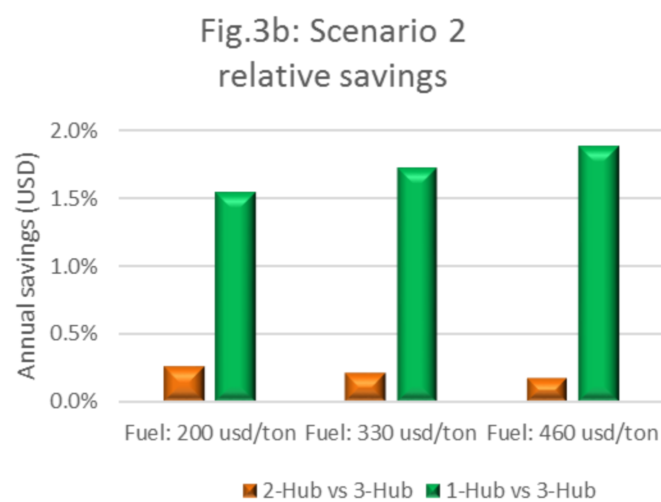
The 2-Hub setup is also seen to provide savings, albeit they are less pronounced with a value of approximately 22 million USD annually corresponding to a saving of 0.6%. Whilst the savings are smaller than for the centralized hub, they are seen to be less dependent on fuel prices.

Scenario 2

For scenario 2 which is more lopsided as opposed to the symmetric setup in scenario 1, the total network cost in the baseline network varies from 3.4-3.8 billion USD annually depending on fuel costs.

Figures 3a and 3b show the resultant savings by switching away from the 3-hub structure to the 2-hub and 1-hub setups.





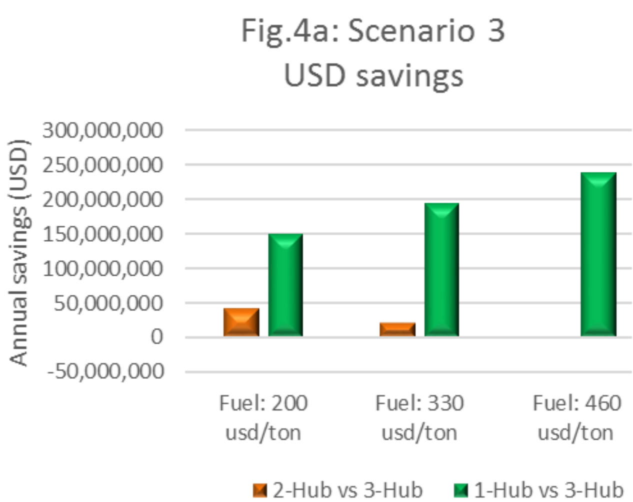
The centralized setup provides significant savings, not unlike scenario 1. The savings are seen to be in the range of 50-70 million USD annually, increasing as oil prices also increase.

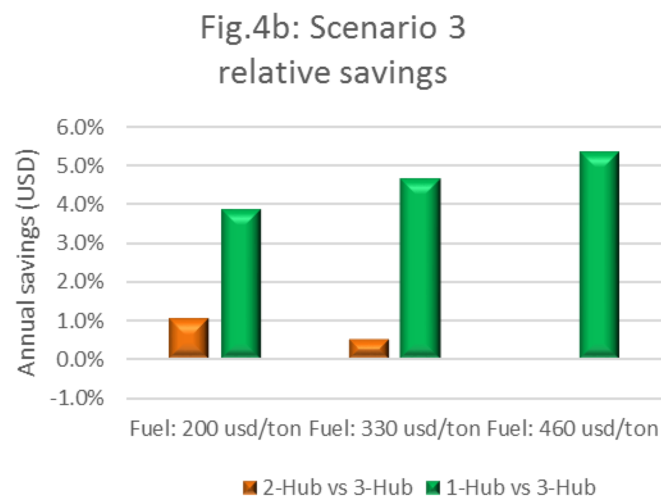
However the 2-Hub setup is significantly reduced in terms of savings potential. Furthermore, not only is the potential for the 2-hub setup reduced, it is also seen to have a negative correlation with fuel prices, resulting in a situation where savings are diminished as oil prices increase. The key reason is that a lop-sided region, in terms of cargo flows, reduces the possibility to have an effective hub-and-spoke scenario being services purely at the entrance and exist points to the region.

Scenario 3

Scenario 3 is a symmetric region in terms of cargo flow, similar to scenario 1, with the difference being a significantly longer distance across the region (such as is the case in e.g. the Asia region). As is depicted in figures 4a and 4b, we see a much larger disparity between the 1-hub and 2-hub setups compared to the previous two scenarios.

For the centralized hub, the savings amount to 150-240 million USD annually which is equivalent to an overall cost reduction of as much as 3.9-5.4%. The impact of fuel prices is even more pronounced than in scenario 1, increasingly favoring a centralized setup at the onset of steeper fuel prices.

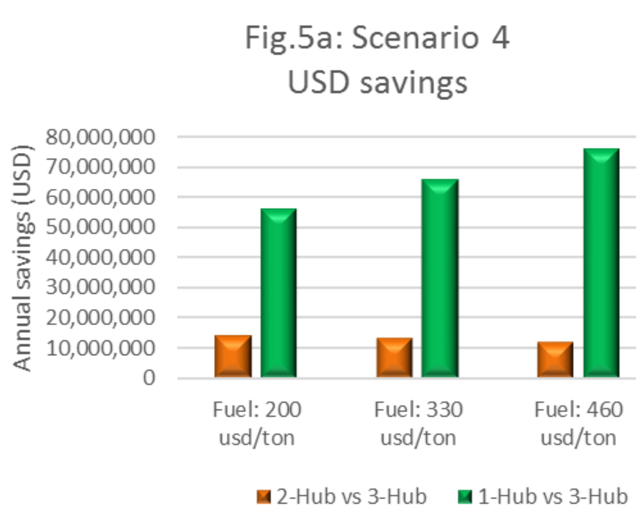


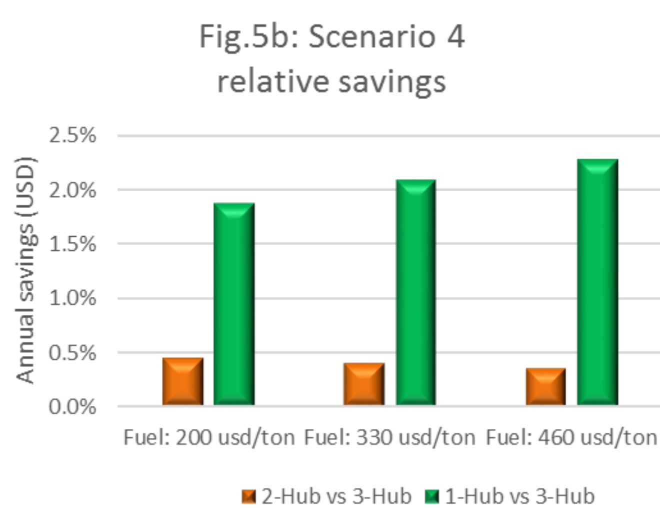


Conversely, the 2-hub setup can become problematic due to its negative correlation with fuel prices driven by the negative impact of longer feedering distances in the extended-length scenario. From a saving of 40 million USD at the low fuel price of 200 USD/ton, this setup actually turns negative when the fuel prices exceeds 455 USD/ton, and at our standard setting of 460 USD/ton reaches an added cost of almost 1 million USD.

Scenario 4

Scenario 4 is symmetric and similar in size to scenario 1, however the volumes shipped are reduced and the vessels deployed are smaller.





As can be seen from figures 5a and 5b, the smaller size vessels do not conceptually change the results from scenario 1. The relative savings potential is only reduced by approximately 0.2 percentage points for both the 1-hub and 2-hub networks, and hence the conclusion from scenario 1 remains materially unaffected, and is as such also applicable to regions wherein the very largest of vessels are not deployable.

Conclusion: Reduce the number of hubs

As mentioned at the outset, the analysis performed is generic in nature and intended to ascertain overall trends. As such the generic region and 1, 2 or 3-hub setups are generic representations of many actual regions.

In reality, carriers do not presently have "clean" 1, 2 or 3-hub setups, but in the main they tend to use multiple hubs throughout major regions, which conceptually resemble the 3-hub setup.

What the analysis have clearly shown is that a centralized 1-hub is indeed preferable in all cases, whereas the 2-hub setup has a saving potential as well, but this can in some circumstances be eroded.

When the LinerGrid tool is used to evaluate specific ports, the actual productivity and move/port cost variation across competitor ports are additional dimensions that are taken into account to evaluate the exact value a port generate to its liner customers.

Two additional commercial and operational considerations need to be taken into account which goes beyond the network itself.

One consideration is robustness of the network. Whilst using the centralized setup it is possible to reap significant savings, this also exposes the network to significant disruption in case of operational challenges at the hub – and, equally important, might place the hub terminal in a strong tactical negotiation position if no other nearby central hubs are capable of handling the full volume. This would tend to reduce the potential value to be gained from the fully centralized setup.

The other consideration is the yield-management potential inherent in the 2-hub network. By focusing hub operations at the entry/exit points of a region, a carrier achieves the possibility to "even-out" volatile cargo flows from the regional ports by gathering cargo at the exit point, in turn securing more consistent high vessel utilization for the deep-sea trades beyond the region. This would tend to increase the potential value to be gained from the 2-hub setup.

The overall conclusion is clearly that there is value to be gained from designing the networks with a more centralized scope in mind. Whether that is ideally the 1-hub or 2-hub setup will depend on the actual conditions weighted against the yield management potential and the requirement for a robust network.

For the carriers, this indicate that it could prove financially advantageous to explore the possibility to centralize existing networks further, and gradually migrate towards such network designs.

For the ports and terminals this shows both a clear opportunity and a clear commercial threat. If the carriers pursue a strategy of constantly improving the economic efficiency of the network, they will over time gradually migrate towards setups which are more centralized than today. This in turn will mean that some terminals will see significant increases in transshipment volumes, whereas other might see a high degree of elimination of transshipment volumes.