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CASE REPORT

Innovations and Computer-based Support: Illustrated by Five Cases

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Abstract:

Introduction:

This article discusses four alternative transportation links between China and Europe – the classical sea route through the Suez Canal, the N.S.E. (Artic) train passage through Russia, and ship and train *via* Genova – in terms of transportation costs, time spent, and reliability.

Conclusion:

It is concluded that the classical sea-route *via* Suez is likely to remain the preferred one for most shippers for a long time, when it comes to its relatively low cost, as well as increasingly improved time feature.

Keywords: Transportation, China-Europe trade, Blockchain analysis, Cloud computing, Suez Canal, Genova.

1. INTRODUCTION

The gradual opening up of the Northern Sea Route (NSR) between Europe and Asia (N.E. Passage) has received a lot of attention, largely for two sets of reasons. To start with, it is important to observe a most tangible effect from the gradual global warming that is taking place, notably significantly less ice and larger sailing season. More importantly, however, the transportation link between Asia, China in particular, and Western Europe is becoming even more important to the world's economic order today than ever, both when it comes to the lowering of transportation costs, as well as when it comes to saving time on this transport leg [1, 2].

The factors that so far have led to transportation cost savings have partly been more efficient container ships – larger (mow more than 20.000 TEU in size) and more fuel efficient -, as well as more efficient container ports for faster loading and/or unloading. Now another factor is emerging also, namely to achieve additional cost- and time saving through more efficient handling of the flow of documents that support container-based transportation.

Two important analytical advances are driving many of the changes. Through so-called cloud computing and large data analysis it has become feasible to classify container shippers' preferences when it comes to their focus on low transportation costs, speed of transit and/or reliability of, transportation option. And, through so called blockchain analysis it has become clear that considerable cost- and time savings can be made through the simplification of the document flow.

While we shall not here report on the technical aspects of these specific analytical effects, we shall indeed refer to the implications from these findings, namely:

- Cost savings from alternative routes and/or from streamlined documentation flows.
- Time savings also from alternative routes and/or from streamlined document-handling processes.

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2. MAJOR TRANSPORTATION ROUTE CHOICES

There seems to be the four major alternative route choices:

a. The "classical" sea-route, from China's east coast, through the Malacca strait, across the Indian Ocean, through the Suez Canal, across the Mediterranean, the bay of Biscay, and through the British Channel, to Rotterdam or Hamburg. This trip is around 11.500 miles long, and typically takes around 40 days. The freight cost per container is around U.S $ 100.- . Since ocean freight rates tend to fluctuate a lot, it is difficult to give a relatively stable cost estimate. It should be noted that the freight rates have come down significantly (say, from around U.S.$ 400.-per container in 2010 to around U.S.$ 100.- today). This shall make the classical sea-route relatively more economically attractive than the other three major route alternatives, now to be briefly explained.
b. The Northern Sea-Route (Artic route, N.E. Passage) through the North Sea, the North Atlantic, rounding the North Cape, sailing through the Artic Ocean or the Northern side of Russia, across the Bering Straight and Sea, and on the Pacific, to Shanghai. The distance here is around 7.400 miles (*i.e*. a significantly shorter sailing route than the conventional one, saving around 4.100 miles. The normal sailing time is more difficult to specify, primarily due to differing ice conditions, but a passage of 25 days might be roughly correct. The cost per container may be approximately U.S $ 2.000.-, but there is not yet a firm previous price level established.
c. The freight train route from Chinese in-land industrial cities such as Chongqing, Wuhan, Zhengzhou or Shenyang, through Russia, Belarus, and Poland, to the major markets in Germany (the so-called Northern Route), or alternatively, through Kazakhstan (the so-called Southern Route). This is around 12.000 km long (*i.e*. around 8.400 miles), and a typical passage would take only around 20 days, *i.e*. around half of the time of the classical sea-route. But, the cost per container is also significantly higher, around U.S.$ 5.000.-
d. The "hybrid" route: *via* ship to Genova (similar to the classical route, and then *via* train through northern Italy, through Switzerland through the newly opened Gotthard Tunnel (67 km long, the world's longest rail tunnel, 8.5 Billions S.Fr. investment) and the soon-to-open, much shorter Airolo tunnel, then through the German Rhine valley to the major European markets. The sea-route is here ca. 80% of the "classical" route, and would thus require a 30 days of sailing. The train route comes in addition, with a length of ca. 1000 km (ca. 700 miles), *i.e*. and another 2 days, totaling around 32 days for this option. The cost per container might be around U.S.$ 900.-, but no firm price levels have been established.

Let us now discuss each of these four transportation alternatives in some more detail, including also to highlight the major policy issues associated with each.

3. THE CLASSICAL ROUTE *VIA* SUEZ

It should be noted that the Suez Canal has a long history. It was initially opened around year 100 b.c. and was operational for more than 600 years, until around year 500 a.c. when it was abandoned. The canal, in its modern form, was opened in 1844. A major expansion was completed in 2014, at a cost of around 8.5 B. U.S.$. Even the largest container ships in existence (ca. 21.000 TEU) can now get through Suez. For Egypt's government it is probably key to recoup its major investment in connection with the canal expansion relatively fast, impacting the level of the through-pass fee, which is relatively high.

A plan to build a canal across the Malacca Peninsula has been discussed for more than 20 years. This might reduce the transportation time on the "classical" route with around 1 day, from ca. 40 to ca. 39. So far, the Thai and Malaysian governments have not found this investment worthwhile, however. It would also be noted that extensive dredging would be needed in the bay of Thailand.

As noted, the costs per unit freighted are by far the lowest when it comes to this alternative, but the transportation time is by far the longest. Thus, for shippers the costs versus benefits connected with making use of this option would depend on the strategy of each particular one. Some shippers have globalized their business value chains. Europe-based corporations such as Adidas or Ecco shoes, for instance, have outsourced much of their manufacturing to China /S.E. Asia, while R&D and Marketing/Sales are done out of Germany/Denmark respectively. Or, going the other way, major German automobile-makers are producing many key components in Germany but assembling the cars in China. For these types of firms to save time, and to ensure predictability in delivering, route alternative 3 (*via* train) would probably be relatively more important than transportation cost per se. For other shippers where their value-chains are not affected, the opposite might probably be the case. Cost saving would be critically important here, while the time it

would probably be relatively less critical. Examples here might be some corporations that deal with basic materials (say paper, ores, oil, *etc*.) or, when it comes to most finished good, such as electronics or appliances.

The major drive for ship-owners has been to reduce cost per transported unit, by investing in longer and longer ships, *i.e*. to take advantage of economies-of-scales. As noted, the newest container-ship giants are now having capacity of more than 21.000 TEU! The speed for a typical container ship has however, actually tended to be reduced, now to around 20 knots, compared to the much higher speed of ca. 27-30 knots that was common a few years ago.

In total we see that the cost side is driving the use of the alternative a) (Suez) option.

4. THE NORTHERN SEA ROUTE (ARTIC, N.E. PASSAGE)

As noted, one effect from the general warming in our world's climate has been that the N.S.R. might become more feasible due to much less heavy ice! It should be noted that the N.S.R. is not new. It was first successfully transcended by Nordenskiöld in 1874. The discoverer of the South Pole, Amundsen (in 1911) transcended N.S.R. in 1919, as the world's No. 3.

Global warming does not perhaps have such a major impact on the NSR, at least not yet. The ice conditions during the winter can still be severe, and the NSR is closed to though traffic during the winter season [3]. During the winter, there is shipping only in the western part of the Kara Sea. In general, there seems to be more real ship traffic in these Artic waters relative to N.S.R. through-passing. During parts of the summer season, ice breaking support would still be needed.

It is not, however, only the climate change but several technological advances that have made the N.S.R. a more feasible option:

- Stronger ice-breakers, generally powered by strong nuclear engines.
- Better ice-reinforcement of the hulls of the (ice-class) ships.
- Stronger engines and more efficient propellers.

The relative absence of ice class ships with high capacity, and scarcity regarding available ice-breaker capacity are hampering increased activities in the NSR. To export Russian resources out of the Artic (ores, gas oil, timber, wood products, *etc*.) presently seems to have a higher priority than NSR. We might perhaps conclude that the NSR alternative is not realistic today.

Let us, however, highlight some factors that might make the NSR more realistic in the future:

The Russian republic is the major stakeholder here. A strict process of transit permitting is being applied. In 2015 there were 715 applications, expensive and time-consuming process, involving passage through 7 permit zones. This process is however, likely to become relaxed. Government expenses to organize and implement ice-breaker-lead convoys through the ice are also considerable. And, huge investments in new ice-breakers are being made.

Considerable investments shall probably also have to be made when it comes to building adequate port facilities along Russia's northern coast-line. The navigational conditions in general are not good, with considerable investment needs in the development of accurate sea-charts and sea-route marks.

Considerable time-savings regarding transportation might however be had, as already pointed out. Thus, the use of the NSR option might be particularly attractive to shippers, particularly those who might have global value-chains. But there are at least two impediments there:

- The N.S.R. is only open for ca. ½ of the year. During the remaining 6 months the adverse weather/ in conditions make the use of NSR difficult to impossible. For a shipper it is thus difficult to plan for an uninterrupted faster delivery of goods, unless making use of options 3 or 4 for these months, as shall be discussed later.
- A relative lack of predictability and safety. As noted, the bureaucracy on the Russian side can be formidable, both when it comes to the granting of passage permits, as well as when it comes to the organization of convoys through the ice. Thus, delays can be many, and hard to predict.

And more special purpose ice-reinforced ships would have to be built. Today's so called Ice Class a ships are probably not strong enough to withstand the rough conditions that typically are prevalent at the NSR [4]. And, due to relatively shallow waters, through one area of narrow passage in particular, the size limitation for container ships would

be a mere 4.500 TEU. Also, when it comes to the use of bunkers fuel there is an added cost to ship-owners. Normal, heavier-grade bunkers might not be usable since the heavier fuel would not easily sustain low temperatures.

It should be noted that the world's largest container- shipowner, A.P. Möller-Maersk, Copenhagen has ordered 7 new 3.800 TEU ice-strengthened container ships. Officially these are to be sailing in the Baltics. It is however, widely assumed that these are intended for the NSR.

5. TRAIN-ROUTE, TRANS RUSSIA

The first form test trains between China and Germany ran in 2004. By 2015 this had grown to more than 400 trains. It should be noted that more than 40% of China's cost production comes from the Xingjian area, as well as ca. 22% of the country's oil production [5]. China seems to be exporting their surplus regarding both of these commodities to Europe *via* this route.

A major issue is the fact that the Russian railroad system has broader gauge than what is the normal standard in the rest of the world – 1520 mm versus 1435 mm – a decision taken by the late tsar Alexander II in the late 1800 ds, for defense reasons, and now coming back to haunt speedy implementation. Considerable investments would need to be incurred to upgrade the Russian rail system. This applies to the Northern Route. The Southern Route (the Silk route) has normal rail gauge but offsetting the potential benefit from this is the fact that there may be additional, unpredictable political problems, since this route crosses through many more countries.

Thus, the key advantages for shippers when it comes to this route option would be the time saving as well as predictability. Hence, the three major German car manufacturers are making use of this option according to Handelsblatt. And, for many shippers the fact that these train services links China's manufacturing in-land sites with major industrial sites in Germany, represents an additional benefit – no need for transshipment to/from ports such as Shanghai, Rotterdam or Hamburg, and avoidance of port delays. Thus, the results are cost savings and time savings!

6. SHIP AND TRAIN, *VIA* GENOVA AND THE ALPS (TUNNEL)

Less is known about this 4th route option, since this too is still not fully operational. As already pointed out the Swiss have built the world's largest rail tunnel. Another, slightly shorter tunnel is to be open through Airolo, also in Switzerland in 2018. It is a problem, however that essential parts of this route are still behind schedule. Notably, the container port of Genova (Italy) has not been upgraded yet. This also seems to be the case when it comes to the rail link between Genova and the Swiss border. On the German side the upgrading of the rail line through Rhine Valley is also delayed.

A key benefit regarding this option is that one would be able to reach the various industrial centers in Germany directly, *i.e*. not having to tranship through Rotterdam or Hamburg. Perhaps also feeder services to the Baltics and to Scandinavia might benefit when it comes to this alternative, say, with a new transshipment port for such feed shipping activities to be built at the German Baltic sea coast. There would be relatively few new investment needs for ship owners when it comes to this option. It should be noted, however, that the overcapacity large container ship situation might now become even more severe than today, given the relatively shorter route between China-Genova, compared to China-Rotterdam/Amsterdam.

CONCLUSION

The primary conclusion seems to be that cost savings versus speed of transportation, but also reliability and predictability regarding holding the schedule, seem to be the major factors to impact the decision to go for each of the 4 transportation alternatives when it comes to the China-Europe link. And, the large data analysis seems to confirm this, namely that to achieve low costs seems to be critical for some shippers, while to benefit from transportation time savings seems key for others. The "classical" sea-route *via* Suez definitely dominates when it comes to transportation costs, and the reliability here is good. But, time is a problem! Blockchain analysis to streamline the paper flow associated with container-based transportation comes in here and is expected to lead to cost savings as well as time savings [6].

The NSR option (Artic, N.E. Passage) seems to imply so many uncertainties that this option perhaps cannot be considered to be real at this stage, despite of the distance advantage relative to option 1. The trans-Siberian rail route is indeed expensive, but relatively fast and reliable. And finally, the ship/train route *via* Genova and the Alps is not yet ready and can thus not be considered to be a real alternative today. So, it comes down to the "Suez" option or the rain

option. Clearly, there are other factors too that might impact the choice, such as seasonality issues or environmental issues, but the three most critical ones seem to be cost savings, transportation time savings, and reliability considerations.

When it comes to securing the lowest possible transportation cost for each TEU transported, the classical sea-route through Suez, is by far the dominant option, and is likely to remain so in the foreseeable future. And benefits from streaming the document flow when it comes to container transportation are likely to further strengthen this route option's competitive position. The rail alternative shall not be likely to even be competitive on a strict transportation basis.

The time issue would be of particular concern for these shippers who might have adopted a global value chain, say, where functions such as production versus sales and marketing might be undertaken at different locations. Here the rail alternative would be attractive. Over time, perhaps a combination of ship-train, *i.e*. option 4 would have to b worked out, clearly, however, the remaining infrastructure investments for making this option a reality might be too high. Reliability seems to be good when it comes to option 1 – container ships *via* Suez, but with perhaps a big unknown being the pirates off Somalia. When it comes to option 3 – train – there might be some questions related to political factors

The NSR passage waterway is not likely to become a commercially viable alternative, at least not for many years. It cannot compete when it comes to the cost side, nor when it comes to safety and reliability concerns. The lack of year-round usage is further a major negative. This seems to be consistent with what Tuomas Kiiski concluded in a recent Doctoral Thesis [7], namely that the NSR option is unrealistic for through-faring shipping today. Only local Russian transportation seems realistic.

So, it seems as if the conventional container ship route between East Asia and Europe *via* Suez would remain dominant, at least for a long time to come. The NSR is not likely to become competitive, both for economic reasons (cost of ice-breaker support, *etc*.) and for reasons of lack of predictability (unforeseen ice conditions, extraordinary waiting for ice-breakers, permit problems). The train link across China, Russia, and the former Eastern Europe, while relatively attractive due to the short time of transit, is likely to remain too expensive relative to the conventional "Suez" route. And, the ship-train route *via* Genova is unlikely to become realistically operational for many years. Remaining infrastructure investments, particularly on the Italian side are slow to come!

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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