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Dubai, a hub for Dhow shipping? Study of the connectivity between standardized networks and local networks

(unfinished version; please do not quote)

Abstract

The article starts with a quick survey of the existing literature, then presents its theoretical and methodological frame, and tests the complementarity/duality of the means of transport, and the level of inclusion of the port in the city. Finally, several hypothesis about the normalization process of dhow trade are laid down to finalize the the test of the level of connectivity between standardized networks and local networks.

***Keywords:** Dhow, Middle-East, Short-sea shipping, Duality, Normalization, Network economy*

1. Introduction

The persistence of dhow shipping in the Indian Ocean, the Persian Gulf and part of the Red Sea is puzzling for the maritime economist. Indeed, nowadays, almost every commodity can be carried easily and cheaply through the global network of container shipping lines, directly or through a hub (Song & Panayides, 2015). Given the difference of capacity between a dhow (even big, like a “500-tons baghlah”; Martin, 1980) and a containership (even a small 1200 TEU feeder one), the survival of dhows in such a competitive environment is puzzling. Of course, in the thousand-year history of dhows (Martin, 1980; Sheriff, 2010), the arrival of new containerized transport services in the 1980s (Stopford, 2009) is relatively recent. But dhow shipping is still active in the region.

In Dubai for instance, more than 400 dhows can be seen on a regular basis (in a census based on satellite pictures). Thus, two systems of maritime transport are coexisting and remaining distinct, while carrying the same type of good. Theoretically, only the most efficient units of production should survive in a fierce competitive environment such as the one in the maritime sector (Kessides and Tang, 2010). Such differences of size and flows between dhows and container ships should not be observable on a given flow trade nowadays. Two explanations are at least possible. Dhows and container ships may be either complementary for the same commodities, or dually fitted for different kind of commodities. The purpose of this article is to test the first explanation with the help of the “footprints” let by ships as taken by satellite pictures displayed by googlemaps. Indeed, given the difference of size between a container ship and a dhow, dhows are able to reach every small coastal city contrary to container ships. Thus, ships footprints let on satellite pictures allow to test the existence of a complementarity between the network of dhows and container shipping lines.

Additionally, those ships' footprints allow to test the proximity of dhow ports with container terminals. In this perspective, different norms of shipping are interconnected in big ports where container ships and dhows are exchanging cargo. The paper puts forward several hypothesis to explain how and where those norms are traded in big ports.

The article starts with a quick survey of the existing literature, then presents its theoretical and methodological frame, and tests the complementarity/duality of the means of transport, and the level of inclusion of the port in the city. Finally, several hypothesis about the normalization process of dhow trade are laid down to finalize the the test of the level of connectivity between standardized networks and local networks.

2. Survey of the existing literature

Dhows

The literature about Dhows is quite scarce. The most recent work on dhows is Verne's (2017) ethnographic approach of dhow trade between Zanzibar and Jakarta. As Verne's survey of the literature put it, the existing literature on dhows is very poor and often too old to catch recent evolutions of dhow trades. For instance, the latest publication on transport and logistics in East Africa (Abdillahi et al., 2015) does not mention the part played by dhows in this region.

Most of the literature (Martin, 1979, 1980, 1981 ; Gilbert, 2002 ; Agius, 2005) is devoted to the the sailing period of dhows in the Arabian/Persian Gulf and does not include their conversion toward the thermal propulsion. Historical and ethnographic approaches dominate in the littérature (Agius et al., 2010 ; Sheriff, 2010 ; Verne, 2017). The last real studies on the economics of dhows date back to the 60's (see Villiers, 1948 ; Talbot, 1962 ; Noble, 1963 ; McMaster, 1966 ; Hoyle, 1968), exception made of Gilbert's (2004) book.

This scarcity is not surprising, considering the huge surge (and now domination) of containerized trade since the late 70's that led to the lack of interest in dhow trade..

The literature (which is mainly written by geographers) on Dhow ports is also very rare (Talbot 1962 ; Hoyle, 1968 ; Walker, 1981 ; Dharmasena, 1987), probably due to the very low level of the capital intensity ratio of their stevedoring companies. But Gilbert (2002) already stressed that « dhows went to places that steamers could not go », due to their low draft. This constraint lasts all the more with the growing size of feeder containerships.

Martin (1982) belongs to the rare study on actual movement of goods carried by sailing dhows in the Indian Ocean in the seventies. He describes also lots of other aspects (main ports, handling of dhows, boatyard...) of the dhows economy.

The decline of dhows is described by Martin (1980) and Dharmasena (1987), who depicted the impacts of the container revolution in Oman (Martin, 1980) and in Bombay/Mumbai and Colombo (Dharmasena, 1987), and by Agius et al. (2010), who stated that wooden dhows are not built anymore and that traditional boatyards do only the maintenance and repair of remaining olding dhows.

Maritime economics and Network economics

If the economics of dhows is too old, lots of aspects of their economy are already depicted elsewhere. Regarding the focus of this article, network economics and particularly hub and spokes networks with feeder vessels are well known (Fagerholt, 2004 ; Stopford, 2009 ; Song and Panayides, 2015). In this perspective, the « time factor » (Notteboom, 2006) in particular is probably useful to understand the survival of dhows in the region, but also their ability to bypass nowadays strict ISPS process and norms in modern ports. Indeed, any additional call in the regular line of a feeder ship adds costs and loss of time (Guy and Urli, 2006 ; Wiegmans et al., 2008 ; Ducruet and Notteboom, 2015). The competitiveness of dhows is thus dependant of such trade-offs made by big shipping lines that allow - or not - dhows to sail through the net of containers.

Thus, this paper intend to identify what economic rationale may explain the resilience of dhow traffic, contrary to Verne's assertion that « [c]ontrary to classical economic readings of trading businesses that solely follow an economic rationale, a trade journey [of a dhow] can be understood as much more than an economically driven movement between two places » (Verne, 2017, p. 134).

3. Methodology

Unfortunately, data on dhows are missing or difficult to get in most of the ports. In the absence of official statistics, a close examination of satellite pictures provided by Google-earth allows to get a rough estimation of the activity of dhows on banks of Indian ocean

countries. Indeed, dhows have characteristics that make their identification possible: their global shape, a size comprised between 15m and 50m, the presence of a castle at the stern of the boat, the shape of their clustering. We can count them and sort them by class of size. Our classification include 6 classes : very small (< 15m), small (15-20m), medium (20-25m), large (25-40m), very large (40-50m), long (40-50m). In order to avoid the confusion between fisher dhow and cargo dhows, we defined an arbitrary threshold value of 20m long under which dhows are not counted. Long dhows have been included in our census because of their presence in clusters of dhows, even if their shape does not match the usual dhow shape.

According to Ousman*, a dhow shipping agent interviewed at Djibouti, a dhow has usually the equivalent “capacity of 16 to 18 trucks”, i.e. 300-400 tons. But different classes of dhow exists, with “a 1200 tons of transport capacity for the biggest”, confirmed Mohamed*, a Somalian shipowner interviewed at Djibouti. This order of magnitude was indeed recorded in Djibouti's port data in 2017. As stated in a previous communication about Djibouti (Lendjel and Abdillahi, 2018), the biggest shipment discharged from a dhow in this port between 2014 and 2017 was 1739 tons.

Thanks to those interviews and to previous literature, we associated each class of size with an average tonnage (200t for small dhows, 300t for medium dhows, 600t for big dhows, 1000t for long dhows and 1200t for very big dhows), so as to provide a first assessment of dhows transport capacity in each country.

This implies a careful scrutiny of thousands of km of coasts and even of rivers, which would need lots of time if ports and jetties hadn't also very identifiable characteristics of shape.

Regarding our questioning about the connectivity of dhow networks, this technique is also helpful for the checking of the presence of a container terminal in the vicinity which is also a clue of the interconnectivity of those different networks. Hence, we picked up also their GPS coordinates in order to asses the distance between dhow ports and their degree of vicinity with container terminals.

But this technique of identification has many limits. Blurred pictures could mislead the identification process of dhows. Moreover, satellite pictures are taken randomly in a given year, with no regularity or coherence regarding their dates. Pictures always bear the year of the copyright, but not their exact date. For instance, the date of the satellite picture of Dubai is probably different from the one of Sharjah or Bandar Abbas... Additionally, the number of dhows can be dependent of waiting time in port, or of non-working days, and lead to a wrong appreciation of the level of activity of dhows...

Those data have thus to be considered as dubious and carefully handled.

Due to the lack of time, only a limited number of countries is included in the perimeter of our investigations. Seven of them have been fully surveyed, and 4 additional but incompletely surveyed have been included to give a clue of the extent of the dhow network (see Table 1).

Table 1: perimeter of the data

Country	Status	Cities	Ports spotted
Bahrein	Complete	2	2
Iran	Complete	38	93
Koweit	Complete	2	2
Oman	Complete	19	24
UAE	Complete	4	19
Yemen	Complete	10	22
Djibouti	Incomplete	1	2
Irak	Incomplete	1	1
Pakistan	Incomplete	2	4
Qatar	Incomplete	2	3
Somalie	Incomplete	2	4
Total général		83	176

We have identified 162 locations of dhows in 75 cities over 6 countries, and included 8 additional cities from incomplete surveys of 5 countries.

Additionally, several interviews have been done at Djibouti with port operators, shipowner, shipping agent, dockers, port authority, captain and seafarers in order to get a more qualitative insight of this activity.

Finally, connections with container line networks has been identified through container terminals of those countries and through their connections provided by container lines of the two main alliance (2M and Ocean Alliance). Those data were collected in 2018.

4. Test of the connectivity between standardized networks and local networks

The data collected allows a first appraisal of the importance of dhows in the region.

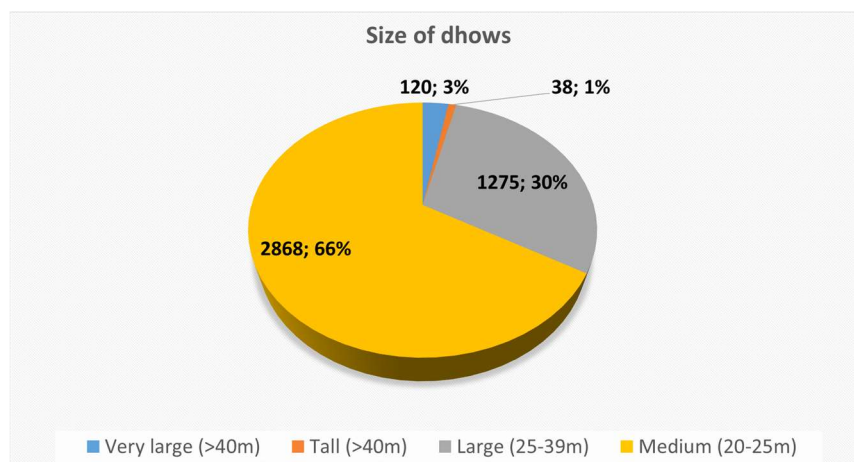
Quantity and size of dhows

Globally, we identified 4301 dhows of 20m long and more in our survey. Two third of them were medium size dhows, one third of large and very large dhows (Figure 1).

Distribution of dhows per country and city

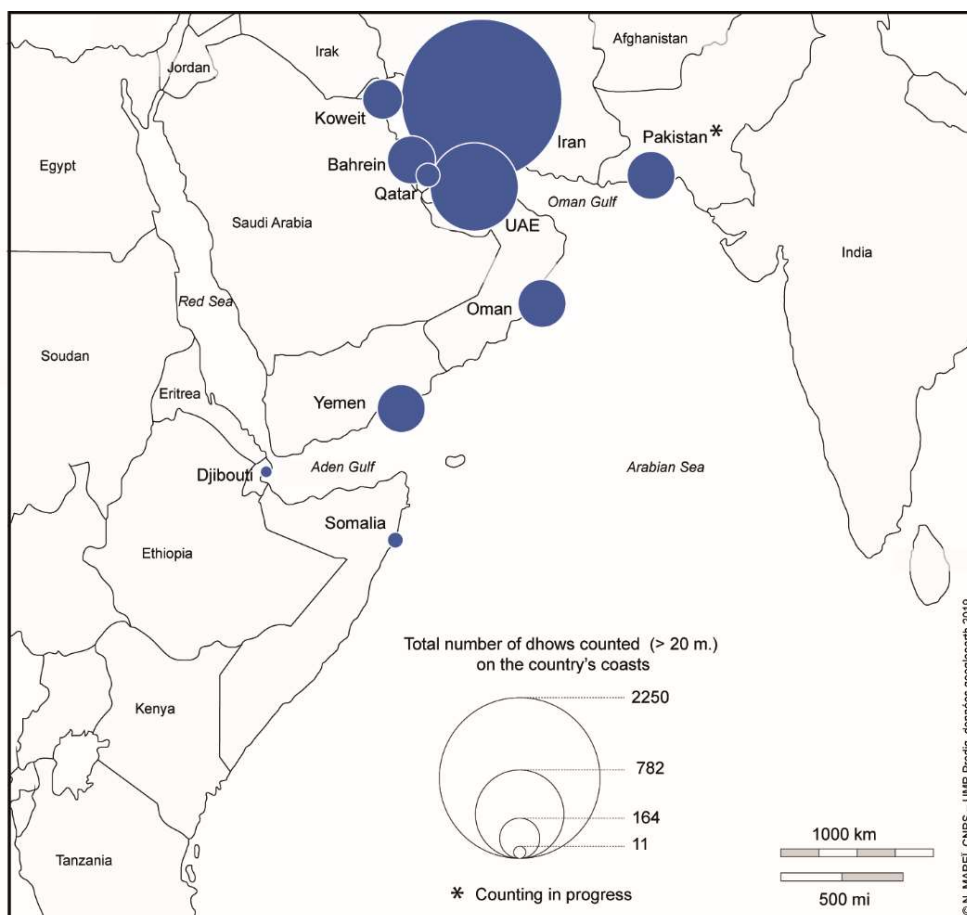
Figure 1 : distribution of dhows per class of size

Dhows are often clustered. This prevails also for the largest dhows, because only 16% of the ports host very large dhows. Those dhows are clustered in 3 cities (Sharjah, UEA; Bushehr, Iran; Al Mukalla, Yemen)



representing together 64% of the total fleet of very large dhows.

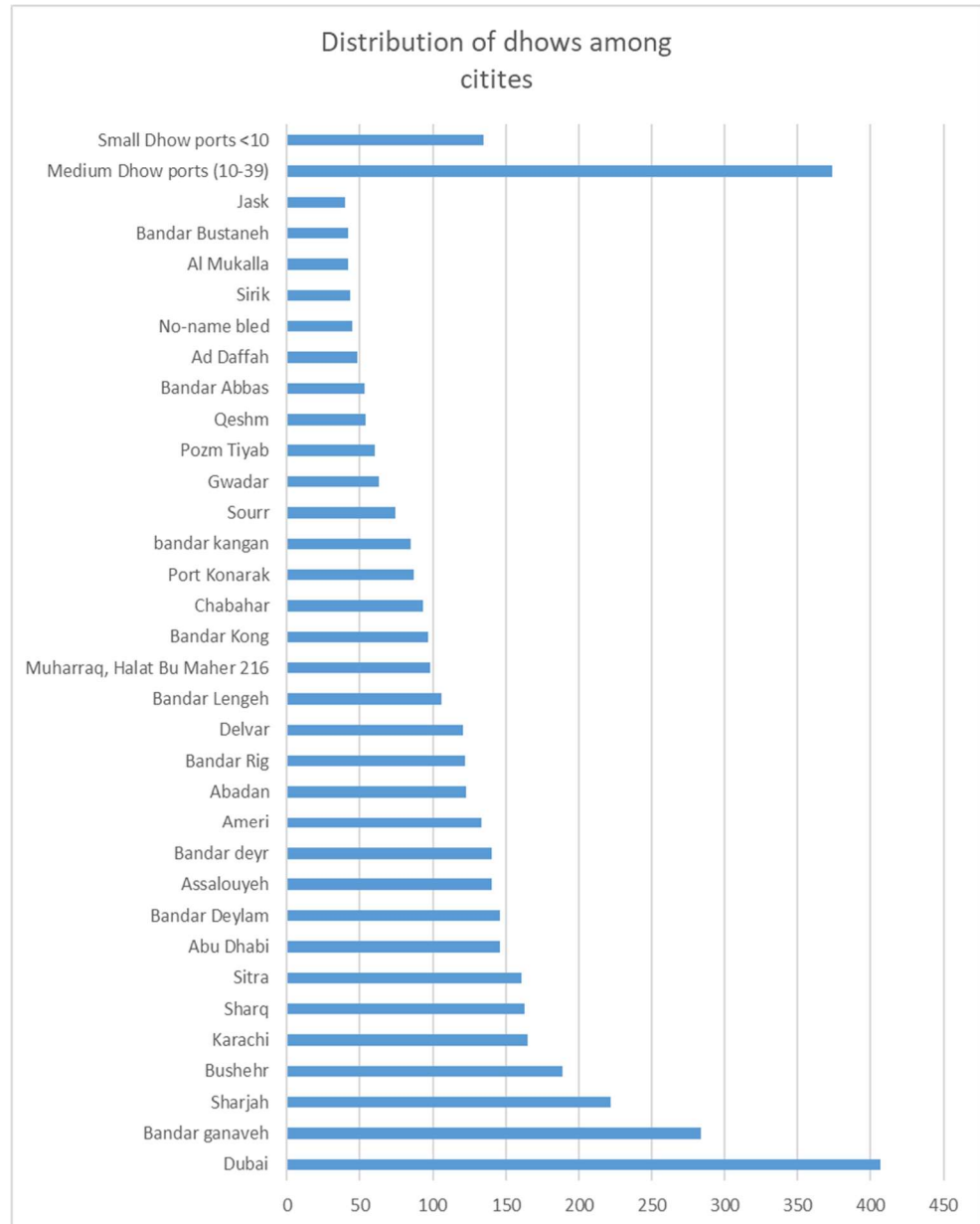
With 407 dhows, Dubai appears to be the center of gravity of the dhow network (Figure 3). But, the UAE are not the biggest country for dhows. We counted 3 times more dhows in Iran than in the UAE. 10 of the Iranian dhow ports host more than 100 dhows (Figure 2 below cons).



Thus, if Dubai may be considered as the hub for dhow transport, due to its vicinity with the main trade place of the region, Iran – probably along with the Pakistan - is the first by far regarding dhow activity

in the region (see Figure 3)¹.

Figure 3 : Dhows in the cities



But many port-cities of the region seem to play important parts in dhow business. According to the Djiboutian maritime agent interviewed, Aden is the barycenter of dhows in the Aden Gulf, even if satellite pictures do not confirm that statement with only 14 dhows seen in that port in 2019. Other places, such as Bandar Ganaveh (Iran) with its 284 dhows, Sharjah (UEA, 222 dhows), Bushehr

(Iran, 189 dhows) or Karachi (Pakistan, 165 dhows in one of his port, and probably much more in the others of this huge city) seem more relevant.

¹ But Pakistan seems also a very big country in that respect that we need to check in the next phase of this research project.

But the dhows are spread in many cities around the Persian gulf, the Indian Ocean and the red sea, even along the Euphrate river in Iran, proving thus their ability to interconnect many destinations.

Transport capacity of dhows and their productivity

To give a clue of the importance of the transport capacity of dhows, a comparison was made with the total capacity of transport - in DWT - of CMA-CGM's services in the countries within our perimeter. As expected, even with 135 times more dhows than CMA-CGM's containerships, the total capacity of dhows matches approximately this of one major container line operator in the region (2 MT for CMA-CGM in the region, vs 1,8 MT for dhows; see Table 2). Dhows are thus not as anecdotic as we could expect.

Table 2: characteristics of the dhow fleet studied

<i>Size</i>	Quantity of dhows per size class	Total capacity (in tons) of dhows per size class	Seafarers per class of dhow size
Medium (20-25m)	2868	860 400	17208
Big (>25m)	1275	765 000	10200
Tall (>40m)	38	38 000	380
Very big (>40m)	120	144 000	1440
Total général	4301	1 807 400	29228

Of course, the true measure of a transport capacity is not static but dynamic. Unfortunately, if CMA-CGM communicates about the duration of its different services that allow to compute their dynamic capacity of transport, similar data can not be found for dhows. Besides, the tramping character of dhow transport involves lots of waiting time that are difficult to assess. The dhow I visited at Djibouti in March 2019 waited 20 days to get a cargo. And, according the its shipping agent, the waiting time may last up to 2 months. Unfortunately, Djibouti's port data couldn't provide the average waiting time of dhows.

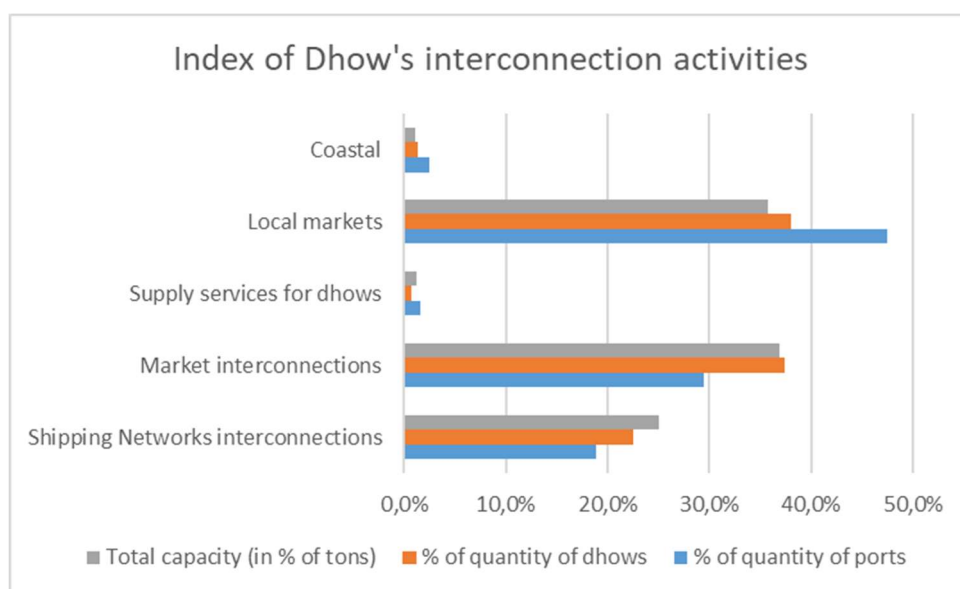
Regarding the human aspects of the importance of dhow, given several assumptions about the composition of dhow crews, we also estimated the number of seafarers for both activities. Whereas the crew of a containership has 20 seafarers (Stopford, 2009, p. 228), the smallest

dhow has 6 and the biggest 12². Thus, we're estimating the number of dhow seafarers at almost 30 000, compared to the 680 on board of the liner operator's fleet. Dhow transport is approximately 43 time more labor intensive than container transport, which implies a greater social visibility of dhow seafarers. But, with an almost similar static transport capacity, the potential level of labor productivity of a dhow seafarer is thus 43 times lower than his colleague boarding a container ship... But, of course, dhow shipping is far less capital intensive than container transport.

Shipping network interconnections

As expected, no dhow have been spotted inside any modern container terminal within the perimeter of our data. Nevertheless, dhow quays are sometimes located in the vicinity of container terminals or multipurpose terminals. A limited number of dhow ports are "connected" (in the vicinity of) with container shipping lines. Among the 86 cities studied, only 8 have a modern container terminal in the vicinity of a dhow port. Adding multipurpose ports, 19% of dhow quays are connected with shipping networks (either container lines or general cargo lines; see Figure 4 below). But in some countries, like Oman, the dhow network seems deprived of any connection with the main container terminal (Sohar, in Oman): indeed, no dhow was spotted in any port between Fujairah to Mascate (Sohar being located in the middle) over 200km of coast (or 311 km by road).

Figure 4 : neighborhood of dhows ports



When a container terminal³ is in a vicinity of a dhow port, dhows have an average bigger capacity than those mooring in the vicinity of other kind of terminals (Figure 5). In

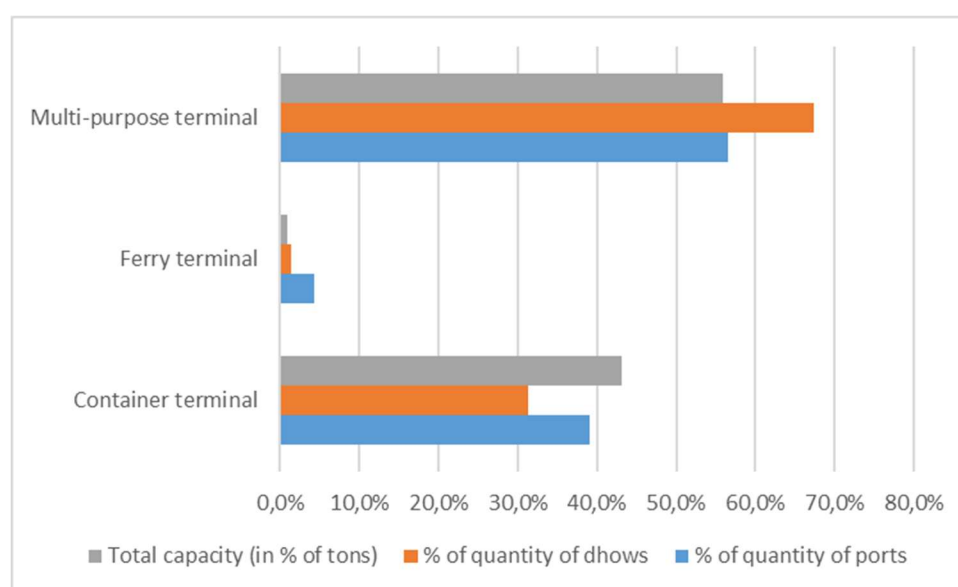
other words, scale economies of container ships have a positive effect on the size of dhows

² Interesting aspect of ICC-IMB reports are their factual aspects regarding crew and the location of the hacking of the ship. On that respect, the hijacked dhows in 2017 had both a 13-14 members crew.

³ A « container terminal » means here a terminal dedicated to the handling of containers with gantry cranes.

spotted in their vicinity, proving by this way the existence of interconnections between those networks. But the distance between dhow quays and modern container terminals is in average 21 km as the crow flies, excepted for Bushehr (Iran) and Raysut (Oman) where dhows were mooring inside the terminal. Hence, the dhow network seems clearly distinct from the container network and cannot be considered as an immediate feeding component of container lines. Commodities have to be processed through a logistic system to pass from the container network to the dhow network and conversely, involving at least one road haulage leg.

Figure 5 : Shipping network interconnections with dhow ports



Indeed, even though interconnected, dhows and containerships are usually handled on different quays (dhows are manually handled in the oldest part of ports imbedded in the city, whereas modern handling terminals are distant from the city), with different levels of capital intensity of the handling (small reach-stackers in the best case for dhows, but more frequently with only a team of dockers carrying cargoes on their back; big cranes and straddle-carriers on dedicated quays for containers), different administrative processes (straight and digitalized for containers, informal with papers for dhows) and different security norms (ISPS code for container terminal, free access for dhows). This is for instance the case at Dubai where the “dhow wharfage” is located in the vicinity of the main traditional markets, in the very center of the city whereas Jebel Ali, the container terminal, is at the periphery of the city. As Mohamed - a dhow shipowner - said in our interview in march at Djibouti, “dhows do not work at container terminals; they work where there are no container terminals, where big ships cannot come “.

But interconnections in the shipping industry are not limited to sole container terminals. Dhow quays are sometimes located in the vicinity of multi-purpose ports or ferry terminals (Figure 5). In this case, the distance (as the crow flies) between the dhow quay and the multi-purpose terminal is in average 3km, because some of them are located inside the multi-purpose port (7 dhow ports). Closer than container terminals, multi-purpose terminals seem thus to play an important role in the dhow trade. Globally, the interconnections with shipping networks display more capacity (meaning more “large dhows” and “very large dhows”) than the other interconnections (see Figure 4).

Market interconnections

If the interconnections with the other shipping networks play a significant role in the dhow economy, the most important interconnections remain those with local markets and big market places. Together, three quarter of the dhow ports are connected with them. Dhows are supplying mostly local markets (48% of the dhow ports) with small-sized boats (36% of the total transport capacity in tons) (Figure 4). And logically, big market places (30% of the dhow ports) such as Dubai are connected with larger dhows (37% of their total capacity). Hence, the importance of Dubai for the dhow trade comes probably more from its role as dominant market place in the region than from the importance of its hub role for container shipping lines.

Thus, the dhow network can itself be split into two sub-networks: one dedicated to big market places and the shipping interconnections; the other one dedicated to local markets. This was confirmed by Ousman, the shipping agent specialized in the dhow market interviewed at Djibouti. He provided the example of a “large 1400 tons dhow carrying Indian sugar from Mumbai to Djibouti once a year” for the former, and a “loop trade between Aden (Yemen) and Berbera (Somaliland) or Djibouti for the Charchari women” for the later.

Those subnetworks do not share the same perimeter of sailing. Thanks to their size, “only very large dhows can cross the Indian Ocean to the Pakistan or India; the others are limited to the dhow season (7 months a year) and to coastal shipping in the Red Sea the the Aden Gulf due to the wind and the sea instability” said Mohamed, a dhow shipowner.

For populations mainly located by the seaside, short sea shipping appears to be the most convenient way to supply them. But the level of economic development and of highways connections also matters, because the more the value of time increase with this level, the more the road haulage is chosen in the detriment of short sea shipping (Bergantino and Bolis, 2008). In the case of Oman, we already pointed out that we spotted no dhow in any port between Fujairah to Mascate over 200km of coast. But this area is precisely the most populated area of the country, Salalah excepted. Likewise, in Iran, most of the population is

located inside the country and not along the shore. In other words, dhows are supplying markets of small groups of isolated populations.

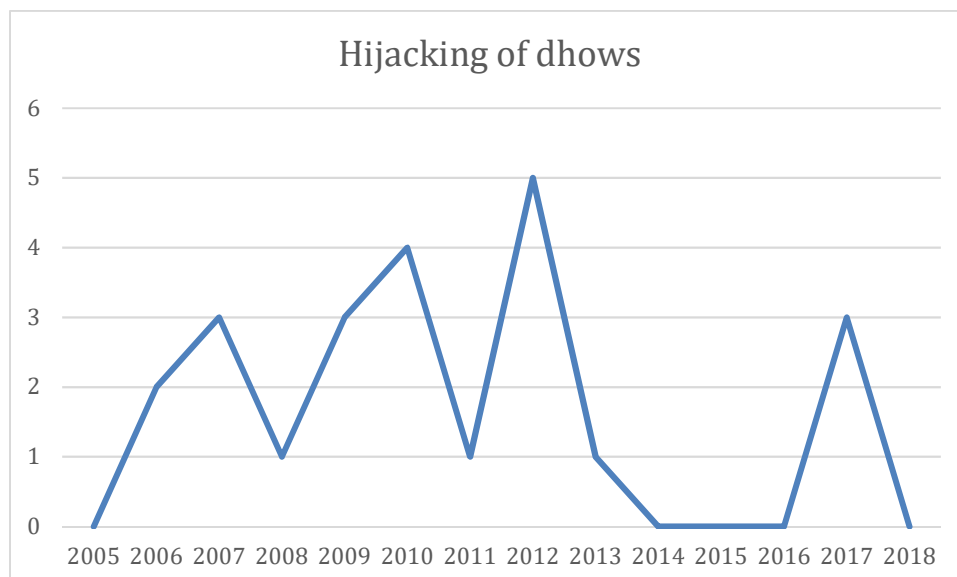
Geopolitics and security : opportunity or threat for dhows?

With the importance of dhows in Iran, we cannot avoid to wonder if the long blockade of Iran is not the root of the survival of the dhow business. Indeed, lots of dhows are mooring in the vicinity of small cities along the Iran coast. But with 75M inhabitants, Iran is not a small country and the importance of the demand is largely enough to generate an important short sea shipping through the Persian gulf, even without a blockade.

Likewise, a major container operator such as CMA-CGM no longer serves Yemen ports for security reasons. Miss Abdourahman Cher, the commercial General Manager of the Doraleh multi-purpose port of Djibouti, stated in an interview we made in march at Djibouti that “shippers use dhows to send their shipment to Yemen instead of container ships through Al Hudaydah”. Hence, “small is beautiful” for avoiding war risks and minimizing the consequences of the potential loss of cargo for shippers.

Conversely, dhows are also victims of piracy, as stated in last ICC-International Maritime Bureau reports. Over the last four years, dhows have been hijacked 3 times in 2017, in regression compared to the previous period (see Figure 6).

Figure 6 : Hijacking of dhows (2005-2018), ICC-IMB Data;



Source: ICC-IMB 2010, 2015, and 2019.

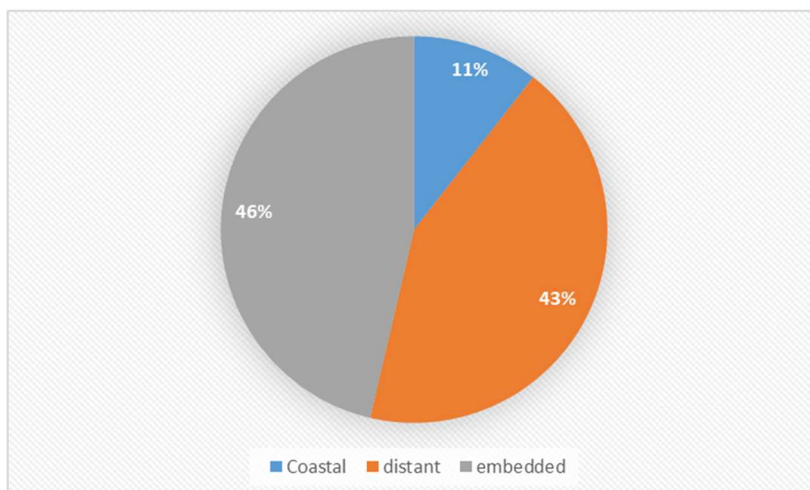
Thus, except near the Somali coasts, dhows are sailing relatively safely and are a reliable mode of transport.

5. Level of inclusion of Dhow ports in the city [part still on-going to achieve]

The embeddedness of the port and its proximity to traditional markets is probably part of the explanation of the survival of dhow trade.

As mentioned earlier, dhow quays are not located inside container terminals, but close to market places. Dhow trade appears here as a very simple and convenient way to make business. Its proximity allows to diminish transaction costs, waiting time and organization costs for shippers. And their availability helps to maintain the lowest price of transport.

Figure 7 : index of embeddedness of dhow ports



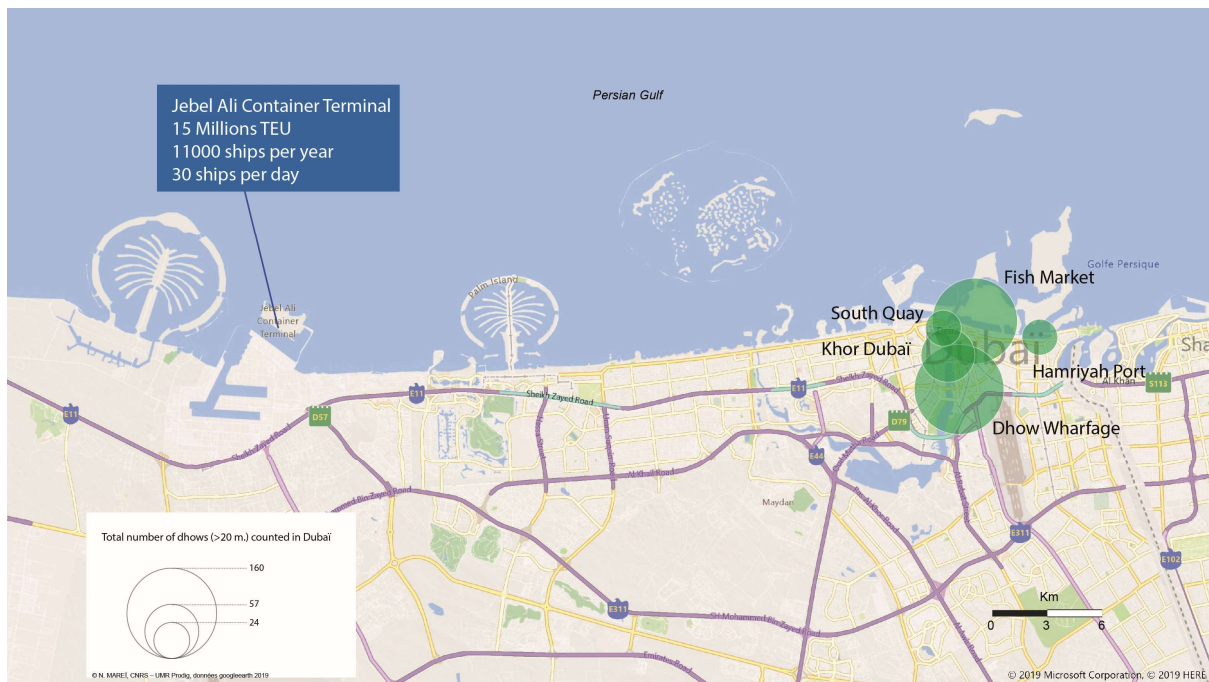
The high labor intensity of dhow is also part of this proximity. No fences prohibit the access to dhows. Dhow quays are in majority (46%, if we include dhows spotted off-shore, 52% if we don't) inside/embedded in the

cities (see Figure 7 below cons). Dubai Dhow warfage is the most famous example of this embeddedness.

As can be seen on the map (see figure 8), the 407 dhows are all located in 5 different quays of the inlet of the channel Khor Dubai. Their clustering helps the organization of their handling and diminish the searching costs for brokers, shipping agents or freight forwarders. It even probably diminishes the number of brokers and intermediates involved in the standardized process of container transport. Dhow transport appears as a low cost process compared to container transport. But a closer inquiry need to be done to allow such analysis.

Dhows are part of old, non-standardized traditional activities of ports before the containerization, before the new generation of ports that have left the cities for the sake of space and do not deal with dhows because of ISPS norms.

Figure 8 : Map of the localization of dhows at Dubai's port Rashid



Basically, the map highlights the existence of a dual maritime transport that continues in the region, with an old capillary distribution in parallel of containerized networks, out of cities.

Conclusion

The comparison of the container with the dhow is interesting, because it helps to understand what one pays with the container, which finally may be more expensive than the dhow: the willingness to pay for the normalization in all its aspects. The addition of all costs (transport costs, transaction costs, bureaucratic costs) has not been made here but one can easily imagine the pros and cons of dhow trade compared to the standardized transport of container.

A full understanding of the maritime industry implies to include even niche market and alternative shipping models. Unfortunately, academic literature has tended to neglect in preference for more prominent modes and market such as containerized trade. Shipping is indeed imbedded in local and regional institutions (in the sense of the neo-institutionalist approach) such as those examined in the paper and this needs to be taken into account for a deeper understanding of maritime issues.

Additionally, this paper may contribute to reevaluate the optimal size of ships and their network configuration in the short-sea shipping business.

On a sociological standpoint, this paper may also contribute to understand the role of hub ports and local network for the social acceptance/diffusion of cargo through a local normalization process.

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