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MARITIME WORLD CITIES:

DEVELOPMENT OF THE GLOBAL MARITIME MANAGEMENT NETWORK.

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Abstract:

This paper extends the current scientific state of the art concerning maritime world cities through an update of the general literature on world cities and maritime world cities, by adding new calculations using the management structure of container as well as bulk operators and finally a confrontation of these results with the actual communication networks. This research firstly uses the methodology for identifying world cities developed by the Globalization and World Cities (GaWC) research group. This GaWC methodology presumes regular contacts between all offices of a global company as self-evident. New calculations are made for the management of container flows in 2009 and 2012. A second exercise calculates the maritime city network based on the management of bulk transport operations. Finally, interviews with the managing directors of the Antwerp branches of the 20 major global container lines revealed the actual communication patterns between their offices. For container terminal operations, it is found that Hong Kong, Singapore, Tokyo and Shanghai in Asia, Hamburg in Europe and New York in the Americas became the most important cities in 2012. The major cities for bulk transport operations management are Singapore, Tokyo and Shanghai in Asia, London in Europe and New York in the Americas. The results also suggest that the bulk network is less integrated and globalized than the container network. The interviews show that the GaWC methodology using the management structure of container liner companies gives a good proxy of the contacts between maritime cities. Some caution is however advised as contacts from Antwerp with offices in nearby ports such as Rotterdam and Hamburg are underestimated by the GaWC methodology. In contrast, contacts with cities located at larger distance where fewer headquarters are located were overestimated. As a result, it is advised to policy makers to attract a sufficient number of important maritime offices to obtain the status of maritime world city.

Keywords: maritime management, world cities, GaWC, container transport, bulk transport operations, corporate communication

1. Introduction

The significance of individual cities in the global maritime industry can be defined in various ways. It is commonly indicated by statistics on port traffic which is an important measure of trade-related activities. However, the provision of shipping to support trade is also depending on a wide array of shipping management and maritime service functions which can be performed in locations far from the physical trading activities. Cities where global companies collocate, enable information and knowledge sharing which can create synergies, and subsequently these cities get integrated into networks through globalized companies (Sassen, 2013). Therefore, an alternative perspective on the role of cities in the maritime industry is worth considering.

The approach of *Globalisation and World Cities* [GaWC] provides a suitable methodology in which cities are analysed in terms of their global capacity and network connectivity for business services provided by financial, legal, accountancy and advertising global companies (Beaverstock et al., 1999; GaWC, 2014; Taylor, 2001; Taylor et al., 2002). In order to serve clients in the whole world, advanced producer services firms (APS) have a global network of offices in cities around the world that act as hubs. Information, knowledge and other resources are concentrated in these hubs and shared (Brown et al., 2010; Zook and Shelton, 2012). Firms benefit from the presence of specific knowledge and other international companies in the city. GaWC ranks cities according to the number of offices of global companies in each city, weighted by the strategic role and the employment size of the office in the global company (headquarters are most important, while the presence of only an agent is the least important); this information is gathered through official websites, annual reports and eventually interviews with managers of the global companies.

Maritime transport is an important factor in the formation of intercity networks (Bretagnolle and Pumain, 2010; Friedmann, 1986). Port cities became specialized nodes in long-distance trade. Verhetsel and Sel (2009) applied the GaWC methodology on global container firms in order to produce the maritime world cities network. Maritime advanced producer services are not only attracted by the throughput of a port, but mainly by the presence of other maritime companies. Although being competitors, they need to exchange specific knowledge, so port cities tend to concentrate maritime and other APS firms (Jacobs et al., 2010). Especially for port operations, proximity of a port city is important to provide some specialised services such as brokerage, maritime insurance and classification (Jacobs et al., 2011). The recent financial crisis and changes in the structure of individual container lines because of concentration through mergers, acquisitions and alliances (Harlaftis and Theotokas, 2006; Hayuth, 2007) justify an update of the management network of container lines. This would make it also possible to verify whether global cities become more maritime in nature, or whether the necessity of maritime activity for world cities decreases. One can also wonder whether important differences exist between container and bulk management networks. The term container and bulk management refers to the activities in the offices of the firms that coordinate respectively container and bulk shipping and terminal operations. The present article will distinguish among *container maritime world cities* and *bulk maritime world cities*, each representing a different dimension of maritime world cities. These long names are shortened in this article to *container world cities* and *bulk world cities* to guarantee fluent reading of the text. The authors are aware of critiques on the GaWC methodology addressing the underlying assumption that presumes intensive communication between all the different offices of global companies (Halbert

and Pain, 2010; Rozenblat, 2010), so finally the question is raised in this paper whether the presumed communication patterns reflect the actual communication.

The paper is divided into seven sections. Section 2 gives an overview of the recent existing literature concerning world cities and the maritime industry, and it also refers to the GaWC approach and its critiques. Section 3 presents the used methodology. Section 4 examines evolutions in the management of container flows and their impact on the structure of the maritime world cities network. Section 5 analyses the management network based on the location of the offices of global companies engaged in bulk shipping. Section 6 elaborates on the critiques of GaWC approach: presumed and actual communication will be compared. In the last section some conclusions are formulated, taking into account suggestions for further research and policy implications.

2. Literature review

On the list of GaWC World Cities in 2012 far more cities appear than twelve years before (GaWC, 2014, 2009a). Especially in Asia, Eastern Europe and Latin-America new world cities developed. Hanssens et al. (2011) call this the shift from west to east. Eight out of the ten biggest GaWC cities in 2012 are important port cities. Nevertheless, there are important world cities like Paris and Chicago with few port activities. Maritime transport and trade have always been one of the major forces that contributes to the formation of strongly integrated networks between cities (Friedmann, 1986). As Zhang and Lam (2013) show in their maritime cluster typology, different types of maritime cities emerge from maritime clusters ranging from pure cargo handling places to maritime service and management centres. This article focuses on the latter type. As more differentiated networks come together in a city, connectivity increases even more (Pflieger and Rozenblat, 2010). A first question to be answered is how much the GaWC ranking, based on the location of APS global firms, coincides with the ranking of maritime world cities?

Containerisation is an important materialisation of a globalising economy, characterised by a fragmentation of production and consumption. Because of increasing containerisation since the 1970's in the USA and afterwards in Europe (Rushton et al., 2010), maritime mass transport became an important trend. Container transport has grown rapidly since 1995 in growing economies like China, whereas this growth was slower in mature economies like Japan and the USA (Baird, 2007). Despite a small decline after the financial crisis, container traffic reached its highest level ever of 572.8 million TEU in 2011, a rise of almost 6% compared to 2010 (UNCTAD, 2013). Meanwhile container liners form big conglomerates through mergers, acquisitions and especially alliances (Low et al., 2009). Liner companies operating containers are organised in a large global network in order to achieve greater efficiency (Lun et al., 2009). This raises the second question: how developed is the maritime network of container operating companies after the financial crisis of 2008? In other words, which are the container world cities?

Another important type of freight transport displaying globalisation in world trade is bulk shipping, where shipping large consolidated masses of cargo such as oil, iron ore, gas, grain and coal leads to transport cost savings. According to Harlaftis and Theotokas (2006), the management networks of bulk shipping are less globally integrated than those of liner shipping: they are more regionally organized. The analysis of the location and network structure of bulk shipping companies enables a comparison of the network of bulk managing companies with the GaWC ranking and the city network of container operating companies.

A major assumption of the GaWC approach is that an office of a global company is having contact with all the other offices regardless the important influence of size and distance. However some critiques arise. Watson and Beaverstock (2014), Rozenblat (2010) and Halbert and Pain (2010) argue that quantitative research has to be supported by qualitative analysis and insight. This would make it possible to understand how communication is really organised in and between firms. Halbert and Pain (2010) find in their research on APS firms that a lot of interactions presumed by GaWC do not exist. Through interviews the real interactions, behaviour of individuals and actual flows can be traced (Watson and Beaverstock, 2014). In order to address these critiques ourselves, after measuring the maritime network quantitatively, a qualitative approach is applied in section 5 in order to distinguish between presumed and real interactions in the container shipping sector. In other words, this qualitative approach allows identifying actual maritime corporate communication, which could contribute to building an enhanced framework for combining qualitative and quantitative methodologies in world city network research.

3. Methodology

In this section, first the GaWC methodology to identify maritime world cities is described. This methodology presumes regular contacts between offices of a company in different cities. To verify the assumptions of the GaWC methodology, in the second part qualitative interviews were organised to compare actual and presumed contacts between cities.

3.1. Identifying maritime world cities through the GaWC methodology

The methodology to gather information and to unveil the network characteristics of container and bulk maritime networks is described in general by GaWC (Beaverstock et al., 1999; GaWC, 2014; Taylor, 2001; Taylor et al., 2002) and for maritime cities more specifically by Verhetsel and Sel (2009).First, the global capacity or service level is calculated in order to describe the evolution of the importance of maritime cities. Next, the connectivity between these cities is calculated and compared to the results of previous studies.

The first characteristic of world cities that is calculated, is the global capacity or service level *Cj*. This is the sum of the service values for all global container or bulk service companies in one city (Beaverstock et al., 1999). As was done by Verhetsel and Sel (2009), we calculate the service level from matrix *V* with *i* rows representing the global firms and *j* columns, one for each city. Each service value v_{ij} can range from 0 to 7. To attribute the service value a distinction is made between headquarters, regional offices and subsidiary headquarters, all based on size, number of employees and offered services. It is expressed through a value ranging from 0 (no office) to 5 (headquarters), and in the case of container lines two points are added for the presence of own terminals, weighted by their share of ownership. To obtain the needed detailed information on offices and their size, websites, annual reports and if necessary managers of the included companies were consulted. The aggregate *Cj* is calculated as follows: $C_j = \sum_i v_{ij}$.

To obtain the second characteristic of world cities, the connectivity, we calculate the relational element $r_{i,ab}$ between cities *a* and *b* for firm *i*, using again data from matrix *V* as follows: $r_{i,ab} = v_{ia} \cdot v_{ib}$. Afterwards, these values are summed over the firms *i*, to calculate the interlock link between cities *a* and *b*: $r_{ab} = \sum_i r_{i,ab}$. To arrive at a proportional value p_{ab}, we divide r_{ab} by *H*, calculated as

$H = \sum_i {h_i}^2$ where h_i is the highest service value provided by firm *i* across all the cities where this company is present. In this way we get to $p_{ab} = r_{ab}/H$ (Verhetsel and Sel, 2009).

3.2. Comparing observed and presumed contacts between cities using qualitative interviews

As the authors are aware of critiques on the GaWC approach concerning the assumption that equal communications exist between all offices of a global firm, interviews were organised to check these presumed and real contacts (Halbert and Pain, 2010).

This research was carried out by interviewing the responsible managers of the 20 major container liner offices in Antwerp. They were asked in interviews of 15 to 20 minutes to give an overview of the own offices in other cities that are contacted on a regular basis. Further, information was asked about the frequency of communication, the way of contact and the function of the exchanged information. These three components are each divided into three categories (**Error! Reference source not found.**). For the type of contact, written communication involves email, letters and fax. Spoken communication includes telephone and voice over IP methods. An extra aspect of communication is nonverbal communication, that can only be transmitted through face-to-face meetings and video conferencing (Littlejohn and Foss, 2009). The function of contact makes a distinction based on the importance of information exchanged. Routine contacts deal with the pro forma exchange of paper work and standard procedures. Commercial and operational contacts take place when information about a customer or about the operation of ships and containers is exchanged. Strategic communication is the highest level of communication and allows organisations to communicate about their strategic positioning in the market.

Table 1: Categories for each component of contact

Value	Frequency (M_{ij})	Type (T_{ij})	Function (F_{ij})
3	Weekly or more	Written, spoken and non-verbal communication	Strategic
2	More than monthly, but less than once a week	Written and spoken communication	Commercial and operational
1	Only a few times a year	Written communication only	Routine

Every factor X_{ij} in **Error! Reference source not found.** denotes a characteristic of the contact between Antwerp and city *j* within firm *i*. After weighing and summing the factors X_{ij}, a city gets a weighted score P_{ij} (between 1 and 3), which indicates the contact intensity of the Antwerp office of company *i* with its office in city *j*. The value '0' is also a possibility in cases where no contact with that city is available within a company.

$$P_{ij} = \alpha_M M_{ij} + \alpha_T T_{ij} + \alpha_F F_{ij}$$

The weights of frequency and function are set to 0.4 and the weight of type to 0.2, as the latter is thought to be less important. Companies in fact are quite well acquainted with exchanging information efficiently using different types of information channels. Nonetheless, the type of communication gives a good indication of quality and is thus still included in this analysis. The function of the information however makes a better distinction concerning the importance of contacts. It can also be assumed that more frequent contacts play a more important role than

occasional contacts in the management of a business. One always has to make sure that $\alpha_M + \alpha_T + \alpha_F = 1$ to end up with a P_{ij} value between 1 and 3. In order to test the sensitivity of the results, the weights were also set to 1/3 for each α_i, which resulted in the same outcome. In order to find the intensity P_j of the link between Antwerp and city *j*, one has to sum the P_{ij} over the firms *i*.

$$P_j = \sum_i P_{ij}$$

When the most important city's P_j's are obtained, a classification is made of the actual contacts between Antwerp and the other cities *j*. This can be compared with the links between Antwerp and the other cities predicted by the GaWC method. In order to make sure that possible bias from data collection for the GaWC method is reduced, the managing directors of the Antwerp branches were also asked to review the different scores of their offices, upon which few adaptations had to be made.

4. Evolutions in the management of the container maritime network (2006-2012): identification of container world cities

To make a comparison with previous research, information for 2012 is gathered in a similar way as in Verhetsel and Sel (2009) and Van Hove (2009). This allows comparing the network structure over time. The analysis of global capacities in the container maritime network is followed by a discussion of the connectivity.

4.1. Service levels: concentration of container maritime services in cities

In order to calculate service levels of cities, service values of the container service companies included in

Table 2 are used. Notice that not only container lines but also some container terminal operators are included. To select the global container lines, the 75 lines with the highest capacity (Alphaliner, 2012) are evaluated on their international character. They have to feature more than 15 international offices and they have to be represented in the three major global regions: North-America, Europe and South-East Asia. Some different container lines are selected compared to the previous studies. After 2006, CP Ships was taken over by Hapag-Lloyd, while Delmas became part of CMA-CGM. MISC Berhad, IRISL Group (as HDS Lines in 2009) and Rickmers-Linie were still included in 2006 and 2009, but are excluded here, as they no longer fulfil the globalisation criteria. Compañía Chilena de Navegación Interoceánica S.A. (CCNI), Maruba, Sinietrans, Chipolbrok and TBS were already excluded in 2009. A new company included here is STX Pan Ocean. As far as the terminal operators are concerned, the same four global companies as in the previous studies are included and were selected from DREWRY (2010).

Company service values *Fi* displayed in

Table 2 are calculated as the sum of the service values over all cities of one company; these are determined by the number of offices in a city and their service value (1-5). Maersk, MSC and CMA CGM are clearly the most globalised service companies for maritime container transport in 2012. An overview of the top 20 container world cities is given in Table 3, together with their respective positions in 2006 and 2009 and their positions in the GaWC ranking of 2004 and 2012. Calculations are based on a matrix *V* containing 26 firms and 281 cities. Table 4 gives an overview of the world ranking of ports by throughput in 2011, extended with the respective positions in 2009 and 2005.

Table 2 : Included container companies (ranked by capacity for container lines) and company service values (2012)

Company (capacity)	Fi
Maersk Line (2,628,023 TEU)	527
Mediterranean Shg Co (2,211,911 TEU)	502
CMA CGM Group (1,362,323 TEU)	528
COSCO Container L. (715,545 TEU)	329
Evergreen Line (681,995 TEU)	357
Hapag-Lloyd (649,424 TEU)	370
APL (602,279 TEU)	359
CSCL (580,453 TEU)	311
Hanjin Shipping (567,754 TEU)	248
MOL (510,863 TEU)	292
OOCL (429,859 TEU)	230
Hamburg Süd Group (415,344 TEU)	261
NYK Line (401,989 TEU)	320
Hyundai M.M. (365,309 TEU)	360
K Line (351,405 TEU)	274
Yang Ming Marine Transport Corp. (342,654 TEU)	266
Zim (326,156 TEU)	320
PIL (Pacific Int. Line) (301,823 TEU)	288
UASC (267,938 TEU)	248
CSAV Group (261,559 TEU)	255
Wan Hai Lines (168,816 TEU)	171
STX Pan Ocean (Container) (39,607 TEU)	37
Hutchison Port Holdings (HPH)	48
APM Terminals	69
PSA International	42
DP World	79

Source: Own composition and calculations based on (Alphaliner, 2012)

Table 3 : Container world cities : service levels Cj - Top 20

Category	City	Cj 2012	Rank 2012	Rank 2009	Rank 2006	GaWC rank 2012	GaWC rank 2004
Alpha 1	Hong Kong	88	1	2	1	3	3
	Singapore	79	2	1	3	5	6
	Shanghai	73	3	5	4	6	23
	Tokyo	72	4	12	5	7	5
	Mumbai/Nhava-Sheva	70	5	6	17	12	33
Alpha 2	Seoul	67	6	8	9	24	24
	Hamburg	67	7	3	2	54	43
	Dubai	64	8	27	18	10	51
	Rotterdam	60	9	10	10	116	95
	New York/New Jersey	60	10	7	6	2	2
	Antwerp	60	11	13	11	109	129
Beta 1	Taipei	59	12	11	19	41	25
	Los Angeles/Long Beach	57	13	24	36	18	15
	Ho Chi Minh City	55	14	17	25	70	110
	Bangkok/Laem Chabang	54	15	14	7	38	27
	Kaohsiung	50	16	40	28	241	>200
	Genoa	50	17	16	14	268	195
	Busan	50	18	19	>50	279	>200
	Qingdao	50	19	20	13	193	>200
	London	50	20	4	8	1	1

Source: Own composition and calculations based on (GaWC, 2009b, 2014; Van Hove, 2009; Verhetsel and Sel, 2009)

Table 4 : World ranking of ports by throughput (TEU)

Ranking 2012	Port Name	Total TEU 2012	Rank based on total TEU 2009	Rank based on total TEU 2005
s1	Shanghai	32.529.000	2	3
2	Singapore	31.260.000	1	2
3	Hong Kong	23.117.000	3	1
4	Shenzhen	22.940.130	4	4
5	Busan	17.040.567	5	5
6	Ningbo	16.175.000	8	15
7	Guangzhou	14.763.600	6	18
8	Qingdao	14.503.000	9	13
9	Dubai	13.280.000	7	9
10	Tianjin	12.303.000	11	16
11	Rotterdam	11.865.916	10	7
12	Port Klang	10.001.495	13	14
13	Kaohsiung	9.781.221	12	6
14	Dalian	8.917.000	22	28
15	Hamburg	8.891.560	15	8
16	Antwerp	8.653.169	14	12
17	Los Angeles	8.077.714	16	10
18	Tanjung Pelepas	7.718.818	17	19
19	Xiamen	7.201.700	19	21
20	Tanjung Priok	6.460.000	26	22

Source: (Containerisation International, 2014; UNCTAD, 2010; Verhetsel and Sel, 2009)

A comparison of Table 3 and Table 4 reveals that the rank of cities according to their management service level differs from their rank by TEU throughput. As Cartier (1999) noted, some maritime activity centres do not have an important port anymore. The first six cities ranked by service level in

Table 3 are all Asian. In

Table 4 the top three ports (ranked by TEU) are the same top three as for the container world cities. Moreover the eight most important ports are all Asian. Nonetheless, Shenzhen, Ningbo, Guangzhou and Tianjin are not included in the top 20 of container world cities in 2012. The first European city in the list of container world cities is Hamburg in the seventh position, followed by Rotterdam (9th) and Antwerp (11th). As far as North-America is concerned, New York is ranked highest on the tenth position, followed by Los Angeles (13th). South-American, Oceanic and African cities are not in the top 20 of container world cities.

As compared to 2006 and 2009 (

Table 3), Hong Kong and Singapore have always been part of the top three container world cities. Hamburg, where two container operators have their headquarters, fell back because of the growing importance of the Asian ports and especially Shanghai, a tendency also observed in the ranking by throughput. This is also the case for New York, whereas Rotterdam and Antwerp can retain their position near the top ten. The decrease of the absolute importance of New York may be linked to the increasing importance of other cities in North-America, mainly Los Angeles. After a decline in 2009, Tokyo regained a top five position in 2012. This top five is completed by Mumbai, confirming its leap since 2006 through increasing presence of regional offices despite the absence of headquarters of the major container service operators. It is closely followed by Seoul, another Asian city that is steadily increasing as a maritime city but where no container terminals are present, which also confirms its minor importance in throughput. Even bigger moves forward are observed in the cases of Taipei, Los Angeles and Ho Chi Minh City.

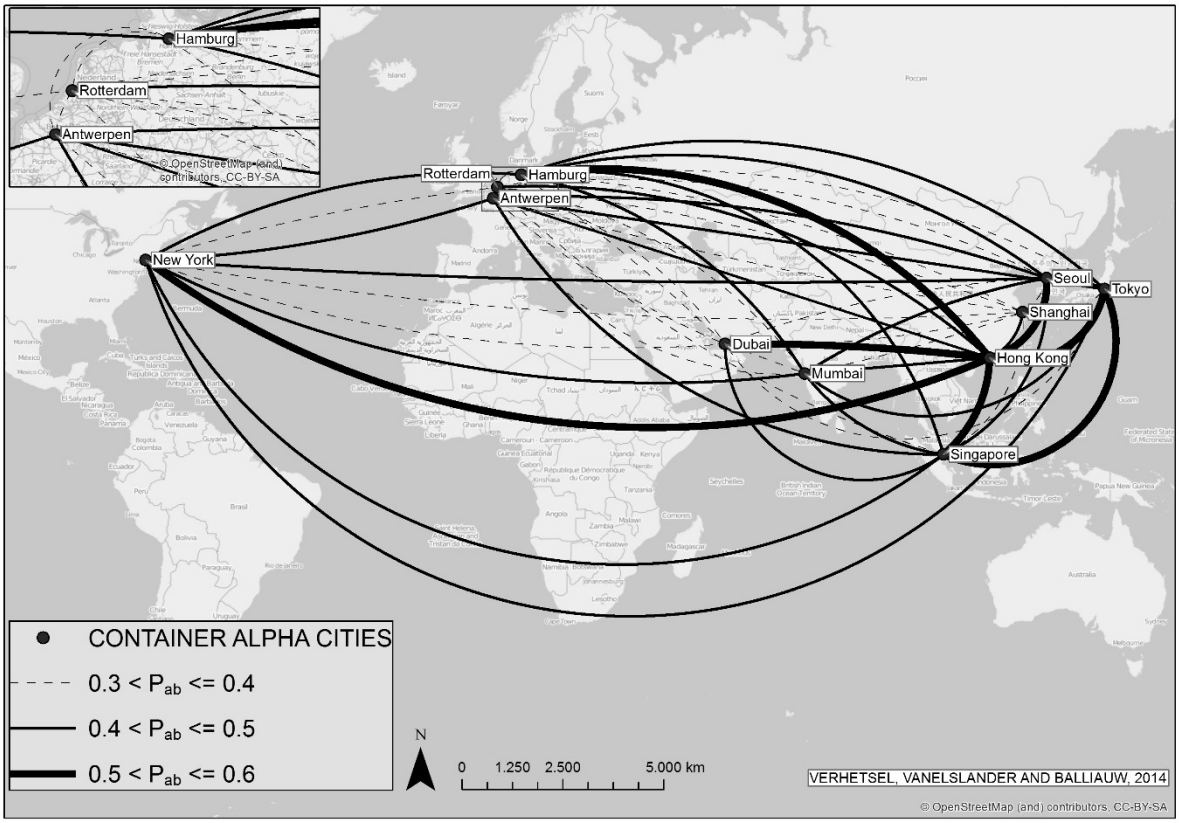
A comparison with the 2012 GaWC world cities ranking (Table 3) indicates that Hong Kong, Singapore, Shanghai, Tokyo and also Dubai are important maritime world cities also appearing in the global top ten of GaWC. London on the contrary, the most important global city, is only the 20th in the maritime ranking. In addition, New York with its second position in the global GaWC ranking is only the number ten in the maritime container ranking. This indicates that their maritime services are relatively weak compared to the high presence of classic APS.

4.2. Network and connectivity of container maritime Alpha cities

Figure 1 gives an overview of the container Alpha network, illustrating the importance of the links between cities. It is constructed using data of the 11 Alpha container world cities and the five biggest container lines ranked by service values (Maersk Line, MSC, CMA-CGM, Evergreen and Hapag-Lloyd). Evergreen (service level 357) was chosen above APL (service level 359) because Evergreen has a clear global management structure, while APL works rather with a series of local operating offices.

The triangle of Tokyo, Hong Kong and Singapore is strongly integrated. Also Seoul is strongly connected to this triangle. Mumbai and Shanghai however are less strongly integrated in this Asian network. Their connections are similar to the connection between Dubai and the Asian triangle. Hong Kong is a very important node in the network, as the strongest connections to the other continents involve Hong Kong. For Europe, the strongest connection is made with Hamburg. As opposed to the strongly integrated Asian network, contacts within the European network are apparently less intense. For North-America, there is a strong connection between Hong Kong and New York.

Figure 1 : Container Alpha cities network (2012)



Source: Own composition (based on Annex 1)

Compared to the network of 2006, calculated by Verhetsel and Sel (2009), the network of container maritime Alpha cities is bigger and more strongly integrated. The increased amount of transported goods and the increasing number of mergers and acquisitions, as well as alliances and slot-exchange agreements between liner companies can account for these observations (Low et al., 2009; UNCTAD, 2013). More communication is necessary to coordinate bigger companies and extended alliances. This also requires more offices to coordinate activities in different areas.

For this reason, Hong Kong is still seen as the most important container world city in 2012, if we look both at the service level and connectivity. The shift from west to east for GaWC world cities (Hanssens et al., 2011) is thus also confirmed for container maritime services. Verhetsel and Sel (2009) considered Hong Kong, New York and Hamburg as the most important maritime cities in 2006. The three most important container cities in 2012 are all Asian cities: Hong Kong, Singapore and Tokyo. Shanghai, a main maritime Alpha city, has a high global service level, but surprisingly it is rather loosely connected to the Alpha network of container liner companies because the top 5 operators are weakly represented there. For Europe, the main hub remains Hamburg and for the Americas, New York is occupying this central role.

5. Evolutions in the management of the bulk shipping networks (2009-2012)

This section analyses the evolution of the bulk shipping network, both dry and liquid. The same methodology as applied to container lines and terminal operators is used for the network of bulk shipping companies, with the exception that container terminal operators are replaced by mining companies (ENERGY DIGITAL, 2011), as they host the most important amounts of terminal activities in the dry bulk sector's transportation (Ceulen, 2010, p. 52). For liquid bulk, the fuel providers having own maritime transportation activities are included. To calculate the service levels, the value '3' is attributed to an important bulk office, '2' is the value for a small bulk office and '1' is the value assigned to a liner office that refers to other offices for bulk activity (mostly container lines or operators that also offer some bulk transport operations). Firstly, a calculation of the global capacity shows the evolution of the importance of bulk world cities. Next, the connectivity between the main bulk world cities is studied and compared to the results of previous research (Ceulen, 2010).

5.1. Service levels

Table 5 lists the bulk shipping companies included in the research. The same criteria as those of Ceulen (2010) are used: bulk shipping and mining companies with a global strategy (represented in the three major globalised regions) and at least five own offices. Only five offices are required for bulk world cities because the bulk business is much less globally organised than container business (Harlaftis and Theotokas, 2006). When the service values of the different companies *Fi* are calculated as the sum of the service values for all cities where a company is located (Table 5), it results in a top seven that is solely composed of companies that are also offering container services. In addition there is a wide gap between the *Fi*'s of these seven companies and Stolt-Nielssen, the first exclusive bulk company. The *Fi*'s in Table 5 are also much lower than those in

Table 2 for container operating companies. This confirms that bulk shipping companies are less globally organised than container shipping companies.

Table 5: Included bulk shipping and operating companies (service level)

K Line (Fi = 265)	Grieg Shipping A/S (Fi = 32)
China Shipping (Group) Company (Fi = 253)	SK Shipping (Fi = 32)
Hanjin Shipping (Fi = 236)	Exmar (Fi = 31)
MOL (Fi = 196)	TBS Shipping (Fi = 29)
China Ocean (COSCO) (Fi = 139)	Berlian Laju Tanker (Fi = 29)
NYK Line (Fi = 125)	Egon Oldendorff (Fi = 28)
APM-Maersk (Fi = 116)	Tokyo Marine Co Ltd (Fi = 27)
Stolt-Nielsen SA (Fi = 77)	Palmali Shipping (Fi = 26)
Vale S.A. (Fi = 64)	Pacific Carriers (Fi = 24)
Odfjell ASA (Fi = 59)	Angelicoussis Group (Fi = 23)
STX Pan Ocean (Fi = 57)	Sovcomflot Group (SCF) (Fi = 23)
Petrobras (Fi = 56)	Alcoa (Fi = 21)
MISC (Fi = 47)	Interorient Navigation Co (Fi = 21)
Teekay Corporation (Fi = 46)	Overseas Shipholding (Fi = 20)
Schoeller Holdings (Fi = 44)	Torm (Fi = 20)
Pacific Basin Shipping (Fi = 39)	DS Norden (Fi = 20)
Daiichi Chuo (Fi = 38)	Jo Tankers (Fi = 19)
Aegean Marine Petroleum (Fi = 36)	Iino Kaiun Kaisha (Fi = 18)
Clipper Group (Fi = 35)	Tsakos Group (Fi = 17)
Sanko S.S. (Fi = 35)	BP PLC (Fi = 17)
BHP Biliton (Fi = 34)	Polish Steamship Co (Fi = 16)
BW Ltd (Fi = 34)	NIOC (Fi = 15)

Source: Own composition based on (Ceulen, 2010; Goedstouwers, 2012) and (ENERGY DIGITAL, 2011)

Table 6 lists the top 20 cities for the bulk shipping sector, calculated on a matrix containing 44 firms and 110 cities. The three most important globalised regions are represented in the top four of bulk world cities. The first two cities are both Asian cities, Singapore is by far the most important bulk city when the *Cj*'s are compared. Singapore has a high service value in bulk shipping, but only three companies have their HQ in Singapore: China Ocean (COSCO), BW Ltd and Pacific Carriers. Singapore obtains its elevated service value from the high number of companies that have an important bulk office or a regional office in Singapore. The second position is occupied by Tokyo. In contrast to Singapore, there are more companies whose head offices are located in Tokyo. There are even two top five companies with headquarters in Tokyo, namely K-Line and MOL. The other companies with a head office in Tokyo are NYK Line, Daiichi Chuo, Sanko S.S., Tokyo Marine Co Ltd and Iino Kaiun Kaisha. The two first Asian cities are followed by London in Europe and New York in North-America. The fifth and final Alpha 1 bulk city is Shanghai, another important Asian port city.

On the sixth position, a second North-American city can be found: Houston is the first Alpha 2 bulk city and is followed by two other Asian cities (Manila and Mumbai). On the ninth position for the first time a South-American city, Rio de Janeiro, appears as an important maritime world city. It is followed in the ranking by three Asian cities (Seoul, Beijing and Hong Kong) and Dubai from the Middle East. Melbourne in Oceania on the 14th position is another example of an Alpha bulk world city from outside the three major globalised regions. Houston, Rio de Janeiro, Dubai and Melbourne play this important role in the management of bulk shipping because extraction regions of raw

materials are located nearby. The African continent is not represented in the top 20, as the first African city appears to be Cape Town, a Gamma city in the 33rd position.

Table 6: Bulk world cities: service levels Cj - Top 20

Category	City	Cj	Rank 2012	Rank 2009	GaWC rank 2012	GaWC rank 2004
Alpha 1	Singapore	120	1	1	5	6
	Tokyo	98	2	2	7	5
	London	96	3	3	1	1
	New York/New Jersey	87	4	4	2	2
	Shanghai	74	5	5	6	23
Alpha 2	Houston	59	6	6	66	62
	Manila	58	7	7	57	65
	Mumbai/Nhava-Sheva	58	8	8	12	33
	Rio de Janeiro/Macae	46	9	10	86	63
	Seoul	46	10	13	24	24
	Dubai	45	11	9	10	51
	Beijing	44	12	15	8	22
	Hong Kong	41	13	11	3	3
	Melbourne	41	14	14	34	26
	Rotterdam	40	15	16	116	95
Beta 1	Antwerp	36	16	23	111	129
	São Paulo	36	17	20	15	14
	Vancouver	34	18	17	76	58
	Copenhagen/Hellerup	33	19	27	48	68
	Hamburg	32	20	12	54	43

Source: Own composition based on (Ceulen, 2010; GaWC, 2009b, 2014)

In comparison to the previous study of the bulk network (Ceulen, 2010, p. 58), the top eight cities remain the same. Hamburg is facing the most significant downturn, dropping from the 12th position in 2009 to the 20th position in 2012. Beijing, Antwerp, São Paulo and Copenhagen have advanced in the ranking of bulk world cities.

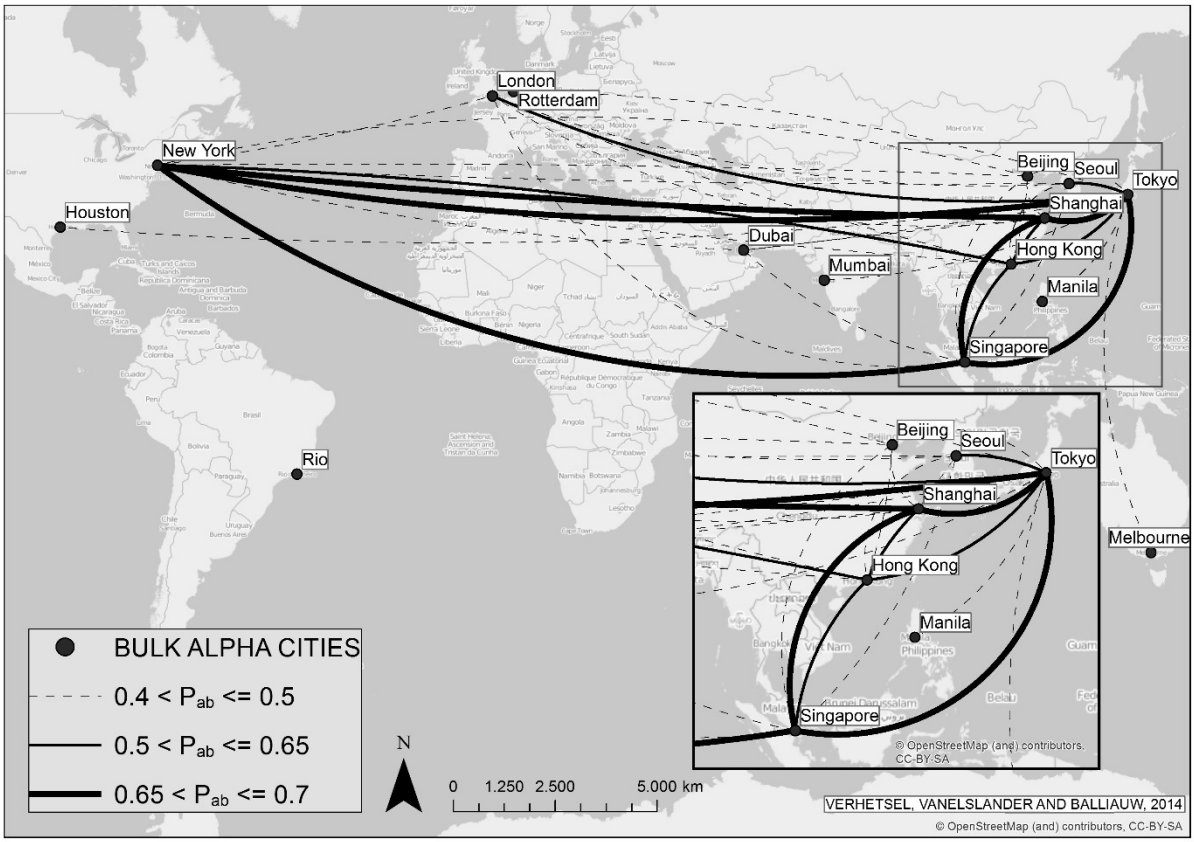
Three out of the top five bulk world cities are Asian, nonetheless the Asian domination is less distinct than in the case of container world cities where the first six cities are all Asian. In the case of bulk world cities, London (3rd) and New York (4th) rank much higher than as container world cities. Cities that are both very important as a container and bulk city are Singapore and Shanghai. Hong Kong and Hamburg are less important in bulk shipping compared to their container world city status. London, Houston and Manila are much more important in the bulk cities ranking compared to the container cities ranking. Another difference with the container segment is the presence of cities from South-America (Rio de Janeiro, São Paulo) and Oceania (Melbourne) among the top 20 bulk world cities. African cities are not represented in the container top 20, nor in the bulk top 20. As opposed to the container ranking of world cities, the first two and most important GaWC cities (London and New York) are present in the top five of bulk world cities. Other important GaWC world cities in the bulk top ten are Singapore, Tokyo, Shanghai, Mumbai and Seoul. Houston and Manila are less important as GaWC cities, but play an important role as bulk cities.

5.2. Network and connectivity of bulk Alpha maritime cities

Figure 2 gives an overview of the network between the 15 Alpha bulk world cities by using the top five bulk companies (K Line, China Shipping, Hanjin Shipping, MOL, COSCO). The connectivity between the bulk world cities was calculated in the same way as for container world cities. The most important link is found between Tokyo and Singapore, the two major bulk world cities. The Asian network is completed by Shanghai. These three cities are intensively connected. Further on, this Asian network is strongly connected with New York as important links between New York and each of the three Asian cities are observed. No important links with European cities can be found. The most important link with Europe is a secondary link between Tokyo and London, where important exchange markets for bulk goods are located. South-America has Rio as an important bulk city based on service levels, however it is merely connected to the network of Alpha bulk world cities. The same observation can be made for Melbourne.

To conclude, Tokyo, Singapore, New York, London and Shanghai are the most important bulk world cities when considering both the global network and the service levels of these cities. Note that the two main GaWC world cities, London and New York, still play an important role as a location for the decision making of bulk maritime operations. This suggests that the bulk maritime services that once were at the cradle of international cities nowadays still get reflected by the ranking of global cities.

Figure 2: Bulk Alpha cities network (2012)



Source: Own composition (based on Annex 2)

6. Communication between offices of global container liner companies

The methodology to compare observed and presumed contacts, described above is executed including the 20 major container liner companies present in Antwerp and focusing on the container Alpha maritime network extended with London, Le Havre, Barcelona, Genoa and São Paulo. The reason for this choice is that these Beta cities were cited more than five times by the managing directors of the liner offices in the Antwerp area. An overview of the surveyed companies (ranked according to their capacity in TEU as included in

Table 2) and the included cities (ranked by their status as container world city as included in

Table 3) is given in Table 7. All the container liners from

Table 2 are included here, except MOL that only has a sales person in Antwerp and STX Pan Ocean that has no office in Belgium.

Table 7: Included companies and cities

Companies	Cities
APM-Maersk	Hong Kong
MSC	Singapore
CMA CGM Group	Shanghai
COSCO Container L.	Tokyo
Evergreen Line	Mumbai
Hapag-Lloyd	Seoul
APL	Hamburg
China Shipping (CSCL)	Dubai
Hanjin Shipping	Rotterdam
OOCL	New York
Hamburg Süd Group	London
NYK Line	Genoa
Hyundai M.M. (HMM)	Barcelona
K Line	São Paulo
Yang Ming	Le Havre
Zim	
PIL (Pacific Int. Line)	
UASC	
CSAV Group	
Wan Hai Lines	

The relative order of links between Antwerp and the other maritime cities resulting from the interviews, is included in

Table 8 and compared with the relative order of links predicted by the GaWC method. Instead of analysing every relative position, it is considered more appropriate to divide the ranking into categories of ascending contact intensity, compensating in this way for measurement errors. By using natural breaks, four categories are established: intensive, strong, average and little contact.

Table 8: Observed versus presumed contacts between Antwerp and other container cities

Type	Observed			Presumed		
Intensive	Rotterdam	Hamburg				
Strong	Singapore	Shanghai	Hong Kong	Hong Kong	Hamburg	Singapore
Average	London	New York	Le Havre	Shanghai New York	Mumbai Rotterdam	Seoul Tokyo
Little	São Paulo Tokyo Seoul	Genoa Dubai	Barcelona Mumbai	Dubai Barcelona	Genoa London	São Paulo Le Havre

The interviews reveal that Rotterdam and Hamburg are connected in a very intensive way with Antwerp. Antwerp and its nearby ports have contact on a daily basis, mostly using face-to-face communication. Contacts with Rotterdam, the maritime hub in The Netherlands, are mainly at the operational and commercial level (14 out of 20). Only 30% of the contacts with Rotterdam are of strategic nature. All this does result in much stronger communication between Antwerp and Rotterdam compared to the GaWC method. The situation with Hamburg is different. As Hamburg hosts a lot of regional offices and even a few headquarters, 11 out of 19 interactions include strategic communication. This confirms the role of Hamburg as a major container world city in Europe. It was decided to create the *Strong* category, as the contacts are much more intensive than those of the *Average* group (Annex 3). Strong contacts from Antwerp are observed with Singapore, Shanghai and Hong Kong. This is closely related to the predictions of the GaWC method, although contacts with Shanghai were somewhat underestimated. Special historical ties between Antwerp and Shanghai (friendship cities since 1984) could be an explanation. More importantly, Shanghai and Antwerp do have an important maritime transport connection, with both cities featuring in a number of important loops and with COSCO having a direct investment in the Antwerp Deurganckdock terminal (Van de Voorde and Vanelslander, 2014).

Further we observe contacts of average importance with London, New York and Le Havre. The contacts with London and Le Havre are underestimated by the GaWC methodology. London is only a Beta maritime city and thus predicted to be loosely connected to Antwerp. This prediction results from the absence of (important) offices of many container companies in London. As a consequence, only 10 out of the 20 companies report structural contacts with London. Nonetheless these contacts are very intense and often strategic (6 out of 10), as these London offices are highly positioned in the hierarchical structure of the container liner companies. Proximity and accessibility also facilitate face-to-face and frequent contacts with London. A similar logic is true for Le Havre, making this contact also more important than predicted. Finally little contact is observed with São Paulo, Genoa, Barcelona, Tokyo, Dubai, Mumbai and Seoul. Overestimations of the GaWC model are revealed especially in the contacts with Mumbai, Seoul and Tokyo.

The results show some important tendencies. Firstly, proximity and accessibility increase the intensity of contact between cities, compared to the prediction by the GaWC model. Rotterdam, Le Havre and London are more strongly linked to Antwerp than predicted. Business in the Hamburg-Le Havre range has to be coordinated in order to offer complementary services and conditions in the region. This is not the case for Mediterranean cities, as Genoa and Barcelona are not only more distant from Antwerp, but are also less important container world cities.

Secondly, the results of Mumbai, Tokyo and Seoul show that cities with few headquarters are connected less strongly than predicted with distant cities like Antwerp. Connections and business are in such a case driven by the central hubs where more headquarters are present. Contacts over longer distances are coordinated by headquarters. Hence globalisation can be calculated in a good way by the presence of headquarters, although this has to be completed with information on regional offices as they do play an important role in maritime communication within a region. Antwerp offices are accordingly strongly connected with their respective European regional offices.

Finally, the empirical interview test shows that the quantitative GaWC model used by Verhetsel and Sel (2009) allows a good prediction of the network of maritime world cities. As a result, it is possible to discern the major hubs in the maritime network from peripheral world cities using the GaWC method as a proxy. Nevertheless geography still matters, as contacts with distant maritime cities are overestimated and contacts with nearby cities are underestimated, although these latter contacts can be more of operational rather than strategic nature. Applying the same methodological approach in other sectors could reveal how accurately the GaWC method works in other sectors and to what extent corrections are needed by qualitative research.

7. Conclusion and further research

After a review of the recent literature concerning world cities, container and bulk transport and the maritime sector, the GaWC research methodology for maritime world cities was applied to global container operating companies in order to analyse the evolutions in the container word city network between 2006 and 2012. The Asian cities of Hong Kong, Singapore, Tokyo and Shanghai are now the most important container world cities. In Europe, Hamburg is the most important city, followed by Rotterdam and Antwerp. In North-America, New York is the main container world city. The boom of Asian cities is continuing. However it is found that some important ports are not represented in the top 20 of container world cities, indicating a lack of maritime decision power in these cities. Other important world cities like London and New York do not have a large port. In that, the ranking of GaWC cities differs clearly from the container cities ranking indicating a minor importance of container services on global world city formation. An analysis of the container world city network showed that the integration of this network has increased in the period between 2006 and 2012.

Applying the same GaWC methodology to the bulk sector unveiled that Singapore, Tokyo, New York, London and Shanghai are the major bulk world cities, representing the three global regions in the top five. Moreover, other continents like South-America and Oceania also have alpha bulk world cities, namely Rio de Janeiro and Melbourne. The dominance of Asian cities is thus less pronounced in bulk shipping. The greater similarity observed between the bulk and GaWC cities ranking probably reflects the role of traditional bulk transport operations in the emergence of cities in the past. The network of bulk world cities is less integrated than the container world cities network. Strong connections are found between Singapore, Tokyo, Shanghai and New York. Considering both container and bulk maritime services Singapore, Tokyo and Shanghai stand out as the major maritime world cities.

Interviews with the managing directors of the Antwerp offices of the 20 major container lines revealed different aspects of their communication with own offices in other important maritime cities. The GaWC method provides a good proxy to predict contacts between maritime world cities, although communication with nearby cities is underestimated, while contacts with increasing distance between cities are overestimated. Contacts with nearby offices often have a more

operational character than a strategic one. When headquarters are involved, also at longer distances, strategic communication becomes more important.

The present research offers inspiration to test whether the GaWC method is good in predicting global contacts and service levels also in other service-providing industries and for other cities. The robustness of the proposed method must be tested further by repeating it for other cities and sectors. In addition, to gain a more comprehensive insight into the functioning of the maritime management network, it could be interesting for future research to analyse more profoundly the interactions of the global maritime network with global firms from other business services, like the financial and legal sectors that are especially intertwined with the maritime sector. For policy makers the major suggestion of this research is that in order to become an important maritime world city, the attraction of at least a few global headquarters and a large number of regional offices is essential. In turn this could generate more intensive connections with other cities, not only maritime world cities but also other world cities through an extended network of business services. In the end this could allow a city with a world port to grow to an all-round world city.

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APPENDIX

Annex 1: Alpha network containers (Matrix P)

	Hong Kong	Tokyo	Singapore	Seoul	New York	Hamburg	Antwerp	Mumbai	Dubai	Shanghai	Rotterdam
Hong Kong	**0,64**	**0,60**	**0,56**	**0,53**	**0,53**	**0,53**	**0,50**	**0,50**	**0,46**	**0,44**	**0,43**
Tokyo	**0,60**	**0,63**	**0,55**	**0,50**	**0,50**	**0,49**	**0,45**	**0,47**	**0,45**	**0,37**	**0,39**
Singapore	**0,56**	**0,55**	**0,53**	**0,47**	**0,49**	**0,48**	**0,45**	**0,45**	**0,41**	**0,37**	**0,39**
Seoul	**0,53**	**0,50**	**0,47**	**0,46**	**0,46**	**0,43**	**0,43**	**0,42**	**0,39**	**0,38**	**0,38**
New York	**0,53**	**0,50**	**0,49**	**0,46**	**0,47**	**0,46**	**0,42**	**0,42**	**0,39**	**0,38**	**0,38**
Hamburg	**0,53**	**0,49**	**0,48**	**0,43**	**0,46**	**0,49**	**0,40**	**0,41**	**0,36**	**0,36**	**0,34**
Antwerp	**0,50**	**0,45**	**0,45**	**0,43**	**0,42**	**0,40**	**0,42**	**0,40**	**0,37**	**0,36**	**0,35**
Mumbai	**0,50**	**0,47**	**0,45**	**0,42**	**0,42**	**0,41**	**0,40**	**0,39**	**0,37**	**0,34**	**0,34**
Dubai	**0,46**	**0,45**	**0,41**	**0,39**	**0,39**	**0,36**	**0,37**	**0,37**	**0,35**	**0,32**	**0,32**
Shanghai	**0,44**	**0,37**	**0,37**	**0,38**	**0,38**	**0,36**	**0,36**	**0,34**	**0,32**	**0,34**	**0,32**
Rotterdam	**0,43**	**0,39**	**0,39**	**0,38**	**0,38**	**0,34**	**0,35**	**0,34**	**0,32**	**0,32**	**0,32**

5 Annex 2: Alpha network bulk (Matrix P)

	Singapore	Tokyo	London	New York	Shanghai	Houston	Manila	Mumbai	Rio	Seoul	Dubai	Beijing	Hong Kong	Melbourne	Rotterdam
Singapore	**0,66**	**0,66**	**0,49**	**0,66**	**0,66**	**0,40**	**0,37**	**0,40**	**0,13**	**0,50**	**0,41**	**0,43**	**0,62**	**0,40**	**0,40**
Tokyo	**0,66**	**0,73**	**0,54**	**0,66**	**0,66**	**0,44**	**0,42**	**0,44**	**0,12**	**0,52**	**0,43**	**0,43**	**0,64**	**0,46**	**0,44**
London	**0,49**	**0,54**	**0,46**	**0,49**	**0,48**	**0,37**	**0,34**	**0,37**	**0,12**	**0,46**	**0,36**	**0,30**	**0,46**	**0,37**	**0,37**
New York	**0,66**	**0,66**	**0,49**	**0,66**	**0,66**	**0,40**	**0,37**	**0,40**	**0,13**	**0,50**	**0,41**	**0,43**	**0,62**	**0,40**	**0,40**
Shanghai	**0,66**	**0,66**	**0,48**	**0,66**	**0,67**	**0,40**	**0,37**	**0,40**	**0,13**	**0,50**	**0,42**	**0,42**	**0,62**	**0,39**	**0,40**
Houston	**0,40**	**0,44**	**0,37**	**0,40**	**0,40**	**0,30**	**0,27**	**0,30**	**0,10**	**0,37**	**0,30**	**0,23**	**0,38**	**0,30**	**0,30**
Manila	**0,37**	**0,42**	**0,34**	**0,37**	**0,37**	**0,27**	**0,26**	**0,27**	**0,08**	**0,33**	**0,27**	**0,21**	**0,35**	**0,28**	**0,27**
Mumbai	**0,40**	**0,44**	**0,37**	**0,40**	**0,40**	**0,30**	**0,27**	**0,30**	**0,10**	**0,37**	**0,30**	**0,23**	**0,38**	**0,30**	**0,30**
Rio	**0,13**	**0,12**	**0,12**	**0,13**	**0,13**	**0,10**	**0,08**	**0,10**	**0,05**	**0,14**	**0,10**	**0,06**	**0,11**	**0,09**	**0,10**
Seoul	**0,50**	**0,52**	**0,46**	**0,50**	**0,50**	**0,37**	**0,33**	**0,37**	**0,14**	**0,48**	**0,38**	**0,28**	**0,46**	**0,35**	**0,37**
Dubai	**0,41**	**0,43**	**0,36**	**0,41**	**0,42**	**0,30**	**0,27**	**0,30**	**0,10**	**0,38**	**0,31**	**0,21**	**0,38**	**0,30**	**0,30**
Beijing	**0,43**	**0,43**	**0,30**	**0,43**	**0,42**	**0,23**	**0,21**	**0,23**	**0,06**	**0,28**	**0,21**	**0,38**	**0,41**	**0,22**	**0,23**
Hong Kong	**0,62**	**0,64**	**0,46**	**0,62**	**0,62**	**0,38**	**0,35**	**0,38**	**0,11**	**0,46**	**0,38**	**0,41**	**0,60**	**0,38**	**0,38**
Melbourne	**0,40**	**0,46**	**0,37**	**0,40**	**0,39**	**0,30**	**0,28**	**0,30**	**0,09**	**0,35**	**0,30**	**0,22**	**0,38**	**0,31**	**0,30**
Rotterdam	**0,40**	**0,44**	**0,37**	**0,40**	**0,40**	**0,30**	**0,27**	**0,30**	**0,10**	**0,37**	**0,30**	**0,23**	**0,38**	**0,30**	**0,30**

6

7

Annex 3: Interconnectivity from Antwerp maritime businesses: resulting values from the interviews and the GaWC method

Category	Position	City	Pj (interview)	Category	Position	City	Pj (GaWC)
Intensive	1	Rotterdam	52	Strong	1	Hong Kong	0,41
	2	Hamburg	49,2		2	Hamburg	0,41
Strong	3	Singapore	29,8		3	Singapore	0,4
	4	Shanghai	29,6	Average	4	Shanghai	0,36
	5	Hong Kong	28		5	Mumbai	0,36
Average	6	London	23,8		6	Seoul	0,36
	7	New York	23,4		7	New York	0,35
	8	Le Havre	21,2		8	Rotterdam	0,33
Little	9	São Paulo	12,6		9	Tokyo	0,33
	10	Genoa	11	Little	10	Dubai	0,31
	11	Barcelona	9,8		11	Genoa	0,29
	12	Tokyo	7,6		12	São Paulo	0,27
	13	Dubai	6,6		13	Barcelona	0,26
	14	Mumbai	4,8		14	London	0,24
	15	Seoul	3		15	Le Havre	0,23