Freight transportation flows: New trade regions and trade routes

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This paper highlights the trends in global freight transportation which has recently shown intense growth but also a "new" geography of flows. In particular the analysis describes the growth in relation to GDP with reference to destinations (Europe, United States) and to the origin of flows. The trends identified show the emergence of new patterns of routes and nodes. Moreover, logistic services are proving to be an advantage for the Mediterrean area which is the place of transshipment and unloading of containers arriving from Asia. At present, there is not a strict hierarchy between hubs in the Mediterrean basin, in contrast with what has happened in the North of Europe. In Southern Europe, the competition among regions to attract these new flows is becoming fierce. Factors playing a fundamental role in this scenario are: accessibility to the main populated and economically dynamic regions of Europe, existing infrastructure (although there is a need to update and modernise facilities), regional development policies, and, above all, the strategies of the global terminal operators.

Keywords: international trade, hub, maritime transportation, global terminal operators

1. Introduction

In recent decades we have seen a steady growth in international trade and international transport. The main driving forces behind this growth are the worldwide growth of the global economy and the relaxation of trade barriers. Furthermore, increased opportunities for communication, the improved efficiency of transport operations as well as the standardisation of processes, make it possible to integrate supply chains on a worldwide scale. Consequently, the development of logistics has become an important factor in economic competition between regions (Capineri and Randelli, 2004).

The increase in freight flows at the worldwide level is favoured by more efficient means of transport and the relaxation of trade barriers but it shows a changing geography of flows. As in any phase of economic development, trade relationships do not affect all regions equally: throughout history there has always been an alternating picture of advantaged and less advantaged regions.

The success or failure of a transport hub depends strictly on the pattern of international trade. For example, China and South East Asia are becoming the origin and destination of a large portion of freight transport, whereas the Mediterranean basin seems to be the strategic area for incoming flows to Europe and for transshipments to the U.S.[1]. Thus Mediterranean ports are faced with the problem of updating their capacity and facilities.

The enlargement of trade areas has required an adjustment in trade routes and in particular maritime routes. Among the various means of transport, air is still more expensive and limited, although it shows significant progress. Moreover, technological innovations represented by containerization and new large carriers have proved to be fundamental in a context which requires ever faster and cheaper services. A large variety of more agile production and logistics concepts have been identified to manage product flows (Tavasszy et al., 2002). The whole world is becoming our market but also our competitor.

Logistics activities are increasingly being outsourced to specialized companies such as OEM (Original Equipment Manufacturer) suppliers, contract manufacturers for the assembly of final products and logistics service providers. These companies are able to execute logistics processes at a lower cost by applying economies of scale and managing activities for various customers. Every company is searching for the “best in class”, worldwide. Best in class means best price, reliability and time performance.

Furthermore, transport hubs have changed from the simple physical interfaces (sea / land, air /land, etc.) they once were, and have successively turned into more complex regions. Seaports, for example, have become commercial and industrial centers, logistics and distribution platforms, and are now becoming intermodal nodes in international supply chain networks, the efficiency of which now drives trade competitiveness.

2. Increase of transport intensity

In general we have seen that trade growth is more accelerated than the changes in real GDP. The recovery of the world economy, even in the last few years, is evident from both the annual trade and output indicators. Global merchandise production and merchandise exports

[1] The growth of transshipment activities complements the development of hub ports: container transshipment is believed to make up 20% of total maritime container traffic today, and is growing.

recorded their highest annual growth in the last three years. Merchandise trade increased by 4.5 per cent in the OECD countries, significantly faster than world merchandise production, which recovered by nearly 3 per cent. However, the average annual growth of trade and output in 2003 was still below the average expansion rate recorded in the second half of the 1990s (see figure 1).

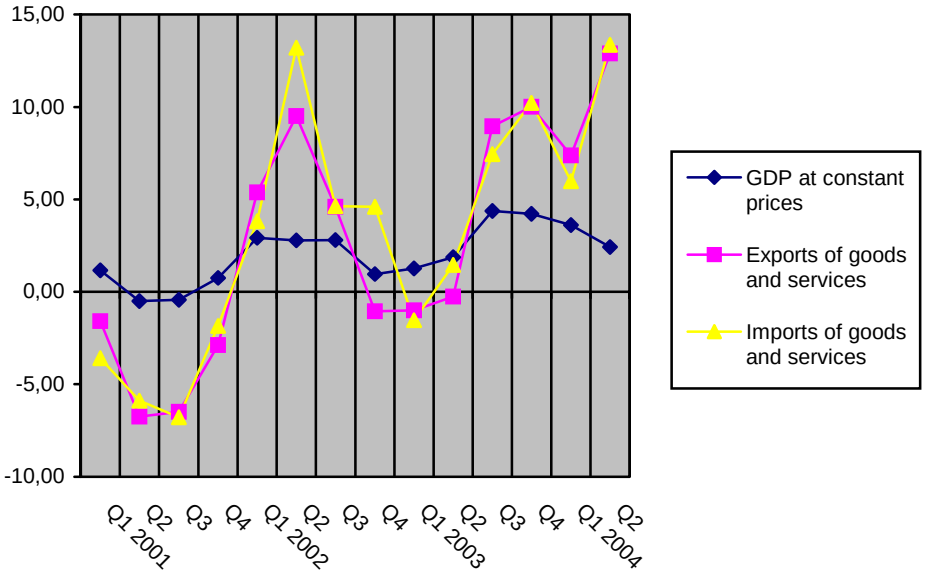

Figure 1. Real GDP and trade growth of OECD countries, 2001-04 (Percentage change on a quarter to quarter basis)
Source: World Trade Organization, 2005

The ratio of goods and services trade (imported and exported in value) to GDP grew in the U.S. and EU-15[2] in the period 1990-2003. In the U.S. the ratio grew from 10% to 12.5% for goods and remained around 3% for services. In EU-15, in the same period, goods changed from 26% to 34% of GDP while services increased from 5% to 8%, even if it is correct to say that part of the difference is due to fact that EU data include intra-trade.
In the same period in the U.S. the ratio of freight tons to GDP declined, reflecting the growing importance of services relative to goods manufacturing industries and the shift from commodities production to diversified goods with higher ratios of value to weight[3]. Up to 1980, ton-miles grew at a much faster rate than tons (although still declining in ratio to GDP) as the U.S. economy became more spatially integrated and firms sought more distant markets. Since then, however, tons and ton-miles have grown at roughly the same rate[4].
However, it would be a mistake to interpret these trends as meaning that freight is becoming less important. As we have seen above, the value of goods shipped to GDP continues to

[2] EU 15 include: Belgium, Denmark,Germany, France, Greece, Italy, Ireland, Spain, Portugal, Great Britain, Netherlands, Luxembourg, Austria, Finland, Sweden.
[3] Miniaturization is likely to affect many products, accelerating the trend towards lighter and smaller goods. As a result, weight and bulk may become less important for shipping. Instead of being based on weight, shipping rates may rely on other criteria.This development may make fast-in-time (FIT) shipping more feasible, by requiring less shipping capacity (Suarez Villa 2001).
[4] The trend is very similar in Europe and the difference in statistic datas is related to the importance of intra-trade between european countries.

expand in the U.S. and Europe, so the trends in tons and ton-miles reflect economic shifts away from low value commodities, rather than a decreasing dependence on the movement of goods within the economic systems, which are becoming more globally organized, in the U.S. as in Europe for various reasons:

- worldwide growth of the global economy and emergence of new industrialised countries;
- relaxation of trade barriers;
- increased efficiency of transport operations;
- increased standardisation of transportation processes;
- global labour market segmentation.

3. Origin and destination regions

The freight transport scenario in Europe shows that the trade value in EU15 was around 440 (billion euros) in 1990 and in 2003 more than 980 billion (in 2000 it reached 1003 billion euros) (see table 1). In the same period (1990-2003) export trade value changed from 395 billion euros to 972 billion (see table 2).

Table 1. Import value in billions of euros of EU15

Country	**1990**	**1995**	**2000**	**2003**
Switzerland	37.13	43.22	60.02	55.96
Japan	51.43	54.3	87.13	66.78
China	11.38	26.34	70.27	95.22
United States	91.53	103.67	199.02	151.17
Russian Federation		21.49	45.72	51.84
Europe area[1]	38.2	67.02	138.3	170.96
ASIAN NIC[2]	37.57	55.56	108.92	93.34
Canada	10.05	11.71	18.4	15.26
Mexico	3.02	3.21	7.04	6.16
Brazil	9.66	10.82	17.63	17.87
Australia	5	4.97	8.86	8.73
Total	442.51	545.25	1033.34	987.73

Source: Eurostat, 2004
Notes:
[1] Includes Norway, Poland, Czech Republic, Turkey, Hungary, Romania
[2] Includes India, Malaysia, Singapore, South Korea, Taiwan, Hong Kong

Table 2. Export value in billions of euros of EU15

Country	1990	1995	2000	2003
Switzerland	45	51.04	70.78	68.41
Japan	24.5	32.9	44.94	40.06
China	5.79	14.69	25.5	40.13
United States	82.66	103.32	232.94	220.48
Russian Federation	-	16.13	19.92	33.07
Europe area[1]	32.12	70.36	145.14	161.39
ASIAN NIC[2]	34.09	66.52	88.47	81.1
Canada	10.43	10.34	20.64	20.97
Mexico	4.27	4.51	14.04	14.07
Brazil	3.94	11.37	16.06	12.13
Australia	7.64	10.5	15.73	17.26
Total	395.91	573.28	941.27	972.92

Source: Eurostat, 2004
Notes:
[1] Includes Norway, Poland, Czech Republic, Turkey, Hungary, Romania
[2] Includes India, Malaysia, Singapore, South Korea, Taiwan, Hong Kong

The geography of the origins and destinations of import and export flows can be briefly described as follows.
One of the most significant features of economic relations between the EU and the rest of the world over recent years has been the rapid growth of trade and, geographically, the rise of a few countries or areas, like China and Eastern Europe, especially the Russian Federation and ex-communist countries. In particular, between 1999 and 2003, EU15 trade with China more than doubled, with exports rising from 19.35 bn euros to 40.13 bn, and imports growing from 49.65 bn to 95.22 bn. The EU15 deficit in trade with China rose from 30.3 bn in 1999 to 55.09 bn in 2003. In contrast, over the period 1999-2003, total extra-EU15[5] trade (with countries outside Europe) grew by just over a quarter (+26.6%).
This rapid growth in trade has in fact been observed since the beginning of the 1980s. In 1980, China was the 25th largest destination for EU15 exports, and the 22nd largest source for EU15 imports. By 1990, China ranked 14th for EU15 exports and sixth for EU15 imports. In 1999, China was the seventh largest destination for EU15 exports, and the fourth largest source for EU15 imports; by 2003 China had moved to the third place for EU15 exports, behind the U.S. and Switzerland, and was in the second place for EU15 imports, behind only the U.S. (see figure 2).
EU15 trade with China is strongly concentrated in manufactured goods. Nearly two thirds of EU15 exports to China are “Machinery and vehicles”, and a further 20% are “Other manufactured articles”, while each of these groups of products accounts for just under half of EU25[6] imports from China. At the detailed level, the main EU25 exports to China were motorcars and aircraft, while the main imports were computers and parts (including monitors and printers), mobile phones, digital cameras, toys, travel goods, footwear and clothing.

[5] It refers to the other European countries not included in EU15
[6] EU25 include EU15 countries (see footnote above) and new accession countries: Latvia, Estonia, Lithuania, Hungary, Czech Republic, Poland, Cyprus, Malta, Slovenia, Slovak Republic.

In 2003, EU15 exports of machinery and vehicles to China amounted to 26.4 bn euros, and imports to 47.9 bn. The trade deficit was 21.6 bn. EU25 exports of other manufactured articles to China were 7.9 bn, and imports 49.5 bn, with a trade deficit of 41.6 bn.
Comparing January-September 2004 with January-September 2003 apart from imports from the U.S. which fell (-1%) and exports to Canada, which were stable, EU25[7] trade flows with its major partners grew. The most notable increases were for imports from China (+21%), Turkey and South Korea (both +18%), Brazil (+17%) and Russia (+14%) and for exports to Turkey (+34%), Russia (+21%) and China (+18%).

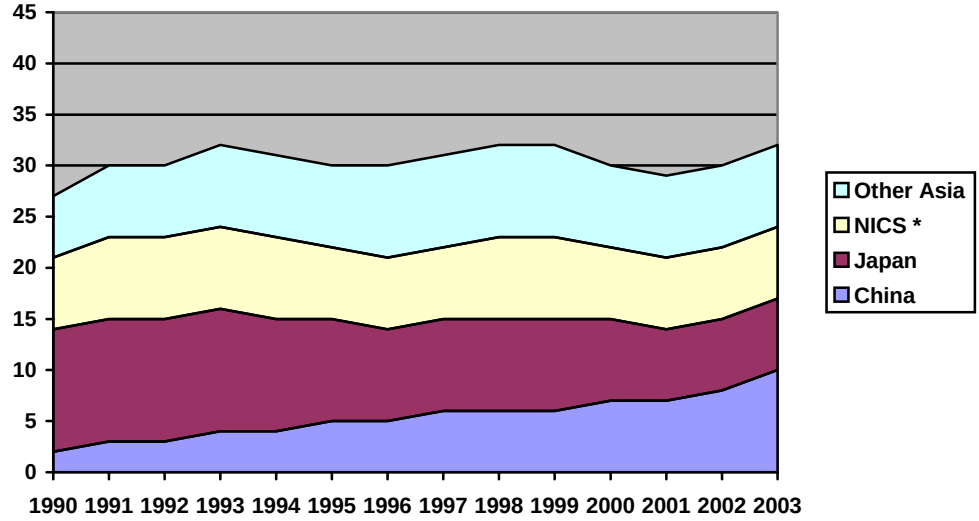

Figure 2. Share of China and other Asian countries in EU (15) merchandise imports, 1990-2003 (percentage).
Source: World Trade Organization, 2004
* NICS = Taiwan, South Korea, Singapore, Hong Kong

EU25 trade was characterised by an increase in the EU25 surplus with the U.S. (+55.1 bn euros in January-September 2004 compared with +49.3 bn in January-September 2003), Switzerland (+9.9 bn compared with +8.9 bn) and Turkey (+5.8 bn compared with +2.2 bn). The EU25 trade deficit increased with China (-54.6 bn compared with -44.5 bn), Russia (-25.3 bn compared with -23.8 bn) and Norway (-18.3 bn compared with -17.4 bn), but decreased with Japan (-23.0 bn compared with -23.6 bn). So the trend, even in the 2004, has been confirmed.
Even in the U.S. imports from China grew from 3% in 1990 to 13% of total value import in 2003, but the total imports from Asian countries decreased to 37% while it was 42% in 1995 (see figure 3).
In conclusion, in the last five years the rise of China as a major exporter and importer has attracted the attention of many observers. China's surging import demand for oil and other primary commodities such as copper and soybeans has contributed significantly to higher price levels. China's increased purchases of investment goods, semi-manufactured goods and machinery parts have sustained output and exports in many East Asian economies. China has replaced Japan as the biggest Asian market both for Asian and European exporters.

[7] In 2004 Eurostat started to furnish data for EU-25 instead of EU-15.

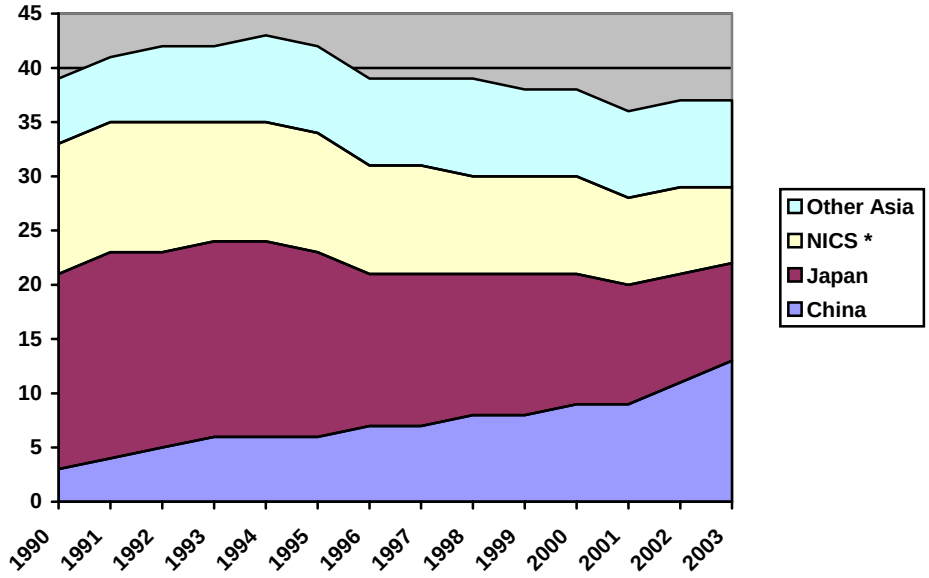

Figure 3. Share of China and other Asian countries in U.S merchandise imports, 1990-2003 (percentage).
Source: World Trade Organization, 2004
* NICS = Taiwan, South Korea, Singapore, Hong Kong

Although China's imports expanded faster than exports in 2003, the country still recorded a significant trade surplus. In 2003, as in the second half of the 1990s, China's merchandise export growth was two times faster than that of world exports. China became the largest source of imports in Japan and the second largest for the European Union after the United States. In the U.S. market, China replaced Mexico as the second largest supplier after Canada in 2003. China's shares in world exports of office and telecom equipment, and textiles and clothing range from nearly 13% to 23%. In office and telecom equipment, its exports have overtaken those of the United States, Japan and the extra-regional exports of the European Union. China is also the world's largest supplier of textiles and clothing if intra-EU trade is not taken into account.
The pattern of international trade shows the leading role of South East Asia as origin of trade flows; this has affected the role of the U.S., Japan and Europe in terms of the industrial production. Such changes have induced a development of sea-shipping which enables even cheaper and faster goods movement.

4. Modal split: the emerging role of sea-shipping

We have seen that in the past decade import and export flows in EU-15 have almost doubled in value, but they have fallen in terms of weight. Even if Eurostat data are not complete, the growth of tonnage of goods entering and leaving the EU is clear, for all kind of modes. Nearly 60% of freight tonnes in EU foreign trade are transported by ship (see table 3).

According to Contship, one of the most important container shipment companies in Europe, the number of container movements will increase by 2015 about 75%, in the Mediterranean area alone, which is the area most affected by the growth of Asian imports. In 2010 more than 54 million containers will transit the Mediterranean, especially from China, compared to the 32 million moved in 2004. Saturation point will be reached in 2010 at 82%, clearly over the limit, with serious problems of congestion at nodes.

Table 3. International goods (incoming and outgoing in thousands of tonnes)

Mode of transport	1993	1994	1995	1996	1997	1998	1999	2000	2001
train	263194	290616	297440	293480	311635	318092	320439	347802	349631
road	344014	363594	383739	386188	383586	433402	477269	510467	525675
inland waterways	397375	432397	446033	440074	460379	455870	443800	464153	467739
maritime	NA	NA	NA	NA	1917326	1990561	1966408	2006069	1984231
aviation	5186	5984	6498	6812	7320	NA	NA	NA	NA
Total	1011762	1094585	1135705	1128550	3082243	3199923	3209915	3330491	3329277

Source: Eurostat, 2003

Current reality and forecasts are similar in the U.S., where nearly 80% of freight tonnage in U.S. foreign trade is transported by ship (see table 4). Although the vast majority of freight tonnage in U.S. foreign trade moves by water, air and truck transportation are nearly as important when freight value is considered. By value, the water share drops to 40 percent, with 28 percent moving by air and 21 % moving by truck.

Table 4. Weight of U.S. international merchandise trade by mode of transportation: 2003

Mode of transport	Exports	Modal %	Imports	Modal %	Total trade	Total modal %
train	26,176	5.3	80,867	6.6	107,043	6.2
road	93,851	19.1	94,954	7.7	188,806	11.0
maritime	364,613	74.1	969,996	78.8	1,334,609	77.5
aviation	2,634	0.5	3,912	0.3	6,547	0.4
pipeline	1,951	0.4	78,009	6.3	79,959	4.6
Other	2,820	0.6	2,802	0.2	5,622	0.3
Total	492,046	100	1,230,540	100	1,722,586	100

Source: U.S. Department of Transportation (USDOT), 2004

According to the American Association of Port Authorities, world freight traffic is concentrated in about 10 ports: Singapore, Hong Kong, Kaohsiung (Taiwan), Rotterdam, Busan (South Korea), Long Beach, Hamburg, Los Angeles, Antwerp and Shanghai[8]. Table 5 shows that 51% of total container traffic is held by the first ten ports which include three north European ports (Rotterdam, Antwerp and Hamburg) but none in the Mediterranean.

[8] According to the World Bank, maritime freight traffic will increase by 4% - 5% up to 2010.

Table 5. Container traffic at world ports (TEUs, 000s)

Rank	Port	Country	Teus
1	Hong Kong	China	20499
2	Singapore	Singapore	18411
3	Shanghai	China	11280
4	Shenzhen	China	10615
5	Busan	South Korea	10408
6	Kaohsiung	Taiwan	8843
7	Los Angeles	United States	7149
8	Rotterdam	Netherlands	7107
9	Hamburg	Germany	6138
10	Antwerp	Belgium	5445
11	Dubai	United Arab Emirates	5152
12	Port Kalang	Malaysia	4840
13	Long Beach	United States	4658
14	Quingdao	China	4239
15	New York/New Jersey	United States	4068
16	Tanjung Pelepas	Indonesia	3487
17	Tokyo	Japan	3314
18	Bremen/Bremerhafen	Germany	3190
19	Laem Chabang	Thailand	3181
20	Gioia Tauro	Italy	3149
21	Tianjin	China	3015
22	Ningbo	China	2772
23	Guangzhou	China	2762
24	Tanjung Priok	Indonesia	2758
25	Manila	Philippines	2552
26	Algeciras	Spain	2516
27	Yokohama	Japan	2505
28	Felixstowe	United Kingdom	2500
29	Xiamen	China	2331
30	Nhava Sheva	India	2269
31	Nagoya	Japan	2074
32	Kobe	Japan	2046
33	Keelung	Taiwan	2001
34	Salalah	Oman	2000
35	Valencia	Spain	1993
36	LeHavre	France	1977
37	Colombo	Sri Lanka	1959
38	Oakland	United States	1923
39	Jeddah	Saudi Arabia	1777
40	Tacoma (WA)	United States	1738
41	Melbourne	Australia	1721
42	Charleston	United States	1691
43	Dalian	China	1670
44	San Juan	United States	1666
45	Barcelona	Spain	1652
46	Hampton Roads	United States	1646
47	Osaka	Japan	1610
48	Genova	Italy	1606

49	Piraeus	Greece	1605
50	Tanjung Perak	Indonesia	1575

Source: American Association of Port Authorities, 2003

The forecasts of the U.S. Department of Transportation say that international freight shipment, which in 1998 amounted to 1.787 million tons, in 2010 and 2020, will be respectively of 2.556 and 3.311 millions of tons, an increase of about 85%.
It is obvious that increased trade will require investment in infrastructure, in the U.S. as well as in Europe, especially at maritime ports. The marine cargo terminals are in an escalating struggle with commercial developers to acquire waterfront property. The future development of container ports in the U.S. and Europe will soon be severely constrained. West Coast ports in the U.S. and especially the two busiest, port of Los Angeles and Long Beach, are faced with congestion and vessels have to wait several hours outside the port before being unloaded. Even the Panama Canal has already reached the 84% of its capacity. In Europe the Mediterranean ports, which will handle even containers bound for the U.S. coming from Asia, are not prepared for the increase predicted by all forecasts.
Ports are facing serious infrastructure problems especially channel and harbour depth. Prior to 1985, all container vessels were designed to be longer and larger than the maximum size permitted, for example, to go through the locks in the Panama Canal. These ships, known as "Panamax", had a draft of no more than 13.17 yards and were designed to carry up to 3,800 Twenty-foot equivalents (TEU). Today's ships are longer and deeper than Panamax ships and hold many more containers. For example, the new vessels ordered by Maersk Sealand are all over 12.000 TEU, over three times the size of the Panamax. With the growth of these vessels, current channel and harbour depths at many ports will prevent these ports from being served by the larger vessels. In the U.S. only seven of the national ports currently have harbours with a water depth of 45 feet or more. Even the Panama Canal is not appropriate for the traffic of big vessels. In Europe the situation is probably worse: in Italy, which wishes to become the European logistic platform for container traffic coming from the Suez Canal, only Trieste harbour is able to hold big vessels.

5. Sea giant carriers: the challenge for container traffic

Intercontinental transport is dominated by sea shipping, carried out by either tramp or liner traffic. While ports have always been important nodes in the logistics system, globalization of production has sharpened the need for ports to be value adders, not value subtractors in the supply chain and has given ports a unique opportunity to become value-adding entities. A port is the interface between intercontinental transport and a place in the hinterland being considered for production, assembly or final distribution. Its capability and efficiency can greatly influence the decision on where to locate a plant or distribution centre, and can often determine whether a local producer can compete globally or regionally with other producers.
Containerisation of seaborne trade is less than 50 years old and deep-sea containerisation is only 35 years old. Yet it has dramatically changed requirements for cargo handling and port facilities. Since the 1970s containerization has revolutionized shipping and especially liner shipping. The introduction of containers has reduced the costs of packaging, breakages and theft, but above all it has simplified the process of transshipment between different modes of

transport and opened up the possibility of multimode door-to-door transport, thus becoming a pre-condition for the internationalization of subcontracting and just-in-time production systems. However, transport improvements achieved through containerization have primarily benefited the transport of manufactured goods.

More than 60% of the world's general cargo trade moved by sea is carried in containers. On trades among highly industrialized countries the percentage approaches over 80%. This is a remarkable market penetration for a technology that dates only from the mid-1950s, when the first converted ship with 58 containers made its initial voyage between New York and Houston. Since then, there has been a continuous increase in both number and average size of container ships. There is now a world capacity of more than 6 million TEU in operation and about 1 million TEU on order. Even more significant is that the post-Panamax[9] container ships now in operation have a capacity exceeding 4,000 TEU and, with a length in excess of 322.62 yards and a beam of over 35.32 yards.

The trend toward bigger and bigger container ships is continuing (Stopford, 2002). At the beginning of 2001, 130 post-Panamax container ships were on order (now operating), including 63 ships with capacity exceeding 6,000 TEU (Source: Fairplay Newbuildings, 2001). Among the ships on order is a new class of 10,000 TEU capacity container ship for Maersk. New technologies in container ships are evolving quickly and today ships of 10,000 to 12,000 TEU capacity are under construction and are expected to make their appearance within the next year. They are expected to be deployed on the Europe-Far East route. At the Asian end, the ports of Singapore, Hong Kong, Yantian, Shanghai and Yokohama are prepared for ships of this size. At the European end, the port of Rotterdam is completing the Maasvlakte II expansion in order to be ready for these mega container ships, while in the Mediterrenean only the ports of Algeciras (Spain) and Trieste (Italy) can receive these vessels at present. Looking further ahead, container ships with capacity of 15,000 TEU or greater are a real possibility. A new term, Malacca-Max, has even been created for the largest of these vessels. This ship would be capable of carrying 18,000 TEU. It would be 437,45 yards long, 65.62 yards wide and have a draft of 22.97 yards, which would be the maximum depth for crossing the Malacca Straits, making it effectively the maximum sized container ship that theoretically can be envisaged. Also the introduction of container ships capable of considerably faster service speeds than ships now in service are being developed. One carrier, Norasia, is contemplating orders for 2,000 TEU ships capable of 32-knot service speed and has been exploring concept designs for ships capable of 40 knots. Another carrier, FastShip, plans to order four 1,430 TEU vessels capable of a 38 knot service speed, with specially designed terminal facilities at both ends of the route capable of discharging and loading the ship in four hours[10].

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[9] In the 1990s, post-Panamax container ships were ordered by most of the major linehaul carriers, including Maersk, OOCL, Hanjin, Evergreen, Hyundai, Cosco, NYK, MOL and NOL. The most notable orders were those of Maersk and P&O, who took delivery of a string of ships with capacity of more than 6000 TEU, designed for service speed of 25 knots at maximum draft of 14.76 yards. Additionally, through design changes the capacity of Panamax size container ships increased to 4800 TEU. In the late 1990s, Hapag Lloyd ordered seven 4800 TEU container ships with service speed of 25 knots and draft of 14.76 yards, yet designed within the size limits of the Panama Canal.

[10] FastShip plans to start a containerized service between Europe and the U.S. East Coast in 2002 designed for high-value, time-sensitive cargo. Four 1423 TEU vessels capable of 38 knot service speed would make the 3266 mile ocean crossing in less than four days, with the goal of providing seven day door-to-door service between major destinations in Europe and the U.S. To provide this service, the developer plans a new type of highly automated terminal designed to minimize turnaround time.

Larger flows require larger vessels, just-in-time requires faster vessels, standardisation procedures developed with containerisation require special handling and shipment operations. The consequence is that ports have to adjust to these changes and this requires strong investment mainly carried out through public-private partnership both in the US and EU.

6. Emerging global terminal operators

The past decade has seen the emergence of terminal operators (see table 6) who have established their regional or worldwide presence (Slack et al., 2002). Like companies in other sectors, they see business opportunities in a period of globalisation and have been capitalizing on the trend toward privatising port facilities (Midor et al., 2000). According to a World Bank database, 62 transactions involving privatisation of container terminals took place between 1990 and 1998. Many of these transactions involved a relatively small number of players.

Table 6. Top container carriers (2004)

	Carrier	Country	TEU in service
1	AP Moller Group[1]	Denmark	900 509
2	Mediterranean Shipping Co	Sw./Italy	618 025
3	Evergreen Group[2]	Taïwan	437 618
4	P&O Nedlloyd[3]	UK / NL	426 996
5	CMA - CGM[4]	France	373 191
6	APL	Sg./USA	295 321
7	Hanjin Group[5]	S. Korea	284 710
8	NYK [6]	Japan	265 192
9	Cosco Container Lines	China	253 007
10	China Shipping Container Lines	China	236 079
11	OOCL	China	216 527
12	Mitsui Lines (MOL)	Japan	213 195
13	Zim Israel Navigation	Israel	196 420
14	CP Ships[7]	Canada	196 317
15	K Line	Japan	195 750
16	Compania Sud Americana de Vapores[8]	Chile	190 143
17	Hapag-Lloyd	Germany	186 610
18	Yang Ming Marine Transport Corp	Taiwan	168 006
19	Hyundai Merchant Marine	Korea	139 243
20	Hamburg Sud[9]	Germany	131 713
Sum of the above			5 924 572

Source: Containerisation International Yearbook, 2005
Notes:
[1] includes Maersk Sealand, Portlink, Safmarine
[2] includes Hatsu and Lloyd Trestino
[3] includes Farrell Lines, Mercosul Line-Oceanica AGW
[4] includes ANL and Feeder Associates, Ybarra CGM and MacAndrews
[5] includes Senator Lines
[6] includes TSK Lines
[7] includes of ANZDL, Canmar, Cast, Contship, Italia, Lykes and TMM Lines
[8] includes Libra, Montemar & Norasia
[9] includes Alianca, Columbus Line and CAT and Ellermans

Among the principal international terminal operators are Hutchison Port Holdings, Maersk Sealand, P&O Ports, Sea-Land Terminals, ICTSI, PSA Corporation, Dubai Ports Authority, Stevedoring Services of America and BLG-Eurokai. These terminal operators now account for about 40% of the world's annual container handling. The main operators include:

- *Hutchison Port Holdings* launched its global expansion in 1991, utilizing the experience and capabilities it developed operating container terminals in Hong Kong. It now operates container terminals in more than 17 ports and handles more than 14 million TEU annually.
- *Maersk Sealand* now manages 32 terminals worldwide and is involved in 36 other terminals, most of which came with the acquisition of SeaLand. Algeciras is generally seen as the prototype of a modern Maersk Sealand terminal that has been designed to play the role of a global or at least a regional hub. One of the company's most impressive investments has been the new transshipment terminal in Salalah, which is a joint venture with the government of Oman.
- *P&O Ports*, based in Australia, manages more than 20 ports worldwide and handles about 6 million TEU annually. The company recently acquired International Terminal Operating Company, giving it an extensive terminal operating presence on the U.S.Atlantic and Gulf Coasts.
- *Sea-Land* Terminals remains a major player in container terminal operation, despite the transfer of shipping and terminal operations to Maersk as part of the merger transaction. The company continues to operate terminals in the U.S., Hong Kong, China, Australia, Russia, Finland and the Dominican Republic.
- *ICTSI*, based in Manila, operates terminals in the Philippines, Pakistan, Argentina, Saudi Arabia and Mexico. Recently it entered a joint venture to manage a terminal in Thailand and signed a concession contract to manage and operate the Dar-es-Salaam container terminal. In 1999 the company handled about 2.2 million TEU.
- *PSA Corporation* in the mid-1990s embarked on a major effort to develop an international presence in port operations, utilizing its experience in Singapore. PSA now operates terminals in Singapore, Yemen, Portugal, China, Italy, India and Brunei. In 1999 PSA handled about 18 million TEU, 2 million of which was from foreign ventures. The Corporation's mission statement explicitly mentions that PSA over the next ten years aims to operate a string of ports overseas, handling some 10 million TEUs and managing up to a third of its port, logistics and related business overseas.
- *Dubai Ports Authority* has joined the global container terminal race and has recently set up a new company to seek out overseas port operating contracts. DPA now operates terminals in Beirut, Jeddah and Djibouti, as well as its base facilities in Jebel Ali and Port Rashid.
- *SSA*, based in Seattle, has for more than 50 years been involved in cargo handling in U.S. ports. Building on this experience, the company has expanded globally and now operates terminals in Panama, Vietnam, South Africa, India, Indonesia and Mexico and plans new ones in Egypt and Bangladesh.
- *BLG-Eurokai*, a German stevedoring company handling about 3 million TEU annually, has gained international presence by acquiring stakes in terminals in Portugal and Italy, including the Medcenter Container Terminal at Gioia Tauro, and provides technical support for a new container terminal in Sepetiba (Brazil).

- In addition, other shipping companies have developed container terminals in various parts of the world to support their shipping operations. For example, *Evergreen* operates terminals in Taiwan, Panama, U.S., Italy and Vietnam; *Cosco* operates terminals in Hong Kong, China and Italy; *NOL/APL* has terminals in the U.S., Pakistan, Vietnam and Japan.

7. Networks and hubs

In the geography of transportation, hub-and-spoke networks are very attractive as they are a tangible spatial manifestation of a process (O'Kelly, 1998). Hubs are geographical in that they serve a specific regional area and they often confer benefits on the region in which they are located. Hubs are usually a catalyst for agglomeration and scale economies.

In maritime freight transport, carriers have been increasingly using regional hubs for transshipment of containers. This is a worldwide trend that is accelerating as larger container ships come into service and the advantages of hub-and-spoke operations become more apparent. The hub-and-spoke concept is intended to maximize utilization of large container ships while providing market coverage to a maximum number of ports. This is accomplished via a network of regional and sub-regional hubs with onward service to outlying locations. Large linehaul ships, often with more than 4000 TEU capacity, provide service between regional hubs. Progressively smaller ships are used to pick up and distribute containers within the region.

The most obvious benefit is the income generated from operations of a transshipment hub because of the double handling of containers. Consequently, container throughput in hub ports can be greatly boosted particularly when expressed in TEUs. More importantly, transshipment hubs provide local importers and exporters direct access to linehaul service, reducing transportation time (and possibly freight rates) to and from overseas markets. Reduced transport time directly impacts the competitiveness of exporters and the cost of imports, in turn creating jobs and income throughout the economy. Many developing countries have created free trade zones in combination with the hub port as engines for economic growth. For example, Jebel Ali illustrates how a hub port in conjunction with an associated free trade zone can create significant economic activity. The port, which began operating in 1979, now has 67 berths and is serviced by 100 shipping lines. About 1,450 companies from 85 countries have been attracted to start up operations in the free trade zone.

At the same time hubs are facing a highly competitive market segment where customers have options to use other facilities and pricing. An issue confronting the developer of a transhipment hub is how to prevent "hub hopping" in a situation where the number of competing hub facilities is growing rapidly and carriers have the ability to take their business elsewhere.

In such a situation, a carrier who represents a significant portion of the terminal's business can assert considerable pressure on the terminal owner and/or port to increase the service level offered and at the same time reduce charges and make concessions by threatening to vacate the hub.

If we look at the European container port system, it partially confirms the findings by Hayuth[11] (1988) who suggested that the concentration tendency will eventually reach a limit or might even develop into deconcentration.
The medium-sized and large load centres in the Mediterranean can threaten the competitive position of the major ports of the North (Hamburg, Le Havre, Rotterdam, Antwerp, etc.). The quality improvements and major investments in these load centres actually have already contributed to a partial rechanneling of traditional north-south land and water feeder trades. The increasing number of hubs in the Mediterranean will most probably lead to a further traffic distribution between east-west and north-south (Notteboom, 1997). To a certain extent, the number of high-quality land and feeder services between northern ports and the market areas in southern Europe will determine the level of this traffic distribution. Especially for the geographical market segments of northern Italy, Switzerland, southern Germany, Spain and the middle and south of France, inter-range port competition between northern and Mediterranean ports will undoubtedly increase in the coming years (Song, 2003). Partially in view of competition with Mediterranean ports, Northern European ports have supported the infrastructure development of multimodal transport corridors.
Although intermodal services in Europe have developed well over the last ten years, Charlier and Ridolfi (1994, p. 242) pointed out that "the (multimodal) operations established in Europe are not a copy of the North American model, since Europe is still fragmented geographically, politically and, despite the recent establishment of a European community-wide market, economically". For instance, although some major north-south links have been established, western Europe still possesses no massive container railway corridors comparable to minibridge and landbridge activities in the U.S., mainly because of inefficiencies in organizational structures (e.g. the involvement of several railway companies) and the lack of technical standards (e.g. varying current on national electrified networks) or physical constraints (e.g. limited opportunities for double stack trains due to height limits). In the past, these elements undoubtedly had a negative impact on the concentration pattern in the European container port system. For the future, a further absence of a far-reaching political, economic and technical harmonization in intermodal transportation would be disadvantageous for the (northern) European load centre ports. It would negatively affect the necessary development and optimisation of efficient hinterland corridors and networks around these load centre ports (Brooks, 2000). The resulting dispersion of container flows especially to medium-sized container ports would prevent further concentration in the container port system.

8. Conclusions

In conclusion, the effects of the new origin of flows (South East Asia), of the concentration at Northern European ports and the changes of routes for large carriers transit (Suez as strategic crossing from Asia to Europe and even US), it is possible to forecast an increase in

[11] Hayuth's model on the dynamics within container port systems (Hayuth, 1981) is the result of empirical research in the US container port sector and is of particular interest in the study concentration tendencies in the European container port sector. Hayuth distinguishes five phases, each with different characteristics with respect to concentration patterns, port-hinterland relationships and technological innovations.

importance of the Mediterranean area that will cause a strong competition among both existing and expanding hubs. The investment choices of terminal operators will be fundamental in shaping the future of this sector in the area. Moreover, port regions supported by regional and national policies in creating infrastructures (road and railway connections, services, etc.) could obviously have a competitive advantage.
Furthermore, the increasing significance of Suez Canal as a transport gateway could create some problems in the future, since the Egypt area cannot be considered a "high security zone", particularly after the recent terrorist attacks. Improving political relationships with Egypt and with the whole of North Africa and the Middle East can be considered an important issue, not only for peaceful cohabitation and integration between the people of the world, but also for international freight flows.
Table 7 shows changes in container traffic at European ports and clearly identifies how increases have been stronger in most of the Mediterranean hubs compared to the Northern European ones. According to these trends, three different types of hubs can be identified: mature, emerging and regional hubs.

8.1 Mature hubs

Mature hubs already have at their disposal a widespread network of transport connections. The main challenges for these hubs will be to ensure that terminal capacity and accessibility of the area remain of high standard in order to accommodate the growth in traffic. Most of the mature hubs are confronted with limited availability of sufficient land for development and sufficient terminal capacity.
Logistics facilities in strategic hubs are focused on forwarding and warehousing. The forwarding activities are related to sea freight or airfreight forwarding. Warehouses are typically 'Gateway' warehouses for the European market where freight is consolidated from various sources and redirected in high volume flows to national or regional warehouses elsewhere in Europe. The warehouses around airports can also be characterised as typical European Distribution Centres (distribution to end customers) since airfreight is characterised by low volume, high value products.

8.2 Emerging hubs

Emerging hubs have the geographical advantage of being located at the crossroads of new routes and "penetration" connections to the rest of Europe and even North America. Compared to mature and feeder hubs their position has a better investment climate (e.g. cheaper and more readily available land, lower labour costs). Hinterland regions should try to take advantage of this and try to attract new investors to the region. Both shippers and 3PLPs are attracting new investors. New shippers bring new demand for logistics services to the region. 3PLPs bring new logistics services. Warehousing and networking facilities are typical 3PLP facilities for hinterland regions. Therefore it is advisable to stimulate public and private partnerships that aim to develop an integral logistics strategy for the region focusing on how to increase the current demand for logistics services in the region.

Table 7. Container traffic at European ports in 1000 TEU (1990-2002) and % change 2001/2002

Port	Country	1990	1995	1999	2000	2001	2002	02/01
Rotterdam	NL	3 667	4 787	6 245	6 268	6 102	6 515	+6.8
Hamburg	DE	1 969	2 890	3 750	4 248	4 689	5 374	+14.6
Antwerp	BE	1 549	2 329	3 614	4 082	4 218	4 777	+13.3
Bremen	DE	1 198	1 524	2 201	2 712	2 896	3 032	+4.7
Gioia Tauro	IT	-	16	2 253	2 653	2 488	2 955	+18.7
Felixstowe	UK	-	-	-	2 853	2 800	2 750	-1.8
Algeciras	ES	553	1 155	1 835	2 009	2 152	2 234	+3.8
Valencia	ES	387	672	1 005	1 308	1 507	1 821	+20.9
Le Havre	FR	858	970	1 378	1 465	1 525	1 720	+12.8
Genoa	IT	310	615	1 234	1 501	1 527	1 531	+0.3
Barcelona	ES	448	689	1 235	1 388	1 411	1 461	+3.6
Piraeus	EL	426	600	965	1 161	1 196	1 405	+17.5
Southampton	UK	345	681	920	1 061	1 161	1 275	+9.8
La Spezia	IT	450	965	843	910	975	975	+0.0
Zeebrugge	BE	342	528	850	965	876	959	+9.5
Marseille	FR	482	498	664	722	742	811	+9.3
Gothenburg	SE	352	458	624	696	698	756	+8.4
Tilbury	UK	-	-	-	-	513	569	+10.9
Livorno	IT	-	-	-	501	532	547	+2.8
Liverpool	UK	239	406	515	540	524	535	+2.1
Lisbon	PT	264	309	369	389	438	488	+11.2
Helsinki	FI	246	296	321	376	438	457	+4.2
Dublin	IE	215			445	435	456	+4.8
Aarhus	DK		223	327	404	409	403	-1.5
Hong Kong		5 101	12 550	16 211	18 098	17 900	19 140	+6.9
Singapore		5 224	11 846	15 945	17 087	15 520	16 800	+8.2

Source: Containerisation International; Institute of Shipping Economics and Logistics, Bremen

8.3 Regional hubs often with a feeder role to mature and emerging hubs

The main focus of these hubs with an international function will be to offer sufficient capacity on international transport connections, meaning for example increasing terminal capacity and frequency of services. Most hinterland regions have a feeder function towards mainports, mainly/partly because they can host only smaller but faster vessels. These relations often exist in the form of rail or inland waterway connections (see e.g. port of Duisburg on the Rhine river). The region should try to expand connections not only to mainports but also to other important transport nodes around the region, for example large (inter)national airports, inland ports or important continental terminal locations. The supply of these transport services should be focused on the demand of the industrial and logistics base in the region. Therefore it is advisable to encourage the establishment of an organisation with public and private partners that aim to develop an integral logistics strategy for the

region focusing on how to increase the accessibility of the region and the network of terminal connections. Regional hubs with international function show more presence of networking facilities and large scale (national or European) warehousing. Regional hubs are more suitable for these activities compared to strategic hubs because of their lower operating costs, availability of land and accessibility.

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