THE INTRODUCTION OF AN ECOLOGICAL DIMENSION IN PRODUCT PORTFOLIO ANALYSIS

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Abstract

Government regulation and societal demands force corporations to take into account environmental considerations. The attractiveness of economic activities needs to be assessed not merely in terms of economic potential as measured by market share and growth rate, but also in terms of environmental repercussions. As a result, environmental elements are increasingly considered as strategic decisions. This paper aims at augmenting traditional product portfolio analysis with an environmental dimension, so as to include ecological parameters in strategic decision making. This new approach is then applied to the analysis of seaport traffic portfolio structures in the Hamburg-Le Havre range.

INTRODUCTION

Government regulation as well as societal demands are forcing corporations to take into account environmental considerations in their business decisions. The attractiveness of existing economic activities and new investment projects needs to be assessed not merely in terms of economic potential as measured by market share or growth rate, but also in terms of environmental repercussions. As a result, environmental elements and decisions are increasingly considered as strategic decisions. This paper aims at augmenting traditional production portfolio analysis with an environmental dimension, so as to include ecological parameters into strategic decision making. This new approach is then applied to the analysis of seaport traffic portfolio structures.

This paper includes both a conceptual framework and an application to the port sector. The analytical instrument is applied to the traffic figures and modal split of the most important ports in the North West European Hamburg-Le Havre range. As a result, the impact of decisions by port authorities and port operators to use specific traffic modes can be identified.

First, a conceptual framework is developed that allows to include an ecological dimension into product portfolio analysis. Traditional portfolio analysis only considers the micro-economic aspects of business activities. In that case, the average market share and the average growth rate of strategic business units are used as key indicators of competitiveness. In this paper, it is suggested building upon Ilinitch and Schaltegger (1995) and Burke and Lodgson (1996), to develop a portfolio analysis approach that takes into account a number of environmental elements. This conceptual framework is then applied to the port sector. Finally, the analysis leads to relevant policy recommendations for government, port authorities and port users in the North Western Europe. The tool developed in this paper allows to assess the relative position of ports vis-a-vis specific rivals not only in terms of, e.g., growth and market share, but also in terms of environmental characteristics.

INTRODUCING AN ENVIRONMENTAL DIMENSION IN TRADITIONAL PORTFOLIO ANALYSIS

Traditionally, a seaport was regarded as "a gateway through which goods and passengers are transferred between ships and the shore", see Goss (1990, p. 208). The recent port economics literature suggests, however, a change in port functions, associated with changes in the competitive environment in which ports operate.

Although a substantial body of economics driven literature on 'seaport competition' exists, there is no agreement on the definition if port competition. The most recent views on port competition argues that it is a process whereby port operators attempt to acquire trade and traffic volumes in specific traffic categories. Port authorities and governments are considered as external actors that determine the business environment and working conditions of the port sector, as well as the constraints within which seaports have to operate.

Given these basic assumptions, the competitive position of port operators is influenced by decisions taken in rival seaports. Effective strategy formation requires operators to know their own port's - strengths and weaknesses as well as those of its main (present or future) competitors. Portfolio analysis can be used as a technique to identify these strengths and weaknesses.

Portfolio analysis is an evaluation technique originally developed in the field of strategic management in order to assess the competitive position of strategic business units is large, diversified companies. However, the technique can easily be applied to other economic sectors. In particular, it is very useful for determining the competitive potential of seaports in terms of market shares, growth rates and diversification effects.

Verbeke, Peeters and Declercq (1995), Notteboom and Coeck (1994) and Winkelmans and Coeck (1993) have argues that the main purposes of a portfolio analysis, are threefold :

1. to provide statistical information regarding changes in competitive position ;
2. to determine the competitive potential of a business unit, in relation to anticipated future developments ;
3. to aid in strategy formation, especially in the context of resource allocation programmes.

The conventional analytical instrument used in portfolio analysis is the growth-share matrix. This technique allows to decide for each business whether to invest, to use the business unit for financing other businesses or to divest. In accordance with Dyson (1990) and Hax and Majluf (1983), the use of portfolio analysis allows to support strategic planning. Dyson states that by focussing on market share and industry growth and recognizing these elements as indicators of profitability, the technique also has a secondary impact on determining of objectives, performance measurement and selection and it can be used as an effective evaluation instrument for the development of a long term strategic port planning.

A product portfolio analysis, which was originally developed in the field of strategic business planning by the Boston Consulting Group, allows to position businesses and business units using two variables, i.e. market share and growth rate. The main contribution of this tool is to determine the 'position' of the units analysed and to indicate their potential.

According to the Boston Consulting Group, a firm's set of Strategic Business Units (SBUs) or product market entities can be positioned in a decision matrix, as a function of their market share and relative growth rate, see Figure 1. The Boston Consulting- or BC-matrix evaluates the competitiveness of the different SBUs of a firm and can also be used to analyse the relative competitive position of a company as compared to a series of other companies. The BC-matrix distinguishes four distinct market positions, ie. 'question marks', 'stars', 'cash cows' and 'dogs'. Question marks (high growth rate and small market share) are SBUs demanding important investments in order to gain market share, due to their high growth rate. When an important market share is combined with an above average growth rate, a 'star'-position is obtained. These SBUs represent the 'success stories' of a company. Cash cows (large market share and small growth rate) generate financial resources, needed to reinvest in e.g. question marks. Dogs have little intrinsic economic potential as they are unable to generate sufficient cash flows as a result of a small market share combined with a less than average growth rate.

Extensive empirical research (e.g. De Lombaerde and Verbeke (1989)) on seaport competition has led to the conclusion that seaport authorities in the Le Havre-Hamburg range are primarily interested in (a) increasing the port's market share vis-à-vis rivals in the range and (b) a diversification of their traffic structure, in order to stabilize growth. The BC-approach therefore appears particularly appropriate to study the traffic portfolio of individual ports. This is especially important for seaport authorities that want to stimulate the expansion of the operators active in their port.

The traditional BC-matrix can easily be applied to the port sector. The original concept of SBUs is modified into Strategic Traffic Units (STUs). The STUs that can be distinguished are the major traffic categories such as liquid bulk, dry bulk, containers, ro-ro and conventional cargo.

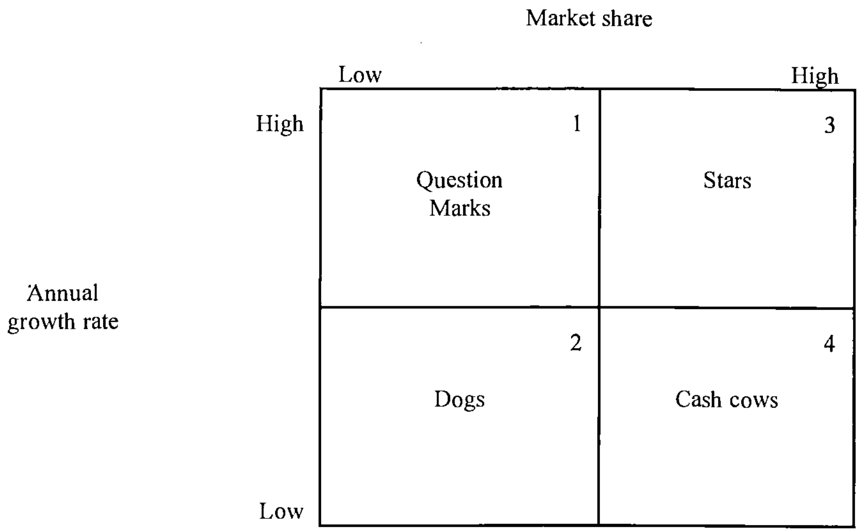


Figure 1 : The Boston Consulting Matrix

The two basic dimensions 'traffic growth' and 'market share' allow to position seaports as a whole or specific traffic categories according to their economic performance. As a result, important insights may be gained by the port authority as well as the port users as regards their competitive position with respect to their main competitors.

The most important contribution of the port portfolio analysis is that it allows to determine the intrinsic potential of ports, to increase (or at least maintain) their market share(s) and/or to improve their growth rate in specific commodity groups. It aims at assessing the relative competitive potential of different seaports. By translating the SBU-concept into terms related to seaports (i.e. into the STU-concept) any traffic flow can be positioned in a decision matrix.

In accordance with the more general BC-matrix or the growth-share matrix, four distinct market positions can be distinguished. STUs that combine a larger than average market share with a fast growth are considered to be 'stars'. These traffic flows represent the ports' potential to survive and to maintain or strengthen their market position and/or traffic growth. Profitability depends on sustaining these STUs. More slowly growing STUs which also have a large market share are 'cash cows'. Excess resources from these STUs are primarily used to sustain existing star-STUs or, by increasing investments in specific traffic categories, to create new 'stars'. STUs that combine a smaller than average market share with a large growth rate are considered as 'wild cats' (also called 'question marks' or 'problem children'), as their potential for further growth and increasing market share is still rather uncertain. In general, a small market share can be balanced with traffic growth, through increased marketing efforts or by a quality improvement of services. Finally, STUs with a lower than average market share and a small or even negative growth rate are considered as 'dogs'. These STUs offer little or no potential for further development. Therefore, the general rule is to divest such STUs. Nevertheless, they can be of great use as a complement for products with a high profitability. In addition, 'dog'-services may be important for port users requiring a total service package.

Different visualisation representations of a port portfolio can be generated. First, the port range can be considered as a portfolio of individual ports. In this case, the different ports are positioned in the matrix according to their total traffic, without distinction between relevant commodity groups or traffic categories. To provide a comparison with the original BC-matrix, the average growth ratio per year, i.e. growth rate in the range and the average market share are represented respectively horizontally and vertically. As a result, a comparable decision matrix is created in which the position of the ports is described in terms of the concepts 'star', 'cash cow', 'question mark' and 'dog'. The next visualisation of the port portfolio represents the internal traffic structure of individual seaports in the range. In contrast with the previous portfolio, the relative share of each traffic category in the port's total traffic is represented as well as the respective growth ratio in each category. Therefore, each seaport individually is considered as a portfolio of traffic categories. A classification of traffic flows within each port is the result of this analysis. In the third version of the portfolio analysis, the port range is considered as a portfolio of ports for each commodity (or traffic flow). For each individual traffic category a port's performance is compared with the performance of rival seaports in the range. As a result, a classification of ports for each specific traffic category is provided. Finally, the fourth version of the portfolio analysis examines traffic flows in terms of their average share in the different ports of the range. Each relevant traffic category is examined in relation to the share of this category within the individual seaport and in comparison to all other ports in the range. This analysis introduces an additional dimension to the portfolio analysis, i.e. a circular shape with a surface proportional to the absolute importance or weight of the traffic category, in each seaport as well as in the total range.

The major disadvantage of the conventional analysis described above is that the environmental impact of ports is not taken into account. An additional environmental consideration would allow to evaluate the environmental impact of specific cargo types. This environmental dimension is determined by the type of transport used to move the cargo towards the hinterland. Here, a distinction can be made between road transportation, rail and inland navigation as the most important hinterland transport mode.

The decomposition of overall traffic flows over these transport modes may indicate either an environment friendly transport or the use of transport modes that impose serious effects on the natural environment. Therefore, a positioning of different ports that aims at including the environmental impact of the transport activities has to provide an analysis according to the performance of the ports on three dimensions, i.e. market share, market growth and the use of an environment friendly type of transport.

Jose (1996) and especially Ilinitch and Schaltegger (1995) have suggested the use of a 'green business portfolio', integrating ecological factors into traditional portfolio analysis in order to address emerging strategic environmental issues. Their ecologically-oriented portfolio matrix quantifies the environmental impact of business activities and compares them with the economic performance of these businesses, based upon the traditional indicators i.e. relative market share and relative growth rate. The environmental impact is estimated by using 'pollution units' or the discharges of toxic substances in air, land and water. The economic performance dimensions are the same of those used in the BC-matrix and result in the familiar matrix and BC-quadrants. The combination of both perspectives leads to the development of a three dimensional matrix. The optimal position in the ecologically oriented product portfolio analysis is the green star which combines high economic impact with low environmental harm. A dirty dog position is not a desirable position in the matrix : these products might cause sustainable environmental harm without significant economic benefits in terms of market share or growth rate. Between these two extremes a number of 'middle positions' exist, such as the dirty cash cow, the green dog or the green question mark. A dirty cash cow possesses a high market share in dirty technologies. A green dog position suggests a combination of a weak economic performance within an environmentally attractive business. However, this positioning may indicate the potential to become a green question mark or even a green star in a stronger economic climate.

In the next section, the possibilities of applying the ecologically-oriented portfolio analysis to the port sector are investigated and an operationalisation of the theoretical concepts will be provided.

This operationalisation will allow to determine whether the position of the studied ports has to be revised based on the used transport modes

AN APPLICATION OF THE ENVIRONMENTAL PORTFOLIO TECHNIQUE TO THE PORT SECTOR

Maritime traffic flows in the Hamburg-Le Havre range

As international seaport competition takes place between seaports which share the same hinterland and try to obtain large volumes of specific traffic flows, an analysis of the competitive position of a seaport needs to be carried out taking into account its performance within a specific port range. A port range can be defined as a group of ports situated on the same seashore and sharing the same hinterland. The most important seaport range in Northern Europe is the Hamburg-Le Havre range. All major seaports situated between Hamburg and Le Havre, i.e. Antwerp, Ghent and Zeebrugge (Belgium), Bremen and Hamburg (Germany), Rotterdam and Amsterdam (the Netherlands) and Le Havre and Dunkirk (France) are included in this range.

Total maritime traffic flows in the Hamburg-Le Havre range remained fairly stable during the observation period 1980-1995, recording an average annual growth rate of approximately +0.6%. The growth rates of the individual ports, however, are much more diverse. Especially the smaller ports grew faster than the overall port range. Only the French ports recorded a decline in maritime traffic and as a result lost market share in 1995 as compared to the base-year 1980.
Table 1 provides an overview of the evolution of total maritime traffic in the Hamburg-Le Havre range.

Table 1 - Total maritime traffic volumes in the Hamburg-Le Havre range (1000 t)

	1980	1985	1990	1995	Average annual growth 1980-1995
Antwerp	81935	86246	102009	108074	+1.86 %
Ghent	18424	26673	24439	21583	+1.06 %
Zeebrugge	14189	14166	30350	30574	+5.25 %
Rotterdam	276818	250668	287868	294303	+0.41 %
Amsterdam	22432	27612	31332	31229	+2.23 %
Hamburg	63097	59791	61360	72124	+0.90 %
Bremen	26961	29827	30204	31071	+0.95 %
Le Havre	77505	48735	54019	53782	-1.80 %
Dunkirk	41218	32167	36560	39380	-0.29 %
TOTAL	622578	575885	658140	682120	+0.61 %

The average annual growth rates, included in the last column of Table 1, need to be considered not only for the total observation period, for separate time spans of, e.g., five years, i.e. the evolution in 1980-1985, 1985-1990 and 1990-1995 in order to reveal hidden fluctuations and/or recent trends. Table 2 represents the different growth rates of the total traffic flow for the selected periods.

Table 2 - Annual growth rates of total maritime traffic volumes in the Hamburg-Le Havre range (in %)

	1980-1985	1985-1990	1990-1995	1980-1995
Antwerp	+1.03	+3.41	+1.16	+1.86
Ghent	+7.68	-1.73	-2.45	+1.06
Zeebrugge	-0.03	+16.46	+0.15	+5.25
Rotterdam	-1.97	+2.81	+0.44	+0.41
Amsterdam	+4.24	+2.56	-0.07	+2.23
Hamburg	-1.07	+0.52	+3.29	+0.90
Bremen	+2.04	+0.25	+0.57	+0.95
Le Havre	-8.86	+2.08	-0.09	-1.80
Dunkirk	-4.84	+2.59	+1.50	-0.29
TOTAL	-1.55	+2.71	+0.72	0.61

The figures of Table 2 indicate that only the period 1980-1985 revealed an overall negative annual growth rate. Especially the French ports (Le Havre and Dunkirk) and Rotterdam were characterized by a substantial traffic decrease in this period. Ghent, Amsterdam and Hamburg on the other hand recorded strong annual growth rates.

The period 1985-1990 was characterized by an impressive growth of the port of Zeebrugge. Antwerp, Rotterdam and Amsterdam then grew at a rate of approximately 3% per year and the French ports experienced a revival of the growth of their traffic volume in this period. The German ports and Ghent were characterised by much less favourable growth rates Finally, the period 1990-1995 revealed relatively small growth rates. Bremen, Dunkirk and Antwerp were still characterised by favourable figures, whereas Ghent recorded the worst evolution: its traffic decreased by approximately 2.5% per year.

The market shares of individual ports in the Hamburg-Le Havre range are included in Table 3.

Table 3 - Market shares of individual ports in the Hamburg-Le Havre range (in %)

	1980	1985	1990	1995	Average 1980-1995
Antwerp	13.16	14.98	15.50	15.84	15.14
Ghent	2.96	4.63	3.71	3.16	3.80
Zeebrugge	2.28	2.46	4.61	4.48	3.35
Rotterdam	44.46	43.53	43.74	43.15	43.69
Amsterdam	3.60	4.79	4.76	4.58	4.53
Hamburg	10.13	10.38	9.32	10.57	9.86
Bremen	4.33	5.18	4.59	4.56	4.73
Le Havre	12.45	8.46	8.21	7.88	9.03
Dunkirk	6.62	5.59	5.55	5.77	5.87

Although Rotterdam's traffic volume did not improve substantially during the overall observation period, this port is still the most important player in the Hamburg-Le Havre range. Antwerp remained the second most important seaport. Hamburg and Le Havre both have a market share of approximately 10% and the smaller seaports (Dunkirk, Bremen, Amsterdam, Zeebrugge and Ghent) recorded a market share of 5% or less.

The average growth rates of the traffic categories under consideration in the period 1980-1995 indicates that the growth of individual categories diverges substantially, see Table 4. The figures in Table 4, combined with the market shares in Table 5, reveals that a strong tendency towards specialisation exists.

Table 4 - Annual growth rates of traffic categories in 1980-1995 (in %)

	Liquid Bulk	Dry Bulk	Containers	Ro-ro	Conv. Cargo	Total
Antwerp	+2.01	-0.50	+10.06	+7.66	-0.22	+1.86
Ghent	-1.22	+1.28	+4.49	+7.73	-0.74	+1.06
Zeebrugge	-0.41	+4.46	+8.05	+7.81	+15.48	+5.25
Rotterdam	-1.10	+0.94	+6.87	+5.43	-1.32	+0.41
Amsterdam	+2.82	+2.46	+4.45	+1.55	-2.51	+2.23
Hamburg	-3.42	+0.96	+11.41	+3.28	-3.01	+0.90
Bremen	-1.67	+0.93	+6.44	+2.83	-3.24	+0.95
Le Havre	-2.23	-3.15	+4.38	+5.30	-4.05	-1.80
Dunkirk	-0.42	-0.79	+1.47	+10.41	-2.88	-0.29
TOTAL	-1.22	+0.50	+7.83	+6.55	-1.72	+0.61

In general terms, containers and ro-ro traffic increased by approximately 7 to 8% per year, i.e. respectively by 7.83% and 6.55%. With respect to 'containers', Hamburg and Antwerp outperformed the other ports in the Hamburg-Le Havre range. Zeebrugge, Rotterdam and Bremen performed according to the average growth rates for containers in the range. Only the French ports and Ghent are 'underachievers' with respect to the container trade.

The French port of Dunkirk, however, recorded the highest growth rate with respect to ro-ro traffic : an annual growth rate of more than 10% over the period 1980-1995 was realized. The Belgian ports largely determine the growth path of ro-ro-traffic : the port of Antwerp increased by 7.66%; the port of Ghent by 7.73% and the ro-ro-traffic in the port of Zeebrugge increased by 7.8% per year. Overall, dry bulk traffic stagnated during the observation period and liquid bulk and conventional cargo traffic volumes decreased by approximately 1.5% per year. The major reason for the declining conventional cargo trade can be found in an increased containerisation of general cargo.

Table 5 - Market shares of the considered traffic categories in 1980-1995 (in %)

	Liquid Bulk	Dry Bulk	Containers	Ro-ro	Conv. Cargo	Total
Antwerp	9.75	14.86	16.25	9.04	40.85	15.14
Ghent	0.87	8.84	0.10	2.38	4.27	3.80
Zeebrugge	1.36	2.21	4.01	30.06	1.20	3.35
Rotterdam	55.55	41.11	40.19	21.35	20.82	43.69
Amsterdam	4.71	6.80	1.04	1.77	2.52	4.53
Hamburg	6.10	10.18	16.79	5.80	14.34	9.86
Bremen	1.23	3.68	12.18	7.59	11.08	4.73
Le Havre	16.09	3.17	8.45	9.15	1.10	9.03
Dunkirk	4.35	9.15	0.98	12.86	3.82	5.87
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00

Table 5 represents the market share of the traffic categories considered. These figures reveal a striking specialisation of each port in the Hamburg-Le Havre range in specific commodities or traffic categories. Despite the decreasing traffic volume, Antwerp can still be characterised as a 'conventional cargo'-port. Ghent is a traditional dry bulk port and Zeebrugge can be called a 'ro-ro' port. The port of Rotterdam is specialised in liquid bulk, although the volume of dry bulk and container traffic is also very substantial, as almost 40 to 50% of range traffic of these traffic categories is handled in this port. The German ports are to be considered as container ports : the competence of these ports for this traffic category is clear from their market share figures.

Finally, the French ports of Le Havre and Dunkirk appear to achieve a favourable performance mainly in the area of liquid bulk and ro-ro traffic. As is indicated in Table 4 and Table 5, Rotterdam can be considered as the 'overall winner' or major port in the Hamburg-Le Havre range in terms of transhipped cargo volumes, followed by the port of Antwerp.

Nevertheless, it should be emphasized that no valid conclusions can be drawn from only considering Table 4. A specific port can have a relatively high growth rate in a specific traffic category, but as a result of its very low market share (see Table 5) this may only have a minor positive effect, e.g. the port of Ghent as regards container trade.

Table 6 provides more details as regards the share of each traffic category in total port traffic. This enables to draw relevant conclusions with respect to the specialization of individual ports.

Table 6 - Market shares of the different traffic categories in total port traffic 1980-1995 (in %)

	Liquid Bulk	Dry Bulk	Containers	Ro-ro	Conv. Cargo	Total
Antwerp	24.97	32.43	15.35	2.81	24.44	100.00
Ghent	8.91	77.34	0.37	3.04	10.33	100.00
Zeebrugge	15.66	21.79	16.93	42.67	2.95	100.00
Rotterdam	49.55	31.21	12.65	2.27	4.33	100.00
Amsterdam	40.10	50.00	2.98	1.82	5.10	100.00
Hamburg	24.19	34.24	25.34	2.69	13.54	100.00
Bremen	10.08	25.77	35.10	7.26	21.80	100.00
Le Havre	70.06	11.60	12.45	4.73	1.17	100.00
Dunkirk	28.89	51.72	2.11	11.22	6.05	100.00
TOTAL	38.96	33.14	13.98	4.77	9.14	100.00

Table 6 largely confirms prior results. Although the maritime traffic in the port of Antwerp is well diversified regarding the considered traffic categories, a clear specialization is shown in conventional cargo and bulk trades. The port of Ghent is a port specializing in dry bulk whereas the port of Zeebrugge is characterized as a roro-port. Rotterdam and Amsterdam are specific bulk ports. Hamburg and Bremen are specialized in containers and conventional cargo. Finally, the French port of Le Havre and Dunkirk are characterized by large volumes of respectively liquid bulk and roro.

An operationalisation of the 'environmental' portfolio analysis approach

Applying the ecological portfolio technique as developed by Ilinitch and Schaltegger (1995) to the port sector turns out to be difficult. Indeed, the environmental impact of handling different types of cargo and the use of different transport modes to move the cargo towards the hinterland cannot be described quantitatively in an unambiguous fashion. This, however, is one of the cornerstones of the Ilinitch-Schaltegger framework. Moreover, only an indication of the environmental impact of the transport modes used to move cargo to the hinterland can be provided. Based upon data on external effects, it is clear that the use or road transport (black or dirty position) has a stronger environmental impact than the use of rail transport (red or contaminating perspective). The use of inland navigation is considered as the transport mode that generates the least externalities (blue or environmental position).

In addition, an implementation of a port portfolio analysis as described above is difficult when trying to take into account the different transport modes. Indeed, no statistical source exist that reports the tonnage of an individual traffic category moved to the hinterland by the three transport modes considered. The share of the different transport modes in not registered by the port authorities for the individual traffic categories. At best, an indication of total traffic of every transport mode can be supplied by the port authorities.

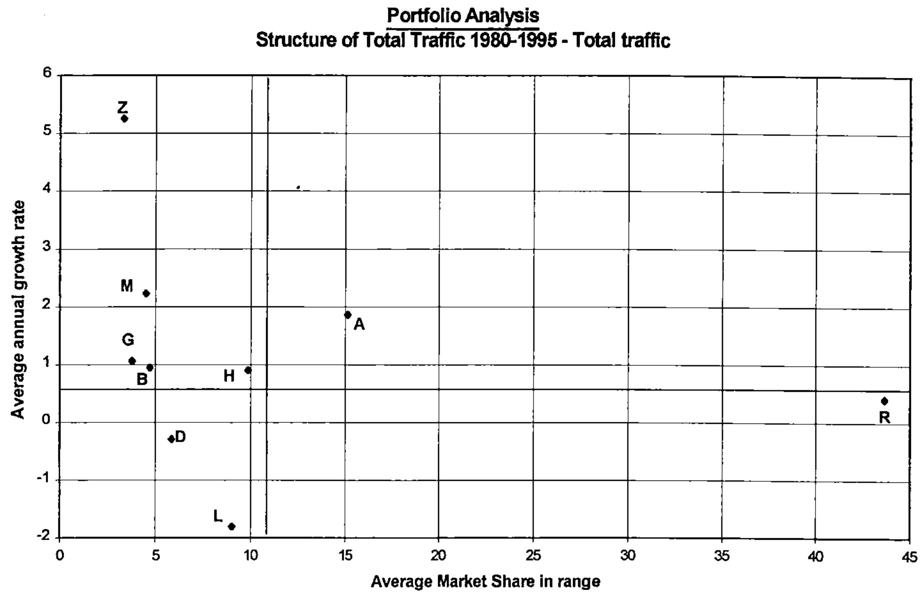
An important question is : "Can the Ilinitch-Schaltegger framework of the ecologically-oriented portfolio analysis also be applied to the port sector or what elements need to be modified in order to operationalize the framework ?" As indicated above, the conventional product portfolio analysis technique can easily be applied to the port sector, taking into account the economic indicators 'relative market share' and 'relative growth rate'.

When performing a conventional portfolio analysis, e.g. ports are positioned according to their total traffic (see supra - first representation and positioning according to the average market share in the total port range and average annual growth rate of the entire port (traffic)) in the observation period, without distinction among relevant commodity groups or traffic categories. When 1980-1995 is used as an observation period and the traffic evolution of the major ports in the Hamburg-Le Havre range is considered, the analysis can be visualized as in Figure 2.

The total market share of each port is indicated on the X-axis as a percentage of the total range traffic. The annual growth rate of the traffic is represented on the Y-axis. The bold vertical line expresses the theoretical average market share, i.e. assuming all seaports in the range have the same market share. The horizontal bold line allows to make the distinction between relatively fast and slow growing seaports, as it indicates the average annual growth rate of the entire port range in the period 1980-1995. During this period the average annual growth rate attained 0.61%.

The annual growth rate, visualized on the Y-axis, has been negative for the French ports (Le Havre and Dunkirk) and was below average for Rotterdam during the observation period. Figure 2 shows that the German ports as well as Amsterdam, Ghent and Zeebrugge have a small market share, but grow relatively faster than the average port in the range. Therefore, they are considered as question marks. The total traffic of the ports of Hamburg and Bremen hardly grew in the selected period. Here, it should be emphasized that Zeebrugge has a growth rate of more than 5% (5.25%), nearly 4.5 percent higher than the average. The French ports are in an overall unfavourable situation as they have both a small market share and a low growth rate, especially the port of Le Havre. Rotterdam has an enormous market share (over 43%, whereas the second largest port, Antwerp, represents only 15%) but nevertheless it lacks sufficient growth in order to be considered as a star. As a result, only one port in the studied port range receives an overall star-status in the observation period 1980-1995, i.e. the port of Antwerp.

This analysis does not take into account the ecological or environmental component. Traffic that arrives in the port also need to be loaded or unloaded. Three different types of transhipment can be distinguished : (1) sea-sea transhipment, (2) transhipment to local origins and destinations and (3) transhipment towards the hinterland. The Member States Group on Ports and Maritime Transport - North Sea Group (1995) provided an indication of the importance of the different types of transhipment in the ports of the Hamburg-Le Havre range, see Table 7.



Legend :

A : Antwerp — G: Ghent — Z : Zeebrugge — R : Rotterdam — M : Amsterdam

H : Hamburg — B : Bremen — L : Le Havre — D : Dunkirk

Figure 2 - Portfolio analysis - total traffic structure 1980-1995

Table 7 - Shares of sea-sea transport, local transhipment and hinterland transport of total throughput of ports

Ports	Share of transhipment (in %)		
	sea-sea transport	local transport	hinterland transport
Belgian ports			
Antwerp	13.69	27.06	59.25
Ghent	5.71	9.81	84.48
Zeebrugge	14.05	8.69	77.26
Average	**11.15**	**15.19**	**73.66**
Dutch ports			
Rotterdam	15.46	27.05	57.49
Amsterdam	18.62	37.02	44.36
Average	**17.04**	**32.04**	**50.93**
German ports			
Hamburg	6.34	30.81	62.85
Bremen	11.36	29.34	59.30
Average	**8.85**	**30.08**	**61.08**
French ports			
Le Havre	8.40	69.83	21.77
Dunkirk	0.00	64.80	35.20
Average	**4.20**	**67.32**	**28.49**
AVERAGE RANGE	***10.40***	***33.82***	***55.78***

Table 7 suggests that only 56% of turnover in the ports of the Hamburg-Le Havre range is actually moved toward the hinterland. The remaining part is transhipped by sea (10.4%) or is meant for local destinations (33.8%). When evaluating the economic impact of the use of transport modes in hinterland transportation only this last share should be taken into account.

Table 8 - Distribution of port's hinterland transport

Ports	Share of transport modes (in %)		
	rail	road	inland navigation
Belgian ports			
Antwerp	26.7	42.8	30.5
Ghent	26.4	44.0	29.6
Zeebrugge	22.8	74.3	2.9
Average	**25.3**	**53.7**	**21.0**
Dutch ports			
Rotterdam	3.1	45.4	51.5
Amsterdam	5.1	24.2	70.7
Average	**4.1**	**34.8**	**61.1**
German ports			
Hamburg	40.0	44.0	16.0
Bremen	50.0	40.0	10.0
Average	**45.0**	**42.0**	**13.0**
French ports			
Le Havre	26.2	72.8	1.0
Dunkirk	35.8	61.5	2.7
Average	**31.0**	**67.2**	**1.9**
AVERAGE RANGE	*26.23*	*49.89*	*23.88*

However, in order to determine the environmental impact of the transport of goods towards the hinterland, additional information concerning the modal split of hinterland transport in necessary. The Member States Group on Ports and Maritime Transport - North Sea Group (1995) also provides an indication of this modal split in the ports of the Hamburg-Le Havre range.

Approximately 50% of all goods that are transported toward the hinterland are transported by means of road transport. Rail and inland navigation both attain approximately the same amount of 25%. A large difference among ports within a single country and among ports located in different countries can be observed.

Based on this information, the portfolio analysis provided in Figure 2 can be reassessed and interpreted from an environmental point of view.

The French ports of ***Le Havre*** and ***Dunkirk***, that were positioned in the 'dog'-quadrant of Figure 2, are performing even worse when the environmental component/hinterland transport is taken into account. A total of 60 to 70% of hinterland traffic uses road transport as its main transport mode, causing a substantial amount of externalities. Therefore, both Le Havre and Dunkirk can be considered as 'black or dirty dogs'.

The conventional portfolio analysis indicates that the German ports of ***Hamburg*** and ***Bremen*** are characterised as question marks, indicating they are above average growers with a below average market share. Rail and road transport are equally used as hinterland transport modes (40% rail and 44% road in Hamburg, 50% rail and 40% road in Bremen). As in Hamburg the majority of goods are carried by road, it can be described as a 'black question mark'. Bremen on the other hand is characterised by a dominance of rail transport; therefore it is called a 'red question mark', suggesting that its environmental positioning is better than that of Hamburg.

The port of ***Amsterdam*** takes a similar position than Hamburg and Bremen in the traditional portfolio. However, when the environmental component is also taken into account, a different positioning is obtained. Indeed, the share of transport modes used for hinterland transport is dominated by inland navigation. As a result, Amsterdam can be classified as a 'blue question mark'.
The Belgian ports of ***Ghent*** and ***Zeebrugge*** turned out to be 'black question marks' when their 'environmental performance', i.e. the use of different hinterland transport modes, is included in the analysis. This resulted in a similar positioning as Hamburg : a small market share, above average growth rate and a dominance of road transport as a means to move cargo to the hinterland.
Rotterdam has a dominant position in terms of market share. Its growth rate is below average which explains its place in the cash cow-quadrant. However, it is a 'blue cash cow', as on average inland navigation dominates transport of total cargo shifted to the hinterland.
Finally, ***Antwerp*** is a star according to the traditional economic benchmarks, see Figure 2. Taking the distribution among hinterland transport modes into account, this port can be considered as a 'black star'.

To conclude, when taking into account environmental elements, only the Dutch ports of Rotterdam and Amsterdam reveal an environment friendly position. They use inland navigation as an alternative to road transport to shift goods towards the hinterland. The German ports of Hamburg and Bremen are rail ports and the Belgian and French ports of Antwerp, Gent, Zeebrugge, Le Havre and Dunkirk are typical road ports. As a result, in contrast to the conventional analysis that positions Antwerp as a winner, the Dutch ports of Rotterdam and Amsterdam could be considered as overall 'winners' when including environmental aspects in the analysis.

CONCLUDING COMMENTS AND RECOMMENDATIONS

In this paper, a conceptual framework is presented introducing an ecological dimension in portfolio analysis. Based on the modal split and on the different transport modes used to shift cargo to the hinterland, the performance of a port in terms of the environment can be determined. As a result, a two phased analysis has to be used. First, the competitive position of a port or a port operator is evaluated by means of traditional product portfolio analysis. The second phase of the environmental portfolio analysis consist of evaluating the modal split of the ports.

The basic difference between both parts of the analysis is that a shift is created from thinking in terms of total throughput of cargo in the port towards thinking in terms of the used transport mode.

Figures for the most important North West European ports in the Hamburg-Le Havre range indicate that about 55% of total traffic transhipped in the ports is actually moved to the hinterland. One half of this tonnage is moved by means of road transport, the other half is equally divided among inland navigation and rail transport. Based on the figures of the ports in the Hamburg-Le Havre rang, the Dutch ports of Rotterdam and Amsterdam are the only ports that can maintain (or even improve) this position.

However, a number of important questions have to be asked by policy makers, port authorities and port operators.

First, does the favourable or unfavourable environmental position result from 'natural' or 'created' factor conditions ? In the case of using inland navigation, the favourable position mainly results from natural of inherited factor conditions, i.e. the availability of inland waterways. The favourable position of the Dutch can be largely explained by this element : the use of inland navigation is based on a 'natural' advantage, rather than being the result of a deliberate choice of government, the port authority or the port operator or as the result of a 'created' factor condition.

Second, what is the impact of strategic or demand conditions in obtaining a favourable position ? At this moment, the impact of strategic governmental decisions is limited. Also the demand for using environment friendly modes of transport is not really developed. However, the increased use of, e.g., JIT-production requires the use of a none congested transport mode. As road transport is characterised by a large possibility of congestion, the use of this transport mode might be discouraged. In future, demand conditions and strategic elements (e.g., a deliberate choice of government of stimulating environment friendly transport modes) might be important elements in obtaining a favourable environmental position.

Third, to what extent are environmental and economic performance complementary substitutes ? The analysis included in this paper might give the impression that economic and environmental performance are enemies rather than possible allies. In fact, they have to be considered as complementary issues and both types of performance don't have to be mutually exclusive by definition. Government, port authority and port users have to apply procedures that are instrumental to maintain or augment the competitive position of seaports, taking into account the possible limitations of the environment and the environmental characteristics of individual transport modes.

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