REGULAR SHIPPING LINES BETWEEN THE CANARY ISLANDS AND THE SPANISH PENINSULA: COMPETITION OR COLLUSION?

C. Pérez-Labajos[1], B. Blanco Rojo[2] and J.R. San Cristóbal Mateo[3]

ABSTRACT

The shipping companies which operate regular lines are allowed to reach legal agreements aimed at making a rational use of their resources. It is common, therefore, for shipping companies to form 'fleet conferences' on a regular line, if this allows them to optimise their activity on it. This paper addresses the real problem of the rationalisation of the sea transport services between The Canary Islands and The Peninsula. Can these services be optimised through agreements? In order to find answers of a qualitative nature, the existing resources are analysed. Three models which are alternatives to the present situation are developed by means of perfection heuristics, taking into account both the most suitable itineraries and the composition of the fleet in keeping with the real transport needs. The comparison of these results confirms that the current model is inefficient and invites both the shipping companies and the users of this form of transport to reflect upon the need to initiate a debate on the joint use of resources.

Key words: Marine Policy of Alliances, Policy agreement, Joint operation

1. INTRODUCTION

The shipping companies which operate regularly between The Canary Islands and The Peninsula monopolise part of the so-called 'national coastal trade sea traffic' [1].

For the Canary Islands, the strategic importance of such regular lines is great, since they form the main channels of freight transport to and from the peninsula. All of the cargo transported is unitised, so all of the shipping companies operating on them use container ships or RoRo (Roll on Roll off) systems.

[1]Professor of Maritime Economics. E–mail: clabajos@unican.es
[2]Professor of Business Studies. E–mail: blancob@unican.es
[3]Associate Profesor. jose.sancristobal@unican.es
 Ocean & Coastal Economics & Management Group R&D. University of Cantabria. Germán Gamazo, 1.39004 SANTANDER (SPAIN). Tel. 942 201362; Fax 942 201303

Historically, this traffic has been reserved for ships with Spanish flags, so that the sub-sector was completely closed to foreign competition. Perhaps for this reason, few Spanish shipowners foresaw the liberalisation of the coasting trade, even though a number of events pointed towards it. It was felt that the liberating dynamics would only affect international traffic [2].

Those who were most convinced that the coasting trade was 'a different matter' thought, in keeping with the community doctrine, that this was a domestic matter and should thus be governed in the internal context of each national territory.

But the liberalisation of the coasting trade was only a matter of time. On June 23rd, 1992, the Council of the EEC approved the text of the Act of Liberalisation of the coasting trade by a qualified majority and with the votes against of Great Britain, Denmark and Ireland. Hence, on December 7 of that same year, The EEC published the Act by virtue of which the principle of the free provision of sea transport services within the member states was applied. The Act contemplated 5 stages in the liberalisation. The first began on January 1st, 1993 and the last came into effect on January 1st, 1999, the year in which all the coasting trade traffic in the EEC was liberalised, all cargo reserves disappearing [3].

Faced with this new scenario, what did the shipping companies do and how did the Spanish shipping sector respond to the new challenge?

Between 1997 and 1999 there was a rapid growth in the sea transport capacities offered, well above the amount of demand, both measured in Tm x miles (Tonnes transported times miles covered).

In the period analysed (1997-2001) a substantial growth was observed in the capacity of the fleet on offer, both in the form of container ships and RoRo ships. The technical file on the average craft in those years is shown in Table 1.

Table 1: Evolution of the average craft in traffic between
The Canary Islands and the Peninsula

Characteristics average craft	1997	1998	1999	2000
Gross tonnage (GT)	6.550	7.038	8.420	9.007
Deadweight	7.112	8.003	9.107	9.692
Container ships (TEUS)	480	548	583	632
Ro-Ro (Linear metres)	1.333	1.333	1.830	1.723

Elaborated by authors

This explains in part the high degree of non-occupation of the fleet during this period. In 1999, the total occupation of the fleet was below 40%. However, given the asymmetry of the traffic, the results are very different for the up-flow (cargoes from The Canary Islands to the Peninsula) and for the down-flow (cargoes Peninsula to The Canary Islands), as can be observed in Table 2.

*Table 2: Occupation of fleet in regular sea traffic between
Canary Islands and Peninsula*

Traffic	% occupation of fleet			
	1997	1998	1999	2000
Península-Canaries	84,0%	71,2%	60,8%	75,3%
Canaries-Península	34,1%	28,5%	23,2%	40,4%
Total	57,2%	47,7%	39,9%	54,6%

Elaborated by authors

It would seem that the outlook for the future along with the good economic situation of those years led the Spanish shipowners to the conviction that it was a good time to invest in new and/or second-hand ships of greater capacity. In the year 2000, just after the liberalisation, the companies focused again on the profitability of the lines. The elimination of the excess of offer would allow an important, though insufficient, recovery of the sector, which now finds itself in a situation of strong competition and a certain degree of atomisation.

In this context, we believe that a change in the approach of the companies that operate in this sector would be beneficial both for themselves and their users (User Board). We understand that the 'ordering' of this traffic requires a series of agreements and actions aimed mainly at rationalising the resources and defining the type of craft most suitable for each operation [4]. The first step is to create consortiums [5] in order to make a joint use of the crafts of the different companies [6,7,8]. The so-called fleet conferences are common practice among regular line operators [9]. Secondly, the renovation of the fleet should be made by substituting the old units with crafts which are suitably adapted to the requirements of the traffic [10]. This should be a gradual process allowing the old units to be renewed by larger ones, specially designed for each kind of traffic, with advanced technology, smaller crews and better operative resources for handling merchandise.

We understand that the combination of such actions would allow the appearance of scale economies. This would mean an increase in the size of the crafts and a reduction in the number of ports, with modifications in itineraries and frequencies [11,12,13,14].

Moreover, substantial savings could be achieved leading to both an improvement in the economic results of the shipping companies and a reduction in their fares (negotiated with the User's Board). In short, the result would be a greater efficiency in the sector and an improvement in its competitiveness which would, in turn, allow it to hold its own in the face of increasing international competition.

The main aim of the present work is to establish alternatives to the real sea freight transport situation on regular lines between The Canary Islands and the Peninsula, in order to minimise or reduce transport costs by means of different assignations of fleets and itineraries.

To this end, we shall first analyse the existing resources. Next, we shall estimate the costs of the real situation and formalise alternative models taking into account the most suitable itineraries and the composition of the fleet in keeping with the real needs.

2. METHODOLOGY

Assuming the existence of a policy of alliances, the shipping companies could jointly exploit their resources, determining the types and number of crafts which would allow the routes, itineraries and number of crafts to be determined on the basis of the services (demand). In this context, the idea would be to solve the twofold problem of the optimisation of routes and the composition of a fleet in accordance with the real needs.

There are many algorithms which can resolve both accurately and approximately the problem of the design of vehicle routes in the fields of transport and delivery. The exact methods [15] provide solutions which are optimal but which are difficult to put into practice in certain real situations. For this reason, perhaps, the approximate methods have come to be more widely used in recent years. Heuristic methods, in particular, have been the subject of much of the research in the field [16].

According to Fagerholt [17], the basic problem of the shipping line crafts is similar to that of the design of multitrip vehicle routing design (MVRD). The standard route design problem, known as the Vehicle Routing Problem (VRP), has been dealt with extensively in the literature. Laporte and Osman [18] present 500 bibliographical references on the subject. The VRP can be described as follows: from a set of known demand nodes and of vehicles of a known capacity, determine the delivery routes, from a central depot, which will minimise the total distance covered and the costs [19].

MVRD is studied by Taillard and others [20] and by Brandao and Mercer [21], and these latter authors later designed heuristic taboo searches to solve the problem [22].

The researchers have paid less attention to the problem of determining the most efficient composition of a fleet when it comes to establishing optimal routes. This is somewhat surprising in the sea transport business, where the costs of capital make up some of the most substantial layouts.

Etezadi and Beasley [23] distinguish between the problems of the size of the vehicle fleets (number) and their composition (type). The pioneering work of Dantzig and others [24,25] addresses a similar problem area though with only one type of vehicle whose number is to be minimised. Ball and others [26] study the problem of deciding the size of a fleet of vehicles, both self-owned and hired, under the option of a common carrier. The authors determine which journeys should be served by the self-owned fleet and which by the common carrier. Bodín and others [27] use a heuristic approach to address the problem of the size of the fleet and the itineraries of each vehicle. This method is an extension of the well-known VRP savings algorithm [28]. Addressing the problem of fleet size Desrochers and Verhoog [29] also use a savings heuristic, in this case based on a successive fusion of routes. However, the references indicated do not include the possibility of multiple routes characteristic of MVRD. Murotsu and Taguchi [30] consider the problem of deciding the optimal composition of the fleet. They determine the craft types, represented by the load capacity and the speed of service, and the number of each type.

However, they only consider the transport between two ports, one loading port and the other the unloading port.

Fagerholt proposes the same generic objective as us: to reduce transport costs. He also addresses the problem of optimal fleet size and the optimal routes in the real context of regular line sea traffic between Norway, Europe and the United Status. The algorithm he formalises can be considered as an MVRD since it determines the weekly routes of the crafts on the line. It undoubtedly constitutes a work which is close to reality in its conception. However, it does not take into account the composition of the fleet, since it only uses one type of craft.

As outlined in the introduction, we believe that the type of craft is crucial to the real problem that we aim to address in the present work. The crafts must adapt to the needs of the line and to the characteristics of the ports, and not the other way round. From our point of view, any approximate approach is questionable as regards its practical implementation. In this sense, it should be pointed out that we have not found any work that deals jointly with the problems of fleet composition (type and number of crafts) and with the optimisation of routes in a real case.

Bearing in mind the above, we shall attempt to reach our objective in two steps. Firstly, starting from the existing situation of the freight transport carried by the shipping companies on regular lines between The Canaries and The Peninsula, we shall estimate the real costs of the fleet. The results obtained will be used as an initial solution to our problem. In the second stage, we shall propose alternative models using perfection heuristics in order to improve the initial situation.

3. THE INITIAL SOLUTION: REAL SEA TRANSORT COSTS

On the basis of the characteristics of the itineraries, routes, the loads generated, the ports visited and the crafts available, the shipping companies organise their regular sea transport services between the Canaries and the Peninsula [31].

These coasting trade lines are traditionally articulated around three main routes linking the Canary Islands directly with ports located in three clearly differentiated coasts of the Peninsula: north, south and Mediterranean. Some companies operate on all three routes while others do so on only one or two of them. All of the companies have weekly services but, depending on the distance to The Canaries, it is sometimes necessary to use at least two crafts to serve the line.(see Figure 1)

On all of the regular lines, the shipping companies land at the main ports of Tenerife and Las Palmas. When they do not serve smaller Canary Islands ports, transfers are made to other ships of the same or another company.

In reality, the organisations which serve the various lines are not totally fixed; rather, there is a certain movement between the companies. This allows crafts to be used on different routes in response to the demands of each moment.
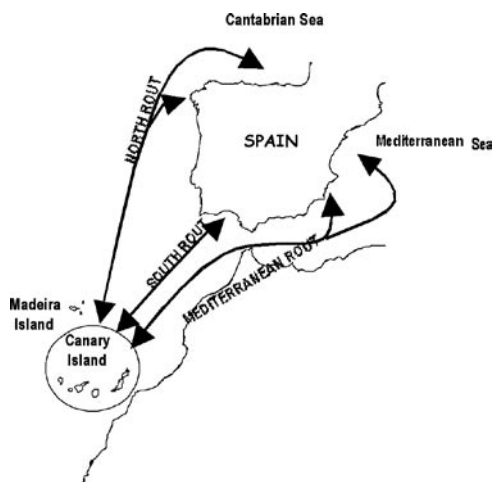
Figure 1: The traffic between the Canary Islands and the Spanish Peninsula. Elaborated by authors

We shall now formalise the organisation of the services offered on the regular coast trading lines between the Canaries and the Peninsula. The year 2,000 was chosen as a reference as the data available for estimating the costs was for this year. In that year, there were 8 shipping companies operating with a total of 30 crafts and 286,353 Deadweight Tonnes. The weekly transport capacity offered by these companies is 15,169 container ships of 20 feet or equivalent units (TEUS: Twenty Equivalent Units) and 13,415 linear cargo metres [32].

The annual costs for each of the 30 crafts that transported freight in the Canaries-Península during the year 2000 have been determined, on the basis of their real technical and operating characteristics. The shipping company costs, those of the itinerary and finally those of the routes will also be determined.

The information used for this process was highly diverse, four clearly differentiated sources being distinguishable. The first is that of the data on the consumption of the crafts themselves, the distances covered and the prices in The Canaries of the various products consumed (fuels, oils and water). Secondly, we had access to some information from the shipping companies on fixed expenses. A third source of information was that which provided us with the 'official' fares applied at the ports of the different lines. Finally, information was obtained on the scale costs of loading and unloading on the different regular lines, thanks to the valuable help of the shipping agents who operate at the different ports used on the three routes.

The costs for each of the ships are determined using a process of simulation of the real operations.

Table 3 shows the results obtained from this process, as well as the costs structure both for routes as for the total transport between The Canary Islands and The Peninsula.

Table 3: Costs structure for sea transport between
Canary Islands and Spanish Peninsula in 2000

CONCEPTS	TOTALS	Northern route	Southern route	Mediterranean Route
Stopover	4,32	3,29	4,74	4,39
Loading and unloading	36,00	34,65	34,62	38,19
Consumption en route and in port	20,38	20,12	21,99	18,73
TOTAL VARIABLE COSTS	60,69	58,07	61,35	61,31
Crew	7,13	5,83	7,54	7,35
Maintenance services	5,32	4,66	4,75	6,29
Supplies and gear	5,39	4,73	4,93	6,22
Insurance	3,40	4,55	3,74	2,42
Hire costs	6,27	17,67	3,33	3,66
Repayments	11,80	4,49	14,35	12,74
TOTAL FIXED COSTS	39,31	41,93	38,65	38,69
TOTAL COSTS (%)	100,00	100,00	100,00	100,00
TOTAL COSTS (thousands €)	220.220	43.234	92.610	84.377
Participation in COSTS (%)	100,00	19,63	42,05	38,31

Elaborated by authors

4. ALTERNATIVE MODELS

Under the assumption of the possible formation of business alliances, we propose three alternatives to the present model, using perfection heuristics whose aim is to reduce transport costs. In these models we redimension the fleet and propose alternative itineraries, which, in all cases, fulfil the condition of transporting the freight to the port of delivery on a weekly basis. The alternative models are designed to verify the following hypotheses:

HYPOTHESIS 1: Under the assumption of invariability of the tonnes transported on a regular line and the maintenance of routes, itineraries and frequencies, an increase in the size of the crafts which operate on the line together with a reduction in their number will reduce the operating costs of the shipping companies involved.

HYPOTHESIS 2: Under the assumption of invariability of the tonnes transported on a regular line and the maintenance of routes and frequencies, a reduction in the itineraries together with an increase in the size of the crafts which operate on the line and a reduction in their number will reduce the operating costs of the shipping companies involved.

In order to verify these hypotheses, three alternative models have been developed. The itineraries, lines and routes for these models are shown in Table 4.

Model 1: Variation in number of crafts

In this first model, we either vary the present situation, in which all of the crafts of a certain traffic must go to all of the ports, for one in which the new larger crafts go to the larger ports where there are big loads and other smaller crafts travel to the smaller ports according to the limitations on draughts. In short, the same weekly services are maintained with fewer crafts.

Model 2: Variation in crafts and ports, maintaining the lines.

In model 1, a high number of small crafts was necessary to be able to enter ports of low draughts. In Model 2, these ports are eliminated and the load is concentrated in larger main ports. This allows us to increase the number of larger crafts and thus reduce the total number of crafts. In order to maintain the services to the final destination, the freight has to be transported via land between the main ports and those which have been eliminated.

The ports defined as main ports on the Peninsula were Bilbao and Vigo on the Northern route, Algeciras (container ships) and Cádiz (RoRo) on the southern route and Barcelona and Valencia on the Mediterranean route. In The Canaries, the main ports were Las Palmas de Gran Canaria and Santa Cruz de Tenerife for the containers. However, some smaller crafts which have time left over will also go to the smaller islands. The RoRo have no problems as these are fast crafts with accessibility to all ports. In this way, transfer costs are avoided in The Canary Islands.

## Model 3: Variation in ports, crafts and lines.

This model contemplates only lines from the south of the Peninsula, which allows a great reduction in the number of crafts. The base ports are now only two on the peninsula: Algeciras for container ships and Cádiz for RoRo crafts. In the Canaries, the base ports are Santa Cruz de Tenerife and La Palmas de Gran Canaria for container ships, while RoRo crafts reach all ports. This is a technically possible alternative which would avoid any transfers to other interinsular crafts and, thus, additional expenses.

Table 4: Itineraries for the alternative models

	Traffic (Routes)	Lines	Itineraries
MODEL 1	North 1	North 1.1	Bilbao- Vigo- Tenerife- Las Palmas
		North 1.2	Gijón- Marín- Tenerife- Las Palmas- Arrecife- Pto. Rosario
	South 1	South 1.1	Algeciras- Las Palmas- Tenerife
		South 1.2	1. Cádiz- Las Palmas- Tenerife- La Palma- Tenerife- Las Palmas- Arrecife 2. Cádiz- Las Palmas- Arrecife- Pto del Rosario 3. Cádiz- Las Palmas- Tenerife- La Palma 4. Cádiz- Las Palmas- Tenerife
		South 1.3	Sevilla- Las Palmas- Tenerife
	Mediterranean 1	Mediterranean 1.1	Barcelona- Valencia- Las Palmas- Tenerife
		Mediterranean 1.2	Tarragona- Alicante- Cartagena- Arrecife- Las Palmas- Tenerife- La Palma
		Mediterranean 1.3	Barcelona- Valencia- Algeciras- Arrecife- La Palmas- Tenerife- La Palma
MODEL 2	North 2	North 2.1	Bilbao- Vigo- Tenerife- Las Palmas
	South 2	South 2.1	Algeciras- Las Palmas- Tenerife
		South 2.2	1. Cádiz- Las Palmas- Tenerife- La Palma- Tenerife- Las Palmas- Arrecife 2. Cádiz- Las Palmas- Arrecife 3. Cádiz- Las Palmas- Tenerife- La Palma 4. Cádiz- Las Palmas- Tenerife
	Mediterranean 2	Mediterranean 2.1	Barcelona- Valencia- Las Palmas- Tenerife
MODEL 3	South 3	South 3.1	Algeciras- Las Palmas- Tenerife
		South 3.2	1. Cádiz- Las Palmas- Tenerife- La Palma- Tenerife- Las Palmas- Arrecife 2. Cádiz- Las Palmas- Arrecife 3. Cádiz- Las Palmas- Tenerife- La Palma 4. Cádiz- Las Palmas- Tenerife

Elaborated by authors
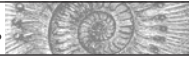
The process through which the type of craft is selected is developed for each itinerary. To this end, the characteristics of the itinerary are analysed on the basis of the distance sailed and the frequency of the service, the characteristics of the cargo to carry between the Canary Islands and the Peninsula (both directions), and the characteristics of the ports where they dock as regards the limitations in draughts and mooring lines. Bearing in mind these aspects, the appropriate crafts are defined and their trips are simulated in order to estimate the costs. (see Figure 2).
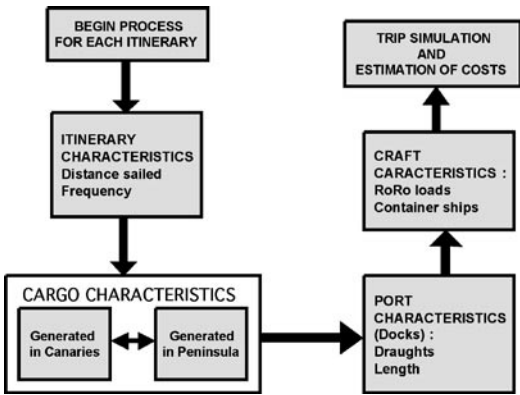

Figure 2: Selection process for craft type per itinerary. Elaborated by authors

All of the figures on the loads handled by the ports and their technical characteristics were obtained from the information published in the records of those ports and from that provided directly by the Port Authorities.

As results of the process of analysis for each itinerary applied to the three models proposed, a series of crafts (types) and a number have been selected, defining the composition of the fleet for each alternative. Among those found most suitable are some crafts which are already operating on the lines. The crafts used in the alternative models proposed are shown in Table 5.

Table 5: Crafts required for the different models proposed

Craft type: Series and year (year of construction)	N° crafts		
	Model 1	Model 2	Model 3
SSW Super 25 (2002)	3	6	4
Kindia (2002)	5	2	1
Nenúfar (1996 y 2002)	2		3
Express (1984 y 1983)	3		
Sister (1993)	1	1	
Levante (2001)	1		
Superfast (1997, 1998 y 2002)	2	3	
TOTALS	17	12	8

Elaborated by authors

Although the year of construction of some of the crafts is later than 2000, it has been assumed that these were available in this year for the purposes of simulating the trips and estimating the costs. In any case, the evaluation of these costs refers to the year 2000.

5. RESULTS OF ALTERNATIVES

The effect of the different models on the composition of the fleet and some of its char–acteristics are shown in Table 6. The variation in the number of crafts and in the capacities of the fleet with respect to those of the year 2000 can be observed.

Table 6: Effects of models on fleet capacities and variations (Var) with respect to the year 2000

Characteristics (number)	Real Situation 2.000	Model 1		Model 2		Model 3	
		Fleet	Var	Fleet	Var	Fleet	Var
Crafts	29	17	-41,4%	12	-58,6%	8	-72,4%
DWT	281080	272159	-3,2%	283633	0,9%	176893	-37,1%
TEUS	15169	17914	18,1%	18140	19,6%	9960	-34,3%
lcm	13343	13343	0,0%	9450	-29,2%	9450	-29,2%

DWT: Deadweight Tonnes
TEUS: Twenty Equivalent Units
lcm: Linear Cargo Metres
Var: Variation on Real Situation

Elaborated by authors

With respect to the real situation for the year 2000, all of the models achieve a reduc–tion in the number of crafts used and a relative increase in the average capacity of the crafts measured in DWT. In Model 1, the capacity for transporting TEUS is increased and the capacity for transporting RoRo cargoes is maintained. In Model 2, there is also an increase in the capacity for transporting containers but the capacity for transporting RoRo cargoes is reduced. In Model 3, there is a reduction in all capacities. The reductions in capacities for models 2 and 3 are due to the change in itineraries, which means that part of the transport will be on land.

Once the crafts were selected for each model, the costs were then estimated for each of the itineraries established for the different alternatives (see Table 7). The results obtained together with those corresponding to the real situation are shown in Table 8. We have differentiated between the fixed costs and the variable costs of sea transport and those of land transport in the relevant models.

Table 7: Comparison of transport costs

ALTERNATIVES	Fixed costs	Variable Costs	Transport Costs	Additional Land Transport	Total Costs
Real 2000	86.567	133.654	220.220	0	220.220
Model 1	89.110	119.294	208.404	0	208.404
Model 2	72.412	110.407	182.819	4.911	187.731
Model 3	48.342	104.825	153.167	49.666	202.833

Values in thousands €

Elaborated by authors

All of the models led to an improvement in the real situation both in absolute terms (Table 7) and in relative terms (Table 8).

Model 2 is the model with the lowest total costs even though it includes the expense of land transport, due to the haulage required from the main ports to the smaller ones. The total savings with respect to the real situation are 14.75%. Model 1 is the one with the worst results since these are distorted by its high fixed costs. It should be pointed out that this is due to the increase in the number of new crafts, so that as well as a saving of 5.37% we have a young fleet.

Model 3 is the most efficient in terms of the running costs, which are reduced by over 30%. The land transport carries a lot of weight in the total costs, so that, in the end, these are only reduced by around 8%. However, the possibility of making contracts to transport large load volumes by land can lead to important discounts in the costs, higher than those of around 25% considered in the present work.

Table 8 shows a relative view of the results obtained for the different alternatives in relation to the real situation.

Table 8: Variations in the models with respect to the real situation of 2.000

ALTERNATIVES	Fixed costs	Variable Costs	Transport Costs	Additional Land Transport	Total Costs
Real 2000	86.567	133.654	220.220	0	220.220
Model 1	89.110	119.294	208.404	0	208.404
Model 2	72.412	110.407	182.819	4.911	187.731
Model 3	48.342	104.825	153.167	49.666	202.833

Values in thousands €   Elaborated by authors

Model 1 confirms hypothesis 1. Models 2 and 3 confirm hypothesis 2.

CONCLUSIONS

1. The current model of freight transport on the regular sea lines between the Canary Islands and the Peninsula is inefficient. The three alternatives to this model proposed here lead to savings of 5.37% (model 1), 14.75% (model 2) and 7.90% (model 3). In all cases, there is a reduction in the number of crafts used and possibly an improvement in the quality of services offered since most of the units used are new.

2. The current situation of strong competition, atomisation of business and excess of ca–pacity describes a scenario where the shipping companies are having great difficulties in recovering their investments. This prevents the necessary and constant revision of the fleet units from being effected. Thus, some shipping companies maintain old units, low quality services and certain risks of damage and/or loss to the loads transported. The policy of maintaining these services, which are cheaper, with the insurance coverage is no solution.

The problems caused by a load which reaches its destination in bad condition due to inadequate transport are not covered by any insurance. The immediate gains received by the 'exporter' can, in the long term, be transformed into substantial and costly losses, sometimes leading to a continued rejection of services or even the total loss of clients.

3. The results obtained for the different alternatives show that a rationalisation of resources by means of the formation of fleet conferences or 'pool' type agreements would allow the shipping companies to reduce their costs drastically, to increase their profit margins and to establish lower fares. Moreover, the shipping companies would then regularly dispose of renewed and operative units.

AKNOWLEDGEMENTS

REFERENCES
(Endnotes)

[1]Pérez-Labajos, C., *Empresa y Transporte en Canarias*, Colección Investigación Empresarial, FYDE-Cajacanarias, Tenerife, 2003.

[2]Council Regulation (EEC) No 4055/86 of 22 December 1986 applying the principle of freedom to provide services to maritime transport between Member States and between Member States and third countries [Official Journal L 378 of 31.12.1986].

The approval of Act 4055/86 imposed the application of the principle of the free provision of services between member states and member states and third countries. This Act established the progressive elimination of cargo reserves in international traffic in three stages. The last stage came into effect on January 1st 1992.

[3]Pérez-Labajos, C., La Liberalización del Cabotaje Marítimo, *El Norte de Economía*, Abril , 1993, p.19

[4] Ministerio de Transportes, *Planes de viabilidad de la Marina Mercante Española*, SPVMME, 1991.

Similar actions were proposed in the context of the Merchant Navy viability plans in order to respond to the problem of the regular coasting traffic lines.

[5]Badaracco, J., *Alianzas estratégicas: El caso General Motors IBM*. Ed. McGraw-Hill Traducción José Real Gutiérrez, Madrid, 1993.

These business alliances have normally had negative connotations, since it was felt that their sole function was to limit competitieveness by controlling the market, prices and distribution channels. However, nowadays, these alliances are reaching a new dimension as a response to the phenomenon of globalisation. The companies opt for associations rather than absorptions as this avoids the disappearance of the absorbed company and avoids all the work of integration. In the world of big businesses, maintaining a dominant position on an international scale is not easy for relatively small companies. Cooperation by means of alliances can be a solution.

[6]Bleeke, J., *Colaboración competitiva: Cómo usar alianzas y adquisiciones estratégicas en el mercado global,* Ed. Addison-Wesley Iberoamericana, Madrid, 1994.

[7]Fernández, E., *Innovación, tecnología y alianzas estratégicas: Factores clave de la competencia,* Ed. Civitas, Madrid, 1996.

[8]Trigo, J., *Alianzas estratégicas,* Ed. Gestión 2000, Madrid, 1998.

[9]Yzal, S., *El flete en el transporte marítimo. Contratación y tarificación,* 2ª ed., Librería Bosh, Barcelona, 1986.

[10]Martín, A., *DRP: Planificación de recursos de distribución,* Ediciones S, 2ª Ed, Barcelona, 1994.

[11]Ballou, R., *Logística empresarial. Control y planificación,* Ed. Díaz de Santos, Madrid, 1991.

[12]Christopher, M., *Logística y aprovisionamiento,* Folio, Barcelona, 1994.

[13]Kolb, F., *La Logística. Aprovisionamiento. Producción. Distribución,* DEUSTO, Bilbao, 1975.

[14]Soret, I., *Logística comercial y empresarial,* ESIC, Madrid, 1994.

[15]Golden, B. and Assad, A., *Vehicle Routing,* North-Holland, Amsterdam, 1988.

[16]Laporte, G., "The vehicle routing problem: an overview of exact and approximate algorithms", *European Journal of Operational Research,* Vol 59, 1992, pp. 345-358.

[17]Fagerholt, K., "Optimal fleet design in a ship routing problem", *International Transactions in Operational Research,* Vol 6, 1999, pp. 453-464.

[18]Laporte, G. and Osman, I.H., "Routing problems: a bibliography", *Annals of Operations Research,* Vol 61, 1995, pp. 227–262.

[19]Lawler, E., *The Traveling Salesman Problem. A guided Tour of Combinatorial Optimization,* Wiley, New York, 1985.

[20]Taillard, E.D., Laporte, G. and Gendreau, M., "Vehicle routing with multiple use of vehicles", *Journal of the Operational Research Society,* Vol 47, 1996, pp. 1065–1070.

[21]Brandão, J. and Mercer, A. "A tabu search algorithm for the multi-trip vehicle routing and scheduling problem", *European Journal of Operational Research* 100, 1997, pp. 180–191.

[22]Brandão, J. and Mercer, A., "The multi-trip vehicle routing problem", *Journal of the Operational Research Society,* Vol 49, 1998, pp. 799–805.

[23]Etezadi, T. and Beasley, J.E., "Vehicle fleet composition", *Journal of the Operational Research Society,* Vol 34, 1983, pp. 87–91.

[24]Dantzig, G. B.; Fulkerson, R. and Johnson, S. M., "Solution of a large-scale traveling salesman problem", *Operations Research,* Vol 2, 1954, pp. 393-410.

[25]Dantzig, G.B. and Fulkerson, D.R., "Minimizing the number of tankers to meet a fixed schedule", *Naval Research Logistics Quarterly,* Vol 1, 1954, pp. 217–222.

[26]Ball, M.O.; Golden, B.; Assad, A. and Bodin, L.D., "Planning for truck fleet size in the presence of a common-carrier option", *Decision Sciences,* Vol 14, No 2, 1983, pp.103–120.

[27]Bodin, L.D.; Golden, B.; Assad, A. and Ball, M., "Routing and scheduling of vehicles and crews: the state of the art", *Computers and Operations Research,* Vol 10, Nº 2, 1983, pp. 63–211..

[28]Clarke, G. and Wright, J., "Scheduling of vehicles from a central depot to a number of delivery points" *Operations Research,* Vol 12, 1964, pp. 568–581.

[29]Desaulniers, G.; Desrosiers, J.; Dumas, Y.; Solomon, M. and Soumis, F., "Daily aircraft routing and schedulin" *Management Science,* Vol 43, No 6, 1997, pp. 841–855.

[30]Murotsu, Y. and Taguchi, K., "On optimum selection of ship fleet-size for investment purposes". In: Haley, K.B. Editor, *Operational Research,* Vol 75, 1976, North-Holland, Amsterdam, pp. 301–322.

[31]Asociación de Navieros Españoles, *Empresas Navieras,* Memorias de los años 1996 al 2001, ANAVE, Madrid, 2001.

[32]Puertos del Estado, *Anuario Estadístico Puertos del Estado,* Memorias de los años 1997 al 2001. Ministerio de Fomento, Madrid, 2001.

LINEAS MARÍTIMAS REGULARES ENTRE CANARIAS Y LA PEININSULA: ¿COLUSIÓN O COMPETENCIA?.

RESUMEN

A las navieras que operan en líneas regulares se les permite llegar a acuerdos legales encaminados a racionalizar sus recursos. Por eso es habitual que las navieras constituyan "conferencias de fletes" en una línea regular, si ello permite optimizar la actividad de las mismas.

El trabajo que se presenta aborda el problema real de racionalización de los servicios de transporte marítimo regular entre Canarias y la Península. ¿Pueden optimizarse dichos servicios mediante acuerdos?. Con el fin de encontrar respuestas de carácter cuantitativo, se analizan los recursos existentes y su organización. Se desarrollan tres modelos alternativos a la situación actual, mediante heurísticas de perfeccionamiento, que tienen en cuenta tanto los itinerarios más adecuados como la composición de la flota de acuerdo con las necesidades reales de transporte. Los resultados comparados permiten afirmar que el modelo actual es ineficiente e invitan a la reflexión -tanto de navieras como de los usuarios que operan en dichos tráficos- sobre la conveniencia de iniciar un proceso de acuerdos que permita la utilización conjunta de recursos.

1. INTRODUCCIÓN

Las empresas navieras que operan regularmente entre Canarias y Península canalizan parte del denominado tráfico marítimo de cabotaje nacional.

Para Canarias, la importancia estratégica de dichas líneas regulares es vital ya que articulan las arterias más importantes de transporte de mercancías con el territorio peninsular. La totalidad de la carga transportada está unitizada. Por ello todas las navieras que operan en las mismas utilizan portacontenedores o RoRo (Roll on Roll off).

En dicho contexto, creemos que un cambio en el planteamiento de las empresas que operan en el sector supondría grandes ventajas tanto para las mismas como para sus usuarios. Entendemos que la "ordenación" de dichos tráficos precisa de una serie de acuerdos y acciones encaminados principalmente a racionalizar los recursos y definir el tipo de buque más adecuado para cada tráfico. En el primer caso, creando consorcios con el fin de utilizar de forma conjunta los buques de diferentes empresas. Las denominadas conferencias de fletes (cárteles) son una práctica habitual en líneas regulares marítimas. En la segunda línea de acción, la renovación de la flota deberá realizarse sustituyendo las unidades antiguas por buques que se adapten correctamente a los requerimientos de los tráficos. Se trata de

un proceso gradual que permitiría ir renovando las unidades antiguas por otras de mayor tamaño especialmente diseñadas para cada tráfico, con tecnología avanzada, tripulaciones reducidas y medios más operativos para la manipulación de mercancías. Es probable que la conjunción de tales acciones permitiría la aparición de economías de escala. Pero ello supondría incrementar el tamaño de los buques y reducir su número, concentrar cargas y reducir el número de puertos, y modificar itinerarios y frecuencias.

En última instancia se podrían conseguir ahorros sensibles que permitirían tanto una mejora de los resultados económicos de las navieras como una reducción de sus tarifas. En definitiva, una mayor eficiencia en dicho sector y una mejora de su posición competitiva que permita –a su vez– afrontar con garantías la creciente competencia internacional.

Teniendo en tales aspectos nos hemos planteado como objetivo del presente trabajo: formalizar modelos alternativos a la situación actual, más eficientes, que permitan reducir los costes mediante la racionalización de los recursos utilizados por las navieras.

2. METODOLOGÍA

El principal objetivo del presente trabajo es establecer alternativas a la situación real de transporte marítimo de mercancías en línea regular entre Canarias y Península cuya organización ha sido abordada anteriormente. Mediante diferentes asignaciones de flotas e itinerarios pretendemos minimizar o reducir los costes del transporte.

Bajo el supuesto de una política de alianzas, las navieras podrían explotar en común sus recursos, determinando los tipos y número de buques que permitieran establecer de forma coherente las rutas, los itinerarios y las frecuencias en base a los servicios necesarios (demandados). En dicho contexto, se trataría de resolver un doble problema de optimización de rutas y de composición de una flota de acuerdo con las necesidades reales.

Existen multitud de algoritmos que resuelven de manera exacta y aproximada el problema de diseño de rutas de vehículos en los ámbitos del transporte y la distribución. Los métodos exactos (Golden y Assad, 1988) proporcionan soluciones óptimas pero son de difícil implementación práctica en determinadas situaciones reales. Quizá por ello los métodos aproximados se han desarrollado con mayor profusión en los últimos años. Pero en particular, los heurísticos han constituido el grueso de la investigación realizada (Laporte, 1992).

Según Fagerholt (1999) el problema fundamental de los buques de línea es similar al de diseño de rutas de vehículos multiviaje VRPMT (Vehicle Routing Problem Multitrayet). El problema estándar de diseño de rutas conocido como VRP (Vehicle Routing Problem) ha sido extensamente tratado en la literatura. Laporte y Osman (1995) presentan 500 referencias bibliográficas sobre la materia. El VRP puede describirse de la siguiente manera: a partir de un conjunto de nodos de demanda conocida y de vehículos de capacidad también conocida, se pretende determinar las rutas de reparto –desde un almacén central– que minimice la distancia total recorrida y los costes.

El VRPMT es estudiado por Taillard y otros (1996) y por Brandao y Mercer (1997), posteriormente estos últimos autores desarrollan búsquedas heurísticas tabú para resolver el problema (Brandao y Mercer, 1998).

Los investigadores han prestado menos atención al problema de determinar la composición eficiente de una flota a la hora de establecer las rutas óptimas. Aspecto sorprendente especialmente en el negocio del transporte marítimo, donde los costes de capital constituyen una de las partidas más significativas.

Etezadi y Beasley (1983) distinguen entre los problemas del tamaño de la flota de vehículos (número) y su composición (tipo). El trabajo pionero de Dantzig y otros (1954) aborda una problemática similar aunque con un solo tipo de vehículo cuyo número pretende minimizarse. Ball y otros (1983) estudian el problema de decidir el tamaño de una flota de vehículos propios y arrendados bajo opción de portador común. Los autores determinan qué viajes deben ser atendidos por su propia flota y cúales por el portador común. Bodín y otros (1983) utilizan un enfoque heurístico para abordar el problema del tamaño de la flota y los itinerarios de cada vehículo. Dicho método es una extensión del conocido algoritmo de ahorros para el VRP (Clarke y Wright, 1964). Para abordar el problema del tamaño de la flota Desrochers y Verhoog (1991) también utilizan una heurística de ahorros -aunque- basada en una sucesiva fusión de rutas. Sin embargo, las referencias indicadas no incluyen la posibilidad de viajes múltiples propias del VRPTM. Murotsu y Taguchi (1976) consideran un problema de decidir la óptima composición de la flota marítima. En tal sentido determinan los tipos de barcos, representados por la capacidad de carga y la velocidad de servicio, y el número de cada tipo. Sin embargo sólo consideran el transporte entre dos puertos, uno de carga y otro de descarga.

Fagerholt (1999) en su trabajo se plantea el mismo objetivo genérico que nosotros: reducir los costes del transporte. Además aborda el problema del tamaño óptimo de la flota y las rutas óptimas en el contexto real de los tráficos marítimos de línea regular entre Noruega, Europa y Estados Unidos. El algoritmo que formaliza se puede considerar como un VRPTM ya que determina las rutas semanales de los buques de línea. Sin duda, se trata de un trabajo muy próximo a la realidad en su concepción. Sin embargo, no tiene en cuenta la composición de la flota ya que utiliza un sólo tipo de buque.

Como ya se ha indicado en la introducción, nosotros creemos que el tipo de buque es crucial en el problema real que pretendemos tratar en el presente trabajo. Los buques deben adaptase a las necesidades de la línea y a las características de los puertos y no al revés. Desde nuestro punto de vista cualquier planteamiento aproximado es cuestionable en cuanto a su implementación práctica. En tal sentido, debemos puntualizar que no hemos encontrado ningún trabajo que trate conjuntamente los problemas de la composición de la flota (tipo de buques y número) con la optimización de rutas en un caso real.

Teniendo en cuenta lo anterior, intentamos alcanzar nuestro objetivo en dos fases. En la primera, a partir de la situación existente de transporte de mercancías realizado por

navieras en línea regular entre Canarias y Península tratado en epígrafes anteriores, estimamos los costes reales de la flota. Los resultados obtenidos se utilizarán como solución inicial de nuestro problema. En la segunda fase, planteamos modelos alternativos mediante heurísticas de perfeccionamiento con el fin de mejorar la situación inicial.

CONCLUSIONES

1. El actual modelo de transporte de mercancías en líneas regulares marítimas entre Canarias y Península es ineficiente. Las tres alternativas planteadas a dicho modelo suponen ahorros del 5,37% (modelo 1), 14,75% (modelo 2) y 7,90% (modelo 3). En todos los casos se produce una disminución del número de buques utilizados y posiblemente una mejora en la calidad de los servicios ofertados ya que se utilizan unidades en su mayoría nuevas.

2. La actual situación de fuerte competencia, atomización empresarial y exceso de capacidad describe un escenario donde las navieras tienen grandes dificultades para recuperar adecuadamente la inversión. Ello impide acometer la necesaria y constante renovación de sus unidades de flota. Así, algunas navieras siguen manteniendo unidades viejas, servicios de baja calidad y riesgos ciertos de daños y/o pérdidas de las cargas transportadas. La política de mantener dichos servicios –más baratos– con la cobertura de un seguro no es la solución. Los "trastornos" originados por una carga que llega en mal estado –debido a un transporte inadecuado– no son cubiertos por los seguros. Las ganancias inmediatas que experimenta un "exportador" pueden trasformarse en el largo plazo en importantes y costosos daños que pueden ir desde el rechazo reiterado de envíos hasta la pérdida de clientes.

3. Los resultados obtenidos en las diferentes alternativas nos permiten afirmar que una racionalización de los recursos mediante la formación de conferencias de fletes o acuerdos tipo "pool" permitiría a la navieras reducir drásticamente sus costes, incrementar sus márgenes y establecer tarifas más bajas. Además las navieras podrían disponer –con cierta estabilidad– de unidades renovadas y operativas.