

CONSOLIDATION OF COASTAL SHIPPING NETWORK IN MID-INSULAR CROATIA

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Abstract: *Sea transport has always been the primary mode for both, passengers and cargo transport between the mainland and the islands along the Adriatic coast. The Liner shipping have had the central role in ensuring regular and affordable transport services in the region. Demand for a regular transport services is primarily derived from the need of goods' delivery and passengers traveling to/from islands. The demand is particularly intensive during the peak summertime season, due to a high level of tourists' mobility. Due to the affordable costs, taken from the users' perspective, the transport is of no commercial value for the transporter unless the state subsidizes part of the transport costs at the level of the concessions announced. This paper focuses on the analysis of transport costs and restructuring of the existing shipping lines in mid-insular Croatia, with the aim of developing a model that would reduce transportation costs and shrink total losses, thus lowering the burden on the state budget. The research points out that the specific reformation of the coastal shipping network would indeed lead to cost savings without compromising passengers/goods mobility among mainland and islands in Central Dalmatia.*

Keywords: COASTAL SHIPPING, LINER SHIPPING, PASSENGERS' MOBILITY, COST SAVINGS

1. Introduction

After 2008, the world economy went into a period of cost reduction and the rationalization has become an essential element in the business entities.

When it comes to the liner shipping, i.e. connecting the mainland with islands, rationalization of costs can be achieved in several ways:

- in the technical sense with the ships of smaller capacity and lower engine power,
- in the economic terms by increasing the effective utilization of ships, i.e. by reorganizing the existing lines.

This paper focuses on the rationalization of the costs in economic terms, since the use of smaller capacity ships and/or lower engine power is not possible on most lines because of the distance of some islands from the mainland and primarily because of the seasonality i.e. the excessive difference between the number of passengers and goods transported through the seasons.

The costs of certain lines in central Dalmatia departing from the city of Zadar are analysed, and then the model that would reduce the total cost of transportation and reduce overall losses from the transportation of passengers and goods is designed.

The main source of data on which the survey is based are planned revenues and expenditures on lines, and statistical data on the number of passengers and vehicles on national lines 435 – Zadar/Bršanj (Iž), 405 – Zadar/Iž/Rava, 405a – Zadar/Sali/Zaglav (Dugi otok), 9404 – Zadar/Rivanj/Sestrunj/Zverinac/Božava/Brbinj (Dugi otok) and 9404a – Zadar/Iž/Rava.

Similar topics have also been dealt with by some other authors such as: Ceder. A., J. Varghese in Analysis of passenger-ferry routes using connectivity measures and Makkonen.T., M. Slaonen, S. Kajander in Island accessibility challenges: Rural transport in Finnish archipelago. Except in maritime affairs, similar problems arise in rail transport where the work of author Schlechte, T., Railway track allocation: Models and algorithms, show some of the possibilities of cost rationalization in public transportation.

2. Liner shipping on the Adriatic

Liner shipping represented, through history, the exclusive form of the intercontinental connections, as well as the transportation of passengers and goods between the coast and islands. Today that is not the case as it has often been substituted by some other transportation modes that are much faster and in certain conditions more functional, such as road or air transportation.

However, the importance of liner shipping has remained evident to date when it comes to linking the islands to the mainland and the

islands to each other. That is reflected, particularly in preventing the outflow of the living population from the islands and through the possibility of developing the economy and tourism on the islands.

The biggest problem of the liner shipping is in most cases seasonality, i.e. reduced demand for larger capacity ships during the winter period, when only a small number of locals use services, and the summer time when the number of passengers and cargoes increases up to several times due to the movement of tourists.

In addition to seasonality, there is furthermore the problem of insufficient utilization of the ships on certain lines with only 20% of time in navigation and the rest, moored alongside the shore.

Insufficient ships' utilization through the year, as well as seasonality in liner shipping, generates costs that multiply exceed the threshold of profitability and are serviced by the state through subsidies. In order to reduce these costs, i.e. to maximally approach the threshold of profitability, it is necessary to analyse the utilization of ships and the cost per line according to the current sailing schedule in order to find the methodology for rationalization through the analysis of the obtained data.

3. Analysis of utilization, costs and earnings

The basis of this research is of an economic nature and is based on reducing the costs of liner shipping and increasing the work performance of ships, so it is necessary first to analyse the current surveyed lines of navigation in order to determine the actual utilization of the ships.

According to the Law on Transport in Liner and Periodical Coastal Maritime Transport (Official Gazette 33/06, 38/09, 87/09, 18/11, 80/13 and 56/16) lines 435, 405, 405a, 9404 and 9404a are defined in the following way:

- state line 435 is categorized as a ferry line, where according to the timetable, 337 trips are performed annually, i.e. ferry spends 1110 hours at sea,
- state lines 405 and 405a are categorized as ship lines, where according to the timetable, 730 journeys are performed per year, i.e. ship spends 2972 hours at sea,
- state lines 9404 and 9404a are categorized as high-speed-craft lines on which catamaran performs 730 journeys per year or 2400 hours in navigation.

From the analysis of the sailing schedule on the lines 435, 405, 405a, 9404 and 9404a it can be seen that, from the total number of hours on an annual basis, the ferry on the line 435 performs 13% of the time in navigation, the catamaran on the lines 9404 and 9404a spends 27% in navigation and on the lines 405 and 405a ships navigate 34% of time, while the rest of the time are moored to the shore. If the effective utilization of ships is increased in a way to

run more lines a day, lying would fall to a lower level thus reducing the losses.

Speaking of the costs in liner shipping, it is necessary first to define what the costs are and how they are distributed. By definition, costs are the value-added expenses of the elements of the production process or service provision, resulting from the business activity of a company. Total costs (TC) can be divided into two basic parts, fixed and variable, due to the change in volume of work and the provision of services. The fixed part of the cost (FC) does not change with respect to the work process or the provision of services, while the variable part of the cost is variable, as it stems from the costs of navigation and is subject to environmental impacts.

For state lines 435, 405, 405a, 9404 and 9404a, fixed costs are: costs of materials, spare parts, maintenance costs, insurance premiums, amortization, workers' compensation, wages and salaries (net), taxes and surtaxes, and other fixed costs which, according to Table 1, amount to 13,752,690.24 HRK.

Table 1: Current fixed costs per line (HRK).

Line	435	405/405a	9404/9404a
Fixed costs			
Cost of materials	200,066.70	61,200.00	135,362.03
Spare parts	177,853.10	204,000.00	495,008.89
Maintenance costs	1,280,127.10	357,000.00	509,332.36
Insurance premiums	250,911.60	122,400.00	154,899.97
Amortization	23,826.10	107,100.00	386,413.74
Workers' compensation	721,961.20	441,456.00	683,005.07
Wages and salaries (net)	1,895,954.80	965,752.00	884,757.37
Taxes and surtaxes	811,791.10	550,461.00	336,701.03
Contributions	544,142.30	345,963.00	254,026.92
Other	316,518.40	510,000.00	24,698.46
Total	6,223,152.40	3,665,332.00	3,864,205.84

Source: Made by the authors according to the data of the Agency for Coastal Maritime Traffic

Variable costs (VC) in liner shipping include: fuel costs, lubricant costs, port fees and other financial costs, among which are those related to banking interest rates and exchange rate differences.

The total variable costs on the observed lines amount to 9,188,787.50 HRK, and the elements of the variable costs are given in Table 2.

Table 2: Current variable costs per line (HRK).

Line	435	405/405a	9404/9404a
Fixed costs			
Fuel costs	2,334,193.00	1,659,845.00	4,213,826.77
Lubricant costs	51,549.60	72,100.00	72,592.87
Port fees	353,288.80	168,300.00	95,461.80
Other	119,511.10		48,118.56
Total	2,858,542.50	1,900,245.00	4,430,000.00

Source: Made by the authors according to the data of the Agency for Coastal Maritime Traffic

The analysis of the structure of fixed and variable costs, given in Tables 1 and 2, on the observed lines shows that the overall costs (TC=FC+VC) reach the amount of 22,941,477.74 HRK, while the total planned feasible revenue according to the data of the Agency for Coastal Maritime Traffic is around 3,550,000.00 HRK (see Table 3).

Table 3: Planned feasible revenue by lines (HRK).

Line	435	405/405a	9404/9404a
Planned feasible revenue	1,500,000.00	800,000.00	1,250,000.00

Source: Made by the authors according to the data of the Agency for Coastal Maritime Traffic

4. Possibility of cost rationalization

Rationalization generally speaking means a better organization and management of a system. Economically, rationalization can be characterized as a measure to achieve changes in the organization of a work process, the use of system elements, human labour and their management tasks in order to reduce costs and increase work performance.

Rationalization of costs on lines 435, 405, 405a, 9404 and 9404a, can be observed through the use of smaller ships and reorganization of the existing lines.

However, it is almost impossible to hire smaller ships on these lines, primarily because of the number of passengers and vehicles transported in the summer months, but also because of the growth trend of nearly 10% per line per year. Since the opening of the passage "Mali Ždrelec" for public traffic and by relocating the public liner shipping through the same, travel time on lines 435, 405, 405a and 9404 decreased by almost 50%.

The reconstruction of the existing bridge Ugljan-Pašman and deepening of the canal enabled the passage of the ferry to the island of Iž. Until that time the ferry operated on the same route but through the passage "Veli Ždrelec" in which case the trip was longer by nearly 10 NM, that is one hour in time.

The following example also indicates that the bridge reconstruction and deepening of the canal have opened up savings' opportunities.

Namely, if the number of trips on the line 435 to the island of Iž is increased thus replacing the existing ship and high-speed lines, transportation costs would be considerably reduced. Due to the overlap with the ferry line, the ship line and high-speed line would be in that case redundant. There are several justified reasons for doing so. The travel time of a catamaran and a passenger ship with port call in every inhabited place on the island, compared with the ferry is slightly shorter, since the ferry port is located at the very beginning of the island of Iž and the transport of passengers from the ferry port to the final destination has been done by a bus, which is much faster but also far cheaper than the existing catamaran and the passenger ship. With the seasonal increase of passengers on lines 405 and 9404, travel time is extended with regard to boarding and disembarkation possibilities of catamaran and passenger ship in relation to the ferry. Considering the possibilities of ferry transport to the island of Iž and the rearrangement of the existing lines as the only option that would achieve savings, while retaining the same number of trips to the observed islands, is the reorganization of the existing lines which would keep the same number of trips to the islands while the duration of travel would not be significantly changed.

In order to achieve savings on the lines, the reorganization should be carried out in the following way:

- On the state line 435 out of season two trips per day should be introduced at 11.00 and 16.30, and three trips during the period from 01 July to 01 September with departures at 10:30, 16:30 and 20:00, where in both cases the first morning departure at 06:15 would be from the port of Bršanj (Iž). The number of trips per year would increase to 795 and the ferry would spend almost 32% of the time on the voyage.
- Cease the state line 9404a on the line Zadar – Iž – Rava due to overlap with the ferry line. Instead it would replace the existing line 405a that runs on the Zadar – Sali – Zaglav route with extension to the Vela and Mala Rava, which would keep the costs in equal boundary values due to almost identical distances of 22 NM in each direction likewise on line 9404a.
- Extend the route on the state line 9404 from the port Brbinj to the ports of Mala and Vela Rava which would further increase the effective use of the catamaran, that is reduce the idle sailing.
- Cease state lines 405 and 405a due to overlapping with other lines according to reorganized sailing schedules. Passengers

from lines 405 and 9404a, which would be taken by the ferry on line 435 to the island of Iž, would drive a local bus to the place of their final destination. The annual subsidy, i.e. the cost of the island's shuttle bus according to the data of the current concessionaire "Liburnija Zadar" varies around 135,000.00 HRK per year which, with the employment of another driver and by carrying out two more daily lines on the route from ferry port Bršanj – Mali Iž to Veli Iž, would be doubled and reach almost 270,000.00 HRK per year.

In order to realize that the reorganization of the lines and the increase in effective utilization can make savings possible it is necessary to analyse the costs that would be generated by the proposed reorganization model. When it comes to fixed costs, in this case they would not change since the travel time for the reorganized sailing schedule in no case exceeds 8 hours, which means that the fixed costs remain unaffected (Table 1.). Those costs, such as the cost of the material, spare parts, maintenance costs and amortization are not voyage-sensitive.

5. Results and discussion

The analysis showed that the assumed fixed costs, after the reorganization of the lines, amount to 10,087,358.24 HRK, which in relation to the current fixed costs of 13,752,690.24 HRK represents a saving of 3,665,332 HRK at the annual level.

The value of variable costs according to the model varies considerably from the current variable costs (see Table 2). Because of the greater number of trips per line, the variable costs have been considerably increased. Based on the costs generated by ships in navigation, according to the model, assumed variable costs would amount to 8,378,734.54 HRK (Table 4).

When the current variable costs are compared with the costs according to the reorganization model, it can be clearly seen that the potential savings on the annual level is 810,052.96 HRK, from which the bus transportation of passengers on the island Iž should be taken away. Thus, the annual savings would be reduced by 270,000.00 HRK and the final amount would be 540,052.96 HRK per year.

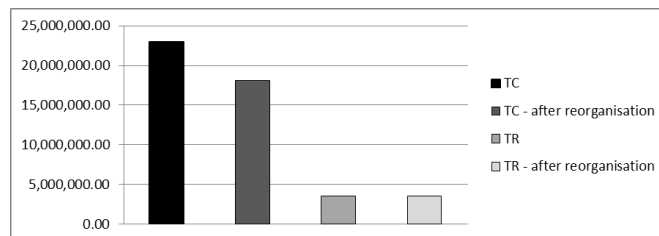
Table 4: Variable costs per line after reorganisation (HRK).

Line	435	9404/9404a
Fixed costs		
Fuel costs	3,011,005.00	4,571,526.77
Lubricant costs	101,549.60	78,272.91
Port fees	353,288.80	95,461.80
Other	119,511.10	48,118.56
Total	3,585,354.50	4,793,380.04

Source: Made by the authors according to the specifications of propulsion and auxiliary engines and data of the Agency for Coastal Maritime Traffic

Reorganized lines should also be analysed through the number of passengers carried and the revenue per line. According to the proposed model, based on the annual statistical data for several years of the Port Authority of Zadar, the anticipated number of passengers carried on the line 435 that would replace lines 405 and 9404a would reach almost 100,000 which would be an increase in the number of passengers on the line of 120%.

The planned revenue on the line with regard to the assumed number of passengers, based on the analysis of statistics on the passengers throughput, would amount to nearly 2,000,000.00 HRK. The number of passengers would be increased on the line 9404 to around 10%, thus assumed total planned revenue from passenger transportation amounted to approximately 1,500,000.00 HRK.



*TC – total costs, TR – total revenue.

Fig. 1 Relation of the cost and profit before and after reorganization of lines (HRK).

Comparing overall planned revenue before reorganization and assumed total revenue according to the proposed model (Figure 1), would eventually be reduced by 50,000.00 HRK since the 9404a high-speed line would be replaced by a ferry where the cost of transport (tickets) is considerably cheaper. However, if the lines were viewed individually, the planned revenue according to the reorganization model would be higher, due to the larger number of passengers per line, which would automatically result in an increase in revenue, which would amount to 500,000.00 HRK.

6. Conclusion

Liner shipping in Croatia as a country with over 1000 islands represents a very important factor, primarily in connecting but also in economic development and survival of life on the islands.

The seasonality but also the unprofitability of most of the lines generates significant losses, which, after the economic crisis in 2008, and the weakening of economic power on the global level, became even more pronounced problems for most coastal countries.

The purpose of this paper was to analyse the costs of liner shipping on individual lines connecting islands with the mainland in Croatian Central Dalmatia in order to develop a model of rationalization of existing costs. The analysis of the navigation schedule has shown that most of the generated costs arise specifically because of the inactivity of the vessels, i.e. their ineffective usability, thus opening up the possibility of reorganizing the lines, i.e. raising the effective usability of the vessels to the maximum values defined by the working time of the crew.

The rationalization model obtained on the basis of the calculated costs of the vessels according to the reorganized schedule of navigation indicates that it is possible to achieve significant savings while maintaining the same number of trips on all lines and at the same time periods.

From the cost analysis before and after the reorganization of the existing lines, and the conclusions drawn from the research, it is evident that this reorganization model represents the basis of rationalization of costs in liner shipping in the region of Central Dalmatia. In an analogous way it would be possible to rationalize even more lines in the broader area of the Adriatic and thus contribute to the future of the sustainable linking of the island with the mainland and the islands to each other.

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