Using System Dynamics to Improve the Marine Manpower of the Passenger Industry in Management Decisions

Alexopoulos, Aristotelis and Fournarakis, Nikolaos and Sambracos, Evangelos

University of the Aegean, University of Piraeus

31 November 2002

USING SYSTEM DYNAMICS TO IMPROVE THE MARINE MANPOWER OF THE PASSENGER INDUSTRY IN MANAGEMENT DECISIONS

A.B. Alexopoulos[*], **N.G. Fournarakis**[∞] **and E. Sambracos**[∀]

ABSTRACT

The Greek merchant fleet maintains a considerable proportion of the world shipping industry, being the largest one in the European Union. However, it needs competitive human resources management to achieve an efficient productivity. Nowadays, there is a quantitative and qualitative shortage of sea-going personnel, particularly in the highest ranks of the crew hierarchy. The picture becomes more dramatic since there are a very small number of new entries into the marine sector and the existing sea-manpower gradually abandons the seafaring profession. In this paper we attempt to define the variables which affect the quantity and quality of seafarers, then to present the elements that define the current trends of seafaring profession and finally to propose a system dynamics methodology for retaining the existing and qualified numbers of seamen, particularly in the passenger market.

Keywords: Passenger Shipping, Marine Labor Employment, System Dynamics

1. Statistical Analysis of the Greek Marine Manpower Market

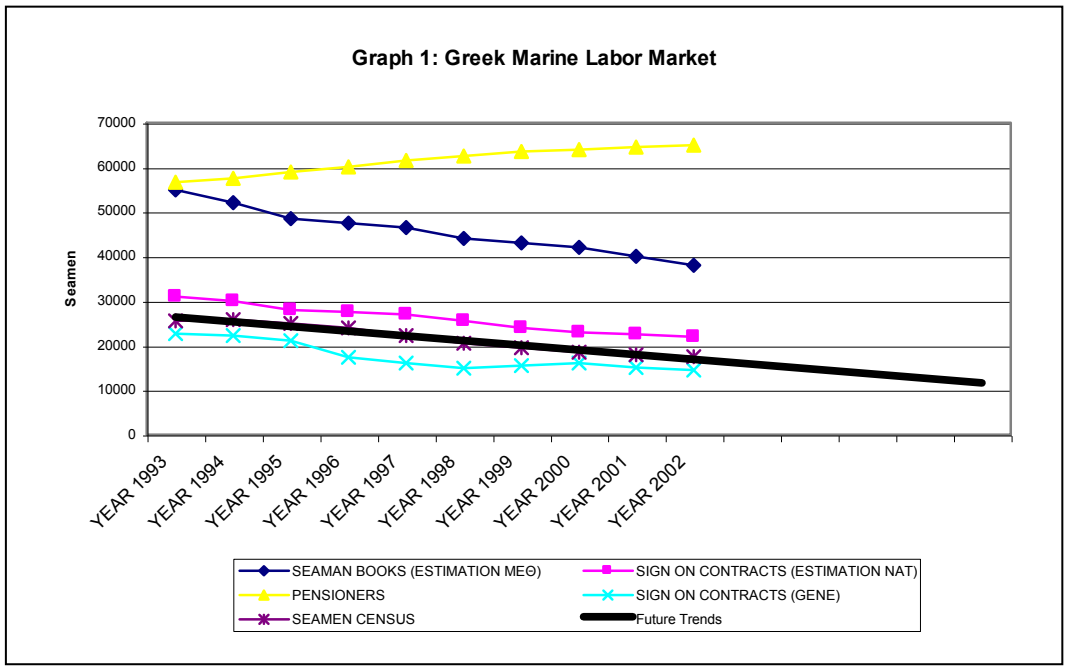
Since 1978 the Greek National Statistics Service (GNSS) carried out every two years a census concerning the sea-manpower on ships flying the Greek flag and on ships beneficially belonging to Greek interests which fly foreign flags but are contracted with the Greek Seamen Pension Fund (GSPF). However, this study does not include the Greek-owned ships flying a foreign flag but with no contributions to GSPF.

Based on the evaluated data, we can observe from Graph No1 (see below) that the number of available seafarers diminished roughly during the 1980 decade. In the beginning of the 1990s we have noticed a gradual change, inasmuch the pensioners and active seamen were almost reaching the same ratio (1:1). In the mid-1990s the pensioners' ratio increased leading to a problematic GSPF. During the same period, there was an increasing number of foreign seamen on board Greek-flagged ships or ships flying foreign flags but contracted with the GSPF and a decreasing number of new entries into the seafaring profession (Gulielmos, 1998 and Obando Rojas *et al*, 1999).

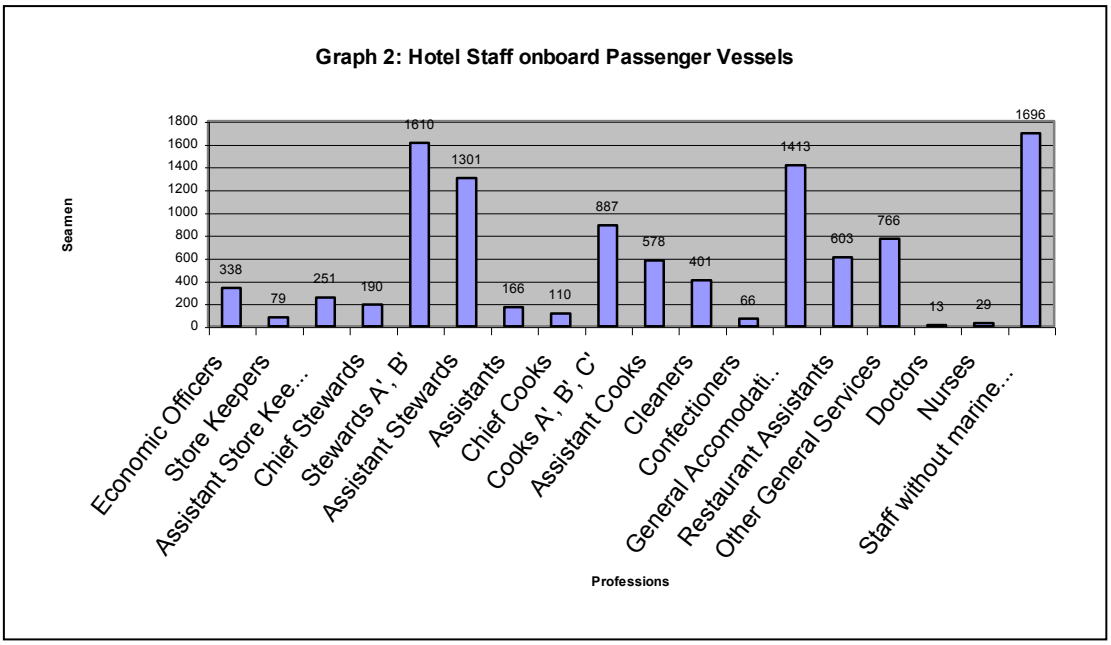
We have attempted to predict the future trends of the basic curve but the evolution is rather pessimistic (Alexopoulos *et al*, 2001). Setting as a starting point the year 1980, it will reach zero (0) after a 10-year period, but on the other side starting from the year 1992 the curve is becoming almost parallel to the axe (representing the stable number of available seafarers) and reaching zero (0) after a 30-year period. In other words, during a period of 10 to 15 years the available number of seafarers shall not be lost but it will almost be equal to the market's needs, provided that the fleet remains the same in numbers and manning levels. The

[*] University of the Aegean, Department of Marine Sciences, aalexopoulos@marine.aegean.gr
[∞] University of the Aegean, Department of Shipping, Trade & Transport, fournarakis@ath.forthnet.gr
[∀] University of Piraeus, Department of Maritime Studies, sambra@unipi.gr

question is what can be done to reverse or minimize these negative trends. It is obvious that we have to move from firefighting decisions into the field of strategic planning.



According to the available census data of 2000, seamen of Greek origin on board Greek ships are representing the 70,6% and those on board Greek-owned ships the 24,9%. Greek-owned ships in general, including those ships that are not contracting with GSPF, are mostly manned by Greek officers despite their higher salaries, because they are considered to be better trained and more experienced than foreign officers. However, these figures are not so accurate since the census data refer only to seafarers employed by Greek-registered and Greek-owned ships with contributions to GSPF. The number of officers that are employed by foreign-owned ships and Greek-owned ships that do not contribute to GSPF can only be estimated through the GSPF computerized system and when the seafarers are called to pay their insurance premiums for retirement services. In Graph No2 we present, in more detail, the number of Hotel staff on board Greek and Greek-owned passenger ships according to their profession.



It is apparent that the existing information regarding the size of the marine manpower varies significantly due to different estimations and methods as well as to the unavailability of accurate statistical data that cannot adequately reveal any shortage or surplus in the manpower market. The total number of the available seafarers stems from the following equation:

$\Sigma_{av} = \Sigma(N_{pos} + N_{car} + N_{stby}) - \Sigma N_{ret} +/- N_{occ}$ where,

Σ_{av} = Number of available seafarers
N_{pos} = Number of existing positions according to the maritime manpower policy (professions onboard ships multiplied by ships flying the national flag)
N_{car} = Number of new entrants into maritime career (including graduates from marine academies)
N_{stby} = Number of stand-by seamen and seamen in international shipping industry (including foreign flag ships owned by Greek and Foreign shipping companies)
N_{ret} = Number of seamen who have either retired (pensioners) or left the shipping industry to work ashore or to occupy themselves in other shipping sectors (ship-management companies, agents, brokers etc)
N_{occ} = Number of occasionally available seamen (usually 4-5 months per year)

Our estimation led us to the assumption that the number of Greek seamen involved in the passenger market is approximately 15,000 but not less than 13,000 and the number of seamen employed in the other freight markets (i.e. tankers, containers, bulk carriers etc.) is approximately 16,000 but not less than 12,000. These figures are based on two parameters according to our survey: (Alexopoulos *et al*, 2001)

- The 'stand by' proportion of the crew employed in the passenger market is about 25-35% of the existing posts and
- The 'stand by' proportion of crew employed in the other markets is about 50-80% of the existing posts.

Bearing in mind that the official unemployment rate of the seafaring profession, according to the Statistical Service of the Merchant Marine Ministry (SSMMM) is almost zero, we must note that an important number of seamen books are inactive due to the individual's personal choice. The main problem of the seafaring profession is that it represents a huge tank (sic) of human resources and occasionally some pensioners re-enlist by taking back their seamen books, depending on the current demand and under legal permission. Furthermore, the entry permission for the lower ranks is almost free, save the IMO's Convention STCW 1978/1995 requirements'.

2. Survey Results in the Greek Passenger Market

The coastal passenger shipping industry in Greece consists of new technology fleets, including new launches (approximately 35%) and conventional ships (approximately 65%). This proportion changes on an annual basis. Ships such as the catamarans, the high-speed single hulls and the hydrofoils are based on modern structures while the ferries, the open ferries and the ro/ro's are the existing ones. Additionally, the cruise industry consists of conventional ships with high quality hotel services.

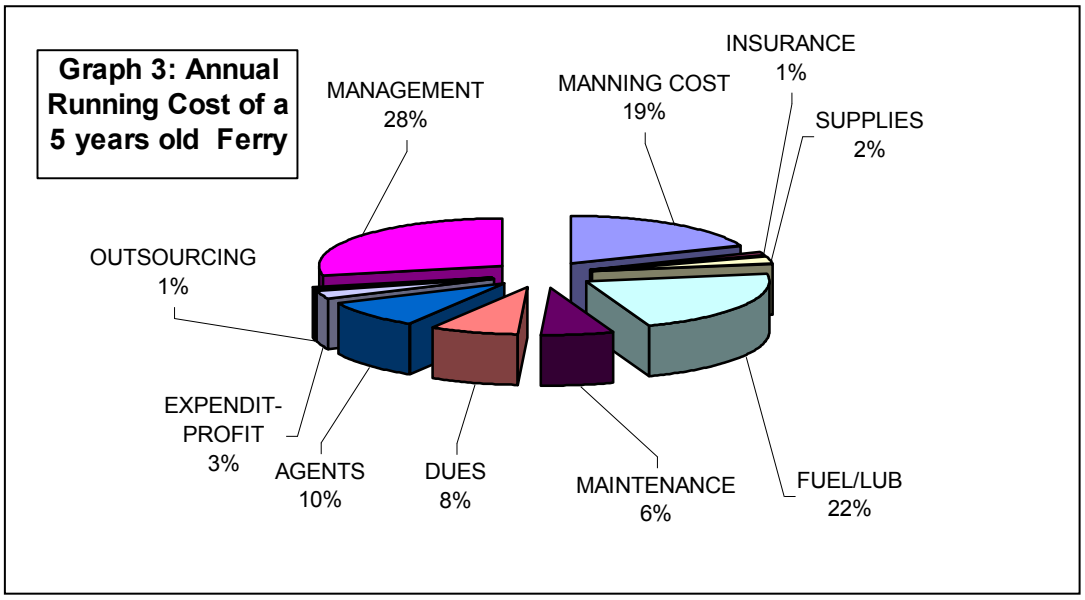
Our primary survey (Alexopoulos - Fournarakis, 2002) was based on a questionnaire that was distributed to all members of the Union of Greek Shipowners of Passenger and Cruise Ships (UGSPCS). The response rate reached slightly more than 60% (company membership) and included the following quantitative figures:

- In respect of the total number of surveyed ships (113 found) with a total gross registered tonnage of 1.473.321 and a total net registered tonnage of 776.033, we have considered that all information extracted for the passenger industry might be admitted as scientifically representing the whole sector.

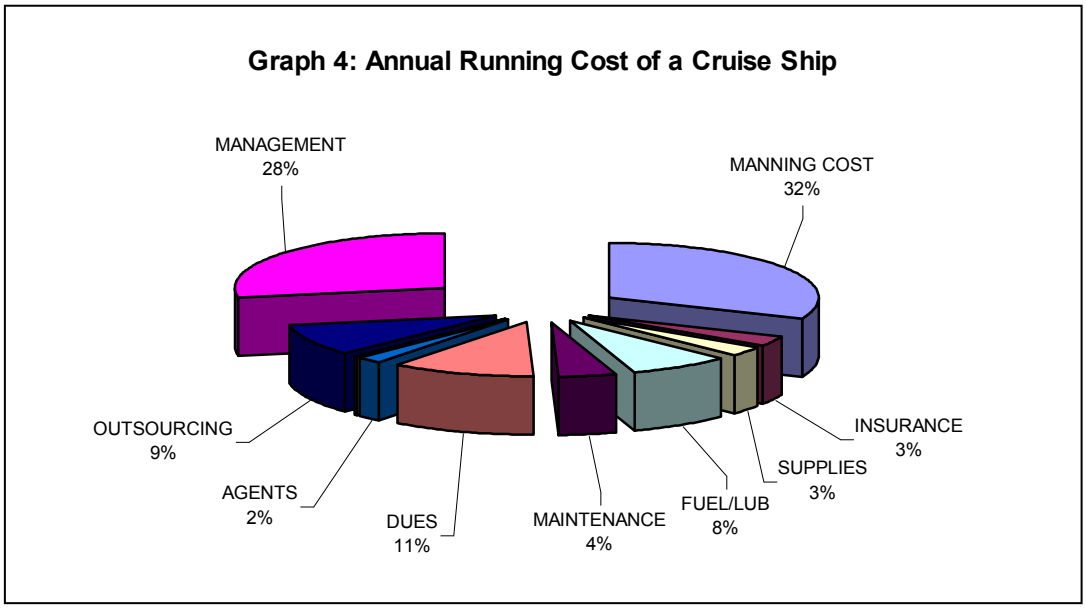
- Concerning the total number of potential transported passengers, the daily voyage capacity has reached the figure of 101.706 passengers, 64.232 seats (in closed spaces), 16.070 cabins and 42.623 beds.
- The total crew numbers of the surveyed fleet were 14.208. Particularly in the cruise fleet the number of seamen were 11.267 (888 of which were of Greek origin) and in the ferry industry the number of seamen were 2.941 (only Greeks).

Nevertheless, it was discovered that the cumulative amounts were not so accurate in order to present the clear picture of the fleet. The next step was to turn to the extraction of some indicative figures related to the cost categories and especially the manning cost level of the sector so that we could use as experiment – scenarios. The major cost categories of these ships were the capital cost, manning cost, fuel and supplies cost, maintenance and repair cost, insurance, agent costs, flag taxation and port dues, outsourcing and management expenses.

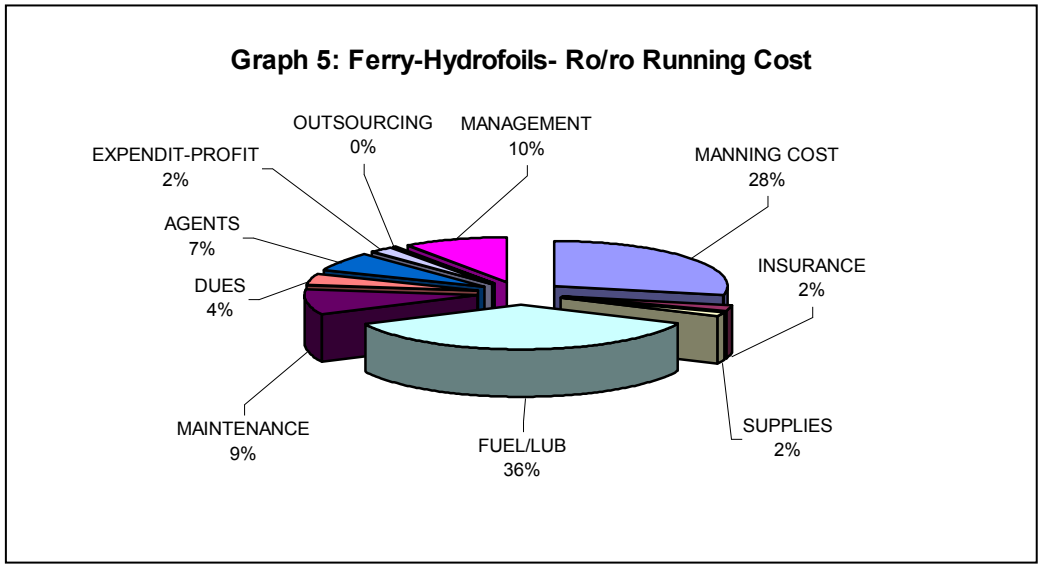
The annual running cost of these ships was classified with a different proportion between the aforesaid categories. Graph No3 presents the running cost categories of an almost new-building ferry where it is pointed out the low proportion level of maintenance, insurance and outsourcing cost categories.



In graph No4 we have observed the high proportion level of management, manning and outsourcing cost of a cruise ship.



In graph No5 (a fleet that comprises of 74 ships of all types) we have presented the high level of fuel, lubricants and manning cost categories.



Based on the findings of this approach, we must mention that the average daily cost of a ferry-passenger ship, flying the Greek flag, is almost 100 Euros (max = 115 Euros, min= 93 Euros). Almost half of this average is shown in the cruise industry (max = 55 Euros, min= 36 Euros) where ships fly foreign flags (either European or non-European). Furthermore, the ratio of hotel staff per passenger in the ferry industry is between 1:14 and 1:30 depending on the hotel facilities or the duration of voyage. In other words, the daily hotel staff cost per potential daily capacity of passengers is between 0,02 and 0,06. The ratio of hotel staff per passenger in the cruise industry is almost 1:3 or the daily hotel staff cost per daily capacity of passengers is between 0,03 and 0,05.

Apart from the different levels of technology and/or the age of ships (Mazzarino and Maggi, 2000) that explains the different proportion of maintenance costs and safety manning costs, the basic results were focused on the very low level of outsourcing costs in the passenger market but not in the cruise market, in comparison with the high level of hotel staff manning cost. In order to achieve a better balance, we have drawn our attention on three major parameters:

- Maintain the annual man-months of the hotel staff in order to avoid anti-social circumstances (i.e. strikes, unemployment levels etc.).
- Improve and control the safety and quality levels of every individual ship and/or route in order to show a safer picture of the whole fleet.
- Reduce the average daily rate of manning cost so that the fleet could become more competitive.

The manpower problem in the Greek Shipping industry is not only the decreasing number of available seafarers but also the long-term loss of Greek ship management know-how, which is the national competitive advantage (Alexopoulos *et al*, 2000). It is important to adopt a different approach and offer solutions in the future by providing an effective tool to decision/policy-makers. In such a way, we must take under consideration not only the appropriate measures but also to estimate the impacts of these measures through computer simulation.

By using the systems dynamics methodology, a simulation model could be created encompassing the Greek Shipping Industry's System as well as the Greek Marine Manpower Subsystem in order to redesign or improve the problematic dimensions. This methodology combines the qualitative and quantitative approach with a more accurate way, using control theory techniques, statistical techniques and computer simulation techniques. Once a valid

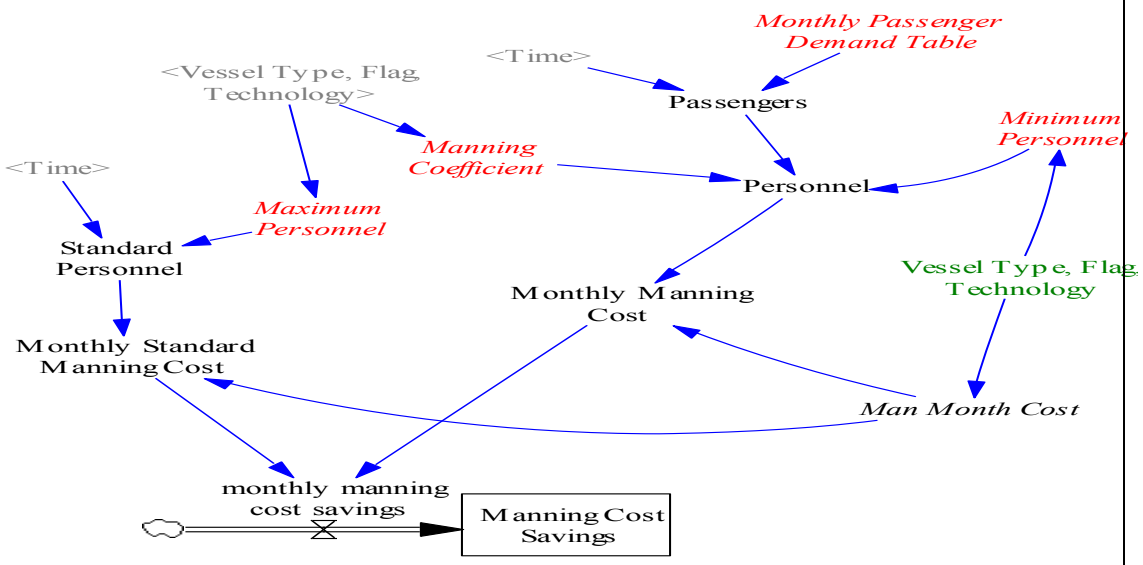
model has been achieved, it then becomes a valuable tool for analyzing systems behavior and as a test-bed for possible redesign strategies.

3. The System Dynamics Approach

Two policies for the manning of vessels have been considered, as described below: (a) The number of crew members is constant for the summer and winter periods as regulated by the state. (b) The number of crew members varies on a monthly basis according to passenger demand (considered equivalent to the occupancy rate), above a minimum number which is considered obligatory, possibly by state regulation. This policy is considered to be applicable to both passenger and cruise markets.

To study the implications of each policy a simulation model has been built based on the methodology of System Dynamics. The simulation model developed is described in the graph below.

Graph No6: Simulation Model



The components of the simulation model are described in detail in the next table.

Component	Type	Description
Vessel Type, Flag, Technology	Constant	This parameter is used to define the type of vessel, so that the model may be used for various types (e.g. high speed monohull, hydrofoil, conventional).
Man Month Cost	Basic parameter	The man month cost defined for the particular type of vessel.
Minimum Personnel	Basic parameter	The minimum allowed number of crew-members in assumed policy No2. This is defined for each particular type of vessel.
Maximum Personnel	Basic parameter	The maximum number of crew-members in assumed policy No1. This is defined for each particular type of vessel.
Monthly Passenger Demand Table	Lookup table	Assumed passenger demand (occupancy rate) for each month in a calendar year, specified for each type of vessel.

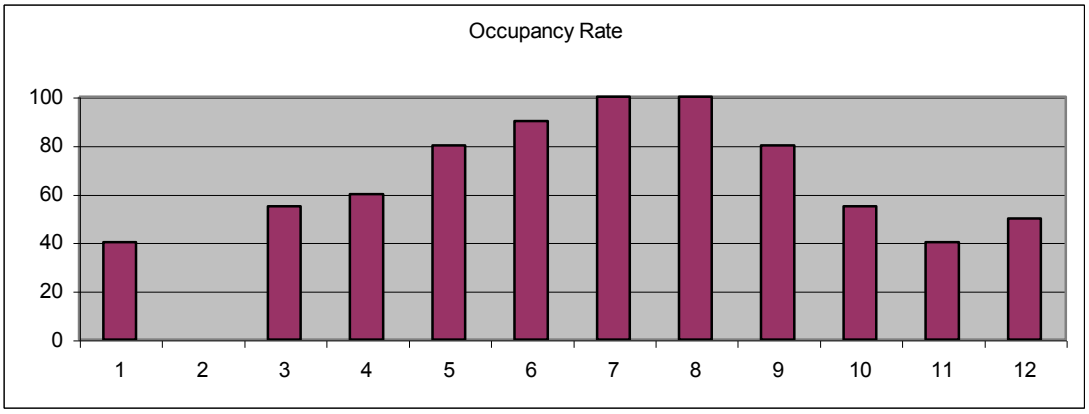
Component	Type	Description
Passengers	Simulation variable	The number of passengers for the current month.
Manning Coefficient	Basic parameter	The number of crew members in policy No2 is determined as Minimum Personnel + Manning Coefficient x Passengers
Personnel	Simulation variable	The actual number of crew-members for the current month, as derived in policy No2.
Standard Personnel	Simulation variable	The number of crew-members, as defined in policy No1.
Monthly Manning Cost	Simulation variable	The manning cost for a given month for policy No2.
Monthly Standard Manning Cost	Simulation variable	The manning cost for a given month for policy No1.
Monthly manning cost savings	Simulation variable (rate)	The difference between Monthly Standard Manning Cost and Monthly Capacity Cost
Manning Cost Savings	Simulation variable (stock)	The aggregate of the monthly manning cost savings annually.

Based on the information received, as part of the survey, a representative theoretical type of vessel was considered with the following characteristics:

Type/flag/technology:	Ro-Ro Passenger / Greek Flag / Conventional
Annual manning cost:	2 750 000 €
Number of Crew (maximum):	76 (summer periods)
Number of Crew (maximum):	65 (winter periods)
Number of Crew (minimum):	50 (including safe and hotel manning)
Man month cost:	3 000 €
Passenger capacity:	1 500 L/B

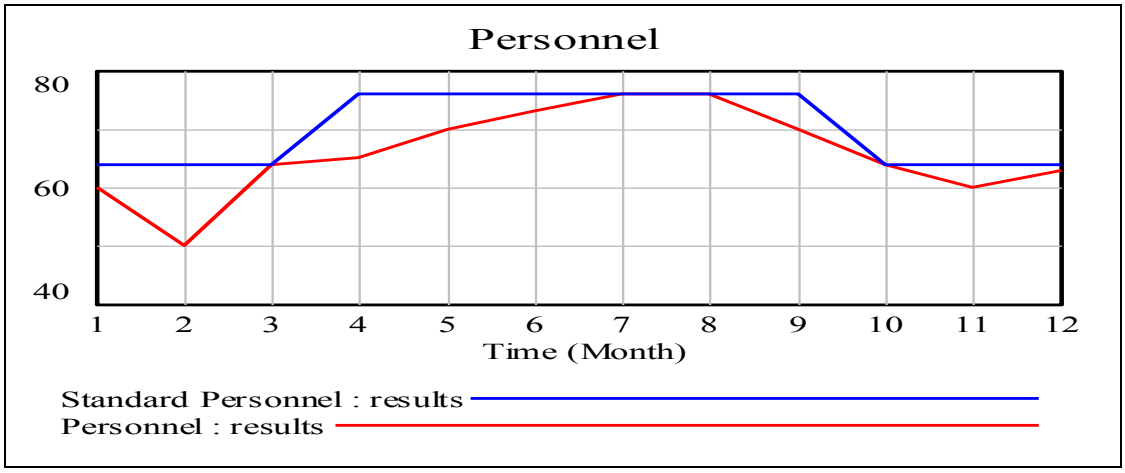
The assumption regarding the vessel's occupancy rate is described in the diagram below.

Graph No7: Seasonal Occupancy Rate



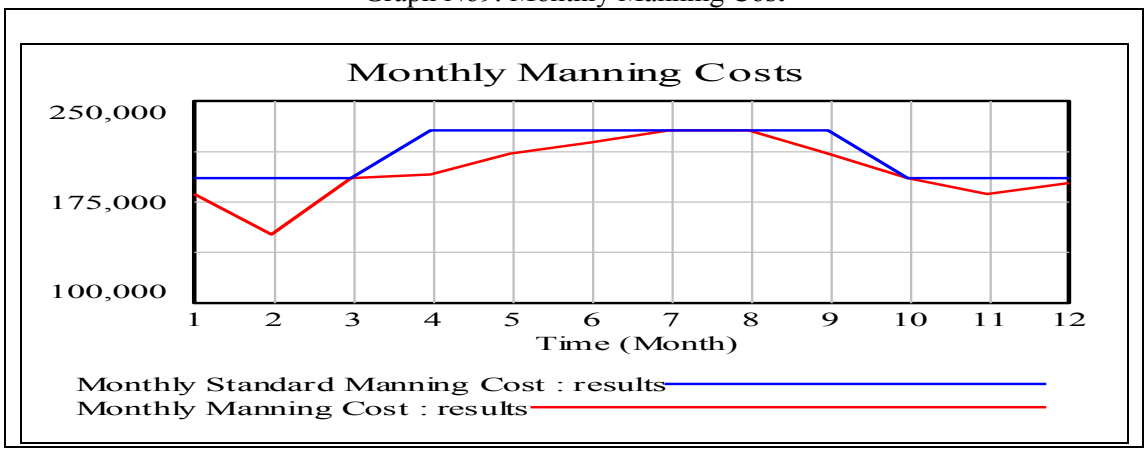
We must note that during the second Month (February) the vessel is considered out of service due to repairs/maintenance. The simulation model was run for the two policy-cases described above and the results are presented below. The number of crew for each policy is shown in the graph below.

Graph No8: Number of seafarers



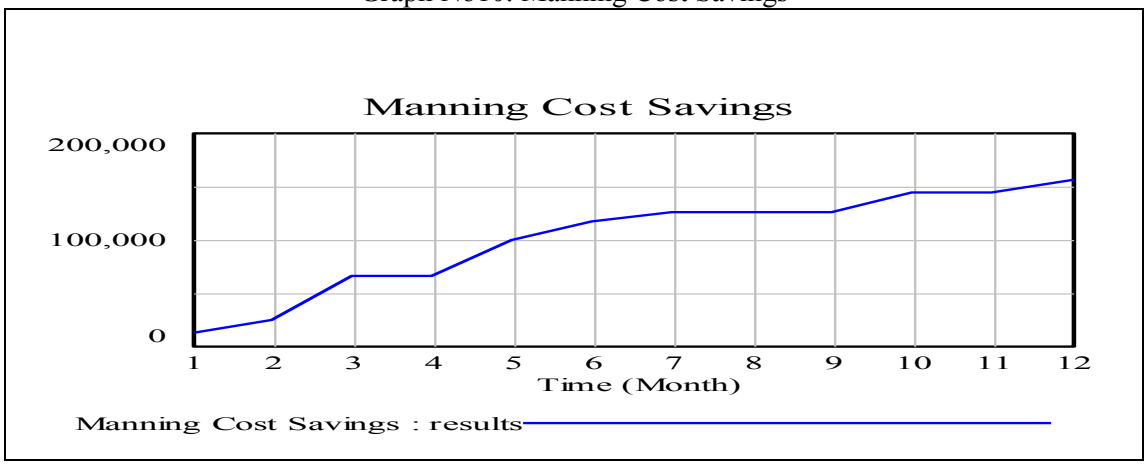
The monthly manning costs for each policy are shown in the next graph.

Graph No9: Monthly Manning Cost



The cumulative cost savings for policy No2 compared to policy No1 on an annual basis is shown in the graph below.

Graph No10: Manning Cost Savings



The new approach is based on a coefficient, which determines the additional hotel staff in relation to the occupancy rate. Its application may improve the competitiveness of the passenger and cruise markets and will contribute to the reduction of annual manning costs by reducing a number of man-months.

4. Conclusions

Suggesting that the availability number of Greek seafarers will prove almost impossible to increase under the present conditions, i.e. many job opportunities ashore and/or the number of pensioners is substantially higher than the one of new entries on a yearly basis, then the problem of maintaining the current status will depend on the criteria presented below:

- The treatment of a gradual student-leakage from the marine academies.
- The re-employment of Greek seafarers that are recruited in foreign vessels, to ships flying the Greek flag.
- Upgrading the percentage ratio of Greek-foreign seafarers on board Greek ships.
- Attracting vessels to fly the Greek flag under beneficiary terms (labor cost) for the shipowners.

Acknowledgements

The valuable comments from the Union of Greek Shipowners of Passenger Ships, the Ministry of Merchant Marine and Dr L.P. Hatzikonstantis, were gratefully acknowledged.

References

Alexopoulos A.B. and Fournarakis N.G., (2002), An Analysis of the Greek Manpower Market in the Ferry and Cruise Industries, Research Study submitted to the Greek Shipowners Union of Passenger Ships, University of the Aegean.

Alexopoulos A.B, Fournarakis N.G. and Katarelos E., (2001), Current Trends in the Greek Marine Manpower Market: A Qualitative and Quantitative Approach, Management Sciences and Regional Development, No3, 1-20.

Alexopoulos A.B., Fournarakis N.G. and Hantzikonstantis L.P., (2001), A System Dynamic Analysis of the Availability Levels of Greek Seafarers, Proceedings of the 2nd International Conference on Safety of Maritime Transport, University of the Aegean.

Alexopoulos A.B, Fournarakis N.G., Katarelos E. and Litinas N., (2000), Nautilus Project: Telematic Applications to the Continuous Training for Mariners, Interim Report, University of the Aegean. [see www.nautilus.edu.gr]

Gulielmos A., (1998), Flagging out and the Need for a New Greek Maritime Policy, Transport Policy, No5, 115-125.

Mazzarino M. and Maggi E., (2000), The Impact of the New Onboard Technologies on Maritime Education and Training Schemes in Europe: Some Findings from METHAR Project, Maritime Management and Policy, Vol.27, No4, 391-400.

Obando-Rojas B. Gardner B. and Naim M., (1999), A System Dynamic Analysis of Officer Manpower in the Merchant Marine, Maritime Management and Policy, Vol.26, No1, 39-60.