

A Web based Application for Ship Routing and Scheduling: A Greek Case Study

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The objective of the specific research project is the design and implementation of an integrated system to improve productivity of a Greek maritime company. In particular, the project involves the development of a Web based Application (WA) that incorporates effective methods for the delivery of high quality services, and encompasses wireless telecommunication technologies and Geographic Information Systems (GIS). The proposed WA interacts with a relational database and treats static and real time information through multiple level user interfaces.

The Case Company

The case company operates in the field of chartering high quality pleasant boats for performing cruises requested by customers who have high levels of purchasing power. The company owns two yachts staffed by 4 persons per each. The yachts are hired by people who want to travel along Hellenic seas, taking advantage of the luxury provided internally by the yacht and its staff, having the infrastructure to communicate effectively through internet services, and focusing on security issues. There is a dynamic modification of the schedule provided, except for specific cases where the contract does not allow such modifications, i.e. when embassies or consulates are considered.

The operational development of the case company involves customer database enrichment and optimization of the service delivery through the minimization of the incumbent costs. Ship routing and scheduling is one of the most important problems faced by the company in an operational basis. In particular, one has to plan the trip, such that the customer needs are met and the total cruise cost is minimized. Thus, optimization of the way the services are delivered to the customer as well as of the ship schedule itself are of primal importance.

Motivation

The motivation for this research project stems from the interrelationship of the following issues:

- i. The case company fails to deliver on-board office capabilities, which are assumed to be important for ship chartering through non-peak periods, that are, periods that are not favourable for cruises.
- ii. Absence of a security system that utilizes the technologies of continuous information gathering, between the yacht and the operational management department of the company. The need for security issues has been intensified lately and thus customers assume as a prerequisite, emergency response strategies and continuous monitoring of the status of their hired ship.
- iii. Inefficient customer related data management and absence of a systemic approach that stores, manipulates, and monitors trip related information.
- iv. Innovation of the specific WA, peculiarity and high complexity of the incumbent routing and scheduling problem and innovation of the developed methodology for solving it.

System Components

Motivated by the issues discussed above, a tailor made Web based Application has been developed to address all the incumbent operational defects and meet the actual needs of the case company. The proposed system consists of three major components with respect to its operational and strategic scope:

1) The **first component** is related with the **ship routing and scheduling** using data gathered by company's databases and GISs. Candidate customers have the opportunity to develop their own trip proposed by the system having defined specific priorities, visits, departure or arrival or both dates, visit durations (or none of them). In the following a brief problem and solution approach description are given.

Problem Description

Given the operational realities followed by the company the incumbent ship routing and scheduling problem can be described as follows. As previously stated customers have some preferences to be satisfied according to which the system will produce the proposed cruise plan. In particular, they can choose among all available stops (islands or other seaports), specify the departure date or arrival date or the visit duration or none or all of them. Furthermore, they can define their own rate of importance with respect to the quality of food, the sightseeing, the beaches, the airport existence, and other as shown in Figure 1. All this information constitutes the input for the solution approach developed. Given all these as well as the total duration of the trip and type of the ship, the objective is to insert other interesting stops (if needed) into the schedule, according to customers requests (priorities), determine the optimum sequence of stops in terms of travelled miles, determine the appropriate visit duration at each stop according to its popularity, and minimize unexploited time per trip.



Είστε εγγεγραμμένος χρήστης Log Off

Search Travel Plan By Parameters

Stage	Arrival	Departure	Duration	
Alimos (Marine)	-	17/03/2008	-	+
Isos Map			4	+ -
Spetses Map	24/03/2008		0	+ -
Alimos (Marine)	27/03/2008			

Service Supply	Low	Airport	True
Popularity	High	Night	Low
History	Low	Food	High
Beach	High	Blue Beach	Low
Interesting Places	Low		

Submit Search Cancel

Figure 1: Customer preferences-input for the adopted optimization method

Solution approach

Since the complexity of the incumbent problem does not allow analytical and exact approaches to solve it, an artificial intelligence based metaheuristic methodology was employed. The proposed method consists of a two-phase multi-start metaheuristic solution framework, called VNTS [1]. In the first phase, several initial solutions are produced using a new greedy construction heuristic that takes into consideration all the operational realities of the problem addressed. In the second phase, the solutions are improved using a Variable Neighborhood Tabu Search (VNTS) hybrid metaheuristic algorithm. The proposed implementation uses Tabu Search (TS) internally within a Variable Neighborhood Search (VNS) allowing the efficient and effective exploration of the solution space. Furthermore, a specialized shaking mechanism is introduced, which utilizes the information provided by local optimum solutions delivered during VNS iterations, in order to diversify the search towards more promising regions.

2) The **second component** is related to **security issues** that ensure smoothness of the yacht's functionality through the real time information gathering from and to the ship, involving all the related organizations and departments of the company. The integrated interface in the proposed system incorporates wireless telecommunication technologies (i.e. Voice over IP, Global Positioning Systems or signals by EPIRB device). According to the requests for 100% reliability the related equipment used provides:

- Bidirectional communication between ship and operational management department of the company
- Smooth information gathering about the ship position and status

3) The **third component** is related to the web based application with respect to **customer satisfaction** before and after the chartering. More specifically, the realization of the proposed system will transform the case company to a full Internet-capable enterprise, which incorporates the related infrastructure for attracting customers through user-friendly interfaces and provide services that develop competitive advantage against its competitors. In particular, the developed user interface provides functionalities that enable the user:

- Choose among predefined trip schedules, successfully experienced by other customers in the past or proposed by the company.
- Use graphical representations and GIS to evaluate the proposed plans, while providing all the related information for the stops of interest
- Use all the related planning tools that aid the user to choose the specifications that match his/her preferences.

Results

The proposed Web based Application utilizes relational databases and integrates geographic, time and cost information through multiple level friendly user interfaces. The use of the system obtained: minimization of the unexploited time per trip by maximizing ship utilization, high quality services delivered to the customer in competitive prices, guarantee of a secure trip through the real time bi-directional communication (Ship-Company), flexible and optimized fleet management, and finally improved competitiveness and increased profitability. The results by the implementation of the system can be summarized in the following three fields:

- *E-Business*, through the development of an innovative Web based platform, which incorporates wireless telecommunication technologies and monitoring of cruises in real time.
- *Development of innovative processes for strategic and operational planning*, with respect to the optimal ship routing and cruise scheduling obtained by the interaction with sophisticated methodologies.
- *Development of planning tools* with respect to the process of chartering, through the use of multiple interfaces that enable the user choose the specifications that match his/her preferences.

To conclude, the proposed WA constitutes an important contribution in the related literature while establishing classical techniques for future developments. In particular, through the realization of the project, the research team acquired the know-how in modelling special routing problems with various peculiarities, and in development of sophisticated methodologies for solving them. Furthermore, know-how acquired also in developing web based applications with multiple level user interfaces. Towards that direction the project research team can demonstrate various publications on international scientific journals as well as proceedings and presentations at international workshops and conferences. The benefits of such systems are various, i.e. high rate of portability, low maintenance costs, simplicity in use, and other that provide the case company the competitive advantage to achieve high rate of customer satisfaction, high quality services delivered while minimizing its operating costs.

Bibliography

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