

# The Maritime Shipping Competition (MSC) 2025: Efficient Maritime Cargo Bidding and Transport Scheduling

Demonstration Track

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## ABSTRACT

The Maritime Shipping Competition (MSC) at AAMAS 2025 introduced a novel challenge focused on autonomous decision-making in maritime logistics. Participants developed agents capable of bidding for cargoes in sequential reverse auctions and scheduling transportation under uncertainty. Using the Maritime Agent-Based Logistics Emulator (MABLE), the competition simulated tramp trade shipping markets with heterogeneous fleets and dynamic cargo opportunities. Agents were evaluated across multiple scenarios varying in fleet composition and operational constraints. The competition and the entries submitted by the participating teams highlight the challenges and complexity of maritime transportation, and encourage further research in this important area.

## KEYWORDS

Competition; Agent-Based Systems; Multi-Agent Systems

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## 1 INTRODUCTION

Maritime transportation underpins global trade and supply chains, accounting for approximately 80% [5] of international cargo movement. While the sector has shown growth in recent years, maritime transportation is also facing critical challenges around geopolitical tensions, climate change and disruptions at key chokepoints such as the Panama and the Suez Canals [7]. These pressures are compounded by environmental targets set by the International Maritime Organization (IMO), which aims to decarbonise shipping by 2050 via more restrictive climate-change-mitigating regulation [4].



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Without intervention, maritime emissions could rise from 3% to 10% of global greenhouse gas emissions [6]. Plans and changes include new types of ships, energy saving technologies, new fuels as well as new markets [3]. To address these challenges, shipping companies are exploring digital solutions such as digital twins and AI-driven optimisation to increase profits and resilience [2]. Multiagent systems (MAS) offer promising approaches for dynamic scheduling and predictive decision-making to reduce costs and greenhouse gas emissions [2, 4]. Many of these digital solutions are in their infancy and could benefit from research on MAS, AI and related technologies developed by the AAMAS community, which, in turn, could find fertile ground to develop and apply novel solutions.

The Maritime Shipping Competition (MSC) was conceived to bridge this gap by providing a realistic, research-driven environment for testing MAS strategies in maritime logistics.

A demonstration video is available on YouTube.

## 2 THE PLATFORM: MABLE

The competition uses the *Maritime Agent-Based Logistics Emulator* (MABLE), an agent-based simulator developed in Python, which models tramp trade shipping markets where vessels operate without fixed schedules and companies compete for delivery contracts; available on GitHub [1]. Users can specify ports, a cargo market with one homogeneous continuous cargo, e.g. crude oil, and shipping companies. When the simulator is run, it generates random cargo transportation opportunities that shipping companies can bid for to transport which then have to be executed. Cargo generation and travel times are based on datasets from the real-world Automatic Identification Systems (AIS) movement data of large crude oil cargo vessels. The current version focuses on code interaction and logs an extendable range of economic and environmental metrics.

## 3 COMPETITION

The competition invited international teams to develop software agents representing maritime shipping companies. Each agent controls a fleet of vessels with varying cargo capacities and fuel consumption profiles. The agent bids for upcoming jobs in the tramp trade shipping auctions, and then efficiently schedules the transport to fulfil the jobs won. Specifically, core objectives include:

Team	Avg Income (£)	Median Income (£)	Avg Penalty (£)
Mai et al.	105,000 ± 123,000	~£51,000	8,000 ± 5,000
Gaskins and Brue	-93,000 ± 135,000	~£-43,000	0
Flavin et al.	-663,000 ± 598,000	~£-272,000	338,000 ± 150,000

**Table 1: Top teams and performance metrics.**

**Bidding Strategy.** Decide which cargoes to bid for in recurring reverse second-price (Vickrey) auctions, considering current commitments and future opportunities.

**Scheduling Strategy.** Optimise routing and scheduling of won cargoes to minimise costs and penalties while maximising profit.

**Uncertainty Handling.** Incorporate incomplete information about future cargoes and competitor behaviour.

Teams submitted a software agent and a short report outlining their strategy. Agents were evaluated based on their average ranking across several tournaments (see Section 4).

The competition concluded with presentations at AAMAS 2025, where results were announced and four prizes awarded: the overall winner received £500, the runner-up £300, and the third-place team £100. Additionally, a *Most Interesting Strategy* prize of £100 recognised the most innovative approach.

## 4 TOURNAMENT DESIGN

Agents were evaluated in a series of simulated scenarios based on real-world data using the MABLE platform [1]. Each scenario represented two years of operations with monthly auctions, offering transportation opportunities equal to nine times the number of competitors, and requiring agents to manage fleets of nine vessels under varying conditions. Each fleet consisted of vessels drawn from three types with varying deadweight tonnage (DWT): **Suezmax** with 80,000–120,000 DWT, **Aframax** with around 160,000 DWT and **VLCC** with more than 250,000 DWT.

Six scenarios were used to test adaptability:

**Balanced Fleet.** 3 Suezmax, 3 Aframax, 3 VLCC per company

**Small Vessels Fleet.** 9 Suezmax per company

**Medium Vessels Fleet.** 9 Aframax per company

**Large Vessels Fleet.** 9 VLCC per company

**One Big Fleet.** One company with 9 VLCC and other companies with 9 Suezmax (rotated so each team controls the large fleet once)

**One Small Fleet.** One company with 9 Suezmax and other companies with 9 VLCC (rotated similarly)

Performance was measured as average income across all scenarios, calculated as revenue from contracts minus fuel costs minus penalties for unfulfilled deliveries. Agents were ranked in each scenario by income, and the overall ranking was the average across all tournaments. For heterogeneous fleets, scenarios were repeated so that every agent operated each fleet composition exactly once.

## 5 RESULTS AND STRATEGIES

The competition attracted diverse algorithmic approaches, reflecting the complexity of bidding and scheduling under uncertainty. The awarded teams achieved different levels of income (see Table 1) utilising the following strategies.

**Winning Team:** *Weiming Mai, Xueying Ou, Ximeng Liao and Haohui Zhang* (Delft University of Technology, Delft, Netherlands and University of Twente, Enschede, Netherlands) submitted *Fast Scheduling and Robust Pricing: An Automated Agent Framework for Competitive Shipping Company Operations under Sealed-Bid Second-Price Auctions*. Their agent combined a *multi-start minimum-cost insertion heuristic* for scheduling with a robust bidding strategy. Before auctions, it estimated costs for potential cargoes and prioritised bids likely to fit efficient routes, using a threshold mechanism optimised offline. After auctions, it inserted won trades into schedules to maximise overall profit. The approach proved highly resilient under uncertainty, though the team accepted small penalties to secure high-value contracts, a trade-off that boosted overall income but might be less acceptable in real-world operations.

This team also received the **Most Interesting Strategy** award for their two-stage design, which separated bidding from scheduling and demonstrated the value of modular decision-making.

**Runner-up:** *Zachary Gaskins and Jacob Brue* (University of Tulsa, Tulsa, United States) submitted *Team Oil Spill MABLE Competition Agent*. Their agent combined a *genetic algorithm* for scheduling with a bidding approach based on *Shapley values*. The genetic algorithm evolved feasible vessel routes through crossover and mutation, while Shapley values estimated each trade’s contribution to overall cost, enabling bids that reflected true marginal costs. This method aimed for fairness and accuracy in pricing and, unlike the winners, avoided penalties entirely which came at the expense of lower overall income.

**Third Place:** *Timmy Flavin, Joe Shymanski and Mikey Ferguson* (University of Tulsa, Tulsa, United States) submitted *Optimizing Vessel Scheduling and Trade Bidding with Simulated Annealing*. Their agent used *Simulated Annealing (SA)* to optimise vessel scheduling and bidding. The approach explored different trade allocations and route configurations by applying small, probabilistic changes to schedules, aiming to improve overall efficiency while avoiding infeasible plans. Their fitness function focused on minimising travel costs and improving route efficiency, indirectly supporting competitive bidding. The approach delivered promising results but faced challenges with strict scheduling constraints.

## 6 CONCLUSION

The Maritime Shipping Competition demonstrates the applicability of multi-agent systems (MAS) techniques to real-world logistics challenges. By combining auction theory, optimisation and learning, participants developed strategies that could inform industrial practices and support decarbonisation goals. The strategies and results highlight significant scope for innovation and further improvements in future research and subsequent competitions.

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