

# Quantitative Analysis of Fleet Operation Status Based on Fleet Development Status Model

## OSV (Offshore Support Vessel) as A Ship for Energy Exploitation and Use

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**Abstract**—A fleet status evaluation model has been established. The domestic offshore support vessel (OSV) fleet are statistical analysis, from the ship number, Total ton, average tonnage, power, average power and age, to obtain the status of the OSV fleet; At the same time, the characteristics of OSV operation are analyzed by analyzing the characteristics of ship operation and ship type, and the features of OSV ship and engineering ship are OSV. The research results can be applied to the research and management of OSV Operation Market.

**Keywords**—Offshore Support Vessel (OSV); fleet status evaluation model; operating characteristics

### I. INTRODUCTION

Offshore Support Vessels (OSV) is a generic term for special ships engaged in operational support during various stages of offshore oil and gas exploration, development and production. That is to say, ships providing, anchoring, ROV/ROT support operations, testing or preparing (guardianship) services related to exploration, development, production, storage and transportation and abandonment of oilfields. Due to the complexity of offshore oil production and development operations and the variety of materials required, in addition to technical operations, offshore oil support ships need to carry offshore oil industry personnel, a small number of suitable dangerous goods, a limited number of toxic and harmful liquids in bulk, and a limited amount of diesel oil to be supplied to offshore facilities.

### II. FLEET STATUS EVALUATION MODEL

The main factors that can characterize the current situation of fleet capacity include the proportion of ships carrying capacity, the proportion of total tonnage, the ranking of average tonnage, the ranking of power and the ranking of ship age. The present situation of ship's capacity is expressed as dependent variable, and the proportion of ship's number, total tonnage, average tonnage, power and age are independent variables. The current situation of ship's capacity varies with the change of ship's number, total tonnage, average tonnage, power and age. Then the model of ship capacity structure adjustment is as follows:

$$F(A, B, C, D) = f_1(A) + f_2(B) + f_3(C) + f_4(D) \quad (1)$$

$$A = F_5(t) \quad (2)$$

$$B = F_6(t) \quad (3)$$

$$C = F_7(t) \quad (4)$$

$$D = F_8(t) \quad (5)$$

This formula is expressed as follows: F (A, B, C, D) represents the change of fleet capacity status with the changes of A, B, C and D, A represents the value of the proportion of ships in time t, B represents the value of the proportion of total tonnage in time t, C represents the order of average tonnage in time t, D represents the order of power in time t, E represents the order of age in time t. T represents the observation time of the main factor for measuring the node.

### III. STATUS OF OSV FLEET

According to the fleet status evaluation model, the data needed are derived from CLARKSON database, and the domestic OSV fleet is analyzed in terms of number of ships, total tonnage, average tonnage, power and age.

#### A. Number of Ships

According to the calculation results of fleet status evaluation model, there are 291 OSV ships in China, of which 87% are in operation and the remaining 13% are idle. 39 domestic offshore oil field service companies provide services to 291 vessels, which remove 3 unknown operators. Among the ships in operation, 36% are OSV ships operated by CNOOC, 32% are OSV ships operated by the Salvage Bureau of the Ministry of Transportation, which are the first and second largest OSV owners in China respectively, and 32% are ship owners of 32 other enterprises. It can be seen that CNOOC plays a leading role in OSV operation in China.

For other OSV-operated ship-owners, including those in operational and non-operational status, the smallest company has only one vessel, the largest company has 15 vessels, more than 75% of the companies have less than 2 vessels, and more

than 50% of the companies have only one vessel. As can be seen, most OSV companies are single-ship companies.

### B. Gross Tonnage

In terms of total tonnage, there are 660,000 total tonnages of domestic OSV vessels, 90% of which are in operation, and the remaining 10% are idle.

Among them, in terms of the total tonnage of ships in operation, the total tonnage of vessels operated by the Salvage Bureau accounts for 37%, that of vessels operated by CNOOC accounts for 34%, and that of other enterprises accounts for 29%. It can be seen that although the number of OSV vessels operated by the Salvage Bureau is not as good as CNOOC, the total tonnage of OSV vessels operated by the Salvage Bureau is higher than CNOOC, indicating that the tonnage of OSV vessels operated by the Salvage Bureau is larger.

For other companies, including those in operation and non-operation, the smallest company has 531 gross tonnage ships, the largest company has 31544 gross tonnage ships, the total tonnage of ships owned by more than 25% companies is less than 2000 gross tonnage, and the total tonnage of companies with more than 50% of the total tonnage is less than 5000 gross tonnage. It can be seen that the total tonnage of most OSV enterprises is below 5000.

The maximum tonnage and minimum tonnage of all ships, including those in operation and non-operation, are 6889 and 399. The total tonnage of each ship is sorted from small to large, and the appropriate interval is selected to accumulate the number of ships whose total tonnage falls in the interval. The total tonnage distribution map of OSV single ship is obtained. It can be seen that the total tonnage of a single vessel is mainly distributed in the range of 1000 to 1999, and the number of vessels in the range accounts for 40%.

### C. Average Tonnage

The average tonnage of domestic OSV vessels is 2275, of which the average tonnage of ships in operation is 2347. Among them, the average tonnage of Salvage Bureau ships is 2695, the average tonnage of CNOOC ships is 2221, and the average tonnage of other enterprises ships is 2139. It can be seen that the average tonnage of operating ships is higher than that of idle ships, indicating that OSV ships with large tonnage are more popular in the market.

For other companies, including ships in operational and non-operational status, the average tonnage of the smallest company is only 531 average tonnages, while the largest company has 4892 average tonnage. It can be seen that the average tonnage of CNOOC and China Rescue Bureau vessels is not the maximum, which is roughly in the middle of all enterprises.

### D. Power

All ships, including those in operational and non-operational states, are removed without filling in the power. The remaining 246 ships have a maximum power of 16 228 KW and a minimum power of 746 KW. They are sorted according to the power from small to large, and the appropriate

interval is selected to accumulate the number of ships whose power falls in the interval. The power distribution map of OSV is obtained. From the results, it can be seen that the power of a single ship is mainly distributed in the range of 2500 to 7500 KW, and the number of ships in the range reaches 64%.

### E. Average Power

291 domestic OSV ships were removed without filling in the power. The remaining 246 ships had an average power of 6181 KW, of which the average power of operating ships was 6438 KW. Among them, the average power of Salvage Bureau operating ships is 7532 KW, that of CNOOC operating ships is 6495 KW, and that of other enterprises is 5200 KW. For other companies, including ships in operation and non-operation, except for six unknown horsepower enterprises, the average power is 10224 KW, the smallest is 1283 KW, and the average power is less than 5000 kW for more than 50% of the enterprises. It can be seen that the average horsepower of most vessels in other enterprises is lower than that of CNOOC and Rescue Bureau.

### F. Age of Vessel

The total average age of domestic OSV vessels is 13 years, of which the average age of operating vessels is 11 years. The average age of vessels operated by the Salvage Bureau is 11 years, the average age of vessels operated by CNOOC is 12 years, and the average age of vessels operated by other enterprises is 9 years. According to the distribution of ship construction years, 2009, 2011 and 2015 are the three peaks of OSV ship building, during which a large number of ships were built and put into use.

For other companies, including those in operational and non-operational conditions, the maximum average age is 39 years, the minimum average age is 1 year, and the number of enterprises exceeds 75%, the average age is less than 10 years. It can be seen that most ships are built within 10 years.

## IV. OPERATIONAL CHARACTERISTICS OF OSV

OSV can be divided into platform staff transfer, oil field support and platform material supply according to its operation function. OSV can carry both platform materials and personnel of offshore platforms, and also undertake various oil field support functions such as oil supply, towing, external fire protection, guardianship and so on.

The transfer of platform staff mainly refers to the transfer between platform and shore provided by OSV ship when the offshore platform staff is handed over in shifts. The materials needed for the platform mainly include dangerous goods specially used for exploration, development and production of offshore facilities. During transportation, the material is usually stored on the deck and cabin of the OSV. The dangerous cargo on deck is packaged on the deck of the ship, such as oxygen cylinder, acetylene bottle, aviation kerosene and radioactive source; the dangerous cargo in the cabin is loaded in bulk in the liquid cargo cabin of the ship, such as methanol, ethylene glycol, liquid mud and waste mud at the wellhead of offshore facilities.

TABLE I. THE TYPES AND MAIN FUNCTIONS OF OSV

Serial number	Categories and main functions		
	OSV Types	Main Functions	Other Functions
1	AHTS	Towing and anchoring	Oil lifting operation support, transportation supply, guardianship, external fire protection, oil spill recovery, diving support, transshipment of personnel at sea
2	Stand-by	FPSO Oil Extraction Operation Support and Oilfield Guardianship	Transportation supply, external fire protection, oil spill recovery, diving support, transshipment of personnel at sea
3	PSV	Transport supply	Guardianship, External Fire Control, Oil Spill Recovery, Diving Support, Marine Personnel Transfer
4	Ice-breaker	Icebreaking	Transportation supply, external fire protection, towing and anchoring, oil lifting operation support, guardianship, oil spill recovery, diving support, personnel transshipment at sea
5	Well Stimulation	Production support for offshore facilities (acidification, fracturing, cementing or sand control support)	Transportation Supply and External Fire Protection
6	Crew boat	Shipping of Personnel by Sea	Transportation supply (some ships have)
7	MPSV	Underwater operation support and hoisting	Transportation supply, external fire protection, diving support, transshipment of personnel at sea

## V. OSV SHIP TYPE CHARACTERISTICS

### A. Multi-Function and mUlti-purpose

OSV ships generally have many functions, such as platform supply, guardianship, rescue, external fire protection, oil spill recovery and so on. They can complete a variety of tasks. According to the different main functions, OSV can be subdivided into many different ship types, but their common characteristics are multi-function and multi-purpose.

### B. Small Tonnage and High Power

Compared with ordinary cargo ships, OSV ships are smaller in size and tonnage. The captain of OSV ships generally does not exceed 100m and tonnage does not exceed 10000 gross tonnages. However, the power of OSV mainframe is generally large, and it is equipped with super-high power device to meet the need of towing large-scale oil platform.

### C. High-precision Dynamic Positioning Capability

According to the special requirements of offshore engineering operation, most of OSVs have dynamic positioning capability. With large thrust bow side thrust device and full

rotary rudder and propeller device, high precision positioning can be achieved in offshore operation. The maneuverability of OSVs is much higher than that of common cargo ships.

### D. Good Wind and Wave Resistance

In order to meet the needs of deep-sea operations under harsh sea conditions, OSV ships usually have good wind and wave resistance, and can achieve safe navigation and operation under harsh sea conditions (12-level wind, 14-meter wave).

## VI. CONCLUSION

There are 292 OSV ships in China, which belong to 40 companies. CNOOC is the largest two OSV ship operators in China. The two companies account for 70% of the domestic OSV market.

OSV ships serve domestic coastal offshore facilities, including drilling platforms, FPSO, etc. In the future, with the development of offshore oil resources in China, the OSV ship market will be further expanded.

OSV is a special type of ship with the characteristics of both transport ship and engineering ship. It has many functions such as platform material transportation, personnel transshipment and oil field support operation. Its maneuverability and wave resistance are far superior to those of ordinary cargo ships, and it has the ability of safe transportation and operation in high sea conditions.

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