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Analysis of the Formation Mechanism of Competitiveness of Shipbuilding Industry in China

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Abstract
The paper based on the analysis of the competitiveness of existing shipbuilding industry, China's shipbuilding industry competitiveness can be divided into potential competitiveness and dominant competitiveness, by diamond model and causal analysis paradigm. Potential competitiveness formed by 5 indicators, demand for production factors, status, and the ancillary industries, industrial organization structure, and government policy; dominant competitiveness show as the shipbuilding's market power. Combined with the present situation of China's shipbuilding industry development, the paper will analysis the formation mechanism of shipbuilding industrial competitiveness in China using the data collected by questionnaire survey, based on structural equation model.

Key words: Shipbuilding industry; Competitiveness; Formation mechanism; Structural equation model

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INTRODUCTION
Current, the research focused on the core competitiveness recognition, influence factor analysis, the construction of the evaluation index, selection of evaluation method and cultivation of competition strategy, and many other aspects. Evaluation methods of industrial competitiveness mainly include factor analysis, AHP, fuzzy comprehensive evaluation method and so on (Liu & Tan, 2011).

By building model and statistical analysis, studies the influence factors of concrete industry core competence and its correlation and causal relationship between them, find out advantages and disadvantages of the industry core competition and put forward some strategies and paths to improve the core competitiveness (Wu, 2009).

1. THE DEVELOPMENT SITUATION OF SHIPBUILDING INDUSTRY
Before the 1980 of the 20th century, China's shipbuilding enterprises build domestic shipping as the main shipbuilding production, and the quantity was small, modest share in the world shipbuilding industry. After the 1990 of the 20th century, with the deepening of the reform of market orientation, not only the shipbuilding industry in china gradually integrated into to world markets, but also by introducing foreign advanced technology and management experience, large-scale production equipment can be realized and rationalization, In order to conform with international, strive to improve the design, production technology, product quality, after sale service and other requirements. The production efficiencies had improved; achieve the goal of rapid development of China's shipbuilding industry. In recent years, China's shipbuilding industry's share of the world market has increased rapidly to become the world's largest shipyard.

1.1 The Share in International Market
In 2008, Chinese new ship orders accounted for the world total share of 35.26%, more than Japan, become the world's second largest shipbuilding country. In 2009, the Chinese ship industry has achieved rapid development, new ship orders accounted for 61.63% of the world, surpassing Korea for the first time, to become the largest

shipbuilding country in the world. And in the past several years have been ahead of South Korea, orders remain above 40% of the world total. The data show that, Chinese shipbuilding competitiveness has improved significantly, and has an unshakable position in the international market since 2008.

At the same time, comparing the number of new ship orders that China undertaken from 2008 to 2013 can be found that: since 2009, by the influence of the international shipping market downturn, China's new ship orders have fallen sharply, Shipping enterprise faced with crisis of capacity. In the international market China's share has declined, but Japan's share has sharply risen, which shows that in the face of the crisis, China's shipbuilding industry competitiveness is not strong.

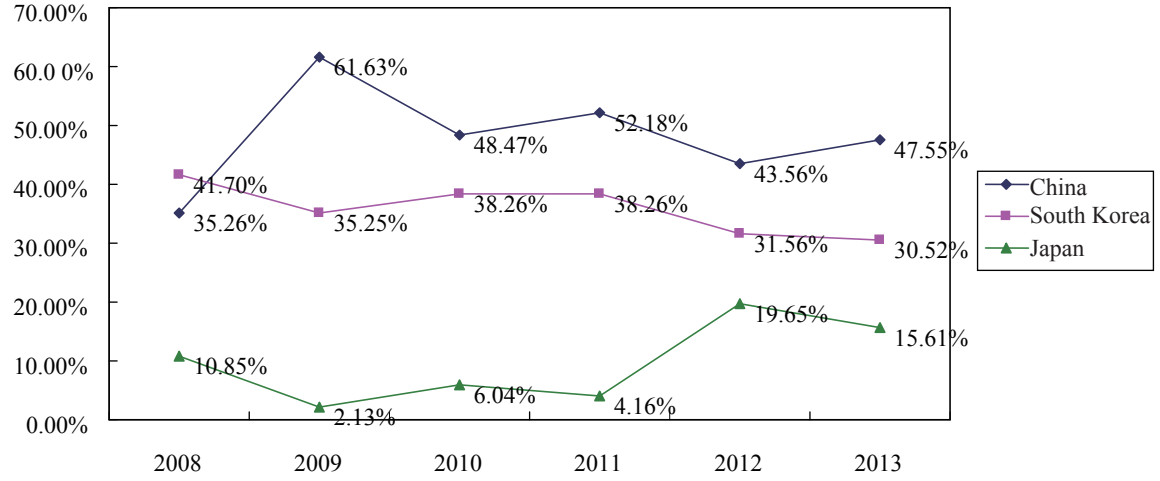

Figure 1
New Ship Orders for Share of China, South Korea and Japan from 2008 to 2013

1.2 Product Structure

At present, the ship type that Chinese shipping industry can build mainly includes chemical ships, liquefied petroleum gas (LPG) ship, container ships, offshore oil platform, and other 11 categories, more than 100 kinds of ship type (Xu & Zhao, 2009). By introducing and absorbing advanced technology, at present oil tanker, bulk carrier and container ship in China are three mainstream ship types which have high competitiveness in the international market. China has developed a series of independent brands, such as "China jiangnan type", "Chinese hudong zhonghua", and also can build all kinds of Marine engineering equipment (Zhou, 2007).

In 2012 the output of China's three mainstream ship types in the three main indexes are shown in Table 1.

Table 1
Output of China's Three Mainstream Ship Types in 2012

Ship type	Output		New orders		Handheld orders	
	M.DWT	Percentage(%)	M.DWT	Percentage(%)	M.DWT	Percentage(%)
bulk carrier	5606.7	72.9	2708.2	68.2	15031.7	68.2
container ship	177.9	2.7	423.5	11.4	1283.1	8.4
oil tanker	1070.5	13.9	357	9	2526.8	16.4

From Table 1 we can see that, the three ships' output, new orders and handheld orders accounted for 89.5%, 88.6%, and 93% in the international market. The three types is the mainstream type fore China, they have strong competitiveness in the international market, especially bulk carrier, which has the absolute advantage in the three major types.

At the same time, because the product structure of Chinese shipbuilding industry is single and high additional value ship is less, once the demands of the three ships have taken pace in large changes, Chinese shipbuilding enterprises will face huge risks.

1.3 Scale of the Enterprise

In 2011, the number of Chinese shipbuilding enterprises has above 1,550 which scale included in the statistics, these enterprises are located in China along the Yangtze River, the coastal areas. In point of the enterprise scale, in 2011, the proportion of large, medium and small shipbuilding enterprises accounted for 8.1%, 20.8%, 71.1%, respectively. Compared to 2009 and 2010, the total number of shipbuilding enterprises decreased significantly, and the number of large shipbuilding enterprises increase, making the large shipbuilding enterprises number ratio increased obviously; Table 2 indicates that, the China

shipbuilding enterprises are mainly dominated by small and medium-sized companies, and less of large shipbuilding enterprises. The number of small businesses in 2011 reduced sharply, this phenomenon maybe says the crisis for Chinese shipping market continues, and has affected the survival of small ship enterprise.

Table 2
The Number of Large, and Small Shipping Companies in China

	Large enterprises		Medium enterprises		Small enterprises		Total	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
2009	56	2.8%	234	11.6%	1730	85.6%	2020	100%
2010	67	3.1%	262	12%	1850	84.9%	2179	100%
2011	125	8.1%	322	20.8%	1103	71.1%	1550	100%

2. SET UP A SET OF SCIENTIFIC INDEX SYSTEM TO ANALYSIS THE SHIPPING INDUSTRY COMPETITIVENESS

2.1 Review of the Literature

Since the 1990s, with the development of international shipbuilding industry, research on the competitiveness of shipbuilding industry also began to rise in domestic and foreign countries, mainly about the factors influencing the competitiveness of shipbuilding industry and evaluation of the competitiveness.

These researches have a variety of different angles, combing inductive the research achievements of scholars, who such as Goff, Yamaoka, Chorales (1990), Surer N Dived (2002), Brodda (2004), Rashwan and Naquib (2006), Sasaki and Sonda (2007), Ke (2006), Li (2007), Li, Han, and Zhang (2003), Liu and Wang (2010) and so on, research direction mainly includes: Production factors, demand conditions, supporting industries, the industrial organization structure and. Literature summarized is in Table 3.

Table 3
Effect on the Competitiveness of Shipping Industry

Factors	Evaluation index
Production factors,	The natural geography resources, labor resources, enterprise scale, infrastructure and equipment level, financing capability, human resources
Demand conditions	International demand, domestic demand (expansion of shipping requirements, update requirements, marine engineering requirements)
Auxiliary industry	The supporting industry, steel industry, shipping industry, electronic industry
The industrial organization structure	Technical level, price, cost, after-sales service, profitability, earnings, financing capacity, industry concentration
The role of government	Policy support from government and industrial, education for related professional, levels of laws system, maturity of the industry association

2.2 The Establishment of the Evaluation Index System of the Competitiveness for Shipbuilding Industry

Based on the principle of objectivity and scientific, according to the basic contents of the competitiveness of shipbuilding industry, from porter's diamond theory model, this paper established the evaluation index system of the competitiveness of shipbuilding industry. Considering the evaluation of the feasibility and some difficulties in data collection, the paper selects 23 indicators (Table 4).

Table 4
The Evaluation Index System of the Competitiveness for Shipbuilding Industry

Competitiveness	Level indicators (latent variable)	Secondary index (display variable)	Number from
Dominant competitiveness	Shipbuilding's market power	New orders	Questionnaire
		Output	Questionnaire
		Handheld orders	Questionnaire
Potential competitiveness	Production factors,	Geographical conditions	Questionnaire
		Coastal	Questionnaire
		Infrastructure	Questionnaire
		Labor quality	Questionnaire
	Demand conditions	International demand	Questionnaire
		Domestic shipping market requirements	Questionnaire
		Update requirements	Questionnaire
		Ship engineering requirements	Questionnaire
	Auxiliary industries	Supporting industry	Questionnaire
		Steel industry	Questionnaire
		Electronic industry	Questionnaire

To be continued

Continued

Competitiveness	Level indicators (latent variable)	Secondary index (display variable)	Number from
Potential competitiveness	Industrial organization	Gross output value of industry	Questionnaire
		Total profit	Questionnaire
		Number of enterprises	Questionnaire
		Management level	Questionnaire
		Industry concentration	Questionnaire
		Investment in research and development	Questionnaire
	Supporting of government	Level of government support	Questionnaire
		Levels of laws system	Questionnaire
		Investment in education	Questionnaire

3. BUILD THE FORMATION MECHANISM MODEL OF CHINA'S SHIPBUILDING INDUSTRY COMPETITIVENESS BASED ON THE STRUCTURAL EQUATION MODEL

3.1 Research Hypothesis

Combined with this construction of the shipbuilding industry competitiveness analysis index, this study puts forward the following research hypothesis, thus building research block diagram, as shown in Figure 2.

H1: Factors of production inputs have a positive influence on shipbuilding market share;

H2: The demand of ship has a positive influence on shipbuilding market ability;

H3: Auxiliary industries have positive effects on shipbuilding market share;

H4: Industrial organization has positive effects on shipbuilding market share;

H5: Government support has positive effects on shipbuilding market share;

H6: Demand has a positive influence on auxiliary industries;

H7: Government support has a positive influence on auxiliary industries.

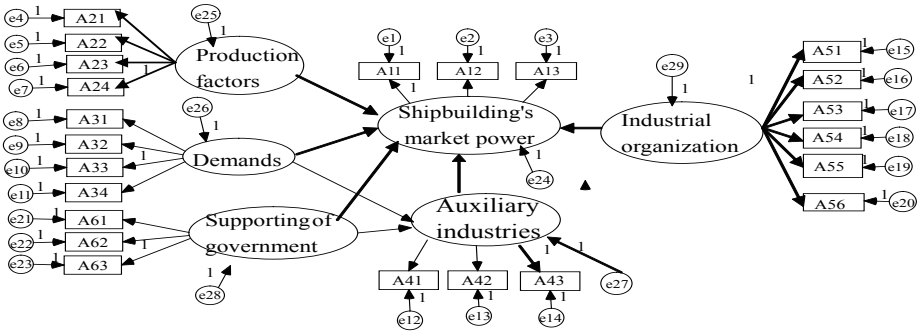

Figure 2
The Framework of Research Hypothesis

3.2 Empirical Analysis

3.2.1 Reliability Analysis

This paper analysis the internal consistency of the questionnaire survey by the Cronbach alpha value, and then analysis the influence of each item to CITC value of operating variables.

Table 5
The Reliability Analysis of Industry Competitiveness Index

Nominal variable	Operating variables	CITC	Alpha if item deleted	Alpha
Shipbuilding's market share	A11	.739	.863	.883
	A12	.780	.827	
	A13	.802	.807	
Production factors	A21	.745	.839	.876
	A22	.702	.854	
	A23	.727	.844	
	A24	.768	.826	
Demand conditions	A31	.660	.797	.837
	A32	.567	.835	
	A33	.802	.733	
	A34	.668	.800	

To be continued

Continued

Nominal variable	Operating variables	CITC	Alpha if item deleted	Alpha
Auxiliary industries	A41	.873	.914	.940
	A42	.904	.889	
	A43	.847	.933	
Industrial organization	A51	.810	.771	.925
	A52	.811	.813	
	A53	.767	.913	
	A54	.838	.903	
	A55	.770	.912	
	A56	.700	.921	
Supporting of government	A61	.587	.718	.774
	A62	.589	.724	
	A63	.659	.646	

From Table 5, CITC values of all operating variable are greater than 0.5, and Alpha values of the nominal variable greater than 0.6,and delete each operating variable will cause the whole nominal variable Alpha is reduced, this indicates that the action variable internal consistency is better, shall be retained.

3.2.2 Validity Analysis

Validity analysis is mainly used to test consistent between the measurement results and the purpose of the study, the extent to which the difference of measurement data and the ideal value.

The first step is to examine standardization factor loading coefficient of each latent variable, load value should be > 0.5, which means that the common variance between item and its variance is greater than between item and error variance, all the load values are significant.

Table 6
Rotated Component Matrix by Varimax

Variables	Rotated component matrix					
	Shipbuilding'smarket share	Production factors	Demand conditions	Auxiliary industries	Industrial organization	Supporting of government
A11	.098	.190	-.062	.279	**.808**	.092
A12	.060	.243	.146	.227	**.825**	.037
A13	.031	.243	.092	.243	**.835**	-.033
A21	.045	**.814**	.180	.059	.215	.030
A22	.025	**.818**	.115	.037	.119	.035
A23	.041	**.833**	.054	.068	.159	.010
A24	-.057	**.869**	-.041	.115	.101	.095
A31	.042	.043	.043	**.721**	.411	-.117
A32	.048	.121	.381	**.672**	.162	.036
A33	-.035	.114	-.017	**.901**	.161	-.033
A34	.041	.038	-.031	**.823**	.140	.200
A41	.075	.086	**.919**	.055	.013	.083
A42	.102	.155	**.930**	.027	.052	.067
A43	.027	.034	**.866**	.085	.070	.189
A51	**.869**	-.008	-.031	.041	.137	.088
A52	**.860**	.044	.018	.021	-.017	.184
A53	**.839**	.065	.024	.077	-.079	.113
A54	**.879**	.022	.094	.031	-.025	.147
A55	**.826**	.019	.068	-.041	.077	.131
A56	**.752**	-.072	.109	-.029	.133	.183
A61	.284	.053	.294	.015	.092	**.695**
A62	.229	.093	.102	.047	-.095	**.782**
A63	.263	.024	.032	.035	.088	**.830**

From the Table 6, each measuring variables converge to its own operating action variables, latent variable interpretation of the item variants that are more than 0.6, and the load on the other factors are less than 0.5, indicating that the scale has good convergent validity and discriminate validity.

The second step is to examine the average variance extracted (AVE value). AVE value should be greater than 0.5, which means that the variance of more than 50% observed variables are explained, structured variables have good convergent validity.

Table7
Validity Analysis of Scale Validity

Nominal variable	Operating variables	Standard factor loading	AVE	KMO
Shipbuilding's market power	A11	.798	0.71	0.88
	A12	.858		
	A13	.870		
Production factors	A21	.753	0.532	0.819
	A22	.655		
	A23	.757		
	A24	.747		
Demand conditions	A31	.789	0.538	0.823
	A32	.625		
	A33	.834		
	A34	.697		
Auxiliary industries	A41	.834	0.519	0.809
	A42	.800		
	A43	.753		
Industrial organization	A51	.834	0.609	0.903
	A52	.829		
	A53	.747		
	A54	.834		
	A55	.738		
	A56	.691		
Supporting of government	A61	.714	0.538	0.777
	A62	.738		
	A63	.749		

In Table 7, the value of standard factor load for each measurement observation item between 0.625 to 0.870, were greater than 0.5; the KMO value of various factors were greater than 0.6; AVE values were greater than 0.5, which showed that the index variables can explain potential variables in the high degree. Therefore, the scale has good validity.

3.3 Hypothesis Test and Data Analysis

The foregoing analysis results showed that all potential variables in this study have reached the critical value of reliability and validity conform to the requirements of structural equation model. A structural equation model of this study is shown in Figure 3. And potential variables are represented by ellipse, observed variables are represented by rectangles.

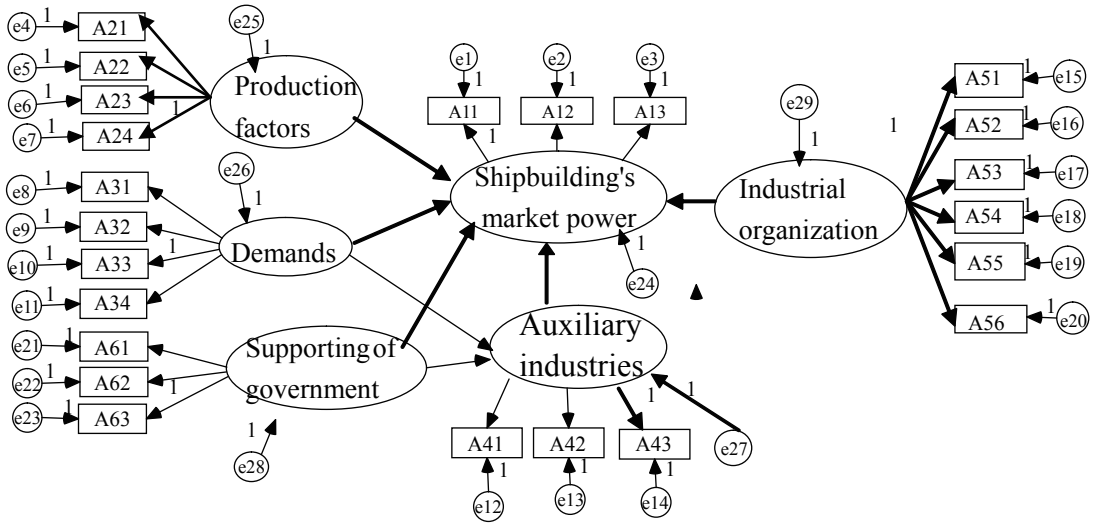

Figure 3
Initial Model

3.3.1 Initial Estimates of the Model

We test the hypotheses of structural equation model with AMOS17.0 by using maximum likelihood estimation to operate. The path coefficient estimation and inspection results as shown in Table 8.

Table 8
Path Coefficient of the Initial Model

Variable relationship	Standardized path coefficients	*P*
Auxiliary industries <--- Demand conditions	.269	***
Auxiliary industries<--- Supporting of government	.628	***
Shipbuilding's market power<--- Auxiliary industries	.224	.024
Shipbuilding's market power <--- Production factors	.349	***
Shipbuilding's market power <--- Demand conditions	.472	***
Shipbuilding's market power --- Supporting of government	.420	***
Shipbuilding's market power <--- Industrial organization	.348	.014

Note: *** $p<0.001$, ** $p<0.01$, * $p<0.05$

From Table 7, all assumptions can pass the test of significance. These show that the construction of the initial model is correct.

3.3.2 The Goodness of Fit of the Model

Table 9
Model Fitting Index Recommended Value and Actual Value

Statistics	GFI	RMR	CFI	NFI	AGFI	χ^2/df
Recommended values	>0.9	<0.1	>0.9	>0.9	>0.5	<5
Actual values	0.833	0.071	0.916	0.838	0.794	1.875

Table 9 lists the indicators reflecting the goodness of fit of the initial model. GFI & NFI have not reached the critical value of 0.9 requirements, but more than 0.8, the difference was not especially large. It can be seen from the comparison of recommended values and actual values of the model that the model fits the sample data fairly well.

3.4 Research Results

In this paper, the results of research hypothesis verification as shown in table10, all assumptions are supported by sample data.

Table 10
Hypothesis Testing Results

Hypotheses	Results
H1: factors of production inputs have a positive influence on shipbuilding market share;	Support
H2: the demand of ship has a positive influence on shipbuilding market share;	Support
H3: auxiliary industries have positive effects on shipbuilding market share;	Support
H4: industrial organization has positive effects on shipbuilding market share;	Support
H5: government support has positive effects on shipbuilding market share;	Support
H6: demand has a positive influence on auxiliary industries;	Support
H7: government support has a positive influence on auxiliary industries;	Support

According to the results of the research hypothesis testing results, the paper obtained the final theoretical model of this study, as shown in Figure 4.

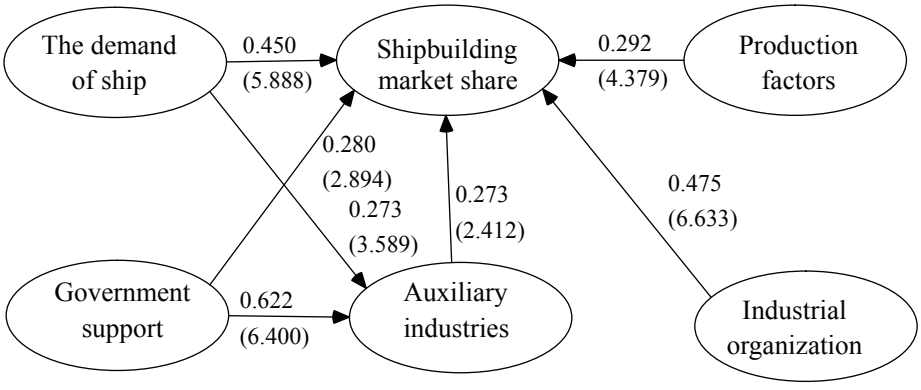

Figure 4
Final Model

In Figure 3 standardized path coefficients and t values are indicated. Through the figure we can be seen that the *t* value are high among 7 hypotheses, the minimum value is 2.412, and the standardized path coefficient of reached 0.05 significant level. All hypotheses received support.

4. ANALYSIS OF THE FORMATION MECHANISM OF SHIPBUILDING INDUSTRIAL COMPETITIVENESS IN CHINA

Through the research results, it is found that the formation mechanism of shipbuilding industrial competitiveness in China mainly consists of the following 5 aspects:

First, Inputs of production factors had a direct role in the competitiveness of the shipbuilding industry. In these countries which economic environments are more advanced, the quality of employees is relatively high in their shipbuilding industry, it plays an important role in improving the competitiveness of shipping industry. The more developed of infrastructure, the lower production costs, and it has certain effect to improve the shipbuilding industry competitiveness.

Second, the demand situation has a direct effect on the competitiveness of shipping industry, and in all factors, and its role is second only to industrial organization structure. The development of shipping market will make a lot of upgrade shipping demand for domestic and international shipping; it also will prompt a rapid development of China's shipbuilding industry.

Third, auxiliary industry plays an assistance role in enhancing the competitiveness of the shipbuilding industry. In the process of ship construction, it needs assist from corresponding supporting industries. The development of ship supporting industry and steel industry plays a role in improving the localization rate of China's ship products, greatly reducing the cost of the product, and improves the economics of the ship, then can ensure the achievement of the project objectives.

The development of electronic information industry helps to promote the management mode of shipbuilding enterprise, systematic, raise the work efficiency, and enhance industrial competitiveness. Development of electronic information industry is conducive to the development of the management information and systematization mode, and also will enhance the productivity of ship enterprises, so as to enhance the industry's competitiveness.

Forth, the change of industrial organization structure significant effect to the promotion of the ship industry competitiveness, and in the action is the biggest of all the affect factors. Industrial areas with high concentration of large shipping companies more, have the ability to dominate the shipbuilding market, are conducive to play the scale economic benefit, technical innovation ability, has a strong role to upgrade the industry. With the development of shipbuilding industry, industrial organization structure will continue to strengthen in the future.

Fifth, government supported has a direct or indirect effect on upgrading the competitiveness of the shipbuilding industry. Government support for shipbuilding enterprise development, industry associations and research investment can make the ship enterprises get support in technology and management. They can promote the reform and innovation of enterprises; enhance the competitiveness of enterprises, thereby enhancing the competitiveness of the whole region and the whole industry.

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