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Research on the enterprise credit rating of container lines

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Research on the Enterprise Credit Rating of Container Lines

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Declaration

I certify that all the material in this research paper that is not my own work has been identified, and that no materials are included for which a degree has previously been conferred on me.

The contents of this research paper reflect my own personal views, and are not necessarily endorsed by the University.

Zhu Qiuyi
2017-07-20

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Abstract

Credit rating is the product of the development of market economy; it occurs and grows with the development of market economy. Credit rating originated from the United States in 1890 and then spread to Europe and Asia. Enterprise is the main part of market economy, and enterprise credit is the foundation of the development of the whole social credit system. In this thesis, in the context of the shipping industry credit system is waiting to be established, introducing credit assessment to the shipping industry and establishing the operating condition rating index system of container lines, which will play an important role in the shipping industry.

This thesis has three parts: First, the thesis has explained the meaning of credit risk and credit rating. And the researcher analyzes the present situation and future trend of container lines, in order to show the necessity of the credit rating of container lines. Then, on the basis of five aspects: quality of enterprise, capital credit, corporate reputation, innovation ability and operation level, the researcher will establish rating index system of container lines operating condition. Using Analytic Hierarchy Process (AHP) to establish the rating model and apply it to the case study (rating for COSCO Shipping, Maersk and OOCL). Comparing and analyzing the result of the case study with the rating result of Drewry. Finally, making the conclusion and summing up the shortcomings of the system.

Through this thesis, I hope the new rating system could help the establishment of container lines credit assessment.

Key words: credit rating, container lines, operating condition, AHP

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1. Introduction

1.1 Background

In September 2016, one thing that shipping industry and the world business would have to say was the bankruptcy of Hanjin Shipping (In the following content the researcher will abbreviate Hanjin Shipping as HJ Shipping). As the world's seventh largest shipping company, HJ Shipping collapsed suddenly and this has brought continuous influences during September. There are some influences as follow:

a) The vessels of HJ cannot have port operation normally. A large number of goods stranded on the ship and the owner was busy in resourcing or changing the booking channel.
b) Because the ship of HJ suspended, some of the routes have appeared capacity shortage. The shipping companies have busy with dispensing extra flights.
c) Because HJ Shipping owned ship companies and ship funds a large number of rent, part of the fund is facing bankruptcy risk chain and they are busy with self-help;
d) Banks, ports, terminals and other major creditors were arresting the ships in order to obtain compensation. (Ping, 2016)

The direct cause of bankruptcy is the capital chain rupture, but the reason behind it is the long-term downturn in the freight rate, a sharp decline in revenue and the capital flowing day by day. The shipping industry is a typical capital intensive industry, which debt level is higher than other industries. In that case, cash flow guarantees the basic operation of the shipping company. Although the shipping company has significantly reduced the cost, it still cannot keep up with the pace of decline in freight rate. In this context, the bankruptcy of HJ Shipping seems to be inevitable, but actually there is another reason for their bankruptcy, which the researcher thinks is the main reason: the confusion of shareholders and improper management. Since the original HJ president Zhao Xiuhao dead in 2006, his widow——Cui Enying served as president of HJ Shipping. Until 2014, Cui Enying

was unable to provide financial support for HJ shipping and the control had passed to Korean Air. In recent year, HJ Shipping heavy loosed a lot after suffering Global transportation downturn. Their debt rate was seriously high and the stock fell. Although Korean Air gave the financial support to HJ Shipping, the situation has become worse and worse. HJ Shipping which had difficulties in the operation did not get enough support from Cui Enying and Hanjin group and this is the reason why the creditors, KDB as representative, were not willing to continue investing in HJ Shipping. HJ Shipping has always been hard to struggle in the past few years, but the operation situation didn't achieve substantial improvement. Service coverage and the need for a variety of ship updates have not kept pace with the pace of industrial development, the nonfeasance and management turmoil of the shareholders which are related to the confusion of the shareholders and their omission.

The impact of bankruptcy of HJ Shipping is far more than its own. It has caused a substantial blow to the global maritime industry and shook the entire industry chain. Because there is no warning mechanism and rating system for Hanjin Shipping, the customer cannot prevent the situation. In that case, people can see that the turbulence of liner shipping has a great impact on the shipping industry. Inspired by this event, the researcher decides to establish a rating system for container lines to change this situation.

1.2 Research purpose

The purpose of dissertation is to research on the rating of liner shipping operation state. The researcher can create a model to analysis the management condition of container lines, and then give them a credit rating. Customers can make decisions according to the credit rating. If the liner companies have poor performance in the rating, they can make decisions in advance which can reduce the loss.

Credit is the inevitable outcome of socioeconomic development. The development and maintenance of credit relationship is an important prerequisite to protect the

social economic order. After comprehensive understanding the container lines, the professional institution or department will make the credit assessment of the reliability and safety and express as a special symbol or a simple text.

Credit rating methods have different classification, such as qualitative analysis and quantitative analysis method, the subjective rating method and objective rating method, factor analysis and comprehensive analysis, fuzzy mathematics rating and financial ratio analysis and so on. However, most of these are just focus on the financial situation. In the shipping market, focusing on the financial situation is too unilateral. On this basis, the researcher would like to build a credit rating system which assesses container lines from many factors comprehensively, mainly focus on their state of operation. Then, the researcher will use a new credit rating model to rate China COSCO Shipping Lines, OOCL and Maersk as case studies.

In 2016, the Shipping Research Institution Drewry has released a credit risk rating of 12 shipping company. In this ranking, China COSCO shipping is rated as at a moderate risk, OOCL and Maersk lines have great rating results, but actually the Central People's government is directly responsible for China COSCO shipping, which means this is a large central enterprise. In my opinion, the result of Drewry is not quite right. In that case, the researcher will compare the result with the new model's and Drewry's. Then, the researcher will modify the system to make it more comprehensive.

1.3 Research methodology

In order to build a comprehensive rating system for shipping market, first, after reading a large number of literatures and consulting experts and combine with AHP, the researcher will construct an index system preliminarily. Then the researcher will use weighted average method to do the credit rating for the company. However, this new credit rating system is not the general sense of credit rating. The researcher will consider many factors and not just focus on the financial aspect.

1.4 Literature review

There are many researchers have paid attention to the shipping market's credit problems since decades ago. Researchers have studied lots of topics about the credit rating problems in the market. Now the researcher will find some literatures from five aspects:

- ✓ The views on credit rating
- ✓ Factors related to the credit rating
- ✓ Views on credit rating in shipping market
- ✓ Credit rating models in shipping market
- ✓ Different credit rating models in different fields

Then the researcher would present the existing problems have found from these literatures.

1) The views on credit rating

Robert J. Rhee (2015) has explained the reason why the rating agencies exist. The author said these agencies classified the information in the credit market. Although they did not provide new information, this sorting function was necessary. It could help investors to analysis the company then wanted to invest.

Lai, Yun(2013) has analyzed whether the rating information of the major credit rating agencies has enlarged the market volatility. The main measurement of this paper was Speculative Market Pressure (SMP) index. By using ordinary least squares (OLS) analysis, the credit rating information provided the market fluctuation forecast information, especially the upgraded rating changes rather than downgraded ratings.

Yintao Lei (2016) analyzed the characteristics of medium-sized enterprises credit rating, the system construction and the countermeasures to improve the quality of small and medium-sized enterprises. The author thought the credit rating method in small and medium-sized enterprises; the qualitative analysis method had relatively large proportion.

Zhou Jia (2015) thought there are differences between main credit rating agencies and sovereign credit rating agencies. This rating difference was a manifestation of local preferences in sovereign credit ratings. And the main factors that leaded to these preferences were political economy, cultural gap and rating procedure itself and so on. The author though it was significant for the development of China credit rating industry.

Xing, Zhan and Ming (2016) thought the bond which was issued by a high reputation credit rating agency would have a higher quality rating. The competition between credit rating agencies increased the rating and reduced the quality of the bond credit rating and the reputation mechanism could inhibit this phenomenon.

2) Factors related to the credit rating

Yanwei Chen (2014) has studied the relationship between credit rating and audit fee. The author found that a low credit rating company would have higher audit fees. The downgrade of credit is related to the increase of audit fees, but the upgrade of credit has no obvious influence on audit fees.

Lobo, Paugam, Pierre and Astolfi (2017) have analyzed the data which was rated by Standard and Poor's during 1986-2012. They found that financial market cycles and business are two factors that influenced the credit rating agencies. Credit rating was proportional to these two factors.

Darren J. Kisgen (2006) has examined that the capital structure decisions could influence the extent of credit ratings. Enterprises which have upgrade or downgrade in credit rating would issue less debt.

Corre, Lee, Sapriza and Suarez (2014) found that the companies would receive stronger financial support from the governments when they had negative effect on bank stock returns in credit rating downgrade. Because the government would support them well, this result was more favorable for the banks which were in advanced economies.

Gu Tingfang (2011) discussed the risk management strategy of shipping enterprises under the background of exchange rate.

Han, Liu and Wen (2015) found that government supervision department regulated on corporate bonds strictly and standardized enterprises behavior in the bond issuance process which made the information of the enterprises more reliable and also improved the information content of bond credit rating. The increase of intervention level of the government regulatory agencies could make the credit rating more standardized.

Chen Wenjuan and Chen Hanwen (2016) have proved that the characteristic and quality of audit committee would influence the credit rating. The study found that the better quality of audit committee, the scale of it was bigger. The higher independence the audit committee members and the more professional the commissioner accountings was, the better credit rating the company had.

3) Views on credit rating in shipping market

Wang and Yu (2013) thought with the continuous combination of new internet technology and the rapid development of the shipping industry, shipping e-commerce platform had developed rapidly. When the electricity platform helps shipping enterprises to improve transaction efficiency, increase the number of orders, it also increases the default risk and the difficulty of credit review. In order to further strengthen the credit construction of shipping enterprises, the authors proposed to improve the shipping enterprise credit system, express reward and punishment measures clearly, improve and perfect the customer management system and reduce the risk of default.

Funmi Afonja (2011) warned that in the next future, when new rules of green shipping, such as low sulfur fuel rules and ballast water requirements, was established, these rules will bring some negative impact on the credit rating for shipping companies, especially those enterprises whose credit rating is B or lower and with limited funds. She pointed out that meeting the new rules may increase the borrowing cost of the low credit company which would further damage their bad credit that they already had. Also, these credit rating agencies had a negative impact on their rating.

Ling Zhizhong (2011) put forward a set of shipping enterprise risk assessment

method, and he explained the problems that people should pay close attention in the risk assessment process.

4) Credit rating models in shipping market

Chen Shun (2004) examined a credit rating system of liner shipping enterprise. He thinks that China's credit rating is in the initial stage. When the credit rating system of the shipping industry has yet to be established, the researcher can establish a liner shipping enterprise credit rating index system which is based on four aspects; there are management qualification, enterprise quality, reputation and reputation of operating performance. On the basis of these influencing factors of credit rating of liner shipping enterprises, author combined AHP and fuzzy comprehensive evaluation to create an evaluation model which is very important to the shipping industry.

Xu Si (2011) thinks shipping industry is a high capital investment, low return and high risk industries. The shipping industry is in the recovery state. Many small and medium enterprises in China desperately need funds for their own development. Then these enterprises which sources of funds are loan were facing the low credit problems. The author analyzed the impact of the credit rating index system on the financing of small and medium shipping enterprises and she suggested the shipping companies to improve their own quality to change their credit rating, then they could improve the financing difficulties problems.

Zhang Hong (2007) studied the early warning index system and the model of customers of shipping companies. The author built a simply and useful warning index system with the sensitivity index, cash flow ratio and the early warning index. Zhang researched the theory and method of customer credit evaluation and early warning for shipping enterprises. He also provided the scientific evaluation of the customers ‘credit of the shipping company and the corresponding measures.

Wang and Xie (2013) professionally explained all the risks of shipping finance practice business on the basis of theory and practice. Combining with the global accident data, the author calculated the evaluation index weight, so as to build a risk assessment and analysis model.

Zhang Wei (2006) explored the quantitative methods of shipping enterprises in credit evaluation to help shipping companies to overcome their own credit risk by analyzing the existing credit evaluation methods and the shipping enterprises credit risk. Also, the author provided an analytical tool for the whole process of enterprise credit management and tried to establish a credit management system in line with its own characteristics.

5) Different credit rating models in different fields

Xu Zunwu (2014) thought the global financial crisis had brought new credit risk and problems and the traditional method of credit risk management had been unable to meet the needs of the new situation. The prior credit risk identification tools for enterprises had limit act on the actual risk control. The author used the enterprise credit risk identification model to study the credit risk of the enterprise from the market volatility. When the market volatility is large or the market continues to slump, the probability of generating the credit risk will be larger and vice versa.

Bertrand Hassani and Xin Zhao (2015) had presented a new rating method for corporations. It was combined with annual accounting ratios and daily credit derivative spreads by an approach which was in two steps to adjust the credit risk of the enterprises. This method was better than the general approaches in the external agencies, because it could integrate the short-term and the long-term data of credit in the company.

Karolik and Anatoli (2006) have proposed a different approach that estimating the data from the joint default distribution. This default dependence structure was consistent with the dynamics of credit migrations. This model was very useful in practice.

He Bo (2015) created a model which estimated the data of subprime mortgage backed securities from 2004.1-2008.10 and examined the impact of credit rating agencies on the impact from the peer agencies. The author had found that choosing two agencies could have complementary effect. Also, he found the effect of peer agencies had little impact on AAA bonds and lower-rating bonds, then increased a lot

for medium rating bonds.

Mou and Yuan (2016) by considering the integration of three aspects: enterprise business, information technology and mathematical model to combine big data and large calculation. On this platform, by combining the actual data, the authors used logical regression model fro credit rating. This new credit rating model could distinguish different customers' credit quality.

Thomas Fischer (2015) introduced a model in a dynamic framework which rating both agencies and bond issuers are of heterogeneous quality. Rating agencies can use expensive research techniques to reveal the underlying nature of bond issuers and engage in rating smoothing. In the study, it shows rating smoothing can compensate for the low quality of the research, even though it is accompanied by a deterioration in the quality of the rating market and market clustering.

Michael Doumposa, Dimitrios Niklisa, Constantin Zopounidisa and Kostas Andriosopoulosc (2015) describes a multi-criteria classification method that combines the structural default prediction model of accounting data to obtain improved prediction and test the incremental information provided in this case. The analysis of the case during 2002 - 2012 shows that the distance from the default measure obtained from the structured model increases significantly compared to the popular financial ratios. However, its strength is significantly weakened when the market value is also considered. The robustness of the results is examined over time, depending on the rating category specification.

Silvia Angilella and Sebastiano Mazz ù (2015) diagramed a situation in which they try to fill the gap through a comprehensive credit risk model ELECTRE-TRI when small and medium-sized enterprises are confronted with many obstacles when they enter the credit market. These barriers increase if SMEs innovate. A small-tri analysis is to achieve a strong operational risk rating of small and medium enterprises. They also carried out a real case study with the aim of describing the multi-objective credit risk model.

Alexander M. and Ella Khromova (2016) developed a reliable model based on the actual use of public information by interested agents, regulators, and banks

themselves. This study relies on the Bankscope database containing information about international bank financial reporting from 1996 to 2011. To fill the gaps in the database, create a MATLAB code. Besides, Standard & Poor's and Moodie are expected to be the most conservative rating agencies, respectively.

Huseyin Oz Turk, Ersin Namib, and Halil Ibrahim Erdalc (2016) discussed the classification and regression trees (CART), multilayer perceptron (MLP), support vector machines (SVM), Bayes Net, and Naïve Bayes, and further made the prediction performance of several artificial intelligence (AI) prediction technology in a heterogeneous sample of sovereign credit rating. The results further show that the predictive performance of the model decreases around the threshold rating, located at the investment level and the speculative level, which is not necessarily the result of the deficiencies of the model.

- **Existing problems**

After learning the literatures above, the researcher can see people have paid attention to the credit problem very early, but there still haven't got an official credit rating system or model for container lines. The credit rating in shipping industries is a demand, but most of the credit rating agencies mainly provide services for banking institution or financial institution. Their credit rating system is not suitable for shipping market.

Then, many recent credit rating agencies only focus on the financial aspect, but the researcher thinks it is too one-sided. The credit rating system should also assess the state of operation and consider the government policy factors.

Recently, the supervisor is carrying out a study which is a part of the national plan. This study is also about how to create a suitable credit rating system for shipping market. This rating system is mainly focus on the rating of liner shipping operation state. The researcher will try the best to make an objective and comprehensive credit rating system.

2. Credit risk and credit rating

2.1 Credit risk

2.1.1 The meaning of credit

The word ‘credit’ derives from Latin in ancient Rome: ‘Credio’, which means trust and reputation. In Encyclopedia Britannica, credit is interpreted as ‘A transaction behavior that a party (creditor or lender) provides money, goods, services, or securities and another party (debtor or borrower) promises to repay within the promised future time.’ In Collection of Words, credit is divided into three parts to explain. a) Appoint people in good faith and use them as trust. b) Keep a promise, keep to the commitment, in order to gain trust of others. c) A special form of value movement that is conditional on repayment.

Credit has two meanings: the category of economics and category of sociology. From a sociological perspective, credit as an ethical constraint, is the convention on ethics which is established between parties involve in social and economic activities and based on honesty and trustworthiness. From an economic point of view, credit is an economic category. It is a unilateral movement of value based on repayment and repayment and interest payment. Also, it is a special form of value movement. In this circumstance, credit is usually regarded as the sale on credit which is caused by the lagging of value exchange. In addition, it is an economic transaction relationship under different time intervals, which is guaranteed by agreement or contract. It is not difficult to se that the credit as a moral category is the basis of all social and economic activities, while the credit in the economic category is used in economic life based on the credit of the moral category. Thus, the researcher put the definition of the former one as generalized credit and the credit that is used to capital borrowing and market trading rules as narrow credit which means people can obtain funds, goods or services without payment. Credit rating mainly aims at narrow credit which emphasizes a

written contract and evaluates it. The credit in the moral category is the constraint of informal system and it usually becomes an important reference in credit rating. (Gao, 2016)

2.1.2 Credit risk

Credit risk is associated with credit activities; as long as there are credit activities, there will be lack of credit, so it will produce credit risk. Credit risk refers to the possibility of loss to the other party due to the failure of one party to fulfill the obligation of compensation in the process of credit transaction, which is also called default risk and risk of break faith. In a credit transaction, if one party intends to deceive the other party or fails to honor an agreement from the beginning of the transaction, the loss to the other party is subjective default risk. This kind of risk caused by malicious deception and moral deficiency and it is also called moral credit risk. For non subjective malicious, because of various other reasons, such as changes in the economic cycle, macroeconomic policy changes and other non subjective reasons, they failure to perform and cause the risk to the other party. This is belonging to non subjective default credit risk. (Li, 2010)

There are four causes of credit risk:

i. Asymmetric information
ii. Legal inadequacy
iii. Credit concept is weak
iv. Macroeconomic factors

According to the subject of risk, credit risk can be divided into enterprise credit risk, financial institution credit risk, personal credit risk and national credit risk. (Gao, 2016)

2.2 Credit rating

2.2.1 The concept of credit rating

There are narrow and general conception of credit rating. The narrow sense refers to the independent third party credit rating agencies access debtors' ability and willingness of repaying debt and use simple symbols to represent the severity of its default risk and loss. The generalized credit rating is an overall evaluation of the ability and willingness of rating objects to fulfill relevant contracts and economic commitments. (Liu&Zhong, 2015)

There have no unified view on the meaning of credit rating, but the content is roughly the same. The following three aspects are included:

a) The basic purpose of credit rating is to reveal the odds of default risk, rather than other types of investment risks, such as interest rate risk, inflation risk, reinvestment risk and foreign exchange risk, etc.
b) The objective of the credit rating is the ability and willingness of the economic entity to perform its obligations or obligations in accordance with the contract as scheduled, rather than the value or performance of the enterprise itself
c) The credit rating is an independent third party with its technical advantage and professional experience, an expert opinion on credit risk of various economic subjects and financial instruments which cannot replace the capital market investors to make investment choices.

2.2.2 Characteristics of credit rating

a) Conciseness: Credit rating reveals the credit status of enterprises by concise monogram, which is a brief tool for evaluating the value of enterprises.
b) Comparability: The rating system of the credit rating agencies makes the enterprises under the same standards in the same industry, thus showing the credit standing of the enterprises in the same industry
c) The generalized service objects: In addition to the self rating of the rating object

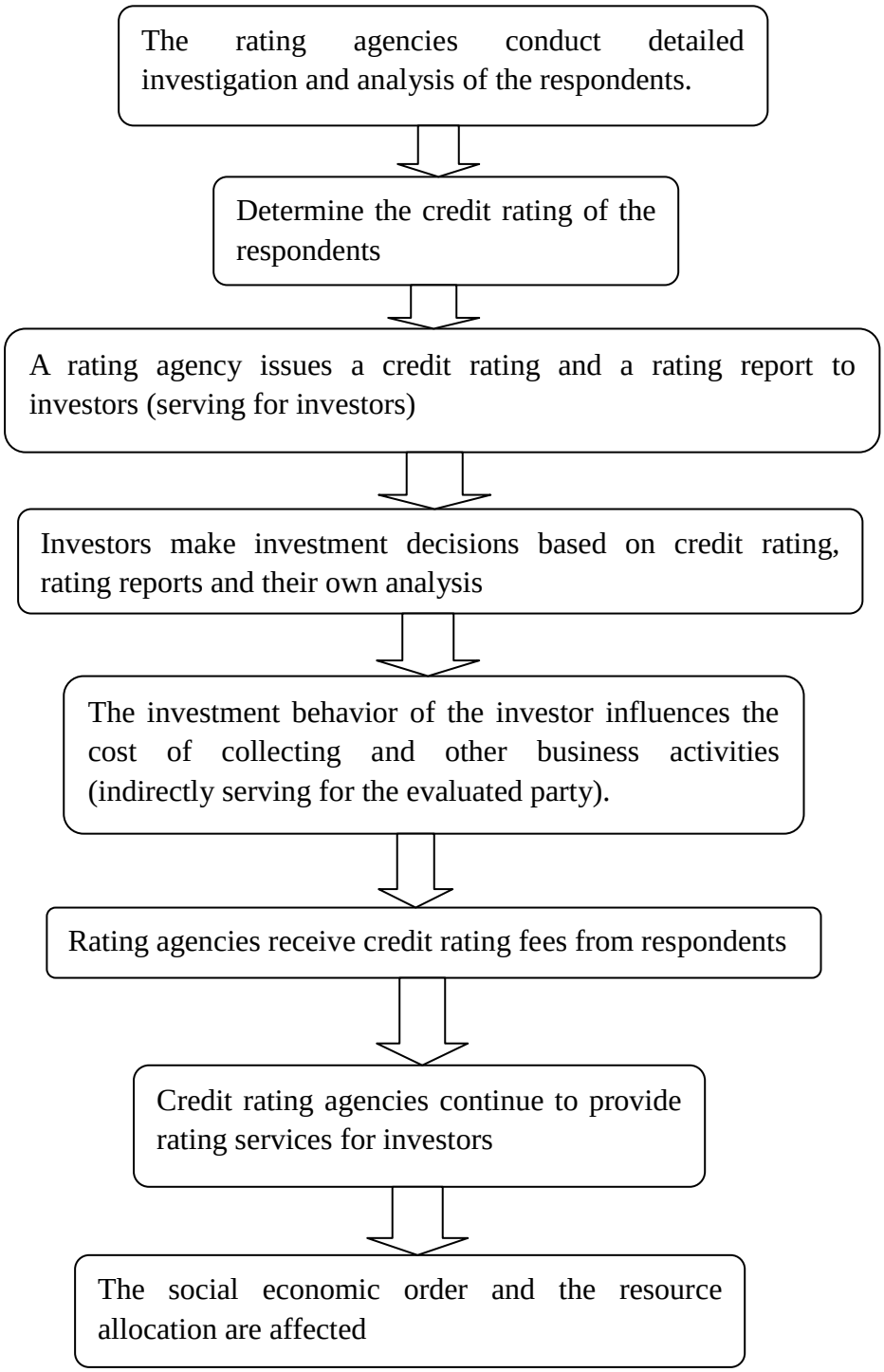
and the improvement of management, the main service participants of the credit rating include：i. Investor ii. Commercial bank、securities underwriting institution iii. Public and mass media iv. Business customers who have economic contacts with respondents v. Financial regulator

d) Comprehensiveness: The credit rating compositely reflects the overall situation and the development of enterprises from enterprise management quality, financial structure, debt-paying ability, operating capacity, operation efficiency, and the overall situation of development prospects. No other single intermediary services can do it.
e) Impartiality: Credit rating is made by an independent professional credit rating agency. The rating agencies abide by the objective and independent principle and are less disturbed by external factors. They can provide objective and fair credit information to the society.
f) Supervisory: First is the choice and supervision of investors in their investment objects. Second is mass media's media supervision. Third is the supervision by the financial supervision department.
g) Figurativeness: Credit rating is the passport of the enterprise in the capital market. A corporate credit level not only affects its financing channels, size and cost, but also reflects the company's social image and the chance of survival and development. This is a reflection of the comprehensive economic strength of enterprises and the identity card of enterprises in the economic activities.
h) The basis of social credit: By credit rating, the social gradually pay attention to the credit status of an enterprise as a microeconomic subject. Thus, it can stimulate individuals, other economic entities and governments to establish the credit values and then establish an effective social credit management system. (Zhu, 2012)

2.2.3 The significance of credit rating

In the market economy, credit rating plays a key role in the development of the

capital market. Credit rating agencies are generally regarded as gatekeepers to the capital markets internationally. Credit rating not only provides the credit service for the investors, but also provides services for the country and national economy. The mechanism of credit rating can be described briefly as follows:



For different users, credit rating has the following functions and functions:

a) For investors,

i. Credit rating simply and objectively suggests risks.

The basic function of credit rating is to reveal the credit risk, so that investors can get objective and concise credit information quickly and conveniently, and provide reference for investors. Investors follow the principle of equivalence of risk and income to reference the credit rating and estimate the default probability and loss of securities. Then, combining with other market factors, they can reasonably make a price of the debt instruments which is used as an evaluation reference for securities pricing and risk and reward. According to the reference, investors decide whether to invest or not and can be protected from the losses due to insufficient information.

ii. Reduce the information costs for investors

Investors are not all experts. Because of limited expertise, they are unable to understand the specific meaning of the disclosure of information. In that case, they cannot determine whether the information is true or not. Also, identifying the information costs a lot (mainly time, manpower, and economic costs), which people call it information costs. If each investor wants to perform a credit risk analysis of the borrower, the cost of the information will be really high. Therefore, it is necessary for the professional credit rating agencies on behalf of broad investor to carry out this work. It will help improve the efficiency of the whole society and save transaction costs.

iii. Risk assessment and management of portfolio investment

The assessment results can be used as the object reference for investor in securities investment portfolio management and risk control in the investment. When the credit level of the investment object changes, the investors will adjust their portfolios in time, which is in line with their own risk and income balance.

iv. Reference to financial institution loans, funds transactions and trading decisions and internal credit evaluation

The financial sector is a high-risk industry, and its risk categories mainly include liquidity risk, credit risk, interest rate risk, exchange rate risk and so on. Among them, credit risk plays an important role in the loan risk management of financial institutions. To prevent the loss of non-performing loans is a core issue of credit risk management in financial institutions, and through credit rating, financial institutions can have a comprehensive understanding of loan enterprises and projects before loaning the money. In this way, they can stop the occurrence of bad loans in advance. After the loan, they should follow up the monitoring. If any major changes occur, they should take measures to solve them in time and adjust the credit rating.

Credit rating provides an objective and true credit rating for business enterprises, which enables the credit status of enterprises to be expressed at different levels. Especially in the international market, the level of credit directly represents the comprehensive quality of enterprises. Enterprises with higher credit rating are more likely to obtain trust from customers and carry out trade activities smoothly in the international market. At the same time, the credit rating is helpful to obtain the counterparty's credit status, understand the real situation of competitors and partners and to prevent business risks. Therefore, credit rating can be used as the reference of capital transactions, trading decisions and internal credit evaluation.

b) For fund raiser,

i. Providing objective and disinterested credit rating and expand financing channels.

Credit rating can give fund raisers an objective and equitable proof in credit situation and make them obtain a permit to raise money in a financial market. Good credit rating is the ID card to raise funds in the market economy.

ii. Reducing the cost of raising funds and improve the efficiency of issuing securities.

The high grade credit can help the fund raiser to obtain the financial organ's support more easily and obtain the investor's trust. Also, they can not only expand the financing scale, but also reduce the financing cost, enhance the stock issuing efficiency.

iii. Improving operating management and establishing a good credit image.

When the enterprise issue corporate bonds, they should announce their credit rating in the mass media. Only the enterprise with high credit level can easily find investors. The credit rating of a loan enterprise may be reported to the various financial institutions or announced to the public through consultation with the bank credit registration consultation system. This kind of behavior will bring some pressure to the enterprise, so that it will promote the enterprise to improve the management and establish a good credit image. At the same time, from the objective evaluation of credit institutions, enterprises can see what aspects of their deficiencies, thereby improving them. Enterprises can also find the gap among credit situation in the same industry and clear their further working direction.

c) For national,

i. Saving state cost

Because of the lack of credit, the economies of various countries bear a great deal of cost. It is said by the specialists that the proportion of ineffective costs to GDP is at least 10% in China's market transactions due to the lack of credit system. By credit rating, this phenomenon can be decreased to a certain extent. Internationally, a change in the credit rating of a country by a rating agency often affects people's confidence in the country and causes the huge undulatory in the financial market, thereby changing the state cost of the country.

ii. Providing the basis for government regulation.

From the trend of international economic development, credit rating actively plays the role of market mechanism, weakens the intervention of the government directly in the market, and strengthens the role of social supervision. These functions have become a consensus. The credit rating has been recognized as the effective social supervision power. On the one hand, credit rating can help regulatory authorities to strengthen market supervision, and effectively guard against financial risks. Credit rating provides scientific management basis and reference for government by providing a credit rating of the enterprise. On the other hand, a large number of credit rating results can reduce the direct intervention of the government on the capital

market, and improve the efficiency, transparency and standardization of the securities market, the financial markets and the insurance market. (Liu&Zhong, 2015)

The government provides credit information and evaluation results based on credit rating agencies. They can grasp the credit status of the whole economic system macroscopically and understand the efficiency of the economic operation so as to formulate relevant macro policies and guide the behavior of the market participants. Such a policy may be more targeted and reduce the delay in policy due to blindness. Also, this policy can improve the efficiency and effectiveness of government macro-control, and strengthen the government's ability to regulate the market and feasibility. (Liu&Zhong, 2015)

3. The analysis of container lines

3.1 General characteristics of container lines

3.1.1 Relevant concepts of container transport

The definition of the container has specific provisions in national standards, international conventions and documents of various countries and its contents are not the same. Different definitions may have different interpretations when dealing with problems, which will not be explained here one by one. Now the researcher only lists the definition in International Organization for Standardization (ISO) and relevant international conventions.

- International Organization for Standardization on the definition of container：

  A container is a transportation device (Liyin, 2008)

a) Has enough strength, can repeatedly be used for a long time.

b) The utility model is suitable for one or more modes of transportation, and the goods in the container do not need to be changed when the goods are transported on the way.

c) A device for rapid handling and carrying, especially for transferring from one mode of transportation to another.

d) Easy to fill and unload the right.

e) Having one or more than one cubic meters of volume.

The term "container" does not include vehicles and general packing.

- Customs Convention on Containers on the definition of containers

The Container Customs Convention (CCC), established in 1972, defines containers as follows: The term "container" refers to a transport device (container, removable cargo tank, or other similar structures).

a) All or part of enclosed space for carrying goods.

b) Durable and firm enough for repeated use.

c) Specially designed to transport goods in one or more modes of transportation, without requiring transshipment.
d) Its design makes it easy to operate, especially in changing the mode of transportation.
e) The design makes it convenient for filling and emptying.
f) The internal volume is one cubic meter or more.

The term ‘container’ includes the applicable accessories and the container equipment, but it does not include vehicles, vehicle accessories and spare parts or packaging. (Levinson, 2008)

The definitions are different from those of IOS:

a) It is pointed out that the container is a transport device (removable cargo tank, or other similar structures).
b) Adding ‘all or part of enclosed space for carrying goods' as one of the primary conditions.
c) Changing the meaning of ‘The term "container" does not include vehicles and general packing' in ISO to ‘The term "container" includes the applicable accessories and the container equipment, but it does not include vehicles, vehicle accessories and spare parts or packaging.' (Containerization, 2017)

- Container transport

Container transportation refers to the mode of transportation in which goods are carried in containers. It breaks all outdated regulatory framework and management systems in the past. And this transport forms a set of independent rules and regulations and administration system, which is the most advanced modern transportation way. Its features are safe, rapid, simple and cheap, which is conducive to reducing the transport links. Door to door transportation can be achieved by the comprehensive utilization of railway, highway, water, and air and other modes of transport for multimodal transport. Therefore, container transport meets with great favor when it first appeared that shows its strong vitality and broad prospects for development. (Levinson, 2008)

3.1.2 Advantages of container transportation

a) Improving the handling efficiency and reducing the labor intensity

Container transportation is a modern transportation mode which uses containers as transportation package and basic transportation unit, makes goods into unitized cargo, and adopts special advanced loading and unloading equipment and transportation tools during transportation. In the course of transportation, a modern transportation mode with special advanced loading and unloading equipment and transportation tools is adopted. This way radically changed the unfavorable situation, such as a wide range of goods, the size of the packaging, the different size of outer packing and so on. Due to the use of the container unit, it is convenient for mechanization and automatic loading and unloading, and the manual handling operation is no longer a heavy load. The efficiency of handling operation has remarkably improved. According to the initial container transportation statistics, the efficiency of container handling is 4 times as much as that of traditional bulk goods, 1.7 times for pallets. With the use and continuous improvement of large container handling and bridge cranes, the loading and unloading speed has been further improved.

b) Reducing the damage or loss, improving the quality and safety of Freight Transport

Because of the high strength of container and good water tightness, the goods in the container can be well protected. During the whole transportation process, the goods are no longer loaded down, and handling times have been reduced. Thus, the goods are not easy to get damage and moisture during removals, loading and unloading process and storage. On the way, the possibility of loss is greatly reduced and the availability of the cargo has considerably improved which makes it the safest mode of transportation.

c) Shorten the transit time of goods and speed up the turnover of vehicles and vessels

Containerization of cargos creates the conditions for the mechanization and automation of yard. The loading and unloading efficiency of the port and the terminal

station is greatly improved. The waiting time during the port and the yard of tracks and vessels and the storage time of the goods in the warehouse are also shorter than before. Container multimodal transport simplifies the transportation procedures of all links and the extensive promotion of electronic technology makes it easier to handle container traffic. All these can shorten the time of goods in transit and speed up the delivery of goods.

d) Saving packing of freight transport and simplifying the tally formalities

The container as a kind of transportation equipment with a certain strength and can repeatedly be used can protect the goods. Container transportation simplifies the transport packaging, saves the goods packing materials and reduces the packing cost of the goods. In the transportation yard, because the container does not require high environmental conditions, it saves the investment of the warehouse in the yard. Besides, using standard containers not only can simplify the tally procedure but also can save the money.

e) Improve transport efficiency, save freight transportation costs

After using a unified cargo unit, transport efficiency has been improved. At the same time, the safety is improved, and the freight transportation insurance expenses are correspondingly lowered. Also, the cost of consigning goods for shippers decreases accordingly. Then, the turnover of capital has been speeding up, which has greatly reduced the cost of logistics.

f) The use of standardized containers promotes the standardization of packaging

With the widespread use of a large standardized transport equipment, commodity packaging has been promoted to be further standardization. At present, China has nearly 400 national standards for packaging. These standards are mostly used or referenced to international standards. And many packaging standards can commensurate to container standards to and promote the standardization of packaging.

g) Uniform transport standards have promoted the development of multimodal transportation of containers

When the containers appear as a standard shipping unit, the size of transport vehicles have developed towards unification. Various means of transport which are designed according to standard containers can make the change between the transport connection becomes more convenient. Without handling the goods inside and just change the container, which improves the efficiency of the transshipment operation. This is suitable for combined transport between different modes of transport. When the cargo is transferring, customs and the relevant regulatory unit only need to do sealing check and customs clearance, so as to improve the transportation efficiency. Therefore, container transport is conducive to the development of container intermodal transportation and promotes the rationalization of transportation.

3.2 Present situation and future trend of container lines

3.2.1 The review of the development of international container shipping market in 2016

a) The world's economic growth slowed, transportation demand t recovered

As the international economic situation is complicated, the fluctuation demand of the main route in container transport is unpredictable. According to the forecast of December 2016 from Clarkson, in 2016, the global container volume has increased about 3.2%. Compared to 2015, 1 percentage points has picked up, at the beginning of 2016 predicted values fell 0.8 percentage points. Of which:

The transport demand The Far East - Europe round-trip route is estimated to be 22 million 100 thousand TEU, have increased by 1.4% as compared with the same period last year; the Pan Pacific route transportation demand was 23 million 800 thousand TEU, have increased by 3.9% as compared with the same period last year; The transport demand of Asian regional route is 52 million TEU, have increased by 5.4% as compared with the same period last year. (Clarkson, 2016)

b) Capacity growth slowed down, idle capacity fluctuated

In 2016, the global idle capacity of container ship capacity is always in the high state. In the first half year, to improve the relationship between supply and demand and maintain the price level, the liner company emphasizes on the control of the implementation of route capacity, which leads to idle capacity is much higher than the same period in 2015. By the end of the third quarter, the liner companies began to increase supply capacity to fill the market vacancy of Hanjin, which results in a slight drop in idle transport capacity. (Containerization, 2017)

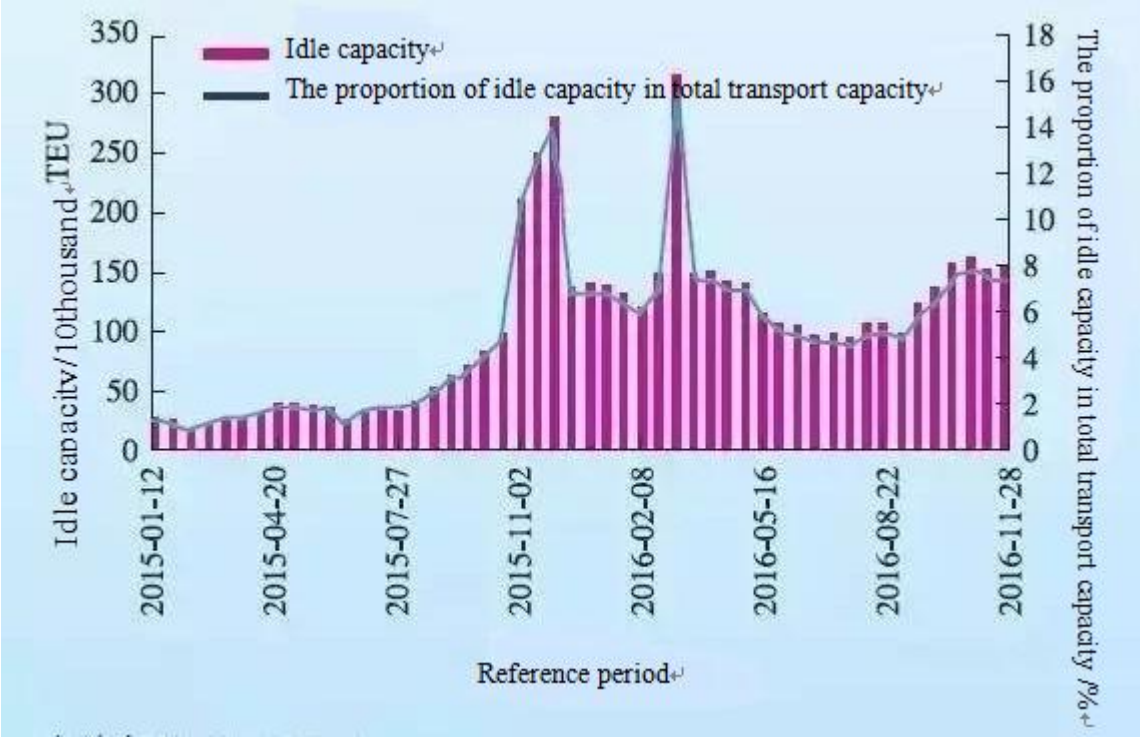


Chart 1 2015.1-2016.11 Global idle container capacity and its proportion in total transport capacity (From Alphaliner)

From the graph, people can see that at the end of November, the proportion of the total capacity of the idle capacity fell slightly to 7.4%, down 6.6 percentage points. (Alphaliner, 2016)

c) The demand for chartering is low and the rent is low

The demand for leasing container ship is under long-term downturn. The rental level of each type of ship is dropping all the way, mainly due to: On the one hand, Influenced by oversupply of container ships since the beginning of 2016, the demand for container ship rental market has been reduced; On the other hand, to enhance the competitiveness of shipping companies, shipping lines often use large vessels. Under

the background of container ship maximization, the lebensraum of small ships is under pressure, and the demand for small-scale vessels with the weak operating economy has continuously declined.

d) Operating income shrink, cost influence appears

The financial data of each liner company has shown that due to the trend of large ships continued to strengthen and the market downturn caused loss of cash flow, capital cost pressures continue to increase. This may be one of the key factors that affect the future business competitiveness of liner companies.

3.2.2 The future trend of container lines in 2017

a) The world economy grows, transportation demand of primary routes rises

According to the forecast of the international monetary fund (IMF), world trade has increased 3.8% in 2017 which is 1.9% larger than that in 2016. In the context of the global economy and commerce accelerated growing, the global container transport demand growth will continue to expand. According to the prediction of Clarkson, in 2017 the global container transportation demand will increase by 4%, which grew by 0.8 % as compared in 2016. Moreover, according to the forecast of Drewry, global container transport demand in 2017 will increase by 2.4%, 1.1 percentage points higher than in 2016. (Drewry, 2016) Considering the recovery of the world economy is still weak, sharp rebound of transportation demand is unlikely to come. It is expected that the global container transportation demand will be increased by 3% in 2017.

b) Fleet scale is enlarged, and large ship proportion is increased

According to Clarkson, in 2017 the global container shipping capacity will deliver new container ships about 1 million 686 thousand TEU. If the ability of all the scheduled TEU is reached, to the end of 2017, the total capacity of the global container ship will reach 21 million 670 thousand TEU, which has increased by 8.4% as compared to the same period in 2016.

Table 1the growth rate of transport capacity during 2013-2017

Year	Transport Capacity/10thousand TEU	The year-on-year growth rate
2013	1714.8	5.5
2014	1826.3	6.5
2015	1974.4	8.1
2016	1998.5	1.2
2017(Regardless of Dismantling Factors)	2167	8.4
2017(Consider the Dismantling Factors)	2069.9	3.6
① All data was counted by the end of the year ②2017 is the predicted value		

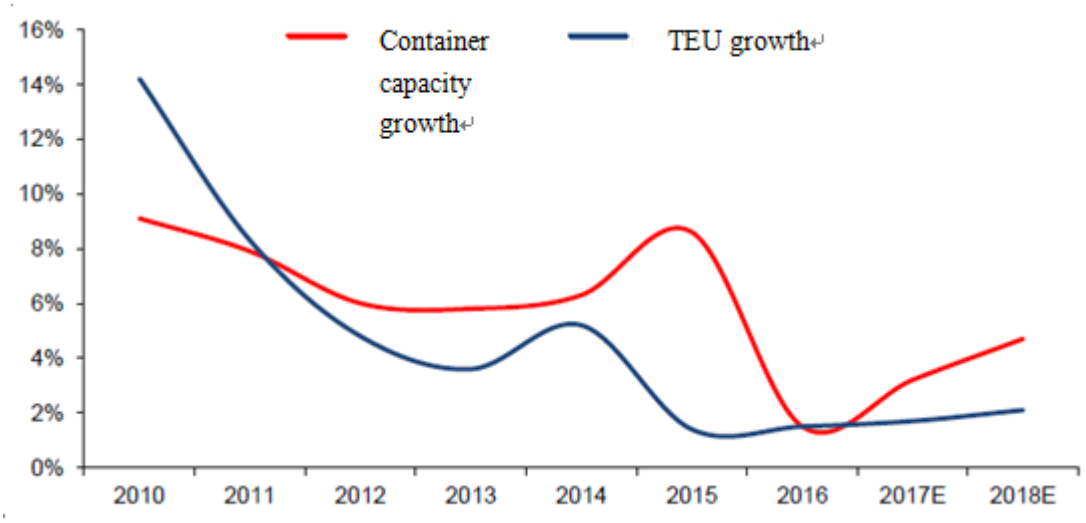
（Data from Clarkson）

In 2016, the global container ship dismantling capacity reached its peak. It is expected that the global container ship dismantling capacity will remain at a high historical level in 2017, and the excess capability of the stock may lead to the postponement of the delivery of new shipbuilding capacity. Accordingly, Clarkson predicted that in 2017 the total global container ship capacity would be 20 million 699 thousand TEU, has increased by 3.6% as compared with the same period. (Clarkson, 2016)

From the overall capacity growth situation, container capacity in the market oversupply situation is still serious in 2017, but considering the factors of idle capacity and the demolition rate in 2017, the real effective market supply capacity may be lower than the overall growth in capacity (3.2%). The actual productive capacity market will greatly depend on the control of the size and the actual delivery of the shipping company.

Overall, people believe that the irrational price competition between container shipping industries will be adequately controlled during 2017-2018. Freight rate gradually increased, which is prepared for the next round of upward cycle and the recovery of the container shipping industry.

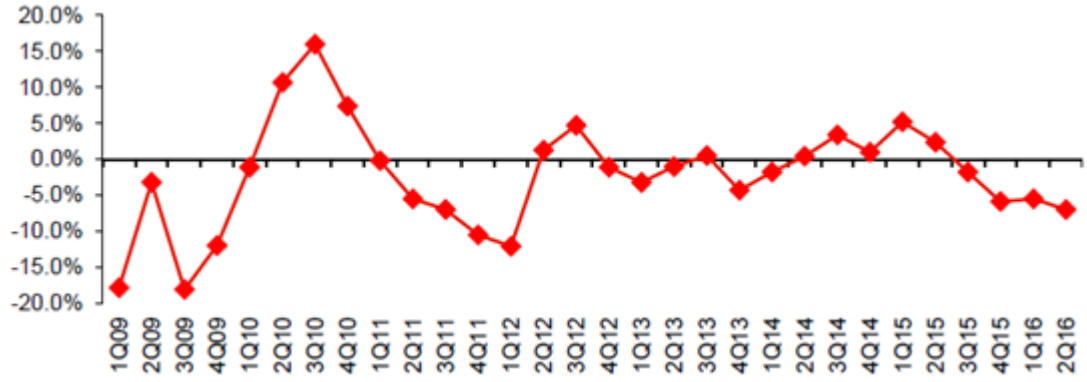
Chart 2 2010-2018E Global container demand and capacity growth



Data from: Public data collation

Since 2012, container transportation has remained subdued, but with the establishment of new shipping alliance, the supply and demand structure has a negative change. I believe that the container shipping is currently at the upward inflection point of savings.

Chart 3 the global container industry average profit rate，2009-2Q16



Data from：Public data collation

From the forecast above, p can see the situation of container lines is not that bad, but it will still have a hard time. In that case, the credit rating is of particular importance. Container lines with good credit can get more opportunities to make money.

4. Reasons for Credit Rating of Container Lines

4.1 Principles for credit rating

The basic principles to be followed in credit rating are:

a) Authenticity: In the credit process, people must guarantee the authenticity and accuracy of underlying data and basic data. Taking a certain approach to verify the authenticity of the underlying data and basic data.

b) Consistency: Basic data, index caliber, evaluation method and the standard should be the same.

c) Independence: Credit personnel should maintain independence in the process, can not be affected by the credit objects and other external factors. They should judge independently according to the basic data and underlying data. Using their knowledge and experience to do the credit rating objectively and equitably.

d) Robustness: In the analysis process of credit rating and credit rating result, the team member should be cautious about their conclusions, especially in the qualitative index score. In the analysis, it is necessary to accurately point out the potential risks affecting the operation of enterprises and make an in-depth analysis of the extreme conditions of certain indicators of enterprises. (Zhu, 2012)

4.2 Reasons for credit rating

Credit rating is the product of the market economy. It is the ability of market participants to fulfill the corresponding economic contract and a comprehensive analysis and measurement of its credibility. It is a kind of indispensable intermediary services in a market economy. The specific functions and benefits of enterprises (units) are summed up in the following five aspects:

a) Enterprises (units) have an effective ID card of credit in the market activity

In the market economy, all enterprises (units) are independent operators. They need to have an effective credit "identity card" to gain the trust of the other party. The rating agency which is strictly investigated and authorized by the market regulators assesses credit rating independently, objectively and equitably by a standardized evaluation process. Then, there will come out an effective credit "identity card." The partners made definitive and equitable credit information, which played an irreplaceable role in the acceleration of cooperative decision-making.

b) Enterprises (units) have a reliable pass to enter the financial market and raise funds

In the capital market, enterprises must have the credit rating which is rated by the qualified assessment institutions, and then they can Use bonds and other financing instruments to raise funds and issue bonds. In the credit market, if enterprises, especially the companies with large loan scale, want to apply for a loan, they should be normatively evaluated by the qualified independent third party professional rating agency. Then, they can receive financial support from financial institutions. In that case, the credit rating is a "pass" to enter the financial market must obtain.

c) An important method for enterprises to reduce the cost of raising funds

In a market economy country, the credit rating of an enterprise is directly related to the cost of raising funds. Enterprises with high credit rating and excellent credit will have lower interest rates for issuing bonds or applying for loans; enterprises with poor credit status will issue higher interest rates for issuing bonds or applying for a loan; the companies without credit rating, which means have no credit records, is not allowed to issue bonds in the market. They are difficult to borrow money. At present, interest rate marketization reformed in China has been steadily promoted. According to the regulations of the People's Bank, The commercial bank loans to enterprises can determine the level of interest rates on loans according to the symmetrical principle of risk and income by interest rate. Therefore, the credit rating is directly related to the enterprise funding cost.

i) The credit rating of enterprises is an important intangible asset

Enterprises need to know the competition in the market, people need to understand the real situation of competitors and partners, and at the same time competitors and partners also need to understand the real conditions of the enterprise. The credit evaluation by the social intermediary organizations can objectively and impartially provide the trustworthy information, which is beneficial for the businesses to promote and cooperate with each other. Good credit rating is a valuable intangible asset for the enterprise. It can attract the concerned parties to be invited and be confident to cooperate with it, which has opened up a large road for business development.

j) An important motivation for improving the management of enterprises

In credit rating in the independent third – party, you can see both advantages and deficiencies of the enterprise and these can help you to define the goals of future efforts and development ideas. For the business with outstanding credit rating, it is an objective affirmation and exact evaluation of their business conditions, so that enterprises can further optimize their management. An operation with a lower credit rating can also see the insufficient from it, so as to find out the problems, improve the work, and improve the management level.

The following two tables show the role of enterprise credit rating and comparison between having a credit rating or not. From these two tables, the researcher can know the reason why we need a credit rating.

Table 2 the role of enterprise credit rating

Brand image promotion	Allowing them to use National Identity on product brand, packing, instruction manual and qualification
Business cooperation	Business investment, Government tender, signing, cooperation and other credit qualifications
On the basis of supply and marketing purchasing	An authoritative credit standard which can be used in selling on credit and marketing purchasing
Management value	The effective certificate of showing business management and service transparency
Financing loan application	National credit rating certificate for institutional venture, financing guarantees, bank loans
Government support	Corporate quality certification for government supported funds and government institutional supervision
International trade credit	In international cooperation and trade, you can show the enterprise national credit certificate

Table 3 Comparison between having credit rating or not

Number	With Credit Rating	Without Credit Rating
1	Obtain government support to get merchants, investment, financing guarantees and bank loans	Lose government assistance, difficult to get bank loans, unable to enjoy preferential policies
2	Have bid credibility and enhance the comprehensive strength and competitiveness	The bidding rate is low, so that makes enterprises in a competitive disadvantage
3	Enhance brand integrity value, improve the competitiveness of peer brands	Low brand value, at the disadvantage of peers
4	Increase and converge more quality	Lose quality customers

	and good faith customer to cooperate	

5. The establishment of the index system

From the analysis of the previous chapter, the researcher can see that the evaluation of the credit rating of shipping lines has a positive effect on the liner shipping industry. But how to assess, what is the content and the basis of evaluation, these are the problems that need to be solved in this chapter.

5.1 Liner shipping enterprise operating condition evaluation index design

Liner shipping business is a special material production sector. Therefore, the assessment of business conditions of shipping lines can not only reference the general business credit evaluation but also combine with the liner industry characteristics. These indexes should not only reflect the materiality principle but also consider it from a special point of view, so as to build a credit rating system that is targeted and meets the needs of the liner company itself. Therefore, in the establishment of indicators, the following factors can be considered throughout the construction of the rating system of container lines operating conditions: quality of industry, capital credit, corporate reputation, innovation ability and operation level and so on.

5.1.1 Quality of enterprise

This evaluation factor is analyzed from the angle of internal management of the business, including a comprehensive evaluation of enterprise. The enterprise quality includes the general enterprise factors and emphasizes the characteristics of the liner transportation enterprise, namely, the liner transportation industry belong to the service industry, and the service quality and the peer evaluation have a great impact on the enterprise. Human resources quality refers to the quality of operators and employees, which includes cultural quality, experience quality, and competencies. The last index in this part is a social responsibility which means the contribution of container lines to social benefit and environmental protection. These behaviors can

also reflect the quality of enterprises.

5.1.2 Capital credit

Capital credit is the core performance of enterprise credit value. The key to establish and maintain the enterprise credit is to see whether the enterprise has relatively solid financial strength. The strength of the fund mainly depends on the asset, profitability, operating capacity, financing capacity, and debt-paying ability.

5.1.3 Corporate reputation

The index content is analyzed from enterprise external credit perspective. By fulfilling the contract signed with counterparties, liner shipping enterprises can obtain the trust of customers, which is called corporate reputation. Including fulfilling the obligation of a contract and actual compliance, which affected by the following factors:

a) Booking agreement performance: The two sides signed the agreement to support the booking space allocation about the consigning of freight, the cost of clearing and other related matters agreement.

Preparation of containers: refers to whether the liner shipping has the appropriate empty containers or the situation that not timely shipping for lack of empty containers.

The situation that no space and refuse to load the container: Due to ship overload, leakage or sending the dock receipt lately, the liner companies did not fulfill booking agreement and change of space or frequency without agreement.

b) Transportation contract performance: The transport contract refers to the carrier of the goods transfers the goods from the starting point to the agreed destination. Then, the shipper or the consignee pays the fare or the freight contract.

c) The performance of service agreement: Refers to the compliance with a service agreement, which is signed by the international shipping operator and the consignee. The main contents of the agreement include The range of port of loading

and the port of destination; the involved commodities; the minimum volume or volume ratio; contract period; service commitment; freight rates and freight list; compensation and so on.

d) The performance of port agreement: Refers to the observance of the port agreement signed by the international shipping operator and the port. The main contents of the agreement include the name of vessel, route, schedule, arrival plan etc.

e) The performance of ship agency agreement: Refers to the observance of ship agency agreement signed by the international shipping operator and the agent. The main contents of the agreement include liability clause, disbursement clause and so on.

f) The fulfillment of statutory obligations: The statutory obligations refer to the compliance with the relevant administrative departments of law, decrees, regulations, rules, and regulations etc. These irregularities can be roughly divided into three categories: Any violation of governmental laws and regulations (laws and regulations of the industry department in charge of transportation) behavior but does not affect the loss of business qualification; violations of other administrative agencies and acts of unfair competition. (Weichun, 2011)

5.1.4 Innovation ability

Enterprise innovation ability enables enterprises to meet or create market demand, enhance the competitive enterprise ability by all kinds of methods, application of knowledge and human intelligence. In this part, the researcher has three factors to show this ability: The proportion of research and development personnel, the ownership of intellectual property rights and the proportion of innovation funds.

5.1.5 Operation level

The operating level is analyzed from the angle of enterprise external reputation. This is the sublimation of business conditions and it can bring economic benefits to

the enterprise. The index is reflected from the business ability and affected by the following factors:

Transport capacity: The practical transport capacity of the international shipping operator specifically refers to the shipping space of selected accommodation area.

Freight volume: The actual number of cargo transportation specifically refers to the volume of the selected area.

Sailing frequency: The number of sailing flights of a certain route that the liner company operating in a certain period.

Operating conditions in other areas: The operating state of other business areas except the assessment area is set to transport capacity or freight volume as indicators, including the national operating conditions and the global operating conditions.

Global network: This refers to the business scope of liner shipping and a structural establishment of liner shipping business, including routes distribution network, the company network and the booking agent.

According to the index design principles, index system of liner shipping business conditions rating is as follows:

Table 4 liner transport enterprise rating index system

Quality of enterprise(U_1)	Human resources quality(U_{11})
	Peer evaluation(U_{12})
	Service quality(U_{13})
	Social responsibility(U_{14})
Capital credit(U_2)	Asset(U_{21})
	Profitability(U_{22})
	Operating capacity(U_{23})
	Financing capacity(U_{24})
	Debt-paying ability(U_{25})
Corporate reputation(U_3)	Booking agreement performance(U_{31})
	Transportation contract(U_{32})
	The performance of service agreement(U_{33})

	The performance of port agreement(U_{34})
	The performance of ship agency agreement(U_{35})
	The fulfillment of statutory obligations(U_{36})
Innovation ability(U_4)	Proportion of research and development personnel(U_{41})
	Ownership of intellectual property rights(U_{42})
	Proportion of innovation funds(U_{43})
Operation level(U_5)	Transport capacity(U_{51})
	Freight volume(U_{52})
	Sailing frequency(U_{53})
	Operating conditions in other areas(U_{54})
	Global network(U_{55})

5.2 Calculate the relative weights

5.2.1 Basic steps of AHP

According to the main factors affecting the operating status of liner shipping enterprises, the researcher has constructed the rating index system. Then, the researcher needs to determine the specific weight of each index. The researcher uses Analytic Hierarchy Process (AHP) to solve this problem. There are six procedures as followed:

1. Building a multiple comparison matrix. By using expert evaluation method, comparing the importance of multiple factors on the same level with 1-9 demarcation method and weighting average expert evaluation scores. All levels of scale are shown in the following table:

Table 5 scale value and meaning of matrix

Scale value	Meaning
1	a_i compared with a_j, they have equal importance
3	a_i compared with a_j , a_i is moderate importance
5	a_i compared with a_j , a_i is obviously important

7	a_i compared with a_j , a_i is strongly important
9	a_i compared with a_j , a_i is extremely important
2,4,6,8	Representing the mean-value of 1,3,5,7,9
Reciprocal	a_j compared with a_i , $a_{ji}=1/a_{ij}$

2. Calculating the relative weight of each evaluation index. After scaling the important degree of each index, the researcher can calculate the weight of each factor according to the scale value. Generally, the researcher can use a sum of square (least square method) and geometric mean method to calculate the weights. Now, I will use a geometric mean method to illustrate the approach.

In the geometric mean method, the researcher first calculate *No.i* component $\omega_i (i = 1, 2, 3.....n)$ of eigenvector W :

$$\omega_i = (\prod a_{ij})^{\frac{1}{n}} \tag{5-1}$$

Then, normalizing each component ω_i （$\omega_1,\omega_2,\ldots,\omega_n$）, the researcher can obtain the importance vector W of a_{ki} relative to a_k, which is used as an eigenvector to judge the A of the matrix.

3. Consistency check. In the general evaluation, owing to appraiser can not accurately judge the value of a_{ki}/a_{kj}, it can only be estimated. If it comes out estimation error, it will inevitably lead to the deviation of the eigenvalue of the judgment matrix A. Therefore, the researcher should do the consistency check for the obtained eigenvector and calculate consistency index C.I.. If the judgment matrix A has an error, then A becomes the inconsistent judgment matrix. Now it meets:

$$AW' = \lambda_{max} W' \tag{5-2}$$

In the equation, $W'=W^T$ represents the relative importance vector with deviation.

The researcher wants to be able to measure the error of the largest eigenvalue between λ_{max} and W due to the incompatibility of A.

If it is completely compatible with the matrix A, then there is $\lambda_{max}=n$; When there is a slight incompatibility, there is $\lambda_{max} >n$. Thus, indicators can be constructed:

$$C.I. = \frac{\lambda_{max} - n}{n-1} \tag{5-3}$$

By searching the table, the researcher can are able to determine the corresponding average random index (RI).

Table 6 average random index (RI)

Order	1	2	3	4	5	6	7	8	9
RI	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46

Data from: Wang Donghua, The theory and application of credit risk measurement mode, Shanghai University of Finance and Economics Publisher, 2007

Calculating consistency ratio C.R., C.R. $= \frac{C.I.}{R.I.}$. If C.R. <0.1, the consistency of the judgment matrix is acceptable. Otherwise, the judgment matrix should be modified. (5-4)

4. Single hierarchical arrangement

After calculating the weights of the different elements, the judgment matrix can be obtained to determine the ordering of the different elements at that level, representing the relative importance of the elements to the upper hierarchy.

5. Total hierarchical arrangement

The total hierarchical arrangement is the combined weight from the top level to the bottom level. The evaluator can use all results of single hierarchical arrangement at the same level, combined with the weight of the elements on the previous element. By calculating the comprehensive importance degree, the combined weights of each element of the hierarchy to the target layer can be obtained, and the total hierarchical arrangement can be carried out.

6. Synthetic decision

Analysts can compare the priorities of various alternatives, thus providing a scientific basis for decision making.

5.2.2 Calculate the index weight

- Single hierarchical arrangement of first-level indicators

From the liner transport enterprise rating index system, the researcher can know there are five primary standards: Quality of enterprise (U_1), Capital credit (U_2), Corporate reputation (U_3), Innovation ability (U_4), Operation level (U_5). In the questionnaire of experts, the importance and degree of each factor are sorted by statistics: Quality of enterprise (U_1), Capital credit (U_2), Corporate reputation (U_3), Innovation ability (U_4), Operation level (U_5). Therefore, the researcher can evaluate each index separately:

$$(U_1, U_2, U_3, U_4, U_5) \quad (9, 7, \tag{5-5}$$

Making use of the assignment of the elements to determine the relative importance,

Table 7 relative importance of each element

	U1	*U2*	*U3*	*U4*	*U4*
U1	1	9/7	9/5	9/3	9
U2	7/9	1	7/5	7/3	7
U3	5/9	5/7	1	5/3	5
U4	3/9	3/7	3/5	1	3
U5	1/9	1/7	1/5	1/3	1

Then calculate the weight of each row of this table：

$$W_{U1} = \sqrt[5]{1 \times \frac{9}{7} \times \frac{9}{5} \times \frac{9}{3} 9 \times} \quad = 2.1 \tag{5-6}$$

$$W_{U2} = \sqrt[5]{\frac{7}{9} \times 1 \times \frac{7}{5} \times \frac{7}{3} 7 \times} \quad = 1.1 \tag{5-7}$$

$$W_{U3} = \sqrt[5]{\frac{5}{9} \times \frac{5}{7} \times 1 \times \frac{5}{3} 5 \times} \quad = 1.2$$

(5-8)

$$W_{U4} = \sqrt[5]{\frac{3}{9} \times \frac{3}{7} \times \frac{3}{5} \times 1 \times 3} = \quad 0.7 \tag{5-9}$$

$$W_{U5} = \sqrt[5]{\frac{1}{9} \times \frac{1}{7} \times \frac{1}{5} \times \frac{1}{3} \times 1} = 0.2 \quad (5\text{-}10)$$

Then let's do the normalization processing:

$$(W_1, W_2, W_3, W_4, W_5) = (0.27, 0.35, 0.12, 0.2) \quad (5\text{-}11)$$

The consistency test is carried out and obtained $C.I. < 0.10$, which the judgment reasonable.

So the researcher can get the respective weights of Quality of enterprise (U_1), Capital credit (U_2), Corporate reputation (U_3), Innovation ability (U_4), Operation level (U_5) are 0.27, 0.35, 0.12, 0.2, 0.06.

- Determining the weights of each secondary factor under the item U_i

Not only the first level factors need to be determined the weight, but the secondary factor of each element also needs to be determined the weights.

By questionnaire, the importance of the index selection under the "enterprise quality" by experts is listed as follows: Human resources quality (U_{11})> Peer evaluation (U_{12})> Service quality (U_{13})> Social responsibility (U_{14}). Then, let's evaluate each index:

$$(U_{11}, U_{12}, U_{13}, U_{14}) = (7, 5) \quad (5\text{-}12)$$

Then establish relative valuation table:

Table 8 the relative importance of each index of enterprise quality factors

	U_{11}	U_{12}	U_{13}	U_{14}
U_{11}	1	7/5	7/3	7
U_{12}	5/7	1	5/3	5
U_{13}	3/7	3/5	1	3
U_{14}	1/7	1/5	1/3	1

The weights are determined by the geometric average method and the weight matrix is obtained after normalization:

$$(W_{11}, W_{12}, W_{13}, W_{14}) = (0.44, 0.31, 0 \quad (5\text{-}13)$$

Consistency check comes out $C.I. < 0.1$, compatibility testing can be done.

Thus, the weights of each index under the enterprise quality are determined as follows: 0.44, 0.31, 0.19, 0.06.

The importance of the other secondary indexes can be obtained in the same way:

$$(W_{21}, W_{22}, W_{23}, W_{24}) = (0.36, 0.28, 0.2 \quad (5\text{-}14)$$

$$(W_{31}, W_{32}, W_{33}, W_{34}, W_{35}, W_{36}) = (0.31, 0.25, 0.19, 0. \quad (5\text{-}15)$$

$$(W_{41}, W_{42}, W_{43}, W_{44}) = (0.56, 0.3 \quad (5\text{-}16)$$

$$(W_{51}, W_{52}, W_{53}, W_{54}, W_{55}) = (0.36, 0.28, 0.2 \quad (5\text{-}17)$$

$W_{21}, W_{22}, W_{23}, W_{24}$ are the weights for Asset (U_{21}), Profitability (U_{22}), Operating capacity (U_{23}), Financing capacity (U_{24}), Debt-paying ability (U_{25})

$W_{31}, W_{32}, W_{33}, W_{34}, W_{35}, W_{36}$ are the weights for Booking agreement performance (U_{31}), Transportation contract (U_{32}), The performance of service agreement (U_{33}), The performance of port agreement (U_{34}), The performance of ship agency agreement (U_{35})

W_{41}, W_{42}, W_{43} are the weights for Proportion of research and development personnel (U_{41}), Ownership of intellectual property rights (U_{42}), Proportion of innovation funds (U_{43})

$W_{51}, W_{52}, W_{53}, W_{54}, W_{55}$ are the weights for Transport capacity (U_{51}), Freight volume (U_{52}), Sailing frequency (U_{53}), Operating conditions in other areas (U_{54}), Global network (U_{55})

- Total hierarchical arrangement

The total hierarchical arrangement is the combination of weights from top to bottom, that is to say, the combined weights of each level factors to the target layer should be obtained.

With the weights of the different factors at different levels, the combination weights need to be calculated in order to perform the comprehensive ranking.

The weight of Quality of enterprise (U_1) in five primary factors is 0.36, and the weight of each index below is as followed: $(W_{11}, W_{12}, W_{13}, W_{14}) = (0.44, 0.31, 0.19, 0.06)$

Therefore, in the combination weight calculation, weights of $U_{11} \sim U_{14}$ are:

$$(W_{11}, W_{12}, W_{13}, W_{14}) = 0.36 \times (0.44, 0.31, 0.19, 0.06) = (0.1584, 0.1116, 0.0684, 0.0216) \quad (5\text{-}18)$$

Similarly, all other indexes can be calculated by combining weights, the researcher can obtain:

$$(W_{21}, W_{22}, W_{23}, W_{24}, W_{25}) = 0.28 \times (0.36, 0.28, 0.2, 0.12, 0.04)$$

$$= (0.1008, 0.0784, 0.0560, 0.0336, 0.0112) \quad (5\text{-}19)$$

$$(W_{31}, W_{32}, W_{33}, W_{34}, W_{35}, W_{36}) = 0.2 \times (0.31, 0.25, 0.19, 0.14, 0.08, 0.03)$$

$$= (0.0611, 0.05, 0.0389, 0.0278, 0.0167, 0.0056) \quad (5\text{-}20)$$

$$(W_{41}, W_{42}, W_{43}) = 0.12 \times (0.56, 0.33, 0.11) = (0.0667, 0.04, 0.0133) \quad (5\text{-}21)$$

$$(W_{51}, W_{52}, W_{53}, W_{54}, W_{55}) = 0.04 \times (0.36, 0.28, 0.2, 0.12, 0.04)$$

$$= (0.0144, 0.0112, 0.008, 0.0048, 0.0016) \quad (5\text{-}22)$$

Finally, the total hierarchical arrangement is performed:

Table 9 total hierarchical arrangement of Liner Enterprises operating status rating

	U1	*U2*	*U3*	*U4*	*U5*	Comprehensive weight	Total hierarchical arrangement
	0.36	0.28	0.20	0.12	0.04		
U11	0.44					0.1575	1
U12	0.31					0.1125	2
U13	0.19					0.0675	5
U14	0.06					0.0225	14
U21		0.36				0.1008	3
U22		0.28				0.0784	4
U23		0.20				0.0560	8
U24		0.12				0.0336	12
U25		0.04				0.0112	18
U31			0.31			0.0611	7
U32			0.25			0.0500	9
U33			0.19			0.0389	11
U34			0.14			0.0278	13
U35			0.08			0.0167	15
U36			0.03			0.0056	21
U41				0.56		0.0667	6
U42				0.33		0.0400	10
U43				0.11		0.0133	17
U51					0.36	0.0144	16
U52					0.28	0.0112	18
U53					0.20	0.0080	20
U54					0.12	0.0048	22
U55					0.04	0.0016	23

6. Case study credit rating by new rating system

6.1 Introduction to the companies

6.1.1 China COSCO Shipping

China COSCO Shipping Corporation Limited (hereinafter referred to as China COSCO Shipping Group or the Group) is the merged entity of China Ocean Shipping (Group) Company (COSCO) and China Shipping (Group) Company (China Shipping) which is an SOE headquartered in Shanghai. And it is a large state-owned enterprise directly managed by the central government. The new group has total assets of 610 billion RMB and has 118 thousand employees.

Until the end of 2016, the overall fleet capacity of the Company is 81 million DWT / 1082 vessels. In which, the company owns 1.69 million TEU/321 vessels, NO.4 of the world's list. The Company owns more than 48 global container terminals and more than 209 container berths all over the world. Annual handling capacity of containers exceeds 90 million TEU, which is the second-largest in the world; the scale of container leasing scale is more than 2.7 million TEU, ranking third in the world, taking the third place in the world; and its offshore engineering manufacturing ability and vessel agency business are also leading in the world.

At present, the company operates 322 routes, including 209 international routes (including foreign branch) and 123 domestic routes. The route covers 254 ports in 79 countries and regions all over the world. (China COSCO Shipping Corporation Limited, 2017)

6.1.2 Maersk Line

The Maersk Group was founded in 1904 and is headquartered in Copenhagen, Denmark. They have 135 branch offices all over the world with approximately 89000 employees. It provides first class services in container transportation, logistics, terminal operations, oil and gas extraction and production, and other activities related

to shipping and retail industries. Maersk Line is the world's largest container carrier company and its service network is worldwide. In.2014, Maersk Group ranked 172nd in the world's top 500 enterprises. Maersk Line owns and operates more than 500 container ships and 1 million 500 thousand containers.

Although the shipping industry has many years of a hard time, Maersk line always maintains profitability by constantly adjusting the business structure. But, Maersk shipping 2016 annual report shows that the company has lost 376 million dollars (earning $1.3 billion in 2015), last time the loss happened was in 2009. The main reason for the company's losses was that the freight rate declined by 19% compared with 2015. The company's operating income was $2.7 billion, reducing 13% at the same period in 2015 ($2.37 billion). (Maersk, 2016)

6.1.3 The Orient Overseas Container Line (OOCL)

OOCL is one of the world's largest companies of international container transport, logistic and terminals. Also, it is one of the most familiar global trademarks in Hongkong. OOCL provides comprehensive logistics and transportation services for customers. The routes involve Asia, Europe, North America, the Mediterranean, the India subcontinent, the Middle East and Australia / New Zealand and so on. In 2016, OOCL has lost 260 million dollars and operating revenue was 520 million dollars. (OOCL, 2016)

Table 10 main route distribution of COSCO, MAERSK, and OOCL

Shipping Lines	Main route distribution
COSCO	Route services covering the whole of Asia, Europe, Chinese coastal, America, Africa, the Persian Gulf and other major trading areas. Main routes are Europe line, Mediterranean line, America line, the Atlantic route, Africa line, the global route, Australia line, Middle East line, East Middle East - Middle East -west American line.

MAERSK	Routes which have comparative advantages: Northern Europe, Britain, the Mediterranean, North America (east coast, West Bank)
OOCL	Japan, Southeast Asia, North America, middle east line. Near-sea routes are their strong suit.

Table 6-1 has shown the main route distribution of these three shipping lines.

6.2 Calculating evaluation score

1) Operation level

The operation level index is a quantitative index, and the measured value is calculated according to a computational formula:

- The calculation method of the index value of transport capacity: Setting α, β, γ. According to Alphaliner TOP 30 which is built based on the existing fleet and order book, TEU capacity available on board operated ships (all figures are consolidated), setting the minimum capacity to 60 points and the maximum capacity of 100 points.

  α indicates the TEU number of one point. α= (Maximum capacity – Minimum capacity)/ (100-60)

  β indicates the extra scores. β = (capacity of shipping line – minimum capacity)/ α

  γ indicates the transport capacity of the company, $\gamma = 60 + \beta$

  Transport capacity score = transport capacity weight $\times\gamma$

- The calculation method of the index value of freight volume: Setting α, β, γ.

  According to Alphaliner TOP 30 which is built based on the existing fleet and order book TEU capacity available on board operated ships (all figures are consolidated), setting the minimum volume to 60 points and the maximum volume to 100 points.

  α indicates the order book number of one point. α= (Maximum volume –

Minimum volume)/ (100-60)

β indicates the other scores. β = (volume of shipping line – minimum volume)/ α

γ indicates the freight volume of the company, $\gamma = 60 + \beta$

Freight volume score = Freight volume weight $\times\gamma$

Chart 4 Alphaliner TEU TOP 30 List 1 (2017.6)

Ra...	Operator	Teu	Share...
1	APM-Maersk	3,421,740	16.3%
2	Mediterranean Shg Co	3,073,439	14.7%
3	CMA CGM Group	2,345,722	11.2%
4	COSCO Shipping Co Ltd	1,745,189	8.3%
5	Hapag-Lloyd	1,522,815	7.3%
6	Evergreen Line	1,047,584	5.0%
7	OOCL	670,386	3.2%
8	Yang Ming Marine Transport Corp.	589,583	2.8%
9	NYK Line	563,260	2.7%
10	Hamburg Süd Group	559,080	2.7%
11	MOL	536,347	2.6%
12	PIL (Pacific Int. Line)	367,237	1.8%
13	K Line	353,566	1.7%
14	Hyundai M.M.	344,408	1.6%
15	Zim	340,975	1.6%
16	Wan Hai Lines	226,133	1.1%
17	X-Press Feeders Group	146,512	0.7%
18	KMTC	118,286	0.6%
19	IRISL Group	97,671	0.5%
20	SITC	94,930	0.5%
21	Zhonggu Logistics Corp.	94,168	0.4%
22	Arkas Line / EMES	73,731	0.4%
23	Sinotrans	67,013	0.3%
24	Quanzhou An Sheng Shg Co	65,891	0.3%
25	TS Lines	63,807	0.3%
26	Simatech	62,081	0.3%
27	UniFeeder	54,533	0.3%
28	Emirates Shipping Line	52,478	0.3%
29	Transworld Group	51,285	0.2%
30	Salam Pasific	48,243	0.2%

Chart 5 Alphaliner TEU TOP 30 List 2 (2017.6)

Ra...	Opetator	Total		Owned		Chartered			Orderbook		
		Teu	Ships	TEU	Ship...	TEU	Ships	% Chart	TEU	Ship...	% existing...
1	APM-Maersk	3,421,740	638	1,665,556	244	1,756,184	394	51.3%	347,822	25	10.2%
2	Mediterranean Shg Co	3,073,439	509	1,080,849	190	1,992,590	319	64.8%	170,050	15	5.5%
3	CMA CGM Group	2,345,722	460	893,211	115	1,452,511	345	61.9%	169,200	17	7.2%
4	COSCO Shipping Co Ltd	1,745,189	314	478,579	80	1,266,610	234	72.6%	535,520	31	30.7%
5	Hapag-Lloyd	1,522,815	220	1,001,420	116	521,395	104	34.2%	29,986	2	2%
6	Evergreen Line	1,047,584	196	548,041	105	499,543	91	47.7%	282,000	33	26.9%
7	OOCL	670,386	104	432,152	55	238,234	49	35.5%	107,065	5	16%
8	Yang Ming Marine Transport Corp.	589,583	97	209,150	45	380,433	52	64.5%	70,000	5	11.9%
9	NYK Line	563,260	97	241,238	41	322,022	56	57.2%	126,104	9	22.4%
10	Hamburg Süd Group	559,080	104	313,508	46	245,572	58	43.9%	30,640	8	5.5%
11	MOL	536,347	82	191,656	24	344,691	58	64.3%	80,640	4	15%
12	PIL (Pacific Int. Line)	367,237	139	298,819	120	68,418	19	18.6%	142,200	13	38.7%
13	K Line	353,566	61	80,150	12	273,416	49	77.3%	69,350	5	19.6%
14	Hyundai M.M.	344,408	59	159,369	21	185,039	38	53.7%			
15	Zim	340,975	74	27,800	6	313,175	68	91.8%			
16	Wan Hai Lines	226,133	87	169,598	71	56,535	16	25%	15,200	8	6.7%
17	X-Press Feeders Group	146,512	94	24,622	21	121,890	73	83.2%			
18	KMTC	118,286	60	60,236	29	58,050	31	49.1%			
19	IRISL Group	97,671	45	97,671	45				58,000	4	59.4%
20	SITC	94,930	72	69,644	50	25,286	22	26.6%			
21	Zhonggu Logistics Corp.	94,168	81	50,329	23	43,839	58	46.6%	20,000	8	21.2%
22	Arkas Line / EMES	73,731	44	64,711	37	9,020	7	12.2%	14,986	5	20.3%
23	Sinotrans	67,013	41	22,768	14	44,245	27	66%	7,600	4	11.3%
24	Quanzhou An Sheng Shg Co	65,891	45	63,172	39	2,719	6	4.1%	38,640	20	58.6%
25	TS Lines	63,807	31	1,578	1	62,229	30	97.5%	7,200	4	11.3%

(Data from Alphaliner)

From the table 1, people can know APM-Maersk is No.1 in the rating and Salam Pasific is No.30, so let us set the capacity of Maersk as the maximum capacity (100 points) and the capacity of Salam Pasific as the minimum capacity (60 points). The capacity of COSCO is 1,745,189 TEU, Maersk is 3,421,740 TEU and OOCL is 670,386 TEU.

$$\alpha = (3421740 - 48243)/(100 - 60) = 84337.43 \quad (6\text{-}1)$$

$$\beta_{COSCO} = (1745189 - 48243)/\alpha = 1696946/84337.43$$

$$= 20 \quad (6\text{-}2)$$

$$\gamma_{C\,O\,S\,C\,O} = 60 + 20 = \{ \quad (6\text{-}3)$$

By using the same method, the researcher can get:

$$\gamma_{Maersk} = 100 \quad (6\text{-}4)$$

$$\gamma_{OOCL} = 67 \quad (6\text{-}5)$$

From order book of the table 2, the researcher can know COSCO is No.1 and TS Line is No.25, so let us set the volume of COSCO as the maximum volume (100 points) and the volume of TS Line as the minimum volume (60 points). The volume of COSCO is 535,520 TEU, Maersk is 347,822 TEU and OOCL is 107,065 TEU.

$$\alpha = (535520 - 7200)/(100 - 6 \tag{6-6}$$

$$\beta_{MAERSK} = (346822 - 7200)/\alpha$$

$$= 340622/13208 = 26 \tag{6-7}$$

$$\gamma_{MAERSK} = 60 + 26 = 8 \tag{6-8}$$

By using the same method, the researcher can get:

$$\gamma_{COSCO} = 100 \tag{6-9}$$

$$\gamma_{OOCL} = 68 \tag{6-10}$$

The scores of sailing frequency, operating conditions in other areas and global network are calculated by the same method.

2) Capital credit and Innovation ability

Capital credit and innovation ability are quantitative indexes. According to the annual report of the company, selecting the data the researcher need and mark them according to the ranking.

3) Quality of enterprise and corporate reputation

The indexes in the quality of enterprise and corporate reputation are all qualitative indexes. In that case, I have asked the employees who have minimum 5 years work experience from SINOTRANS&CSC and Shanghai International Port (Group) to grade the indexes of these three companies. SINOTRANS&CSC is the largest integrated logistics service provider and the biggest international freight forwarding company in China. Shanghai International Port (Group) is the largest port enterprise in mainland China. They have cooperated with COSCO Shipping, Maersk and OOCL for a long time. Asking them to grade the indexes can ensure the scientificity and objectivity.

According to the above method, the researcher obtained the evaluation value of

each factor, and finally obtained the overall assessment value of the operation condition of COSCO Shipping, Maersk, and OOCL. (See Table 6-2, Table 6-3 and Table 6-4)

Table 11 the estimated value of COSCO

First level	Second level	Scores	Comprehensive weight	The final estimate value
Quality of enterprise(U_1)	Human resources quality(U_{11})	90	0.1575	14.175
	Peer evaluation(U_{12})	80	0.1125	9
	Service quality(U_{13})	80	0.0675	5.4
	Social responsibility(U_{14})	90	0.0225	2.025
Capital credit(U_2)	Asset(U_{21})	90	0.1008	9.072
	Profitability(U_{22})	75	0.0784	5.88
	Operating capacity(U_{23})	85	0.056	4.76
	Financing capacity(U_{24})	80	0.0336	2.688
	Debt-paying ability(U_{25})	65	0.0112	0.728
Corporate reputation(U_3)	Booking agreement performance(U_{31})	90	0.0611	5.499
	Transportation contract(U_{32})	90	0.05	4.5
	The performance of service agreement(U_{33})	90	0.0389	3.501
	The performance of port agreement(U_{34})	90	0.0278	2.502
	The performance of ship agency agreement(U_{35})	90	0.0167	1.503
	The fulfillment of statutory obligations(U_{36})	95	0.0056	0.532
Innovation ability(U_4)	Proportion of research and development personnel(U_{41})	85	0.0667	5.6695
	Ownership of intellectual property rights(U_{42})	85	0.04	3.4
	Proportion of innovation funds(U_{43})	85	0.0133	1.1305
Operation level(U_5)	Transport capacity(U_{51})	80	0.0144	1.152
	Freight volume(U_{52})	100	0.0112	1.12
	Sailing frequency(U_{53})	90	0.008	0.72
	Operating conditions in other areas(U_{54})	90	0.0048	0.432
	Global network(U_{55})	95	0.0016	0.152

Total score of COSCO: 85.54

Table 12 the estimated value of Maersk

First level	Second level	Scores	Comprehensive weight	The final estimate value
Quality of enterprise(U_1)	Human resources quality(U_{11})	90	0.1575	14.175
	Peer evaluation(U_{12})	80	0.1125	9
	Service quality(U_{13})	80	0.0675	5.4
	Social responsibility(U_{14})	90	0.0225	2.025
Capital credit(U_2)	Asset(U_{21})	95	0.1008	9.576
	Profitability(U_{22})	85	0.0784	6.664
	Operating capacity(U_{23})	90	0.056	5.04
	Financing capacity(U_{24})	85	0.0336	2.856
	Debt-paying ability(U_{25})	85	0.0112	0.952
Corporate reputation(U_3)	Booking agreement performance(U_{31})	90	0.0611	5.499
	Transportation contract(U_{32})	90	0.05	4.5
	The performance of service agreement(U_{33})	90	0.0389	3.501
	The performance of port agreement(U_{34})	90	0.0278	2.502
	The performance of ship agency agreement(U_{35})	90	0.0167	1.503
	The fulfillment of statutory obligations(U_{36})	95	0.0056	0.532
Innovation ability(U_4)	Proportion of research and development personnel(U_{41})	70	0.0667	4.669
	Ownership of intellectual property rights(U_{42})	70	0.04	2.8
	Proportion of innovation funds(U_{43})	70	0.0133	0.931
Operation level(U_5)	Transport capacity(U_{51})	100	0.0144	1.44
	Freight volume(U_{52})	86	0.0112	0.9632
	Sailing frequency(U_{53})	90	0.008	0.72
	Operating conditions in other areas(U_{54})	90	0.0048	0.432
	Global network(U_{55})	95	0.0016	0.152

Total score of MERSK: 85.85

Table 13 the estimated value of OOCL

First level	Second level	Scores	Comprehensive weight	The final estimate value
Quality of enterprise(U_1)	Human resources quality(U_{11})	90	0.1575	14.175
	Peer evaluation(U_{12})	80	0.1125	9
	Service quality(U_{13})	80	0.0675	5.4
	Social responsibility(U_{14})	95	0.0225	2.1375
Capital credit(U_2)	Asset(U_{21})	80	0.1008	8.064
	Profitability(U_{22})	85	0.0784	6.664
	Operating capacity(U_{23})	85	0.056	4.76
	Financing capacity(U_{24})	80	0.0336	2.688
	Debt-paying ability(U_{25})	80	0.0112	0.896
Corporate reputation(U_3)	Booking agreement performance(U_{31})	85	0.0611	5.1935
	Transportation contract(U_{32})	85	0.05	4.25
	The performance of service agreement(U_{33})	85	0.0389	3.3065
	The performance of port agreement(U_{34})	85	0.0278	2.363
	The performance of ship agency agreement(U_{35})	85	0.0167	1.4195
	The fulfillment of statutory obligations(U_{36})	95	0.0056	0.532
Innovation ability(U_4)	Proportion of research and development personnel(U_{41})	70	0.0667	4.669
	Ownership of intellectual property rights(U_{42})	70	0.04	2.8
	Proportion of innovation funds(U_{43})	70	0.0133	0.931
Operation level(U_5)	Transport capacity(U_{51})	67	0.0144	0.9648
	Freight volume(U_{52})	68	0.0112	0.7616
	Sailing frequency(U_{53})	90	0.008	0.72
	Operating conditions in other areas(U_{54})	90	0.0048	0.432
	Global network(U_{55})	90	0.0016	0.144

Total score of OOCL: 82.27

6.3 Compare the result of new rating system with Drewry

6.3.1 Credit rating by Drewry in 2016

Drewry, the independent professional consulting agency of shipping research, has issued a risk rating of 12 sample shipping companies. Parameters and weights are as follows: balance sheet 45% + diversification strategies 10% + transparency 10% + management / control 15%, the maximum of integrated score is 5 points. The score is more than 3.5, then the company has a low risk (green light); between 2.5 and 3.5, medium risk (yellow light); lower than 2.5, high risk (red light).

Chart 6 the rating graphic of Drewry 2016

- Green light:

Maersk: Great financial condition with a solid foundation

OOCL: Business performance is temporarily poor, but the performance of the balance sheet is great.

Wan Hai: Strong balance sheet and reasonable debt ratio

- Yellow light:

Hapag-Lloyd: After merging UASC, the debt has raised.

CMA CGM: After acquiring APL, the debt has inflated.

COSCO Shipping: After merging, the loss has increased

Evergreen Line: Poor balance sheet

MOL: High debt, low income

NYK: Financial performance is lower than the peers

Kline: Performance dragged down the financial situation

- Red light

HMM: Reorganization is a temporary way to release the poor finance performance

Yang Ming: Having the worst financial performance

6.3.2 Compare the result of new rating system with Drewry

In the new rating system, the researcher can get the score of COSCO, Maersk and OOCL are 85.54, 85.83 and 82.27. Let us change it to Drewry standard.

$$X_{COSCO} = 85.54 \times 5/100 = 4.28 \quad (6\text{-}11)$$

$$X_{MAERSK} = 85.83 \times 5/100 \quad (6\text{-}12)$$

$$X_{OOCL} = 82.27 \times 5/100 \quad (6\text{-}13)$$

From the result, the researcher can see they are all more than 3.5, which means these three companies all have a great performance in operating conditions. In Drewry, COSCO Shipping belongs to yellow light zone in 2016, while in the new credit rating system; it is in the green light zone. In the rating of Drewry, the rating is focused on the performance of balance sheet while the proportion of management is the lowest. After calculating the index weight of the new rating system, people can see the proportion of human resources quality is the biggest; the second one is peer evaluation and the third one is the asset. It is easy to see that experts believe that the company's management and peer evaluation is more important than assets. So in my opinion, the standard of Drewry's rating is not comprehensive. Besides, COSCO Shipping is a large state-owned enterprise directly managed by the central government. The government will always sponsor the company, so the researcher

don't have to worry COSCO Shipping will have credit or financial problem. The situation of Hanjin Shipping will not happen on COSCO Shipping. In that case, when doing the rating, the researcher should also consider the government factor to make it be a more overall rating.

7. Conclusion

With the development of market economy, the concept of credit industry has been paid wide attention by the others. The mainstream of social credit is the transaction between enterprises, enterprise credit is the dominant factor affecting the whole social credit, and it is the foundation of a social credit system. Enterprise credit rating is the product of the construction and development of enterprise credit system, and credit evaluation has great significance to the structure of enterprise credit and social credit system.

Shipping plays a major role in the world. Maritime industry plays an important and irreplaceable role in the national economy, foreign trade and the promotion of sustainable economic development. Liner shipping is the most important operation manner in the shipping industry. Therefore, it is important to introduce the evaluation of the operation status of enterprises to the maritime sector. It plays an important role to assess the quality and reputation of container lines.

The establishment of the rating index system for shipping enterprises' operation status is a new topic in the maritime industry, involving many factors. In this thesis, a combination of theoretical analysis and case study is used to make a useful discussion of this subject, and the conclusions are as following:

1) The establishment of shipping enterprise management status rating index system is the key point of this thesis. This thesis first puts forward the factors influence the operating condition rating of container lines, mainly involves five aspects: enterprise quality, capital credit, corporate reputation, innovation ability and operation level; and design a set of operable index system, so as to fill the blank of the study on rating theory of container lines operating condition.
2) After the establishment of index system, the researcher uses AHP and synthetic judgment method to do empirical research on COSCO, Shipping, Maersk, and OOCL. From the index system, the researcher can see the influence of different factors on the state of operation and the enterprise

comprehensive management condition. From the new index system, the researcher can see the quality of enterprise has accounted for the largest proportion, which means nowadays people think the quality of enterprise is more important when they want to know the operating condition of one company.

3) This study provides a theoretical framework for the design of evaluation index system of container lines and other related industries. It also has a major role in the development of the actual credit evaluation work. From the case study, it shows that when doing the evaluation of the operating condition, the researcher should also consider the government factor. It also has an impact on the credit of the company.
4) In the course of writing the thesis, OOCL has been acquired by COSCO Shipping, which further reflects the need for a comprehensive rating of a container line.

In this thesis, the research on the credit rating of container lines is an attempt. Because of the limited knowledge, researching time and data sources, index system and evaluation model are still needed to be improved. For example, in the case study, if the time is enough, the researcher could find more experts to mark the indexes of three companies or make an expert questionnaire to make the score more accurate. Moreover, the rating system is not applicable to unlisted companies. In the case study, the data the researcher found is all released in their annual report, because the companies are listed companies and the data is disclosed and transparent. If the researcher want to rate an unlisted company, such as MSC, it is difficult for us to collect the data. Then, the score is hard to be confirmed. How to improve the rating system to be both suitable for listed and unlisted companies? This question needs to be further researched in the future.

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Appendix - Questionnaire of rating index of container lines operating condition

The questionnaire shows that:

a) The purpose of the questionnaire is to determine the relative weight of operating status of liner companies. We use expert scoring method to determine the weight from five aspects: **Quality of enterprise (A), Capital credit (B), Corporate reputation (C), Innovation ability (D), Operation level (E)**.

b) Please score the relative importance of each indicator according to the scale standard (scale values reflect the relative importance of each element).

Scale value	Meaning
1	a_i compared with a_j, they have equal importance
3	a_i compared with a_j , a_i is moderate importance
5	a_i compared with a_j , a_i is obviously important
7	a_i compared with a_j , a_i is strongly important
9	a_i compared with a_j , a_i is extremely important
2,4,6,8	Representing the mean-value of 1,3,5,7,9
Reciprocal	a_j compared with a_i , $a_{ji}=1/a_{ij}$

a) Weight determination of importance comparison of primary indicators (i : j)

J / i	Quality of enterprise (A)	Capital credit (B)	Corporate reputation (C)	Innovation ability (D)	Operation level (E)
Quality of enterprise (A)	/				
Capital credit (B)		/			
Corporate reputation (C)			/		
Innovation ability (D)				/	
Operation level (E)					/

b) Weight determination of importance comparison of **Quality of enterprise (A)**

(i : j)

j / i	Human resources quality (A1)	Peer evaluation (A2)	Service quality (A3)	Service quality (A4)
Human resources quality (A1)	/			
Peer evaluation (A2)		/		
Service quality (A3)			/	
Service quality (A4)				/

c) Weight determination of importance comparison of **Capital credit (B)** (i : j)

j / i	Asset (B1)	Profitability (B2)	Operating capacity (B3)	Financing capacity (B4)	Debt-paying ability (B5)
Asset (B1)	/				
Profitability (B2)		/			
Operating capacity (B3)			/		
Financing capacity (B4)				/	
Debt-paying ability (B5)					/

d) Weight determination of importance comparison of **Corporate reputation (C)** (i : j)

j / i	Booking agreement performance (C1)	Transportation contract (C2)	The performance of service agreement (C3)	The performance of port agreement (C4)	The performance of ship agency agreement (C5)	The fulfillment of statutory obligations (C6)
Booking agreement performance (C1)	/					
Transportation contract (C2)		/				
The performance of service agreement (C3)			/			
The performance of port agreement (C4)				/		
The performance of ship agency agreement (C5)					/	
The fulfillment of statutory obligations (C6)						/

e) Weight determination of importance comparison of **Innovation ability (D)** (i : j)

j / i	Proportion of research and development personnel (D1)	Ownership of intellectual property rights (D2)	Proportion of innovation funds (D3)
Proportion of research and development personnel (D1)	/		
Ownership of intellectual property rights (D2)		/	
Proportion of innovation funds (D3)			/

f) Weight determination of importance comparison of **Operation level (E)** (i : j)

j / i	Transport capacity (E1)	Freight volume (E2)	Sailing frequency (E3)	Operating conditions in other areas (E4)	Global network (E5)
Transport capacity (E1)	/				
Freight volume (E2)		/			
Sailing frequency (E3)			/		
Operating conditions in other areas (E4)				/	
Global network (E5)					/

If you think there are other important indicators to reflect the liner company's operating condition, please also generous with your instructions：

_____

_____

_____

Thank you for your participation !