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Shenzhen energy group's strategic decision of logistics service

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SHENZHEN ENERGY GROUP'S STRATEGIC DECISION OF LOGISTICS SERVICE

By

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China

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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 material is included for which a degree has preciously been conferred on me.

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

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ABSTRACT

Title of Dissertation: **Shenzhen Energy Group's Strategic Decision of Logistics Service**

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This dissertation is a study of the performance of different logistics service solutions in Shenzhen Energy Group, comparing the results calculated by classic financial methods with each other.

An overlook of Shenzhen Energy Group is demonstrated under the present situation, and some theories have also been presented behind this phenomenon.

I put up specific analyses of the externality and internality of Shenzhen Energy Group with the help of Michael Porter's Five Forces Model. With the fluctuation of coal price, Shenzhen Energy Group needs a new method of coal procurement and logistics management to conquer the dilemma.

Specific modes of logistics solutions are calculated and analyzed in Chapter Two. Then, I conclude that if the thermal power station can run logistics as well as professional logistics providers, it should use the in-house strategy in order to make the total logistics cost at the optimal level.

Further comparison tells us that the operational cost weighs most of the total logistics cost, and a thermal power station should outsource the logistics service if it cannot control the logistics cost as well as a logistics expert. Additionally, it is cost-effective for an enterprise to build new ships than to acquire second-hand ships. And I support the strategic alliance of establishing a joint venture of coal transportation for Shenzhen Energy Group.

The freight rate is the utmost factor when a power station decides to outsource the logistics service or establish a joint venture. So the two parties involved in the joint venture contract should trade off and negotiate this issue meticulously.

At the end of my dissertation, I strongly recommend Shenzhen Energy Group cooperate with COSCO to establish a logistics company transporting coal for all the thermal power stations in this energy group. In favor of both the two parties, it is best for this joint venture to build new ships, and carefully deal with the issue of freight rate.

KEYWORDS: Coal Price, TPL, Core Competence, Mutual Benefit, Strategic Alliance, Freight Rate, NPV

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LIST OF ABBREVIATIONS

TPL	Third Party Logistics
LNG	Liquid Natural Gas
SEG	Shenzhen Energy Group
JIT	Just-In-Time
MT	Metric Tons
NPV	Net Present Value
COA	Contract of Affreightment

Introduction

Shenzhen Energy Group was established in the early 1990s in order to solve the problem of electricity shortage in the emerging southern Chinese city of Shenzhen. And this firm is a public company in Shenzhen Stock Exchange Market, most of the stock shares owned by the state. From this aspect, it can be concluded that this company is a typical Chinese stated-owned enterprise with its core business lying in coal-fired power stations. So far, Shenzhen Energy Group has seven power stations, two of which are coal-fired power stations in Shenzhen with 6×30Kw and 2×35Kw coal generators. Though Shenzhen Energy Group has fewer coal-fired power stations in number, these coal-fired power stations have occupied the top position of importance in this group because they are the most mature and profitable business in SEG, and hence their profit and cost has crucial significance towards the whole group. Maybe, these coal-fired power stations can be wholly named as the "cash cow" in Shenzhen Energy Group.

The price of coal has strategic influence on the business performance of Shenzhen Energy Group because the core business of coal power stations has coal as its only chief raw material, and inevitably, the fluctuation of coal price will affect its balance sheet dramatically. According to empirical experience, the fuel cost consists 60% of the total cost in a coal-fired power station so the price of coal plays a strategic role of cost control in a coal-fired power station. Unfortunately, during the year of 2004 and 2005, the price of coal has rocketed up by 15.08% in average whilst the highest by

60%, up to RMB 400-500 per ton. What makes things even worse is that the freight rate of coal transport and some intermediary costs have dramatically increased as well. For instance, the freight rate of ocean transport has commonly gone up by RMB14-16 per ton since January 2005. However, the electricity price is not that friendly to the market economy since the government in China collectively and centrally controls the electricity price. Consequently, the electricity price cannot respond to the fluctuation of coal price quickly and only slight adjustment has been made to the electricity price, which has little effect on compensating the extra cost of those coal-fired power stations.

Like many other enterprises running coal-fired power stations, Shenzhen Energy Group should also be confronted with the cost pressure arising from the increased coal price and freight rate despite the up-going demand for electricity with its price unchanged. As a result, in order to avoid the decline in its financial performance and keep the stock price stable, Shenzhen Energy Group has to deal with the crisis of the insane coal price in the short term. And in the long term, the company has to set up a new strategy to maintain its competitive advantages lying in a relatively stable price of raw material supply. The re-consideration of its logistics system can be a very meaningful topic of the new strategy because a more competitive supply chain can become a new core competence in Shenzhen Energy Group as Wal-Mart and IKEA are doing in the 21st century. In this century, the competition is no longer between single entities, but between different supply chains. Therefore, an effective supply chain can make the balance sheet of this group more decent and keep those stakeholders always confident and satisfied.

Literature Review

The modern supply chain management philosophy understands that the competition today is between different supply chains rather than between separate entities. As a result, the extra cost in a supply chain should be removed from the whole supply chain rather than be passed from one to another. With the development of Chinese economy, its domestic enterprises are so eager to change their traditional logistics operational methods that they are looking for a completely new mode of logistics service with more expertise and competence. Hence, this issue has occupied the position of top importance in the visionary and energetic Chinese entrepreneur's daily resolution. Therefore, it is necessary for Shenzhen Energy Group to establish a new logistics system so that it can conquer the crisis of the fluctuation of coal price.

When talking about the re-construction of a logistics service system, one must think of third-party logistics at sight. TPL is just like any procurement behavior of other service or products from the suppliers to the manufacturers. From a broad viewpoint or, in other words, a macro-viewpoint, third party logistics shares the common features of other outsourcing activities, such as the outsourcing of HR or IT resources. It is a trade-off between cost and control. As a result, the strategic decision-making process in an enterprise to decide whether it should employ TPL appears to be the same as the usual outsourcing decision making process. The goal of TPL is to reduce the investment in specialty of both people and facilities without affecting the enterprise's control of the whole logistics system. Hence, the enterprises could mainly focus on their core competence and through cooperation, the partners of logistics outsourcing are able to make full use of each other's competitive advantages and become more powerful and competitive in the market. There are several types of TPL service. For instance, some companies utilize the warehousing service while some others are employing the transport part. However, fundamentally, there are only two kinds of TPL, outsourcing the whole supply chain management and outsourcing part/parts of the whole supply chain management. And in other aspects, the strategic alliance is much more integrated than the usual TPL cooperation, so this type of TPL or strategic alliance is much more competitive.

However, although TPL enjoys so many advantages, it also suffers some disadvantages that might ruin the common application of TPL to cases or enterprises all around the world. For example, the enterprises are so afraid to lose control of the logistics service. Is there a feasible strategy to combine the advantages of both in-house and outsourcing logistics service? Hereinafter, I am going to introduce a new idea of hybrid operational philosophy that can be justified under the joint venture mode. By comparison between the results of these three solutions, I will create a methodology to select the most suitable solution and the criteria for judgment. In my dissertation, I recommend the hybrid solution of a joint venture. However, maybe it cannot be valid or suitable to every case, so the methodology and judging criteria are more meaningful than the results.

1 The Environmental Analyses of this Enterprise

1.1 The External Situation of this Enterprise

Now I am going to discuss the external situations of Shenzhen Energy Group by the means of Michael Porter's Five Forces Model. Figure 1 represents the main philosophy of Michael Porter's Five Forces Model.

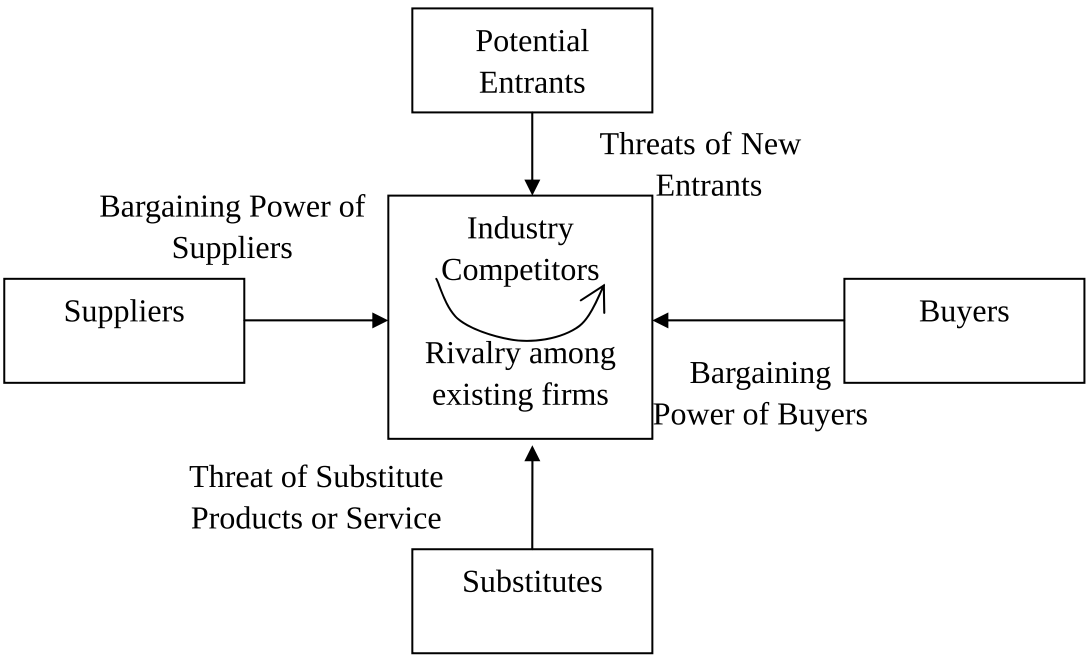

Figure 1 - Michael Porter's Five Forces Model

Source: Dr. Gary A. Lombardo. (2005). *Managing Strategy and Change in Shipping.* Unpublished lecture handout, World Maritime University, Malmö, Sweden

From figure 1, I can find that there are five determinant factors in Michael Porter's Five Forces Model. Hereinafter, I am going to analyze these five aspects respectively.

Suppliers

First of all, I will analyze the Chinese domestic coal market in details, because it is the market that really determines the position of the suppliers and buyers when they are negotiating with each other about the price and some other significant terms in the trade contracts.

Chinese economy has grown dramatically in recent year, and the domestic energy consumption will rise accordingly. From figure 2, with the development of Chinese economy, the electricity generated by coal-fired power stations has increased dramatically in the last decade. As a result, the fuel coal consumed by those coal-fired power stations will also grow tremendously as shown in figure 2. Hereby, I assume that if the coal consumed by those coal-fired power stations occupied most of the total coal consumption in China, the fluctuation of the electric coal demand would influence the domestic coal price dramatically.

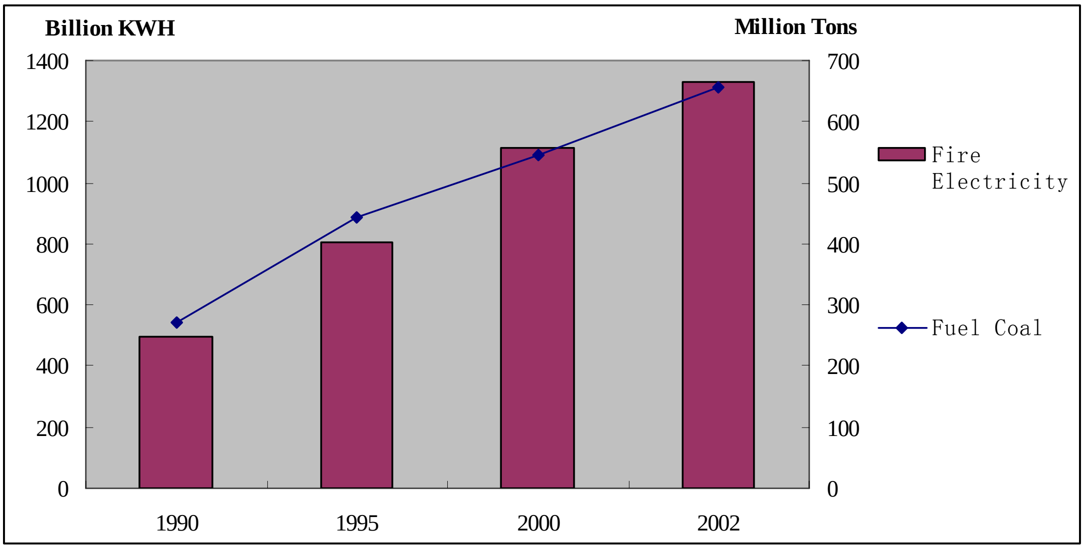

Figure 2 - Electricity Generated by Coal-fired Power Stations and Volume of Fuel Coal Consumed from 1990 to 2002 in China

Source: The National Bureau of Statistics of China web site has the data in figure 2 (http://www.stats.gov.cn)

From figure 3, it is easy to find that the proportion of the electric fuel coal used by the thermal power stations weighs most of the total amount of the coal consumption in China. And the proportion of electric fuel coal in the total coal consumption has grown from 26% in 1990 to 48% in 2002. In addition, the proportion of electric fuel coal trends to increase in the future. For instance, in the year of 2005, all the thermal power stations produced 1986 billion KWH of electricity, and the growth of the thermal power stations is higher than the growth of the whole electric industry in 2004 and 2005. So the demand of the electric coal can affect the price of the whole coal market enormously. And in fact, we can find that from 1990 to 2002, the total coal consumption of China has increased by 29%.

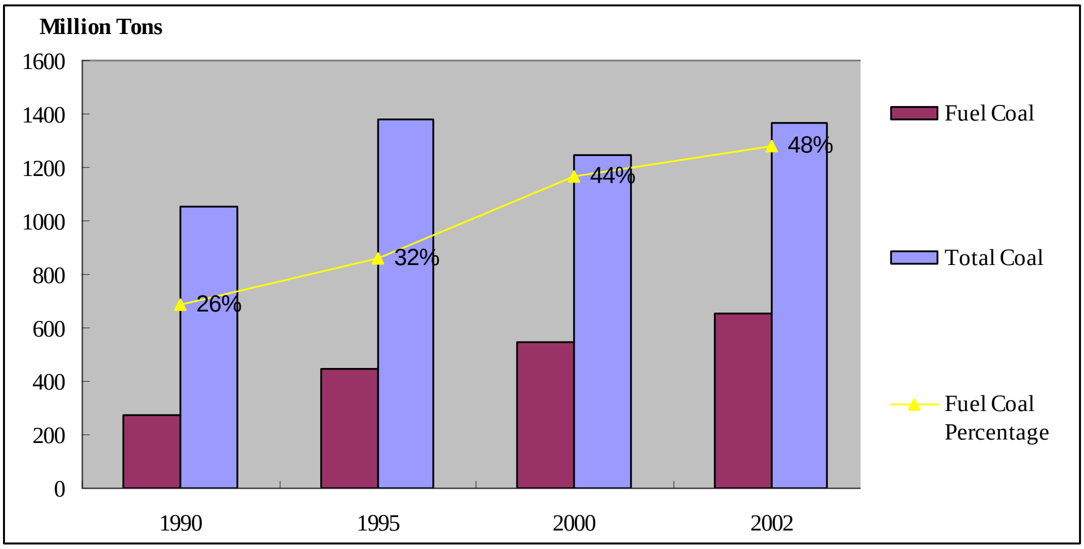

Figure 3 - Proportion of Electric Fuel Coal in the Total Coal Consumption in China

Source: The National Bureau of Statistics of China web site has the data in figure 3 (http://www.stats.gov.cn)

From figure 4, we can find that the domestic production of coal cannot surplus the domestic coal consumption in most years, and sometimes the supply of coal were even much less than the demand, such as in the year of 2000. Since the year of 2000, the coal consumption has increased much faster than the coal production, whilst the coal production has been relatively stable. Consequently, some unpredictable policies or government control can influence the domestic coal production severely in China. And I will analyze this cause in details later when talking about the trend of the price of electric coal in the domestic market. Hereby, I can conclude that the supply of coal is less than the demand of coal in Chinese domestic coal market, so the coal price will keep on rising if the Chinese economy goes on growing as the current trend and the domestic coal production is still limited due to the existing technology and coalmines. And I will analyze this conclusion in the following paragraphs through classic economics theories.

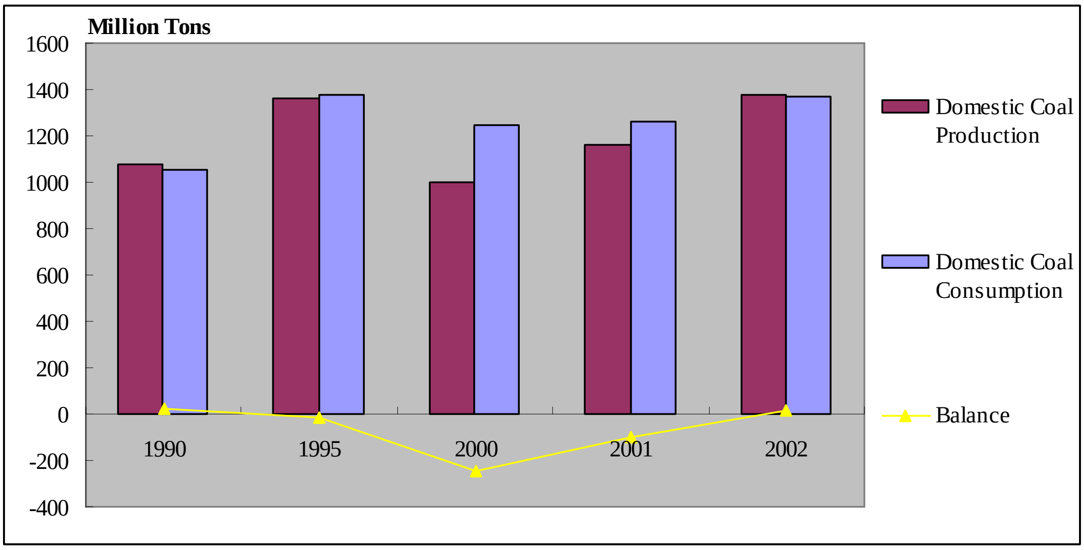

Figure - 4 Supply and Demand of Coal in the Chinese Domestic Coal Market

Source: The National Bureau of Statistics of China web site has the data in figure 4 (http://www.stats.gov.cn)

Shenzhen Energy Group's suppliers are almost dwelled in the northern part of China whilst those coal-fired power stations of Shenzhen Energy Group are all scattered around in the southern part of this country. So the coal has to be transported throughout China from north to south either by train or by sea, and this geographical separation between the suppliers and the consumers derives the need of coal transportation. Contrary to the concentrated control of coal production to few coal enterprises in the developed coal-production countries, Chinese coal industry is loosely dotted with small mines and the top eight coal enterprises have occupied only 20% of the total market share in China. In terms of this, I am able to conclude that the Chinese domestic coal market is a Perfectly Competitive Market since this market is full of millions of different suppliers in small size who are producing homogenous goods of herein coal and whose individual price is determined by the average price of the whole market. Figure 5 is the demonstration of a Perfectly Competitive Market.

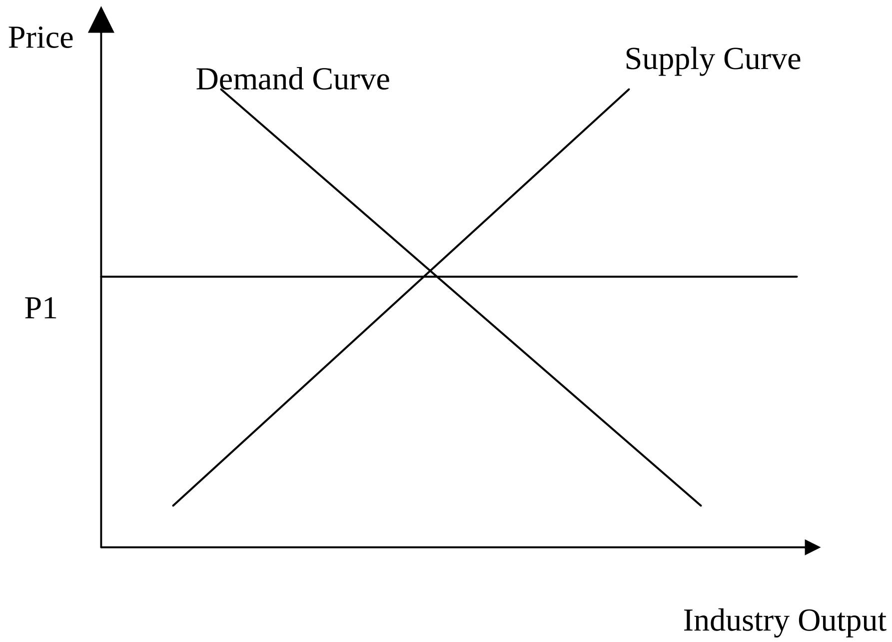

Figure - 5 Perfect Competition

Source: Samuelson, P.A., & Nordaus, W.D. (1998). *Economics* (16th ed.). The McGraw-Hill Companies, Inc.

According to statistics, coal-fired power stations now consume more than 60% of the total coal production in China as I have mentioned at the beginning of this chapter. As a result, the coal price in the domestic market is profoundly affected by the domestic consumption of electricity. And in the year of 2004, electricity consumption of China rose by 14.9% more than that in 2003 with an astonishing annual GDP growth of 9.5%. According to the continuous remarkable performance of Chinese economy in recent years, the optimistic domestic economists dare to predict that the strong growth of Chinese economy will keep in that trend for a long period of time. So hereby, the skyrocketing coal price can be justified by the astounding growth of the electricity demand induced by the magnificent domestic GDP advancement. For instance, in the year of 2005, China produced 1038 million tons of concrete, 49 million tons of fertilizer, 34 million tons of steel. It is known to all that these heavy industries are extremely energy consuming. Due to the tremendous growth in coal demand, the demand curve will move towards northeast.

Though the demand for coal has reached a historical level in China, the coal production has been encumbered with some government policies for safety concerns. For example, on July 21st, year 2005, 5290 coalmines were forced to cease to operate according to the law. The coal mines in China are potentially dangerous and poorly equipped, and in the first six months of 2005, 2672 miners died in accidents when working, rising by 3.3% more than that during the same period of 2004. Therefore, the government is determined to formalize the operation procedures and safety standards of all the mines nationwide in spite of the huge demand for coal production. And in the year of 2004, a serious accident called “Xing Ning” happened in a coalmine from Meizhou of Guangdong Province. After this accident, the provincial administration of Guangdong Province prohibits all the local coalmines to work any longer. As a result, from that time, all the coal used for electricity generation in Guangdong Province has to be imported from outside, such as Shanxi Province or even Vietnam, let alone Shenzhen Energy Group. So the coal transport of SEG has become the bottleneck of the whole supply chain of coal, and unless SEG can deal with this coal transport issue well, it could not run at a competitive level. Due to the unpredictable production encumbrance and the limitation of the coal production, the coal supply will not increase too much. As a result, the supply cure will move towards southeast slightly. Figure 6 is the final results of these fluctuation and adjustments.

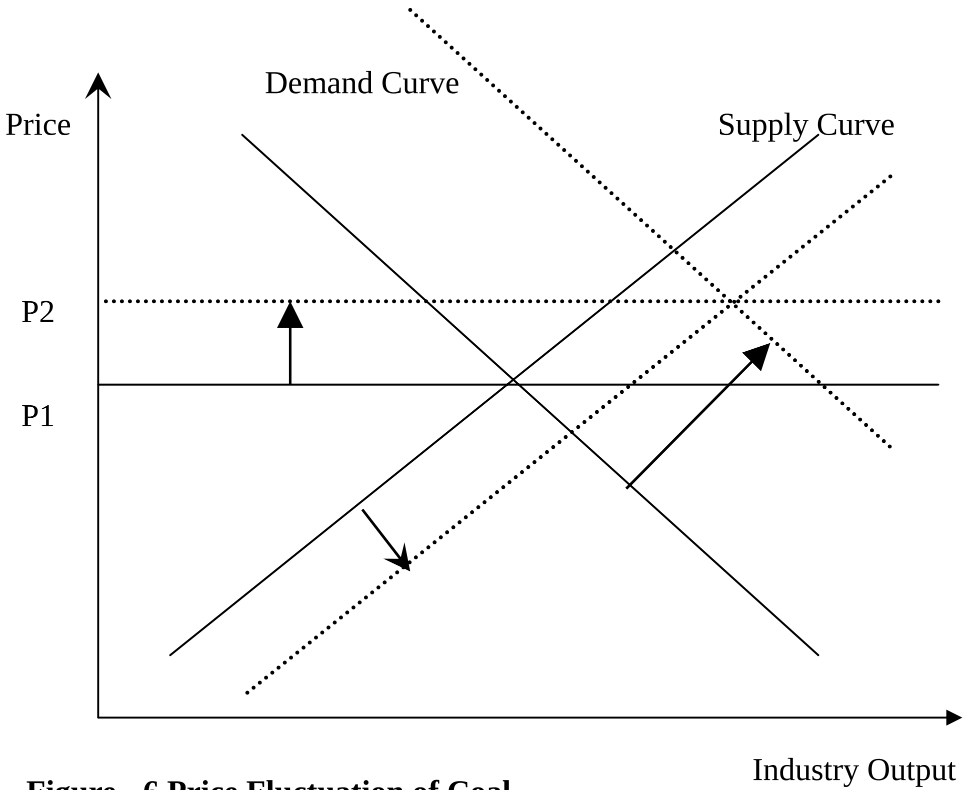

Figure - 6 Price Fluctuation of Coal

Source: Samuelson, P.A., & Nordaus, W.D. (1998). *Economics* (16th ed.). The McGraw-Hill Companies, Inc.

From the above analyses, I can conclude that the price of coal will rise according to the classic micro-economy theory, no matter who is the buyer of the coal, because all of the reflections mentioned above are automatic responses to the market conditions, and a single entity in China is not large enough to affect the price of the whole market on its own except the interference from the central government. So the fuel cost of most coal-fired power stations will inevitably ascend to a higher level despite the complaints they have yelled at their suppliers because in this world, there is not such a supplier who would like to share his profit with his clients when the market is almost reaching the zenith.

Moreover, there are some special conditions of the coal market in China. The coal and electricity enterprises have very special relationship since 1992. After the price of coal was allowed to change freely according to the market in 1992, the domestic coal market has been deliberately divided into two segments, one of which consisting 60% of the whole coal market is for the coal-fired power stations and priced by the government, the other of which consisting 40% of the whole coal market is for the free market and priced by the market. Therefore, the coal price for electricity enterprises are much lower than the market price, so almost every coal enterprise who provides the electricity coal is extremely dissatisfied with the current pricing policy and has furious argument with those coal-fired power stations about the price issue. Finally, it comes the very moment to settle this issue because the coal price has almost reached its ceiling in the past two years, and the conflicts between coal enterprises and coal-fired power stations have been triggered even more furious than before. For example, some coal enterprises would even breach the signed contracts of electricity coal rather than fulfill them. These coal suppliers possess extremely strong bargaining power not only because they are the state-owned large enterprises but also they have done their business under the principles of the market economy theory for a long time. As a result, the customers of these coal enterprises might probably be the international buyers, and these providers do not have to sell their coal with superior quality at an undesirable price. Hereinafter, I will discuss this market phenomenon in details through figures and economics analyses.

Figure 7 can represent the current Chinese coal market conditions perfectly.

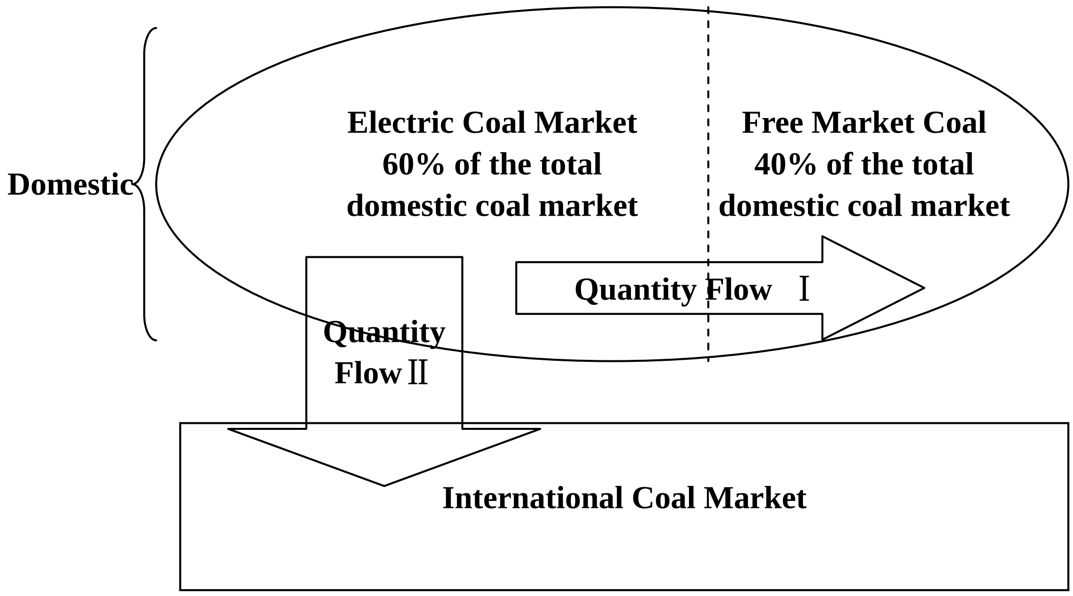

Figure 7 - Deliberate Segmentation of the Coal Market through Political Means in China

According to the above analyses, the price of the electricity coal is strictly regulated and “suggested” by the central government. However, in fact, the global coal market should be regarded as an integrated entity. So if there were not quota or export tariff in Chinese coal exportation, at this price level, those suppliers would not be willing to provide enough electricity coal to the buyers. As a result, the needed coal amount for the coal-fired power stations equals to Q2 in figure 6 whist the coal amount that those suppliers are willing to provide at this price level equals to Q1 in figure 6. So the gap between the supply and demand which equals to Q2-Q1 has to be fed through other means, such as coal import or procurement of market coal at the free market price. Or I could explain this phenomenon in another aspect. Some coal that ought to be provided as the electricity coal would flow to the domestic free market or international market, and those coal-fired power stations has to buy this coal at a higher price, as the quantity flow Ⅰ and Ⅱ shown in figure 7. In July 2005, the coal price of the international market was 52 USD per metric ton, and at the same time, the coal price of the domestic free market was 400 RMB per metric ton. So the coal price of these two markets was almost the same, but because the average freight rate of international coal transport was 15 USD per ton, the coal of the domestic free market was more competitive than the international coal. However, some neighbor countries of China, such as Japan or South Korea, are able to import the coal from the Chinese free market because of the lower freight rate due to the closer geographic distance. Similarly, some neighbor countries of China, such as Vietnam, are able to export the coal to South China due to the lower freight rate. As a result, the quantity flow Ⅰ of coal can be feasible without the existence of quota and tariff. In other words, some Chinese coal-fired power stations might lose some domestic electricity coal at a lower price, and have to import some coal at a higher price from the international market instead. Similarly, in the domestic coal market, the electricity coal can be more easily changed to free market coal by selling at a higher price and breaching the signed contracts when the coal price is high enough. So the quantity flow Ⅱ of coal can be feasible as well. Fundamentally, in spite of the complicated coal flow procedure, the so called market coal obtained by the coal-fired power stations at a higher price level is just the coal which ought to be the electricity coal, but the coal suppliers are not willing to sell the coal to the coal-fired power stations at such a low price. In conclusion, the gap between the supply and demand that equals to Q2-Q1 will be fitted by importing or procuring international or domestic coal at a higher.

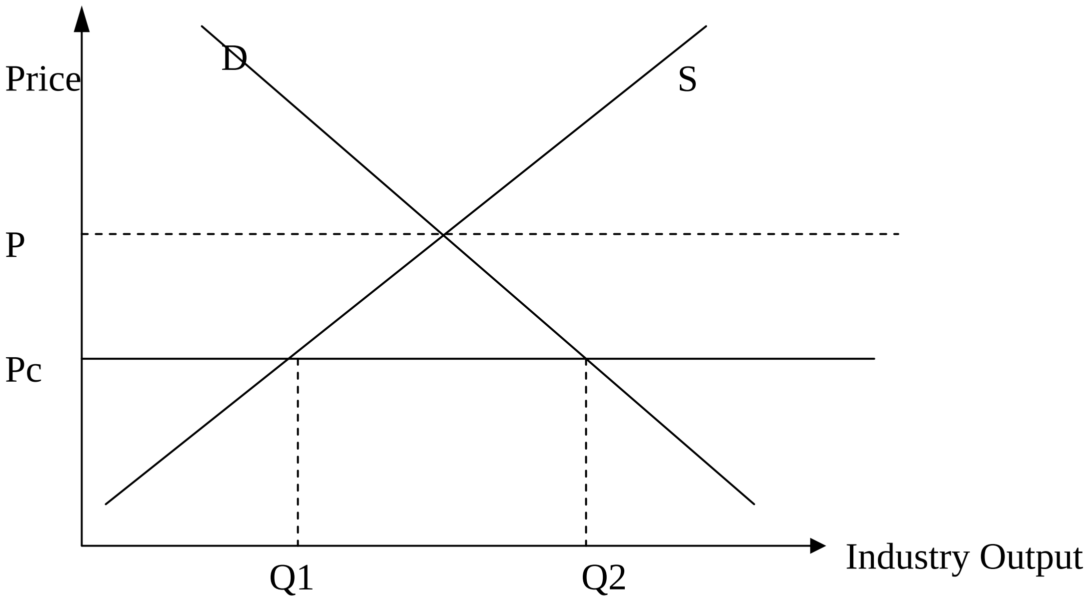

Figure 8 - Current Chinese Electricity Coal Market Condition

Source: Samuelson, P.A., & Nordaus, W.D. (1998). *Economics* (16th ed.). The McGraw-Hill Companies, Inc.

However, in reality, the Chinese government has imposed strict export and import quota on the coal exportation since the year of 2003. For instance, in the year of 2006, the quota of coal export in China is 80 million metric tons. So the coal of the domestic free market cannot easily flow to the international market, and the volume of the coal export only occupies slight proportion of the total domestic coal production. Therefore, the Chinese domestic coal market is a relatively single entity, and the suppliers would not provide enough coal for those coal-fired power stations at such a low price level set by the central government.

Figure 9 can demonstrate the situation that I have discussed above. It is not difficult to find that in the past decade, the domestic coal supply cannot surplus the domestic coal demand, and it is necessary for the domestic coal users to import coal from the international market. Unlike the usual assumption made by most Chinese people due to the large domestic coal inventory and production, the Chinese coal market absorbs plenty of coal from the international market.

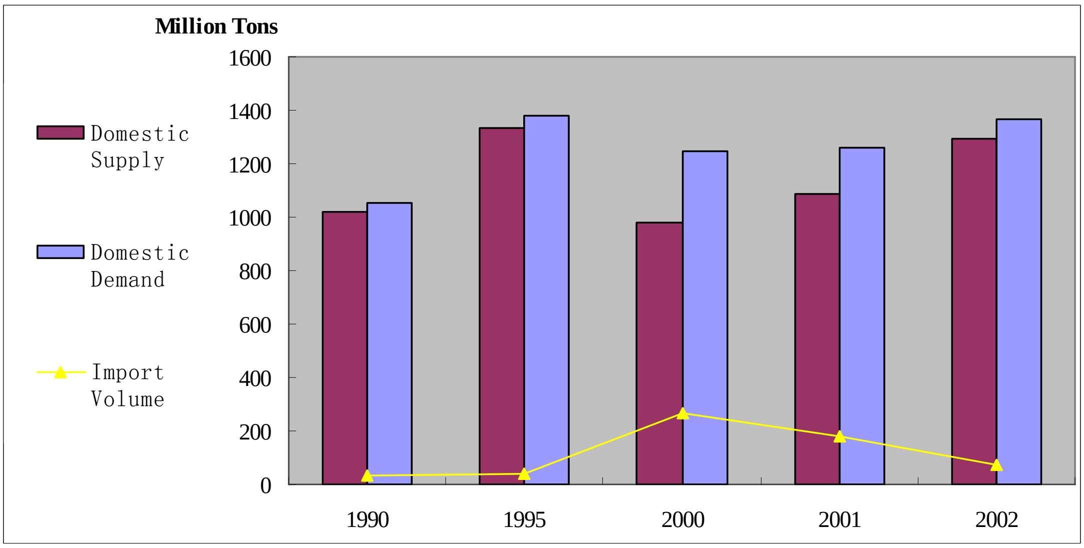

Figure 9 - Domestic Supply and Demand of Coal in China

Source: The National Bureau of Statistics of China web site has the data in figure 9 (http://www.stats.gov.cn)

As a result, when the coal price goes up dramatically, those coal suppliers will have more buyers and stronger bargaining power than before because it is the booming demand of coal that has caused the price to rise. So at this moment, the suppliers will exert themselves to increase the price of electricity coal because of the stronger bargaining power. And the outcome of this argument is that the price of those electricity coal procurement contracts has increased by 5% in average in the year of 2006. And the above result is negotiated by the suppliers, buyers and the government through great effort for millions of times.

In conclusion, Shenzhen Energy Group could not control the price of the coal unless Chinese authorities permit the exchange of coal futures that is illegal at this moment.

Therefore, the fuel cost of SEG will rise according to the market in the short term, and in the long term, the coal market will fluctuate more widely than before since the domestic coal market has been changing much freer. The supply chain of coal for Shenzhen Energy Group becomes more and more vital for SEG because the risk involved in the fuel supply has become much bigger. Hence, the re-consideration of the supply chain for SEG has reached the strategic role in this enterprise's business arena.

Similarly, in terms of coal transport, because of the increased demand for coal and the geographical isolation between coal production and consumption areas in China, the demand for coal transport has ascend dramatically as well in 2004 and 2005. Due to the limited total transport capacity in the market, the freight rate of coal has risen accordingly. For instance, since January 2005, the freight rate of offshore ocean transport has increased by RMB14-16 per ton. The offshore transport suppliers, such as China Shipping and COSCO, also have very strong bargaining power like those coal suppliers. Although the ocean transport is more mature and competitive than other industries in China because the international ocean transport market of China was opened to the outside much earlier than other industries, the domestic offshore ocean transport must been fulfilled by those ships flying the Chinese flags. Therefore, the domestic offshore transport market is a relative separate market in China. This market acts in accordance with the classic economics theory as well, so the supply and demand of ocean transport capacity will determine the freight rate. However, the carriers are able to withdraw some old ships trading in the international market and put them into the domestic coal trading market in a very short period of time through the method of ship importation instead of new ship-building or the procurement of second-hand ships. Those ship owners can make their ships flying the convenient flags become the ships flying the Chinese flags and registered under the Chinese

Nationality. From this aspect, the offshore coal transport market is more competitive than the coal market. But more than 50% of the offshore transport market of China has been under the control of the company named China Shipping. Therefore, this company has very strong bargaining power in the domestic transport market and can influence this transport market dramatically. Though COSCO is re-establishing and integrating the offshore transport in the group, the market share of each ship owner in the domestic transport market will not change in the short term.

From the above analyses of the suppliers, I conclude that now Shenzhen Energy Group is facing serious challenges and great pressure from the up-going price and freight rate of coal in the market. If the enterprise wants its balance sheet to keep healthy, it should resort to some new management concepts or logistics solutions, which will be helpful to their cost control. For instance, the upstream or downstream integration of the whole supply chain can fulfill this target of those coal-fired power stations, such as those in Shenzhen Energy Group.

Buyers

The buyers of Shenzhen Energy Group are almost the local residence, industrial and commercial enterprises, and agricultures in Shenzhen. The electricity has been divided into mainly four categories in China, such as residential electricity, industrial electricity, commercial electricity and agricultural electricity etc. Hence, the price of electricity various from type to type, and the price of industrial electricity is the highest whilst the price of the agricultural electricity is the lowest. The price of electricity is quite different from other products or service since it is strictly regulated by the government and cannot change flexibly in accordance with the market. In addition, in China, the price of electricity is pretty much lower than that in the western countries, such as United Kingdom and France that have a relatively more scientific pricing system of electricity. For example, according to the data provided by J.P Morgan, the return rate of the investment is only 0.4% in the electricity transmission network in China annually. However, in many other countries, this rate can be around 4%-7%, and in fact, this return rate of China is the lowest in the world. Personally, I do not think that the current pricing system of electricity would change in the near future, though the electricity price has recently been changed slightly nodded by the relevant regulatory authorities, because this revolutionary adjustment of the electricity pricing policy must be discussed and authorized by the central government, and inevitably, the whole procedure of this revolution requires plenty of time. In terms of this, though the consumers of electricity are loosely scattered around, their bargaining power is very strong, because the government will protect the interest of most citizens and any slight fluctuation of electricity price could not come into force unless series of serious and tedious audits are heard by the municipal jury. Though the price of the industrial electricity has been raised somehow through great effort of those electric enterprises approved by the government, the price of the electricity cannot rise as easily as before since the government insists that the electricity market be stable.

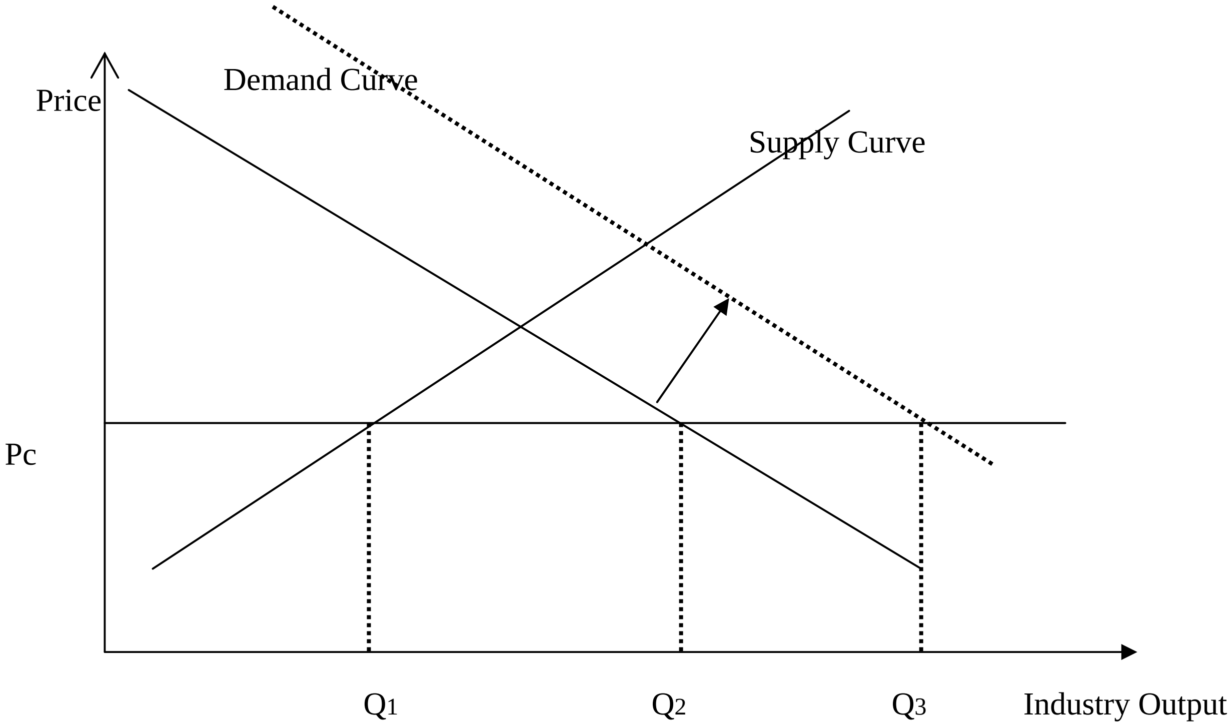

Figure 10 - Supply and Demand Curve under Government's Regulation of a Ceiling Price

Source: Samuelson, P.A., & Nordaus, W.D. (1998). *Economics* (16th ed.). The McGraw-Hill Companies, Inc.

Hereinafter, I will analyze the effects caused by the government's regulation imposing on the electricity price. In fact, from figure 10, I am able to find that the government's ceiling price of electricity is detrimental to the current situation of electricity shortage, because it is not difficult to conclude that the electricity shortage is even worse when the demand for electricity has gone up but the ceiling price remains the same. So the government should alter its regulations and policies of electricity pricing system, and obviously only can a free electricity market relieve the dilemma confronted not only by the coal-fired power stations but also by the whole country.

In light of buyers, I conclude that the current situation is very serious for Shenzhen Energy Group because its profit margin could not be enlarged in the short term despite the increased revenue. Because this company can hardly find any methods to raise the price, the solutions to the current crisis most probably lie in the cost reduction.

Substitutes

The substitutes of electricity do not really exist nowadays, because it is a certain kind of energy with special features of its own, for example, environmental friendliness, restriction of the electric appliance's consumption range, and transmission simplicity etc. As a result, the electricity consumption cannot easily be replaced by gasoline or coal. For instance, the TV sets or the lights cannot consume gasoline as their energy. So the real competition is between several types of electricity generated by different methods, such as nuclear power stations, coal-fired power stations, and hydraulic power stations. In China, among the total installed capacity of electricity, 73.7% is from thermal power stations, and 23.2% is from hydraulic power stations. Thereafter, I am going to compare them with each other from different aspects.

Comparison of the Construction Period: The ordinary construction period of a hydraulic power station is about 8 to 10 years, which is around 6 to 10 years of a thermal power station as well, and roughly 10 years of a nuclear power station. So the construction periods of these three different types of power stations are relatively similar, and in terms of the construction period, these three different types of power stations are in the same competitive level.

Investment Comparison: According to Mr. Qiu's thesis, at the end of the completion of construction, the total investment of a hydraulic power station is RMB2600 per KW, that of a thermal power station being RMB2888 per KW and that of a nuclear power station being RMB6000 per KW at the discount rate of 10% in the year of 1991. Obviously, a thermal power station as Shenzhen Energy Group is running is almost as competitive as a hydraulic power station, and additionally they are more advantageous than a nuclear one in terms of the initial investment.

Annual Operational Cost: Mr. Qiu also calculated the operational cost per year respectively for a hydraulic, thermal and nuclear power station, and that of a hydraulic one is RMB0.46 cent per KW×h, that of a thermal one being RMB3.4 cent per KW×h, and that of a nuclear one being RMB2.86 cent per KW×h in the early of the 1990s. It is self-evident that the annual running cost of a hydraulic power station is much more advantageous than that of a thermal one or a nuclear one. And the thermal power stations are as competitive as nuclear ones in terms of the operational cost in China. Moreover, Shenzhen Energy Group is now suffering from a server crisis of coal price fluctuation which makes the relative high operational cost even higher.

Table 1 - Comparison among Hydraulic, Thermal and Nuclear Power Stations

Type / Criteria	Construction	Investment	Operational Cost
Hydraulic	8-10	2600	0.46
Thermal	6-10	2888	3.4
Nuclear	10	6000	2.86

Source: Qiu, Z.E. (1991). The systematic analyses of the economy comparison among hydraulic, thermal and nuclear power stations. *Yangtze River,* 22, 32-35.

Table 1 has summarized the mentioned results of the comparison above, and I can find that a hydraulic power station is the most competitive among these three types because the investment cost and the operational cost of such a power station are both the lowest compared with the thermal power stations and the nuclear power stations. In the financial aspect, the thermal power stations are almost as competitive as those nuclear power stations.

However, the accessibility of a power station is not only connected with the financial report, but also it is connected with the current technological level and environmental concerns in a region or a country. For instance, the nuclear power stations are very technology intensive, and the local residence believe that they are potentially hazardous to the environment due to the radiation probability. As a result, the enterprises that want to invest in such a project cannot obtain approval easily from the government, because the public are against such a project. Similarly, environmentalists argue with the scientists and government severely about the issue of the construction of hydraulic power stations because those environmentalists believe that a hydraulic power station is harmful to the ecology system in the surrounding region. As a result, the hydraulic power stations and the nuclear power stations have developed quite slowly in these years in China due to the technological and environmental restraints.

After the above analyses, I conclude that Shenzhen Energy Group suffers from a huge cost disadvantage arising from the skyrocketing coal price compared with its biggest competitors of hydraulic power stations, but the inaccessibility of hydraulic resources in China and the time-consuming approval procedure of a hydraulic power station can relieve this competitive pressure. So the current competitors of Shenzhen Energy Group are mainly from those operators running thermal power stations as well, and I will analyze this aspect in the following section.

Industrial Competitors

Shenzhen Energy Group has occupied 80% of the installed capacity of electricity in Shenzhen, and appears to be the monopoly in the local electric industry. So in the short term, no electric enterprises will be able to catch up with Shenzhen Energy Group in the provincial market share. However, in the long term, after the completion of some major hydraulic projects, like the famous China Three Gorges Project, Shenzhen Energy Group will be confronted with serious competition in light of higher viable cost and logistics cost. Obviously, a hydraulic power station does not need any fuel but only water is adequate to drive the generators. In terms of this, such a hydraulic power station does not require any raw materials or derived logistics service, which involves quite a lot of cost and risk. However, the hydraulic power stations also suffer from their own disadvantages, such as the long distance between the power stations and the electricity consuming areas, and the imbalance of hydraulic resources among different seasons. So in light of this, the competition between hydraulic power stations and thermal ones will continue for a long period of time. The local electric market of Shenzhen will mostly consume coal-fired electricity because the hydraulic energy resources in the Guangdong Province are not very abundant and the thermal power stations are more accessible and feasible.

Shenzhen Nan Shan Power Station Corporation has an installed capacity of almost 900,000 KW, and it is the biggest thermal power station driven by LNG in China. LNG has been recently introduced to China as the fuel for power stations, and it is very environmentally friendly. Therefore, the developed countries are more willing to construct this type of power stations, especially in Japan. More importantly, the construction of a LNG power station is much cheaper than that of a coal-fired power station, so the annual depreciation of a LNG power station is much lower. But the market share of Nan Shan Power Station is much lower than that of Shenzhen Energy Group; so in the short term, Nan Shan is a threat to SEG, but cannot compete with SEG. Additionally, in the long term, the price of LNG might probably increase by 75% during the next five years in Asia. Hence, the fuel cost of such a LNG power station will rise significantly accordingly. Furthermore, the current price of LNG is higher than the price of coal, but the price of coal will not fluctuate as much as the price of LNG. As a result, I take a pessimistic view of the Nan Shan’s return rate to its stakeholders since the variable cost of Nan Shan Power Station Corporation will ascend more dramatically than the variable cost of Shenzhen Energy Group, especially in the fuel cost that comprises most of the total cost. In conclusion, in the long term, Shenzhen Energy will be much more competitive than Nan Shan Power Station Corporation in the cost.

The new energy resources such as solar energy, nuclear energy and wind energy is very expensive in the initial capital investment, because these are technology intensive projects, and the introduction of these new concepts requires time, investment, experiments, observation and promotion. Thereby, it will take tens of years for those scientists to spread those technologies before they can really take the place of the traditional energy resources causing heavy pollution. So in the short term, the power stations transforming the new energy resources into electricity would not come into the spotlight.

1.2 The Internal Situation of this Enterprise

Mawan Power Station is a sub-company of Shenzhen Energy Group and it is also the core business of SEG. Therefore, the management level of this power plant occupies the top position in SEG. Hence, I believe that the business mode of this thermal power station is suitable enough to embody the operation of the whole group.

The first phase of the construction of Mawan thermal plant has an installed capacity of 2×350,000KW whilst the second having 4×350,000KW. During the first phase, the annual coal consumption is 2,100,000 tons whilst the second being 4,200,000 tons. In summary, the annual coal consumption of this power plant equals to 6,300,000 tons. Figure 11 demonstrates the management structure of Mawan Power Station in Shenzhen Energy Group vividly.

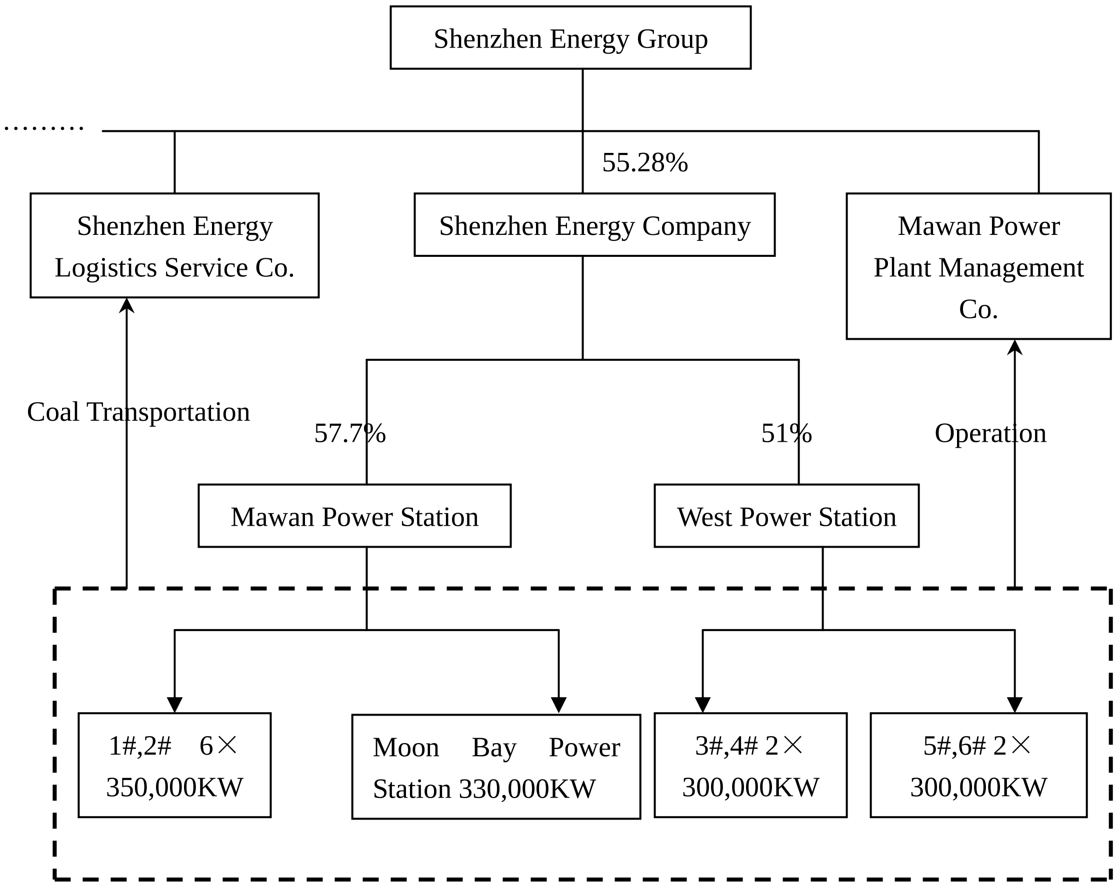

Figure 11 - Operational Structure of Shenzhen Energy Group

Source: The Shenzhen Energy Group web site gives detailed information on its own backgrounds

(**http://www.sec.com.cn**)

From figure 11 of Shenzhen Energy Group, I can find that Shenzhen Energy Group possesses a complex bureaucratic structure which makes the whole group operate systematically and functionally. And its sub-company, Shenzhen Energy Logistics Service Company, executes the logistics service for all these power stations under the leadership of Shenzhen Energy Group. However, except some trucks for inland transport, this logistics company does not possess any ships for water transport, or any trains for long-distance inland transport. The chief purpose of this logistics transport company should be the integration of the whole procurement and transport activities, in other words, the integration of the whole supply chain. So we can take Shenzhen Energy Group Logistics Service Corporation as a 4PL logistics operator who integrates the whole supply chain of coal procurement for Shenzhen Energy Group. Though Shenzhen Energy Logistics Service Corporation has outsourced the logistics service to several professional logistics companies, such as COSCO Shenzhen, the whole supply chain is not perfectly arranged, because Shenzhen Energy Group almost procures its total volume of coal from several but limited numbers of coalmines in north China and this strategy ignores a very significant philosophy of portfolio concept. Hereinafter, I will elaborate this theory through a specific example with the help of linear programming and decision-making.

Table 2 - Original Coal Procurement Plan

Supplier	Quantity	Price	Cost (Thousand)
Pithead Coal	600,000	295	177,000
Yunnan Coalmines	100,000	298	29,800
Guizhou Coalmines	400,000	306	122,400
Sichuan Coalmines	100,000	310	31,000
Chongqing Coalmines	100,000	308	30,800
Hunan Coalmines	100,000	310	31,000
Local Coalmines	100,000	270	27,000
Total	1,500,000	299	449,000

Table 2 is a coal procurement plan of a power station[1], and the total amount of coal consumed annually is fixed. The average total cost of the coal equals to only 299 RMB per ton in this strategy whilst the average price of coal is from about 310 to 350 RMB per ton in the domestic market. From table 2, it is not difficult to find that this strategy costs less than that procuring all the coal from north China and the total risk can also be reduced by this portfolio strategy by allocating the procurement of coal to several suppliers, because a coal-fired power station will possess more bargaining power when dealing with several small or medium local suppliers than when dealing with only one or two large state-owned suppliers. Therefore, when the market fluctuates greatly, the coal-fired power station will be able to control the fixed contracts and price. Furthermore, if it is possible, the coal-fired power station can even invest in the coalmines. In this way, the coal-fired power stations will have more control in the coal price when the market fluctuates. Moreover, strategic alliance with powerful coalmines can also help coal-fired power stations to control

[1] I deliberately create all the information in table 2 & 3 to support my following ideas.

the price and risk involved in the coal procurement, but this situation cannot demonstrate the advantages of the portfolio strategy. The plan in table two is not the most cost-effective one, because through exquisite linear programming, I can obtain a plan that makes the total cost at a lower point without affecting the total procurement quantity[1].

Table 3 - Final Coal Procurement Arrangement

Supplier	Quantity	Price	Cost (Thousand)
Pithead Coal	650,000	295	191,750
Yunnan Coalmines	100,000	298	29,800
Guizhou Coalmines	300,000	306	91,800
Sichuan Coalmines	700,000	310	21,700
Chongqing Coalmines	500,000	308	15,400
Hunan Coalmines	800,000	310	24,800
Local Coalmines	250,000	270	67,500
Total	1,500,000	295	442,750

Table 3 is the adjusted coal procurement plan of this power station, and from table 3, it is easy to find that the total cost of coal has been reduced by over than RMB 6 million and the average price of coal is RMB 4 less than the former plan. Obviously, after adjustment, the procurement plan becomes more scientific and cost-effective. However, it may not be the most desirable procurement plan since the restraints of these factors vary from case to case and the desired objectives do not always remain the same.

[1] Professor Ding Yi-zhong exquisitely discussed the procedure of decision-making and linear programming in her class and book.

From the above example, I can conclude that the total procurement cost will fall down when the whole logistics system becomes more sophisticated or a strategic alliance is successfully introduced to the group. If the logistics system of this power station is effective enough to afford a more complex supply chain or procurement plan, the total procurement cost of this enterprise will decrease accordingly. So the whole supply chain should be taken as an integrated one and the total cost of this supply chain is much more important than the sole logistics cost or the procurement cost [1]. As the new modern supply chain management philosophy goes, the competition today is between different supply chains rather than between separate entities.

In conclusion, from the above analyses, Shenzhen Energy Group needs to re-develop its logistics system to improve the performance of the whole supply chain. Though the current logistics system of SEG is relatively advanced with the philosophy of 4PL management, the logistics service still has some leeway for improvement. Hereinafter, I will present three possible solutions to the current logistics system of SEG, and analyze them respectively.

[1] Professor Bourverie-Brine has talked about this philosophy in his class.

2 The Possible Solutions of the Issues in this Enterprise

Shenzhen Energy Group has many options to improve the efficiency of its logistics service so that the supply chain of those power stations can be further integrated. A well-organized logistics system can greatly help the supply chain improve its performance. The transport of coal is the bottleneck of the supply chain of coal, because the volume of coal transportation is so huge that the cost and risk involved in the coal transport are very tremendous. For instance, a full ship of coal just resembles an enormous volume of coal in inventory that ties up with plenty of money and risk. Therefore, the shorter the transport time is, the less the interest lost will be. A just-in-time logistics service is also suitable for a thermal power plant to transport coal so that the inventory cost can be at the lowest level. Because the daily consumption of coal is very astounding in a thermal power station, the safe inventory level occupies the utmost position for a thermal power station. Once the inventory of coal runs out, the off-work cost of such a power station can be astonishingly high. A roughly optimal inventory level can be found through calculation to make the total inventory cost and risk at the lowest level which equals to the safe inventory level according to the law. So the optimal situation of inventory is that the transport of coal is seamlessly connected with the coal consumption of a thermal power station with a scientific inventory level in case the supply chain is broken for some unexpected reasons.

If the efficiency of coal transportation can be improved dramatically, SEG is able to reduce the capital cost tied up with the coal inventory, and the holding cost of the inventory will also be decreased by the optimization of coal inventory as well. Afterwards, I will elaborate three specific logistics solutions to improve the competitive advantage of SEG. Hereby, I must declare that the following calculation will all be based on the assumption that SEG is capable to run the logistics service as competitive as the professional logistics enterprises do, and the supply chain of SEG follows a JIT mode.

2.1 The In-house Logistics Operational Solution

As the scheme of this section goes, I am going to analyze the in-house strategy. If SEG wants to do logistics on its own, it needs to acquire the assets to fulfill the coal transportation, such as ships, warehouses, trucks and so on. These investments will cause interest lost tied up with the capital and those assets will depreciate year by year. Thereafter, I will apply financial formula and calculations to the analyses of in-house strategy. In order to make the problem easier, I will take the Mawan Power Station as an example, and other cases are similar to this example.

The safe inventory level of coal equals to the amount that is enough to generate electricity for two consecutive weeks or 14 days according to empirical experience of a thermal power station and the regulations from the provincial administration. In Mawan Power Station, the safe inventory is $\frac{2{,}100{,}000+4{,}200{,}000}{365}\times 14$ =241,644 tons and the daily consumption of coal is $\frac{2{,}100{,}000+4{,}200{,}000}{365}=17{,}260$ tons. The quay of Manwan Power Station has two berths, each of which has the capacity of a 50,000 tons ship according to what He, W.Q. and Gao, Y.Z. has mentioned in the article of "*Terminal Structural Design for Shenzhen Mawan Power Plant*". However, in fact, even a ship with the deadweight of about 68,000 MT can still be discharged in this berth[1]. In terms of the stowage factor of coal, such a ship can carry about 65,000 tons of coal in average[2]. According to the theory of economy of scale, the larger the ships are, the lower the average cost of coal per ton will be. However, the depth of the two berths in Mawan power station restrains large ships from berthing. So I take the ships with a DWT of 65,000 tons as the coal carriers for Mawan power station, and with these ships the cost of coal per ton can be optimized. In addition, Mawan power station can also employ smaller ships to fulfill the coal transport service, but the average cost of coal per ton will increase accordingly. SEG would not choose this strategy unless under some special or urgent circumstances. For instance, SEG could not prepare adequate coal to transport when the coal supply is interrupted temporarily by some unexpected reasons.

According to empirical experience, it takes about 17 days to complete a round-trip voyage from Qinghuangdao to Mawan Power Station[3]. One full ship of coal can provide enough fuel for this power station to operate for about $\frac{65,000}{17,260} = 3.77$ days. So Mawan Power Station requires $\frac{17}{3.77} = 5$ ships as the minimum number of ships to transport coal. However, the above conclusion is based on the assumption of an existing two-week inventory of coal. So this model will not be valid under some emergent situations, such as coal shortage or fire accidents of coal.

[1] *The documents of COSCO Shenzhen Shipping Corporation* have detailed information about the ships carrying coal for Mawan Power Station, like Peng Wei having the DWT of 68676 MT.
[2] This number is not calculated but from *the documents of COSCO Shenzhen Shipping Corporation*, so herein the stowage factor of coal is about 1.06 that is less than the ordinary factor of 1.30-1.42.
[3] The voyage time can be calculated according to the data from table 4.

Table 4 - Voyage Time from Mawan Power Station to Qinghuangdao (Days)

Voyage Time from M to Q	Load Time	Voyage Time from Q to M	Discharge Time	Total Voyage Time
5.15	3.35	5.01	3.23	16.74

Source: *The documents of COSCO Shenzhen Shipping Corporation.* (2006). Shenzhen: Author.

If SEG decides to operate the logistics service on its own, this enterprise has to invest 5 ships at least. According to the regulations of the offshore transport, the maximum age of a bulk carrier in service cannot be over than 33 years old, and in order to take the uncertainties into account and make the calculation simpler, I take the maximum age of a ship in service as 30 years. Now, SEG still has three options: to purchase five new bulk carriers, to acquire five second-hand ones, or to time-charter five bulk carriers. Moreover, I have to point out that SEG could also apply a portfolio strategy for the in-house logistics service. For instance, SEG could purchase some new ships whist the rest ships could be second-hand or time-chartered. But the strategic decision of a portfolio situation has also to be determined by the different features of new ship mode, second-hand ship mode and time-charter ship mode respectively. Hereinafter, I will analyze these three situations respectively.

New Ship Mode

According to table 5, I can calculate the average building price of a new ship with a DWT of 70-75,000 is 30 million US dollars in the year of 2004. In order to avoid the complexity of the price fluctuation of shipbuilding, I take 30 million as the shipbuilding price of Shenzhen Energy Group despite the variation and risk involved in the ship building market. Because SEG is not a shipping enterprise in China, its ships can only be applied to the straight-line depreciation according to the Chinese tax law. In light of the tax law, if SEG purchases ships on its own, it cannot enjoy the tax-reduction privileges as a shipping service enterprise. Therefore, the total capital cost of ships is 30×5=150 million US dollars in the present value. Moreover, it takes about 18 months to build such a ship, so SEG will spend at least 18 months to build these 5 ships simultaneously. And I take 2 years as the total new-ship building time in light of those uncertainties. However, when the new-ship building market is booming, all the shipyards around the world are fully occupied as what has been happening in recent years, and the time of building a new ship will be much longer than under this circumstance. But I ignore this aspect in order to avoid the complexity of those unexpected market conditions and make the results of these calculations more understandable.

The average cost of a single voyage is about 260,000 US dollars, so the operation cost of a single ship is $260{,}000 \times \frac{365}{17} = 5{,}600{,}000$ US dollars annually. The interest rate is 3.60% of a 5-year-period deposit account in China, and I take this rate as the discount rate of the NPV calculation. As a result, the discounted value of the total operation cost of a single bulk carrier running for 30 years equals to PV (3.60%, 30, 5.6) = 101.72 million. However, in terms of the time of building the ships, the present value of the total operation cost of a single bulk carrier equals to $\frac{101.72}{(1+3.60\%)^2} = 94.8$ million. The scrapping market varies greatly as well, and I take the recent market price as the final scrapping price in order to limit the complexity of the model. The latest price of scrapping market is about 300 US dollars per ton according to “the import of the hulk in the beginning of this year”, *Recycle of Chinese Resources* (2006), and the average light ship with a DWT of about 60,000 tons weighs around 10,000 tons. So the present value of the final scrapping income of a single ship is $\frac{300\times 10{,}000}{(1+3.60\%)^{32}} = 967{,}407 = 0.97$ million. So the NPV of this investment equals to:

$$NPV = -150 - 5\times 94.8 + 5\times 0.97 = (619) \quad \text{Million US dollars}$$

Table 5 - Bulk Carrier Building Price in 2004 (million USD)

Ship Type	Sep.02	Sep. 03	Apr. 04	May. 04	Jun. 04	Jul. 04	Aug. 04	Sep. 04
25-30,000 dwt.	14.5	16.5	19.0	19.0	19.0	19.0	18.5	19.0
45-55,000 dwt	19.0	19.5	28.0	28.5	28.5	28.5	27.5	28.5
70-75,000 dwt	21.0	23.0	31.5	32.5	32.5	32.5	31.5	33.0
150-180,000 dwt	34.5	38.0	52.5	52.5	52.5	53.5	54.0	58.5

Source: *The Drewry Monthly.* (2004). 10.

Second-hand Ship Mode

The second ship model is very complex, because the age of such a bulk carrier can vary in a wide range. And all these second-hand ships cannot endure in service for the same period of time due to the different quality of various ships made by different shipyards and the different abrasion levels of various ships maintained by different seafarers. As a result, there might be numerous different cases, and I assume that SEG purchase a ship of 15 years in service, because there was a similar case that in the year of 2005, "Gleamray Maritime of Greece sold a ship of 69332 dwt built in 1990 to Pt.Arpeni of Indonesia at the price of 29 million US dollars" according to Monthly Comment on the World Ship Market. Additionally, the second-ship market is changing dramatically from year to year, and I cannot find any strong connection between the age of a ship and its price, so I am not able to formulize the numerical relationship between the age and price. It also prevents me from optimizing the age of the acquired used ship. And the second-hand ships also enjoy an advantage of quick entrance into the market, because they do not need any construction period. As a result, they can be put into service immediately after the trades of second-hand ships are settled despite a very short period of time to import these ships into the domestic offshore transport market, because the China Maritime Code regulates that the Chinese domestic offshore transport can only be fulfilled by those ships flying the Chinese flags.

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If SEG purchased the 15-year-old ships, the number of the ships should be $5\times\frac{30}{15}$ =10. And I take 30 years as the total service time of those ships in order to be in accordance with the case mentioned before. But the acquisition interval of every 5 ships should be 15 years, because SEG only needs 5 ships in every 15 years. So the present value of these ships equals to:

$$\text{PV}=29\times5+\frac{29\times5}{(1+3.60\%)^{15}}=230 \text{ Million US dollars}$$

The present value of the total operation cost of these 10 ships equals to:

$$PV= 5\times PV\ (3.60\%, 30, 5.6) = 508.6 \text{ Million US dollars}$$

The present value of the final Scrapping income of these 10 ships equals to:

$$PV=5\times\frac{300\times 10{,}000}{(1+3.60\%)^{15}}+5\times\frac{300\times 10{,}000}{(1+3.60\%)^{30}}=14{,}016{,}167=14 \text{ Million US dollars}$$

And the total NPV of this investment should be:

NPV=-230-508.6+14= (724.6) Million US dollars

Time-Charter Ship Mode

According to the current offshore market condition, the daily hire of a ship with 70,000 DWT is about 20,000 USD. So the annual hire of these five ships equals to $20{,}000\times 365\times 5=36{,}500{,}000=36.5$ million USD. And the present value of total hire of these five ships in thirty years equals to:

$$PV = 5\times PV(3.60\%,30,36.5)=3315 \text{ Million}$$

In a time-charter party, the charterer should be responsible for the voyage cost[1], so the discounted value of the total operation cost of a single bulk carrier running for 30 years equals to PV (3.60%, 30, 5.6) = 101.72 million. The total discounted value of the operational cost of these five ships is 101.72×5=508.6 million. As a result, the NPV of this strategy should be:

[1] Professor Sandevarn has mentioned this in his class.

$$NPV = -3315 - 508.6 = (3823.6) \quad \text{Million US dollars}$$

In conclusion, the NPV of the New Ship Model has the highest value, and as a result, if SEG wants to operate the logistics service on its own, it had better to purchase five new ships to run the offshore seaborne transport. However, this strategy is time-consuming, and if time doe not permit, SEG should acquire five second-hand ships to save time though this strategy will cost a little bit more. And SEG should not consider to time-charter five ships to run coal transport unless under some emergent occasions, for instance, temporary coal-transport shortage. As I have mentioned in the foregoing chapter, a portfolio strategy can also be used when SEG is capable to operate logistics service as well as a professional shipping company. In other words, SEG could purchase both new and used ships whilst chartering ships to do this offshore coal transportation. But the proportion of new, second-hand and time-chartered ships in the portfolio should depend on the purpose of the project. For instance, if the project mainly focuses on the Net Present Value, new ships are mostly preferred. But if the project mainly concentrates on the time consumed, second-hand ships or time-chartered ships are mostly desirable. With the help of linear programming, an optimal portfolio strategy can be worked out. However, this in-house strategy suffers from a disadvantage of inflexibility or elasticity. For instance, when SEG cannot prepare enough coal to transport from North to South, it should still use these large ships to transport coal no matter these ships are purchased or chartered[1].

[1] The ships under a time charter party cannot be easily changed either.

2.2 The Outsourcing Logistics Operational Solution

The sub-company of SEG now is outsourcing its coal transport to COSCO Shenzhen through a contract of affreightment, and the latest freight rate is about 7.5 US dollars per metric ton. And the annual total coal consumption of Mawan Power Station is 6,300,000 tons. So the annual total freight cost of coal for this thermal power station equals to:

$$7.5 \times 6{,}300{,}000 = 47{,}250{,}000 = 47.3 \text{ Million US dollars}$$

And the discounted net present value of total freight in thirty years equals to:

$$NPV = PV(3.60\%,30,47.3) = 859.15 \text{ Million US dollars}$$

So the NPV of this strategy equals to (859.15) million USD. However, the calculation above ignores the fluctuation of the offshore market freight rate in thirty years. In other words, the assumption of the outsourcing mode underestimates the risk involved in the offshore seaborne trade market. The freight rate of coal in this case is above the average freight rate level because the current market is higher than the ordinary conditions.

When the freight rate of coal varies 1 USD per metric ton, the NPV of this strategy will change:

$$NPV = PV(3.60\%,30,6.3) = 114.43 \text{ Million US dollars}$$

The operational cost of coal transport per ton equals to:

$$\frac{260{,}000}{65{,}000} = 4 \text{ US dollars per ton}$$

Regardless of the depreciation of the bulk carriers, the lowest freight rate the 3PL can offer is 4 US dollars per ton. As a result, the highest NPV of this strategy equals to[1]:

$$NPV = PV(3.60\%, 30, 4 \times 6.3) = (457.7) \quad \text{Million US dollars}$$

So the Net Present Value of this strategy can vary from (457.7) million US dollars to (859.15) million US dollars. In order to make the calculation easier and more understandable, I take the mean of (457.7) and (859.15) as the final NPV of this outsourcing strategy. So the Net Present Value of such an outsourcing strategy equal to:

$$NPV = \frac{-457.7 - 859.15}{2} = (658.4) \quad \text{Million US dollars}$$

This strategy is much more flexible than the in-house strategy because SEG can ask for both larger and smaller size of ships due to the terms of the COA. If SEG can control the operational cost as well as a professional enterprise, the net present value of the new ship mode in the in-house strategy roughly equals to that of the outsourcing strategy. However, on one hand, SEG cannot do as well as a professional shipping service firm. On the other hand, the risk involved in the offshore shipping

[1] According to the classic economics theory, one firm can also operate when the market price equals to the variable cost.

market cannot be simply explained or calculated as the average value of the highest and lowest freight rate level because I cannot guarantee that the freight rate of the offshore shipping market goes like a linear function. As a result, this calculated outcome is a rough reference or indication of the reality.

2.3 The Joint-Venture Logistics Operational Solution

Personally, I advocate this logistics mode very much, because it is a hybrid operational mode which combines the advantages of both in-house and outsourcing. Hereinafter, I will elaborate the financial outcomes of every specific situation in this mode, which might have very interesting or unique appearances. Though I strongly support this solution, some of the financial results cannot match my viewpoint or even reverse my suggestion. Why does this happen? The main reason lies in the assumptions I have made before. I have assumed that SEG can do logistics as well as professional logistics enterprises, and the freight rate of the joint venture is the same as the market rate. In the next chapter, I am going to explain the effects of these assumptions, and discuss how these options will change according to the changes of the assumptions.

Usually, each of the electric enterprise and the logistics company will contribute half of the total assets of the joint venture, and I am not going to discuss the other situations of the stakeholders' proportions. So the capital structure of the new logistics company appears as figure 12:

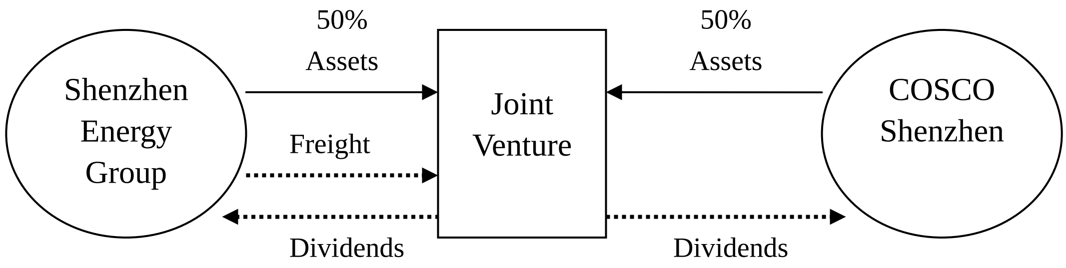

Figure 12 - Structure of the Joint Venture

The shipping company must invest five ships as its assets in the joint venture, and SEG has to pay half of the total price of these five ships to COSCO as its assets[1]. This joint venture can also enjoy the privilege of flexibility. For instance, when the SEG cannot prepare adequate coal to transport, COSCO could find a smaller ship in its own fleet in a short period of time because the interest of COSCO is also connected with SEG through this joint venture. And I have calculated in the previous section that the strategy of building new ships costs least but is time-consuming, and second-ship mode costs more but saves time. Thereafter, I will analyze these two options for SEG respectively to do some comparison.

New Ship Mode

At the beginning of this joint venture, SEG has to pay half of the total price of these five ships, which equals to 75 million USD. Additionally, SEG has to pay 14 million USD as the cash flow of half a year for the joint venture, while the other half should be paid by COSCO[2]. However, it will take at least two years for the joint venture to

[1] The two parties can also use other ways to cooperate with each other through negotiation, for instance, 40% and 60% stock share cooperation.
[2] This amount of cash flow is assumed hereby. And the cash flow can be more or less than this amount.

build these five ships; so during the first two years, this joint venture cannot start to run immediately. Hence, the present value of the cash flow paid by SEG equals to $\frac{14}{(1+3.60\%)^2}=13$ million USD. Moreover, SEG also has to pay 47.3 million USD annually to the joint venture as the freight[1], and the present value of the total freight for thirty years equals to $\frac{PV(3.60\%,30,47.3)}{(1+3.60\%)^2}=800.5$ million USD. Thereafter, I will calculate the annual net income of this joint venture which is closely connected with the dividends of SEG with the help of an income statement.

Table 6 - Income Statement of Joint Venture (New Ship) (Million)

Revenue	Year XXXX
Freight	47.3
Costs and Expenses	
Operating, selling, general and administrative expenses	(28)
Depreciation[2]	(5)
Earnings before Interest and Tax	**14.3**
Less Tax[3]	(4.7)
Net Earnings	**9.6**

If this joint venture does not retain any earnings and allocates all the net profit as the dividends to SEG and COSCO, the present value of the income from this joint venture to SEG equals to: $PV=\frac{PV(3.60\%,30,4.8)}{(1+.3.60\%)^2}=81.25$ million USD. And at

[1] I take the current freight rate of coal as the long term freight rate of coal in this joint venture.
[2] I use linear depreciation method to calculate the annual depreciation cost of this joint venture.
[3] The income tax rate equals to 33% in China.

the end of thirty years, the net assets of this joint venture equals to:

Cash Flow + Scrapping Income = $28{,}000{,}000 + 300 \times 10{,}000 =$ 31,000,000 = 31 Million US dollars

The present value of the assets is $\frac{31}{(1+3.60\%)^{32}} = 10$ million US dollars.

So the net present value of this strategy for SEG equals to:

$$\text{NPV}=-75-13-800.5+81.25+\frac{10}{2} = \text{(802.3) Million US dollars}$$

From the financial aspect, this strategy cannot compare with the in-house New Ship Mode. However, it is a theoretical calculation and inevitably, this calculation has ignored quite a lot of significant factors, such as the logistics expertise and the professional threshold. Unless SEG maintains its operational cost as COSCO does, the final outcome will change profoundly if SEG is not as competitive as COSCO in the logistics cost management. And I will analyze the influence of the operational cost in the following chapter.

Second-hand Ship Mode

This mode is quite similar to the second-hand ship mode I have mentioned before in the section of in-house logistics service. However, the major difference lies in the annual dividends from the joint venture, and the initial capital investment.
The initial capital investment of SEG equals to:

$$PV = \frac{1}{2} \times [29 \times 5 + \frac{29 \times 5}{(1+3.60\%)^{15}}] = 115 \text{ Million USD}$$

Table 7 - Income Statement of Joint Venture (Second-hand Ship) (Million)

Revenue	Year XXXX
Freight	47.3
Costs and Expenses	
Operating, selling, general and administrative expenses	(28)
Depreciation	(9.7)
Earnings before Interest and Tax	**9.6**
Less Tax	(3.2)
Net Earnings	**6.4**

Similarly, the initial cash flow that SEG has to invest must be adequate for the joint venture to run for half a year. Thus, the present value of the initial cash flow equals to 14 million. Since the joint venture can run once it is started, the present value of the total freight that SEG pays to the joint venture annually equals to $PV(3.60\%, 30, 47.3) = 859.15$ million US dollars. The present value of the total income from the joint venture equals to $PV(3.60\%, 30, 3.2) = 58.1$ million US dollars. And the present value of the final assets equals to $\frac{15.5}{(1+3.60\%)^{30}} = 5.4$ million US dollars. So the net present value of this strategy equals to:

$$NPV = -115 - 14 - 859.15 + 58.1 + 5.4 = (924.65)$$

Like the result from the above analysis, the NPV of this strategy is even less than that of the Second-hand Ship mode in the in-house logistics section. But the outcome is based on the assumption that SEG can do logistics as well as the professional logistics enterprises, such as COSCO. Therefore, it is a question of core competence, and on most occasions, an unprofessional enterprise cannot do the job out of its own field as well as in its own field. Hereinafter, I will discuss this issue in Chapter Three in details; try to discover some factors behind the phenomena, and to draw some conclusions at the end of the dissertation.

3 The Comparisons of the Results from Each Different Solutions

In-house versus Outsourcing

It is interesting to find that if an enterprise can operate logistics as well as the experts do, it should do the logistics by its own. Because from the financial calculation I have done before, it is not difficult to find that in-house logistics service costs the enterprise least in the long term. However, the main flaw of this assumption lies in that usually an electric enterprise cannot arrange transport as well as a professional shipping company. Thus, SEG might not be able to control its logistics cost as COSCO does.

However, the gap of management capability between SEG and COSCO cannot easily be identified or evaluated by numerical methods. So the authentic operational cost cannot be assumed accurately, thus the results of the calculation being not valid. I can only conclude that the NPV of the total operational cost weighs over than 70% of the total NPV of each strategy, so if the operational cost rises up significantly, the final NPV will change dramatically. As a result, operational cost is the most important factor that determines the in-house or outsourcing strategy in terms of financial performance.

And in order to analyze the significance of this factor, I will introduce the concept of “NPV elasticity” of the operational cost. Herein, the “NPV elasticity” of the operational cost stands for the amount of the final NPV that will change according to one unit change of operational cost. For example, if the operational cost changes 1 million per ship every year, the NPV of the strategy will change:

$$PV = 5 \times \frac{PV(3.60\%,30,1)}{(1+3.60\%)^2} = 84.6 \text{ Million US dollars}$$

in the mode of in-house logistics by building new ships. Similarly, if the operational cost changes 1 million per ship every year, the NPV of the strategy will change:

$$PV = 5 \times PV(3.60\%,30,1) = 90.8 \text{ Million US dollars}$$

in the mode of in-house logistics by acquiring second-hand ships. So from these calculations, I find that the final option of the strategy is greatly affected by the efficiency of the cost control of the whole logistics system. And if the annual operational cost per ship has gone up by 2 or 3 million US dollars, the current option of in-house logistics service will be discarded, because the NPV will change about 200 or 300 million US dollars which is a remarkable proportion of the total NPV.

Millions of cases has proven that TPL can reduce the total logistics cost astonishingly, such as the case of Shanghai General Motor Company. And the most important strategic reason for shippers to be interested in outsourcing their logistics activities is still a need to reduce costs or amount of capital invested. And figure 13 will demonstrate that cost reduction ranks the top position among those driving forces of TPL.

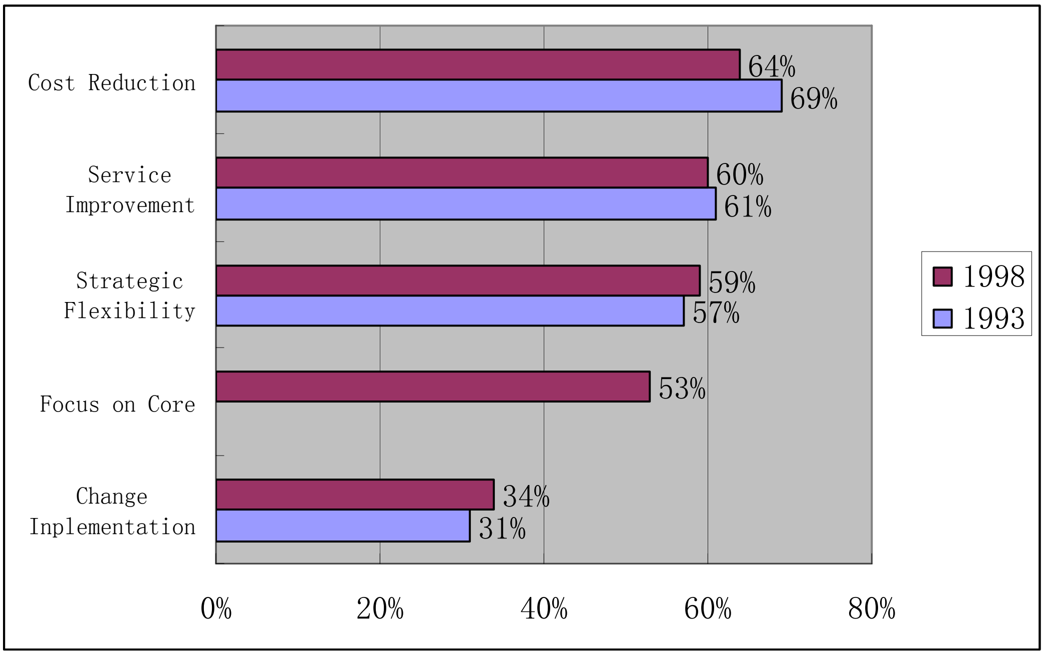

Figure 13 - Strategic Reasons for Outsourcing

Source: Peter van Laarhoven, Magnus Berglund, & Melvyn Peters. (2000). Third-party logistics in Europe--five years later. *International Journal of Physical Distribution & Logistics Management*, 30, 425-442.

From figure 13, it is obvious that cost reduction is the overwhelming reason for an enterprise to outsource its logistics service. And figure 14 tells us that 40% of the enterprises' intention of cost reduction has been fulfilled by the TPL, while only 9% of the original purpose was unsatisfied in 1998. Hence, I can conclude that TPL is a feasible for SEG to reduce its logistics cost. It is also evident that SEG could not do as well as COSCO. In terms of this, SEG should outsource the logistics service or cooperate with other professional logistics service providers in order to make its balance sheet more decent.

However, though outsourcing logistics service reduces the total logistics cost, TPL also involves much risk. For instance, SEG might be afraid to lose the control of the logistics system which is one of the core functions in SEG as well. Additionally, SEG might not be able to control the risk involved in the fluctuation of the shipping market efficiently. However, a joint venture can solve the shortages of TPL, because SEG can also monitor the logistics service as one of the chief stakeholders in the joint shipping entity. Beside this advantage, I will analyze some other factors that might change the disadvantageous position of the strategy of a joint venture afterwards.

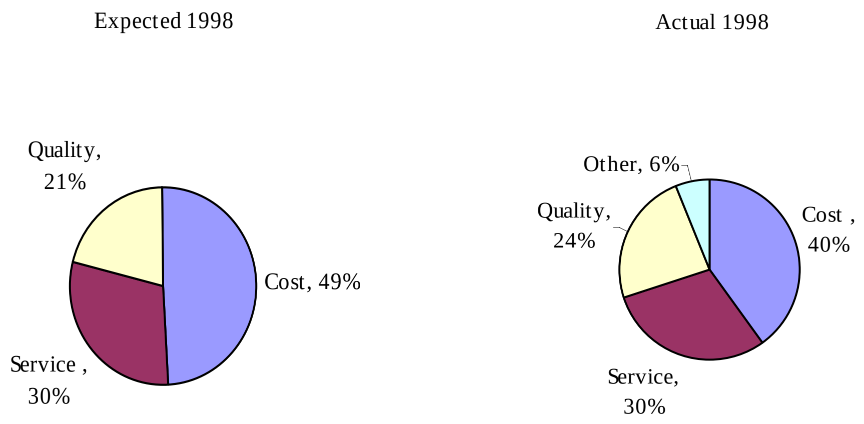

Figure 14 - Expected and Actual Benefits from TPL

Source: Peter van Laarhoven, Magnus Berglund, & Melvyn Peters. (2000). Third-party logistics in Europe--five years later. *International Journal of Physical Distribution & Logistics Management*, 30, 425-442.

Outsourcing versus Joint-Venture

As what I have discussed before, SEG should outsource its logistics service through TPL or a joint venture method rather than the in-house logistics mode. However, at the first glance, it seems to be more desirable for SEG to outsource the logistics service than to cooperate with COSCO through a joint venture. But are there some key factors that have profound effects on the option of this strategy as what I have just discussed in the former section of in-house versus outsourcing? The answer is YES.

The key factor of the joint venture is the annual freight paid by SEG, because it is not difficult to find that the freight contributes over than 96% of the total NPV in each strategy. With the same methodology, I will calculate the effect of one unit change in the freight, and it can be taken as the “NPV elasticity” of the freight.

If the freight changes one million US dollars each year, the total NPV of this option of building new ships in joint venture mode will change:

$$PV = \frac{PV(3.60\%,30,1)}{(1+.3.60\%)^2} = 17 \quad \text{Million US dollars}$$

If the freight changes one million US dollars each year, the total NPV of this option of acquiring second-hand ships in joint venture mode will change:

$$PV(3.60\%,30,1) = 18 \quad \text{Million US dollars}$$

And if the freight changes one million US dollars per year, the freight rate of coal will change:

$$FreightRate = \frac{1{,}000{,}000}{6{,}300{,}000} = 0.16 \quad \text{US dollars per ton}$$

Obviously, the freight rate of coal can be negotiated easily if SEG cooperates with COSCO when they have established a joint venture with each other. I take the optimal situation as the bottom line when the gross profit equals to zero. So the current annual freight can be reduced by 14.3 million US dollars or 9.6 million US dollars at most. And the maximum NPV that can be reduced by the freight reduction equals to 243 million USD and 173 USD respectively. Obviously, these are very outstanding numbers which could have fundamental effects on the final decision.

If the freight changes one million US dollars each year, the total NPV of the income from the joint venture of building new ships will change:

$$PV = \frac{1}{2} \times \frac{PV(3.60\%,30,1 \times 0.67)}{(1+3.60\%)^2} = 5.67 \text{ Million US dollars}$$

If the freight changes one million US dollars each year, the total NPV of the income from the joint venture of purchasing second-hand ships will change:

$$PV = \frac{1}{2} \times PV(3.60\%,30,1 \times 0.67) = 6.08 \quad \text{Million US dollars}$$

Hereby, I will calculate the balance point when the NPV of the new ship mode of a joint venture equals to that of the outsourcing mode.

When these two NPVs are the equal, the annual total freight should be:

$$\text{Annual Total Freight}=\frac{802.3-658.4}{17-5.67} = 12.7 \quad \text{Million US dollars}$$

Hence, the current freight rate ought to be reduced by $\frac{12.7}{6.3} = 2$ USD per metric tone. As a result, when the freight rate is over than 5.5 USD per ton, the option of outsourcing is better than that of the acquisition of new ships of a joint venture; and when the freight rate is less than 5.5 USD per ton, the option of the acquisition of new ships of a joint venture is better than that of outsourcing.

Hereafter, I will analyze the balance point when the NPV of the second-hand ship mode of a joint venture equals to that of the outsourcing mode.

When these two NPVs are the same, the annual total freight should be:

$$\text{Annual Total Freight} = \frac{(924.65 - 658.4)}{(18 - 6.08)} = 22.3 \text{ Million US dollars.}$$

Hence, the current freight rate ought to be reduced by $\frac{22.3}{6.3} = 3.5$ USD per metric tone. As a result, when the freight rate is over than 4 USD per ton, the option of outsourcing is better than that of the acquisition of second-hand ships of a joint venture; and when the freight rate is less than 4 USD per ton, the option of the acquisition of second-hand ships of a joint venture is better than that of outsourcing.

The above result is very important, because on most occasions, when a joint venture is initiated, the professional logistics enterprise is willing to provide the transport facilities from its current fleet because in the way, it can withdraw the capital investment tied up with the ships as soon as possible. Therefore, SEG should exert itself to negotiate with COSCO to reduce the freight rate due to the cooperation between these two powerful giants in their own field. However, in fact, it is SEG who wants to cut its logistics cost strongly. In terms of the financial aspect, COSCO will lose half of the profit compared with the strategy of cutting the freight rate. But in other hand, COSCO could obtain half of the total price of 5 ships in advance. And from this aspect, the investment of those ships can be withdrawn earlier than the plan operated by COSCO on its own. Additionally, COSCO can also avoid the risk involved in the fluctuation of the shipping market, because no matter how dramatically the shipping market changes, this joint venture remains to be a cash cow of COSCO, and the ships involved in this strategic alliance will never be out of job or hunt for food on their own. Hence, the two parties in this strategic alliance will mutually benefit from this negotiation, and the two members should trade off the benefits and losses during the negotiation.

New Ships versus Second-hand Ships

It is known that the demand for ocean transport has increased strongly in the past a few years, because the Chinese economy, especially its steel industry, has grown rapidly recently. And the prosperity of the steel industry definitely causes the booming of iron ore import. Hence, the ocean freight rate will go up responsively. The market is so sensitive and elastic that the investment of ships has become much more than before. Because the bankers are very conservative and averse to risk, they are not willing to provide any loan to those ship owners when the shipping market performs poorly. When the freight rate goes up, it is easy for those ship owners to finance enough money from the banks to build new ships. Afterwards, the price of both new and second-hand ships will rise up.

Nowadays, the acquisition of new ships is more competitive than the acquisition of second-hand ships, which is mainly caused by the sublime market price of second-hand ships. Because the freight rate has rocketed-up dramatically in recent years, the price of a second-hand ship is almost as much as that of building a new one. In fact, this phenomenon is very abnormal and unusual.

Thus, under what conditions should SEG build new ships, and when should SEG purchase second-hand ships? I will demonstrate the calculation procedure to conclude the results.

It is important to find this very point when the NPV of both new ships and second-hands ships are the same, because SEG could choose any one of the two strategies at this point.

Assume: New Ship Price = A

Second-hand Ship Price = B

$$5 \times A = 5 \times B + \frac{5 \times B}{(1 + 3.60\%)^{15}}$$

$$\text{Result} \quad A = \frac{27}{17} B$$

In conclusion, when the price of a new ship is about 1.6 times as the price of a second-hand ship, the two options are both feasible. Furthermore, when the price of a new ship is less than 1.6 times of the price of a second-hand ship, SEG should choose to build new ships. Similarly, when the price of a new ship is more than 1.6 times of the price of a second-hand ship, SEG should choose to purchase second-hand ships. Obviously, when the transport market is as high as the situation now, the price of a second-hand ship is as much as a new one. It is wise for SEG to build new ships. However, when the transport market falls dramatically, the price of a second-hand ship will be as low as the scrapping value. It is wise for SEG to purchase second-hand ships instead. However, when the ship-building market is booming dramatically, the new ship-building will take quite a longer time than the ordinary average time, so the discount period will change accordingly and the introduction of new ships will be even harder. Hence, the NPV of new ship-building mode will be different. Hereby, the fluctuation of the ship building market has been ignored, and as a result, the conclusion cannot be valid sometimes during the abnormal ship-building booming periods such as the recent years.

4 Summary and Conclusions

From the above analyses, I suggest that it is best for SEG to cooperate with a professional logistics provider, such as COSCO, in order to reduce the total logistics cost by means of a joint venture. Moreover, this joint venture should firstly choose to build new ships under the current market condition, and in favor of SEG, the freight rate that SEG pays to this joint venture could be further lower than the market level. However, if the logistics partner is not willing to purchase new ships or the current transport capacity for SEG is so limited that this joint venture has to buy second-hand ships; on one hand, SEG has to persuade the logistics partner to make use of a portfolio strategy that means to acquire both new and second-hand ships. On the other hand, SEG can ask this joint venture for a lower freight rate as well.

However, for that logistics provider, the situation will be adjusted a little bit. It is desirable for this joint venture to build new ships under the current market condition too. But this logistics expert should try to increase the freight rate in order to gain more profit every year. So from this aspect, the two parties involved in this strategy should trade off the freight rate issue according to the market conditions. The risk and profit of such a joint venture ought to be balanced for both the two parties, and only when the freight rate is at an optimal level, can the two parties involved in such a joint venture gain the best profit and reduce the risk to the lowest level.

This type of logistics operational mode combines the advantages of both the third party logistics and the in-house logistics service. For instance, through this logistics mode, Shenzhen Energy Group can better integrate the whole supply chain of all the thermal power stations under the name of this energy group, such as Mawan Power Plant, the Moon Bay Power plant etc. SEG can procure all the coal consumed by the thermal power stations together as an integrated entity, and this kind of procurement method could make the procurement cost much lower than the thermal power stations purchase fuel coal separately, because SEG will have stronger bargaining power as a larger buyer than as isolate entities. Similarly, in the transport filed, the integrated buyer can also have stronger bargaining power. Additionally, Shenzhen Energy Group could even invest in the coalmines to integrate the upstream of the supply chain completely or partially. For example, SEG can cooperate with some large coalmines all around China, just like the cooperation with COSCO in the transportation field. Or instead, SEG can even establish coalmine firms to mine coal for its own power stations. However, this strategic decision also varies from case to case depending on different situations, like the transport integration of the supply chain.

Additionally, through this joint venture mode, SEG can reduce the whole supply chain cost due to the increased transport efficiency, like third party logistics. However, SEG can control the coal transport better than the third party logistics mode instead. And SEG can also have the privilege to transport its coal at a lower price regardless of the transport market conditions. However, unlike the in-house logistics mode, SEG does not have to tie up huge capital with building new ships or purchasing second-hand ships. Instead, another professional carrier, such as COSCO, can share the risk and investment involved in such a project. In addition, the joint venture has more logistics expertise than the transport firm set up by SEG alone. And this joint venture is much stronger than the current one because this new firm is supported by two powerful groups. Furthermore, this joint venture can enjoy the tax-reduction privileges like a professional shipping service enterprise. The tax-reduction privileges can make the balance sheet of the joint venture much better than SEG does logistics on its own. Furthermore, the ships in the fleet of this joint venture can be more flexible because the professional shipping service provider could offer or alter the trading ships in case the market changes.

However, this joint venture requires higher level of management skills than a transport firm established by only one enterprise alone, because this joint venture has to be monitored and managed by these two enterprises, such as the financial statements and management staff. Moreover, the higher level of management expertise needs more investment and cost. As a result, one of the main disadvantages of this joint venture mode is that the two parties involved in this new firm have both to be powerful and strong enterprises that possess professional management expertise and strong financial capacity. Therefore, this joint venture mode can only be used by large enterprises. In this case, SEG happens to be a state-owned large enterprise. Hence, SEG just has to look for a large and strong enterprise to establish such a joint venture, such as COSCO or China Shipping.

In conclusion, the two parties have to trade off the number of new and second-hand ships, and try to build as many new ships as possible under the current market conditions. Furthermore, in order to achieve a situation of mutual benefit for both the two parties involved in this strategic alliance, the joint venture should find a scientific freight rate that will change annually according to the shipping market and the negotiation between the two parties. And in the long term, Shenzhen Energy Group should also invest in some coalmines in order to reduce the raw material procurement cost. This joint venture mode can reduce all the risk involved in the shipping market fluctuation to the optimal level, and combine the strength of both the two parties together.

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