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Research on third party chemical logistics in Shanghai

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RESEARCH ON THIRD PARTY CHEMICAL LOGISTICS IN SHANGHAI

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 previously 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: **Research on Third Party Chemical Logistics in Shanghai**
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China has been on a way of carrying out heavy chemical industry and the prolific chemical products will affect the chemical logistics market. Shanghai is the one of the most potential region to develop the third party chemical logistics in China.

Problems in chemical logistics in Shanghai are found through the situation analysis in the dissertation. Some models such as Grey model and Quadratic curve model are made to forecast the future development of the future market. Then, AHP – FSE methodology is used to analyze the effectiveness of the third party chemical logistics and how to choose a proper provider. And some advanced experience is referred to help better develop the 3PL in chemical industry in Shanghai. In addition, SWOT analysis is also adopted to give a clear cognition of third party chemical logistics in Shanghai. Also, some suggestions to better develop third party chemical logistics are put forward.

Key Words：third party logistics, chemical logistics, Shanghai

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LIST OF ABBREVIATIONS

3PL	Third Party Logistics
AHP	Analytic Hierarchy Process Model
CEFIC	European Chemical Industry Council
CIDX	Chemical Industry Data Exchange
EDI	Electronic Data Interchanger
FSE	Fuzzy Synthetic Evaluation
GDP	Gross Domestic Product
GPS	Global Positioning System
HSE	Health and Safety Executive
ISO	International Organization for Standardization
JIT	Just in Time
KPI	Key Performance Indicator
MDL	A world-leading publisher of scientific, technical and medical information products and services
MIS	Management Information System
SQAS	Safety and Quality Assessment Systems
SWOT	Strength, Weakness, Opportunity and Threat

Research on Third Party Chemical Logistics in Shanghai

Chapter One

Introduction

1.1 Background of research

There are many differences between chemical logistics and general logistics. Chemical products exist in several states; so they can be transported by container vessel, bulk vessel as well as pipe. Their special chemical and physical natures, such as toxicity, causticity，inflammability, and explosibility, limit the condition and restrict rules and regulations in the hinges of the whole logistics process. In addition, the transporting packing for chemical products is sorted by various materials and shapes, from small packages to ISO tankers，require some devices with professional specialization. Third party logistics means that there would be a third party rather than the provider or the demander of the business in charge of the logistics part. The role of Third Party Logistics Providers in supporting the transformation of the industry was a recurring topic alongside the value in process improvement, collaboration and connectivity. The particularity of the chemical products industry and the expanding market scale provides huge market demand and developing momentum for the third party logistics. Enjoying the service for third party logistics featuring safer products transportation, more professional operation, lower incurred cost, companies can concentrate more on their scientific research of production and market tapping of products.

1.2 Significance and objectives of the research

In recent years, the outlook for chemical industry logistics developed in Shanghai is optimistic. Generally speaking, the demand of domestic and international chemical

industry brings the chemical logistics a bright future. Shanghai carries out reform of opening to the outside early and is the manufacture base for nation's large petrochemical industry. The market and portfolio of the third party chemical logistics in Shanghai will extend rather than to shrink with the more specific specialization as its up-going develop trend. The third party chemical logistics market is one of the main profit sources in Shanghai. It is meaningful to research on this market as it has close relationship with how to bring the profit to the logistics industry in Shanghai as well as how to reduce the cost for chemical businesses. The lack of clear-headed recognition of this market will hold up the step of the economic growth of Shanghai and deprive of its sound industry development. The layout and research on the third party chemical logistics market is necessary and have its practical meaning.

So the Objectives of the dissertation is：Through the analysis of the chemical logistics market and the forecast of the import and export situation of the chemical logistics in Shanghai to construct model for the better development of third party chemical logistics in Shanghai and find out the existing problems. Then try to propose reasonable and scientific suggestions to the chemical logistics in Shanghai to make the third party logistics better serve the chemical industry in Shanghai while ensuring the efficiency, high profit, low cost and safety.

1.3 Main Content and Research methodology

The first part of the main body adopts the related conceptions, analyzes the current situation of third party chemical logistics in Shanghai and presents the existing problems of chemical logistics in Shanghai. The second part makes a demand forecasting of the throughput volume of main chemical products ex Shanghai Port by two models: Grey model and Quadratic curve model; and then analyzes the supply situation of third party chemical logistics. The third part of dissertation analyzes the

characteristics and evaluates the factors effectiveness of third party chemical logistics by AHP（Analytic Hierarchy Process） model and FSE（Fuzzy Synthetic Evaluation） methodology. In the next part, I refer some advanced experience of some foreign countries and regions to give some hints for development of Shanghai's chemical logistics. In addition, SWOT analysis is also adopted to give a clear cognition of third party chemical logistics in Shanghai. Also, some suggestions to better develop third party chemical logistics are put forward in this chapter.

1.4 Literature review

The chemical industry logistics in China is still in the infant stage. The government doesn't put much into the logistics infrastructure and is lacking for the experience, which limits the development of logistics industry to some extent. View from the world wide, there are some successful experience and qualitative analyses about the third party logistics, however, the quantitative analysis specializing on certain area's chemical logistics development model is very few.

Yi Ban said in *Chemical Logistics is Becoming the Third Party Profit Source* (2006, Sept. 1) that specialists believe in that Yangtze Delta Region is one of the regions which economy is growing at the greatest rate as well as one of most important regions which produce, store and transport chemical products. With the opening of Shanghai Chemical Industrial Park, Nanjing Chemical Industrial Park, and Ningbo Chemical Industrial Park and the development of some important ports nearby, the demand and market scale of the chemical logistics market in the Yangtze Delta Region will continue to grow[1].

[1] Yi Ban (2006, Sept. 1). Chemical Logistics is Becoming the Third Party Profit Source. *China Chemical Industry Post*, pp. 2

Liu Guoguang said in *Port Construction Fosters the Chemical Logistics in China's Provinces* (2006, August 24) that China's Shandong Province is nation's biggest chemical province. Specialists hit the nail on the head, saying that the only way to take advantage of it is to construct the ports and carry out the chemical logistics nearby[2].

Wang Xinhong said in *Ningbo Chemical Logistics Wants to Improve China* (2005, May 23) that the chemical logistics was developed relatively early in Ningbo. But there was the bottleneck at that time: the low service level can not satisfy the market demand. Nowadays, the Chemical Industrial Park has been reconstructed and applies the theory "Cooperation between Zone and the Port"[3].

Zhang Hongtao & Pei Feng reported in *Market Focus on the Yangtze Delta's Chemical Logistics Market* (2006, April 27) that Shanghai Petrochemical Logistics, one of the biggest third party chemical logistics enterprises in Shanghai, has seven suggestions to make the company become domestically famous and globally influential. They are a. to integrate the logistics resources; b. to construct a logistics network; c. to set up logistics alliances; d. to accelerate the information construction; e. to cultivate more professionals; f. to improve the logistics equipment, storage and transportation mode; g. pay more emphasis on the customers' value[4].

Zhang Jianwei, the CEO of Sino-trans, indicated on 2006, Aug. 28 that the third party chemical logistics company should cover every crunodes of the logistics

[2] Liu Guoguang (2006, August 24). Port Construction Fosters the Chemical Logistics in China's Provinces. *China Chemical Industry Post*, pp. 6.
[3] Wang Xinhong (2005, May 23). Ningbo Chemical Logistics Wants to Improve China. *Chemical Industry Post*, pp. 4.
[4] Zhang Hongtao, Pei Feng (2006, April 27). Market Focus on the Yangtze Delta's Chemical Logistics Market. *SMU Transaction Supplement*, pp. 8.

service including projects planning, and also provides other value-added services such as special packages, the entire insurance, etc[5].

McKinsey & Company told in 2004 that Chemical companies are rapidly losing the luxury of pondering when and how to approach China. Many of their key customers have already taken the leap and are moving production there. Meanwhile, Chinese chemical companies, backed by low factor costs, are competing effectively for these customers and are beginning to encroach on global markets. These two trends will have a profound effect on the global value chain for chemicals[6].

Hua Fa said in *Singapore Wants to Develop Chemical Logistics* (2001, Oct.18) that Singapore began to enter into chemical logistics market in 2001 and nowadays the Chemical Cluster is formed in the country successfully. Their redeeming feature is that they put emphasis on safety control, the third party logistics, and the chemical industry park[7].

Yu Xuerong said in *Focus on General Situation of Chemical Parks in the World* (2005) that similarly, some other European ports such as Rotterdam, Anterwerp, Ludwig also have their chemical industry parks and choose various transportation modes，and which infrastructures and equipments are applied to minimize the cost possibly incurred by chemical logistics[8].

Prof.A.McKinnon said in *Supply Chain Excellence in the European Chemical*

[5] Li Zhishi Sinotrans(2006, Sept. 4). Chemical Logistics Focuses on Yangtze Delta. *International Business Post*, pp. 10.
[6] McKinsey (2004). Global Chemicals: China Remakes an Industry. *China today 2004 Special edition*, pp. 6.
[7] Hua Fa (2001, Oct.18). Singapore Wants to Develop Chemical Logistics. *China Business Post*, pp. 4.
[8] Yu Xuerong (2005). Focus on General Situation of Chemical Parks in the World. *International chemical industry information*, No.5.

Industry (2004, Oct.) that results of the EPCA-CEFIC Supply Chain Excellence Think Tank Sessions has identified a long list of supply chain improvement measures that chemical companies should now be seriously considering. Most of them can be grouped under six general headings: Collaboration，Segmentation，Coordination, System Optimization，Standardization, and Liberalization[9].

[9] Prof.A.McKinnon (2004, Oct.). Supply Chain Excellence in the European Chemical Industry. *The European Petrochemical Association in cooperation with Cefic*

Chapter Two

Development and current situation of third party chemical logistics in Shanghai

2.1 Related concept adoption

2.11 Chemical logistics

There are many definitions for logistics in different experts' points of view. I appreciate the explanation for logistics by UK Institute of Logistics and Transport (1998) very much: Logistics is the positioning of resource at the right time, in the right place at the right cost and at the right quality. And in my opinion, good logistics service means more "Rights"[10]. Chemical logistics is different from general logistics due to the special natures of the chemical. That is toxicity, causticity, inflammability, and explosibility, etc.. In addition, chemicals also can be transported in different modes as they exist in several states. Those mean that this kind of logistics needs some professional service to support. For example, the logistics network in the petroleum industry is highly inflexible, which arises from the production capabilities of crude oil suppliers, long transportation lead times, and the limitations of modes of transportation. Every point in the network, therefore, represents a major challenge (Jenkins and Wright. 1998)[11].

Chemical industry is international in nature. Thus, these commodities and products are transferred between locations that are always cross nations and regions. The long distance between supply chain involved parties and low efficient modes of transportation trigger not only high transportation costs and in-transit inventory, but

[10] Christopher Bonverie Brine (2006). *Integrated supply chain management.* Unpublished lecture handout, World Maritime University, Malmo, Sweden.

[11] Raed Hussain, Tiravat Assavapokee and Basheer Khumawala (2006, Nov.). Supply chain management in the petroleum industry: Challenges and Opportunities. *International Journal of Global Logistics & Supply Chain Management.* Vol. 1, No. 2, pp.90 – 97.

also large inventory carrying costs in terms of safety stocks at the location of the end user. The great distances between them indicate a high uncertainty of transportation times that can influence suppliers in terms of service levels and end users in terms of safety stock costs. In addition, the transportation process is carried out either by vessels, trucks, pipelines, or rails. In many situations, a shipment has to exploit multiple transportation modes before arriving at the final customer's location. Such constraints or limitations on transportation modes in this field induce long lead times from the shipping point to the final customers' location compared to other fields. As a result, considering the amount of inflexibility involved, meeting the wide prospect of chemical demand and its derivates while maintaining high service level and efficiency is a major challenge in the chemical logistics industry.

2.12 Third party chemical logistics

Logistics is an essential part in the chemical industry and will tiger various logistics cost. Chemical companies can choose to do the logistics themselves or outsource this part to the third party. "Third-party Logistics is simply the use of an outside company to perform all or part of the firm's materials management and product distribution function." (Simchi-Levi, 2000) And Logistics costs can vary from 3.6% of the purchase price for a best-in-class (BIC) site to 20% at the other extreme (Karimi et al., 2002)[12].

Third party logistics means that there would be a third party rather than the provider or the demander of the business in charge of the logistics part. The particularity of the chemical products industry and the expanding market scale provides huge market demand and developing momentum for third party logistics. It is estimated by

[12] I.A. Karimi (2005). Management of Supplies and Movements of Tank Containers in Chemical Logistics. Retrieved November 2, 2005 from the World Wide Web: http://aiche.confex.com/aiche/2005/techprogram/P28759.HTM

experts that the application of professional third party logistics service can at least save 10% of the logistics cost. Enjoying the service for third party logistics featuring safer products transportation, more professional operation, lower incurred cost, companies can concentrate more on their scientific research of production and market tapping of products.

Generally, a 3PL company provides services including whole or a least part of the listed in Table 2-1 rather than focusing on a single function.

Table 2-1 Third Party Logistics Service

1. Transportation / Distribution	·General Trucking Service (TL, LTL); ·Inter-modal Transportation service (rail, ocean, air freight) ·Specialized Services (bulk, tank, hazardous material, refrigerated goods etc.) ·Time-constrained services (JIT, over night, same day etc.) ·Shipment tracking & tracing
2. Warehousing / Distribution	·Public/Contract/Regional warehouse ·Operation Technology (bar coding, radio frequency, VMI etc.) ·Value-added services (cross-docking, freight consolidation, pick & pack, etc.) ·Order processing and fulfillment
3. Custom Services	·Custom Brokerage ·Duty Drawback
4. Freight Finance Services	·Freight Audit ·Freight Bill Payment
5. IT Support	·EDI capability ·Logistics information system & other software ·Web-based solution

6. Product Support Services	·Reverse logistics ·Value-added services (package, label, mark, test, assembly etc.)
7. Logistics Management / Consulting	·Fleet operation ·Distribution network design ·Carrier selection/negotiation/routing ·Facility location analysis/selection/design ·Inventory management

Source: Regan A.C. and Song J., An Industry in Transition: 3PL in the Information Age

In the Table 2-1, these are the whole items included in the third logistics part. In theory, chemical enterprises can choose the whole part to outsource or part to outsource. As the chemical logistics is a very professional operation, so the “service package” may be the best choice. Without the service provided by the third party logistics company, the chemical industry may need to have their own truck fleet, warehouses and have to put energy on the port affairs.

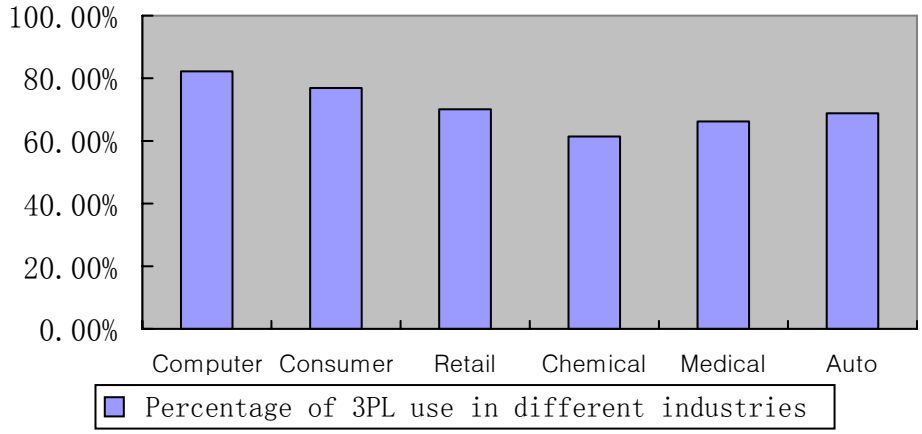

Figure 2-1 Percentage of 3PL use in different industries （2000）

Source "What's ahead for 3PLs” Modern Materials Handling, April, 2000

The figures in Figure 2-1 are the products applying 3PL more than other industries, it illustrates that the percentage of 3PL in the chemical industry was already more than 60% in the approximately last century in the whole world.

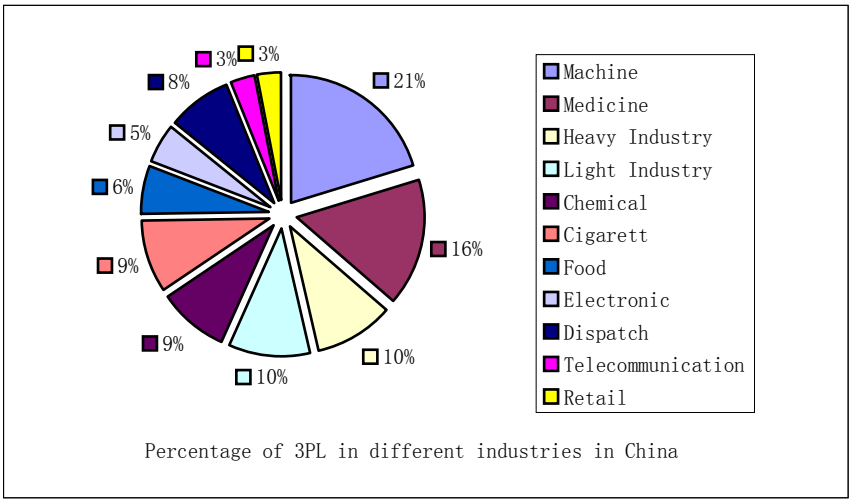

Figure 2-2 Percentage of 3PL use in different industries in China （2004）

Source: www.snet.com.cn

The figures in Figure 2-2 are percentages of different industries applying 3PL, it illustrates that the percentage of 3PL in the chemical industry is only 9% in 2004, is much lower than the number world wide in 2000. It shows that in China, most enterprises self-manage the whole logistics process and don’t adopt the outsourcing.

Nowadays, as a matter of fact, most these enterprises in China are not only responsible for the productions and sales, but also own the truck fleet and warehouse to manage the logistics by the company itself. However, they usually can not control the logistics cost in the best way as the efficiency of dock, tanker transportation and fleet doesn’t play to the full, thus part of the logistics infrastructure is wasted. Logistics is a costing and capital intensive activity: the whole process needs large

space, many devices and staffs, and depends on the computer hardware and software. The problems most these kinds of enterprises face is the lack of resources, so improving the resource utilization becomes the premise of enterprises' survival. These chemical enterprises should realize that they are not experts on transportation running or inventory controlling. In order to put more energy on the main business to be more competitive, they should consider outsourcing some operations to the third party.

2.2 Development of third party chemical logistics in Shanghai

China's third-largest industry, only behind textiles and machinery, chemicals account for more than 10 percent of the country's GDP and nearly 40 percent of the growth in global demand[13]. While the country is getting on the way of dramatically increasing its production of chemicals, it remains in a net deficit position in the world market. That is to say, there is enough room to move up. These make the chemical logistics a spotlight in China area. China has been on a way of carrying out heavy chemical industry and the prolific chemical products will affect the chemical logistics market. And the chemical sales are coming out top in the global wide these years. Better dealing with the chemical logistics to decrease the cost and increase the proficiency is a potential third party profit source.

Shanghai, as China's international shipping centre, attracts many Multi National Corporations to set up chemical production bases as well as many world famous logistics magnates invest. It is not only an important port, but also an important logistics center of Yangtze Delta Region. Shanghai municipal government support

[13] Alex Ruf. Dick Yip(2006). The Yin and Yang of Chemical Logistics: Logistics Challenges of Sino-European Chemical Trade. *Business Forum China 2006 06*

the chemical logistics by presenting the strategic planning and show the attitudes of doing their endeavor to expand the chemical logistics. The Shanghai Chemical Industrial Park has become one of the developing and constructing projects of "the Eleventh Five-Year Plan". With the opening of it and the rolling investment from world-scale logistics companies, the third party logistics of chemical industry is attached more importance to. Thus, it is a hot topic nowadays and has a practical research meaning.

With the economic globalization, the chemical logistics is advancing in a high speed in Shanghai, which is the largest economic hub of eastern China. Chemical bases in Shanghai have been constructed in a good plan and its improvement is supported by the municipal government. It is estimated that the overall production value of petrochemical in Shanghai, which is a representative chemical, will reach 280 billion yuan. The existing chemical enterprises in Shanghai are developing quickly and the chemical logistics has a bright future though the third party chemical logistics is still in the enfant stage in Shanghai as it's a burgeoning industry.

Though the level of 3PL provider in Shanghai is relatively high in China and it is one of the most potential regions to develop the third party chemical logistics, but Shanghai still have gap between some advanced countries. For example, the transportation cost in China is 3 times higher than that in the west countries. In 2005, the total logistics cost is as high as 33860 trillion yuan and doubles the cost of developed countries[14]. So there are still potentials to develop the third party logistics.

[14] The Present Situation and Development of Third Party Logistics in the Chemical Industry. Retrieved from the Word Wide Web: http://www.52angell.com/jingjilunwen/xingyejingji/2007-03-21/9961_2.html

2.21 The chemical logistics centre in Shanghai: the Shanghai Chemical Park

The logistics of the chemical industry in Shanghai used to adopt the dispatch according to the fixed producing quantity. The material supply group in accordance with the producing demand and the transportation dispatch taches compose the supply and logistics system of various layers and complicated structures, among which the large group of manpower delivery, management and control, and the high running costs make the chemical products low market competency[15].

The following Figure 2-3 is the traditional structure of chemical purchase system in Shanghai.

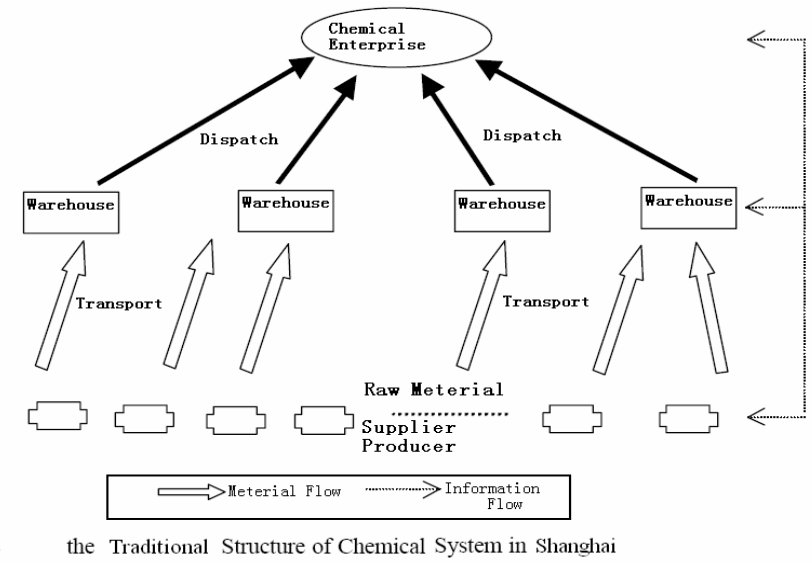

Figure 2-3 the Traditional Structure of Chemical System in Shanghai

From the Figure 2-3, it can find out that the above system is very large and too many parties are involved in. And there are problems and abuses in the system without the

[15] L. K. Nozick and M. A.Tumquist (1998). Integrating Inventory Impacts Into a Fixed-charge Model for Locating Distribution Centers. *Transportation research part E.* Vol.34, No.3, pp.173-186

logistics center and the raw material suppliers spread around in 12 districts and 10 counties in Shanghai: the transportation efficiency is low and the punctuation is not guaranteed; Information communication is delayed; the storage cost must be high; the ability of the enterprise's logistics management is not so satisfied. Of course, the complexity of the traditional structure may incurred by lacking of outsourcing.

Chemical companies can enjoy further market penetration if the warehousing operation is outsourced when they want to exploit a new region. In addition, outsourcing helps preserving valuable capital. We should know that chemical enterprises don't want to put money into warehouses as it is a non-productive area for them. Spending money in new product development is a more wise choice. For both vendors and buyers, outsourcing can help to reduce the insurance risks and costs.

The outsourcing should be hotter and hotter. So the chemical park is coming into being. After 1st July in 2005, the chemical logistics center has been established: The Shanghai Chemical Industrial Park. The Shanghai Chemical Industrial Park is located at the point of intersection of Jinshan district and Fengxian district, which is 50 kilometers away from downtown. That also means 45 minutes' drive will do from the park to the central area thanks to the A4 Highway net connects Shanghai and Ningbo as well as Shanghai and Hangzhou. In the Chemical Industrial Park area, there is equipped with feeder railway and Pudong railway (Fengxian － Pudong Airport － Zhangmiao), which has the span of 113 kilometers. The Shanghai Chemical Industrial Park can be communicated with both Huangpu River and the Yangtze River after dredging up the shipping system of the freshwater. The park has specialized wharf built, and only has 55 kilometers to go from the Yangshan

deepwater port. Besides, it takes only 50 kilometers from the park to the Pudong Airport or Hongqiao International Airport. The geographic condition facilitates the transportation service[16]. (The map of location of the Shanghai Chemical Industry Park is shown in Figure 2-4)

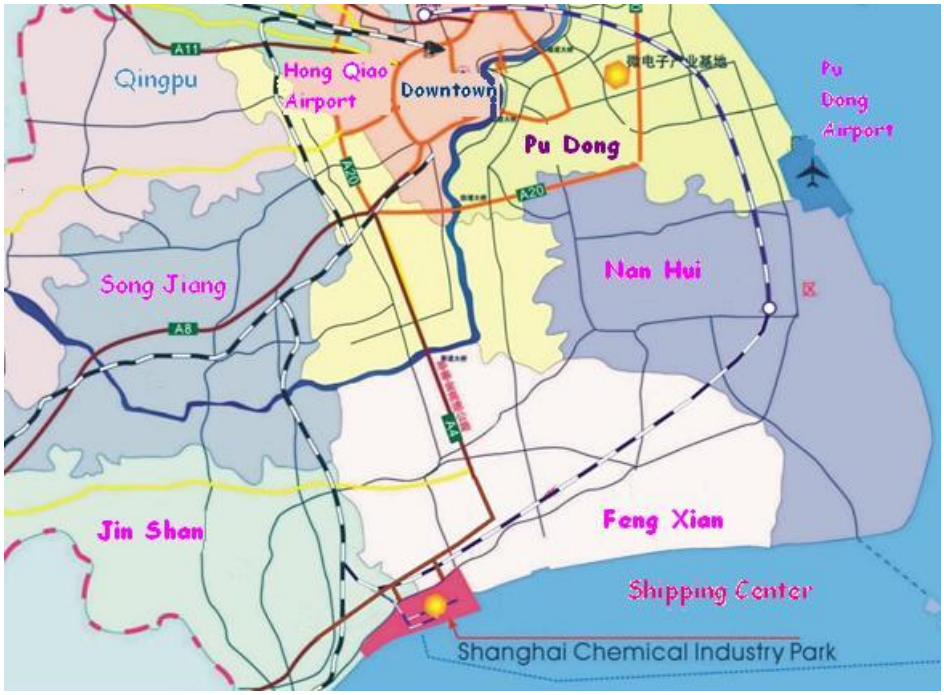

Figure 2-4 Map of Shanghai Chemical Industry Park

Source: http://www.scip.com.cn

The logistics center is the hinge of the chain business of high-efficiency as well as the crucial point of modern logistics. The logistics center is very important due to its multi-functions. It can combine the dispersed cargo together to be managed more easily. It also connects different transportation modes and facilitates the multimodal transportation. Besides, logistics center will increase the logistics level, control the logistics costs, and improve the service quality. Meanwhile, the proper location of the

[16] Shanghai Chemical Industry Park website: http://www.scip.com.cn

center means less time of truck driving, which can reduce the air pollution to some extent. In my opinion, the Shanghai Chemical Industrial Park is playing the similar role of the chemical logistics center in Shanghai. Whether it is a proper location should meet the requirements of the several aspects: adaptability, harmony, economy, strategy and flexibility.

The following Figure 2-5 is the advanced and expected structure of chemical purchase system in Shanghai after reform.

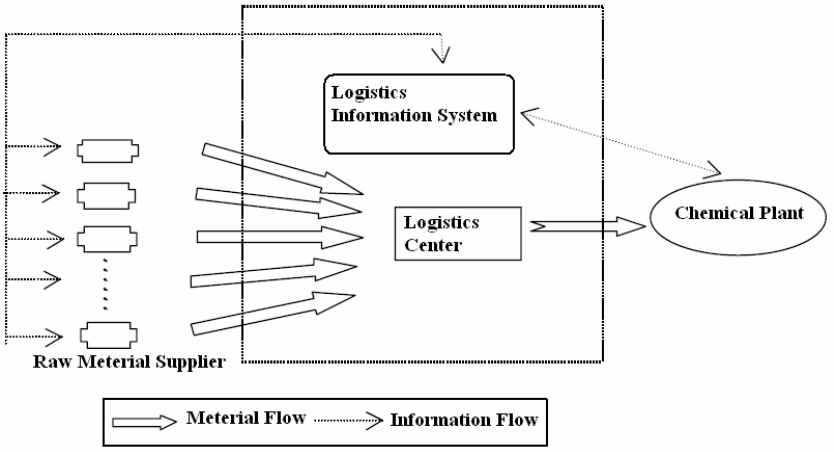

Figure 2-5 the Advanced Structure of Chemical Logistics System in Shanghai

From the Figure 2-5 above, the running pattern of establishing and locating the logistics center can provide the entire service and the information system is more advanced. The chemical enterprise can rest easily about the logistics part and focus on their main business.

Table 2-2 the data of before and after the Logistics Integration

	Before the Logistics Integration	After the Logistics Integration	The Improvement
Flow Time/week	26.32	15.45	-10.87
Average Cost/yuan	8675	4315.5	-4359.5
Resource Utilization/%	6.83	9.47	2.64

Source: Shanghai Logistics Net (www.sh56.com)

From Table 2-2, we can get that after the logistics center promote the logistics integration, the flow time is reduced by 10.87 h a week, and the average cost is cut by more than half, and the utilization is increased by 2.64%.

Furthermore, more than 10 chemical producing projects are supported by foreign investors, namely, they are Shanghai Secco 900000 ton Each Year Ethylene Project; Bayer Polymer Integrated Infrastructure Project; BASF / Huntsman / GaoQiao / TianYuan / HuaYi Integrated Isocyanates Project in Shanghai; Lucite MMA Project; ABS and SBR (butadiene - sodium rubber) Projects; Phenol Pheny l - Keton Project; PVDF、HFA Project; Tian Yuan PVC Project, etc...Every local people will be gratified to witness the great development and investment of the chemical logistics center. However, these large-scale projects not only bring profit to the Shanghai Chemical Park and opportunities to third party chemical logistics providers, but also put forward the separating and sorting problems as different chemical products may occur chemical reactions when putting closer to or together.

To summary, building up a good logistic center in Shanghai has reduced the supply chain stock and increased the efficiency and response speed to strengthen the

competency of the port and promoted the modernization of the chemical industry in Shanghai. We should also pay attention to better layout of the chemical park when enjoy the existing plentiful and substantial fruit of it now.

2.22 The existing problems of chemical logistics in Shanghai

1. The third party chemical logistics has not been developed maturely

Although the output of the chemical products in Shanghai is going up gradually, the supporting service is not keeping up with. Decades ago, S&W International Chemical Logistics Ltd is the one of the countable third party logistics companies focusing on chemical logistics in Shanghai. Nowadays, some big giants such as Sino-pec begin to realize the necessity to have the specialized third party logistics companies to complete the logistics parts. Though it is a good inspiration, more and more specialized 3PL providers are needed to ensure the proper running of the chemical products movement.

2. Some old 3PL providers are not qualified

Most chemical logistics enterprises are transferred from the transportation department or the storage department of the large-scale chemical enterprises. The work divided is not so clear in such kinds of enterprises. So the function of the logistics enterprise can not play to the full and the communication is lacked of. Then, a little of carelessness may lead to accidents. For example, the ambiguity of the nature of cargoes or the classification misplay, the cargo unworthiness, the unqualified packages, the unsuitable stowage or isolation, the rough loading or discharging, the improper management measures and the weakness in the emergencies. All these unqualified providers without security guarantee should be phased out.

3. The utilization of the logistics facilities should be increased

In Shanghai, we won't be worried about the advancement of the logistics facilities. But whether they have high utility would be a question. Many investment projects are on the stocks, such as the 900000 ton each year ethylene project styrene device invested by Shanghai Secco Petrochemical Co.,Ltd. From the point of transportation, some repeated routines will appear and the transportation net is not perfect enough. From the point of space utilization, many storage' function is still on the stage of warehouse rather than the comprehensive logistics function.

A comprehensive transportation infrastructure as well as a structure of ways and direct links to major ports is also needed. Until these become realities, some foreign chemical companies will require logistics service providers who know this market intimately and have their own 'infrastructure' of branch offices in Shanghai.

4. The level of information need to be higher

The information system is still in the debugging phase and the relative independence lead to the traditional material flow, cash flow and information flow in the time and money costing situation. The city government of Shanghai though has required all vehicles transporting dangerous and toxic materials to be equipped with GPS (global positioning system) devices. The technology such as EDI, RFID, and GPS systems are still in the promoting stage, the enterprises are not easy to get instant information to inspect the situation simultaneously. The shared information and compatible interface between the upstream and downstream is still the problem up to solved.

5. Lacking of the experts specialized on the chemical logistics

Shanghai is the talents' pool, however, the number of compound talents of chemical and logistics is still limited. Most managing personnel are not familiar with the

whole chemical logistics and is making up mistakes through trying. Also, the cultural gaps and language barriers to doing business in Shanghai should not be underestimated as more foreign enterprises are entering into Shanghai.

6. Safety problems

"With the fast development of the heavy chemical industry on the Yangtze River Delta, on which Shanghai perches, experts say, the city will expose itself to higher risks in dangerous chemicals transport."[17] The workers fluxion is too frequent, so the quality of these workers can not be guaranteed as they don't have enough time to adapt themselves to the worker before they changed the job. The extensive management can not meet the requirement of technology. Also, the rules and regulations in the field of chemical logistics are not in the unified form. Further more, the overloading is serious on the land, and the traffic accidents of dangerous chemicals are happened frequently. The safety problem is not easy to come over. All these should be improved to intensify the safety in the chemical logistics in Shanghai.

[17] Shanghai Orders Dangerous-materials Transport Vehicles to Have GPS Devices. People's Daily Online. Retrieved October 22, 2005 from the World Wide Web: http://english.people.com.cn/200510/22/eng20051022_215922.html

Chapter Three

Demand forecasting and supply analysis of third party chemical logistics in Shanghai

3.1 Demand forecasting

Whether the capacity of the chemical logistics center is satisfied? How will the chemical products in Shanghai influence the chemical logistics? What etc.? A forecasting may work out these questions.

The throughput volume of main chemical products ex Shanghai port in year 2002, 2003, 2004, 2005, 2006, 2007 which is calculated by the Shanghai Custom is in the following chart.

Table 3-1 Throughput Volume of main chemical products ex Shanghai Port

Year	2001	2002	2003	2004	2005*	2006
Throughput Volume	680	975	1330	1596	2030	3010

Unit: million tons

*from 1st July 2005, Shanghai JinShan Chemical Logistics Park is officially put into use.

Source: China transportation yearbook

The increasing trend of import & export value of chemical product ex Shanghai Port can be shown in Figure 3-1.

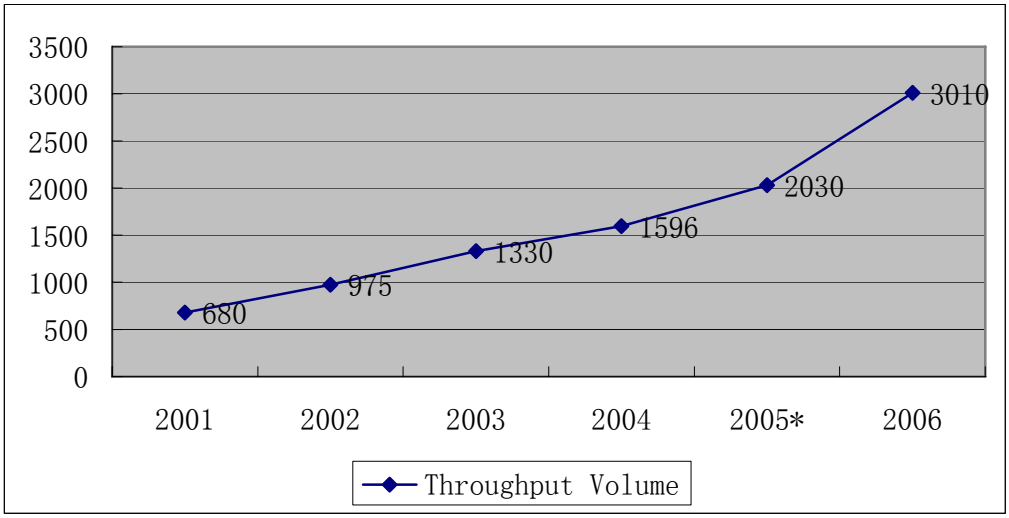

Figure 3-1 Throughput Volume of Chemical Product ex Shanghai Port

It's easy for us to find that the throughput volume of chemical cargo ex Shanghai Port keeps increasing gradually with moving of time, the trend of increase is tend to be slight, and the trend of increase is tend to be linear. Because in the past six years, China chemical industry was in a period of stable development and in year 2006, establishment of many large-scale foreign invest projects slightly increase the slope of growth. Here we will forecast the future trend of throughput volume of chemical product by Grey Model and Quadratic curve model.

Grey Model of forecast is developed from the principle of Grey system. It links the discrete variables, uses the differential equation to replace difference equation, uses the created series to replace the original time series to weaken the randomicity of original time series and uses the created new series to build a dynamic liner model to make forecasting. GM has made many distinguish achievements and is widely used in the fields of economic, engineering, agriculture and so on.

Quadratic curve model is one of the time series forecasting methods. It takes time as

the self variable to analyze the change of independent variable with moving of time. The model of quadratic curve model is: y=a+bx+cx^2

We use y to indicate the value of import & export, and x for number of times, then we set x1=x, x2=x^2, and the model can be changed into an liner equation f(x)=a+bx1+cx2. We can solve the equation and get the value of a, b and c.

Here we will use the above two mathematics model to forecast the throughput volume of following several years based on the time series data.

Data series：680 975 1330 1596 2030 3010
Data number：6 Total：9621 Average：1603.5 Variance：580477.9167
Standard Deviation：761.891

Grey model：y=521.831354e^(0.282552t)
Original Data：680 975 1330 1596 2030 3010
Model Data：692.2149 918.2305 1218.043 1615.747 2143.305 2843.117
Forecasting Error：-12.2149 56.7695 111.9574 -19.7467 -113.3054 166.8826
Decidable Coefficient：0.97 Average Absolute Error：96.1753
Estimated Standard Error：119.3569
Error Ratio：0.1209 Precision Level：Level A (high)
Estimated Data：2007 2008 2009 2010
Forecasting Result：Y=3771.426 5002.837 6636.317 8803.146

Quadratic Curve Model：y=718.9-36.739286t+66.803571t^
Original Data：680 975 1330 1596 2030 3010
Model Data：748.9643 912.6357 1209.914 1640.8 2205.293 2903.393
Forecasting Error：-68.9643 62.3643 120.0857 -44.8 -175.2927 106.6072
Decidable Coefficient：0.9903 Average Absolute Error：115.6229
Estimated Standard Error：129.5817
Error Ratio：0.1389 Precision Level：Level A (high)
Estimated Data：2007 2008 2009 2010
Forecasting Result：Y=3735.1 4700.414 5799.335 7031.864

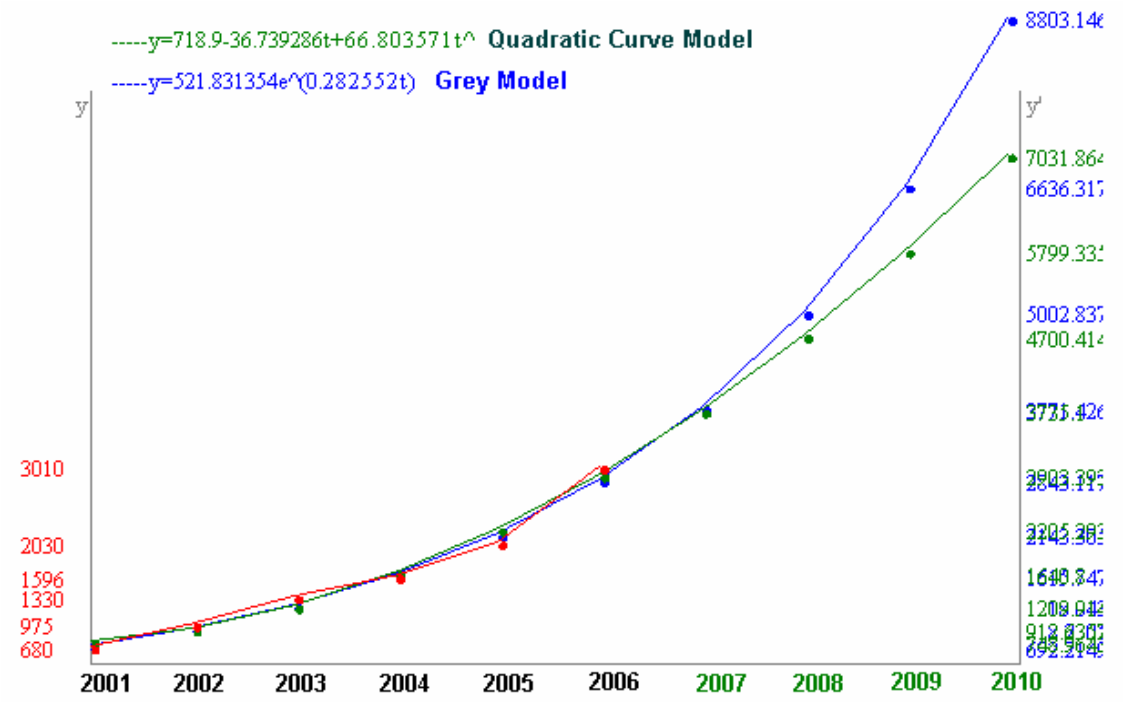

Figure 3-2: the Simulated Curve of throughput volume of chemical cargo ex Shanghai Port

From the Figure 3-2, we can find that the Grey Model curve has a better degree of simulation and its simulation equation is: y=521.831354e^(0.282552t) (R=0.98)

So we believe in the following several years, the throughput volume of chemical products ex Shanghai Port will keep increasing smoothly, and the increasing rate is tend to be a bit quicker. The throughput volume will reach 8803.14 million tons in year 2010, which is 292.46% of the data in year 2006 and 433.65% comparing with year 2005 when the Shanghai JinShan Chemical Logistics Park was officially opened. With the rapid growth of throughput volume, there will be a much bigger market for the third party chemical logistics in Shanghai. Large scale outsourcing chemical logistics services will be the trend of the following year. While enjoying the happiness of growing business opportunities, third party chemical logistics providers should also pay attention to the problems come by such as limited capacity, higher

requirements and so on which will face them in the near future.

We should say that Shanghai is making stable improvement in its business environment. Twenty years ago, the central government was so obsessed with attracting foreign investment, it virtually had no idea. Years ago it started centralizing the manufacture of certain products in industry related zones. The government is now addressing many other issues. However, the situation is further complicated by shortages of transport capacity and warehouse space. According to the data forecasted, the increasing trend is unconvertible. So the enlargement should be in the construction plan sooner or later. In addition, various chemical projects are carried out in the chemical park, the separation is necessary to prevent reactions. Also, the dangerous cargo should be deposited at more proper place. How to use the limited space to ensure both the optimized utilization and safety should be attached more importance to.

3.2 The supply situation of third party chemical providers in Shanghai

After the construction of the chemical park in Shanghai as the chemical logistics center, many foreign chemical companies are building plants in Shanghai to be closer to their customers, while maintaining their own operations to meet local demand. This situation poses special transportation and logistics challenges for both Shanghai and its Western trading partners. Opening up the yellow page, you will find countless listing companies named as Logistics Co., Ltd, as a matter of fact, most of these companies are not experts on this field. The real specialists in third party chemical logistics in Shanghai are limited, to name, they listed in Table 3-2. The chemical giants from world wide outsource the information service, application management and commercial flow (including distribution, storage, transportation, etc.) to the 3PL providers in order to lower the cost, optimize the industry chain, and improve their

core competency. These famous international chemical enterprises include Vopak of Netherlands, BP of Britain, Bayer and BASF of Germany, etc. This kind of outsourcing will not only bring profit to the chemical suppliers, but also benefit the 3PL providers and end users as the whole process is a value-added chain.

For example[18], the operating income of Shanghai Huayitianyuan (Xintianyuan) chemical logistics co. Ltd breached 800 million yuan for the first time and realized the greatest growth in 2006. The main reason for the dramatic growth is that it carried on the package, storage and transportation of one of the Bayer's projects. In the peak time, the 3PL company will be responsible for 2200 operations (0.5 ~ 1.2 t per operation per day).

It is obvious that the foreign chemical investors are choosing 3PL to focus on their core business. In the mean time, it is an attractive cake as well as a big business opportunity for the 3PL providers. Each part gains what they want in this cooperation. Who will take the cake in the potential local chemical industry in Shanghai? It will be another delicious business cake to share.

[18] God W. (2007, Feb. 27). Who Will Take The Cake of Chemical Service Outsourcing? Retrieved from the World Wide Web: http://club.china.alibaba.com/forum/thread/view/27_21910769_.html

Table 3-2 Main Third Party Chemical Logistics Providers in Shanghai (2006)

Main 3PL (Chemical) Providers in Shanghai Area	**Unit: 10000 Tons/ Year**	**Enterprise Feature**	**Share**
Sinochem International Corporation Shanghai Logistics Branch	***81***	SOE	***59%***
S&W International Chemical Logistics Ltd	***66***	SOE	
Shanghai Xintianyuan Logistics Co., Ltd.	***69***	SOE	
Shanghai Petroleum Chemical Logistics	***45***	SOE	
Shanghai Chemical Industry Park Logistics Co.,Ltd.	***91***	SOE	
Shanghai Dingheng Shippng Co., Ltd.	***35***	SOE	
ShangWin Chem 3PL Co., Ltd.	***31***	SOE	
Shanghai Sinotrans Chemical Logistics Co., Ltd	***65***	SOE	
Shanghai Huitong Shipping Co., Ltd.	***46***	Civilian-run Enterprise	***17%***
Shanghai Taikun Logistics Co., Ltd	***42***	Civilian-run Enterprise	
Shanghai Safetrans Chemical Logistics Co., Ltd	***57***	Civilian-run Enterprise	
Shanghai COSCO-SHOKUYU Shipping Co., Ltd.	***50***	FIE	***24%***
Stolt-Nielsen Transportation Group Shanghai Shipping Co., Ltd.	***52***	FIE	
NORIMC Logistics Co., Ltd.	***38***	FIE	
Shanghai Keyun Logistics Co., Ltd	***45***	FIE	
Total	**813**	—	**100%**

Source: http://www.jctrans.com

Then, let us find out the third party chemical logistics service supply situation. Focusing on Table 3-2 above, we analysis the supply situation through 15 main third party chemical logistics providers in the Shanghai area, most 3PLs for chemical logistics in Shanghai are undertook by them. The average capacity of the chemical logistics service is close to 55 tons per year of each logistics enterprise and the total number is around 813 tons a year. In the year 2006, from the export and import volume and the number of providers, chemical logistics served by 3PL providers occupies only near to 20%. According to the forecasting, the tonnage will gradually

climb up during the year, so the gap between the number of third party chemical logistics providers and demand volume is getting wide. As it is known that most multinational chemical corporations outsource their logistics operation to the third party. Then the figure of gap also indicates that at present, most chemical enterprises in Shanghai do the logistics themselves. Thus, there is much room for more 3PL providers' development and advancement. In addition, from Table 3-2, market share of SOE logistics enterprises is 56%, more than half of the total capacity; the Joint Venture partly invested by foreign investors is 1/4. As the 3PL is a profit source, so we should encourage more 3PL providers from local area do the chemical logistics.

Chapter Four

Effectiveness analysis of third party chemical logistics

It is clear that the chemical market is growing gradually, and how to choose suitable service providers to meet the demand is mainly focus on the logistics part.

Table 4-1 Labor Cost and Logistics Cost in a Chemical Enterprise

Labor Cost	Logistics Cost	Ratio
9%	40%	4
Labor Time	Logistics Time	
10%	90%	9

Source：www.cel.gov.cn

Related document show that in the chemical enterprise, the cost and time percentage on the labor and logistics is listed in the table above. The benefit won through logistics cost control is about 5 times the labor cost control, and the time won is 9 times of it. So we should compare the chemical enterprise does logistics itself and by 3PL provider, then try to control the logistics part.

4.1 Third party chemical logistics vs. self logistics

4.11 Characteristics of third party chemical logistics

The preexistence of the third party chemical logistics enterprise is the company engaged in the transportation, storage or freight forwarding related fields. The change should not only be presented on a more vogue name. The third party chemical logistics enterprises provide more senior and more complete service, including the organization, coordination and management of the chemical logistics activities, the design and implement of chemical management strategy, order

distribution and inventory management of the chemical products, and the chemical supplier selection and supervision. Moreover, it is not an easy one-to-one deal between the 3PL provider and its customer, but a long-term business cooperative relationship share the profit and risks as well.

Though it is a topic for discussion whether the third party chemical logistics enterprise should be existed independently, the service the 3PL provider provided is very complete and is penetrating every aspect and tache in the related fields and plays an important role in many other logistics fields such as producing logistics and consuming logistics.

We can analysis selection reasons of the third party chemical logistics:

1. The strategic layer

The chemical company can focus on the main business. The enterprise can realize the optimization of the resource to best use the limited human resource and the finance resource. For example, chemical products research and development, market tapping, techniques improvement and chemical products producing, etc.

Also, choosing the 3PL for the chemical enterprises can reduce the investment and risks. The investment of the facilities, devices and information systems in the modern logistics fields is very large and the uncertainty and the complexity of the chemical logistics demand would cause the huge risks. And the 3PL can help to avoid of them.

Moreover, the 3PL provider can help the chemical enterprises establish local relationship. The experts in the 3PL enterprise will help the chemical enterprises be familiar with the local regulations more easily. As it is known to us, many foreign chemical giants invest in Shanghai and they do need such kinds of local 3PL provider

to give them some suggestions to the point. And the regulations in Shanghai about chemical products such as the management of dangerous cargo always have the local characteristics, so the one of 3PL providers in Shanghai is more suitable for the foreign investors.

2. The advantage of logistics capacity

It helps to promote the globalization. It is the concrete characteristic and fruit of the economy globalization for the modern chemical enterprises to produce and sell the products in the world wide. And it is evident that the imports of chemicals are more than exports in Shanghai. But it is impossible for these activities to develop soundly without the existence of the 3PL provider.

Further more, it helps to exercise the new technology. In order to improve the enterprise's competitive advantage and specialization level, the third party chemical logistics provider can help to acquire the latest technology without the access input.

Also, the adoption of 3PL provider can help accelerate the market response speed. It will make the chemical company to face the challenge of the changing market and the short product life cycle.

Moreover, choosing the proper third party chemical logistics enterprise would optimize the information analysis and management ability to transfer the original data to the practical information. For the chemical industry, the simultaneous inspection is very useful and practical, so the 3PL provider with good electronic system is very attractive.

3. Lower the cost

The professional 3PL provider can utilize the economy of scale and improve the utility of every tache to make the chemical enterprise get profit.

The 3PL will have a good application in the chemical industry. However, we should also pay attention to some aspects to better adopt the third party chemical logistics and avoid some possible side-effects of the adoption of the 3PL enterprise such as the control power of the logistics will be weakened, the risks of the client management will increase, and dangers of confidential information leakage as well as the related business running risks will appear.

4.12 Comparison with self logistics

Logistics by the chemical enterprise itself includes establishing its own storage and dispatch center, carrying out the storage and dispatching themselves and ensuring the precise and punctuality by their own power. If the whole logistics process is not very complicated, the self-logistics is a not bad choice as it is coordinative, concise and stable.

However, we should realize that chemical logistics is not a general logistics. The input of the chemical enterprise would be very large if it does the logistics itself. After the establishment of chemical logistics system, the scale of the chemical enterprise needs to be larger as only the large scale can guarantee the low cost, or it will in the condition of non-profit for a long time. Also, it will have impact on the flexibility of the enterprise as the input and time cost is very large.

Further more, for such a large logistics system, the specialized experts on chemical logistics as the software are needed to match the hardware. But the comprehensive ability of the present practitioners is not so satisfied and talents on logistics are hard

up. Facing the complicated chemical logistics problems such as safe transportation, they often adopt their subjective experience to solve rather than the professional technology.

4.2 Effectiveness analysis of third party chemical logistics through AHP and FSE

Through the above qualitative analysis of the third party chemical logistics, we may have a much more clear idea of that the status of 3PL is high and lofty in the chemical industry. In the real chemical logistics market, we are not lacking of the service providers and what we are seeking for are the qualified and specialized 3PL providers for chemical logistics. Adopting the AHP[19] (Analytic Hierarchy Process) and FSE[20] (Fuzzy Synthetic Evaluation) method to identify the effectiveness of third party chemical logistics may be a feasible idea.

S&W International Chemical Logistics Ltd is one of the most specialized third party chemical logistics providers in Shanghai, and ABC Logistic Ltd is a small 3PL provider. I would like to take these two enterprises as an example in the following AHP and Fuzzy Synthetic Evaluation method adoption.

First, we may choose several KPIs and set up an index system to identify the effectiveness of the third party chemical. We may evaluate the service provider by certain criteria consist of the following indicators as Table 4-2 shown.

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[19] Zhang F. J., Li B. and Duan T. Y. (2005). Evaluation of the Service Quality of Third - party Logistics Based on Fuzzy AHP.

[20] C.N and Z.H. (2004). The Fuzzy Synthetic Evaluation of Enterprises Core Competition. Retrieved from World Wide Web: www.paper.edu.cn

Table 4-2 KPIs to evaluate the effectiveness of third party chemical logistics

Target Layer	Criteria Layer	Factor Layer	3PL Provider
The Effectiveness of Third Party Chemical Provider	Service Quality	JIT level	S&W VS ABC
		Reliability	
	Logistics Cost Control	Service Charged	
	Safety Guarantee	Facility	
		Supervision	
	Environment Friendly	Transportation	
		Storage	
	IT system	GPS on trucks	
		EDI platform	
	Personnel Qualification	Experience	
		Related Certificate	
		Employer Training	

Second，we should determine the priorities of elements at each level. A set of comparison matrices of all elements in a level of the hierarchy with respect to an element of the immediately higher level are constructed so as to prioritize and convert individual comparative judgments into ratio scale measurements. The preferences are quantified by using a nine-point scale. We can find the meaning of each scale measurement explained in Table 4-3. That means comparisons are given in terms of how much a certain element is more important than another element. The priority weight of each element is obtained by inquiring certain specialists，that is the FCE method.

Table 4-3 Scale of preference between two elements

Preference weights	Definition
1	Equally preferred
3	Moderately preferred
5	Strongly preferred
7	Very strongly preferred
9	Extremely preferred
2,4,6,8	intermediates values
Reciprocals	Reciprocals for inverse comparison

Next, these comparisons generate a matrix of relative rankings for each level of hierarchy in Table 4-3. The λ max value is an important validating parameter in AHP. It is used as a reference index to select information by calculating the consistency ratio CR of the estimated vector in order to decide whether the pair-wise comparison matrix provides a completely consistent evaluation. The consistency ratio is calculated as follows:

Calculate the relative weights and λ max for each matrix of order and compute the consistency index for each matrix of order n by the formulae:

CI = (λ max -n)/(n-1)

The consistency ratio is then calculated using the formulae:

CR = CI/RI

*** When CR < 0.1, we can believe the matrix has the complete consistency.**

The structure and the calculation for the comparison matrixes are shown below.

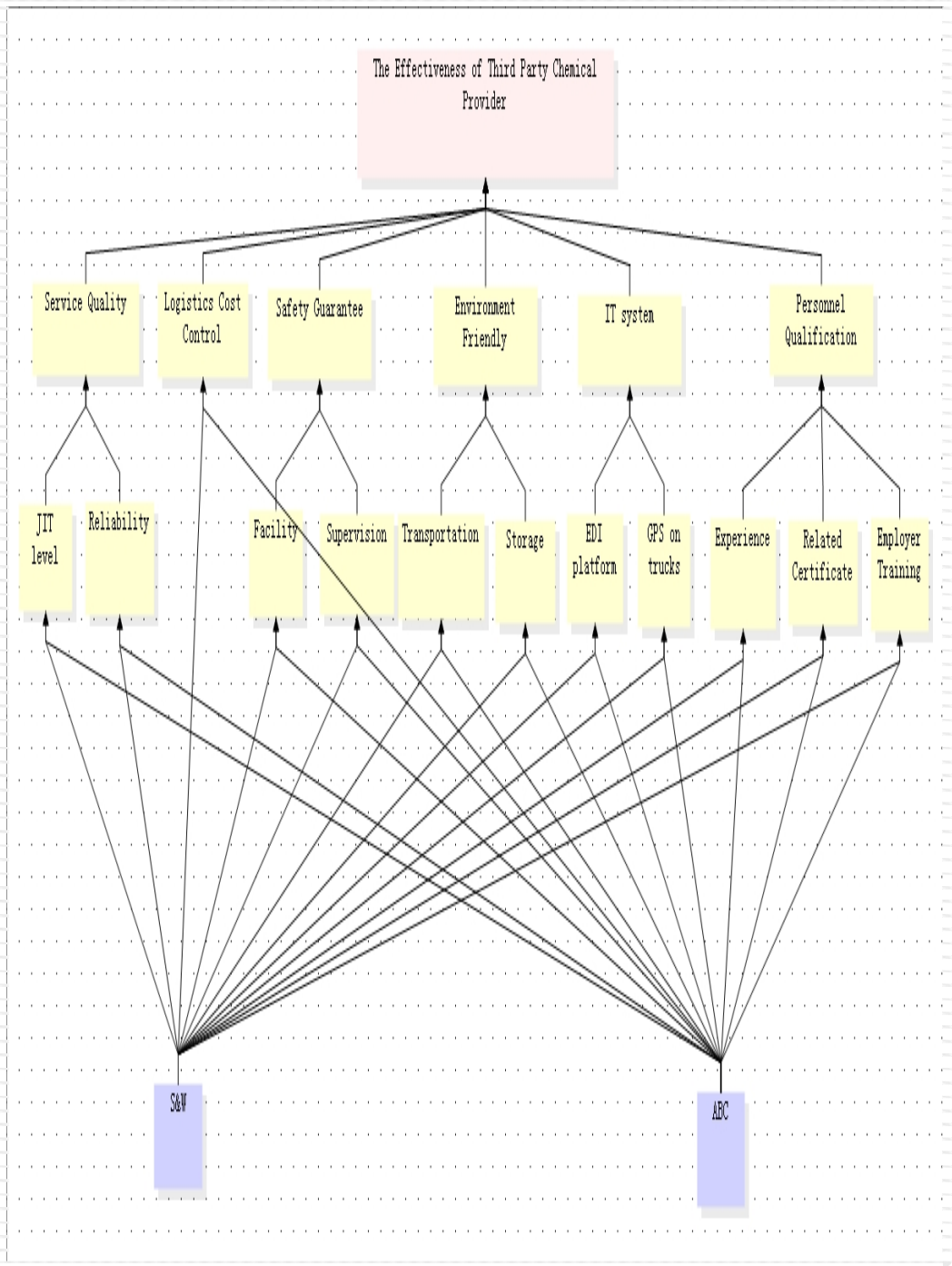

Figure 4-1 the Effectiveness of Third Party Chemical Provider

Table 4-4 Metric for hierarchy

Result

2 3PL Providers	Weight
ABC	0.3050
S&W	0.6950

1. The Effectiveness of Third Party Chemical Provider CR：0.0610; Contribution Weight：1.0000

The Effectiveness of Third Party Chemical Provider	Service Quality	Logistics Cost Control	Safety Guarantee	Environment Friendly	IT system	Personnel Qualification	Weight
Service Quality	1.0000	2.0000	0.5000	5.0000	5.0000	3.0000	0.2467
Logistics Cost Control	0.5000	1.0000	0.5000	5.0000	3.0000	5.0000	0.1958
Safety Guarantee	2.0000	2.0000	1.0000	5.0000	7.0000	8.0000	0.3872
Environment Friendly	0.2000	0.2000	0.2000	1.0000	0.3333	0.5000	0.0399
IT system	0.2000	0.3333	0.1429	3.0000	1.0000	3.0000	0.0798
Personnel Qualification	0.3333	0.2000	0.1250	2.0000	0.3333	1.0000	0.0506

2. Service Quality CR：0.0001; Contribution Weight：0.2467

Service Quality	JIT level	Reliability	Weight
JIT level	1.0000	0.2000	0.1667
Reliability	5.0000	1.0000	0.8333

3. Logistics Cost Control CR：0.0021; Contribution Weight：0.1958

Logistics Cost Control	ABC	S&W	Weight
ABC	1.0000	2.0000	0.6667
S&W	0.5000	1.0000	0.3333

4. Safety Guarantee CR：0.0090; Contribution Weight：0.3872

Safety Guarantee	Facility	Supervision	Weight
Facility	1.0000	3.0000	0.7500
Supervision	0.3333	1.0000	0.2500

5. Environment Friendly CR：0.0011; Contribution Weight：0.0399

Environment Friendly	Transportation	Storage	Wi
Transportation	1.0000	1.0000	0.5000
Storage	1.0000	1.0000	0.5000

6. IT system CR：0.0087; Contribution Weight：0.0798

IT system	EDI platform	GPS on trucks	Wi
EDI platform	1.0000	0.5000	0.3333
GPS on trucks	2.0000	1.0000	0.6667

7. Personnel Qualification CR：0.0176; Contribution Weight：0.0506

Personnel Qualification	Experience	Related Certificate	Employer Training	Weight
Experience	1.0000	0.3333	0.2500	0.1220
Related Certificate	3.0000	1.0000	0.5000	0.3196
Employer Training	4.0000	2.0000	1.0000	0.5584

8. JIT level CR：0.0003; Contribution Weight：0.0411

JIT level	S&W	ABC	Weight
S&W	1.0000	2.0000	0.6667
ABC	0.5000	1.0000	0.3333

9. Reliability CR：0.0029; Contribution Weight：0.2056

Reliability	S&W	ABC	Weight
S&W	1.0000	7.0000	0.8750
ABC	0.1429	1.0000	0.1250

10. Facility CR：0.0000; Contribution Weight：0.2904

Facility	S&W	ABC	Weight
S&W	1.0000	7.0000	0.8750
ABC	0.1429	1.0000	0.1250

11. Supervision CR：0.0016; Contribution Weight：0.0968

Supervision	S&W	ABC	Weight
S&W	1.0000	2.0000	0.6667
ABC	0.5000	1.0000	0.3333

12. Transportation CR：0.0306; Contribution Weight：0.0199

Transportation	S&W	ABC	Weight
S&W	1.0000	4.0000	0.8000
ABC	0.2500	1.0000	0.2000

13. Storage CR：0.00300; Contribution Weight：0.0199

Storage	S&W	ABC	Weight
S&W	1.0000	2.0000	0.6667
ABC	0.5000	1.0000	0.3333

14. EDI platform CR：0.0045; Contribution Weight：0.0266

EDI platform	S&W	ABC	Weight
S&W	1.0000	3.0000	0.7500
ABC	0.3333	1.0000	0.2500

15. GPS on trucks CR：0.0020; Contribution Weight：0.0532

GPS on trucks	S&W	ABC	Weight
S&W	1.0000	1.0000	0.5000
ABC	1.0000	1.0000	0.5000

16. Experience CR：0.0010; Contribution Weight：0.0062

Experience	S&W	ABC	Weight
S&W	1.0000	1.0000	0.5000
ABC	1.0000	1.0000	0.5000

17. Related Certificate CR：0.0001; Contribution Weight：0.0162

Related Certificate	S&W	ABC	Weight
S&W	1.0000	2.0000	0.6667
ABC	0.5000	1.0000	0.3333

18. Employer Training CR：0.0001; Contribution Weight：0.0282

Employer Training	S&W	ABC	Weight
S&W	1.0000	1.0000	0.5000
ABC	1.0000	1.0000	0.5000

After getting the result from calculation, we can find the weigh for each indicator in the effectiveness of the party chemical logistics. Also, values of CR are all smaller than 0.1, which means they have the complete consistency. Among these indicators, in the criteria layer, Safety Guarantee and Service Quality rank first and second, and in the Factor Layer, Reliability and Facility weight much more than other factors. Though the result is more or less influenced by people's subjective opinions, we should lay more emphasis on these factors while not ignore other factors. And as a matter of fact, these parts are having close relationship of the chemical logistics running.

Also, we can find that S&W (0.6950) is doing better than ABC (0.3050). However, the scale of preferences are only decided by several experts, I suggest to invite another several experts specializing in logistics enterprises to evaluate whether they find the result is safety through scoring the performance(**Excellent: 3; Good: 2; Bad: 1**) of the two 3PL providers and we can identify their advices by calculating the

percentage of the total number of the experts specializing in logistics enterprises (i.e. how many experts among the total experts believe one of two providers is excellent, good or bad in certain area among the indicators). It is an adoption of FCE. The whole calculation process and the result can be shown below in an excel table.

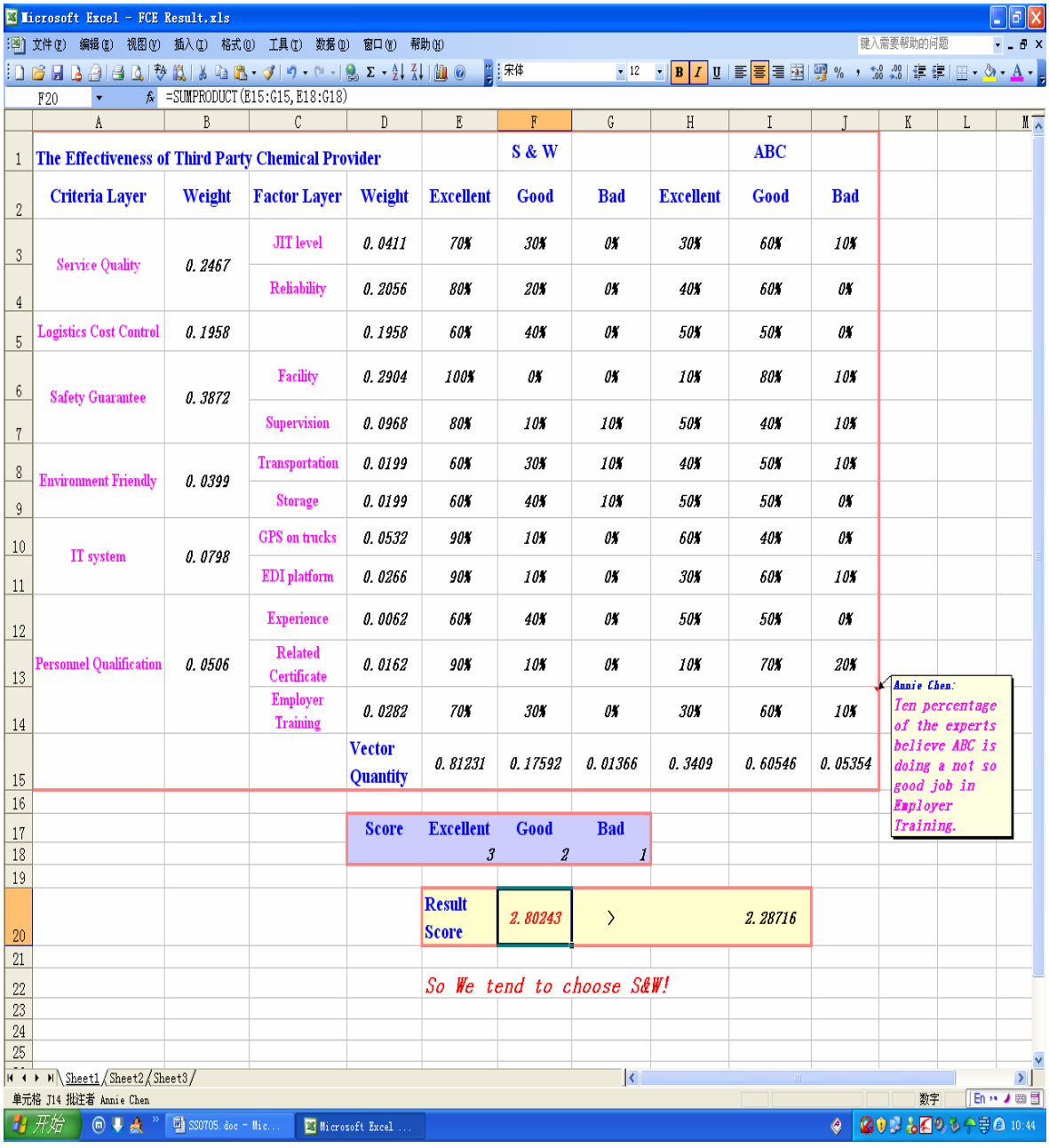

Figure 4-2 the selection from S&W and ABC

In reality, S&W International Chemical Logistics Ltd is dong a much better job than ABC. The company wins the consumers hearts through its high-quality service, advanced facility (e.g. It is the only one logistics company owns the qualification to do the ISO tanker leasing out service) and safety guarantee. So we have every reason to believe the feasibility and validity of the adoption of AHP and FSE methodology in the chemical logistics fields. Next time, we can use the related data to identify proper 3PL providers among the polarized logistics market. Similarly, the methodology can be used to analysis the other segmentation third party logistics field to get the effectiveness of each factor influencing its running and development.

There would be a great demand for 3PL providers these years, especially the specialized third party chemical logistics providers. Putting the in one basket is not a wise choice, it is sensible to select the qualified ones and kick out the improper ones. The above methodology can be one of the effective ways to judge and evaluate the ones suitable for serving the chemical logistics in Shanghai. There are some famous universities and institutions focusing on logistics research in Shanghai, and it is one of the talents gathering center, so inviting some specialists and experts will not be the problem.

Chapter Five

Indications and suggestion for Shanghai third party chemical logistics

5.1 Foreign successful experience

5.11 Singapore: the running pattern of the Singapore Chemical Logistics Zone[21]

Jurong Island chemical zone in Singapore is the biggest petro-chemical producing and logistics base as well as the third biggest petroleum refining base. Both the planning notion and the constructing experience of the development of Jurong Island's petro-chemical industry will be used for reference of Shanghai's new burgeoning chemical park as well as the fitting infrastructures as the chemical logistics system is bringing to the spotlight now.

Jurong Island is linked up by filling the sea with island. The advantaged shipping condition builds up the irreplaceable status of the petro-chemical industry of Singapore in the Asia even the world wide. And several small islands make up the zone and the "filling sea" project was carried on by 4 stages and the land area was as large as 3200 hectares by the year 2005, so the capacity can be ensured.

Through the concentrating investment of Jurong Island made the Chemical Cluster, that is the incorporating development pattern of upstream and downstream. The material can be transmitted by the pipes in the park and all the infrastructures and public projects are shared among enterprises to reduce the logistics cost and invest cost to the whole hog. The investors are including Eastman, DuPont, Teijin, Celanese, ExxonMobil, Shell, and Mitsui Chemical, etc. Now it is the important petroleum refining center and ethene producing center.

[21] Wang D.S. (2007, Jan. 5). Singapore's Chemical Industry. Retrieved from the World Wide Web: http://www.istis.sh.cn/list/list.asp?id=4213

As a result of the industry development and market segmentation, the international chemical producing enterprises seldom carry out the chemical logistics themselves, but outsource this part to the 3PL providers. They include waterway, land transportation operators, terminal and storage establishment operators, chemical warehouse, ISO tanker and pipeline operators. Whoever, the producing enterprises or the trading enterprises, all hope to deliver the products fast, precisely and at the low cost.

Jurong Island Chemical Zone consists of many logistics establishments such as the crude oil, the liquid chemical terminal, pipelines and storage facilities. These are all crucial to the formation of the Chemical Cluster.

Hint for reference to improve the chemical logistics in Shanghai

The enterprises in Shanghai construct their own terminals and tankers while the enterprises in Jurong Island mainly depend on the professional third party storage companies. For example, Vopak, Oiltanking and Tankstore are some of them. Vopac is the biggest storage company of oil and liquid chemical products in the world, the tanker storage area is as high as 15 million square meters. And Oiltanking's tankers cover the area of near 9 million square meters.

Chemical Cluster is an innovative notion and should be used for reference to apply to the Shanghai's pattern. SCIP has put forward the blue print of five incorporations, including "products and projects incorporation" and "logistics and transportation incorporation". They are similar to the notion of Chemical Cluster. The logistics function of the logistics park can satisfy the demand of the chemical production and development while the input and output of the products support the development of

the chemical park. They are supplementary.

As the chemical logistics center, the land resource is getting scarce with the projects introducing and investing. The improvement of the efficiency is very important. So try to reduce the proportion of the terminals provided for the chemical enterprises themselves and increase the proportion of the 3PL provider may make it more efficient.

5.12 Europe: The safety guarantee in the chemical logistics

In the web site of CEFIC, we can find such description of the framework of the corresponding system to deal with the emergent things happened in the chemical logistics:

"Within the framework of Responsible Care, the chemical industry in Europe makes every effort to transport goods to and from its manufacturing sites and storage locations safely and in full accordance with relevant regulations and codes of practice. In the event of an incident, the chemical industry will provide information, practical help and, if necessary and possible, appropriate equipment to the competent emergency authorities should be adopted in order to minimize any adverse effects."[22]

The following chart illustrates the typical flow of response in transport emergencies. However, each country can adapt the operation of a national ICE scheme according to its own specific needs and practices already in place.

[22] CEFIC website (Transport and Logistics): http://www.cefic.org/Templates/shwStory.asp?NID=492&HID=378

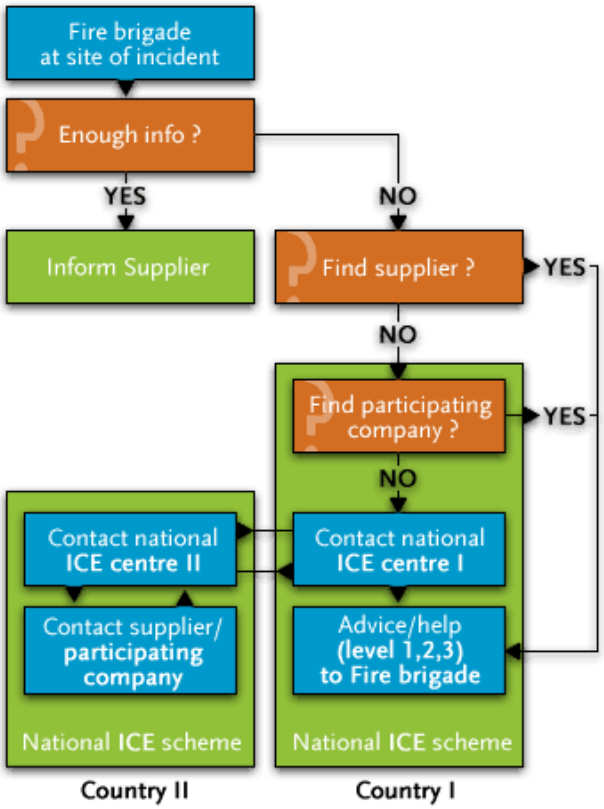

Figure 6-1 the Emergency System

Source: www.cefic.org

Hint for reference to improve the chemical logistics in Shanghai

The chemical logistics enterprise should have more social responsibility consciousness and safety consciousness. In Shanghai, the department in charge of the chemical production and transfer and delivery is not existed. So the crucial solution to the safety problem is to be coordinated through government and come to an agreement. We should also try to set up such a emergency system to strictly control and inspect the six segments of chemical production, storage, prosecution, transportation, utilize and castoff deposition, especially the virulent, flammable and explosive, and corrosive chemical transportation. And the system can be connected

to the net of other counties, regions and even countries.

5.13 An excellent system provider for third party chemical logistics providers

We have numerous third party logistics providers in the shipping industries, and some of them are specialized in the chemical logistics. Besides the experience, the setting and management systems are more import for there providers. The above is an advanced running pattern designed by MDL for certain third chemical logistics.

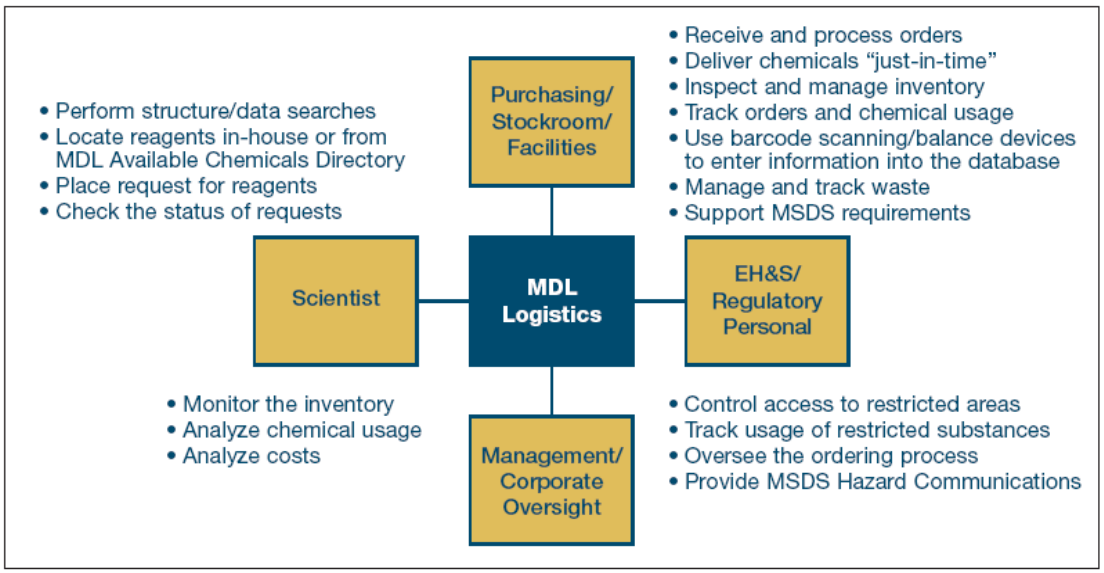

Figure 6-2 the Running Pattern of MDL

Source: www.mdl.com

MDL Logistics is a unique solution that maximizes the efficiency of the chemical logistics and procurement workflow by permitting you to[23]:

"1. Manage regulated substances by creating reagent lists and security groups

2. Consolidate chemical inventories and reduce purchasing costs

3. Provide accurate data for EH&S, material distribution and management

4. Integrate with purchasing systems

[23] Elsevier MDL website: www.mdl.com

5. Integrate with laboratory hardware, such as barcode scanners, balances and storage robots
6. Integrate with MDL Reagent Selector, MDL Plate Manager and other MDL solutions"

Hint for reference of the third party chemical logistics in Shanghai

Nowadays, enterprises begin to focus on their core source and business and outsourcing becomes the main developing direction. 3PL has developed very fast because of its special technology and management. The third party chemical logistics enterprise should pay attention to promote attractive marketing and develop more quickly to satisfy the ever growing chemical market in Shanghai. I suggest these enterprises to introduce the strategies of products strategy, pricing strategy, channel strategy and sale promotion strategy through a better network platform. Third party chemical logistics should have an electronic data platform to provide more specialized service such as status check, order making, cost analysis and information sharing.

5.2 SWOT analysis of third party chemical logistics in Shanghai

SWOT[24] analysis is "a tool for auditing an organization and its environment. It is the first stage of planning and helps marketers to focus on key issues. SWOT stands for strengths, weaknesses, opportunities, and threats. Strengths and weaknesses are internal factors. Opportunities and threats are external factors."

In the analysis of third party chemical logistics in Shanghai, the forecasting of its developing trend has been made and some problems have been found. The SWOT analysis may help to get a more clear idea of the internal and external factor

[24] Retrieved from World Wide Web: http://marketingteacher.com/Lessons/lesson_swot.htm

influencing the third party chemical logistics in Shanghai and may be referred to get some indications and suggestions for better planning and developing from it as shown in Table 5-1.

Table 5-1 SWOT Analysis

Strengths	More specific and specialized work division Better resource allocation More time saved More tightened cost control Improve the customer service level Increase the flexibility of the chemical enterprise Higher efficiency and security Fitting for the prosperous chemical industry
Weaknesses	The good and bad providers are intermingled Plan and layout is hard to catch up with the development
Opportunities	Foreign capital investing accelerate the development Becoming international logistics center including chemical logistics Development green logistics to contribute to the environment
Threats	Fierce competitions among the regions in China area Big consumer region, not the raw material producer Environment problems

5.3 Suggestions for the development of the third party chemical logistics in Shanghai

1. We should have long views for the layout of the chemical logistics

development

For the 3PL companies, they should not only focus on the present or short-term operation expansion and should view the future if they want to expand their scale and found their own brand. So the area of land requisition and storage construction (including area and numbers) must be invested in a long view to avoid the passive complexion. The layout of the infrastructures should fit for the future situation according to some forecasting analysis[25].

For service providers, the real fact to know is that the chemicals industry is "a mature business with the same competencies," says Mark Rourke, vice president and general manager of transportation management at Schneider Logistics, Green Bay, Wisc. "3PLs must consider the opportunities. Are we helping chemical companies think about the next five years rather than the next five days? We always think of end-to-end total costs, not just the dollar costs of transportation."[26]

In the business development, the planning is the first thing should to, and stepping up, and then advancing gradually. For Shanghai' chemical products logistics market, the eye should cast on the Caojin Chemical Industry Park as it is the biggest chemical zone in China at present. The reconstruction should also be laid importance on to meet the future demand of import and export of chemical products. After the accumulation of enough capital, the consummate running net will be set up to the nation wide, even to the world wide.

2. Set up higher doorsill of specialized qualification and lower level of capital

[25] S. Wixey and S. Lake (1998). Transport Policy in the EU: A Strategy for Sustainable Development? *World Transport Policy & Practice.* Vol.4 No.2.

[26] Gregory DL Morris (2006, June). Chemical Producers Put New Emphasis on Logistics Safety and Security. *Chemical Logistics* , pp. 60.

registered for 3PL providers

We can get from the above analysis that the current situation of third party chemical logistics providers can not meet the flourishing chemical market, not to say years later, the gap will be wider. We should encourage the superior enterprises with high level of chemical logistics specialization and turn back the unqualified ones. The 3PL market is full of providers with different level, to check on and set up a specialized institution to judge the qualification is necessary. In addition, government should encourage local chemical logistics service providers other than the foreign ones to take up the 3PL business as the chemical logistics is a high profit industry.

3. The government should draw laws on the chemical logistics

The related laws on the chemical logistics should come into being and the government should strictly regulate them. Many products are dangerous cargo in the chemical industry, controlled or supervised improperly; the wealth as well as the security will be threatened. For example, when a big accident of leakage concerning the chemical logistics occurred, the liability should be specific. If there doesn't have a complete and integrated law, who will be liable for the environment damage and public's health?

4. Automatic systems are needed.

The 3PL providers should own a set of automatic reconnaissance and protection system and transportation and storage devices. Then they can tackle the tough problems and accidental incidences and provide the remedial measures. In addition, the adoption of relative devices can help to increase the running efficiency, save the time and lower the cost. For example, using the truck with trail in the chemical

transportation and adopt CIDX in a more proficient way[27].

The automation potentials, however, are considerable. Inventory levels ought to be reduced, control rules ought to be standardized, quantities of the product ought to be harmonized along the logistics chain and facilities of the production ought to be utilized as much as possible.

The function of the logistics center should also be improved and the related facilities should catch up with the advanced countries to eventually realize the information automation, intelligence, flexibility and socialization.

5. Setting up a high quality chemical logistics experts.

(1) We should focus on training and cultivating the group of professional specialists because it will bring up new pioneers in this new burgeon industry in Shanghai. Then the safe storage, disposal and transportation of chemical products can be insured. Of course, these cultivations should also take foreign experience, culture, and barriers into account. For example, European chemical companies like British Petroleum and logistics service providers that specialize in hazmat handling can be learned to help educate Shanghai's chemical industry in respect of the importance of standards, regulatory compliance, and avoiding dangerous, costly incidents.

(2) The salary of the relative employers should be higher. What is one of the main causes of the frequent flow of the personnel of the related industry? The income and the job welfare guaranteed! In Singapore, the employers in the relative industry get high salary, so the job-hopping is rarely happened in chemical

[27] Managing the Unexpected in Complex Chemicals Supply Chains. Retrieved from the World Wide Web: www.sap.com/chemicals

logistics. We can take this into account. At the same time, the enterprise should assess the employer from the safety cultivation and infuse them with the consciousness that safety is the benefit on some extent.

6. Setting up the HSE system

One of the main difference between chemical products and general cargo is the chemical may cause environment pollution if some leakage or explosive, etc. are occurred. We should develop chemical industry not only regarding the importance of standards, regulatory compliance, and avoiding dangerous, costly incidents, but also set up the HSE system to make steady improvement in environment protection as well as the consideration for people's health. The government is now addressing environmental issues, including reduction of chemical wastes, recycling and re-utilizing, serious supervision. It is practical to make a whole HSE system, and this should be canonized as an important issue in development of third party chemical logistics.

7. The interviews with industrial supply chain managers and key decision makers.

Industrial supply chain managers and key decision makers will help to source service providers' contact details quickly and easily; benchmark providers with brief profile, turnover and employee details; target country specific operators; identify strengths and weaknesses of each transport provider; understand the operational capabilities and fleet sizes of operators on a country by country basis; identify the key quality accreditations (ISO, SQAS etc.) for each service provider; evaluate the existing client base of leading service providers[28].

[28] Retrieved from World Wide Web: http://www.industrialnewsupdate.com/news/logistics-shipping/archives/2005/04/index.php

Conclusion

We can find the third party chemical logistics market has a flourishing future and a lot of business opportunities.

(1) The output of the chemical is developing in the prosperity in Shanghai. The market demand is expanding quickly: both the export and import of the chemical products are increasing gradually and more and more foreign giants invest in Shanghai chemical industry. These all promote the chemical logistics development in Shanghai and indicate that the potential room to move up and more business chances involved in.

(2) The third party chemical logistics has the big market. The 3PL providers still occupy the small proportion of the whole chemical logistics market. The chemical logistics is the capital-intensive running activity and, from storage, transportation to the delivery, all of which need wide space, numerous land, vast investment on facilities and many personnel and much man power. The use of 3PL can help the chemical enterprises to utilize the limited source more effectively and share the facilities. So the adoption of 3PL in the chemical industry in Shanghai has the irreversible trend. And AHP- FSE model can be adopted in choosing the proper providers. Let’s find out what the third party chemical logistics will bring to the Shanghai chemical industry.

1. It helps to optimize the production and management level and lower the logistics cost in Shanghai

Modern logistics is developing from centralizing logistics to logistics of frequency and small amount. Also, the otherness in the chemical products and their various

special natures has different demand standard for the transportation vehicles. As a result, the specialized flexible production line of chemical enterprises is needed to satisfy the blending production of multi-purpose products. Modern logistics will ask the enterprises to adopt the advanced supply chain management technology to intensify and optimize the enterprise's management process. Thus, the lead time can be reduced. The processed materials can be transported to the production line when needed. It is estimated that the inventory can be reduce by 4% while the transportation cost can be reduced by 15% when the instant supply is applied.

2. It helps to adopt the new technology in the chemical logistics industry

In the modern logistics, many transportation enterprises expect to get the information of the running location and situation of laden trucks, thus they can carry out the plan modification, economy analysis, freight auditing and the cargo inquiry after the information analysis. So the advanced technology such as GPS system is necessary to be fixed on these trucks.

3. It helps to promote the safety of the chemical products

The vehicles are purchased or leased by the third party logistics enterprises by batches to ensure the JIT supply. Then they will be asked to have good performance, especially the stability and the reliability. The chemical products transportation service provider must also provide high-quality products to satisfy the demand of the modern logistics. They must fit for each other to promoter the safety in the chemical logistics field.

4. It helps to promote the demand of the specialized truck

The special nature of the Chemical, especially the viability of the dangerous cargo and liquid chemical products, will increase the competition of the fright market and

promote the logistics to the trend of high quality; high efficiency and high speed as well as to urge the prosperous development of various specialized trucks.

5. It helps to improve the transportation efficiency

Designed properly, the modern logistics procedure can make the situation of the empty rate decrease by 5%. Thus a large amount of fuel and time cost can be saved.

(3) The chemical logistic has a long way to go. The Shanghai Chemical Industry Park, as the chemical logistics center in Shanghai, has the potential to be enlarged. The ever growing trend make the construction of the chemical logistics center only the beginning of the industry development.

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