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# **Supply Chain Performance Measurement**

The integrated project of Shengda Market Chain and Lijin Agricultural Base




Bachelor's thesis

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ABSTRACT

The Shengda Market Group is one of the biggest professional supermarket chains of Shengli Oilfield. The company was founded in January 1996 and is located in the Dongying area. Shengda has its own logistic center with domestically leading equipment and facilities of cold chain, sorting, segmentation, testing and packaging. Besides, Shengda Market adopts the modern integrated supply chain model “Intermediary organization + agricultural cooperative organizations”, establishes the partnership with Agricultural Base to agree the intended sales and purchases of agricultural products. Currently, Shengda Market has established the partnership with three agriculture production bases. The aim of this thesis is to study the agricultural supply chain, the specific characteristics of agricultural supply chain in China and the general models used in China. In addition, focus is on one of those agricultural production bases, Lijin, to evaluate the integrated supply chain performance.

The thesis is composed of 7 sections: introduction for the study, agricultural products supply chain, agricultural supply chain in China, supply chain performance measurement, analysis, conclusion and summary. In the introduction, the company background, thesis background and the objectives, models and methods used during the research are presented. The second section discusses the definition of agricultural supply chain and its general characteristics. The section of agricultural supply chain in China analyses the specific features of the Chinese agricultural supply chain and the common supply chain models used in Chinese agricultural products are analyzed. This leads to the integrated supply chain model that is used in Shengda Market Chain and Lijin Agricultural Base - “Intermediary organization + agricultural cooperative organizations”, and based on this the framework of supply chain performance measurement is presented in Chapter 4. Following these are analysis, conclusion and summary.

To conduct the thesis, both qualitative and quantitative methodology was used. The data collection was both primary data collection and secondary data collection. The primary data is from personal interviews and questionnaires. The main objective of personal interviews is to get familiar with Shengda Market and the integrated project in order to create evaluation framework and questionnaires. The main purpose of the questionnaires is

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collecting the data for the evaluation of supply chain performance. Through this investigation, 46 effective questionnaires have been given. As for the secondary data, the research material and information were mainly collected from paper-based and Internet sources. The evaluation method used in this thesis is fuzzy comprehensive evaluation.

Therefore, according to the evaluation results, strengths and weaknesses of the supply chain performance are summarized and presented at the end part of the thesis. The evaluation result will be used on higher-level management to improve project management and decision-making.

**Keywords** Agricultural supply chain, supply chain performance measurement, fuzzy comprehensive evaluation

**Pages** 49 p. + appendices 4 p.

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## Appendix 1 Questionnaires

## 1 INTRODUCTION

With the development of agricultural production, the annual output of agricultural products is continuously increasing. Good quality agricultural products have to search for wider market. With the traditional sales channel of agricultural products, it is difficult to establish a secure reputation in the minds of consumers and it is hard to maintain the value of agricultural products. Hence, many good and special agricultural products are limited in the area of production and cannot enter into the larger market and bigger circulation, leading the production and sale to be left behind in development.

Meanwhile supermarkets are developing rapidly. More and more customers choose supermarket instead of traditional agricultural products market because it can offer a better purchasing environment. However, most of the supermarkets in chain still relied on intermediary companies or large wholesale market to get fruits and vegetables. In this way, it generally took two or more days in transportation and storage process. Several of the intermediaries not only brought the difficulty for the product quality guarantee, but also increased costs. In order to attract more customers, supermarkets have to search for a better supply chain model, to get better quality products with lower price.

Under these circumstances, more and more supermarkets are giving up the traditional purchasing channels. Instead of that, they are establishing partnerships with agricultural cooperative organizations, extending their procurement system to producer and purchasing products directly from farms, forming a circulation, so called "chain supermarket + agricultural cooperative organizations".

Shengda Market Group, China, initiated this thesis. The main objectives of this thesis are to study and analyze the agricultural supply chain and the main models used in China. Furthermore, based on the specific characteristics of the agriculture supply chain, the supply chain performance of "chain supermarket + agricultural cooperative organizations" project of Shengda Market Group will be evaluated. This thesis will primarily comprise three parts. Firstly, supply chain and agricultural supply chain will first be introduced with their characteristics. This includes different models used in China and so forth. Secondly, the practical operations will be presented in the later part as a guideline to show Supply Chain Performance Evaluation Model, Index and Method that are used during the evaluation based on the integrated project "chain supermarket + agricultural cooperative organizations". The last part is the results and conclusion gotten from the evaluation.

### 1.1 Company Background

Shengda Market, the first professional supermarket chain of Shengli Oilfield, was founded in January 1996. It is now one of the biggest supermarket chains in Dongying area, which owns the most number of stores and offers the

broadest service. Over the years, Shengda Market adheres to the operating mission to “ensure customer satisfaction, realize people, convince and help the people”.

At present, the number of stores of Shengda Market reaches 60 and its business area is more than 80000 square meters. In the national fast moving consumer goods retail chain ranking, it rose from 87 to 78, continuing to maintain the lead position of regional retail chain industry. It is selected as the key cultivating pilot, an enterprise for “Base + Supermarket” project by Dongying. It was elected to be a member of China Chain Store & Franchise Association in both 2008 and 2009. In 2009, Shengda market opened 14 new stores, increased expansion business area by around 10000 square meters and achieved sales revenue of 800 million RMB.

Meanwhile, Shengda Market actively responded to the call of “Base + Supermarket” of the government and became its pilot unit. In June 2009, Lijin fruits and vegetables direct sourcing base started and in August 2010, Guangrao fruits and vegetables direct sourcing base was launched. With the continuous progress of the various measures, the quality of fruits and vegetables got a substantial increase and the price of them became more reasonable. At present, the sales of vegetables and fruits increased nearly 30% compared to 2008. On 20th of October 2010, cold chain fresh food logistic center was launched. The logistic center covers an area of 10000 square meters, with domestic leading cold chain, sorting, segmentation, testing, packaging equipment and facilities, with the capacity to process 30000 tons of fresh goods per year.

In the future, Shengda market will continue to keep development as a priority, and strives to expand the market chain to 100 stores in 2012 with the sales revenue exceeding 900 million RMB. In addition, Shengda plans to open a market every 500 meters along the main road and for districts where resident population exceeds 500. New stores’ replenishment cycle period is shortened to 3 days, in order to make rapid development and carry out the franchise as well as possible. Shengda supermarket companies strive to increase both on-time delivery and delivery reliability rate to 95% in the next year that will provide better base for further store expansion and operation. The massive update of logistics center enhances its own distribution, reduces intermediate links, increases sales profits and enriches regional commodity markets leading to a significant reduction in the sales price that perfectly maintains the brand image. (Chunling Zhang, interview 4.6.2012)

## 1.2 Thesis Background

Currently, Shengda has established the partnership with three agriculture producer bases and has the ability to offer 3000 different kinds of main commodities accounting for 70% of all fresh goods in the market. The average order reliability rate of Shengda is 90%. (Chunling Zhang, interview 4.6.2012)

This thesis focuses on the study of Agriculture Supply Chain, to analyze its characteristics and different models used in China. The objective of this is to

get better understanding of Agriculture Supply Chain in China provide a excellent foundation for the evaluation in the second part.

Furthermore, the Supply Chain Performance of “chain supermarket + agricultural cooperative organizations” project will be evaluated based on the oldest agricultural producer base, Lijin, of Shengda Market Group to collect the data. The data will be used on higher management level to improve project management and decision-making.

### 1.3 Research Objectives, Model and Method

The main research methods used in this thesis include personnel interviews, meetings and questionnaires. The main objective of the personnel interviews and meetings is to get better image of the projects’ development, assisting in establish the Supply Chain Performance Index and create questionnaire that can cover every angle of this integration project in order to get results which are closer to the reality. The evaluation method be used in this thesis is Fuzzy comprehensive evaluation.



## 2 AGRICULTURAL PRODUCTS SUPPLY CHAIN MANAGEMENT

With the development of science and technology, the output of agricultural products has been growing rapidly. Take China as example, the average annual growth rate from 1978 to 2003 is shown in Table 1.

	1978-1984	1985-1998	1999-2003
<b>grain</b>	5.0	2.3	-4.1
<b>Rice</b>	4.5	1.3	-5.1
<b>wheat</b>	8.5	51.9	-6.6
<b>corn</b>	4.6	5.8	-2.5
<b>soybean</b>	4.2	2.9	1.9
<b>cotton</b>	19.3	0.6	6.1
<b>vegetables</b>	7.5	7.8	10.0
<b>fruits</b>	7.0	12.6	23.5
<b>Meat products</b>	9.0	8.3	4.2
<b>Aquatic products</b>	4.9	14.1	3.4

Table 1 Average Annual Growth of Agricultural Products Output in China

While, the value that people spend on food has increased substantially year after year. The consumers of agricultural products are more demanding these days, and no longer rely on 'seasonal' food. The agricultural market has changed from seller's market to buyer's market. The 'Older' business practices involved managing the problem of maintaining huge inventory of all products, which required buying more goods than needed to avoid shortages. Instead of old 'inventory-driven system', today 'service-driven system' is used. This type of system is 'pulled' by customer demand rather than being 'pushed' by a supply system. Supply Chain management is a concept that is used increasingly to replace traditional fragmented management approaches of buying, storing and moving of goods. (Kathryn Webster, 2001, chapter 3)

### 2.1 Agricultural Products Supply Chain

The Council of Logistics Management defines Supply Chain management as the processes of planning, implementing and controlling efficient flow of raw materials, in-process inventory, finished goods and related information from the original point to the consumption point, for the purpose of conforming to customer requirement. (Ashish Bhatnagar, 2009, P2)

Agricultural Products Supply Chain (Agri-SC) is a branch of Supply Chain and specific for agricultural products, referring to the collection, aggregation, storage and transport of agricultural products from the farm to the consumer and to all intermediate levels such as the processing facility (factory), market and retailers (Franklin Crowell).

The physical movement of Agri-SC is shown in figure 1, and can be subdivided into a number of sectors. Agriculture producers are the 'primary producers'. The processing enterprise that processes food into products

ready for the table or further cooking, together with the packaging companies, are an intermediate stage, and wholesalers, retailers and restaurants are the end stages of the supply chain. At each stage in the chain, the food is passed into a new ownership and 'value' is added. The added value includes the additional costs of processing, packaging and distribution, together with profits. In addition, costs of unwanted products and waste are covered at these stages. Hence, the less intermediate levels goods go through, the more benefit the end customers receive.

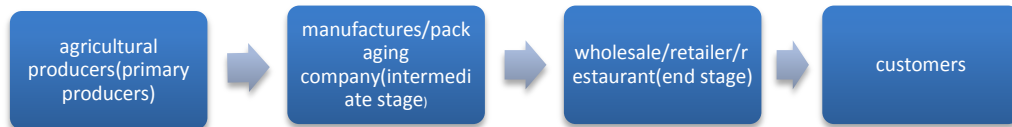


Figure 1 Physical Movement in Agricultural Supply Chain

Ashish Bhatnagar (2009, P6) summarizes the advantages of Supply Chain Management in 9 aspects as follows:

- 1) Reduced inventory at all sites of supply chain.
- 2) Reduced costs.
- 3) Faster order processing speed.
- 4) Reduced lead times.
- 5) Reduced warehouse costs.
- 6) Reduced obsolescence.
- 7) Greater responsiveness to customer changes.
- 8) Electronic links to suppliers and customers.
- 9) Speeding up the development cycle.

## 2.2 The Characteristics of Agri-SCM

Although Agri-SCM is a branch of SCM, because of the specific characteristics of agricultural products and agricultural production, Agri-SCM is distinct from the supply chain of manufactory industry or service industry. On the one hand, the production is easily influenced by natural conditions and crops' life cycle. On the other hand, fresh agricultural products are people's daily necessity. The demand elasticity is small. Agricultural products have the characteristic of expense universality and they are dispersed around the world. (Zhao Yingxia and Guo Xiangyu) All of those characteristics cause Supply Chain Management of agricultural products to differ greatly from Supply Chain Management of other industries. Generally summarized, the Agri-SCM characteristics are described in the following sub sections.

### 2.2.1 Strong Seasonal Characteristic

Since different plants are suitable for different natural conditions, such as climate, water, soil in different region, the agricultural production has strong seasonal characteristics. On the one hand, the production and material purchase of the farmers have the seasonal characteristic. However, the agricultural product manufactories or wholesales are working around the year. On the other hand, the output season of various agricultural and subsidiary products are different between each season, but the demand for agricultural products is constant which causes the imbalance of agricultural supply chain. (Zhao Yingxia and Guo Xiangyu) The imbalance of agricultural supply chain requires higher level and specific service of logistics, such as the capacity and management of warehouse, the demand forecast and so forth. Seasonal characteristics should be considered as the main part of developing Agri-SC.

### 2.2.2 Strict Requirements

The seasonal characteristic of agricultural products requires timeless logistics and the nature characteristic of it asks for the specific technology to maintain the products fresh and keep the good quality. Most agricultural and subsidiary products have the characteristic of the easy putrescence and the high requirements of freshness. In order to ensure the quality of products, certain technical measures need to be taken, including preventing insects, moisture proofing, antisepticing, and drying. This requires specific logistics equipment facility, such as special warehouses, special-purpose carrier vehicles, and special-purpose loading, unloading and processing equipment and personnel. The agricultural logistics emphasizes safety, no pollution and requests realizing “the green logistics”. (Zhao Yingxia and Guo Xiangyu)

### 2.2.3 Long Distance Between Production Area and Sales Area

As is known, because of the nature characteristic, agricultural products need timeless logistics and specific technology to maintain the freshness. However, the long distance between agricultural production area and sales area increased the difficulty of logistic. The agricultural production area is normally at countryside, far away from city. Nevertheless, the biggest consumption area is at urban city where there is large population. Large demanding and multi-space brings the contradiction of production and marketing, supply and demand time. In additional to the nature characteristic of agricultural product, agricultural logistic have to be more efficient in order to maintain the quality of products.

#### 2.2.4 Various Products and Big Scale

Agricultural product variety is rich and the circulation is extremely big. For example, In China, the cotton yield was 7,500,000 tons in 2008, decreased 16% compared to 2007. The output of oil plants was 29,500,000 tons, increased 14.8% production; the output of sugar was 130,000,000 tons, increased 6.7% production. The overall meat output was 72,690,000tons, increased 5.9% compared to 2007. The vegetables and fruit steadily developed the foundation of the optimized variety. (China agriculture development report, 2008) Except the farmers own families' consumption, most of the products have become commodities and go to the circulation. The various products and big scale asks for better logistic service.

#### 2.2.5 Dispersibility

Since most of the logistic service objects in agricultural products supply chain are millions of private farmers, the number of them is very large. However, specific to every farm, the logistics scale is very small and products are different. Hence, the scale of Agri-SC service must be extended which raises higher requirement of information system, centralized collection and distribution system.

#### 2.2.6 Complexity and Collaboration

From the farm to the end consumer, at every intermediate levels of Agri-SC, there are a number of participants involved into the process and this requires high level of collaboration between each other. There are a number of things where there needs to be cooperation, such as shared sourcing, information on-time delivery, responsibility dividing, sharing the benefit, coordination actions and so on. In order to optimize the benefit and efficiency of the whole supply chain, each members of the supply chain have to establish a long-term strategic relationship. Every member of supply chain is required to consider each other's benefit and cooperate, in order to succeed among the competitors.

### 3 AGRICULTURAL SUPPLY CHAIN IN CHINA

China is a large agricultural country, employing over 300 million farmers, which occupy the majority of the national population. China ranks first in worldwide agricultural products output, the agricultural products varieties are rich and the circulation is big. Agriculture, rural areas and farmers are the three important historical problems, which have influenced China's economic development in the long-term. Agriculture logistic played an important role in the agriculture product industry.

However, Chinese agricultural logistics is still in a backward state. The loss percentage of fruits and vegetables during the process of picking, transportation, and storage in China is about 25% to 30%, which comprises about 130 tons of vegetables per year and 12 million tons of fruits. The decay losses could provide the demand of nearly 200 million people. In 2008, the value of losses was up to 100 billion RMB, having decreased from 120 billion RMB in 2009. Hence, the development of the agricultural product supply chain has become one of the key aspects affecting economy of the whole country.

After three decades of reform and opening-up, Chinese logistic system has progressively improved. Many different logistic parties have emerged out and agriculture logistics infrastructure has been improved. Modern trade methods are used and basic multi-level circulation pattern has been formed already. Although agricultural product logistics in China has been built up with some success, compared with developed countries, it is still in a backward state. In this Chapter, the characteristics of Chinese Agri-SCM and its model will be discussed.

#### 3.1 Characteristics of Chinese Agri-SCM

Chinese Agri-SC shared many characteristics with the Agri-SC of other countries. However, because of the specific history and geograph, it also has its own characteristics.

##### 3.1.1 Dispersed Production and Logistic Management, Household Responsibility System

Chinese agriculturally employed population occupies the overwhelming majority, but the production demonstrates small and dispersed characteristics and is lead in the mode of single household management. One of the reasons causing this small and dispersed household production and management is Household Responsibility System (HRS) .

In the late 1970s and early 1980s, economic reforms were initiated in China. Household Responsibility System had been introduced to rural areas. HRS was a contracting system; a popular method is called “contracting everything to family”, which allowed households to contract land, machinery and other facilities from collective organizations. After the harvest, households had to sell a certain amount of products to state officials at

stipulated prices and anything else above these quotas could be sold at a higher price to other buyers. These would normally be sold again to the free market with fluctuate price (John Malcolm Dowling, 2008). The aim of HRS was to preserve basic unified management of the collective economy, while contracting out land and other goods to households. Households could make operating decisions independently within the limits set by the contract agreement, and could freely dispose of surplus production over and above national and collective quotas.

The growth of the agricultural products output, in the first few years after HRS launched, was significant. It reached 7.1% from 1979 to 1984. After 1985, the growth slowed down, but at still remained strong 4% growth during the following decade.

	1970-1978	1978-1984	1985-1995	1996-2000	2001-2005
<b>GDP growth</b>	4.9	8.5	9.7	8.2	9.5
<b>Agriculture</b>	2.7	7.1	4.0	3.4	3.9
<b>Industry</b>	6.8	8.2	12.8	9.6	10.7
<b>Non-farm rural enterprises</b>		12.3	24.1	14.0	

Table 2 Production Growth in Agricultural Industry TVEs

Although Household responsibility system has had a decisive role in Chinese agricultural history, it causes the agriculture production to demonstrate small and dispersible characteristics. In 2010, there were about 193 million peasant households in China and the average farmland for one peasant household was around 0.57 hectares. The peasant households who owned more than 3.4 hectares of farmland accounted for 0.45%. (China agriculture development report, 2010) This dispersed production and management method lack of the scale benefit and will have a difficult time to obtain them when the economical scales reach certain level.

Because of the HRS production system, the purchase of agricultural production materials and the sale of the agricultural products are also presented in a dispersed way. This dispersed purchase and sales channel is blind. It has a low utilization rate of equipment and long, unstable lead-time for supply of production materials. This is hard to catch up along with the development of economy and the consumers' enhanced demand of quality.

Currently, Chinese agricultural products circulation faces the conflict of "small peasant households and big market". Most of the production is still based on household. The production scale is small and the organization level is low. According to China agriculture development report (2009), approximately 60% to 70% peasant households have to consider the distribution channel themselves. There is no efficient connection system between single farmer and market. Information system, centralized collection and distribution system are desperately needed to maintain the information flow and physical goods flow.

### 3.1.2 Unstructured and Immature Logistics Market

As mentioned before, Chinese agricultural production is based on small-scale peasant households' production. The organization degree of logistics market is low. Most of the peasant households have to find the sales and distribution channel themselves and they enter into the market in an unorganized and dispersed way, which causes agricultural products lack of competitive market power and self-protection ability. This dispersed way of production and management is incompatible with the modern logistics system requesting specialization division. The development of intermediary organizations in the agricultural product logistics market is immature and cannot provide fully functional service. Both the pre-production consulting and the post-production circulation processing have not developed commendably. The entire rural market system is imperfect. Market elements such as land, labor, science and technology, finance, information elements have not truly formed. (Zhao Yingxia & Guo Xiangyu) Besides, there is no standardized management and control system for the transportation, storage, packaging, and distribution of agricultural products. The 3rd party logistics companies who provide fully functional services are still limited. The marketability degree of logistics is still low.

The main parties of modern logistics include primary producers (peasant households, agriculture cooperative organizations), intermediates (processing enterprises, package companies), wholesales and other end retailers. The large amount of small logistics parties and different operation models generate a long logistics channel, leading to the extension of logistics lead-time. In addition, the repeated loading, unloading, storage and transportation processes also cause large amount of waste.

At present, Chinese agricultural supply chain is still at an early stage of development, the organization degree of supply chain is low. The logistic parties are generally small with single function. In addition, the dispersed production systems, cause unstable supply, unstandardized operation order and dispersed network. The logistics activities are dispersed, unprofessional and inefficient. Meanwhile, after economic reforms, with comprehensive marketization of Chinese agricultural products circulation, the comprehensive socialization and continuous development of agriculture industries, the scale and varieties of agricultural products entering into market is continuously increasing. The old commodity economy can no longer satisfy large-scale demand of agricultural products.

### 3.1.3 High Costs

China is a large agricultural country; the agricultural products output of China is ranked first in the world. However, because of this large area and the specific production system - HRS, the logistics of agricultural production materials and agricultural products are not only large but also dispersed. The costs of logistics are very high. Hence, once reduced logistics cost in the agricultural production and agricultural circulation, the income of farmers can have a significant increase.

Chinese agricultural logistics cost generally accounts for the total cost of 30% to 40% of the product price; the grain accounts for above 40%; the fresh product accounts for above 60%. However, in the developed country logistics cost generally accounts for the total cost of the product by about 10%. The agricultural product C.I.F price in some developed agricultural country such as US, Canada and the European Union is even lower than China production price, its primary cause lies in excessively high logistics costs of Chinese agricultural products in the process of storage, transportation, processing and sale. Most agricultural products through long-distance traffics are primary shape, and there are many low added-value products in agricultural product logistics structure. (Zhao Yingxia & Guo Xiangyu)

Besides, the large waste in the logistics process is also a significant reason causing the high logistics costs. The preservation technology of Chinese agricultural logistics is a clear laggard. According to China agriculture development report (2010), less than 25% agricultural products used preservation technology to keep the freshness and processed products percentage is under 10%. The loss of products in the procurement, transportation, storage and other logistics process is up to 25%-30%. Nevertheless, in developed countries, the loss percentage is generally less than 5%. Poor technology is also an important reason keeping the logistics costs up. Currently, the logistics costs of agricultural products account for 25% - 30% of overall costs, but in developed countries, it is only about 10% (Table 3)

	Logistics cost/ over-all cost	Loss percent-age in the logis-tics	Pro-cessed percent-age	Pro-cessed add value	Percentage of chain market sales
<b>Devel-oped coun-tries</b>	10%	5%(grain) 1% - 5% (vege-tables and fruits)	80%	1:3 – 1:4	80% - 85%
<b>China</b>	40% (grain)  60% (vege-tables and fruits)	15%(grain)  25% - 30% (vegetables and fruits)	10%	1.0: 1.8	Less than 30%

Table 3 Comparing Statistics of Agricultural Logistics in China and developed countries

#### 3.1.4 Backwardness of Logistics Facilities and Technology

Most agricultural products are easily putrescending and certain processing technology is needed in the circulation process, such as sorting, drying, refrigerating, antisepticising, in order to maintain the freshness. However, in China the logistics facility and logistics technology are rarely on this level.

##### 1) Cold Chain

In a developed country, the vegetables logistics is always done in the low temperature conditions. This forms one “cold chain”, namely the field-



picking precooling → cold storage → refrigeration truck transportation → wholesale house cold storage → supermarket cold cabinet → consumer refrigerator. Take the Dutch as an example; it uses modernized refrigeration equipment to store and transport agricultural products and food. Because the process is prompt and appropriate, the loss proportion of vegetables in circulating processing is only 1%-2%. Because the logistics foundation investment of China is insufficient, the agricultural product logistics loss is serious and it is difficult to enhance benefit. (Zhao Yingxia & Guo Xiang-yu)

## 2) Lack of Transportation Capacity

There is still a shortage in the capacity of transportation. On the one hand, most rural areas do not have roads, railways or highways accessing every village. The transportation model is simple and limited. On the other hand, due to the natural characteristics of agricultural products, the requirements for transportation equipment are high. Large amount of specific transportation equipment is needed. However, at present, the transportation equipment is still not sufficient. According to China agriculture development report (2010), about 70% of vehicles used for agricultural products transportation are pickup trucks, and 30% are sealed boxcars. Only 25% of the road transportation used is refrigerated, and accounted for about 55% railway transportation used refrigerated system.

## 3) Bad Storage Condition

From production areas to the end customers, because of the difference between time and space, agricultural products need to go through storage many times, in order to balance supply and demand. However, at present the Chinese agricultural storage facilities still lag behind; storage conditions are not that good; the level of machinery and equipment is low; the distribution is irrational; the dedicated and special warehouses (such as low temperature storage, cold storage, three-dimensional Cooperative Bank) are at a serious shortage. According to China agriculture development report (2010), China's grain warehouse can only meet 65% -70% of the grain reserves. This forces some of the grain to be stored to simple warehouse storages or mixed warehouses or even in open storages. This method is not only increasing mildew chance, but also accelerating the aging of grain and severe rat and other pest infestation.

## 4) Low Mechanization Level of Loading and Unloading

The utilization of handling equipment, such as forklifts, pallets, freight elevators, lifting platforms, laneways, cranes etc., is limited in China. Most of loading and unloading tasks are still relying on manual operation. Low mechanization level of loading and unloading not only increases the logistics costs but also increases the transportation lead-time. According to the China agriculture development report (2010), the transportation and storage costs of fresh agricultural products create 60% of the total cost. This is greatly reducing the market competitiveness of agricultural products. Ad-

ditionally the low mechanization level of loading and unloading increases the difficulty of large-scale operation.

#### 5) Low Intensive Processing Degree

Chinas agricultural products sold are mostly primary products, and the proportion of processed products is small. Chinese processed products' value-added ratio is 1:1.8, but US's is 1:3.8. Chinese agricultures and food industrys output value ratio is 1:0.31, but US's is 1:2.7 and Japan's is 1:1.22. Because the agricultural products intensive processing degree is low and the added value is not high, Chinese agricultural raw products are surplus, structural contradiction is prominent, and agricultural products lack the competitive power. (Zhao Yingxia &Guo Xiangyu)

### 3.1.5 Blocked Information Flow

The informationization degree of agriculture logistics is directly influenced on efficiency and benefit of agriculture logistics. The information runs through the whole supply chain from pre-production and producing to post-production. At every stage, logistics information should be processed timely.

At present, Chinese agricultural information network is imperfect, the peasant households live dispersely, their communication channel is impeded, the market supply and demand information cannot be transmitted fast enough and the cost of the peasant household obtaining the market information is high. Because of lacking the effective information guidance, blindness lies in the agricultural materials and products production and circulation. Therefore, it is difficulty to deal with the market demand change. (Zhao Yingxia &Guo Xiangyu) The block information flow has had a severe impact on agriculture logistics. It is a key constraint element limiting the development of agriculture logistics.

#### 1) Low Percentage of Farmer Internet Users

According to information public by China Internet Network information center (CNNC), there are about 780 million Internet users in china. Nevertheless, the one in agriculture-related profession is representing less than 1%. The majority of which are agricultural management and technical personnel and they are highly concentrated in the developed regions, such as Beijing, Shanghai, Guangdong, Zhejiang and Jiangsu. The real farmers Internet user is almost negligible. One of the reasons causing this low rate of farmer Internet users is the high network and computer cost. We can have a simple calculation. The average price of a computer in china is about 3000-4000 RMB, rural telephone internet access fees of 3.6 RMB per hour, plus a variety of training costs, generally it is hard for a small peasant household to afford such costs.

In China, the peasant households which have the ability to use Internet for reaching the market and technology information are limited to only 0.18%. Compared with other industries, the e-commerce proportion is very small.

The peasant households that use Internet to purchase production materials are less than 0.12% and the ones using Internet to sell products are less than 0.15%. Only 7.1 percent of rural Chinese population is using Internet. About 23.1% of population is lacking Internet access because they do not have equipment and nearly 53.3% is because they do not know how to use computers or Internet. Hence, the household's ability to use Internet for acquiring market and technology information or use it to purchase and sell products is very limited. (CNNIC public in 28th march 2008)

## 2) Uneven Distribution and Undevelopment of Agricultural websites

According to the CNNIC survey, the distribution of Internet users and the distribution areas of agricultural sites are similar. They are concentrated in big developed east cities rather than central and western regions. However, the regions where economics are backward with lower technical level have more requirements for information and technology. At present, websites that offer agricultural information are rare and utilization degree is low. These sites can be divided into the following types:

- 1) the website established by the central ministries or each level of state;
- 2) the website established by agricultural colleges or research institutes;
- 3) the website established by various industries;
- 4) small amount of the websites established by individuals;
- 5) some of the non-agricultural information websites also offering agricultural information.

However, beside several state-level Web sites, most of the local level websites still need improving. It is common to have similar content in each website. Some websites even have similar settings of the navigation bar. In addition, most of the content of agricultural website is used to promote local agriculture rather than offer advices to production. The information that really applies to farmers is not enough. Furthermore, most of the information is directly reflected. The information and analysis that can assist farmers in developing their production is still confined. Besides, most of the rural e-commerce sites publish only products' price, but not the evaluation or prediction the market demanding. The role of experts is not really formed.

## 3) Lack of Database

China is a vast land, with the population over 1.3 billion, where the production and consumption of agriculture products is very great. It has the richest varieties and biggest circulation than any other country in the world. In addition to the natural characteristics of the agricultural production, the involved information is both related to the natural environment and socio-economic development. The establishment of large databases has only started in recent years. Although each unit has its own database, but they can rarely be used. This data cannot play its role, causing huge waste.

### 3.1.6 Shortage of Qualified Technical Persons

China's logistics training started in quite late period. According to Chinese Ministry of Education (2008), modern logistics talent is one of the 12 categories of shortage talents in China. Until 2010, the annual average demand of logistics talent is 20,000 to 30,000 people. Based on the current speed of development, the Chinese logistics professionals' gap will reach to 6 million at that time. Therefore, speeding up the modern logistics personnel training is very important for the modern logistics and the agricultural product logistics development.

Many cities have faced the embarrassing situation of Logistics Talent Shortage. Owing to the enlargement of logistics personnel training, the logistics talent shortage issue has eased, however, high qualified logistics talent is still insufficient.

Although China already had several dozens universities setting up logistics specialty, and many cities that have faced the embarrassing situation of Logistics Talent Shortage starting the enlargement of logistics personnel training, these courses or training are more emphasized particularly on the industry logistics, and the agricultural product logistics talented persons are deficient. A plenty of specialized knowledge is required for agricultural logistics, such as the knowledge of flowers and plants logistics, fast-frozen fish logistics, meat logistics and other preliminary, intensive processed food logistics and so on. In other developed countries, such as Holland, the logistics operators must pass through the inspection and have the correlating profession employment certificate. (Zhao Yingxia & Guo Xiangyu)

### 3.2 Chinese Agri-SCM models

China is a large agricultural country. A batch of different Agri-SCM models is used in China. In this chapter, based on different supply chain processes and central enterprises, four representative commonly used supply chain models will be present primarily, listing those as the Agri-SC driven by wholesale markets which is the leading part of chain, the one is driven by Agricultural cooperative organizations of production therefore taking the lead role, the Agri-SC driven by Agricultural products logistics zone, the Agri-SCM driven by Intermediary organization. Each of them is suitable for different situations and has their own advantages and weakness.

After this, the supply chain model used in Shengda Market chain and Lijin agricultural base will be described. This supply chain model is based on idea of "Intermediary organization + agricultural cooperative organizations" and takes the integrated organization as the center. Through study and analysis of its processes and characteristics, we are provided with a perfect foundation for further supply chain integrated measurement.

### 3.2.1 Wholesale Markets as the center

Commodities were originally exchanged directly by people. But with the increased range of commodities and the amount of sellers and buyers, markets have been gradually formed. It has been suggested that two people may trade, but it takes at least three persons to have a market, so that there is competition on at least one of its two sides (Sullivan, arthur and Steven M. Sheffrin. 2003).

The agricultural products' Supply Chain model that takes the wholesale markets as the center is the most known Supply Chain model in China. Since 1995, Ministry of Agriculture had started the construction of the agricultural product wholesale markets. Over a decade of development, wholesale markets have become the main agricultural products sales channel in China and play the vital role in the agricultural product circulation. So far, there are 11 batches and 503 fixed-point markets all over China that cover the main big or medium-sized cities and the host production area of the agricultural products (Zhao Yingxia &Guo Xiangyu).

Based on its function, we can generally divide it to wholesale market of production area and wholesale market of distribution area. The wholesale markets of distribution areas are typical markets with various exchanges and bulk operations that face the bulk of customers' daily changing demands.

It is reasonable to trade in these kinds of wholesale markets that guide the logistics of agricultural products and it exists everywhere around world. However, it is not always so reasonable to do the same thing at the markets of producing areas. In the countries, like U.S. and Australia, the agriculture products are produced by few specialized large-scale organizations. For them, the issue of gathering agriculture products does not exist. Agricultural products can be entered to the main logistics channel directly without gathering together. The link with wholesale markets of producing areas is removed which enhances the efficiency of Supply Chain and reduces logistics costs. While, in other countries, who are using dispersed, small scale and diversified production model like China, both the number of producers and the range of breeds is extremely large, and this leads to bulk transactions and bulk operations in the production area. It is also the reason that wholesale markets of producing areas have been formed. (Zhang Wensong&Liao Danfeng)

In China, there are about 4000 wholesale markets of agricultural products in 2009, nearly 57% is at producing areas and 43% is at distribution areas. The reason that the number of wholesale markets of producing areas exceeds that of wholesale markets of distribution areas is because of the dispersive planting characteristics in China. (China agriculture development report, 2009)

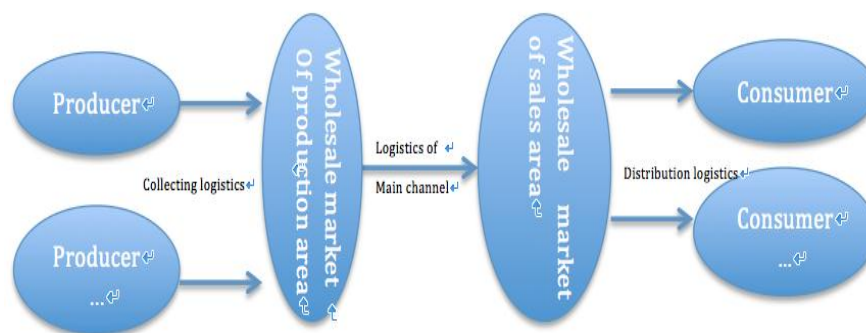


Figure 2 Three-Segment “Double Markets” Model

Because China adopted an independent production pattern taking the family as a main body, it has formed a typical three-segment model “dispersing - gathering - dispersing”, which is also called “double markets” model, as showed in Figure 2. In this double markets model, goods are first gathered to the wholesale markets of producing areas from independent households, and then delivered to wholesale markets of distribution areas through main logistics channels, and from there distributed to the different supermarkets, retails, restaurants and so forth.

To a certain extent, this kind of three-segment model plays a role of agricultural products logistics. Nevertheless, from the view of modern supply chain, this three-segment model abates the efficiency of supply chain and increases the logistics costs and trade costs. From the households to wholesale markets of producing area, the products at least go through one time trade and one time logistics; from wholesale markets of producing areas to wholesale of distribution areas, the products at least need to go through one time trade and one time logistics; from wholesale markets of distribution area to supermarket, retailer, restaurant, the products at least experience one time trade and one time logistics and from retailers the products still need go through one time trade and one time logistics until it arrives in the customer’s hand. Every additional logistics transformation goes along with the additional logistics costs, because of transformation of conveyance, package, and logistic organizations, loading and unloading of products, storage and so on. Once this transformation does not adopt the standards of logistic technology, the transformation cost will be higher.

But this kind of pattern also has its strengths, it can realize scale collection and distribution by non-scale organizing way (public markets platform), solve the uneconomical problems caused by dispersive and subtle production through the non-organization's way to a certain extent.

By comparison, using scale and professional organism of production (such as agricultural cooperative organization which will be introduced below) to replace the wholesale markets of production areas, the products can be delivered to the wholesale markets of distribution areas or other processing enterprises. This kind of agricultural supply chain model can at least avoid trade and logistics transformation at wholesale market of producing areas, greatly decreased transaction cost and logistic cost, and also

enhances the efficiency of logistics. This two-segment logistics model is so called “production -distribution”, or model of “central markets”, as shown in Figure 3.

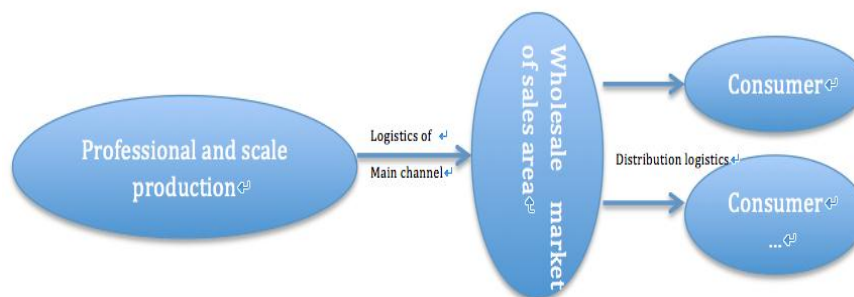


Figure 3 Two-Segment “Central Market” Model

The main difference between three-segment model of “double markets” and two-segment model of “central market” is the systematization level of backward production. The higher the systematization is, the more distinct advantages there are to adopt two-segment model of “central markets”. The advantages are not only in area of logistics, but also in area of production and the harmonious development of the whole agricultural system including production, that is, all organizations of the supply chain are in equal positions. The system is in balance of development and the total social benefit and economic benefit of the system are optimal. Therefore, China should increase the systematization in the area of agricultural production, and change the three-segment model of “double markets” to the two-segment model of “central markets” gradually. (Zhang Wensong&Liao Danfeng)

### 3.2.2 Agricultural Cooperative Organizations of Production as the center

From the angle of logistics costs and efficiency purely, the two-segment model of “central markets” is better than three-segment model of “double markets”. But we must consider Chinese agricultural production, the dispersive and independent production characteristics. Chinese agricultural supply chain cannot adapt the two-segment model of “central markets” directly. The two-segment model of “central markets” is suitable only when the trade and logistics reach to certain scale. Therefore, many researchers suggest using agricultural cooperation organization to integrate dispersed peasant households and forming the conditions for the usage of two-segment model “central markets”.

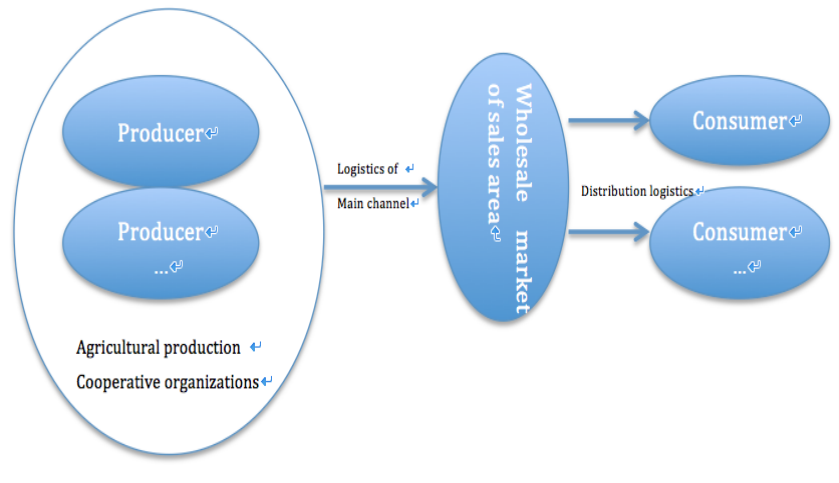


Figure 4 Agricultural Cooperative Organizations Model

The main purpose of building up agricultural cooperative organization is to enhance the systematization degree of agricultural production, to let the farmers enter the markets in higher organization forms and subjects and to overcome the contradiction between small-scale production and big markets and large logistics, as shown in Figure 4.

The agriculture in European Union (EU) is developed. It is all attribute to the advanced agricultural production technology, science operation, high industrialization system and effective agricultural product circulation. Besides, the agricultural cooperative organization of EU is also developed. Through agricultural cooperative organizations, agricultural labor unions, agricultural enterprises and special associations of agricultural products, countries provide to farmers a series service and the economic cooperation such as the necessary warehousing, the transportation and the sale relating with pre-production, production, post-production. In order to realize the integration and mass effect of agricultural products logistics by forming competitive subjects of certain capital strength and considerable operating ability. (Zhang Wensong&Liao Danfeng)

However, the model of agricultural co-operation organization has only optimized the agricultural logistics from production stage, but has not optimized the whole supply chain process.

### 3.2.3 Agricultural Products Logistics Park as the center

The Logistics Park or logistics zone referred to as a facility has clearly defined physical boundaries but has infrastructure (especially multimodal, at least road and rail) that is used by several operators. It is usually created within the framework of regional development policies as joint initiatives by firms, Chambers of Commerce and Industry (CCIs), regional and local authorities, or central government. (European Conference of Ministers of Transport. Economic Research Centre. 1997.)



Therefore, the agricultural logistics park is a place where service of logistics of agricultural products can be joined. It is the place where multiple level and function enterprises of logistics integrate. It offers different types of logistics facility and service with specialized standard. The agricultural products Supply Chain model that takes the logistics parks as the center is based on the idea of intensivism and integration of logistics activity. Relying on the advantage of whole and complemented agricultural logistics park, it formed the integration effect and the scale that accelerated the development of integration and intensivism of agricultural product logistics. Agricultural Logistics Park not only realizes the integration of agricultural products logistics in logistic process, the intensivism of management in integrated management and the enlargement of scale in industry cluster, but also offers the function of storage, transporting, loading and unloading, processing, information management and so on. Therefore, it forms a highly efficient and social logistics system, as shown in Figure 5.

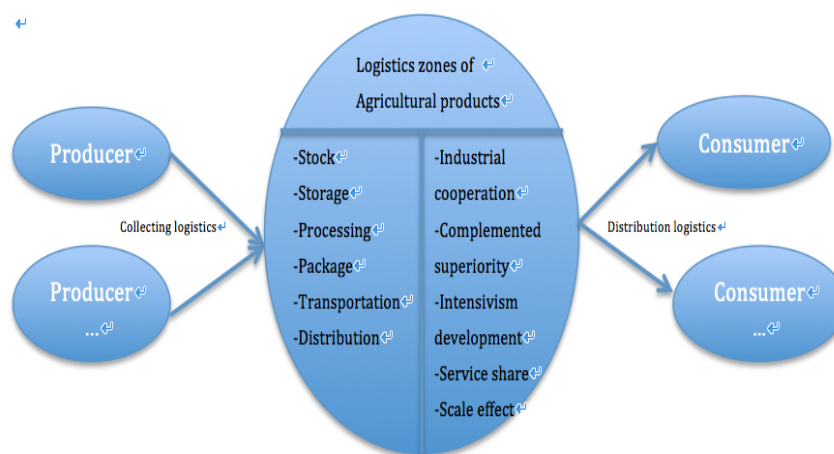


Figure 5 Logistics Park Model

Supply Chain not only includes information flow, business flow, cash flow and logistics, but also includes a number of logistics activities such as logistics processing, packing, warehousing, transportation, distribution and so on. What is more, it involves logistics technology and logistics management that can improve and raise the level of logistics. Therefore, establishing an agricultural products logistics park is an effective way to develop modern logistics of agricultural products, enhance the ability of collection and distribution function of wholesale markets and to realize the intensification, integration, and formalization of agricultural products logistics. (Zhang Wensong & Liao Danfeng)

The Agricultural Logistics Park is an integration of supply chain resource and logistics activities, an important part of agricultural logistics system, a concentrated expression of logistics integration. Via the development of agricultural logistics park, it gathers multi-function service enterprises together and realizes the shared logistics information and logistics infrastructure. Forming a close partnership between each enterprise, in order to solve the issue brought by dispersed agricultural production and the weak

competitiveness of single logistics company. Through agricultural logistics park better specialized agricultural products logistics services are offered, more complemented service that single company could manage can be received, the integration operation of agricultural logistics is realized, the effect of scale and reducing the costs is enhanced.

However, the model of Logistics Park is mainly used for the integration of supply chain resources and logistics activities, next level will be the further development of wholesale market, but still the whole supply chain process has not been optimized.

### 3.2.4 Intermediary Organization as center

Agricultural cooperative organizations of production optimize the logistics model by paying more attention on the concentration of production. This kind of organization concentration method is also adopted during the circulation from production to consumption. The mediating function of trade is not only the market, but can also be the organization.

Although market can reduce the trade costs to certain level and have active effect on trade, market is only a trade place, and it cannot replace the organization to do the trade and the logistics. On the opposite, intermediary organization can take place of mediating function of markets. Intermediary organization can play the role of both trade and logistics to realize integration of information flow, business flow and logistics, as shown in Figure 6. (Zhang Wensong&Liao Danfeng)

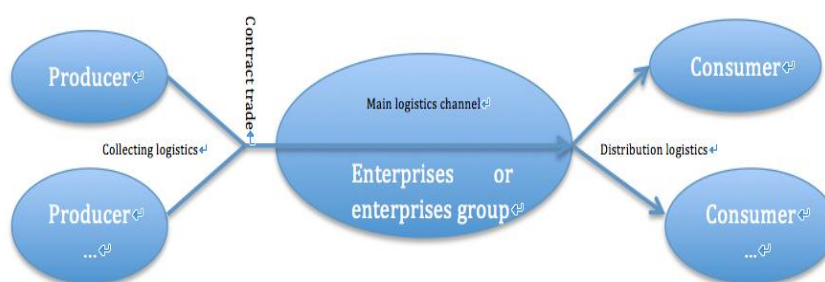


Figure 6 Intermediary Organization Model

There are many successful cases of using this Supply Chain model. Most of them are processing enterprises of agricultural products and chain supermarkets. They collect agricultural products from dispersive peasant households and process them together. Then deliver the products to markets through organizational distribution channels and sell them. The intermediary organizations greatly reduce the medium links, realize the integration of supply chain, enhance agricultural logistics efficiency, and reduce the logistics costs.

However, the model of intermediary organization only optimizes circulation system of agriculture products, but cannot optimize the whole supply chain process.

3.2.5 “Intermediary Organization + Agricultural Cooperative Organizations” as center

The model of intermediary organization can be further developed to “Intermediary organization + agricultural cooperative organizations”, referred to use contracts to carry on resources integration and bring organism of production into integration.

Take “chain supermarket + agricultural cooperative organizations” as example. Agricultural cooperative organizations and chain supermarket signed an intent sales agreement to agree to offer direct agricultural products to chain supermarket. This modern distribution channel provides an excellent platform for high quality agricultural products to enter into market. The Corporation between Lijin agricultural Base and Shengda chain market utilized this model.

The essence of “chain supermarket + agricultural cooperative organizations” is to introduce a modern distribution channel to rural area under market economy condition, to link up small agricultural production with big market, to build up an integrated chain between production and market, to achieve business win-win of farmers, retailers and customers.

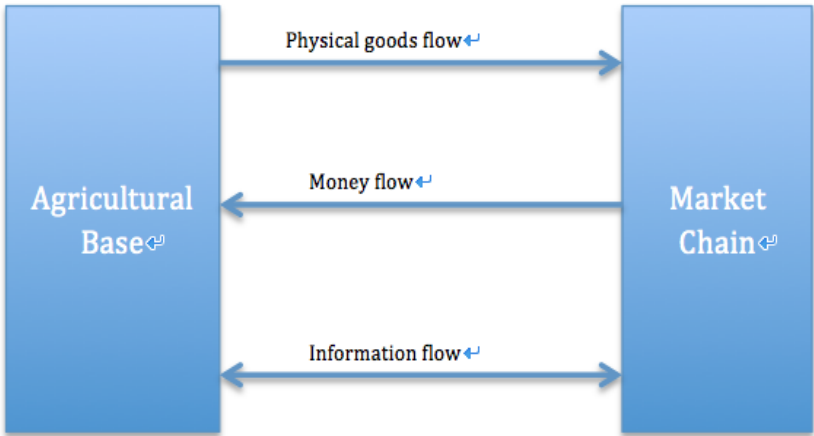


Figure 7 “Chain Supermarket + Agricultural Cooperative Organizations” Model

Assisted by “chain supermarket + agricultural cooperative organizations” supply chain model, as shown in Figure 7, farmers get first hand information of market demand and products prices, efficiently avoiding production blindness. On the other hand, “chain supermarket + agricultural cooperative organizations” provides a perfect sale platform for agricultural products. Utilizing the specific features of supermarket, such as country-wide chain stores, ramified distribution channel, quick response to market

changes, enables products get to customers faster. Agriculture production vendors, local supermarket, nonlocal supermarket and foreign supermarkets are pulled to the same platform to meet and negotiate to maximize the benefits that normal farmers can get. What's more, "chain supermarket + agricultural cooperative organizations" minimized the intermediate links, which not only decrease the costs of logistics and sourcing but also maintain the freshness of products. According to Ministry of Commerce of the People's Republic of China (2009), through direct sourcing the distribution costs are reduced around 20% to 30%. Direct sourcing provides a perfect foundation for the inexpensive fresh agricultural products supply and greatly reduces the costs of supermarket.

In conclusion, "chain supermarket + agricultural cooperative organizations" has not only solved the problem of urban residents of less choices and un-fresh agriculture products, but also solved the worries of farmers that it is difficult to predict sales market. In addition, it saves the cost of business, which can be called multi-benefit.

With the development of society, dispersive farmers will change into agricultural cooperative organizations, wholesale markets will change into logistic zones of more functions, organizations of retail agricultural products will change into chains, and development model of modern logistics of agricultural products will change into the model of "cooperative organizations and retail chain".

## 4 SUPPLY CHAIN PERFORMANCE MEASUREMENT

Performance measurement is the selection and use of quantitative measures of capacities, processes, and outcomes to develop information about critical aspects of activities, including their effect on the public (Bernard J. Turnock). Many experts believe performance measurement is a very important component in supply chain planning and control. An appropriate performance measurement and performance management is an asset for enterprise resource management and business mission control. Performance measurement can give feed back on the effectiveness of the plans and their implementation (Chow, G. & Heaven, T.D. & Henriksson, L.E. 1994.).

Therefore, after complete “Chain Supermarket + Agricultural Cooperative Organizations” project, Supply Chain performance needs to be evaluated to check the efficiency of operation needs and find out the existing issues in order to create a perfect foundation for further development.

### 4.1 Supply Chain Performance Measurement Principle

Many experts provide good Supply Chain Performance Measurement principles, and each of these says essentially the same thing. They might use different words to describe performance measurement or look at performance measurement from different angles, but the underlying concept is the same.

Beamon (1996) presents a number of characteristics that are found in effective performance measurement systems, and can therefore be used in evaluation of these measurement systems. These characteristics include: inclusiveness (measurement of all pertinent aspects), universality (allow for comparison under various operating conditions), measurability (data required is measurable), and consistency (measures are consistent with organization goals).

Bernard J. Turnock and John T. Thompspon defined 8 key attributes of performance measure.

- 1) Validity, a valid measure is one that captures the essence of what it professes to measure.
- 2) Reliability, a reliable measure has a high likelihood of yielding the same results in repeated trials, so there are low levels of random error in measurement.
- 3) Responsiveness, a responsive measure should be able to detect change.
- 4) Fuctionality, a functional measure is directly related to objectives.
- 5) Credibility, a credible measure means is supported by stakeholders.
- 6) Understandability, an understandable measure means easily understood by all, with minimal explanation.

- 7) Availability, an available measure is readily available through the means on hand.
- 8) Abuse-proof, an abuse-proof measure is unlikely to be used against that which is, or those who are, measured.

Based on the characteristics of agriculture products and “chain supermarket + agricultural cooperative organizations” project, certain principles will be followed during the thesis research

- 1) Systematization

The Supply Chain Performance Measurement System of “chain supermarket + agricultural cooperative organizations” project is a multi-factor, multi-target system. So the measurement index needs to be visible in as full-scale as possible, indicating both the internal organizational performance and the connection with external environment.

- 2) Practicality

The purpose of establishing “chain supermarket + agricultural cooperative organizations” project Performance Measurement System is to find the bottlenecks of the Project, in order to optimize the project performance. Hence, the Measurement System should have clearly defined layer, a simple measurement method. The meaning of indicator should be simple and be easily understood.

- 3) Accessibility

Performance Measurement is a complicated task. Before establishing an indicator, the accessibility and collectability of data should be considered.

- 4) Integration of Descriptive Standards and Numerical Standard

Performance Standards can be descriptive or numerical. A descriptive standard characterizes certain infrastructure components or certain activities – that is, certain capacities or processes – that are expected to be in place. A numerical standard establishes a quantifiable level of achievement. (Bernard J. Turnock and John T. Thomspson) In this thesis research, we will combine these two standards, and use qualitative and quantitative index in order to build up the mathematical model for measurement system.

## 4.2 Supply Chain Performance Measurement Model

In this thesis research, the performance measurement index system created by Mingyu Zhang (2010) for the integration of supermarket and agricultural base is utilized. This index system is based on the Balance Scorecard and the Supply Chain Operations Reference (SCOR) model theories.

#### 4.2.1 Balanced Scorecard

Balanced Scorecard is a performance measurement and strategic management system, developed in 1992 by Harvard Business School professor Robert S. Kaplan and management consultant David P. Norton, and here list of some popular definitions of Balance Scorecard.

Balanced Scorecard is a strategic management tool that helps measure, monitor, and communicate your strategic plan and goals throughout the organization in a way that is understood by everyone. (The financial gazette, July 3, 2003)

A Balanced Scorecard is a framework for implementing strategy that translates an organization's mission and strategy into a set of performance measures. (Hongren, Datar, Foster 2005, P5)

Balanced Scorecard translates organization's mission and strategy to specific targets in the assessment system. The balanced scorecard includes financial measures that tell the results of actions already taken," Kaplan and Norton explained in their 1992 Harvard Business Review article. "And it complements the financial measures with operational measures on customer satisfaction, internal processes, the organization's innovation and improvement activities—operational measures that are the drivers of future financial performance", as show in Figure 8. It also mixes outcome measures, the lagging indicator, with performance drivers, the leading indicator, because “outcome measures without performace drivers do not communicate how the outcomes are achieved”. Balanced Scorecard lets organization understand its current achievement and how to optimize its potential competitive advantage.

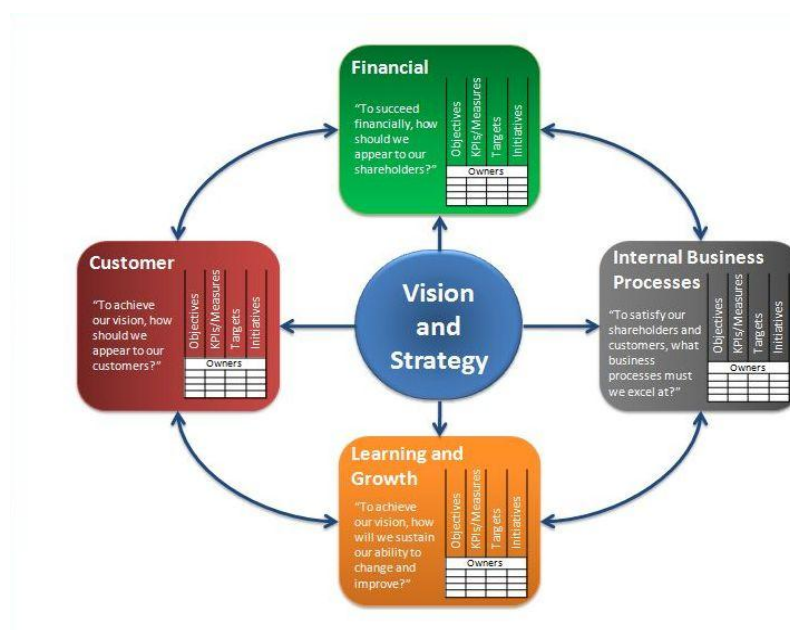


Figure 8 Balanced Scorecard

As described by Kaplan and Norton (1996, p. 105), the implementation process can be divided in to four stages:

- 1) Translating the vision and gaining consensus;
- 2) Communicating the objectives, setting goals and linking strategies;
- 3) Setting targets, allocating resource and establishing milestones;
- 4) Providing feedback and learning

#### 4.2.2 Supply Chain Operations Reference (SCOR)

Supply Chain Operations Reference (SCOR) is a tool that can be used to depict design; measure and benchmark supply chains or parts of supply chains. It combines elements of business process reengineering, benchmarking and leading practices into a single framework. Under SCOR, supply chain management is defined as these integrated processes: Plan, Source, Make, Delivery, and Return – from supplier's supplier to the customer's customer, and all aligned with a company's operation strategy, material, work and information flows, as showed in Figure 9. (Peter Bolstorff & Robert Rosenbaum, 2003, P2)

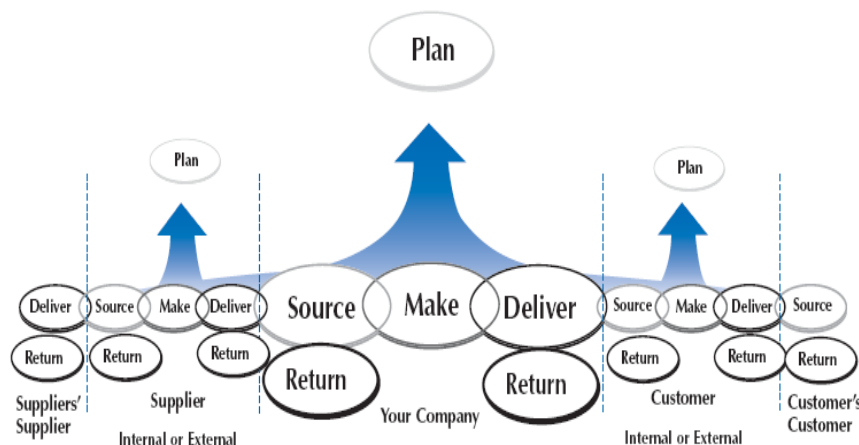


Figure 9 Supply Chain Operations Reference

Here is what is included in each of these process elements:

- **PLAN:** Balance resources with requirements and establish / communicate plans for the whole supply chain, including Return, and the execution processes of Source, Make, and Deliver; Management of business rules, supply chain performance, data collection, inventory, capital assets, transportation, planning configuration, regulatory requirements and compliance, and supply chain risk; Align the supply chain unit plan with the financial plan.
- **SOURCE:** Schedule deliveries; receive, verify, and transfer product; and authorize supplier payments; Identify and select supply sources



when not predetermined, as for engineer-to-order product; Manage business rules, assess supplier performance, and maintain data; Manage inventory, capital assets, incoming product, supplier network, import/export requirements, supplier agreements, and supply chain source risk.

- **Make:** Schedule production activities, issue product, produce and test, package, stage product, and release product to deliver. With the addition of Green to SCOR, there are now processes specifically for Waste Disposal in MAKE; Finalize engineering for engineer-to-order product; Manage rules, performance, data, in-process products (WIP), equipment and facilities, transportation, production network, regulatory compliance for production, and supply chain made risk.
- **DELIVERY:** All order management steps from processing customer inquiries, quotes to routing shipments and selecting carriers; Warehouse management from receiving and picking product to load and ship product; Receiving and verify product at customer site and install, if necessary; invoicing the customer; manage delivery business rules, performance, information, finished product inventories, capital assets, transportation, product life cycle, import/export requirements, and supply chain delivery risk.
- **RETURN:** All Return Defective Product steps from source – identify product condition, disposition product, request product return authorization, schedule product shipment, and return defective product – and deliver – authorized product return, schedule return receipt, receive product, and transfer defective product; All Return Maintenance, Repair, and Overhaul product steps from source – identify product condition, disposition product, request product return authorization, schedule product shipment, and return MRO product – and deliver – authorize product return, schedule return receipt, receive product, and transfer MRO product; All Return Excess Product steps from source – identify product condition, disposition product, request product return authorization, schedule product shipment, and return excess products – and deliver – authorize product return, schedule return receipt, receive product, and transfer excess product; Manage Return business rules, performance, data collection, return inventory, capital assets, transportation, network configuration, regulatory requirements and compliance, and supply chain return risk. (Peter Bostorff & Robert Rosenbaum, 2003)

The SCOR model includes three levels of detailed processes. Level One defines the scope (the number of supply chains), and contents (how the performance is measured). It is used by top management to set performance objectives through positioning decisions, as shown in Figure 10.

SCOR Process	Definitions
<b>Plan</b>	Processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production and delivery requirements
<b>Source</b>	Processes that procure goods and services to meet planned or actual demand
<b>Make</b>	Processes that transform product to a finished state to meet planned or actual demand
<b>Deliver</b>	Processes that provide finished goods and services to meet planned or actual demand, typically including order management, transportation management, and distribution management
<b>Return</b>	Processes associated with returning or receiving returned products for any reason. These processes extend into post-delivery customer support

Figure 10 SCOR MODEL Level One

As configuration level, the Level Two focuses on process categories. It defines the requirements need to be meet on the basis of operations and supply chain strategy, describes the configuration of planning and execution processes in material flow, as shown in Figure 11. Level Two elements identify the type of items and consequent process that are used to move material from location to location. (Peter Bolstorff & Robert Rosenbaum, 2003, P89)

SCOR Process Type	Characteristics
<b>Planning</b>	A process that aligns expected resources to meet expected demand requirements. Planning processes: <ul style="list-style-type: none"> <li>• Balance aggregated demand and supply</li> <li>• Consider consistent planning horizon</li> <li>• (Generally) occur at regular, periodic intervals</li> <li>• Can contribute to supply-chain response time</li> </ul>
<b>Execution</b>	A process triggered by planned or actual demand that changes the state of material goods. Execution processes: <ul style="list-style-type: none"> <li>• Generally involve - <ol style="list-style-type: none"> <li>1. Scheduling/sequencing</li> <li>2. Transforming product, and/or</li> <li>3. Moving product to the next process</li> </ol> </li> <li>• Can contribute to the order fulfillment cycle time</li> </ul>
<b>Enable</b>	A process that prepares, maintains, or manages information or relationships on which planning and execution processes rely

Figure 11 Score Model Level Two

At Level Three, details are given for each process element, such as individual definition, along with suggested metrics, best practices, inputs and outputs, supporting features and so on. The objective of it is to assign members of design team to lead subteams focused on each of the six SCOR Level Three transaction types. These transactions are aligned with the SCOR processes. They are: purchase order – SOURCE; work order – MAKE; sale order - DELIVERY; return authorization - RETURN; fore-

casts - PLAN; and replenishment orders - PLAN. (Peter Bolstorff & Robert Rosenbaum, 2003, P154)

Combined the features of BSC and SCOR models, in addition to the s of agricultural products logistics and integration of supermarket and agricultural base project, MingYu Zhang (2010) created a performance measurement model used specific for integrated project of “Agricultural Base + Market Chain”. It is based on three different dimensions as shown in Figure 12, Value dimension (from internal performance measurement to customer value), development dimension (from current performance to future development), integrate dimension (from individual performance to coordinated performance).

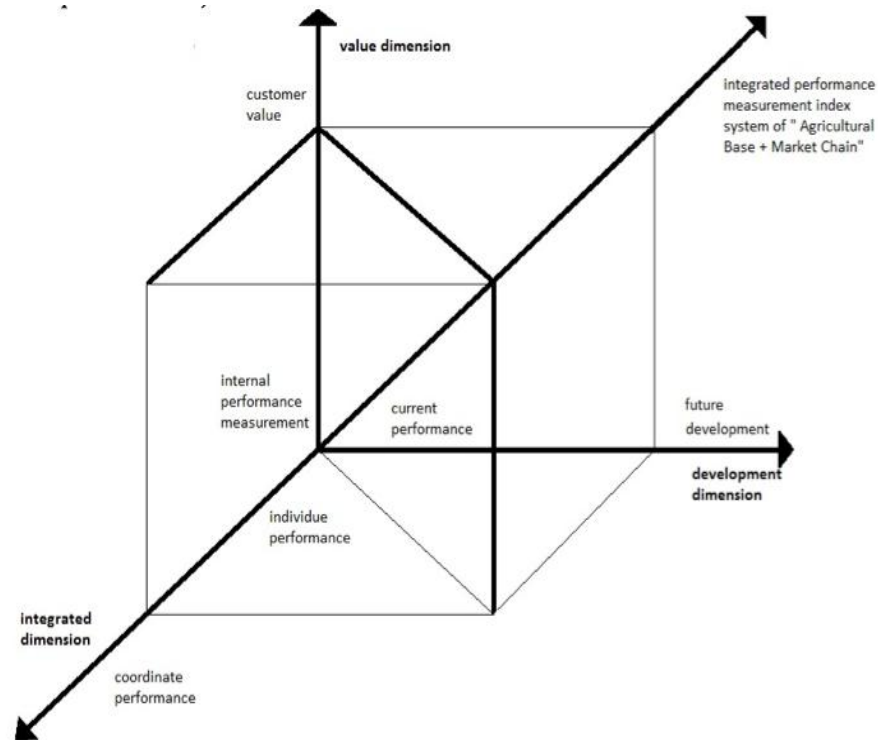


Figure 12 Performance Measurement model of integrated project of “Agricultural Base + Market Chain”.

#### 4.3 Supply Chain Performance Measurement index system

Based on the measurement model provided above, Yuming Zhang proposed Performance Measurement Index system of supermarkets and agricultural base project. It includes four components, internal operation performance measurement, integrated coordinated performance measurement, customer value and support & development, as shown in Figure 13.

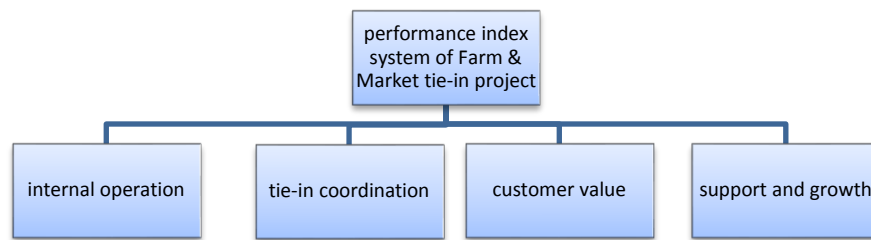


Figure 13 Performance Measurement Model of Integrated Project of “Agricultural Base + Market Chain”.

Consult Performance Measurement Model and Index System that Mingyu Zhang presented, in addition to the characteristics of Shengda Market and Lijin Agricultural Base, supply chain performance evaluation index of “Market chain + agricultural cooperative organizations” is based on the aspects below, as showed in Figure 14.

#### 1) Internal Operation

Internal operation evaluation mainly appraises internal performance of subjects in system.

##### a) Business Operation

On-time-delivery rate: It refers to the percentage of on-time delivery accounts of total deliveries in agricultural base in a period.

Goods loss rate: It refers to the proportion that agriculture products mortify, metamorphose and get lost in the process of production, transition, transport, storage and sales.

##### b) Financial

Net interest rate: Financial performance is the most objective data and criteria for evaluating economical benefits.

##### c) Market Capacity

Market capacity index is used to balance market share and growth speed of integrate Project. It can be indicated by business scale and business growth rate.

Business scale: Uses the percentage of agricultural products got from tie-in project in total agricultural production to calculate the utilization integrated model used in overall Market

Business growth rate: Uses the growth situation of integrate project in overall business to evaluate the development of integrate project

d) Basic Infrastructure

Sometimes the utilization of information technology in a company can be seen as a source of strength. It can be evaluated from the utilization of information tools and the situation of technical devices.

2) Integrated Coordination

The indicator measures, coordination capabilities and performances of subject

a) Strategic Level

Strategically Integrated: whether or not establish long-term cooperation relations or set common strategic goals

Benefit Integrated: whether or not has an equal agreement on products' prices and risks.

b) Operation Level

Organization Integrated: whether or not information transfer and coordination between multi-departments has been achieved.

Process Integrated: The coordination between each main process in the supply chain. Whether or not set the coordinated solution together. When issues come out, whether or not bring up solution together.

Information Integrated: whether have computer information system and can use computer information systems; equally shared sales and products information.

Standard Integrated: Whether or not achieved same standard between every organization and apartment.

c) Culture Level

Culturally Integrated: The integration subjects have unanimous values, and reach agreement on the understanding of customers, services, cooperation, and trusts

### 3) Customer Value

To what extent the customers are satisfied with the quality of the fresh agricultural products and the service.

Complaint rate: It shows how many customers complain on the quality of product and service.

Customer satisfaction level: The level of customer satisfaction includes the quality of products, the freshness of the products, and the safety of products and so on

### 4) Support and Growth

Support and growth ability is a significant guarantee for Tie-in Project. Here it is divided into external environmental support and internal Human Resource support.

#### a) Macro-Environment

Policy environment: The policy of the government is indicated by the financial support and the political trends.

Infrastructure: The hardware facilities mainly include the bay, transport, storage equipment and communication facilities; the software facilities mainly include the laws, regulations, research institutions, industry associations, training institutions, financial market and security management

#### b) Support and Growth

Training: the proportion of training.

Technical talents: the proportion of high technical talents.

Innovative capacity of employees: the innovation proportion in field of process, technology, and management.

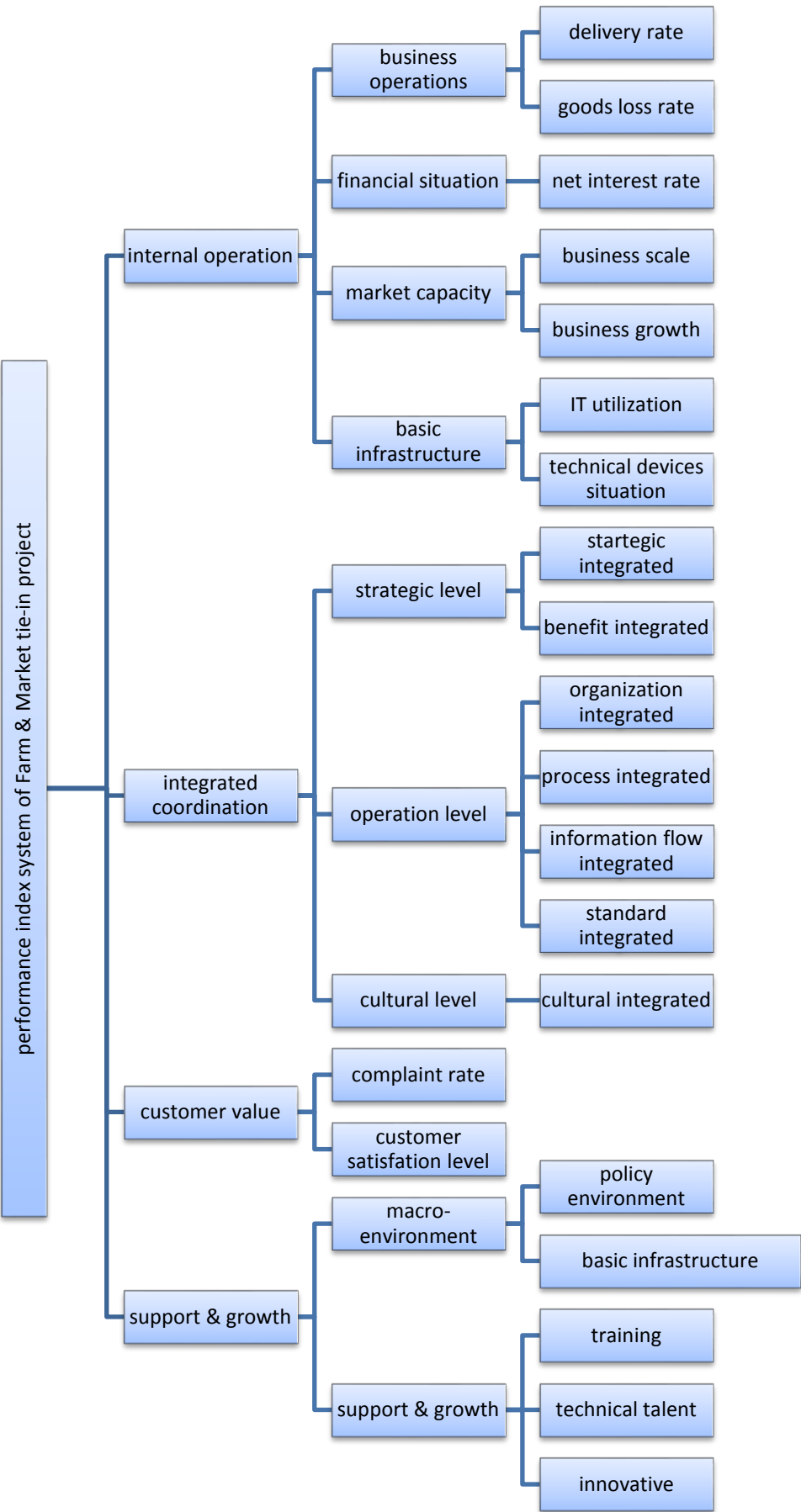


Figure 14 Performance Measurement model of "Agricultural Base + Market Chain".

#### 4.4 Supply Chain Performance Measures method

Fuzzy set were introduced in 1965, when Lotfi A.Zadeh published his historic article 'Fuzzy Sets', where he described the concept of a fuzzy set and some basic principle of fuzzy set theory (FST) (Shang Haiji, 2006,P159). Fuzzy comprehensive evaluation method is a synthetically assessment method that based on fuzzy mathematical principles to evaluate things and phenomena affected by variety of factors (Li et al. 2001). It regards evaluation objectives as a fuzzy set (named the Factor Set  $U$ ) composed of variety of factors with different assessment levels selected. Another fuzzy set named the Evaluation Set  $V$  is employed to calculate the membership degree of each individual factor in the Evaluation Set to establish a fuzzy matrix. The quantitative evaluation value of each factor is finally determined by calculating the weight distribution of each factor in evaluation goal. It applies the fuzzy transformation theory and maximum membership degree law, and makes a comprehensive evaluation to various factors (Zhang et al. 1992). The basic steps of fuzzy comprehensive evaluation method are introduced as follow (see Shang Haiji, 2006 for details).

##### 1) Determining the Factor Set of Evaluation Object

Level 1		$U=\{u_1, u_2, \dots, u_i, \dots, u_n\} (i=1,2,\dots,n)$
Level 2	$U_i \in U$	$U_1 = \{u_{11}, u_{12}, \dots, u_{1p}, \dots, u_{1z}\} (p=1,2,\dots,z)$ $U_i = \{u_{i1}, u_{i2}, \dots, u_{ij}, \dots, u_{im}\} (j=1,2,\dots,m)$ ...
Level ...	...	...

A factor set  $U$  is an ordinary set of various sub-factors.  $U=\{u_1, u_2, \dots, u_i, \dots, u_n\}$ , where  $u_i (i=1,2,\dots,n)$  is the sub-factor of first level, which can be fuzzy or not,  $n$  is the number of sub-factors of first level; If  $u_i$  can be further divided into various sub-factors, then it will have level 2.  $U_i \in U$ ,  $U_i = \{u_{i1}, u_{i2}, \dots, u_{ij}, \dots, u_{im}\}$  where  $u_{ij} (j=1,2,\dots,m)$  is sub-factor of  $U_i$ ,  $m$  is the number of sub-factors of second level. This can be continuously divided to lower level. When evaluating, count from lowest level sub-factors to higher.

##### 2) Determining the Evaluation Sets

$$V=\{v_1, v_2, \dots, v_h\}$$

Evaluation set is composed of various kinds of evaluation indicators made for the judged object.  $h$  is the number of levels into which evaluation indicators are to be divided to. For example, when  $h=5$ , then the evaluation standard can be {very good, good, normal, bad, very bad} or {10, 8, 6, 4, 2}.

##### 3) Determining Evaluation Factors Weight vector



Level 1	$W = \{w_1, w_2, \dots, w_i, \dots, w_n\}$ ( $i = 1, 2, \dots, n$ )	$\sum_{i=1}^n w_i = 1, w_i \geq 0$
Level 2	$W_1 = \{w_{11}, w_{12}, \dots, w_{1p}, \dots, w_{1z}\}$ ( $p = 1, 2, \dots, z$ ) $W_i = \{w_{i1}, w_{i2}, \dots, w_{ij}, \dots, w_{im}\}$ ( $j = 1, 2, \dots, m$ ) ...	$\sum_{j=1}^m w_{ij} = 1,$
Level ...	...	...

The importances of different factors are different. We set a weight  $w_i$  ( $i = 1, 2, \dots, n$ ) for each  $u_i$  to reflect its importance. For example,  $w_{ij}$  is the corresponding weight of  $i$ -th sub-factor  $u_{ij}$  in single factor  $U_i$  ( $i=1, 2, \dots, n$ ;  $j=1, 2, \dots, m$ ), weights at each levels should be unitary and non-negative

#### 4) Determining Evaluation Matrix

$$U_i = \{u_{i1}, u_{i2}, \dots, u_{ij}, \dots, u_{im}\} (j = 1, 2, \dots, m)$$

$$R_i = \begin{bmatrix} r_{i11} & r_{i12} & \dots & r_{i1h} \\ r_{i21} & r_{i22} & \dots & r_{i2h} \\ \dots & r_{ijk} & \dots & \dots \\ r_{im1} & r_{mi2} & \dots & r_{imh} \end{bmatrix}, r_{ijk} = \frac{a_{ijk}}{a}, k = (1, 2, \dots, h)$$

Suppose the evaluation is based on the  $i$ -th factor  $u_i$ .  $R_i$  is the corresponding evaluation matrix of  $u_i$ ;  $m$  is the number of sub-factors of  $U_i$ ;  $h$  is the number of levels into which evaluation indicators are to be divided to;  $a$  represent the number of people who participate the evaluation;  $a_{ij}$  represent the number of people who evaluate sub-factor  $r_{ij}$  as  $k$ .

#### 5) Fuzzy Comprehensive Evaluation

$$B = W \circ R$$

After determining the  $R$  and  $W$ , by fuzzy transforming, change the fuzzy weight vector  $W$  of factors set  $U$  into the fuzzy vector  $B$  of evaluation set  $V$ , namely  $= (b_1, b_2, \dots, b_h)$ . Among the equation, " $\circ$ " is fuzzy operator called the comprehensive evaluations synthetic and  $B$  is fuzzy comprehensive evaluation set

$$B = [w_1 \quad w_2 \quad \dots \quad w_m] \circ \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1h} \\ r_{21} & r_{22} & \dots & r_{2h} \\ \dots & r_{jk} & \dots & \dots \\ r_{m1} & r_{m2} & \dots & r_{mh} \end{bmatrix} = (b_1, b_2, \dots, b_h)$$

5 EVALUATION AND ANALYSIS

The evaluation of Shengda Market and Lijin Agriculture Base Supply Chain Performance are followed according to the process map shown in Figure 15.

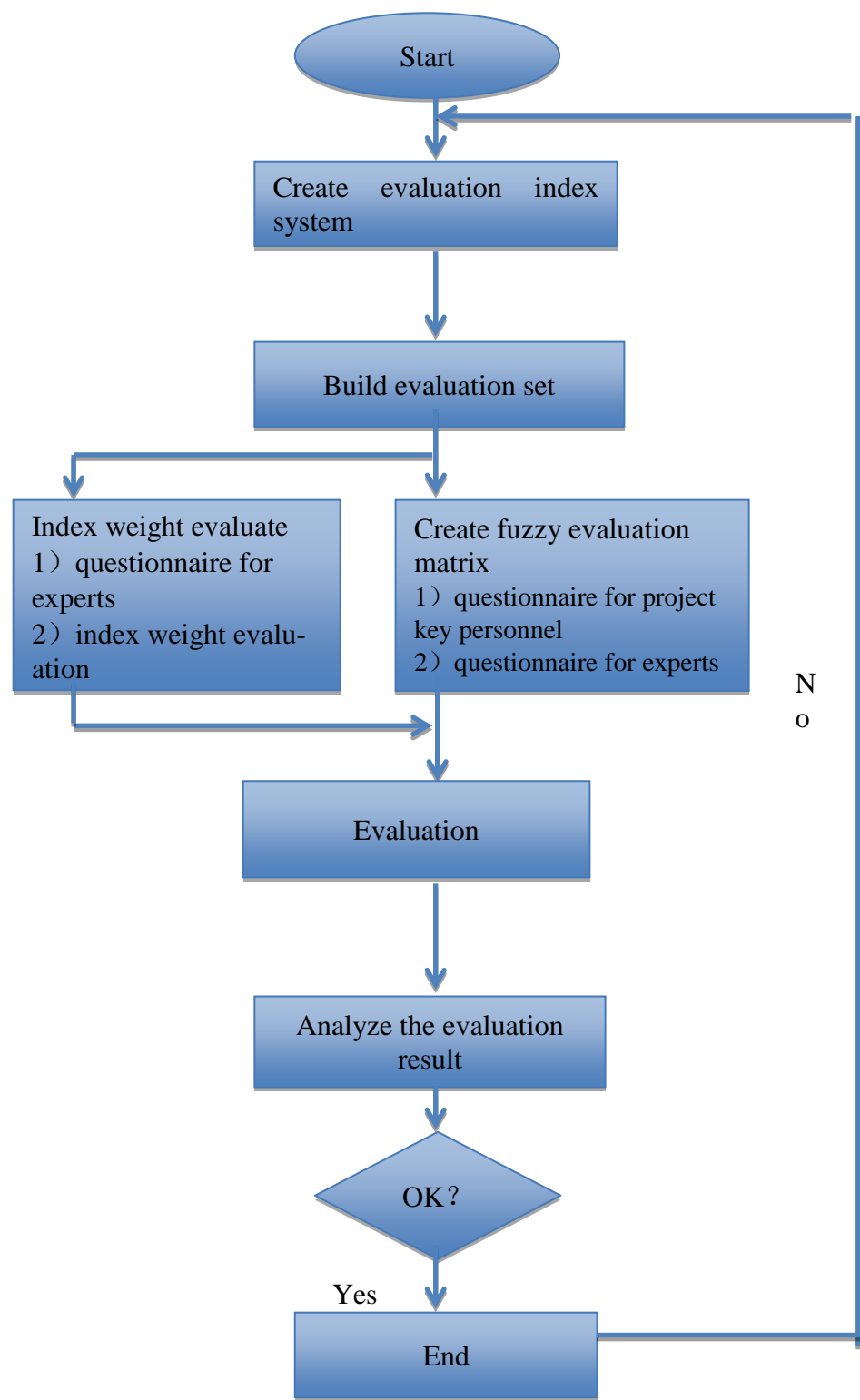


Figure 15 Evaluation Process Map

1) Create Evaluation Index System

Factor Sets of evaluation object need to be defined first. The objectives of this research is to evaluate the Supply Chain Performance of Integrated project of Shengda Market and Lijin Agriculture Base. The details of the factor set are introduced above from Page 30 to Page 33.

2) Determining the Evaluation Sets

The evaluation sets used in this research are divided in to five grades: *{very good, good, normal, bad, very bad}*,  $h = 5$

3) Determining Evaluation Factors' Weight vector

The experts of Shengda Market have defined the Weight of each evaluation factor. The detailed weight of each factor is shown in Figure 16 below.

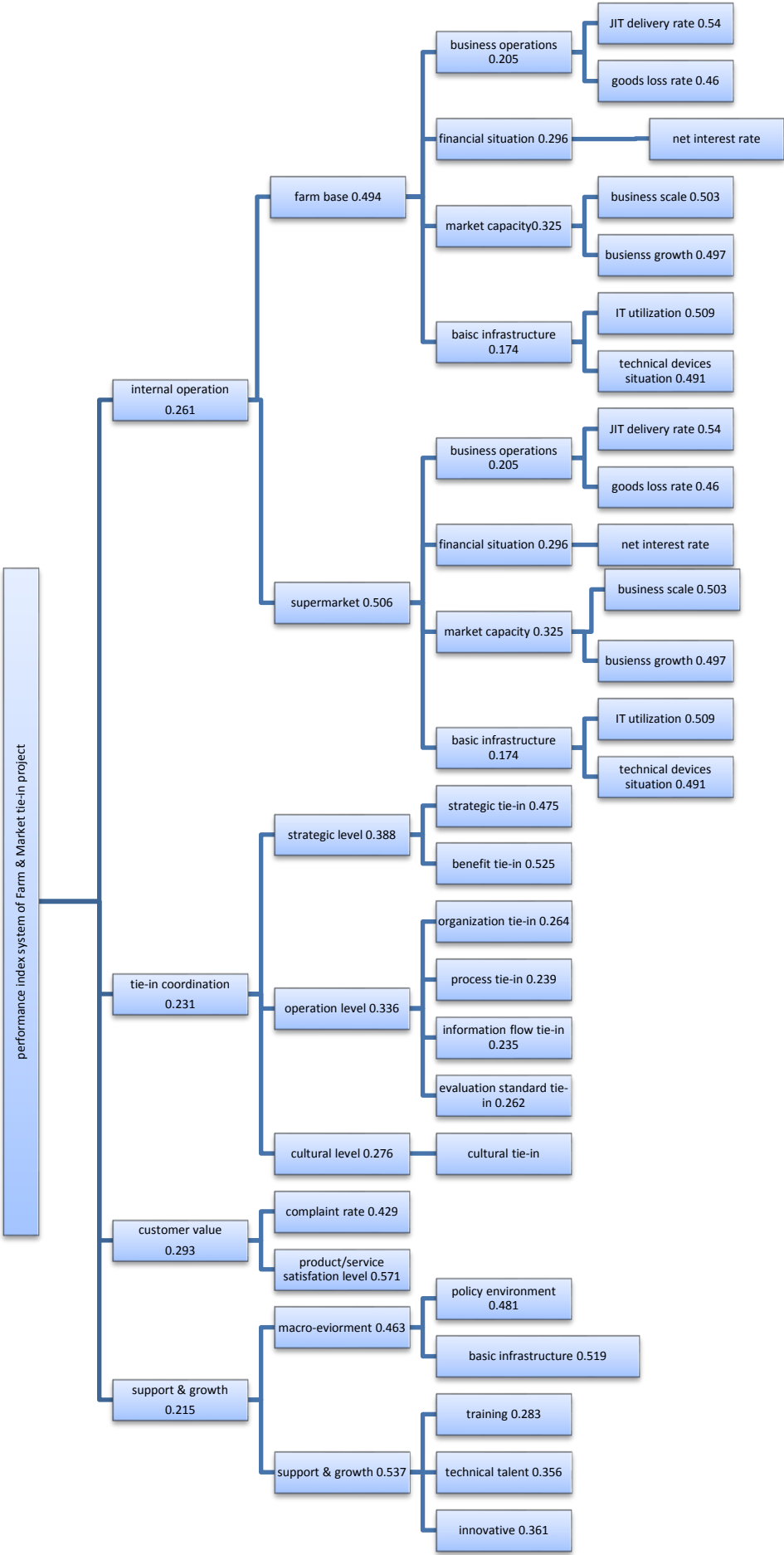


Figure 16 Evaluation Factors Weight Vector

#### 4) Create Questionnaires

The questionnaires are created based on the factors of evaluation index system. The questionnaire needs to cover every angle of the evaluation and in as full-scale view as possible. The questions need to be explained clearly and be easily understood.

#### 5) Fuzzy Comprehensive Evaluation

The evaluation method is based on the questionnaire. The survey respondents are from Lijin agricultural base and the Shengda market. Through this investigation, 46 effective questionnaires have been given. Among those, 17 questionnaires are from Lijin agricultural base and 29 are from Shengda market. Sixty-five percent of the respondents were male and the female respondents occupied only 35%, as shown in the Figure 17.

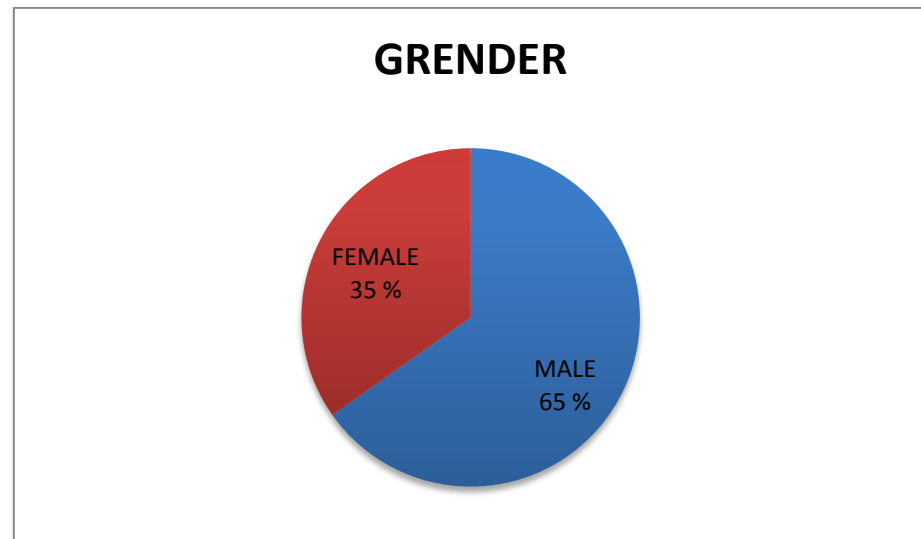


Figure 17 Pie Chart of Questionnaire Respondents Gender

The respondents of this integrated supply chain performance questionnaire are from 18 years old to 55 years old. Among it, 11 respondents are of group between 18 and 25 year olds. There were 15 people on the scale of 26 years old to 35 years old. There are 17 respondents ageing between 30 and 45. Only 3 employees are from 46 to 55 years olds group.

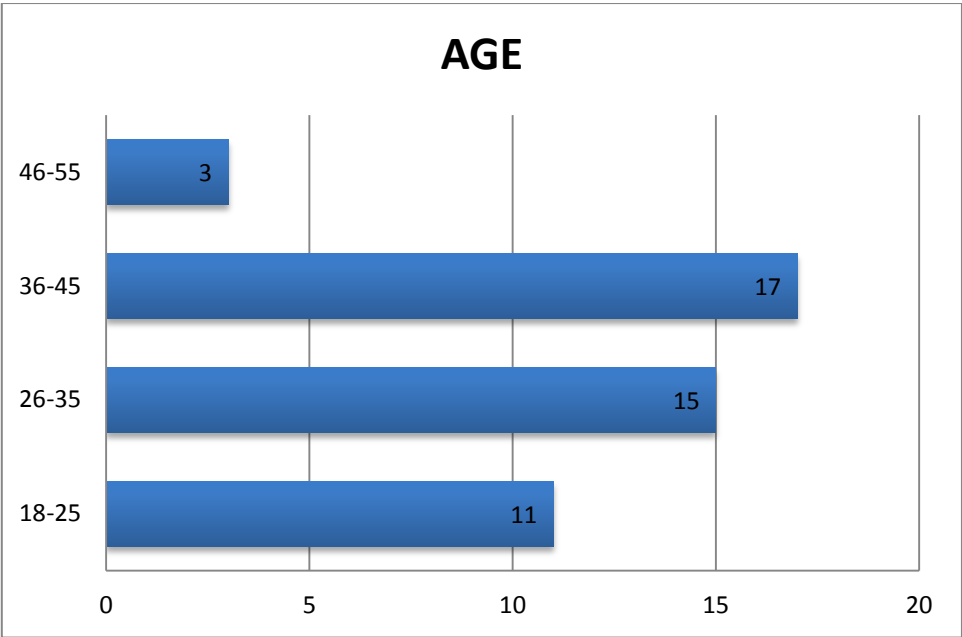


Figure 18 Bar Chart of Qustionniar Respondents' Gender

The educational background of the respondents is shown below in Figure 20. Nearly 43.4% and 42.3% respondents have bachelor degree and secondary school degree, respectively. The respondents who got master degree or above are comprised about 4%. Five people only graduated from middle school.

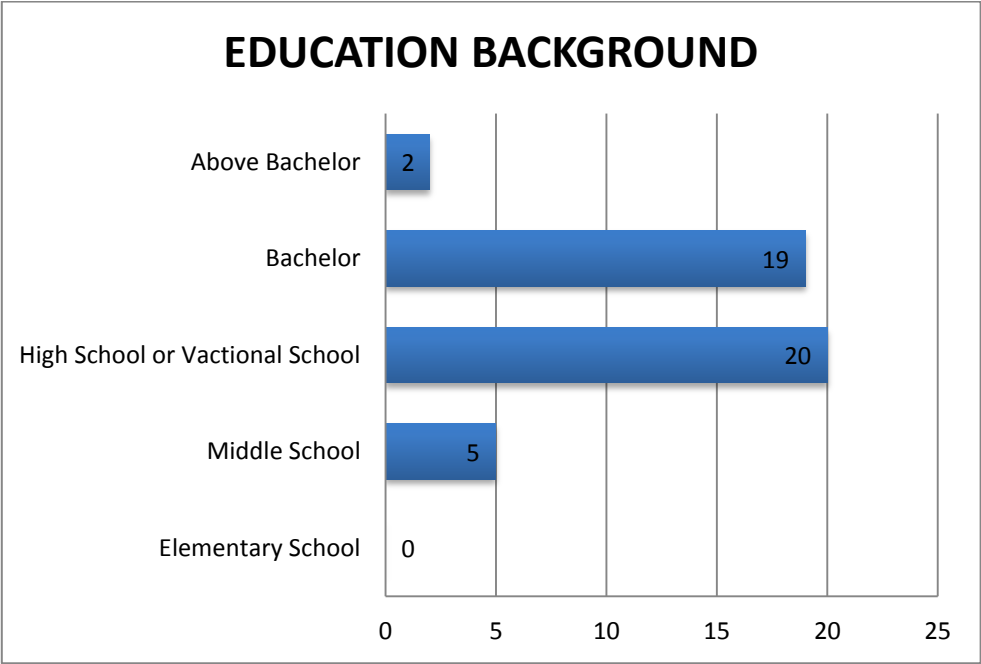


Figure 19 Bar Chart of Qustionniare Respondents' Education Background

Base on the questionnaires, the evaluation matrix result is list below in Table 4.

Evaluate Content		Excellent	Good	Normal	Bad	Very Bad
<b>Production Base</b>	on time delivery rate	0.353	0.294	0.294	0.059	0.000
	goods loss	0.059	0.471	0.235	0.176	0.059
	net profit	0.235	0.412	0.294	0.059	0.000
	business scale	0.059	0.412	0.471	0.059	0.000
	business growth	0.176	0.412	0.294	0.118	0.000
	utilization of IT	0.176	0.176	0.588	0.059	0.000
	tech.equipmt situation	0.176	0.294	0.412	0.118	0.000
<b>Chain Market</b>	on time delivery rate	0.586	0.103	0.241	0.069	0.000
	goods loss	0.138	0.552	0.276	0.034	0.000
	net profit	0.069	0.379	0.379	0.138	0.034
	business scale	0.310	0.069	0.379	0.138	0.103
	business growth	0.276	0.034	0.621	0.034	0.034
	utilization of IT	0.379	0.448	0.103	0.069	0.000
	tech. equipmt situation	0.276	0.379	0.172	0.069	0.103
	strategy intergrate	0.261	0.435	0.283	0.022	0.000
	benefit tie-in	0.261	0.304	0.326	0.109	0.000
	organization tie-in	0.065	0.326	0.457	0.152	0.000
	process tie-in	0.283	0.174	0.435	0.109	0.000
	information tie-in	0.326	0.304	0.217	0.109	0.043
	standard tie-in	0.413	0.217	0.043	0.304	0.022
	corporate culture tie-in	0.283	0.109	0.435	0.152	0.022
	complaint rate	0.109	0.609	0.152	0.130	0.000
	customer satisfaction	0.283	0.109	0.435	0.174	0.000
	policy environment	0.261	0.326	0.152	0.261	0.000
	base infrastructure	0.087	0.217	0.457	0.239	0.000
	employee training	0.217	0.065	0.239	0.391	0.087

Table 4 Evaluation Matrix Result

For multi-level factors system, fuzzy comprehensive evaluation should process from lowest level to highest. The first level result and final result of supply chain performance of Shengda “Market chain + agricultural cooperative organizations” is presented below.

Contents	Excellent	Good	Normal	Bad	Very Bad
<b>business operation</b>	0.282	0.371	0.396	0.097	0.024
<b>intergrate coordinati</b>	0.270	0.258	0.335	0.126	0.011
<b>customer value</b>	0.208	0.323	0.314	0.155	0.000
<b>support &amp; growth</b>	0.225	0.156	0.239	0.296	0.084
<b>overall preformance</b>	0.245	0.285	0.324	0.164	0.027

Table 5 Evaluation Result 1

#### 6) Analysis of the Evaluation Results

Though the calculation, most of the people think the overall performance is normal, accounting for 32.4%, and over half think it works better than normal, which means staffs think the integration of Shengda Market and Lijin Agricultural Base have had a certain effect, offered better products, price and shopping environment for customers. But there is still something that can be improved to maximize the customer satisfaction. In order to get detailed information of which parts of the supply chain need paying more attention, the lower level of the evaluation index be analysed to get more information.

- According to the evaluation results, most of the employees evaluate the internal business operation as normal, nearly 40%, and about 37% defined it as good. Among business operation evaluation results, the employees from agricultural base gave higher grade for it than the people from Shengda Market Chain. The grades are shown in Table 6.

Internal business operation evaluation	Excellent	Good	Normal	Bad	Very Bad
<b>Lijin Agriculture Base</b>	0.183	0.373	0.353	0.084	0.005
<b>Shengda Market</b>	0.282	0.371	0.396	0.098	0.024

Table 6 Evaluation Result 2

In order to find out the resason causing these results, the lower level evaluation results were studied and analysed, and it was found out that the grade of business growth of Lijin agricultural base is much higher than that of Shengda market. This can be understood as Lijin agricultural base is a new organization. The growth of it is from zero to now. But for Shengda market, the partnership with Lijin Agricultural Base is only an establishment of new supply channel. Its business growth



effect is not that obvious compared with Lijin Agricultural Base. Also, the grade of financial benefit from Shengda Market Chain is not ideal which means the operation costs for Shenda are still very high. Further, Shengda market can reduce the operation costs by extending business scale and the cooperation with other agricultural bases. In addition, the basic infrastructure of agricultural base is still in need of development.

- The final grade of integrated coordination is also on the normal level. As shown in Table 7, the integration at strategy level works best, more than 60% employees think it is good or excellent, and nobody evaluated it as very bad. Then is operation level, but still more than half of the employees believe it is better than normal. However, the integration at cultural level is not that ideal. Most of the employees only gave normal grade for it and nearly 20% think it works badly or even worse. Among it, the integration of information and standards functions very well and the integration of corporate culture, process and organization is a little bit left behind. It depicts that Chain Market and Agriculture Base is more concentrated on quality, standard of products and the efficiency of information flow. The integration of processes and organization is still in a need of enhancing, and on the base of this is to achieve the further integration of the enterprise culture.

Integrated Coordination	Excellent	Good	Normal	Bad	Very bad
Strategy Level	0.261	0.366	0.305	0.067	0
Operation Level	0.270	0.256	0.287	0.171	0.016
Cultural Level	0.282	0.209	0.435	0.152	0.021

Table 7 Evaluation Result 3

- On the part of customer value, the performance measurement result is good. This illustrates that both Shengda Market and Lijin Agricultural Base put things like quality of products and customer satisfaction on a very important place, focusing on achieving higher customer value.
- The factors of support and growth are not presenting as good results in this evaluation, in fact those were the lowest scoring ones among the first level factors. To check the details, the bad evaluation grade of basic infrastructure and employee training is the reason. Which means government should strengthen both the hardware support, such as transportation, communications, and software support like regulation and financial market. Meanwhile, Agricultural Base and Market Chain needs to enhance the training of specific techniques to the personnel to provide the power for the further development of integrate of market chain and agricultural base

## 6 CONCLUSION

In conclusion, the overall evaluation result of the integrated project of Shengda Market and Lijin Agricultural Base is good. This is because through the integration, markets are able to offer fresher agricultural products, with more reasonable prices and better shopping environment, which enhance the achievement of customer value. It is also because the support from macropolicy and the competitive pressures from other market chains that the companies concentrate pooling resources on the development of the integrated projects between market chain and agricultural base.

The business growth of Lijin agricultural base is much higher than Shengda market. This can be understood as Lijin agricultural base is a new organization. The growth of Lijin is from zero to now. But for shengda market, the partnership with Lijin Agricultural Base is only an establishment of new supply channel. The business growth effects for it are not that obvious compared with Lijin Agricultural Base.

Also, financial benefit of Shengda Market Chain is not ideal which means the operation costs for Shenda is still high. This is because the integration project was just launched and the percentage that Shengda purchased through integration project is still small. In the future, Shengda market can reduce the operation costs by extending business scale and establishing more partnerships with other agricultural bases. Besides, the basic infrastructure of agricultural base still needs developing in order to offer greater amount of products. The company needs to pay more attention on this part.

About integrated coordination, the integration of information and standards functions very well, but the integration of corporate culture, processes and organization is a little bit left behind. It depicts that Chain Market and Agricultural Base are more concentrated on quality, standard of products and the efficiency of information flow. The integration of process and organization still needs enhancing and on the base of this point it is important to achieve the further integration of the culture of enterprise.

On the part of customer value, the performance measurement result is good. This illustrates that both Shengda Market and Lijin Agricultural Base consider the quality of products and customer satisfaction as a very important subject. They are more focused on the achievement of customer value.

The factor of support and growth is not presented well in this evaluation research. Actually, this was the single lowest scoring factor. This is mainly because of bad action of the basic infrastructure and employee training. This means government should strengthen the hardware support, such as transportation and communication. Also software support like regulation and financial market should be strengthened to enhance the construction of basic infrastructure. Meanwhile, Agricultural Bases and Market Chains need provide more training opportunities of specific techniques, to provide

the human resources power for the further development of the integrated project of market chain and agricultural base.

New research will bring light to improvement of the supply chain performance of Shengda Market and Lijin Agricultural Base. The potential topic for further research can be 'the support of human resources of agricultural supply chain'. Skilled people are an important and indispensable force to promote technological innovation and technology transformation. However according to the research, agricultural supply chain professional skills are still limited. Based on this, a further research to discuss the education or training of agricultural supply chain talent should be brought out. It can be discussed both from the company side of view and the viewpoint of society.

Another potential research idea is to define the weight of the evaluation factors. During this thesis research, supply chain manager of Shengda Market defined the weight of each evaluation factors with his experience. This may influence the reliability of final evaluation results to a certain extent. Hence, another research topic can be discussed with the experts from different department in both Shengda Market and Lijin Agricultural Base and define a more precise evaluation weight value index.

## 7 SUMMARY

The thesis will be summarized and presented briefly in this chapter including the main topics and theories.

In this thesis the research objective is about the agricultural products supply chain performance evaluation of integrated project of Shengda Market and Lijin Agricultural Base. To support the evaluation, agricultural products supply chain, its general characteristics and specific characteristics in China and general models used in China were introduced primarily as the theory background. It is very important to discuss the big picture of Agricultural Supply Chain and to look at different aspects of it. Then, the integrated model used in Shengda Market and Lijin Agricultural Base is presented. It is based on the idea of using “Intermediary organization + agricultural cooperative organizations” as center enterprise during the supply chain. To achieve a better understanding of the structure and the questions dealt with in the thesis, it is essential to provide the reader with something visual. Hence the Figure 20 was created.

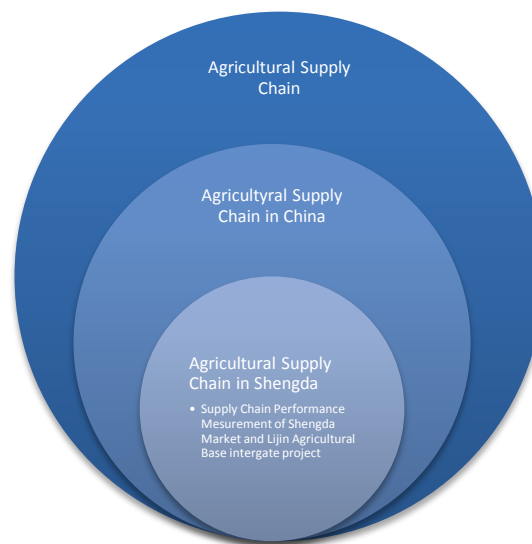


Figure 20 Thesis Structure

Focusing on the integrated project of Shengda Market and Lijin Agricultural Base, supply chain performance measurement and the evaluation framework that was used during the research was introduced. Fuzzy comprehensive evaluation is processed according to the data collected from the evaluation. Based on the results got from fuzzy calculation, the revaluation result was presented.

In order to conduct the thesis, qualitative and quantitative methodologies were used. The data collection was both primary data collection and secondary data collection. The primary data is from personal interviews and questionnaires. The main objective of personal interviews is to get familiar with Shengda Market and also the integrated project between Shengda Market and Lijin Agricultural Base, in order to create evaluation framework and questionnaires for later data collection and research. The major

purpose of questionnaires is collecting the data for the evaluation of supply chain performance. As for the secondary data, the research material and information were mainly collected from paper-based material and internet sources. The entire source list is in following chapter. All the research done was attributed to the supply chain performance evaluation of the intergrated project of Shengda Market Chian and Lijin Agricultural Base.

For further research, the depth and breadth of study requires a great deal of consideration. First of all, to improve the assessment accurary, the evaluation index could be wider in order to cover every angle of the business operation. This would make it easier to achieve a breakthrough effectively. Secondly, when designing the research timetable, the difficulties of data collection should be taken into account, in order to get an adequate assessment data and more accurate evaluation results. Also, it would be better to define the evaluation weight of each of the factors with bigger group from different department and to have in-depth interview with experts. Then last but not least, the evaluation search has its own limitations and may not adopt in every integrated supply chain case. It may only work only on specific agricultural products in specific period.

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## QUESTIONNAIRE

**Integrate Supply Chain Performance Measurement questionnaire  
Of Shengda Market and Lijin Agriculture Base**

In order to develop the present Supply Chain Performance of the integration project of Shengda Market and Lijin Agriculture Base, improve the supply chain process and motivate the employee' performance, Shengda Group determined to evaluate the Supply Chain Performance of this integrate project. The purpose of this questionnaire is to collect information of supply chain performance and to locate possible problems for further development. Please kindly fill the questionnaire that is fully confidential. Thanks for your contribution!

---

**Part 1 Background Information (Please mark the right alternative)**

- 1) Gender  
☐Male ☐Female
- 2) Age  
☐18-25 years ☐26-35 years ☐36-45 years  
☐46-55 years ☐56 years and above
- 3) Educational background  
☐Elementary School ☐Middle School  
☐High School or vocational school  
☐Bachelor ☐Above Bachelor
- 4) Years of service with in Market or Agricultural base  
\_\_\_\_\_
- 5) Department or Company I am working  
\_\_\_\_\_

---

Part 2 Evaluation of current Supply Chain Performance (Please evaluate by the score from 1 to 5. Except the questions marked \* 1 = very bad, 2 = bad, 3 = normal, 4 = good, 5 = very good, for the question marked \*5 = very bad, 4 = bad, 3 = normal, 2 = good, 1 = very good)

1. Internal operation
  - a) What do you think of the on time delivery rate after the integration of Shengda Market and Lijin Agriculture Base? \_\_\_\_\_
  - b) What do you think of the Goods loss rate after the integration of Shengda Market and Lijin Agriculture Base?(The goods loss rate in-



clude the proportion that products mortify, metamorphose and get lost in the process of production, transition, transport, storage and sales.) \_\_\_\_\_

- c) What do you think of the Net interest rate after the integration of Shengda Market and Lijin Agriculture Base? \_\_\_\_\_
- d) What do you think of the utilization percentage of integrated model within overall chain market/ Lijin agricultural Base? \_\_\_\_\_
- e) What do you think of the business growth rate of integrated model used inside of Shengda chain Market/ Lijin agricultural Base? \_\_\_\_\_
- f) What do you think of the utilization of information tools inside of Shengda Chain Market/ Lijin Agricultural Base? \_\_\_\_\_
- g) What do you think of the utilization situation of Technical devices in Shengda Chain Market/ Lijin Agricultural Base? \_\_\_\_\_

2. Integrate coordination

- a) Please evaluate the level of long-term cooperation relations of Shengda Chain Market and Lijin Agricultural Base, and whether or not set common strategic goals. \_\_\_\_\_
- b) Please evaluate the level of equal agreement on products' prices and risks between Shengda Chain Market and Lijin Agricultural Base \_\_\_\_\_
- c) Please evaluate the level of information transfer and coordination between multi-departments and multi-organization. \_\_\_\_\_
- d) Please evaluate the coordination between each main process in the supply chain, such as the coordination between warehouse and transportation: whether or not set the coordinate solution together; when issues come out, whether or not bring up solution together. \_\_\_\_\_
- e) Please evaluate the level of Information flow, including the amount and the utilization of computer information systems for each apartment, whether or not it is enough; the level of equally shared sales and products information. \_\_\_\_\_
- f) Please evaluate the level of standard integration. Whether or not each party in the supply chain has common standards for the products. \_\_\_\_
- g) Please evaluate the level of same unanimous values between each party. Whether or not they have same understanding of customers, services, cooperation, and trusts. \_\_\_\_\_

3. Customer value

- a) What do you think of the complaint rate? \_\_\_\_\_
- b) What do you think of the product or service satisfaction level \_\_\_\_\_

4. Support and growth

- a) What do you think of the policy of government (financial support and political trends)? Can it give good support for integration project of Shengda Chain Market and Lijin Agricultural Base? \_\_\_\_\_
- b) What do you think of the level of basic infrastructure? It includes the hardware facilities; mainly bay, transport, storage equipment and communication facilities, and the software facilities mainly include the laws, regulations, research institutions, industry associations, training institutions, financial market and security management. \_\_\_\_\_
- c) What do you think of the proportion of training the company offered? \_\_\_\_\_
- d) Do you think there are enough technical talents for company, please evaluate it by 5 levels. \_\_\_\_\_
- e) What do you think of the innovation proportion in field of process, technology and management? \_\_\_\_\_

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Part 3 Employees' opinion of Supply Chain Performance Measurement  
(Please mark the right alternative)

- 1) What do you think of the contents of this questionnaire? Can we get a factual evaluation result from it?
  - a) Yes
  - b) Not

If not, why? Please give some suggestions.

- 2) How long is an appropriate Supply Chain Performance Measurement period in your opinion?
- a) Half month
  - b) One month
  - c) A quarter of a year
  - d) Half a year
  - e) Other period not mentioned in the above alternatives, how long?  
\_\_\_\_\_
- 3) Do you think it would be motivating to become more involved in the process of setting work objectives? Please mark in front of the right alternative
- a) Strongly disagree
  - b) Disagree
  - c) Neither agree nor disagree
  - d) Agree
  - e) Strongly agree
- 4) How would you prefer to get performance feedback? Please mark in front of the right alternative?
- a) In a official seminar with colleague
  - b) In a individual meeting with manager
  - c) Through a evaluation report that is public to all departments
  - d) Other channel not mentioned in the above alternatives, what?