



**UNIVERSITY
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**FACULTY OF ENGINEERING
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Cold Chain Logistics

Cold Chain Logistics in China - A case study of a Chinese Food Manufacturer

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Abstract

Background/motivation for the study: Since the late 1970s, China has seen an unprecedented growth in its economy and with that growth follows the improvement in the quality of life for a majority of its citizens. Naturally, people will focus more on the quality of their daily nutritional products as a result. One of the technologies for preserving food products is called Cold Chain Logistics, which is deal with processing, transporting and storing food products. Despite its rapid development in China, the Cold Chain Logistics system still has many problems to be dealt with by its new users thus exploring how it can better adapt to a more demanding consumers is very interesting. We will use Henan Province QI County Yongda Food Industry CO.LTD as an example for illustrating how a food industry company can effectively manage its Cold Chain Logistics system.

Purpose: The purpose of this thesis is to first learn about in Cold Chain Logistics in the food industry through different literatures and second, to understand the main differences in Cold Chain Logistics in the food industry when China is compared with USA and Japan and third, to help Cold Chain Logistics in China be improved through technology and management.

Methods: In order to answer the purposes of this thesis, firstly, we read and write an extensive literature review related to this thesis. Secondly, we use Yongda Company as a case study. Interviews with the one manager and two employees are major source of data collection.

Findings: We present and compare the differences between Chinese, American and Japaneses' implementation of systems through various angles. China's Cold Chain Logistics is still in the development stage. The whole Cold Chain Logistics has not matured. Furthermore, a case study is conducted on how Yongda Company can have many significant advantages over its competitors in Cold Chain Logistics and how their techniques and management styles can benefit other companies if applied correctly throughout China.

Contributions: This thesis will show that how to management Cold Chain Logistics in the real company.

Key words: Cold Chain Logistics, CCL, Yongda Company, food industry.

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1. Introduction/Background

1.1. Research Background

China's fresh food Cold Chain Logistics (CCL) backward in technique equipment which cause inefficiencies in the cold chain logistics system. This result is in serious negative results as great loss and high prices of fresh food.

As described by Changsheng (2007), in some developed countries, there has formed a complete food cold chain logistics system. This complete food cold chain logistics system includes production, processing, storage, transportation and sale. As summarized by Bogataj (2005), the government through establishment of laws, regulations and public services in macroeconomic regulation significantly enhance the transport rate and transport quality through the regulation impels the fresh food freezing and cold storage. As mentioned by Brown (2007), it can also delay cell respiration rate and biochemical reaction, delay the effect of the enzyme, oxygen and light generated by chemical and biological technology changes in the process to improve the food quality. Hazard Analysis Critical Control Point (HACCP) system is to assist in identifying factors. It was first presented by Dr. Howard Bauman in 1971 as a preventive approach to food safety that aims to identify and eliminate physical, chemical and biological hazards during the production process rather than finished product inspection. This system was adopted by the United States Department of Agriculture (USDA) and Food and Drug Administration (FDA) during the 1990s for large establishments and later followed by medium-sized and small businesses.

At present, Chinese consumers' preferences to buy fresh food gradually rise. The requirements for fresh food also gradually rise. So the development of Cold Chain Logistics is very important in China.

1.2. Purpose

There are many companies in China who uses Cold Chain Logistics in its daily management but there any detailed case analysis on the subject is almost non-existent. Therefore, due to the lack of this analysis, we think that this thesis will benefit other companies to improve its productivity and product quality by closely examining and comparing how Yongda Company implement its CCL system. The purpose with this study is to examine, evaluate and present the challenges of Cold Chain Logistics in the food industry in China by comparing with its implementation in the US and Japan.

1. 3. Research questions

Our research questions must contain three important parts that can thoroughly provide readers with the answers they seek and they are comprised of factual explanation of CCL, comparison with top level implementers and finally assessment on technological improvements. Using the US and Japan as examples in our thesis will need some extra explanation here. As described by Dingyi (2010), many developed countries have basically established suitable efficient Cold Chain Logistics. China's Cold Chain Logistics is still in the development stage. The whole Cold Chain Logistics has not matured. Therefore, it is only appropriate to choose USA and Japan, who has already attained high maturity of CCL, as examples as well as targets for Chinese companies.

- 1) What is known in the literature on Cold Chain Logistics in the food industry?
- 2) Which are the main differences in Cold Chain Logistics in the food industry when China is compared with USA and Japan?
- 3) How can Cold Chain Logistics in China be improved through technology and management?

In order to answer the purposes of this thesis we have made a case study of Henan Province QI County Yongda Food Industry CO LTD in order to illustrate how a food industry company can effectively manage its Cold Chain Logistics system.

1. 4. Scope of thesis

In this thesis, we research the three aspects Cold Chain Logistics. It includes cold processing, cold storage and cold transportation and distribution.

2. Theoretical Framework

2.1. Introduction of Cold Chain Logistics

2.1.1. Definitions of Cold Chain Logistics

Figure 1 shows an illustration of Cold Chain Logistics.

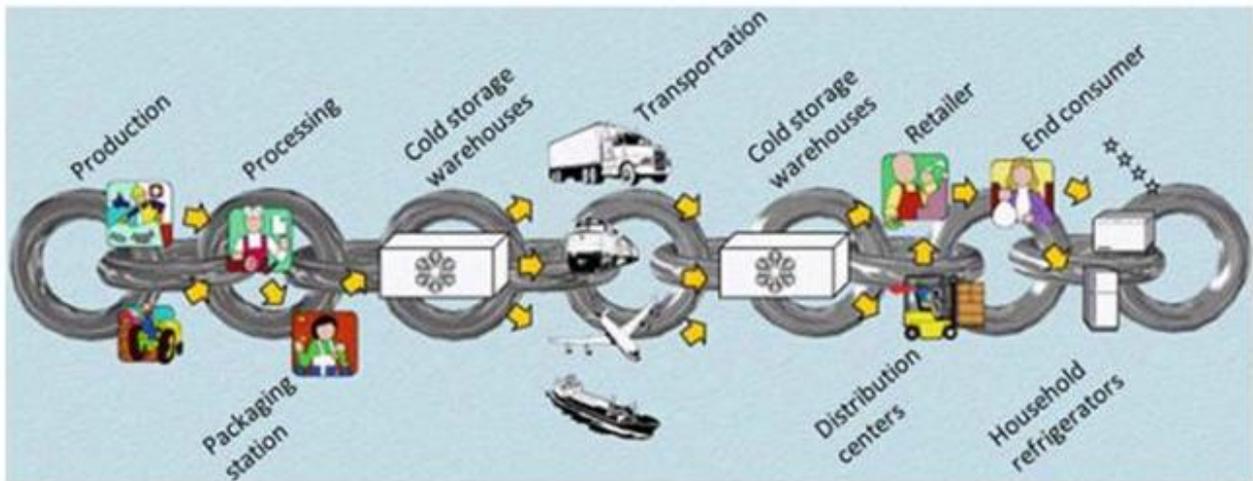


Figure 1. The proposed reference model for a typical Cold Chain Logistics (Rollo & Gnoni, 2010)

As mentioned by Casper (2007), Cold Chain Logistics (low temperature logistics) is comprised of equipments and processes that keep perishable products under controlled cold environment. It deals with the production, processing, packaging station, cold storage warehouses, transportation, distribution centers, retailer, end consumer and in the user household refrigerators of products from the manufacture to the customer that are temperature sensitive. Temperature sensitive products that require Cold Chain Logistics solutions may include: pharmaceuticals, biological, lab samples, chemicals, and foods. As described by Dingyi (2010), the quality of perishable products needs professional and specialized facilities to maintain the right temperatures from production to delivery for consumption.

Figure 2 shows the three main stages of the Cold Chain Logistics; cold processing, cold storage and cold transportation. In this thesis, we choose to focus on these three main parts of the CCL. These three parts cover the Cold Chain Logistics from the manufacturer to the customer.



Figure 2. The three main stages of Cold Chain Logistics

As summarized by Donselaar (2006), these perishable products can be categorized into two types:

- Living products (fruits, vegetables, fresh seafood, fresh flowers, etc.).
- Non-living products (meats, dairy products, processed food, medicines, blood, frozen products, etc.).

All require an appropriate atmosphere to defy microbial spoilage.

2. 1. 2. Features of Cold Chain Logistics

Cold Chain Logistics is complicated and difficult to maintain. As described by Dingyi (2010), the timing, the quality of products, the temperature, the humidity and the environment are all important to Cold Chain Logistics. The three main features are:

Complexity

In the whole Cold Chain Logistics process, the supplier must comply with the '3T' principle. The quality of products depends on low temperature storage and the Time, Temperature, and Tolerance of the transportation. Refer to the relationship between maintain time of cold storage and the product's temperature. The time and temperature of the frozen foods is very important. Because if change the original time and temperature will lead to quality decrease that it is irreversible. Therefore the different products have the different time and temperature to control. Refrigerator temperature control is very strict to manage. The company can use Radio Frequency Identification (RFID) with temperature sensor for temperature control. It is easier to control from manufacture to distribution.

Coordination

Perishable fresh products are difficult to store due to their biological nature, therefore, in every aspect of the logistics process must be coordinated. For example, when the product is delivered to the cold storage warehouse, they should be put in to storage immediately because if it is not put into storage immediately. It may lead to declined of quality. So it can ensure the stable operation of the Cold Chain Logistics.

High cost

Cold Chain Logistics has high investment in refrigeration equipments and insulation technologies are obligatory. The cost with the warehouse and vehicles of Cold Chain Logistics is 3-5 times of the general dry products warehouse and vehicles. The investment in question involves, at its minimum, a main storage hub and a cold-storage transportation vehicle. Cold Chain Logistics transportation costs are also high, because electricity and oil fees are important prerequisite investment in the Cold Chain Logistics.

2. 1. 3. Structure of Cold Chain Logistics

As summarized by Changsheng (2007), there are four parts of Cold Chain Logistics: cold processing, cold storage and cold transportation and distribution.

Cold processing

It includes cooling and freezing of meat and aquatic products, pre-cooking of fruits and vegetables and low temperature processing of dairy products. In this part of Cold Chain Logistics, the necessary equipments are the refrigerating machineries and the quick-frozen machineries where the former lowers the products to their preferred temperature and then the latter would freeze them for longtime storage.

Cold storage

It includes the freezing and storing of foods, and controlled atmospheric storage of fruits and vegetables. It can also ensure the low temperature processing environment for food and other perishable products. In this part of the Cold Chain Logistics, the necessary equipments involved are the refrigerator, the freezer and the domestic refrigerator and other the equipment. As mentioned by Kader (2004), controlled atmospheric storage is for the protection of fresh fruits, vegetables, and their products throughout postharvest handling.

Cold transportation and distribution

It has long and short distance, low temperature transportation of food and other perishable products that are carried out by refrigerated railway carriages, refrigerator vehicles, refrigerated ships, refrigerated containers and other low temperature transports. As described by Foreinio and Wright (2005), supply chain efficiency can be increased by managing the Cold Chain Logistics, thus lowering its costs for the firm operating cold chain.

2. 1. 4. Principle of the Cold Chain Logistics

As mentioned by Dingyi (2010), the core concept of the Cold Chain Logistics is to keep a low temperature environment to ensure the safety and quality of fresh foods. Cold Chain Logistics should follow the requirements which prohibit any change in the product's storage temperature set by the products' manufacturers. Because even small temperature fluctuations can have a direct visual or taste or even bacterial effect. According

to Hazard Analysis Critical Control Point (HACCP) foods should be in right temperature to management. Because any change in the product's storage temperature will have potential microbiological, chemical, and physical hazards, it is not good for people.

As summarized by Jian (2010), he compared with the conventional logistics system then summarizes the 5 principles of Cold Chain Logistics. There are '3P', '3C', '3T', '3Q', and '3M' principle.

'3P' principle

Produce, Processing, and Package. It requires the good quality of raw material produce, the high technology processing, and the packaging must be suitable to the products' properties. Because different products should be use different package. For example: Meats widely used vacuum package. Ice-cream widely used paper box, plastic bucket, etc. This is the quality of the products' early management in the Cold Chain Logistics.

'3C' principle

Employees should Care for the products, keep a Clean environment and keep the environment Cool in the whole process. These are fundamental conditions for guarantee the quality of products.

'3T' principle

The quality of products depends on low temperature storage and the Time, Temperature, and Tolerance of the transportation. Refer to the relationship between maintain time of cold storage and the product's temperature. The time and temperature of the frozen foods is very important. Changes of the original time and temperature will lead to quality decrease, and it is irreversible. Therefore different products have different time and temperature to control.

'3Q' principle

The Quantity and Quality of equipment, and the Quick operation organization in the Cold Chain Logistics. Right quantity and good quality of the equipment, and quickly operation organization can guarantee the products always in a suitable process environment. Quick operation organization refer to the department of the production process, the department preparation transport vehicle for the transportation and the department preparation storage capacity for storage the products, etc. all of these tasks should be quickly coordinated.

'3M' principle

It means that the Means, Methods and Management of storage. In the Cold Chain Logistics, the company should use appropriate transport machinery and storage methods for the all kinds of products. It will make the management more efficient in the Cold Chain Logistics.

2. 1. 5. Temperature control of the Cold Chain Logistics

As described by Casper (2007), temperature-sensitive foods are very fragile in which even small temperature fluctuations can have a direct visual or taste or even bacterial effect. This is the one of the reason why temperature control is very important of perishable products. As described by James and James (2010), a temperature rise will increase the risk of food poisoning and food spoilage. Each product needs a special temperature controlled environment in the distribution process for delivering the product to the store. As mentioned by Kuo and Chen (2010), the temperature control is a key role in the CCL, and to maintaining quality and integrity of the products. Table 1 is shows the different temperature intervals for different kinds of food.

Table 1. Temperature control for frozen and frozen storage of food processing (Ying, 2006).

Temperature	Kind of foods
20 °C	Storage and transportation of the fruits and vegetables cannot tolerate low temperature.
10 °C ~ 0 °C	Pro-cooling process of fruits, vegetables, fresh seafood and white meat and red meat.
0 °C ~ -5 °C	Storage and transportation of slightly cooling food.
-10 °C ~ -18 °C	Storage and transportation of slowly cooling food.
-18 °C ~ -30 °C	Storage and transportation of frozen seafood, ice cream.
-30 °C ~ -50 °C	Storage and transportation of fast frozen foods and tuna.

There are five types of food:

Fruits and vegetables

The transportation temperature of fruits and vegetables must be kept between 0 °C to 4 °C. But different fruits and vegetables have different transportation temperature. For example, the best transportation temperature of bananas must be kept between 12 °C to 14 °C.

Meat

This category includes beef, lamb, pork, chicken and duck, etc. Their main nutrients are protein, fat, sugar, inorganic salt and vitamins. They consist of muscular tissue, adipose tissue, connective tissue and bone tissue. When kept below -18 °C meats will reach their dormant state for optimal cold storage, however, a temperature of -23 °C can prolong its storage lifespan significantly. Therefore, many countries have made clear regulations, which follow the minimum -18 °C storage guidelines, for the transportation of frozen food and aquatic products.

Dairy products

The transportation temperature of dairy products must be kept below -14 °C while most butter and margarine transportation should be below -8 °C in order to preserve their good qualities. However, long-term storage of

hard cheese only requires a temperature between 1 °C to 7 °C while other cheese transportation temperature between 0 °C to 13 °C.

Ice cream

Ice cream transportation temperature must be below -25 °C.

Chocolate

Low temperature transport can preserve chocolate's qualities hence their transportation temperature should be kept between 8 °C to 18 °C.

2. 2. Management and technology of Cold Chain Logistics

As summarized by Shister (2004), the management and technology are important in Cold Chain Logistics. Cold Chain Logistics improve the supply chain efficiency and reduce the cost. This bodes well with the global economy and the growing demands from China expanding agricultural trade improve the product storage time. As described by Global AgriSystem Pvt. Ltd. (2011), the success of implementing Cold Chain Logistics management involves continual monitoring of products temperature throughout distribution, and having appropriate corrective action plans of Cold Chain Logistics. A good Cold Chain Logistics can help to reduce costs, improve products integrity, increase customer satisfaction and reduce wastage, etc. Cold Chain Logistics can use information management system to ensure the quality and transportation of products in the right direction. The relative personnel should develop the technologies of Cold Chain Logistics.

2. 2. 1. Processing – HACCP system

Hazard Analysis Critical Control Point

As mentioned by Guozhi and Jiping (2007), in early 1960s, the National Aeronautics and Space Administration (NASA), the Natick American Army laboratory and the Pillsbury group company common to research of Hazard Analysis Critical Control Point (HACCP). In 1971, the concept of HACCP was first presented by the National Conference on Food Protection to the public. In 1987, the Food Safety and Inspection Service (FSIS), the Food and Drug Administration (FDA), the National Marine Fisheries Service (NMFS) and the Natick American Army laboratory present HACCP to be applied in food operations for food safety. According to University of Nebraska-Lincoln 'Institute of Agriculture and Natural Resources' (2011), the National Advisory Committee on Microbiological Criteria for Foods (NACMCF) was formed. And the National Advisory committee published a report that provided the framework for HACCP in 1992. According to the National Advisory Committee on Microbiological Criteria for Foods (1997), they identified a format for HACCP process analysis based on the seven HACCP principles. As described by Henroid (2003), 'Provided the framework for

HACCP' this report has been adapted by the United States Department of Agriculture (USDA), the Food and Drug Administration (FDA), and internationally through the Codex Alimentarius Commission (CAC) for use in the food industry.

According to the Association of Food & Drug Officials (2011), the HACCP is a management system where foods safety is addressed through analyzing and controlling biological, chemical and physical hazards that derives from production to distribution and consumption of the finished products. As summarized by Guozhi and Jiping (2007), the HACCP can reduce critical microbiological organisms as much as possible, but it is not a zero risk system. The HACCP is to supplement other quality management systems. When doing so, both systems can complement each other and thus be more advantageous for both the firms and the consumers.

According to the National Advisory Committee on Microbiological Criteria for Foods (1997), if a company wants to start a HACCP system it must first write a HACCP plan. The most useful and successful HACCP plans need to be developed from the beginning from the plant. A team of individuals from within the company and some assistance from outside experts are needed to develop a HACCP plan that should include the five preliminary steps and applies the seven HACCP principles. Table 2 is an example of a HACCP plan summary table.

Table 2. HACCP Plan (National Advisory Committee on Microbiological Criteria for Foods, 1997)

CCP	Hazards	Critical limit (s)	Monitoring	Corrective Actions	Verification	Records

A HACCP plan summary table should be including the Critical Control Points (CCPs) identified, Critical Limits, Monitoring System, Corrective Actions, Recordkeeping Procedures, and Verification Procedures.

The five preliminary steps of HACCP

Assemble the HACCP team

The first step in developing a HACCP plan is to organize a team for develops the HACCP plan. The team should be multi disciplinary and have specific knowledge and expertise appropriate to the product and process. For example: engineering, production, sanitation, quality assurance, and food microbiology. The team may need assistance from outside experts who are knowledgeable in these areas. These knowledge and experience can to correctly conduct a hazard analysis; identify potential hazards; identify hazards which must be controlled; recommend controls, critical limits, and procedures for monitoring and verification; recommend appropriate corrective actions when a deviation occurs; recommend research related to the HACCP plan if important information is not known; and validate the HACCP plan.

Describe the food and its distribution

The team should be to describe the food. It consists of a general description of the food, ingredients, and processing methods, and along with information on whether the food is to be distributed frozen, refrigerated, or at ambient temperature.

Describe the intended use and consumers of the food

The team should be to write a list of ingredients and raw materials for the food. The ingredients and raw materials will help to focus on potential hazards. The intended consumers may be the general public or a particular segment of the population (infants, immune compromised individuals, the elderly, etc.).

Develop a flow diagram which describes the process

The team should be to develop a flow diagram is to provide a simple, clear outline of all the steps involved in the process. Also, a simple schematic of the facility is often useful in understanding and evaluating product and process flow. See Appendix B.

Verify the flow diagram

The team should be to verify the accuracy and completeness of the flow diagram. Modifications should be made to the flow diagram as necessary and documented.

The seven principles of Hazard Analysis Critical Control Point (HACCP)

According to the National Advisory Committee on Microbiological Criteria for Foods (1997), they identified a format for HACCP process analysis based on the seven HACCP principles. The seven principles of HACCP have been universally accepted by government agencies, trade associations and the food industry around the world. The seven HACCP principles are the most important steps in writing a HACCP plan. The first and second steps provide the foundation for the HACCP plan. These two steps are essential since application of the other principles. The other five steps are the application of the HACCP plan, and provide the structure to the company for conducting the workings of the HACCP plan.

Conduct a hazard analysis

The team should conduct a hazard analysis as a biological, chemical or physical agent and identify appropriate control measures and develop a list of hazards that is significant and is likely to occur and are reasonably likely to cause injury or illness. If it is not reasonably likely to occur it would not require further consideration within a HACCP plan. They will focus on hazards that can be prevented, eliminated or controlled by the HACCP plan. The team should analyze the ingredients and raw materials, included in the process, product storage and

distribution, and final preparation and the use by the consumer.

Determine the critical control points (CCPs)

Critical control point is defined as a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce to acceptable levels. The potential hazards must be addressed in determining CCPs. Using of microbiological testing is seldom an effective means of monitoring CCPs because of the time required to obtain results. For example: the team helps a food plant to control the refrigeration of a precooked food to prevent hazardous microorganisms from multiplying, also to adjustment of a food to a pH necessary to prevent toxin formation. The basis of control food safety hazards should be complete and accurate identification of CCPs. The team will use a CCP decision tree¹ to help identify the CCPs in the process. A CCP may control one or more food safety hazard. Also a food safety hazard may need one or more CCPs to control.

Establish critical limits

Critical limit is the maximum and/or minimum value of a biological, chemical, or physical parameters that must be controlled at a CCP, then to prevent, eliminate, or reduce to an acceptable level the occurrence of a food safety hazard. The critical limit is usually a measure such as temperature, time, physical dimensions, humidity, moisture level, water activity, pH, titratable acidity, salt concentration, available chlorine, viscosity, preservatives, or sensory information such as aroma and visual appearance. Critical limits must be scientifically based.

Establish monitoring procedures

The team will plan monitoring procedures of measurement or observation to assess the critical limit at each CCP. Monitoring procedures is used to facilitate tracking of the operation, is used to determine when a deviation has occurs and there is loss of control at a CCP, and it provides record documentation for use to verification.

Establish corrective actions

Corrective actions are the procedures to correct a critical limit when the critical limit occurs. The team will identify the problems to prevent, eliminate, or reduce potentially hazardous food occurrence and to correct the process, then to assure that the problem will not occur again, finally to record the corrective actions in the document.

¹ CCP decision tree is a sequence of questions to assist in determining whether a control point is a CCP. See the Appendix A.

Establish verification procedures

Verification is determining the validity of the HACCP plan and check if the system is operating according to the plan. The team may identify activities such as auditing of CCPs, record review, prior shipment review; instrument calibration and product testing verify the correctness of the plan. These processes should take place during the development and implementation of the HACCP plan. It is the maintenance part of the HACCP system.

Establish record-keeping and documentation procedures

Recording information is a key component of the HACCP plan. It can be used to prove that the food was produced safely. Record should include a summary of the hazard analysis (the rationale for determining hazards and control measures), the HACCP plan (and information on the team, description of the products, its distribution, intended use, and consumer, flow diagrams), support a validation records documentation, and records that are generated during the operation of the plan.

Management must be committed to a HACCP approach for a successful HACCP plan to be properly implemented. The benefits of HACCP, in addition to enhanced assurance of food safety, are better use of resources and timely response to problems.

2. 2. 2. Transportation and Storage – GIS, GPS & RFID

As described by Cold Chain Logistics of road transportation (2009), the transportation of Cold Chain Logistics has many ways such as road transportation, railway transportation, water transport and air transport, etc. The cost of road transportation, railway transportation, water transport and air transport are different. The cost of road transportation is cheaper than other ways. In the Cold Chain Logistics competition, the road transportation and the market share has rapid developing step by step. According to the specific conditions of China, the road transportation is the good choice of Cold Chain Logistics. The advantage of road transportation mainly reflects on:

1. The road transportation implementation of ‘door to door’ transport service, and reduce the intermediate link. On the one hand, because of losses products due to transport of the products and to improve the security of the products. On the other hand, the intermediate link decreases which improve transport efficiency, shorten the transportation time and ensure the products delivered on time to the customer.
2. The network of road transportation covers more widely than other transport ways.
3. The road transportation has lower cost than other transport ways.

As mentioned by Goodchild (2010), Geographic information technologies include Global Positioning Systems (GPS), remote sensing and Geographic Information System (GIS). GIS is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographically referenced data. GPS is a navigation and precise-positioning tool. It can show the exact position on Earth anytime, anywhere, in any weather. As mentioned by Yarong et al. (2009), GIS is a powerful tool in logistics for vehicle routing, efficient location of warehouses to customers. GIS use of the process power of the computer can realize reduce costs and more efficient operations. GIS and GPS can tracking the vehicle. GIS can receive GPS data then display data in electronic maps. It can help company to achieve the minimum cost for positioning of trucks, trace of trucks and choice optimization route, and also transport the products to the right place, at the right time and to the right customers. Customers can use this system to trace of the products. It will enhance the transparency of the supply chain, ability of control and improve customer satisfaction.

As described by Kelepouris et al. (2007), RFID as an emerging technology represents a good opportunity for an efficient traceability system in Cold Chain Logistics. RFID is based on a wireless microchip and an antenna in the tag. So RFID does not need physical contact or sight positioning with the reader. RFID system can be developed and implemented so that all items are identified with near 100% accuracy in all locations of interest. As described by Abad (2009), RFID system is important advantages regarding conventional traceability tools. And also is currently used temperature data loggers such as reusability, no human participation, no tag visibility needed for reading, possibility of reading many tags at the same time and more resistance to humidity and environmental conditions. As mentioned by Rollo and Gnoni (2010), RFID tag data storage capacity is big. It can be duplicated. RFID technology has low cost, and simple operation. The working distance is 30 meters. RFID could facilitate visibility of products in Cold Chain Logistics. It cans provide non-contact, real-time data collection and efficient interfacing with the management control system in the cold chain. RFID applications could be to reduce risks associated with product safety and cost, also to increase products shelf life and work efficiency in the Cold Chain Logistics. According by Thrift (2008), RFID provide ID code, it can record the accurate temperature, time, information tracing, easy to define the responsibility and quickly know the transit temperature conditions.

2. 3. PEST analysis

According to Senior and Fleming (2006), PEST refers to the political, economic, socio-cultural and technological factors. PEST is an external analysis tool to describe a framework of macro environmental factors of strategic analysis. The PEST can give the company an overall environment in an overview of different factors. In this thesis, we will use PEST to analysis the Cold Chain Logistics in China. See figure 3.

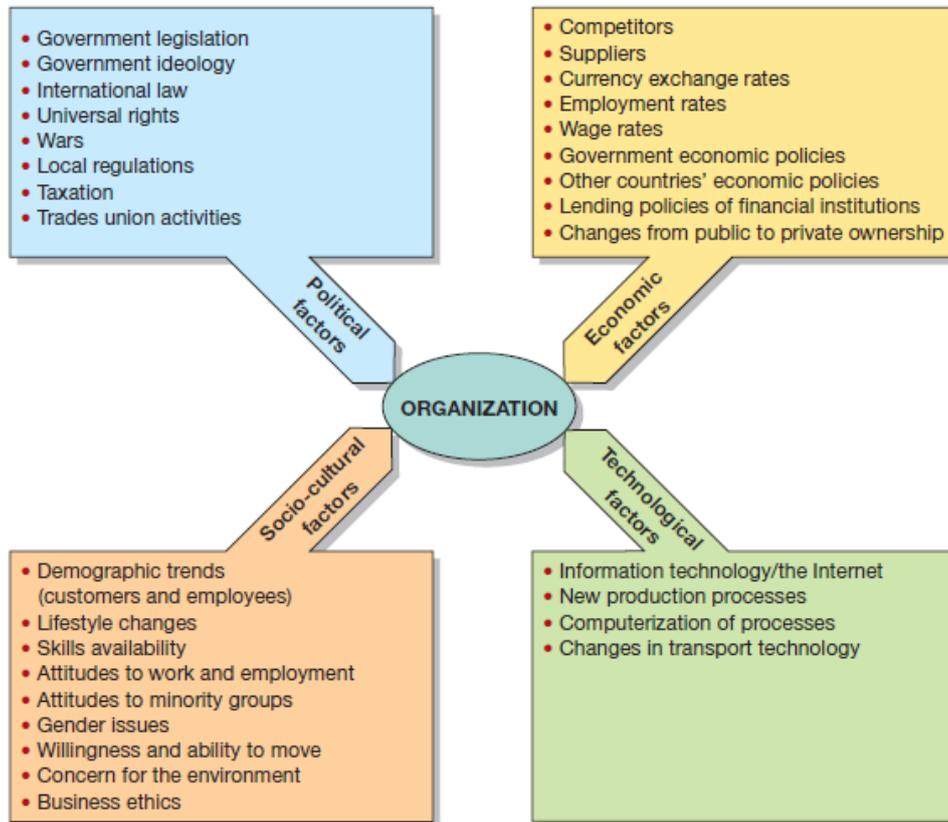


Figure 3. PEST analysis mode (Senior and Fleming, 2006)

The figure 4 is shows the PEST analysis mode which includes:

Political Factors

Political factors include government legislation, government ideology, international law, universal rights, wars, local regulations, taxation and trades union activities.

Economic Factors

Economic factors include competitors, suppliers, currency exchange rates, employment rates, wage rates, government economic policies, other countries' economic policies, lending policies of financial institutions and changes from public to private ownership. An enterprise is a micro individual in the macro environment, so the economic environment has influences on the formulation of the strategy by an enterprise. Economic globalization makes more close economic ties between the countries.

Social - cultural Factors

Social - cultural factors include demographic trends, lifestyle changes, skills availability, attitudes to work and employment, attitudes to minority groups, gender issues, willingness and ability to move, concern for the environment and business ethics.

Technological Factors

Technological factors include information technology, new production processes, computerization of processes and changes in transport technology.

2. 4. SWOT analysis

According by Kotler P. (2008), the SWOT analysis was developed in the 1960's. It used to determine the competitive advantage of the enterprise. SWOT stands for Strengths, Weaknesses, Opportunities and Threats. It is to integrate the company's strategy, internal resources and external environment then helps the company determine the competitive advantage. So, clearly identified the resource of company's strengths and weaknesses, and understand the challenges for company's opportunities and threats. It is very important for making the business strategy of company in the future. These are explanations for the SWOT analysis:

Strengths

A company's strengths are its resources and capabilities such as patents, strong brand names, exclusive access to high grade natural resources and favorable access to distribution networks.

Weaknesses

The absence of certain strengths may be viewed as weaknesses such as lack of patent protection, high cost structure and lack of access to key distribution channels.

Opportunities

The external environmental analysis may have new opportunities for growth such as an unfulfilled customer need, arrival of new technologies and removal of international trade barriers.

Threats

Changes in the external environmental may have present threats to the company such as shifts in consumer tastes away from the company's products, emergence of substitute products and new regulations.

3. Methodology

3.1. Research strategy

As cited by Yin (2003), if we write a case study, we should be following these steps.

Firstly, we should know how to design a case study and there are five functions of a case study design:

1. The type of research question with typically questions like ‘how’ or ‘why’.
2. Study’s propositions that include pointing attention, limiting scope and suggesting possible links between different phenomena. It will help researchers to determine where to find evidence, and guide the researchers related data collection.
3. Study’s units of analysis where the main units must be at the same level as the study questions and typically comparable to those previously studied.
4. Logically linking the data to the propositions and matching pieces of information to rival patterns that can be derived from the propositions.
5. Criteria for interpreting the findings that consists of iterations between propositions and data, matching sufficiently contrasting rival patterns to data.

Secondly, we should collect the evidence and there are six sources of evidence:

1. Documents: Letters, agendas, reports and so on.
2. Archival records: Service records, organizational charts, budgets and so on.
3. Interviews: Typically open-ended.
4. Direct observations: It is useful to have multiple observers.
5. Physical artifacts.

Thirdly, we should analyze the evidence because it is the most difficult aspects of doing case studies. The most important is to have a general analytic strategy, which helps to choose different techniques then start to analysis. Research design can provide a conceptual framework and an action plan for getting from questions to set of conclusions. The reason to choose the case study is based on the purpose of this thesis.

3.1.1. Method to literature review

Based on research questions in this thesis, the literature review are including in three parts. The first part is about what CCL is, which answer the first research question. The second part is the status in CCL of China, USA and Japan, which answer the second research question. The third part deeply understands the CCL in the China, which answer the third research question. And through the case analysis of Yongda, it is a method that

we use to better explore the third research question. We find those literatures are through Google literatures database, and then enter in the correct website. We use the Chinese and English Google to find those literatures. In which case, 'what is Cold Chain Logistics' in the case. There are many papers about CCL. Relevant results are achievable by imputing key words like Cold Chain Logistics, frozen food and food industry. We find the useful literature then download or read in the internet.

3. 1. 2. Case selection

In the corporate world, having competitive advantages over other competitors are very important for a company's success. This is why we have chosen Henan Province QI County Yongda Food Industry CO.LTD as an qualitative single case study in our research since its business model in CCL have surpassed its contemporaries. Yongda Food Industry CO.LTD is an agriculture industry exporting company integrated with feed production, breeder chicken feeding, broiler slaughtering and processing, cooked food production, quickly frozen food production, cold storage and distribution and multiple shops. The company is an AAA class enterprise. "Yongda chicken" brand image and through popular feeling, brand awareness especially in the Henan market, "Yongda chicken" has become a local customers' first choice.

As one of the largest company with refrigerated distribution and food Cold Chain Logistics, Yongda achieved a lot in just a few years. However, in these years, Yongda Company is also facing unprecedented challenges. These challenges come not only from strong competitors and serious competitive environments, but also from the advanced international cold chain logistics. So, Yongda Company should also improve their general comprehension of the food Cold Chain Logistics.

3. 1. 3. Data collection design

In our thesis which discusses the Cold Chain Logistics in food industry companies, we interviewed employees from the Yongda Company. The main interview questionnaire ranges are shown below:

- Firstly, we needed to know how to manage the Cold Chain Logistics by their business model. We asked for their cold storage sanitary management, refrigeration equipment, refrigeration craft and refrigeration warehouse personnel management.
- Secondly, we want to deeply understand how the chicken processing stage is managed in the Yongda Company. We asked for the documentation of chicken leg raw material specification which Yongda Company supplied to KFC (Kentucky fried chicken).
- Thirdly, we want to get familiar with the actual work environment in Yongda Company. We asked for relevant pictures such as forklift, refrigerator warehouse, temperature tracker, staking position, refrigerator car.

Through our interview, one of Yongda Company's managers was able to provide the majority of information concerning the chicken processing cold chain as well as the documentation of chicken leg raw material specification. These documentations deal with their transportation to KFC. Jianfang who, from software and technology department, provided information on the technological part of their CCL where we were able to familiarize ourselves with the current circumstances of the technological application in Chinese food industries. Chuanling is from the product research and development department who talked about the packaging situation of Yongda Company product.

3. 1. 4. Data Analysis

Through our interviews and other articles from academic journals, we got a general overview over the data and the next step is to understand what elements influence the performance of the Cold Chain Logistics the most and also which of these elements can manage the CCL most effectively in a company.

As mentioned by Casper (2007), Cold Chain Logistics deals with the production, processing, packaging station, cold storage warehouses, transportation, distribution centers, retailer, end consumer and in the user household refrigerators of products from the manufacture to the customer that are temperature sensitive. In this thesis, we are mainly contains the three stages of Cold Chain Logistics which it includes processing, transportation and storage of food products. Our thesis mainly contains the three stages of that concept, and we mainly focus on the manager of the processing stage in the three stages. In this thesis, 16 scientific articles have been selected in the journals. The literature review was completed as referred.

We use PEST mode to analyze the Cold Chain Logistics in China and compare it with other developed countries in order to find the difference in Cold Chain Logistics. PEST stands for "Political, Economic, Social and Technological analysis and, not only is it well known within the academic circles, it can also provide a general overview of CCL and its adaptation in China. While it is widely used, it does have its drawbacks. For example, another version of PEST is SLEPT which also takes the legal factors into account. Although exploring how the Chinese government can regulate and implement CCL through its judicial apparatus can be interesting, it can divert the readers from the main points of our research since any information will solely be based on speculation hence the use of its more basic form for our argument. And we use the SWOT analysis tool to analysis the strength, weakness, opportunity and potential threat of the existence for the firm can adjust the enterprise resources and strategy to reach to the better purpose of the company development.

In the case of Yongda Company, we use the chicken leg which Yongda Company supplied to Kentucky Fried Chicken (KFC) as an example to show that how to use the HACCP system to monitor the quality and safety of the food in the processing flow. According to the Association of Food & Drug Officials (2011), The HACCP system controls the food quality from raw material to end users in all the Cold Chain Logistics. This analysis system was first adopted in the USA for protecting public health when consuming perishable products. Since then it has become the standard monitor system worldwide for food safety and since CCL deals with the handling and storing of perishable products, it is only logical that we also use it for our research. In the other two stages, we select the Radio Frequency IDentification (RFID) and Geographic Information System (GIS) measurement instruments to manage and enhance all of the stocks in warehouse. As described by Kelepouris et al. (2007), RFID as an emerging technology represents a good opportunity for an efficient traceability system in cold chains. As mentioned by Yarong et al. (2009), GIS is a powerful tool in logistics for vehicle routing, efficient location of warehouses to customers. However, Yongda has not use RFID technology because of the cost and training in the usage of RFID. But as described by Kelepouris et al. (2007), RFID system can be developed and implemented so that all items are identified with near 100% accuracy in all locations of interest. According by Thrift (2008), RFID provide ID code, it can record the accurate temperature, time, information tracing, easy to define the responsibility and quickly know the transit temperature conditions. So, we suggest Yongda Company can change the handwritten products entry to RFID. Then we compared handwritten products entry with RFID technology's products entry in this dissertation. According to our findings, we combine the HACCP system, GIS and RFID to help Yongda Company and other companies to improve manage their Cold Chain Logistics.

Furthermore, through interviews with the Yongda Company, we were able to obtain information about their management styles and how their advantages can be used in other Chinese food industries. We have also compared and combined the comparative advantages of the developed countries' Cold Chain Logistics and that of the Yongda Company to show how to manage a prosperous and highly competitive food company.

3. 2. Reliability and validity

The reliability of the thesis is based on interviews and information provided by the one of Yongda Company's managers, one of Yongda Company's software and technology department, and one of Yongda Company's research and development department who will fully engaged in the interview. They can give us the correct information about the question. Some of the information like Yongda's social responsibility is open to the public. All the interviews and data are interrelated and guarantee the reliability and validity for the case study.

3.3. Limitations

There are some limitations in our thesis. We only use e-mail and telephone to contact with the employees. We have not visited the company's factory. It is possible that the factory is not as their said. Furthermore, there is a possibility that the current situation of CCL in China has been generalized through our examination of only one food industry. Also, CCL has four main stage but we have only examined three of them. The sale stage has been left out due to its large area of study.

4. Findings

4.1. Overview of Yongda Company

During the basic process of the Cold Chain Logistics, processing in process of product flow, warehousing and distribution are the important part of Cold Chain Logistics for food. In this thesis, we will set the chicken meat products of Yongda Company as an example, to analyze the status of Cold Chain Logistics, and start the analysis of Cold Chain Logistics process of chicken meat products from the three main processes as circulated processing, warehousing and distribution, only on this basis can we provide the base for identification of the key process of Cold Chain Logistics for food.

4.1.1. Brief introduction of Yongda Company

Table 3. The brief history of Yongda Company

Year	History
1984	Mr. Feng Yongshan use 5,000 RMB as the beginning established the Gaocun Livestock industry and chicken egg production.
1988	Mr. Feng Yongshan established Henan Province QI County Yongda Food Industry CO.LTD.
2000	Yongda Company became the supplier of McDonald's and Kentucky Fried Chicken (KFC) and obtaining self importing and export qualification.
2001	Acquired the HACCP certificate.

Table 3 is a brief introduction of Yongda Company's history. Henan Province QI County Yongda Food Industry CO.LTD is an agriculture industry exporting company integrated with feed production, breeder chicken feeding, broiler slaughtering and processing, cooked food production, quickly frozen food production, cold storage and distribution and multiple shops. The company is an AAA class enterprise. "Yongda chicken" brand image and thorough popular feeling, brand awareness continuously improve, especially Henan market, "Yongda chicken" has become a local customers' first choice brand.

Scale of Yongda Company

Yongda presides over 16 subsidiary companies, the existing employees of more than 8,000. The company has 3 chicken processing production lines, annual slaughtering scale of 60 million. Exports and domestic food factory each has one factory. The processing capacity is about 32,000 tons.

Marketing range of Yongda Company

At the local market, the company mainly sells its products to 30 provinces and cities. And Yongda is a long-

term main supplier for McDonald's and KFC. In the international market, Yongda exports to ten countries including Japan, South Africa, Middle East, and Southeast Asia.

Figure 5 shows the market range of Yongda Company.



Figure 5. Marketing range of Yongda Company

From figure 5, we can see Yongda Company market range both on the domestic and international market, so the firm must provide an impeccable process and equipments for take responsibility to their brand and food safety. Yongda Company is used to provide the customers with warehousing, transportation, distribution, circulated processing, consulting and other integrated logistics solutions. Its main business includes several major parts as the distribution and processing of frozen foods, and have a Cold Chain Logistics team to transportation those products. The business of Cold Chain Logistics in the company at present is 27 upstream suppliers, manufacturers who do the distribution business, that is to say, they will deliver the products to the designated locations. Main upstream suppliers are the producers of cooked meat, at the same time they provide enterprises with processing services of flow, including cutting and packaging of the frozen meat and cooked meat. In addition, Yongda Company will accept the commission from any supermarket, so as to take over the appropriate distribution business. Up to now, the number of supermarket stores is more than 180 which products are distributed by department of Cold Chain Distribution.

4. 1. 2. Principle of the Cold Chain Logistics of Yongda Company

'3P' principle:

Produce: Raw materials are through the Good Agricultural Practices (GAP) certification. The raw materials have not drug residues and no hormones; and have provided with inspection and quarantine departments

certificate.

Processing: The processing system is strict accordance with ISO9001 and HACCP system to operations.

Package: Packaging materials is accordance with the requirements of Research and Development and Quality Control departments to adopt. Packing materials before using the packaging managers need sample observation to ensure the quality of the materials. Workshop is strict accordance with the packing process and workshop management system to product packaging.

'3C' principle:

Care: From farms began to catch the chicken, Yongda Company provisions only can use the hands to catch the whole chicken and do not catch chicken's legs or wings. It can avoid damage the chicken quality. In the processing, packing and warehousing links all have operation system to protect the quality of the products and reliability.

Cleaning: Workshop set the sterilizing facilities cleaning and disinfection to prevent microorganism growth. Use 5S management system² ensures warehouse management and also can ensure warehouse clean.

Cool: The workshop is according the product process requirement through the air conditioning system maintain constant temperature. Always keep the warehouse below -18 °C through the temperature monitor machine to monitor the temperature.

'3T' principle:

Time: After the completion of the packaging must be loading to the cold storage at 30 minutes.

Temperature: Raw materials, processing and storage have different temperature control standards. Pre-cooling should between 0 °C to 4 °C at 40 minutes. The temperature of workshop is not higher than segmentation workshop 12 °C. Raw material must be between 0 °C to 4 °C in low temperature storage. The finished product must be loading in cold storage below -18 °C at 30 minutes.

Tolerance: Frozen chicken should keep below -18 °C in the storage and the shelf life is 18 months.

'3Q' principle:

Quantity: According to the warehouse capacity and temperature control requirements to formulate the corresponding equipment quantity and standards.

Quality: The logistics management department and equipment management department will to formulate the planning and design of storage and transportation system, then the purchasing department accordance with the

² 5S is short for 'Seiri', 'Seiton', 'Seiso', 'Seikeetsu' and 'Shit-suke' as the five words start from 'S' in Japan. By the management of the work field and articles, 5S can make a safety, comfortable and bright work environment, cultivate a good work habit and promote the quality of truth, beauty and goodness of the staffs.

corresponding standards to purchase. The same kind of equipment should to use the same manufacturer, the same specification model. In order to reduce the cost, operation maintenance costs and personnel training costs.

Quick: In the processing, each processing has sets the standard of working time. The processing has according the standard production process to operation that can ensure the quality of products. The finish products must be loading to the cold storage at 30 minutes.

'3M' principle:

Means: The mainly means is though control of the temperature of whole workshop, and pre-cooling that can shortened product of waiting time and processing time, etc. Those means can ensure the quality of products.

Methods: low temperature storage, etc.

Management: Through the ISO9001 and HACCP system to management, and make an effective incentive system, etc.

4. 1. 3. Processing of frozen product of Yongda Company

The flow and processing of Yongda Company focuses on simple packaging of meat, the low temperature processing logistics systems of meat products in Yongda Company, which transfer the own processing way of the consumer and the supermarket into the centralized processing through the delicate processing to achieve large-scale practices mode. It is not only convenient for customers, but also reduces waste of resources as well as low efficiency caused by distributed processing in the supermarket. As it is difficult to ensure the strict hygiene control on the meat products in the links after being slaughtered or cooked, they are prone to involve in a secondary pollution, while the flow processing of bulk meat can reduce the possibility of secondary pollution to a certain extent. Through the delicate processing of cooked meat, cold meat done by Yongda Company, it reduces the food safety issues brought by non-professional enterprises due to processing environment, packaging equipment and so on that do not meet the relevant standards, thus bring to the formation of added cost. The specific steps of circulated processing are as shown in figure 6.

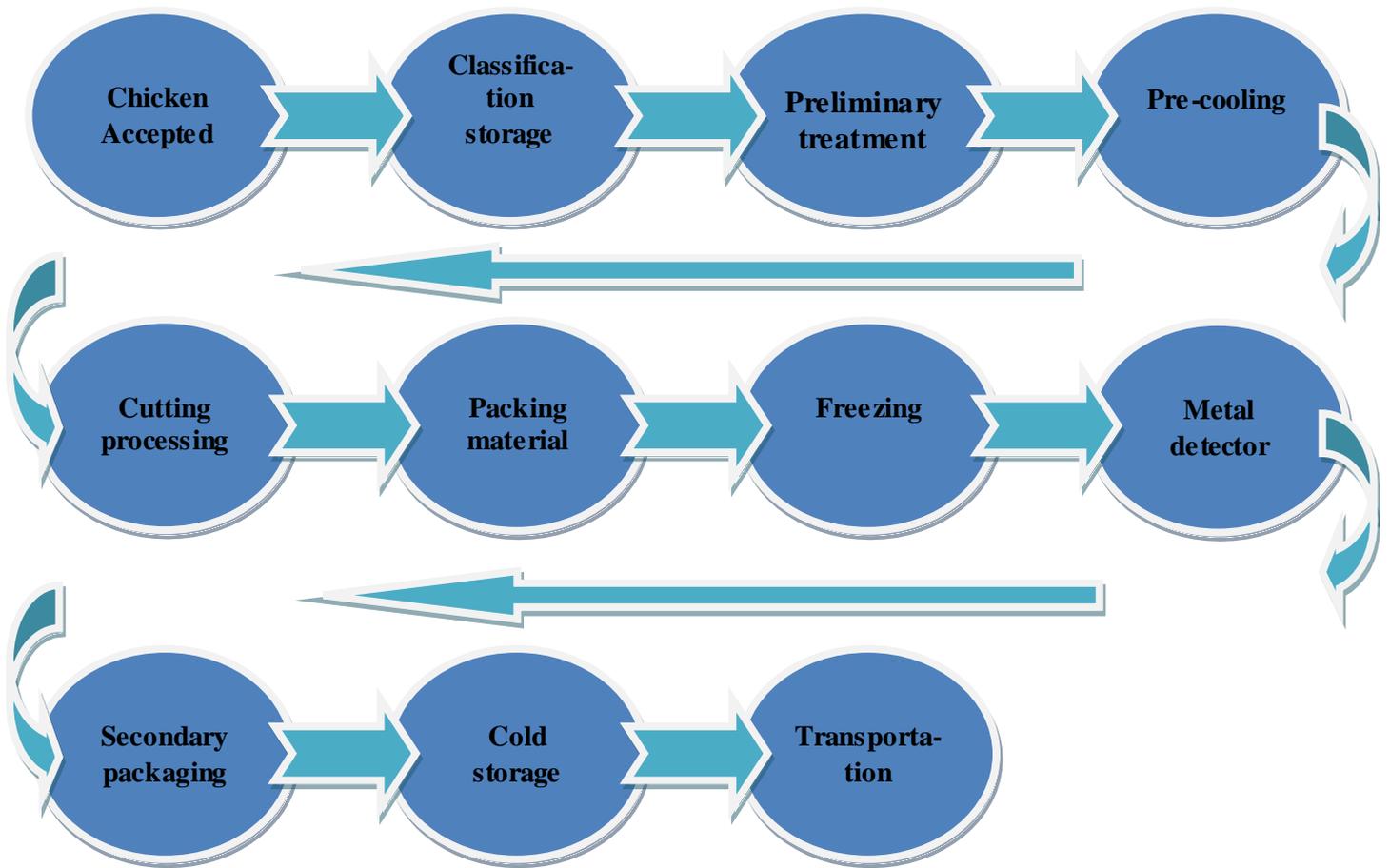


Figure 6. Yongda Company's chicken processing of low temperature chain

From the figure 6 above, we can see how the Yongda Company deals with chicken through low temperature processing system.

1. Chicken accepted. Raw chicken from non-infected areas, inspection and quarantine certificates for animals, feeding and medication records, proof of each batch of sterile vehicle for acceptance, complete and qualified clinical card quarantine inspection chicken slaughter standards issued notice.
2. Classification storage
3. Preliminary treatment: weighing, electricity shock, slaughter, drip blood, scald, molt clean, inspection by sampling.

Weighing

Chicken source passed the test, slaughtered by order, according to feeding records, fasting time confirmed hang time (fasting 12 hours or more), move lightly when unloading to avoid stress in chickens.

Electricity shock

Voltage is 90 volts, frequency is 2900HZ, electric current is 0.6A, and time is 3 seconds, to ensure after the electricity shock, the chicken will wake up in 3-5 minutes.

Slaughter

It is according to Islamic method.

Drip blood

For 4 minutes and 30 seconds.

Scald

Temperature is between 57 °C to 61 °C. Time is 63 seconds, scalding water not less than 1.5 liters/each.

Molt clean

Time is about 1 minute, molt machine should be adjusted according to the size of chicken to avoid removal not clean or broken the chicken off. The knife cannot be too deep caused by contamination of intestinal.

Inspect

The chicken viscera vestigial and carcass contamination remains by sampling before the pre-cooling.

4. Pre-cooling: pre-cooling time is not less than 40 minutes, the before pre-cooling water temperature need maintained between 0 °C to 8 °C, middle pre-cooling water temperature should keep between 0 °C to 4 °C, after pre-cooling water temperature should kept between 0 °C to 2 °C, the middle temperature of carcass should keep below 0 °C to 4 °C. The before pre-cooling pond water should keep at 1 liter/each, the middle pre-cooling pond water should keep at 1 liter/each, the after pre-cooling pond water should maintained at 1.5/each. Naclo disinfectant need to be continuous infused, the before pre-cooling pool disinfectant concentration is between 100 to 150 ppm, the middle pre-cooling pool disinfectant concentration is between 50 to 100 ppm, there is no need to pour into the disinfectant to the after pre-cooling pool, the concentration is less than 20ppm.
5. Cutting processing: split processing should strict accordance with the segmentation method to ensure that the whole division of chest and leg. The temperature of split room should be kept below 12 °C or less.
6. Packaging material consists of acceptance, storage, products packaging and seal.

Acceptance of packaging materials

Evaluation procedures must be determined by qualified suppliers, and provide appropriate business licenses, health permits, letter of quality commitment and other documents. When acceptance, each batch of internal and external packaging materials need to proceed sensory inspection according to standard, then the qualified goods are allowed to enter the warehouse. Random sampling for microbiological testing relative to internal packaging, supplier certified an official composition analysis report each year.

Packaging material storage

Internal and external packaging respective stored in a specialized warehouse. Storehouse should keep ventilate, dry, cool, clean and have facilities to prevent insects, mice, flies and birds. The distance from the ground must be more than 10 cm and away from the wall more than 30cm. The packaging materials should be stacked neatly and clearly marked and issued by FIFO (First In First Out).

Products packaging: processed product should package according to customer requirements in time without backlog. Inside packaging material is high-pressure non-toxic polyethylene plastic bags, it should be disinfected before use, and temperature of packaging room should keep below 12 °C.

Sealing

The distance from opening line to its seal should correspond with processing standards, keep absolute vacuum, shape should organized into a flat surface, neat of four corners.

7. Freezing: frozen product requirements: temperature of frozen room should kept below -28 °C and lasting 4 hours freezing. Product center temperature should keep below -18 °C when product sent out the frozen room. Chilled storage temperature should keep between 0 °C to 4 °C.
8. Metal detector: correction the metal detector sensitivity every 20 minutes. The metal detector alarm stands for the detection of scarp mental products. If the metal detector sensitivity is not normal, all products need detected within 20 minutes. For instance, the regulation has related requirement for the critical limit value in details.
9. Secondary packaging: product need packaging in time after detect of the metal detector. The products need rub cream, weighing, testing before the packaging. Packaged products need storage in time to avoid the product back to temperature. The temperature of secondary packaging room should keep below -12 °C.

10. Cold storage: the temperature of frozen products warehouse should keep below $-18\text{ }^{\circ}\text{C}$, chilled products should keep between $0\text{ }^{\circ}\text{C}$ to $4\text{ }^{\circ}\text{C}$. Products should be classified palletizing, clearly marked, the distance between stack and the wall should not less than 45cm, stack from the ground not less than 15cm, stack height not more than 18 layers, the product issued by FIFO (First In First Out) principle and moved gently.

The temperature of both refrigerator storage and refrigerator transportation of chicken materials will always be keep below $-18\text{ }^{\circ}\text{C}$. See figure 7, which show the temperature monitoring instruments.



Figure 7. Temperature monitoring instruments of Yongda Company

11. Transportation: Refrigeration trucks with full refrigeration abilities are required in this process. Before loading, 75% alcohol must be used for disinfection and the loading time must not exceed more than an hour. Moreover, the temperature inside the refrigerated truck is not to be higher than $0\text{ }^{\circ}\text{C}$. When transporting frozen products, the temperature must always be kept below $-18\text{ }^{\circ}\text{C}$ and for chilled products the temperature should be between $0\text{ }^{\circ}\text{C}$ to $4\text{ }^{\circ}\text{C}$.

4. 1. 4. Thermal Insulation Packaging

The material of the packaging specification which supply from Yongda Company to KFC usually has a requirement for the material of packing, the uniform material of packaging is made of PE (polyethylene) bags. The material of external packing is double pit corrugated board boxes. On the external packing part, for those products not accordance with the shipment requirement such as incomplete identification, breakage, storekeeper will reject to put them in storage. All of the product packing material must correspond with the relevant national sanitation standards and the sanitation control regulations, attached with the health agency inspection report.

Thermal insulation packaging must be suitable to the products' properties, so for Yongda Company or other standardization food enterprise, the best way of finished goods packaging is corporate with an appropriate packaging company. Due to different products should use different thermal packaging, the first step of corporation is assembly CAD model of a thermal packaging system, that is created component-by-component from customer-supplied specifications. This model can then be used for drafting, visualization, editing or simulation purposes.

Low temperature environment is very important for the cold product, strict control the temperature environment can upward the product fresh and alive to extent the quality guarantee period. So the fresh product cannot live without packing. According to China Cold-chain Logistics Development Report (2010), the packing in cold chain has two special requirements: the one is demand of good thermal insulation performance; the other one is good moisture-proof and water-proof performance. The common insulation material is rice husk and cork wood, slag. After the 1980s, new type insulation material has rapid development such as mineral wool, glass wool, PE, etc. As described by Lingsong et al, (2009), the subject of thermal insulation material is PE, but PE is easy to cause the white pollution. Afforest the food packaging material is a significant problem, related personnel should research and popularize the environment protection packaging material or apply the degradable treatment method as much as possible.

4. 1. 5. Sanitation Standard Operating Procedure of Yongda Company

Yongda Company has a detailed Sanitation Standard Operating Procedure (SSOP) to manage manufacturing. A brief introduction of Yongda's SSOP is shown below:

Employees:

1. Personnel engaged in production and quality management must be professional. They should have dazhuan³ or above the corresponding diploma.
2. All of the operation employees must accept health check in location health and quarantine departments. After getting a health certificate personnel can work.
3. Personnel need to wash their hands when working, entering and exiting the bathroom, touch the garbage, etc.

Operating procedure:

1. When products are steamed, first the processed products area's employees should open the evaporate cupboard door area take off the steamed foods then immediately close the steamed cupboard door. Second the unprocessed products area's employees can open the evaporate cupboard door to put the products in.

³ Dazhuan just in China has. It is between high school and university.

The evaporate cupboard door between processed products area and unprocessed products area cannot be opened at the same time.

2. The floor must keep dry, clean and without any damage.
3. The container must keep clean. The employees must ensure the container was cleaned when they are used.
4. The operation employees cannot use the phone when they are working.

4. 1. 6. Transport and Management of Yongda Company

The company establishes advanced logistics and distribution facilities, adopt the modern logistics management means, and combining with the third party logistics company to complete the logistics distribution business. The logistics distribution center has 72 refrigerator vehicles. The vehicle equipped with Global Position System (GPS). It can greatly improving logistics distribution efficiency, reduce logistics cost and improve customer satisfaction. In the process of Cold Chain Logistics for food, the main processes are the distribution process in addition to warehousing process. There are many kinds of patterns of Cold Chain Logistics for food during the specific distribution operations:

Supplier self-made

It is the distribution activities that manufacturers, wholesalers deliver the terminal sales of products directly to the shelf or store in the framed development time.

Self-distribution model

It is of terminal sale that is the terminal vendors (most of them are the chain supermarkets, sales shops of cold chain food, etc.) through self-built logistics system invest to build the modern distribution centers, so as to make unified distribution.

Third-party distribution model

Is the use of third-party logistics enterprises to achieve the cold chain distribution, Yongda Company's Cold Chain Logistics for food is the pattern of third-party logistics and distribution patterns. Yongda Company relies on third-party distribution model can improve the transport situation, make the cold chain logistics for food to be in centralized processing through the joint distribution pattern, so as to shorten the time of refrigerated transportation, save the management space and human resources for the treatment of cold chain logistics for food, reduce zero-load rate, to achieve the integration of social resources, it has played a very important role in promoting the development of Cold Chain Logistics.

Figure 8 shows the specific operating steps for the distribution:



Figure 8. Transport and Management in Supply

The inspection prior to departure

Check the delivered products and their quantity, make good preparation for distribution. Check the condition of the vehicle, the delivery vehicles should be filled with petrol oil. Pre-cool the car to assure temperature protection for loading the products.

Loading the products

When the temperature of the car achieves the distribution requirement, load the goods in accordance with the order to reach the customers along with the distribution line, that is to say, to load the products that belong to the customers in the downstream according to the distribution line, and finally load the products that will be delivered to the enterprise at first.

Transportation

Delivery drivers will deliver the products according to a fixed distribution route for distribution. Before the transportation, the driver should take with distribution list for stores, suppliers' ex-warehouse bill, and service bill of the distribution center. The driver should make sure that the refrigerated trucks keep on setting off cold weather during the transportation, and the products are in a safe environmental temperature.

Delivery

When deliver the last piece of goods to the enterprise in the downstream, and then transfer the products to the receiver of downstream in accordance with the corresponding products and documents, wait for the receiving staff's check for acceptance.

Reverse recovery

After the delivery, the delivery drivers will take back the recovered items. It consists of two parts, one is the packaging materials, make the recycling boxes and other packaging materials which are used for distribution, store the turnover boxes in special places wait for re-use after cleaning and disinfection; the other part is to

place the rejected products and returned products on the high return library buffer after finishing counting, which should be placed according to the classified code of the suppliers, wait for being returned to the suppliers.

Loading and transportation is a major part of distribution processes, after delivering the goods to the seller, the drivers are required to receive the returned defective products from the sellers and recycling the turnover boxes. For the Yongda Company, since the Cold Chain Logistics of food belongs to fast moving consumer goods, their storage time is relatively short, the delivery and transporting process take up most of the time for Cold Chain Logistics of food. Therefore, improving transport links for the distribution of the Cold Chain Logistics of food is critical for business operation, it not only can improve enterprise management and operation level, but also to reduce logistics costs and improve economic efficiency.

4. 1. 7. Storage of Yongda Company

There are two categories of foods that will be sent to food storage system, one is that the corporate is considered as a professional third-party logistics company, the goods will be involved in the distribution business between different warehouses serving for the suppliers, those kind of products will be collected rapidly for concentrated loading and distribution in the workplace and other destinations of the same direction, they are not after a long period of storage. The other type processed products waiting for distribution done by Yongda Company according to the demands of the suppliers or customer demand for product flow in downstream. The operation of warehousing business is to start the work by setting information department as the center, when there are new customers, it is the business of the Information Department to collect the customer ways of In & Out of warehouse, product details, charges and other information to compile customer profiles, and keep it in the Information Department as the data for operating guide. When the customer is In & Out of the warehouse, the corresponding should inform the Information Department via phone, fax or verbally ways etc. The Information Department should issue a single list of In & Out of the warehouse, but there is no specific quantity that will be issued when storage the products, and then notify the appropriate department. One must have a storehouse list with the signature of Information Department, warehousing and delivery person or the customer, when the customers deliver the good by themselves, there must be the valid personal documents and notice of delivery other written certificate before delivering the products.

Figure 9 shows the warehouse operations including storage check, sorting, picking, distribution and outbound delivery process, the specific operational procedures are as follows:

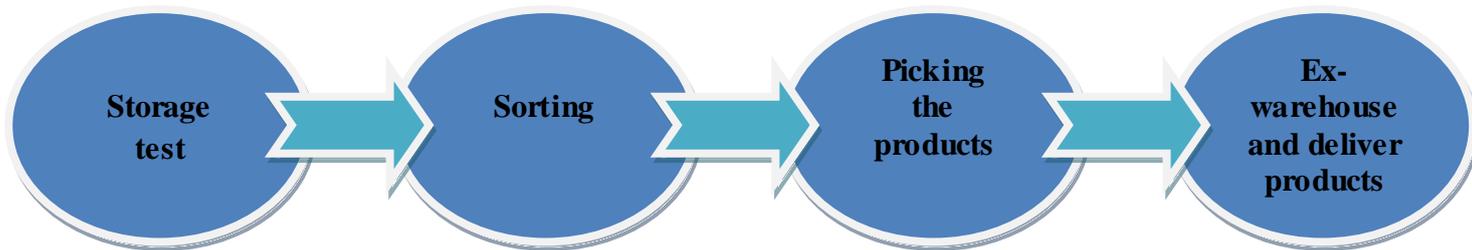


Figure 9. Storage during the Supply

Storage test

Warehouse staff receives notice of the information sector, and they will go to the temporary receipt or processing areas to test the storage products. Qualified products will be delivered to the corresponding warehouse in accordance with the appropriate places of the suppliers and make the cargo be stacked.

Sorting

Distribute the orders to staff for sorting according to the product type and order items, so as to distinguish the destinations among different goods, these operations need to be done at low temperature in order to guarantee product quality. The goods after sorting should make labels with quantity, specifications, quality time in its storage place.

Picking the products

Distribution center will download required distribution of products items, box number, production date of all stores from the Internet, and print out the corresponding distributing list to the distributing staff of the warehousing sector, the distributing staff will pick the products in accordance with delivery routes, he should pay attention to the process of picking products and make verification, transfer of more or less, or the wrong delivery all will result in increased costs, when the sorting staff is sorting the cargo, they should check whether the sorted products meet the specifications, items, quantity, production date on the distribution list at the same time.

Ex-warehouse and deliver products

All the goods finished picking will be transported by forklift to take delivery of the cargo space on the store, waiting for delivery.

The ex-warehouse process of the products

Due to Yongda Company supply the raw material to KFC. Yongda Company belongs to traditional agriculture industry, relative to other industries; they have low level management standards in the RFID aspect. While in the logistics chains is also applied ERP (Enterprise Resource Planning) logistics management software, but in the logistics link, when products send in the warehouse in processing factory, it still using the traditional manual record method, rather than by using RFID technology then transfer the data to EPR software.

Take an example of the process on how Yongda Company operate their products to storage after production, see figure 10.

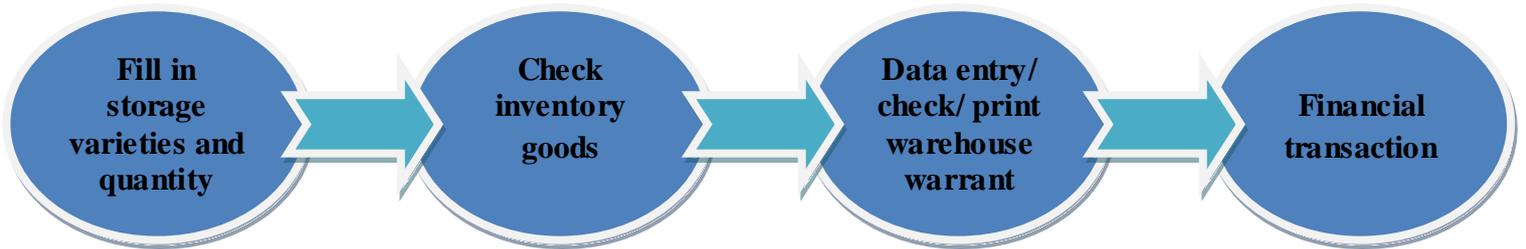


Figure 10. The process of manual enter warehouse warrant

As the figure shown above, the content of each link such as inventory quantity, update inventory system and financial transaction, and how the process does work manually are summarized as follow through the process illustration:

1. Represent for the production workshop statisticians and warehouse keeper respectively fills out the product warehouse warrant, explain storage varieties and quantity.

Figure 11 shows the warehouse of Yongda Company and a manual enter warehouse warrant.



Figure 11. Manual enter warehouse warrant of Yongda Company

2. Represent for the warehouse and production workshop statisticians check the product warehouse warrant.
3. Represent for after the check, the warehouse keeper type the result into sales system, then after the workshop statisticians and warehouse keeper signature, hand in them to finance department as the finished goods accounting in the next day before 9:00 a.m.
4. Represent for finance department do the finance transaction according to the warehouse warrant which handed by warehouse keeper.

4. 2. PEST - The Cold Chain Logistics of China

Political Environment

According to Dingyi (2010), China's logistics industry demand rapid development, the government also strengthened the logistics industry development policy. The State Economic and Trade Commission with other five ministries have issued the development of modern logistics industry to strengthen the logistics. It is effectively based on China's national conditions to promote the development of modern logistics industry, brought the positive news to the logistics industry and stimulating significantly the development of the third-party logistics industry. The central and local governments issued relevant development planning, and support logistics industry development policy.

According to Chinese President Jintao (2009), the Food security law of the People's Republic of China has been implemented since June 2009 first in the Standing Committee of the National People's Congress meeting. This law is in order to ensure food safety and protect people's health and safety. Food producers and traders should be in accordance with laws, regulations and food safety standards in production and business activities, social and public accountability. It can social and public accountability, to ensure food safety, accepts social supervision, commitment to social responsibility.

The infrastructure of Cold Chain Logistics has the storage facilities, distribution center, transportation vehicle, etc. The Cold Chain Logistics has many shortcomings, such as large land occupation, high investment and long term of capital return. With the government pay more attention in the logistics education the logistics industry is gradually improved. It will be for the whole logistics industry development trend has a good effect. Such as the logistics of the integration of resources, adjust the logistics industry structure, and enhance the core competitiveness of the enterprise, etc.

Economic environment

According by National bureau of the People's Republic of China (2011), the annual gross domestic product is about 39,798.3 billion in 2010. Comparing with the previous year is increased by about 10.3%. The foreign trade of China is about \$2,972.8 billion in 2010. Comparing with the previous year the foreign trade of China is increased by about 34.7% in 2010. The fast development of economy, the secondary industry and the tertiary industry have created huge market for the development of the third party logistics. As China entered into the WTO and built trading partnership with more countries. It brought excellent opportunities for the business exploration of the third party logistics enterprises. In addition, the Chinese enterprises have increasing needs for professional and multi-functional third party logistics. According to Bank Consultant, (2011), the national logistics amount is 102.6 trillion Yuan. Comparing with the previous year is increased by about 13.5% in 2011.

In China 90% of third party logistics companies are small. It is estimated that the profits of the market of third party logistics in China will be up to 5.3 billion in 2011 at a growth rate of 27%.

The rate of logistics outsourcing is growing. But as described by Dingyi (2010), China's third party logistics mainly provides inventory management and transportation services. Few companies can provide integrated Cold Chain Logistics services. On one hand it has higher cost of Cold Chain Logistics, on the other hand cannot avoid the higher rate of product loss. Therefore, many companies worry the third party logistics have higher cost, not professional and the logistics Security. So, many companies establish their own Cold Chain Logistics team, or some part of the business select outsourcing. Although, improving the third party logistics of Cold Chain Logistics should take long time, but it will bring large return. China is becoming a third party logistics development of one of the most rapid state.

Social environment

China agricultural products Cold Chain Logistics has taken shape in 1960s. China agricultural production enterprise of cold chain products usually is small and scattered. It leads to cold chain in the circulation should one or more times distribution. It will increase the circulation of Cold Chain Logistics times, increase the loss rate, increase the cost and decrease the marketing efficiency. But at present, primary agricultural products of Cold Chain Logistics demand is increasing. Because the consumers' preference is affect the demand of Cold Chain Logistics. The primary agricultural products include six types: fruits, vegetables, meats, dairy products, poultry and aquatic products. According to National Bureau of Statistics of China (2009), we made this table. The table 4 shows China's agricultural production from 1999 to 2007.

Table 4. China's agricultural production from 1999 to 2007.

(National Bureau of Statistics of China, 2009)

Products	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007
Fruits		62.37	62.25	66.58	69.52	145.17	153.41	161.20	171.02	181.36
Vegetables		385.00	405.14	512.57	483.37	529.09	540.32	549.27	562.84	565.00
Meats		59.49	60.14	61.06	62.34	64.43	66.09	69.39	70.89	68.66
Dairy products		8.07	9.19	11.23	14.00	18.49	23.68	28.65	33.03	36.33
Poulties		21.35	21.82	22.10	22.66	23.33	23.71	24.38	24.24	25.29
Aquatic products		35.70	37.06	37.96	39.55	40.77	42.47	44.20	45.84	47.48

Scale: Million

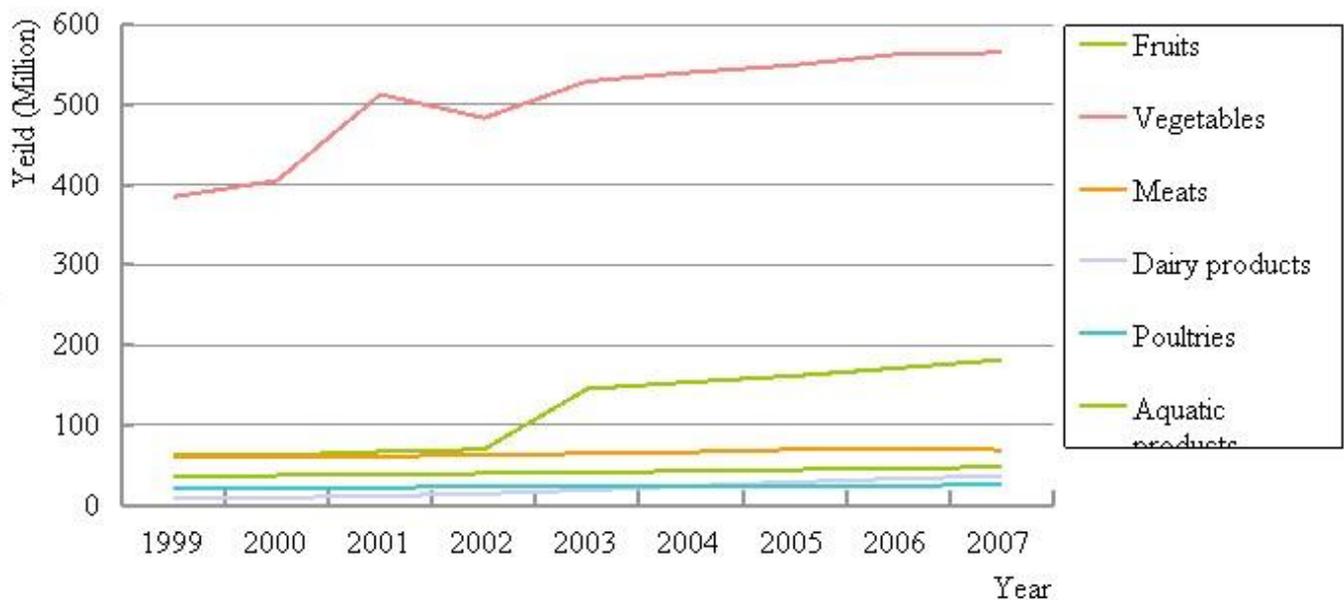


Figure 12. The trend of China's agricultural production.

By Meizi & Xiyu

Above the table 7 and figure 12, we can see the China's agricultural production is increasing every year. Especially fruit and vegetables are rapid growth. According to National Bureau of Statistics China (2009), China is the world's largest fruit and vegetables producers. China is the world's first vegetable production in 2007. Along with the demand of the agricultural products are increasing in China. Therefore, the agricultural product is increasing year by year. And the consumer has high demands on product quality. The supplier should pay more attention in cold chain logistics. So, the demand for primary agricultural products of Cold Chain Logistics is also increasing. Through the development of Cold Chain Logistics to improve the agricultural processing, storage and transportation can reduce losses and waste of the products.

With China's rapid economic development, people's living standards constantly improve. People's consumption preferences also have great change. See table 5, with the constantly development of the economy, people to buy food habits began to shift to other products, such as dairy products and poultry, etc.

Table 5. Chinese urban family per capita annual purchase food quantity from 1999 to 2006.
(National Bureau of Statistics of China, 2009)

Products	Year	1999	2000	2001	2002	2003	2004	2005	2006
Grains		84.9	82.3	79.7	78.5	79.5	78.2	77.0	75.9
Eggs		10.9	11.2	10.4	10.6	11.2	10.4	10.4	10.4
Red meats		3.1	3.3	3.2	3.0	3.3	3.7	3.7	3.8
Vegetables		114.9	114.7	115.9	116.5	118.3	122.3	118.6	117.6
Aquatic products		10.3	11.7	10.3	13.2	13.4	12.5	12.6	13.0
Pork		16.9	16.7	16.0	20.3	20.4	19.2	20.2	20.0
Poulties		4.9	5.4	5.3	9.2	9.2	6.4	9.0	8.3
Fruits		54.2	57.5	59.9	56.5	57.8	56.5	56.7	60.2
Dairy products		7.9	9.9	11.9	5.7	18.6	18.8	17.9	18.3

According to China's cold chain industry nets-a (2011), China's dairy production amounted to 32.9 million tons, the growth of more than 12%, and the growth is first in the world in 2006. In 2006, China's fruit production reaches 97 million tons, vegetable production 560 million tons. China is the world's largest producer of fruit and vegetables. According to China's cold chain industry nets-b (2011), CCL in the developed countries started from the 1920s but China's CCL only dates back to the 1980s. Due to the fast pace of life environment, frozen food has become the food people prefer. China's frozen food extreme expand growth 35% every year from 1997. It is higher than 9% of the world's growth. According to China's cold chain industry nets-c (2011), at present in China, have more than 2,500 meat food factory, the annual meat food products output is more than 10 million tons and the meat raw material output is about 56 million tons; the frozen food factories are more than 2,000, its annual output is more than 8.5 million tons; cold drinks enterprise is more than 1,000, the annual output is more than 10 million tons; dairy enterprise is more than 1,500, the annual output is more than 8 million tons; in addition, the aquatic products output have 41.2 million tons.

The shortage of professional in Cold Chain Logistics is the giant obstacle to the development of logistics and distribution. Compared with foreign countries, China's lack of professional education and training institutions in Cold Chain Logistics. Due to the lack of education in Cold Chain Logistics, it will lead to the professional shortage. The education and training of Cold Chain Logistics in foreign countries is very advanced. In addition to a master's level education, on average, a technical entrepreneur will have about 13 years of work experience before establishing a new venture. As described by Bessant and Tidd (2007), many technicians gained their experience from a larger number of firms they have worked or be a trainee before establishing their own venture. As a result of the formal education and experience, a typical technical entrepreneur will last long

time to start their own technique oriented business. They formed a detailed system to training the related personnel in Cold Chain Logistics. The employers of logistics must receive vocational education and obtained the qualifications before engaged in the work of logistics and distribution. According to Dingyi (2010), as the modern concepts of logistics are accepted and recognized, people pay more attention to improve the existing logistics services and develop the third party logistics. Many enterprises have been aware of that enhance the management of logistics is the resource of increase the profit. They are focus on the management of logistics, improve the internal logistics in the enterprise and build the logistics agency for internal service.

Technological Environment

Due to the fast development of agricultural products, the agricultural product variety, the higher information asymmetry between suppliers upstream and downstream, and the transportation processing is required for the strict quality monitoring and tracking of Cold Chain Logistics. Therefore, the development of Cold Chain Logistics should higher logistics technology to ensure the quality of the product safety. As mentioned by Dingyi (2010), the Cold Chain Logistics has many shortcomings, such as management system, storage facilities, distribution center, transportation vehicle, etc. The table 6 is shows the mainly relevant technologies in the field of Cold Chain Logistics:

Table 6. The main technologies in Cold Chain Logistics

Content	Relative technology	Core technology	Related equipment
Food storage	Automation and sensor technology.	Food storage technology, refrigeration technique.	Different sized refrigeration, freezer display and retail refrigerator.
Circulate	Automotive engineering, GIS, GPS, RFID and process technology.	Refrigeration technique, GIS, GPS, RFID and monitor temperature technique.	Refrigerator vehicle, container and heat preservation box.
Processing equipment	Sensor technology, appearance design and packing machinery.	Food processing technology, refrigeration technique, temperature control and defrost technique.	Pre-cooling equipment, thaw equipment, drying equipment and fermentation equipment.

Compared with general logistics, Cold Chain Logistics has higher investment, complex management and operation, higher technological and equipment requirement and long time return. China's refrigerator vehicles lack of production investment and low technological content and lack of advanced Cold Chain Logistics infrastructure and technology and equipment. As China's Cold Chain Logistics is still developing, these aspects are not perfect. According to the Chinese market monitoring center and China market research center (2010), refrigerated and insulated vehicles quantities in the China are quickly increasing. See table 7, this is the number of refrigerated and insulated vehicles in China.

Table 7. The number of refrigerated and insulated vehicles in China

	Number of vehicles	Number
Year		
1985		6,000
1990		10,000
1995		15,000
2000		24,000
2008		30,000
2009		40,000
2010		50,000

It has increased from 6000 in 1985 to 50000 in 2010.

4.3. SWOT - Yongda Company

At the present, from a view of reality, especially for the unique patent owned low temperature chain of Yongda Company has shown in findings, totally there are three categories cultivation, processing and sales. All the industry has faced the integration of upstream and downstream, problematic of unbalance plagued the competence from downstream to upstream, which influenced the process of cold chain integration and the efficiency of the entire low temperature chain. On one hand, for the improvements, Yongda Company should learn from the strong brand on the field of food industry. On the other hand, for the Bottleneck of the chicken product and production equipment, Yongda Company should explore an innovation network of all aspects especially for the research and development of product and market. For the present status of Yongda Company, we use the SWOT analysis tool to analysis the strength, weakness, opportunity and potential threat of the existence for the firm can adjust the enterprise resources and strategy to reach to the better purpose of the company development. That can go deep into the enterprise management, product research and development, etc. The table 8 shows the SWOT strategy of Yongda Company.

Table 8. The SWOT Analysis of Yongda Company
By Meizi & Xiyu

<p>Strengths:</p> <ul style="list-style-type: none"> • Professional production and Cold Chain Logistics of many decades accumulate numerous of good resources and foundation for future opportunity. • Formed of a certain range of awareness and word of mouth in an area. • Better external public relations support. 	<p>Weaknesses:</p> <ul style="list-style-type: none"> • Lack of brand awareness. • Research and development of the product need to be promoted. • Difficult to control the scattered Cold Chain Logistics position.
<p>Opportunities:</p> <ul style="list-style-type: none"> • China strongly pushes the Cold Chain Logistics policy. • High potential of poultry market, broader space of development. 	<p>Threats:</p> <ul style="list-style-type: none"> • Higher speed of multiple integration within the each linkage of the CCL. • Pressure from the third part logistics and the professional and advanced equipment. • Pay more attention to the management of prominent feature of agriculture and food industry.

From the figure above, obviously, the four aspects of the strengths, weaknesses, opportunities and threats are shown in the context. Due to the higher requirement of Cold Chain Logistics, Yongda Company face with the high competitiveness from the same industry. For example, the speed of multiple integration of linkages on Cold Chain Logistics within the area of food industry to improve the efficiency while processing, transporting

and storing. There are many kinds of patterns of Cold Chain Logistics for food during the specific distribution operations:

Supplier self-made

It is the distribution activities that manufacturers, wholesalers deliver the terminal sales of products directly to the shelf or store in the framed development time.

Self-distribution model

It is of terminal sale that is the terminal vendors (most of them are the chain supermarkets, sales shops of cold chain food, etc.) through self-built logistics system invest to build the modern distribution centers, so as to make unified distribution.

Third-party distribution model

Is the use of third-party logistics enterprises to achieve the cold chain distribution, Yongda Company's Cold Chain Logistics for food is the pattern of third-party logistics and distribution patterns. Yongda Company relies on third-party distribution model can improve the transport situation, make the cold chain logistics for food to be in centralized processing through the joint distribution pattern, so as to shorten the time of refrigerated transportation, save the management space and human resources for the treatment of cold chain logistics for food, reduce zero-load rate, to achieve the integration of social resources, it has played a very important role in promoting the development of Cold Chain Logistics.

Because of the different status when implementation of the tasks and the operations from processing, transporting and storing according to the principles, Yongda Company should choose their own cold chain logistics way through the customer requirements and the forecasting of how choosing the method, the actual way of forecasting the final delivery costs and warehouse costs can help the company choose the shipment method and save budget in order to provide the benefit for both internal and external customers.

On the weakness of Yongda Company, because of the lack of brand awareness, Yongda apply "study from the first" as their motto to stimulate their work personnel's to innovative more products for the better service to their customers. But for some misunderstanding, the customer will put forward of a question is that the brand of the Yongda Company is less famous than other famous food industry which do more advertisement for the brand awareness and brand recognition. That is a limitation and important influence weakness of the development of the case company. In spite of the higher cost of the Cold Chain Logistics, in order to ensure the product quality, Yongda Company has a slogan called safe and secure for quality assurance and customer attraction from all ages, and equipped the GIS and GPS for tracking the vehicles. Mostly important, as the role

is the supplier of KFC, so it is better for the company to strengthen the international level of the brand.

For the future development and improvement, along with growing and expanding of the Yongda Company, they should consolidation warehousing to pulls together shipments from a number of sources in the same geographical area and combine them into larger - hence more economical - shipping loads. That is to say, consolidation and arrangement the warehouse position and shipments position as soon as possible when a company becoming larger and larger, the time duration should controlled in the earlier time as soon as possible. There are several variations of this type system. A single manufacturer should use the consolidation warehouse to pull together the output from several poultries finished goods or raw materials, combining it when possible into a single large shipment to a major customer KFC.

5. Analysis and Discussion

5.1. Comparison of CCL between developed countries and China

The table 9 shows a comparison of different aspects of CCL between China and developed countries. Here, the USA and Japan represented for the developed countries in the Yongda case study.

Table 9. Comparison of Cold Chain Logistics between China and developed countries

By Meizi & Xiyu

Aspect	Developed countries	China	Reason analysis
Cold Chain Logistics rate	95% - 100%	10% - 20%	The Cold Chain Logistics system is initiated in the recent years. Lack of advanced cold chain logistics infrastructure.
Loss Rate	≤5%	25% - 30%	Lack of advanced Cold Chain Logistics infrastructure and technology and equipment.
Cold Chain Logistics vehicle	United States: refrigerated vehicle 200,000; Japan: refrigerated vehicle 120,000.	Refrigerated vehicle 30,000	China's refrigerator vehicles lack of production investment and technology.
Cold storage capacity	United States: 70.74 million m ³ ; Japan: 27.69 million m ³ .	15 million m ³	China pay more attention to construction of meat cold storage, city business Cold Chain Logistics and large medium sized Cold Chain Logistics, neglecting the construction of fruit and vegetable cold storage, the processing of cold chain and wholesale retail cold storage.
Cold Chain Logistics management	Have been basically established suitable efficient Cold Chain Logistics.	China has not established efficient Cold Chain Logistics.	China's Cold Chain Logistics in the development stage, cold chain logistics is not mature.
Logistics team	Third parts logistics	Small and medium enterprises.	It has weak ability of the cold chain enterprises, the small scale of the distribution, high logistics cost, service standards are inconsistent and low efficiency. And it needs to spend more time to develop the logistics team to become professional.
Cold Chain Logistics of regulations and standard system	Well developed	Not complete	The Cold Chain Logistics system is initiated in the recent years. It has started late.

Cold Chain Logistics rate

As described by Yong and Youhua (2011), in 2009 when the manufacturers needed to move the perishable products to the refrigerated vehicles, most took place in an open air and not in a cold or insulated environment. There are 80%-90% of the fruit, vegetable, meat and aquatic products usually are using ordinary vehicle, just have use Cold Chain Logistics about 10%-20% of Cold Chain Logistics rate. Other developed countries' meat and poultry has use Cold Chain Logistics reached 100%, the fruits have use Cold Chain Logistics more than 95%.

Loss rate

Fruit, vegetable and other agricultural products in the picking, transportation, storage and other logistics link loss rate reached 25%-30% in China. According to National Bureau of Statistics of China, (2009), China will be loss fruits of 12 million tons, loss vegetables of 130 million tons every year. China has the highest agricultural products wastage in the world.

Cold Chain Logistics vehicle

According to the Chinese market monitoring center and China market research center (2010), the rate of refrigerated transport in Europe, America and Japan each has 83-90%, Eastern Europe has 50%, but China only has about 20%. China's refrigerator vehicles lack of production investment and technology. In China, about 80% of fruit, vegetable, poultry and aquatic products are transported by ordinary trucks. The figure 13 shows the amount of the refrigerated vehicles in China, United States and Japan in 2008.

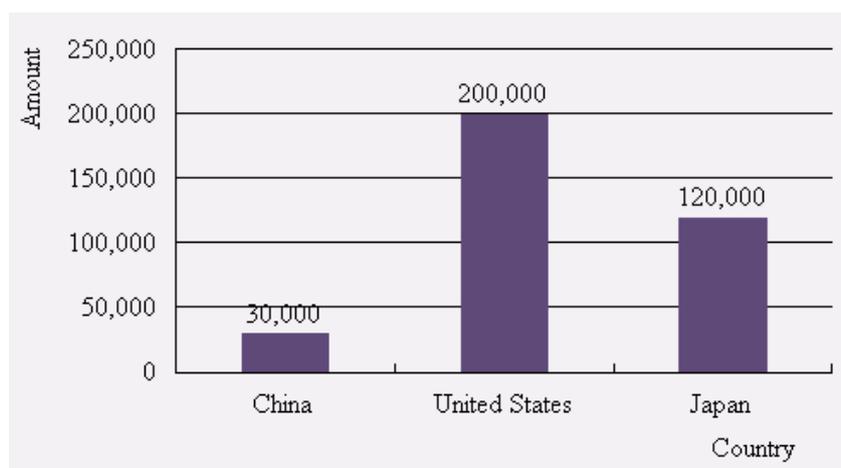


Figure 13. The amount of the refrigerated vehicle in China, United States and Japan in 2008

By Meizi & Xiyu

The United States has refrigerated vehicle quantities about to 200,000 and the Japan has refrigerated vehicle quantities about 120,000, but China just has 30,000. We Compared with United States and Japan. China's refrigerated vehicle quantities are obviously deficiencies.

Cold storage capacity

Figure 14 shows the cold storage capability of China, Untied States and Japan.

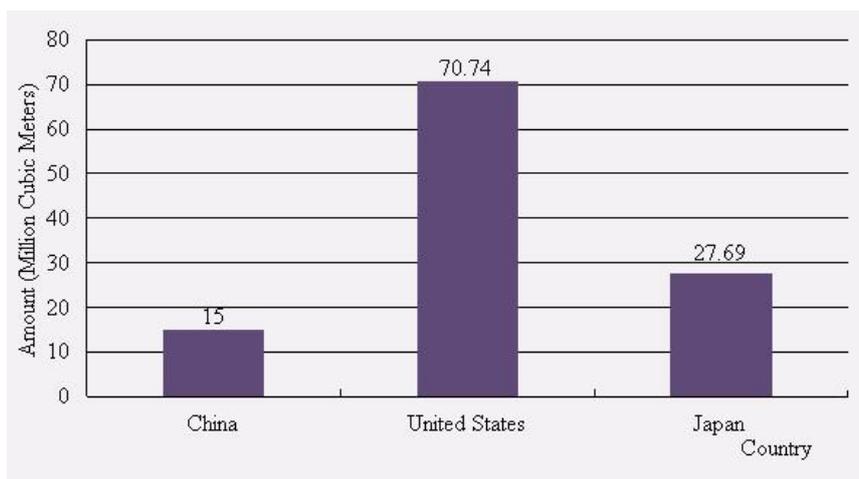


Figure 14. The cold storage capability of China, Untied States and Japan in 2008

By Meizi & Xiyu

In 2008, the cold storage capability of China is about 15 million m³, the cold storage capability of United States is about 70.74 million m³ and the cold storage capability of Japan is about 27.69 million m³. In 2008, Global cold storage volume quantity is 247.77 million m³. Compared with United States and Japan, China's cold storage capability is far below those countries.

Cold Chain Logistics management

As described by Dingyi (2010), the developed countries have basically established suitable efficient Cold Chain Logistics. China has not established an efficient Cold Chain Logistics system, such as use the manual recording more than the automatic system. Because China agricultural products Cold Chain Logistics has taken shape in 1960s. China's Cold Chain Logistics is in the development stage. The whole Cold Chain Logistics is not mature.

Logistics team

As mentioned by Jung et al., (2008), in order to generate a supply chain plan, the manufacturer and the third party logistics collaboration is indispensable. The third party logistics of cold chain development is not complete in China. In the Cold Chain Logistics development of agricultural products, complete management

system has not been formed and the Cold Chain Logistics service system also has not been formed. Existing Cold Chain Logistics enterprises are mainly small and medium enterprises. They are not professional. As described by China's Cold Chain Yearbook (2010), the third party logistics of supply chain has 27% of use logistics team and the third party logistics of cold chain has less more in China. So, it has weak competitiveness, the small scale of the distribution and service standards are inconsistent. And also has higher cost with the Cold Chain Logistics. The whole logistics cost amount about 70% of the perishable products in China. But according to international standards, the highest of perishable products logistics cost do not exceed 50% of in the total cost.

Cold Chain Logistics of regulations and standard system

China agricultural products Cold Chain Logistics has taken shape in 1960s. The Cold Chain Logistics system of laws and regulations and standard system are not complete. The Cold Chain Logistics system is initiated in the recent years. European and American agricultural products Cold Chain Logistics has taken shape in 1930s. At present, European and American developed countries have already shaped complete agricultural products Cold Chain Logistics system.

5. 2. Case study of Yongda Company

We use Yongda Company as an example to illustrate how a Chinese food company can have an effective management of Cold Chain Logistics.

5. 2. 1. Processing - HACCP system

HACCP system is application in food processing can efficient control biological, physical and chemical potential hazard. HACCP system must base on the compliance with Good Manufacturing Practice (GMP) and Sanitation Standard Operating Procedure (SSOP). GMP is a regulation for processing facilities, packaging, storage environment and quality control of food processing companies by government. SSOP is the company according to the GMP to make a regulation for processing practice that protection of hygienic quality of food. It includes the following ranges: Water, Conditions and food contact surfaces clean, Prevent cross-contamination, Hand disinfection and maintenance of toilet facilities, Mark of toxic chemicals, storage and use, Employee's health, Insects and eliminate and control rodents. The company through the SSOP control to ensure the effective implementation of the HACCP. So, before when use HACCP in a company, they should to make a SSOP regulation.

Yongda Company has detail SSOP. It can easily to application HACCP in the company. And Yongda Company acquired the HACCP certificate in 2001. We use Yongda chicken leg processing stage as an example to show

how to use the HACCP in the production stage of the company in combination with their own assessment standards. According to our interview data, we are able to learn how Yongda uses the HACCP system to control and supervise the raw chicken processing but we are unable to get hold of detailed documentation for each and every Yongda's product. Nevertheless, all our data below has been deducted from our knowledge on the raw chicken processing steps because their system of control and supervision is very detailed and similar to each other. This is the chicken leg which for dispose the chicken meat product shown in figure 15.



Figure 15. A processed chicken leg

The chicken legs are supply to KFC. Yongda is a long-term main supplier for KFC.

The HACCP plan is based on the principles of HACCP and delineates the procedures to be followed. So, we need make a plan for the chicken legs to application HACCP.

HACCP plan:

1. The company must to build a positive HACCP team. The Company can hire outside experts who are knowledgeable in engineering, production, sanitation, quality assurance, and food microbiology. They are responsible for developing, implementing and maintaining the HACCP system.
2. The HACCP team should describe the food. We use their chicken leg to show how to describe the food. See table 10.

Table 10: Flow diagram of the frozen chicken leg

Name	Chicken leg
Per weight	90-110g/per
Per size specification	≥7cm
Per bag weight	1kg/bag
Per box weight	10kg/box
Box specification	410mm*320mm*195mm(+/- 10mm)
Packaging materials	Polythene
Ingredients	Chicken leg, water, salt, Humectants (Sodium Tripolyphosphate), spices (Sugar, salt, chili powder, additive, garlic powder, onion powder, vegetable oil, spices, chicken oil, yeast extract)
Processing methods	Rolling and kneading, marinade, cooking, cooling, freezing, packaging
Storage temperature	Below -18 °C
Shelf life	12 month

In a product property need consists of a general description of the food, ingredients, and processing methods, and along with information on whether the food is to be distributed frozen, refrigerated, or at ambient temperature. It can help HACCP team to develop the HACCP Plan.

- The HACCP team should describe the intended use. In this case we should describe like ‘Intended use: Only supply to KFC’.
- The HACCP should make a flow diagram for frozen chicken leg. The figure 16 is a flow Diagram of the frozen chicken leg.

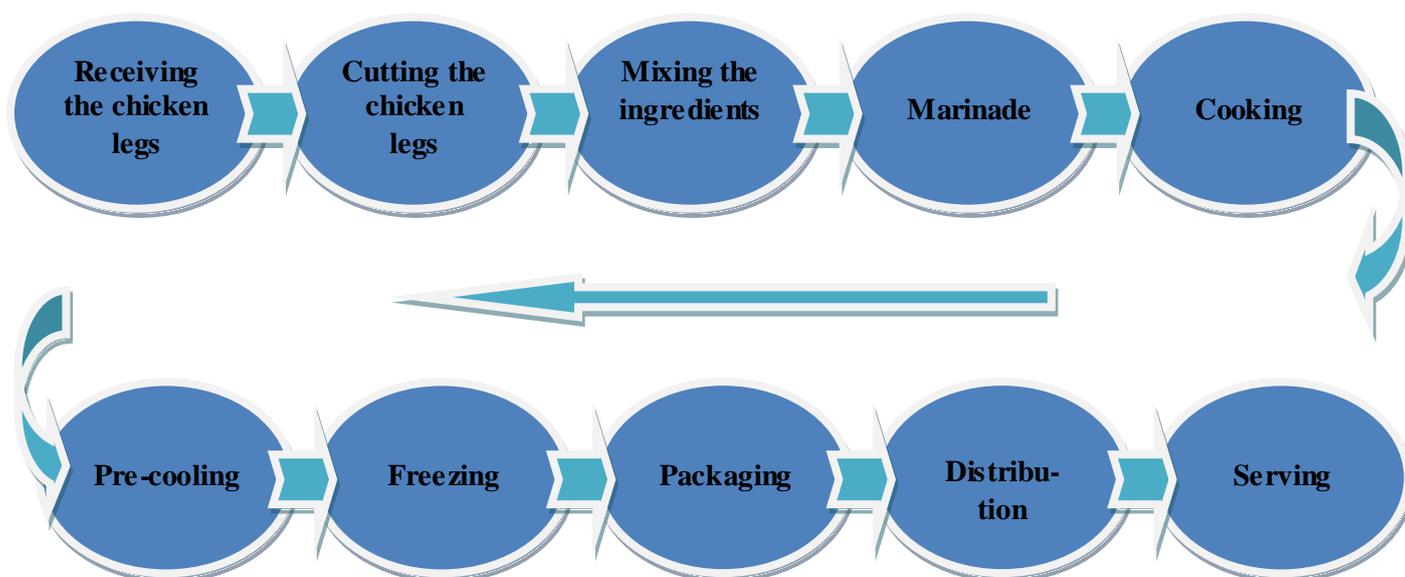


Figure 16. Flow Diagram of the frozen chicken leg.

This flow diagram is to provide a clear, simple outline of the steps involved in the process. The flow diagram

can include before and after the processing steps in the food chain. A simple schematic of the facility is useful for understanding and evaluating product and process flow.

We should use Critical Control Point Decision Tree to help us management the HACCP plan. CCP decision tree is a sequence of questions to assist in determining whether a control point is a CCP. See figure 17.

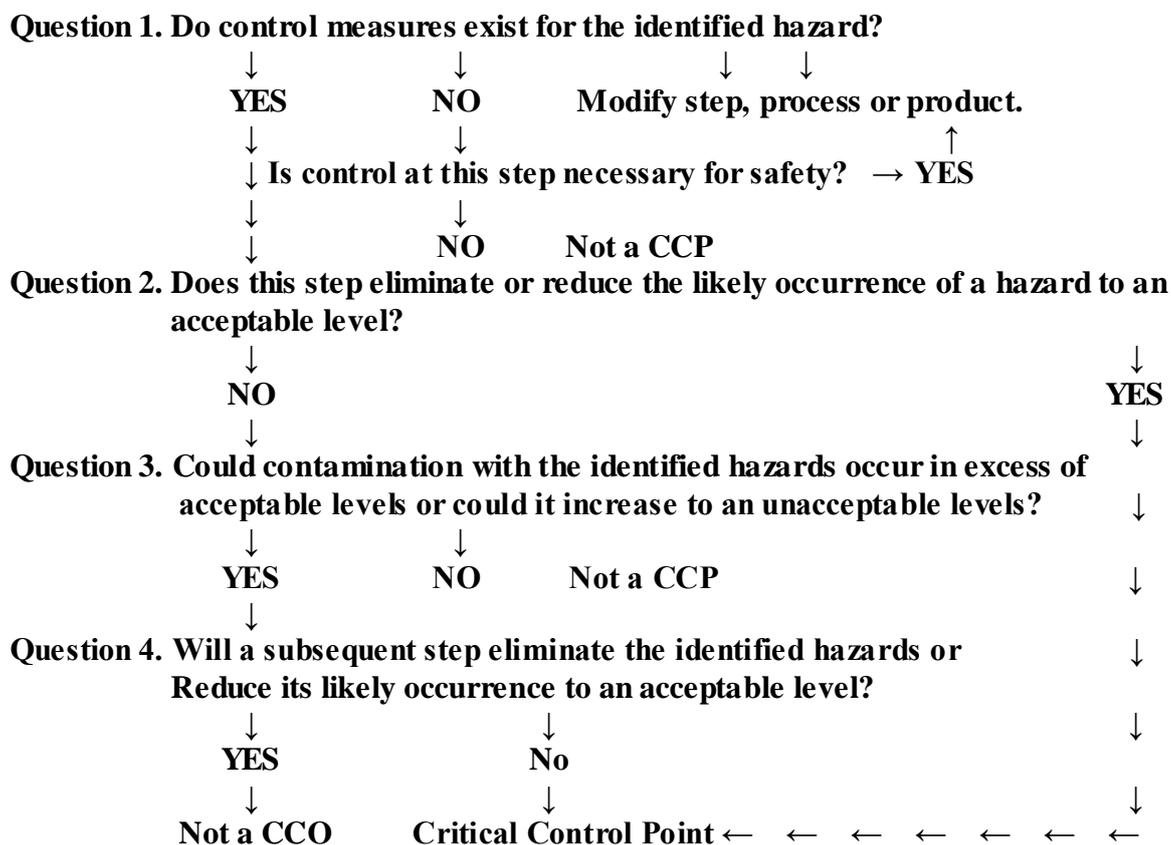


Figure 17. Critical Control Point Decision Tree

The company can use the Critical Control Point Decision Tree help them to find the Critical Control Points.

And the HACCP team should analysis those processes, and then makes a hazard analysis table to help them identify and evaluate hazards. See table 11. Hazard analysis is the key to preparing an effective HACCP plan. The HACCP team reviews the ingredients used in the product, each step in the process and the equipment used, the final product, the product method of storage and distribution, and the intended use and consumers of the product. Based on this review, the HACCP team develops a list of potential biological, chemical or physical hazards at each step in the production process.

Table 11. Identify and Evaluate Hazards in chicken product

By Meizi & Xiyu

Process Steps		Potential Hazard(s)		Evaluate Hazards	Control Measures
Raw materiel	Chicken leg	Biological	Coliform and Salmonella	Epidemiological evidence indicates that these pathogens cause severe health effects including death among children and elderly. Undercooked chicken leg patties have been linked to disease from these pathogens.	Sensory examinations the chicken legs are healthy. Unqualified products would return
			Staphylococcus aureus	Producing an enter toxin which can cause a moderate food borne illness.	
			Shigella	It causes diarrhea or diarrhea.	
		Chemical	NO		
		Physical	Impurities	Affect the food quality.	
	Water	Biological	NO		Taste and sensory examination is good
		Chemical	NO		
		Physical	NO		
	Salt	Biological	NO		Taste and sensory examination is good. Unqualified products would return
		Chemical	NO		
		Physical	Impurities	Affect the food quality.	
	Sugar	Biological	NO		
		Chemical	NO		
		Physical	Impurities	Affect the food quality.	
	Chili powder	Biological	NO		
		Chemical	NO		
		Physical	Impurities	Affect the food quality.	
	Additive	Biological	NO		
		Chemical	NO		
		Physical	Impurities	Affect the food quality.	
	Garlic powder	Biological	NO		
		Chemical	NO		
		Physical	Impurities	Affect the food quality.	
	Onion powder	Biological	NO		
		Chemical	NO		
		Physical	Impurities	Affect the food quality.	
Vegetable oil	Biological	NO			
	Chemical	NO			
	Physical	Impurities	Affect the food quality.		
Spices	Biological	NO			
	Chemical	NO			
	Physical	Impurities	Affect the food quality.		
Chicken oil	Biological	NO			
	Chemical	NO			
	Physical	Impurities	Affect the food quality.		
Yeast	Biological	NO			

	extract	Chemical	NO		
		Physical	Impurities	Affect the food quality.	
	Humectants	Biological	NO		
		Chemical	NO		
		Physical	Impurities	Affect the food quality.	
Cooling	Pre-Cooling	Biological	Pathogenic bacteria breeding	Reduce product temperature, avoid pathogenic bacteria grow, and use the disinfectant kill pathogenic bacteria.	
		Chemical	Sodium hypochlorite residue	Affect the food security.	
		Physical	NO		
	Freezing	Biological	Pathogenic bacteria breeding	Affect the food quality.	
		Chemical	NO		
		Physical	NO		
Package	Package Storage	Biological	Pathogenic bacteria breeding	Affect the food quality and hurt the customers.	Unqualified products are immediately notify the relevant departments, survey and record the reason, and according to procedures and processing of products.
		Chemical	NO		
		Physical	NO		
	Products	Biological	Pathogenic bacteria breeding	Affect the food quality.	
		Chemical	Packaging material of toxic chemicals	Hurt the customers.	
		Physical	Impurities /Damage	If the package damage may be cross infection. Affect the food quality.	
	Sealing	Biological	Pathogenic bacteria breeding	Affect the food quality.	
		Chemical	NO		
		Physical	NO		
	Metal detector	Biological	NO		
Chemical		NO			
Physical		Metal fragments	Affect the food quality.		
Storage	Products	Biological	Pathogenic bacteria breeding	Affect the food quality.	
		Chemical	Rancidity metamorphic	Affect the food quality.	
		Physical	Damage	If the box damage may be cross infection. Affect the food quality.	

Transportation	Supply	Biological	Pathogenic bacteria breeding	Affect the food quality.	
		Chemical	Chemical pollution	Affect the food quality.	
		Physical	Temperature	If the temperature of the product is change in supply, it will be affect the quality of the products.	

Biological hazard

It is mainly refer to the raw material with chicken hair birds cholera, bird flu, Newcastle disease and epidemics; with coliform, salmonella, staphylococcus aureus and shigella; with parasites such as ball. In view of the above situation Yongda company mainly through raw material chicken acceptance strict control, inspection and quarantine proof, each shipment sensory inspection, with the temperature testing, necessary in pathological anatomy and laboratory test to confirm whether the chicken hair infections disease, and according to related procedure (epidemic report program) operation; At the same time, strengthen out in the process of dirty in standard operation and test, will be broken and digestive tract of pollution carcass pick, and the inspection program for processing. Yongda Company use SSOP and GMP to control those products.

Physical hazard

It is mainly refers to the process of raw material chicken the result of transportation physical mechanical damage and the chicken source sex of foreign body. After the frozen Yongda Company use metal detector, SSOP and GMP to control those products.

Chemical hazard

It is mainly refers to the whole chicken in feeding process of improper use of veterinary drugs may cause veterinary drug residue. Yongda Company is mainly through the SSOP to control those products in the process.

This table 11 is to show how the stages of Hazard Analysis are used to Identify and Evaluate Hazards. In this case, we use this standard to find which biological hazards that can be exist in the chicken leg. For example: the common biological include coliform, salmonella, staphylococcus aureus and shigella. And also have other raw material include water, salt, Humectants (Sodium Tripolyphosphate), spices (Sugar, salt, chili powder, additive, garlic powder, onion powder, vegetable oil, spices, chicken oil, yeast extract). The physical hazards include stones, glass and metal. We are called those things is impurities. When found unqualified products are immediately notify the relevant departments, survey and record the reason, and according to procedures and processing of products.

Before identify and evaluate hazards of Hazard Analysis. We should make a table for Critical Control Points. CCPs are located at any step where hazards can be prevented, eliminated, or reduced to acceptable levels. See table 12.

Table 12. Critical Control Points and establish Critical Limits

By Meizi & Xiyu

Process steps	Control limits	Monitoring	Corrective actions
Received raw material	Quality of the chicken leg and other spices, etc. Chicken leg temperature: $-18 \sim -12 \text{ }^{\circ}\text{C}$	Inspection raw material when employees received them	Sensory examinations the raw materials are healthy. Unqualified products would return
Cooking	Steamed cupboard temperature: $100 \text{ }^{\circ}\text{C}$ Product temperature: $\geq 80 \text{ }^{\circ}\text{C}$	Monitor the temperature per batch	Strictly control the temperature, pressure and time of steamed cupboard, and to monitor it.
Pre-cooling	Temperature: $0 \sim 8 \text{ }^{\circ}\text{C}$	Monitor the temperature per batch	Notify the relevant departments, survey, record the reason and temperature regulating.
Freezing	Temperature: $< -28 \text{ }^{\circ}\text{C}$ Product temperature: $\leq -18 \text{ }^{\circ}\text{C}$ Time: 4 hours	Monitor the temperature 2 times for one day	Notify the relevant departments, survey, record the reason and temperature regulating.
Package	Packing room temperature: $\leq 12 \text{ }^{\circ}\text{C}$ Sealing condition Packing specification Box specification	Monitor the final package per batch	Random open the box inspection 3 boxes in every 100 boxes, and random open 2 packages in one box. Took out unqualified products
Metal detector	Iron diameter $\leq 1.5 \text{ mm}$ The iron metal kind diameter $\leq 2.0 \text{ mm}$ Stainless steel diameter $\leq 2.5 \text{ mm}$	Tested once every 20 minutes	Unqualified products are immediately notify the relevant departments, survey and record the reason, and according to procedures and processing of products
Storage	Storage temperature: $\leq -18 \text{ }^{\circ}\text{C}$ Product temperature: $-18 \text{ }^{\circ}\text{C}$	Monitor the temperature 2 times for one day	Notify the relevant departments, survey and record the reason.
Transport	Load temperature: $0 \text{ }^{\circ}\text{C}$ Alcohol disinfected: 75% Loading time: < 1 hour. Transportation temperature: $\leq -18 \text{ }^{\circ}\text{C}$	Monitor the load every time. Use RFID to monitor the transportation temperature.	Notify the relevant departments, survey, record the reason and temperature regulating.

Table 12 shows the critical control points and establishes critical limits. Critical limits are used to distinguish between safe and unsafe operating conditions at a CCP. Monitoring is measurement to assess whether a CCP is

under control and to produce an accurate record for future use in verification. Corrective actions are to prevent foods which may be hazardous from reaching consumers. This table is easier to control and monitoring critical control points of the process.

- The HACCP team should an on-site review operation of products to verify the accuracy and completeness of the flow diagram. If the operation of products has any problem, they should modifications the flow diagram as necessary and documented. We make a verification schedule table to show how to verification HACCP. See table 13.

Table 13. HACCP Verification Schedule

By Meizi & Xiyu

Activity	Frequency	Responsibility	Reviewer
Initial validation of HACCP plan	During initial implementation of plan	Expert	HACCP team
Subsequent validation of HACCP Plan	When critical limits changed, significant changes in process, equipment changed, after system failure, etc.	Expert	HACCP team
Verification of critical control points monitoring as described in the plan	According to HACCP plan	Line supervisor	Relevant authority
Review of monitoring, corrective action records to show compliance with the plan	Every month	Quality assurance	HACCP team
Comprehensive HACCP system verification	Every year	Expert	Manufacture manager

The HACCP verification schedule can validity of the HACCP plan and HACCP system is operating according to the plan. The company first should make a HACCP plan and use the Critical Control Point Decision Tree to help them management the HACCP plan, second should make a table for Hazard Analysis are used to identify and evaluate hazards, third should make a table to identify Critical Control Point and they are located at any step where hazards can be prevented, eliminated, or reduced to acceptable levels. And identify the Critical limits are used to distinguish between safe and unsafe operating conditions at a Critical Control Point. Last, the HACCP team should an on-site review operation of products to verify the accuracy and completeness of the flow diagram to help them to improve the Cold Chain Logistics.

5. 2. 2. Transportation and Storage – GIP, GPS & RFID

Yongda Company has been using GIS (Geographic Information System) and GPS (Global Position System) to change the road and tracking the vehicle. GIS provide geographic data (also called space data), and attribute data (such as demand information, transportation capacity, product, storage capacity and so on) are get from the standard database, and then all of these data are sent to the heart of the system: optimization distribution engine. In order to realize the most proper solution, customer can modify and analysis for these solutions. The vehicle equipped with GPS, it can help the company to tracking the vehicle.

The advantages of the integration of GIS and its optimization calculation model and analysis system:

1. Make the data and model visualization and identify whether they truly represent the supply chain environment.
2. According to the demand, it can provide a more accurate streets and databases, including one-way streets and banning of turning movement.
3. The system generates more rational solution or strategy for the routine selection.

Yongda Company has used temperature sensor to monitor the temperature of transportation process. It can establishes the logistics and distribution facilities and adopt the modern logistics management means. The temperature sensor combination of very best electronic sensor and advanced micro-chip and wireless technologies. The temperature sensor is ideal for advanced supply chain process management. It is comply with HACCP requirements. It is perfect for temperature mapping and cold chain management. The temperature sensor allowing you to easily monitor temperature fluctuations over time during shipment and storage of products.

From the technological process we described in the findings, we can realize how the Yongda Company checks their inventory at present, they still adopt the manual work to account the numbers. Enter the products quantity to software system through the handwork. But we can image, there is so many products need to check, this method not only easy bring about high failure rate, low accuracy, but also low efficiency, large amount of work and high labor cost.

Along with the developing of ICT (Internet and Communication Technology) technology, attempt to apply other new type of finished goods storage model, that is to say, combined the advanced RFID technology, wireless network technology and software technology, realize the automation of finished goods storage, the new professional work operation process shown as follows:

Figure 18 shows the process of manual count warehouse warrant.



Figure 18, The operation process of RFID technology used in finished goods inventory

Process illustration:

As the table shown above, the content of each process is summarized as follow.

1. After manufacture and stacking, let statisticians use the reader direct scanning the label on container, label of container has the product name, specification, weight, batch and other information.
2. Software system will automatic set up a product warehouse warrant via wireless network.
3. According to the result of reader, software system will automatic read-in the product details from reader which include product name, specification, quantity, batch and other information, all the information will be saved in the warehouse warrant.
4. Warehouse keeper entering into the software system while the scanning accomplished, examine verity and print the warehouse warrant, precede paper characteristics flow according to the receipts flow.
5. Financial department proceeding financial transaction according to the record handed by the warehouse keeper.

In the RFID model, both of product accounting and enter is accomplished automatically through the reader and software system no longer through the hand written, decreased the artificial intervene; meanwhile, it can also enhance the working performance.

Two different operation works has large amount of diversity, the comparative analysis hand written and RFID technology is summarized as follow, see table 14.

Table 14: comparative analysis of manual count and RFID count

By Meizi & Xiyu

Compare items	Hand written	RFID technology
Product accounting method	Artificial count	Reader scanning automatically
Product details entering method	Hand enter	Software automatic enter accordance with scanning
Data accuracy	Low	High
Working performance	Low	High
Employee workload	Large	Small
Employee working hours	Long	Short
Labor cost	High	Low
Working cost	High	Low

From the comparative analysis above, we can see, no matter from the aspects of data accuracy, efficient, cost, workload, working hours and so on, RFID enter application has incomparable advantages relative to traditional hand enter, it will become to a new finished products storage mode in food industry.

6. Conclusions

1. What is CCL and what is known in the literature of CCL in the food industry?

Cold Chain Logistics (low temperature logistics) is comprised of equipments and processes that keep perishable products under controlled cold environment. There are many aspects from the point of view, it deals with the production, processing, packaging station, cold storage warehouses, transportation, distribution centers, retailer, end consumer and in the user household refrigerators of products from the manufacture to the customer that are temperature sensitive. The three main features of Cold Chain Logistics are complexity, coordination and high cost. First, the different products have different time and temperature to control. Even small temperature fluctuations can have a direct visual or taste or even bacterial effect. According to Hazard Analysis Critical Control Point (HACCP), foods should be in right temperature to manage. Because any change in the product's storage temperature will have potential microbiological, chemical, and physical hazards, it is not good for people. Second, every aspects of the logistics process must be coordinated in order to ensure the stable operation of the Cold Chain Logistics. Third, the cost of the warehouse and vehicles of Cold Chain Logistics is three to five times that of the general dry products warehouse and vehicles. The company should use '3P', '3C', '3T', '3Q', and '3M' principle to management Cold Chain Logistics. It can help the company to manage Cold Chain Logistics more efficiently. Because a good Cold Chain Logistics can help to reduce costs, improve products integrity, increase customer satisfaction and reduce wastage.

2. Which are the main differences in Cold Chain Logistics in the food industry when China is compared with USA and Japan?

In this thesis based on the knowledge and concepts of Cold Chain Logistics, we combine the Cold Chain Logistics present situation with more developed countries as USA and Japan and that of the Chinese Cold Chain Logistics, such as Cold Chain Logistics ratio, capacity, cold storage capacity, management, logistics team, regulations and standard system. China lacking of efficiency with greater loss and fewer refrigerated vehicles and storage capacity. China has more than 20% - 25% loss ratio than that of the developed countries and has less than 80% - 85% Cold Chain Logistics ratio when compared with the developed countries. It also has 30,000 refrigerated vehicles, which is less than United States which has about 170,000 refrigerated vehicles. When it comes to cold storage capacity. Chinese Cold Chain Logistics also lacks behind in terms of efficient management due to its reliance on cheap manual labor in recording, monitoring etc. Furthermore, laws and regulations concerning Cold Chain Logistics of perishable products are not complete hence Cold Chain Logistics at present.

3. How to improve the Cold Chain Logistics in China through technology and management?

Increase Chinese government to construction of Cold Chain Logistics

First, the government should use its power to manage Cold Chain Logistics through formulating strict market system, strengthening the government supervision, and establishing a complete standard Cold Chain Logistics system of laws and regulations.

Second, the government should speed up its improvement in the infrastructure, in the introduction and development of refrigeration equipment and technology and increase financial support in the Cold Chain Logistics.

Third, the government should actively promote enterprises to change its management behavior and promote consumer behavior towards frozen food, to create a good external environment for development of logistics and distribution, to strengthen the information services, promote international cooperation and exchanges expertise.

Finally, the government should develop incentives for the development establishes the laws and regulations, to create a good market environment of Cold Chain Logistics. The government support the food industry companies with some investment in CCL technology that these firms can have a better chance in developing their business.

Strengthen the Cold Chain Logistics facilities

China agricultures' high wastage rate is well known due to poor standard in its Cold Chain Logistics equipment. Therefore, when dealing with the equipments involved in CCL, China should improve its refrigeration transport and storage equipment so that it can in the near future replace all of the current outdated hardware. This can effectively improve security to the perishable goods circulation and in turn also improve the quality of frozen foods. It should also invest in modern refrigeration management software to collect and process the necessary information from upstream to downstream supplies through GIS, GPS, RFID and other technology. These technologies can improve both the transportation equipments as well as cold storage monitor systems.

Personnel training

Due to the lack educated personnel in China, proper training schools that specializes in Cold Chain Logistics and companies should also increase the staff training in its correct implementation. This can improve the accuracy and effectiveness to management the Cold Chain Logistics.

The future of Cold Chain Logistics development has the following trends in the China.

Integration

A comprehensive cooperation of cold transportation logistics is necessary in order to promote systematic development of Cold Chain Logistics. Since the chief purpose of cold chain logistics is to provide the best

logistic solution during the process of production place, manufacture, transportation, sales, it can be deduced that with the ever higher requirement on food safety, the integration of CCL into the food industries are prerequisite to improved standard of living. Furthermore, highly integrated supply chain is formed through united planning and operation, which further reduces loss, improves logistics efficiency, and provides customers with more satisfied service.

Informatization

The company should use advanced information technology to improve their Cold Chain Logistics, such as GIS, GPS, RFID, refrigeration and electronic identification technology, etc. By doing so, it will transform the current labor intensive CCL to technology intensive CCL.

The case analysis of Yongda Company.

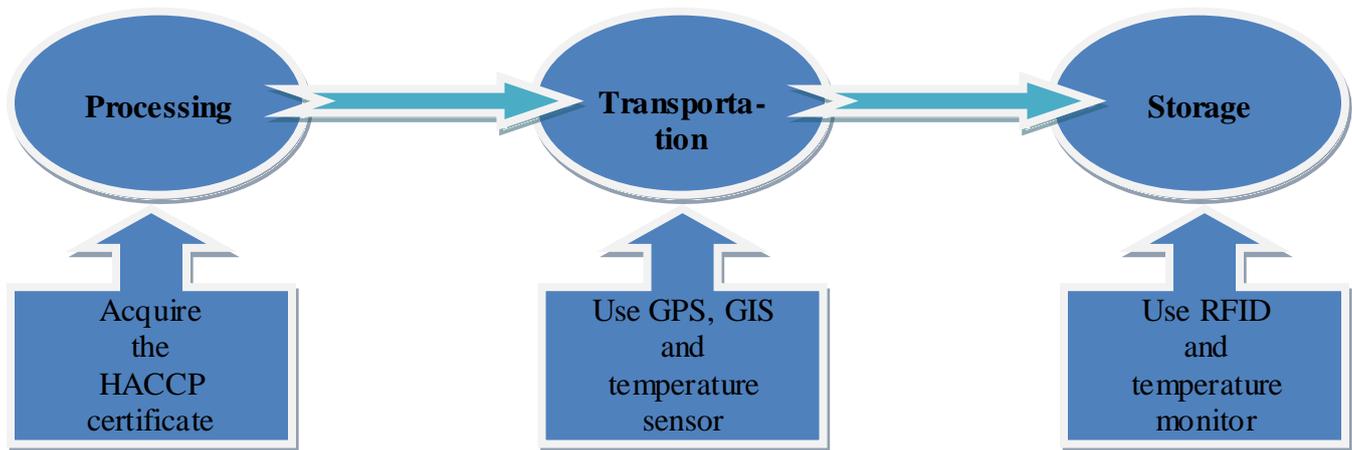


Figure 19. The steps of analysis
By Meizi & Xiyu

Yongda Company is a good company in the Cold Chain Logistics. They have their own logistics team to manager CCL and have their own frozen warehouse. Since building a frozen warehouse requires large investments. If the government can build the frozen warehouse in different city, it will reduce the cost for the food industry company. Yongda's business culture is high quality. They want to use good quality to attract customer. They are requires large investments in Cold Chain Logistics. They are successful. 'Yongda Chicken' has become a local customer's first choice brand. Although they requires large investments in CCL, but they can keep the good brand image in the customers' mind.

According to China's current situation Cold Chain Logistics, we recommend that food industry companies need to follow those steps in the Yongda Company example to manage the Cold Chain Logistics. The company should also acquire the HACCP certificate because the HACCP system is a management system where foods safety is addressed through detailed analysis. Although the HACCP can reduce critical microbiological organisms as much as possible, but it is not a zero risk system. HACCP can monitor the whole processing procedure then improve the quality of the products. We also recommend that the company should use GPS and GIS to monitor the transportation vehicle which will help the company or customer to track the perishable products. Moreover, the company can use temperature sensor to monitor the temperature of products in the whole logistics process which will ensure that the temperature of the products is in the right range.

6. 1. Further study

Cold Chain Logistics has four main stages that include processing, storage, transportation and sale. But in this thesis, we have only examined three of them. The sale stage has been left out due to its large area of study but it will definitely be an interesting topic for further study since it may complement the other three stages and thus completing the CCL circle. After the transportation stage, many finished frozen foods will be sent to all kinds of market. But how to manage those foods will be a good question since retailers and restaurants also need education on how to best preserve the final products, how to market the final products so that it becomes more attractive to the consumers etc. If we know how to manage whole the Cold Chain Logistics then it can help company to improve its CCL efficiency and more importantly, improve its products' competitiveness on the market.

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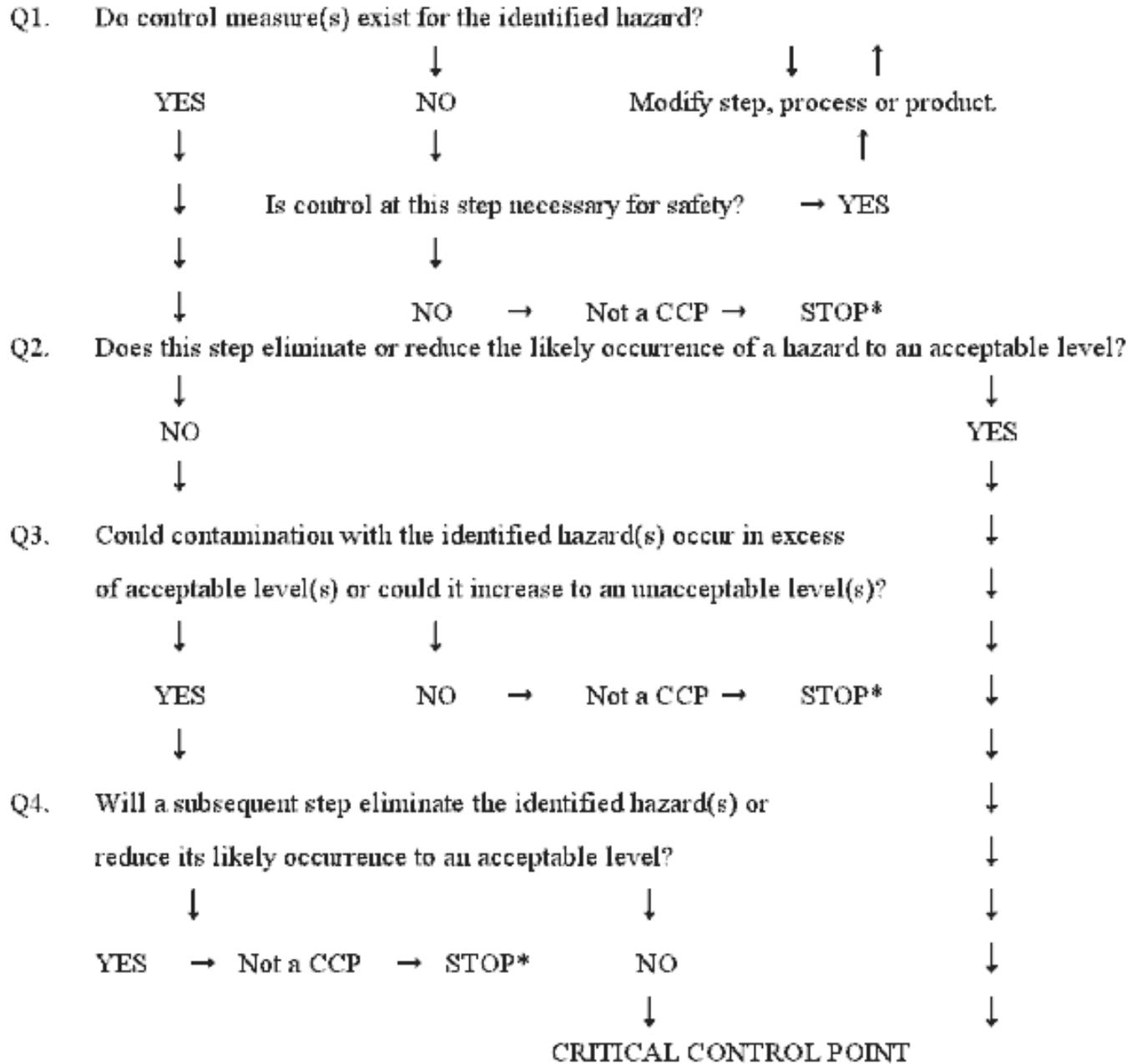
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8. Appendix

Appendix A:

A CCP Decision Tree



APPENDIX B

Example of a Flow Diagram for the Production of Frozen Cooked Beef Patties

