Third party healthcare logistics:
A study of third-party logistics providers in China

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Abstract

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Background: With the strong support from the government and investors, Chinese healthcare sector is developed rapidly. Also, the demand for healthcare logistics has also gradually increased. Currently, most Chinese pharmaceutical manufacturing is using traditional medicine logistics, and due to the late start of Chinese healthcare logistics, there are many problems within the field of healthcare logistics. Therefore, there is a strong demand for professional 3PL providers involving Chinese healthcare sectors.

Purpose: The purpose of this paper is to analyze the status of Chinese healthcare sectors, to indicate the predictable contribution of Chinese 3PL providers after entering. And also, to analyze how different types of Chinese 3PL providers can better adapt themselves to healthcare logistics sectors. Additionally, different opportunities and challenges faced by the Chinese 3PL providers in the field of healthcare logistics has been analyzed.

Methodology: The paper uses positivism philosophy and deductive scientific approach, and both qualitative and quantitative research method is used for the case study. The data collection was conducted through semi-structured interview. Non-probability sampling method is also being used for data sampling.

Conclusion: Based on the analysis of the paper, the problems of complex distribution channel and the drawbacks of the traditional healthcare logistics form are demonstrated. For the entry of 3PL, the predictable contribution that can be made includes reducing medicine prices, ensuring product quality and supply, improving transportation efficiency, and improving the overall market innovation capability. And the different improvement and adjustment for different types of companies to better adapt to the field of healthcare logistics has been presented. Follow-up, Chinese 3PL providers will face different opportunities and challenges from Chinese market perspective, technology factors and political factors.

Keywords: Third-party logistics, Chinese 3PL providers, healthcare sectors, Healthcare logistics, pharmaceutical industry, predictable contribution, improvements and adjustments, opportunities and challenges.
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__________________________________________  _______________________________________
Luyao Wang                                  Yuqiao Hu

Växjö, 2018-05-23
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<th>Description</th>
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<tbody>
<tr>
<td>API</td>
<td>Active pharmaceutical ingredient</td>
</tr>
<tr>
<td>CAPC</td>
<td>China Association of Pharmaceutical commerce</td>
</tr>
<tr>
<td>CDC</td>
<td>Centers for disease control</td>
</tr>
<tr>
<td>CRIFI</td>
<td>China Research Institute for Forward Industry</td>
</tr>
<tr>
<td>CSCMP</td>
<td>Council of Supply Chain Management Professionals</td>
</tr>
<tr>
<td>EDI</td>
<td>Electronic Data Interchange</td>
</tr>
<tr>
<td>EFT</td>
<td>Electronic funds transfer</td>
</tr>
<tr>
<td>EPP</td>
<td>Expanded polypropylene</td>
</tr>
<tr>
<td>ERP</td>
<td>Enterprise Resource Planning</td>
</tr>
<tr>
<td>GDP</td>
<td>Good Distribution Practice</td>
</tr>
<tr>
<td>GMP</td>
<td>Good Manufacturing Practice</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>GSP</td>
<td>Good Supply Practice</td>
</tr>
<tr>
<td>JIT</td>
<td>Just in time</td>
</tr>
<tr>
<td>OTC</td>
<td>Over-the counter drugs</td>
</tr>
<tr>
<td>PRCSC</td>
<td>People’s republic of China State Council</td>
</tr>
<tr>
<td>RFID</td>
<td>Radio Frequency Identification</td>
</tr>
<tr>
<td>RMS</td>
<td>Risk Management System</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and development</td>
</tr>
<tr>
<td>SIP</td>
<td>Structural insulated panel</td>
</tr>
<tr>
<td>TMS</td>
<td>Transportation management system</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health organization</td>
</tr>
<tr>
<td>WMS</td>
<td>Warehouse Management System</td>
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<tr>
<td>3PL</td>
<td>Third party logistics</td>
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Exchange rate used in the paper: RMB to EUR: 1 RMB = 0.134EUR

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1. Introduction

This chapter contains the introduction of the research topic for the thesis. Including a brief introduction of the current situation of Chinese healthcare logistic and Chinese third-party logistics providers. Moreover, problem discussion paragraph identifies the problem regarding Chinese third-party logistic providers for healthcare sectors, which lead out the purpose of the research. For better study of the whole research topic, three research questions have been presented.

1.1 Background

The pharmaceutical industry is an important component of national economy. It has close relations with people's health and quality of life. For many years, China has been committed to the reform and improvement of the healthcare sectors. The government’s attention to the pharmaceutical industry has gradually increased. People’s republic of China State Council (PRCSC) has implemented a health care reform plan and involved the investment for about 10 billion Euros since April 2009 (State Council, 2009), the focus of these investments is to establish a completely public health care system (Gusmano et al., 2011), and to provide better medicine management (Kahler, 2011).

According to DBS bank's forecast, the industry’s sales growth at 8.9% in 2017 will be continuance increased to 9-10% in 2018 (DBS group, 2017). From the perspective of investment, according to data released by China Research Institute for Forward Industry (CRIFI), from 2010 to 2017, the number of the investment case in Chinese pharmaceutical industry increased by an average of over 30%. Between 2015 and 2017, the number of investment cases has a noticeable increase of 159.8%. In 2017, the number of investment cases in the pharmaceutical industry reached 342 (CRIFI, 2018). As more and more investors enter the pharmaceutical industry, and the simultaneous increase in the number of sales and investment cases both indicates that the Chinese pharmaceutical industry market was steadily rising. Support from the
Chinese government has also helped the pharmaceutical industry to achieve continuous development. “Made in China 2025” is a ten-year strategic plan formulated by the Chinese government. From 2015 to 2025, one of China's ten major development projects was for bio-medicine pharmaceutical and high-tech medical devices (Miit.gov.cn, 2015). The development of the pharmaceutical industry along with the birth of new medicines and advanced equipment, has increased the demand for logistics functions for healthcare products in China.

1.1.1 Healthcare logistics

Based on the definition from Council of Supply Chain Management Professionals (CSCMP), logistics is part of supply chain management, which includes planning, implementation, delivery, and control of information, goods, and services, which mainly indicates the delivery of goods and services to meet different customer needs (CSCMP, 2018). In general, healthcare logistic, refers to a concept of logistic in healthcare and pharmaceutical industry. However, due to the peculiarities of healthcare logistics, it will have differences with the form of traditional logistics in a various way (Yoon, 2014). For example the cold storage for vaccine product, and the temperature controlled transportation for temperature sensitive products (Blandine, Smail and Michael, 2018). Therefore, World Health organization (WHO) has regulatory requirements for the logistics activities of pharmaceutical products. For example the announcement of Good Distribution Practice (GDP) guideline and Good Manufacturing Practice (GMP) guideline (World Health Organization, 2011). In addition, healthcare logistics not only includes the warehousing and transportation of medicines, vaccines, etc. but also the use of advanced information systems to ensure healthcare logistics to be perfect, powerful information systems will greatly improve the efficiency of healthcare logistics, such as improving order processing capabilities and shortening delivery time (Blandine, Smail and Michael, 2018). For healthcare logistics, it is more likely a kind of logistics that integrates advanced management techniques and organizational methods (Xiao, 2006).
1.1.2 Third party logistics

Third party logistics (3PL) is also called logistics outsourcing. It means that the company makes the outsources for some or all of its logistics-related activities to a third-party company or organization, and for them to take care (Etokudoh and Boolaky, 2017). With the intensification of market competition, companies are more aware of the importance of their core competence, so the outsourcing of logistic functions has gradually increased (Sahay and Ramneesh, 2006).

1.2 Problem discussion

At present stage, in the healthcare logistics market in China, most pharmaceutical companies use traditional healthcare logistics, which means that pharmaceutical company has developed its own logistic related functions at the same time of doing their main business. But most pharmaceutical companies are not perfect with the formulation of logistics systems, the awareness of logistics-related technologies are not professional enough, or, employees' knowledge of logistics expertise is weak (Yang et al, 2005).

Due to the late start of China's healthcare logistics, the optimization of a single link in healthcare logistics supply chain, has caused many emerging medical logistics projects to remain in the stage of internal adjustment (Xiao, 2006). But for the external perspective of the enterprise, the upstream suppliers or manufacturers, and downstream customers cannot be completely included in the entire supply chain. As mentioned above, modern healthcare logistics not only requires transportation and warehousing, but also simplify and integrates the entire supply chain (Xiao, 2006). According to Yang (2005), Chinese traditional healthcare logistics includes the process from pharmaceutical factories, to different level of distributors, then to hospitals and retailers, then reach the final customers. This circulation model can no longer meet the requirements of today's market development trend and logistic needs in pharmaceutical industry (Yang et al., 2005). So, the demand for more a more
specialized third-party logistics providers involvement, are becoming urgent.

Market share of Chinese 3PL providers 2017 (%)

Figure 1: Market share of Chinese 3PL providers in 2017 (CRIFI, 2018)

For Chinese third-party logistics providers, based on data from 2017, five Chinese 3PL providers were selected, and their market share in domestic Chinese third-party logistics sectors is shown in Figure 1 (CRIFI, 2018). These 5 Chinese domestic third-party logistics providers occupied for around 60% of the market share, it can conclude the scale of operations for these companies. However, compared with the scale, an obvious contrast appeared in the field of healthcare logistics. Among these 5 domestic well-known 3PL providers, through the information gathering, only "SF Express" covers the healthcare logistic business in their cold chain business. For the other 4 company, the provision of their cold chain services is mainly focused on the food industry. With the steady development of the Chinese pharmaceutical industry, there are still plenty of opportunities for the domestic 3PL providers. And for Chinese healthcare logistics industry, there are also a serious lack of third-party logistics providers. Then the research purpose of the paper will be present in next section.
1.3 Purpose

The purpose of this paper is to illustrate Chinese third-party logistics providers within the field of healthcare logistics, through the understanding of the current situation Chinese healthcare sector and the analysis of third party logistics providers in China. Along with the demand for 3PL providers in Chinese healthcare sector, the paper will analyze what predictable contribution of Chinese 3PL providers can make, for different problems exist in current Chinese healthcare sectors, this will also be the subject of the first research question. In order to better adapt to China's healthcare logistics sectors, for different types of 3PL providers, the paper will analyze what kind of adjustments or improvements they need or can be make, in order to better adapt to healthcare logistics or enter the field of healthcare logistics, this will also be the main content of the second research question. Moreover, different opportunities and challenges that Chinese 3PL providers will face in the field of healthcare logistics will be analyzed as the third research question of this paper. So, in the next section, three research questions of the paper will be present.

1.4 Limitation

For the limitation of the paper, the subject of the research is to analysis the adaption for Chinese 3pl providers entering Chinese healthcare logistic market, there are limitations with the selection of these “Chinese 3pl providers”. For one type pf 3PL providers in China, they are also called “3pl providers”, but they are controlled and operated by the Chinese government, mostly they are huge-scale companies, such as “China National Trade & Transportation Corporation” (Now called SINOTRANS&CSC) and “China National Storage & Transportation Corporation”. Such enterprises are large in scale and dominate the market. However, in the article, This type of 3pl companies is not in the discussion because they are state-owned enterprises and are controlled by the Chinese government.

Within the research, the activities of healthcare logistics are mainly focus on
warehousing, transportation, and distributions, for the production and retailing of pharmaceutical product is out of the limit.

1.5 Research question

Research question 1:
What could be the predictable contribution of Chinese 3PL providers to Chinese healthcare sectors?

Research question 2:
How can different types of Chinese 3PL providers better adapt to healthcare logistics in China?

RQ2a: What improvements can be made by Chinese 3PL providers, which has already entered healthcare logistics sectors?

   RQ2a-1: What improvements can be made in warehousing?

   RQ2a-2: What improvements can be made in transportation?

RQ2b: What adjustment need to be made by Chinese 3PL providers, for entering healthcare logistics sectors?

   RQ2b-1: What adjustment need to be made in warehousing?

   RQ2b-2: What adjustment need to be made in transportation?

Research question 3:
What are the opportunity and challenge for Chinese 3PL providers within Chinese healthcare logistics sectors?
1.6 Chapter division

**Figure 2: Chapter division for the paper**
2. Methodology

This chapter contains the description of the methodology approaches, which has been used as the foundation of answering research questions. At the beginning of this chapter, Research Onion model has been introduced, which has been used to support the methodology part building. Moreover, scientific perspective, scientific approach, research method, research strategies, time horizon, data collection, sampling method, data analysis method, scientific credibility, and ethical consideration parts has been presented.

2.1 Research Onion model

The research onion model was developed by Saunders et al. (2016). The Research Onion is a model that has been used for developing the research method (Saunders et al., 2016). It is an useful model for planning and carrying out research methodology investigation. In research onion model, it has different layers that contains different information (See Appendix 1). The first layer of the research onion contains the choice of the scientific perspective. The second layer of the research onion contains the choice of scientific approach, which in term of deductive and inductive. The third and fourth layer of the research onion contains the choice refer to the research method and strategies that will be used. For the fifth layer of the research onion contains the information regarding time horizons, and the sixth layer contains the practicalities method of data gathering and data analysis method (Saunders et al., 2016). For the methodology part of this paper, research onion model has provided tremendous contribution and help to the authors. Through the “outside-in” movement of each layers, a more logical structure is produced. The research onion model of this paper will be present in section 2.13, summary of methodology.
2.2 Scientific perspective

The first important thing when developing and investigating an research question, is to adopt the scientific perspective. According to Johnson and Clark (2006), the choice of the scientific perspective has an significant impact and importance to the on going business research (Johnson and Clark, 2006). As mentioned by Saunders et al. (2009), the choice of the scientific perspective also will influence the view of the researchers, on the relationship between “knowledge” and the process of “developing the knowledge” (Saunders et al., 2009). Additionally, the choice of the scientific perspective, or called research philosophy, is the first layers within the Saunders research onion model, it also explains the priority and importance.

According to Saunders et al. (2009), there are two main types of categories for choosing scientific perspective, which are ontology and epistemology (Saunders et al., 2009). These authors also define ontology as it is concerned with nature of reality, and epistemology concerns with what constitutes acceptable knowledge in a field of study. The purpose of ontology is to study the nature of the existence of objective things, which contains different views including objectivism, subjectivism, pragmatism and so on; For epistemology, it is more concerns with the methods, and exploring the nature and origin of knowledge and theory, which contains different views including positivism, interpretivism, realism and so on. According to Saunders et al. (2009), there is no comparison between various perspectives and views, and there are no distinction of pros and cons also. For the choice of scientific perspective, a best suitable scientific perspective should be choose, based on the research questions that researchers are investigating. Within this paper, authors are willing to selecting 2 different perspective, includes positivism, and interpretivism, which will be introduce later. These scientific perspectives are which may be contribute for the answer of research question (Saunders et al., 2009). Through the introduce and understanding of various perspectives, the selection of the final scientific perspective has been made.
**Positivism**

The theory of positivism was developed in the 19th Century, by French philosopher Auguste Comte. It belongs to the position of epistemology doctrine. According to Bryman and Bell (2015), positivism scientific perspective suggest that taking the methods of natural sciences, and apply it into the study of social reality. There are various other basic principles for positivism scientific perspective. It suggest that science should be conducted in a “value-free” way, which means it should be objective. And the purpose of establishing a theory is to produce testable hypotheses, to determine the credibility (Bryman and Bell, 2015). And as Remenyi et al. (1998) mentioned, through standing on the position of positivism, researchers can do the question investigation based on the existing social reality, and produce out an "law-like" conclusion (Remenyi et al., 1998).

**Interpretivism**

Interpretivism can be seen as the opposite of compare with positivism (Saunders et al., 2009). The interpretivism needs researchers to explain the content of the study. Therefore, the interpretivism integrates individualism, and human interest into the study. Different starting point of view will have different results. Therefore, according to Myers (2008), the explanatory researchers believe that the theoretical reality can be obtained through social construction, such as languages and consciousness (Myers, 2008), so different social actors will conducted different social phenomenon, which should be considered by the researchers, of these different human individual construction.

**2.2.1 Scientific perspective of the paper**

The scientific perspective of this paper is based on the positivism philosophy. Through the analysis of the phenomena in reality, knowledge and investigation conclusions are obtained. Positivism philosophy could help the authors investigate and study the research questions and problems that exist in reality in an objectively
way. Since the main content of the article is the status of China's healthcare logistics and the analysis of third-party logistics providers in China, other scientific perspectives are not considered as the basis for the development of the methodology.

2.3 Scientific approach

When investigating the research question, the use of the theory would be involved and have a significant importance. According to Bryman and Bell (2015), researchers should understand the role of the theory, which means that understanding the relationship between theory and research. So for the role of the theory, it can be made explicit during the design of the research, or may be made explicit before the design of the research (Saunders et al., 2016). There are two main types of scientific approach includes deductive scientific approach and inductive scientific approach (Bryman and Bell, 2015). These two of the scientific approach, deductive and inductive will be focused and introduced as the optional scientific approach for the paper. Regardless of the research field, the discussion of scientific approach is an important part of research methodology building.

*Deductive scientific approach*

Deductive scientific approach is the way to test the validity of hypotheses, and it is the most common view for understanding the relationships between theory and research (Bryman and Bell, 2015). According to Robson (2002), deductive research can be performed in various steps. When hypothesis is made on the basis of the theory, whether this hypothesis is valid or not, requires the verification through an strategic research. Then through the design and implementation of a research strategy, to achieve the effect of testing hypothesis. When getting to the final findings and outcomes, the theoretical hypothesis can be refined or modified based on the research results (Robson, 2002). So, deductive scientific approach can help the author to verify whether the proposed hypothesis is reasonable and effective. According to Saunders et al. (2009), the variables used in deductive scientific approach needs to be measured in a quantitatively way, and to explain the causal relationship between them. Another
characteristic for deductive scientific approach is generalization, which means that, in order to summarize the extensive human behavior from a statistical way, there must be a sufficient range of sample selection, so to ensure the authenticity (Saunders et al., 2009).

**Inductive scientific approach**

Differ from deductive scientific approach, inductive scientific approach is for building the theory. It is a scientific approach that does not involved making hypothesis. At the beginning of the inductive research process, the established observation result was untested, and the aim of data gathering is for testing the observation result, and to create theory based for the observed phenomena (Saunders et al., 2016). In the inductive research process, compared to a large amount of data, the data collected from a small group of respondents, collected and analysis in a qualitative way, could better help the researchers to get more accurate findings (Easterby-Smith et al. 2008). As defined by Saunders et al. (2009), in inductive research approach, theory would follow data, but not vice versa, it can help for effectively summarize and the establish theories.

**2.3.1 Scientific approach of the paper**

Deductive scientific approach has been used in the paper, since the research has been started with the existing theory but not aiming to building the theory. The previous existing theory regarding third party logistic and healthcare logistic has been used as the foundation of investigating the research questions.

**2.4 Research method**

According to Bryman and Bell (2015), the two distinctive research methods are qualitative research method and quantitative research method (Bryman and Bell, 2015). Both of these research methods are widely used by researchers, and the distinguish between qualitative research method and quantitative research method
also make the classification of different data collection and data analysis techniques (Saunders et al., 2016). So the right choice of the research method can help researchers to conduct the question investigation more smoothly.

**Quantitative research**

The purpose of quantitative research is to clearly exhibit the relationship between theory and the investigation research, through the collection of data. The data collected in quantitative research way studies are mostly tend to be numerical data (Bryman and Bell, 2015). These numerical data used in quantitative studies are usually obtained through different data collection technologies, such as questionnaires, etc. The data collection is generally massive and can be shown in the form of figures and statistical data (Saunders et al., 2016), and help researchers to do the problem investigation. As mentioned earlier, these form of quantitative data, as variables could help the conduct of deductive scientific approach.

**Qualitative research**

Qualitative research is a research method that focuses on exploration and understanding (Creswell, 2014). The purpose of qualitative research is to find answers to social science problems, through the way of case analysis or interviews. According to Bryman and Bell, the focus of qualitative research is to understand the phenomenon of society, through the study of the explanations from respondents (Bryman and Bell, 2015). Qualitative research method are often guided by the research and analysis of a small group of respondents, it means that the results of qualitative research are usually not shown as a numerical data analysis, but a textual description of the problem. Therefore, researchers using qualitative research method, need to organize and interpret both numerical and non-numerical data, to clearly indicate their understanding of investigating problems. As mentioned earlier, data collected from a small group of respondents, collected and analysis in a qualitative way, could help the conduct of inductive scientific approach (Bryman and Bell, 2015).
2.4.1 Research method of the paper

Qualitative research and quantitative research methods both have their own strengths and weaknesses and these research methods can be complement to each other (Bryman and Bell, 2015). As mentioned by Saunders et al., mixed methods approach is the general term, when the researchers are using both quantitative and qualitative methods (Saunders et al., 2016). Since the paper are going to use interview to get the primary numerical and non-numerical data as raw information, and also secondary data from the literature, scientific articles and annual reports, will also be collected and used, so the research method of the paper are refers to the mixed research method.

2.5 Research strategies

For research strategies, it has been defined as the “general plan of how the researcher will go about answering the research questions” (Saunders et al. 2016). The determination of the correct research strategy is very important. It helps researchers to understand the research problem through the most appropriate way. For different types of research questions, different research strategies are needed. Therefore, 2 different optional research strategies will be described and introduced, they are experiment strategy and case study strategy. The research strategy that being used in this paper will be point out afterward.

Experiment strategy

The purpose of the experiment strategy is to explore the causal relationship between one or more variables with the another (Hakim, 2000). Through the data collection and investigation of one or a group of variables and the determination of the measures of the affected variables, the causal relationship between them can be reflected. In general, this strategy is more often applied to the natural sciences research, but less to business and management research questions (Saunders et al., 2016). The reason for this as mentioned by Bryman and Bell, most of the independent variables within organization’s business behavior cannot be well-operated and manipulated in
organizations level of control (Bryman and Bell, 2015).

**Case study strategy**

As defined by Robson, case study is a research strategy which dealing with the in-depth empirical research that conducted on specific phenomena in real life, by using multiple source of evidence (Robson, 2002). For the case study strategy, the case can be a single organization, a single location, a person, or a single event (Bryman and Bell, 2015). Because case study strategies are aiming at exploratory and interpretive, so diversity data collection methods has been used, such as using questionnaires, and more commonly, using interview as a qualitative way (Sarah et al., 2011). As one of the most common qualitative research strategies, case study strategies is popular and widely used in business research area (Yazan, 2015; Eisenhardt and Graebner, 2007).

**2.5.1 Research strategy of the paper**

The research questions of this paper are belongs to empirical study of the phenomenon in real life. The research strategy selected by the article is a case study strategy. The scope of the research question in this paper will be formulated in Chinese market. Therefore, the investigation of the problem in Chinese healthcare logistics market is one of the reasons that case study strategy was chosen. In addition, the primary data and the secondary data collected in this paper are both comes from Chinese third-party logistics providers, and conduct the problem investigation through both qualitative and quantitative way.

**2.6 Time horizon**

Time horizon is one of the content within the onion model, which belongs to the fourth layer, it contains the information of time framework for the research project (Saunders et al., 2016). Within time horizon, two main types of distinctions are cross-sectional and longitudinal (Bryman and Bell, 2015). For cross sectional, as
defined by Bryman and Bell (2015) means that, at a specific time, research on a specific phenomena, so called a “snapshot” for the investigated area. Normally, data collection will been involved in cross sectional research for a short or specific period. Longitudinal as another form of time horizon, focusing on the process of change. As mentioned by Saunders et al. (2016), longitudinal are aiming for the understanding of the organization. Longitudinal studies repeatedly collect data over a longer period of time and use it to study how variables change over time (Goddard & Melville, 2004). Because the paper are collecting data not in a long-term, but based on specific times, cross sectional time horizon has been selected in the paper.

2.7 Data collection method

The collection of data is crucial for research. The accurate data collection could help the research problem investigation to be more comprehensive. According to Bryman and Bell (2015), questionnaire, interviews, focus groups, and observations are various primary instruments for data collection. And the collected data can be divided into two types, primary data and secondary data (Saunders et al., 2016; Bryman and Bell, 2015), which will be introduced in this section.

Primary data

The first-hand data collected by the researchers, through their own experience, observation, interviews, etc., may be referred as primary data. As Saunders et al. (2016) defined, primary data is the data collected specifically for the research project being undertaken. There are many ways of collecting primary data, for example through the observation, interview, focus group and so on. The focused primary data collection method in this paper is interview. According to Saunders et al. (2016), interviews could contain different questions in a formalized or non formalized way, for the respondents. And interview could also be an unstructured conversation with respondents. The types of interview can be categorized as three: structured interviews, semi-structured interviews, and unstructured or in-depth interviews (Saunders et al., 2016), which all belongs to the non-standardized interviews, these non-standardized
interviews can be as the method of collecting qualitative primary data.

The first type of the interview is called structured interviews, it represents the question list contains questions which is in a predefined sequence. In the question list, regardless of the respondents, the problem was fixed and voice recording was usually performed. Structured interviews are commonly used to collect data for the conduction of quantitative research (Saunders et al., 2016). The second type is called semi-structured interviews. It contains the same of further more questions compare with structured interview, but the interviewer can make necessary adjustments flexibly, based on the actual situation, such as adjusting the sequence of questions. There are also no fixed requirements for the manner in which the respondents answers, or the way the interviews are recorded, these can be call flexibly handled according to different situation. The third type is called unstructured interviews or in-depth interviews. In this type of interview, the research and the data collection are often conduction in a ‘conversational’ way. Usually there isn't a questionnaire with predefined questions, but only one general discussion area related to the topic and research question. Compared with the other two types of interviews, unstructured interviews reflected more flexibility and creativity of the researchers and respondents. The data and information obtained from unstructured interviews are usually suitable for qualitative research (Saunders et al., 2016; Bryman and Bell, 2015).

**Secondary data**

Saunders et al. (2016) define secondary data as “Data used for a research project that were originally collected for some other purpose”. There are three classification of secondary data according to Saunders et al. (2016), documentary secondary data, survey-based secondary data, and multiple-source secondary data. These secondary data can be obtained from different sources to support researcher’s problem investigation. Documentary secondary data can be both text form and non-text form, such as the books, journals, newspapers articles, and voice record, videos, pictures (Saunders et al., 2016). Survey-based secondary data are commonly refer to the
organizations, that collected through survey strategy. And multiple-source secondary data include the integration of two types of secondary data above.

2.7.1 Data collection method of the paper

This paper will collect both primary data and secondary data for conduct the research question investigation. For the primary data collection, interview method will be used. The interview will be conducted in the type of semi-structured interview, different questions will be set, and some of these questions will be selected and chosen during the interview, based on the situation. The interview are not face-to-face but will be done through telephone or Skype, since the respondents will be the managers or employees in the third party logistic providers company in China. Voice record will be done and the transcription will be translated. The secondary data will be collected through scientific articles from journals and books, also annual reports and official websites from Chinese 3PL providers companies. The collection of primary data and secondary data will be a significant contribution to the analysis part of the paper, from empirical perspective.

2.8 Respondents of interview

For the first company, SF Express, there are two interview respondents. The first respondent is Mr. Fang Yaozong, which will briefly referred as Mr. Fang in the paper, who work as the customer service manager in the logistics department of Beijing SF Express Company. The second respondent was reluctant to disclose his name, so the paper will handled it in anonymously way, so called Mr.A in the paper. He is a warehouse employee from a SF Express warehouse in Beijing. Most of our empirical data and information are gathered from the interview of these two respondents, but for some detailed numerical information, respondents can't provided it accurately. The authors are guided by the respondent and obtained theses numerical data from the company's annual report. There will be distinguish of the source of information in the article.
For the second company, YTO Express, one interview respondents helped us to conducted the interview. Mr. Luo, who work as the customer service manager at Shanghai YTO Express. Mr. Luo has provided us with great help for all aspects of YTO Express information. Similarly, detailed numerical information are obtained from the company's annual report and official website. The interview guide and the question list for semi-structured interview has been presented in appendix 2.

2.9 Sampling method

Sampling is a method that researchers use for selecting the representative group of population from the whole population, as the “sample” (McLeod, 2014). Sampling methods can be mainly divided into two way, probability sampling and non-probability sampling. Probability sampling is the random selection of samples so that all samples in the population have the same probability of being selected. As mentioned by Bryman and Bell (2015), This method keeps errors and sampling biases to a minimum level, also it can ensure the research findings with a higher level of reliability. Authors have also mentioned that, probability sampling can be categorized as four types, that are simple random sample, systematic sample, stratified random sample, and multi-stage sampling and cluster sampling (Bryman and Bell, 2015). The second way of doing sampling is called non-probability sampling. In non-probability sampling, not all samples in the population have the same opportunity to participate and being selected, it means that only certain special samples have the opportunity to participate in the study (Saunders et al., 2016). The selection and judgment of the sample is usually based on the researcher's purpose, research questions, and investigation problems. So this characteristic will make most of the non-probability sampling methods involves the subjective judgments of the researchers.

2.9.1 Sampling method of the paper

As the paper mainly focuses on the third-party healthcare logistics in China, the paper will select one or two representative third-party logistics provider companies in China,
as the respondent of the interview and the source of data. So the sample method will be conducted as non-probability sampling method.

2.10 Data analysis method

According to Yin (2014), there are 5 different types of data analytic techniques, which refers to the data analysis method in the paper, which are pattern matching, explanation building, time-series analysis, logic models, and cross-case synthesis (Yin, 2014).

**Pattern matching**

As mentioned by Yin (2014), when researchers are using the case study research strategy, the most suitable techniques for the data analysis of case studies is using pattern matching. It is a model that a descriptive predicting explanations is provided before the data collection, and compared with the finding of case study investigation. In pattern matching method, the researchers compare and link the theoretical framework of the research with the collected empirical data to better conduct the investigation, and also, through the results of the comparison, the internal validity of the case study can be well enhanced (Yin, 2014). Furthermore, when a descriptive predicting explanations can be matched with the findings, an evidence of the correct explanation for the findings will be shown clearly (Saunders et al., 2016).

**Explanation building**

Explanation building can be define as an special form of pattern matching. Explanation building method usually first explains and describes the collected data, and through these explanations and descriptions, the research in the case is well conducted and build (Yin, 2014).

**Time-series analysis**

Time series analysis can be well implemented into the studies that need to track the changes of variables over the time. When this “tracking” becomes more detailed, a more solid foundation of the case study will be provided (Yin, 2014).
**Logic models**

As quoted by Yin (2014), Logic models technique has become increasingly useful (Mulroy and Lauber, 2004). And it also can be define as another form of pattern matching. The difference is that in this method, the causal effect is highlighted. The events occurring in one phase will be treated as an independent variable in the next phase. The requirements for the sequential of the phases and the mutual dependency between variables is the characteristic of logic models (Yin, 2014).

**Cross-case synthesis**

Not similar to the other data analysis method, cross-case synthesis is only suitable for the analysis of multiple cases, which including at least two cases. Research on multiple cases can reinforce the research findings by doing the comparison between different cases (Yin, 2014).

**2.10.1 Data analysis method of the paper**

Pattern matching data analysis method would be the suitable data analysis method for the paper. This paper combines the theoretical framework of the study with empirical data collected from the company through interviews. By combining analysis the data collected from Chinese third-party logistics providers, and theoretical concepts in logistics, as well as healthcare logistics, to conduct a better analysis of what should be done in Chinese third-party logistics provider companies to adapt to healthcare logistics sectors in China, with a theoretical basis.

**2.11 Scientific credibility**

In business research, two most emphases that need to be considered is reliability and validity (Saunders et al., 2016). These factors are closely related to the quality and credibility of the research.

**Reliability**
As mentioned by various academic scholars, reliability are always considered as the criteria for the repeatable trusty of research findings (Bryman and Bell, 2015). It can show that if the findings of the research are accurate and reliable, and can be used for the future study. Based on Saunders et al. (2016), there are usually four types of threats that may affect the reliability of the research findings. The first threats are subject or participant error, which means that the respondents' subjective emotions will affect the accuracy of the findings. And the threat of subject or participant bias, which means that respondents may not dare to present their true ideas because of the awareness or pressures from their bosses or company's superiors, it may affect the correctness of the finding result. The third kind of threat is observer error, which means that researchers with different ways of asking questions, may bring different answers from respondents, and this may lead to different research findings. And the last threat is called observer bias, which means that different researchers may have different interpretations of respondents’ replies. For handling these threats, choosing a suitable interview time, make the record of the interview and do the anonymity for respondents will reduce the uncertainty from participant error and bias. Highly structured interview questions, especially in structured and semi-structured interviews, will reduce uncertainty and threats from the perspective of the researchers themself (Saunders et al., 2016).

**Validity**

The consideration of validity is also an important part of research quality and credibility. As mentioned by Bryman and Bell (2015), validity of the research is about the integrity of the findings and the research. There are four types of validity for the research, that are the measurement validity, internal validity, external validity, and ecological validity. The measurement validity are primarily applied to the quantitative research in social scientific area. It mainly considered about the correctness of the correlation between the operational measures and methods that being used in the research with the topic and concept from the research. Internal validity are mainly considered of the causal relationship of different variables, such as the affect between
different chosen variables. External validity concerned with if the finding can be generalized beyond the current investigating research, and it also indicates the importance of the selection of the research participants. Ecological validity are mainly concerned with whether the research method is consistent with the reality, and whether the finding of the research can be applied in reality situation (Bryman and Bell, 2015).

2.11.1 Reliability of the paper

During the data collection process, interviews were recorded and anonymous measures were taken into account, to ensure the authenticity of the data and information obtained from the interview. The article adopts a semi-structured interview method. Along with the highly structured interview questions for different respondents, to ensured the flexibility of the interview as well as reducing the uncertainty and threats of reliability.

2.11.2 Validity of the paper

Various factors have being considered to ensure the validity of the paper. The main research area is Chinese healthcare logistic sectors and Chinese 3PL providers, as presented the strongly demand of Chinese healthcare logistic for the 3PL’s involve, problems in a reality are raised. The elaboration of the requirements of healthcare logistics, and the adjustments that Chinese 3PL providers need to make, will serve as the finding to answer research questions. Different proposals can be realistic applied in Chinese 3PL provider companies in the future.

2.12 Ethical considerations

The ethical considerations of business research can been defined as the right behavior of the researcher to the context of the research, the subject of the work, or the affected person's rights (Saunders et al., 2016). Ethical issues arise at all stages of business
management and research, so ethical considerations are particularly important in the process of research investigations. As mentioned by Bryman and Bell (2015), that ethical consideration will directly affect the integrity of the research (Bryman and Bell, 2015).

Diener and Crandall has mentioned that the consideration of business research ethics is generally divided into four aspect. The first is the consideration of whether the participant will be harmed, which means that whether the research will affect the self-esteem or career development and employment prospects of the respondents. Moreover, Emotions of respondents should also be considered in the perspective of ethics (Diener and Crandall, 1978). The second consideration should be regarding the lack of consideration of informed consent, just as mentioned by Bryman and Bell (2015), in many ways, the issue of informed consent should be concerned in business research ethics. The third is the consideration of whether there is a violation of privacy. The main consideration is to focus on whether the researcher infringes on the privacy of the respondents in the name of research, and this is unacceptable (Bryman and Bell, 2015). The unsuitable attitude, behavior, etc. of the researcher in some cases are considered as the infringement of respondent’s privacy. The last consideration is whether or not the research contains deception, deception usually occurs when the researcher presents the research findings as something other than original information. In addition to the four aspects described above, the protection of data, the reciprocal relationship between researchers and respondents, as well as the conflict of interests, also need to be involved into the ethics considerations (Bryman and Bell, 2015).

2.12.1 Ethical considerations of the paper

Each stage of this paper will incorporate the considerations for business ethics. Including the interviewing stage, the data collection and processing stage. The author will introduce the details of the content studied in this report, to ensure that respondents can clearly understand the purpose of this report and respond in a right way. In order to take care of the interviewee's feelings, the interview will be
conducted in a gentle manner. And through the negotiate with the respondents, to ensure that if the data obtained, the personal information of the respondent, or details of the company needs to be processed anonymously. Also, the transcription or the answers of the questions will be presented after the translation from Chinese.

2.13 Summary of methodology

The summary of methodology chapter is presented in the form of a table. In chapter 2, by learning and introducing different methodology methods, the author selected the appropriate methodology method for this paper. Through the selection of these methods, the process of this paper will be clearly demonstrated.

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Methodology selection in this paper</th>
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<tr>
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<tr>
<td>Scientific approach</td>
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</tr>
<tr>
<td>Research method</td>
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<tr>
<td>Research strategy</td>
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<tr>
<td>Scientific credibility</td>
<td>Semi-structured interview recording; Adjustment in Reality for Chinese 3pl providers;</td>
</tr>
</tbody>
</table>

*Figure 3: Methodology selection of the paper*

Based on the methodology used in the paper, and the research onion model developed by Saunders et al. (2016), the research onion of the paper has been shown in the figure form in figure 4 below (Saunders et al., 2016). This figure shows the process of the building of the methodology, from the starting point of a phenomena in reality, to the selected method in each phase. The “out-side-in” structure of each square are in the same logic as Saunders et al.’s original research onion model. The selected method
was underlined in each layer.

Figure 4: Research onion model of the paper based on research onion model by Saunders et al. (2016)
3. Literature review

Literature review chapter contains the information as the theoretical foundation of the paper. Relevant theory for the research topic and research questions has been presented. In healthcare logistic section, the warehousing, transportation of the pharmaceutical product has been presented as the theoretical bases. Different requirements and technologies are presented in the form of theory to support the analysis of research questions. Moreover, the theory of third party logistic and 3PL providers will be present, also as the support of research questions. At the very beginning, is the analysis model of the paper.

![Figure 5: Analysis model of the paper](image)
3.1 Healthcare logistics

In recent years, increasing attentions on the healthcare logistics are evident on various research. The logistic related functions act as an important role in medical industry and healthcare systems. Just as the definition and concepts of logistics, the purpose of healthcare logistics is also to deliver the correct quantity of healthcare products to customers at the correct time. Additionally, in healthcare logistic the involvement of healthcare or pharmaceutical products are required to be accompanied by the acceptable quality and also meet specific healthcare sector standards, moreover, make benefits for both parties (Kafmann, et al., 2005).

The pharmaceutical industry has a fairly high standard for logistics activities. Unlike other industries, healthcare logistics often requires higher security, faster delivery dates, or special storage conditions when transporting and warehousing (Roodbergen et al., 2014). From a worldwide perspective, healthcare logistics has an formalized industry standards. Good Distribution Practice (GDP) guideline and Good Manufacturing Practice (GMP) guideline are two industry standard guidance issued by the World Health Organization (WHO). The entire process of healthcare logistics including warehousing, transportation, and equipment needed has been detailed stipulated, so that let the healthcare logistics industry to have a unified implementation of standards and specifications (World Health Organization, 2010). In 2010, based on the guidance of the WHO's standards, China revised its own industry standards and rules “Good Supply practice (GSP)” (Gov.cn, 2012), which will be introduce detailed in chapter 4.2.1.

Based on different rules for healthcare sector issued, the main activities included in healthcare logistics are warehousing, transportation and distribution of pharmaceutical products (World Health Organization, 2010). In these activities, WHO has stipulate appropriate steps and behaviors to help fulfill the responsibilities involved in different aspects. The activities of healthcare logistic which investigate in this paper and different technologies involved, are mainly focus on warehousing, transport, and
distribution of pharmaceutical product.

3.1.1 Cold chain logistics

The definition of cold chain is similar to the normal supply chain. It is a kind of behavior that starts from the manufacturer to deliver the goods to the end user. In the process of transportation and warehousing, it is necessary to control the products status at a low temperature in every phase, to ensure the effectiveness of the product being stable (Kafmann, et al., 2005). It contains different infrastructure related to storage or transportation (World Health Organization, 2011). Because the pharmaceutical industry has many temperature-sensitive products containing active ingredients, so the cold chain is widely used in the healthcare sector. Due to the particularity of the products targeted by the cold chain, appropriate measures should be taken to ensure the safety and effectiveness of the product in storage and transportation, or every other phases (Yoon, 2014).

The logistics activities of the pharmaceutical product in healthcare logistics have various types, it usually depends on the characteristics of the pharmaceutical product and its storage method. There is no special requirement for ordinary pharmaceutical product, which includes the tablet medicine and other medical equipment, most of them requires the attention of moisture, light, and sealing. But for special type of pharmaceutical product, which includes injections, vaccines, and blood products, etc., there must be special attention (Roodbergen et al., 2014).

3.1.2 Warehousing of pharmaceutical product

Warehousing is an important part of the logistics. For the aiming of the logistic function to providing the right products to the right customers at the right time, warehousing has become an important consideration as one of the key concept in logistic functions (Roodbergen et al., 2014). According to Schönsleben, et al. (2016), the underproduction of the pharmaceutical products has been an critical threat to the
public health sectors. To overcome the threat, many pharmaceutical manufactures has expand their supply chain which means to expand their production site, more production, warehousing activities are conducted at different sites (Schönsleben, et al., 2016). For complex supply chain cycles, which means that more warehousing activities are being demanded, and this also requires that warehousing for the pharmaceutical industry needs to be kept in the best condition (Roodbergen et al., 2014).

Warehousing of pharmaceutical products is not only for the storage of products, some of the special provision and rules of medicines, vaccines and blood production is very important, and even has the significance of life-saving (World Health Organization, 2010). Different considering warehouse conditions, for example, for vaccines and blood products needs to be stored separately with special conditions, or for flammable and explosive productions that also need to be stored separately (World Health Organization, 2010). The use of different advanced technologies to manage warehouses can also help to ensure both the effectiveness and security of pharmaceutical products. In the warehousing section of the paper, the theoretical of warehouse conditions for pharmaceutical product, and warehouse management system & method will be presented.

3.1.2.1 Warehouse conditions of pharmaceutical product

In the current pharmaceutical industry, more and more pharmaceutical products need to be stored under controlled conditions, different products need to be stored under the manufacturer's requirements such as different temperature or humidity conditions to maintain their effectiveness (Roodbergen et al., 2014). According to the World Health Organization's storage guidelines for the pharmaceutical production, there is a clear requirement for the storage of different productions, and the temperature in the temperature control zone should be maintained (World Health Organization, 2011). The guideline from WHO has clarify some products with high risk such as vaccines, blood products or insulin, needs to be placed in the freezer or below 0 degree in the
frozen room, once the temperature is over or below a defined temperature, will cause irreversible damage of the proteins in these products, and it will causing great harm to the users (World Health Organization, 2011). Therefore, some related temperature testing equipment or temperature measuring devices are used to ensure the safety of medicines or vaccines, and to ensure that the temperature of the drugs in the storage area is within a reasonable range according to the manufacturer's requirements (Gov.cn, 2012).

3.1.2.2 Warehouse management system and warehouse technologies

For pharmaceutical products and healthcare sector, as a special industry, the use of different advanced warehouse technologies and warehouse management system can help ensuring the the safety and effectiveness different types of pharmaceutical products. This section will focus on different system and technologies that can be used in the warehousing function of healthcare logistics.

**Warehouse Management System (WMS)**

As well as the warehouse conditions, an effective warehouse management system is another important consideration for warehouse management (Scioscia, 2014). Warehouse Management System (WMS) is a system which supports specific planning needs. Based on Jonsson (2008), there are generally six functions included in the WMS, including good reception functions, putting in stores functions, stock management functions, order reception and order picking functions, dispatch functions, and materials management functions (Jonsson, 2008). Various functions of the WMS system can help the organization manage the warehouse systematically. At the same time, the mastery of the WMS system by the warehouse staff is another key factor (Scioscia, 2014).

**ERP system**

ERP system is widely used in companies worldwide as an enterprise resource management system. According to Rosemann et al. (2005), ERP is a business operating system, and it has the functions to support core business, such as the process
from procurement to production, and cost management and human resources management to improve business efficiency and flexibility (Rosemann, Themistocleous, and Loos, 2005). The main function of ERP is to integrate a cross-functional information system with a business information system and achieve information sharing in each organizational departments (Murthy, 2008).

**Electronic Data Interchange (EDI)**

Electronic Data Interchange (EDI) technology is an information sharing technology that can rapidly deliver business information between company and suppliers, therefore, as a retailer, they usually use EDI technology to interact with suppliers and share demand information (Aviv, 2001). Since information is passed through the computer, EDI has a faster response time, which can greatly improve the efficiency of information transfer, accompanied by a relatively small error rate, so EDI technology can contribute to the standardization of information and shorten the payment cycle (Holmström et al., 2002). The use of EDI is not only for trade activities, some hospitals have also begun to use EDI as a means of information transfer and sharing (Han and Dong, 2017).

**Bar code technology**

Bar code technology is broadly used (Tietz, 1992), and it can increase the efficiency of information delivery and also enhance the accuracy of information. Nowadays, bar code technology has been widely into warehousing and transportation, it can guarantee the efficiency of product flow in the warehouse, so bar codes as a tool to manage inventory can achieve information sharing among various departments of the company (Sudsertsin and Sooksaksun, 2014). Bar code is a way of automatic information identification, it can automatically upload the data, through the scanning using the hand-held terminal. As mentioned by D'Hont (2006), although bar code technology is not costly for implement, but there are still some disadvantage, of the close scanning range and lack of automatic tracking function (D'Hont, 2006).
**RFID technology**

RFID technology is an abbreviation of Radio Frequency Identification, which is an advanced wireless communication technology. In the use of RFID technology, it usually contains four elements, RFID tags, RFID readers, antennas radios, and a computer networks. Unlike traditional code scanning method, the combination of the four elements in RFID technology makes it possible to achieve the indirect contact between different objects for information exchanges, only a certain range is needed (Garfinkel and Holtzman, 2006). There is no need to identify objects through contact, but the collection and transmit of the data are through radio frequency. RFID tags are placed on each product or tray for automatic tracking or scanning (Sudsertsin and Sooksaksun, 2014). RFID tags can be read in any situation, unlike bar code technology, which can only collect information through the scanning from specific angle, so RFID can manage the data in the warehouse more effectively (Sudsertsin and Sooksaksun, 2014).

**Walk-in cold room technology**

In the WHO’s guideline for the pharmaceutical warehouse design, the Walk-in cold room technology has been mentioned. This technology includes different air conditioning equipment as the refrigeration unit, air conditioning equipment has been used in the cold storage area, and temperature transportation technology has been used. The waste heat generated by the refrigerator is transferred to a general warehouse as a secondary use of heat energy. Since the floor of this area is made of insulating plates, so it can only withstand trolleys or walks, but not withstand heavier mechanical equipment (World Health Organization, 2011).

**3.1.3 Transportation of pharmaceutical product**

Unlike traditional logistics, for the transportation of pharmaceutical product in healthcare logistics, the delay in transportation or the product quality problem within the transportation process, may have a serious impact on the health, and even the lives
of patients (Markarian, 2015). Pharmaceutical product transportation should follow the principles of efficiency, accuracy, safety and economical (Ahmed et al., 2010). In order to standardize the pharmaceutical product transportation behavior and ensure the quality of pharmaceutical product delivery, World Health Organization (WHO) has set out a rules for pharmaceutical product transportation within GDP guidelines (World Health Organization, 2010).

Because some pharmaceutical products are different from ordinary products, the factors of safety usually need to be considered in the process of transportation in healthcare logistics. In GDP guidance issued by the WHO, there are also many safety considerations that need to be complied with. For example, transportation personnel need to understand the characteristics of goods in the process of loading and unloading, if they can not be crushed or rubbed; Ensure that chemical products can not be damaged to prevent environmental pollution; For flammable and explosive, radioactive products, or pressurized gas, should be stored separately with special conditions (World Health Organization, 2010).

Pharmaceutical manufacturers or transport companies should be equipped with transportation facilities and equipment that are in line with the scale of operation and meet the requirements of pharmaceutical product quality. Such as using various transportation equipment that have temperature, humidity, and other storage conditions in controlled and monitored. Especially for cold-storage required pharmaceutical products, more advanced cold chain technology has been demanded (World Health Organization, 2010).

3.1.3.1 Transportation equipment

In the transportation of pharmaceutical products, the demand for transportation equipment is mainly targeted at special types of products such as injections, vaccines, and blood products. The common feature of these pharmaceutical products is that they belong to temperature-sensitive pharmaceutical products (World Health Organization, 2011, No. 2). Advanced technology needs to be applied to transportation equipment.
As the product itself becomes more complex and diversified, related transportation technologies must be more advanced to give support (Markarian, 2015). Based on the World Health Organization (WHO) ’s guidelines, the recommend temperature for low-temperature needed pharmaceutical products are between 2-8 ° C, during in-country distribution (World Health Organization, 2010). Therefore, the main considerations in the transportation process are what forms of transportation equipment and technologies can be used, that can adapted to the requirements of healthcare logistics.

In road transport, truck transport is the main mode of transportation in various industries, and refrigerated truck represent one classification of different trucks, which has been widely used in healthcare logistics (See Appendix 2.1 & 2.2). This type of truck is usually equipped with a air-conditioning equipment which serves as a recirculating in-truck space cooling, and the truck wall has equipped with a structural insulated panel (SIP) to reduce the conduction of temperature (Ahmed et al., 2010). The function of this type of truck is to maintain the temperature of the goods. The refrigerated truck used in healthcare logistics usually meet the temperature requirement of 2-8 ° C based on World Health Organization (WHO)’s guideline. Another type of healthcare logistics transport container used is the temperature-controlled container (Fitzgerald et al., 2010), which is normally used in air transport, road transport, and sea fright.

### 3.1.3.2 Monitoring system in pharmaceutical transportation

During the transportation of pharmaceutical products, the status of the products needs to be monitored to ensure the quality (Markarian, 2015). As mentioned in different research, the monitoring methods during transportation are mainly carried out through advanced information systems (Markarian, 2015; Marder, 2017; Garfinkel and Holtzman, 2006; Li and Chen, 2011; Abad et al., 2010)).

**RFID**

Just like the RFID technology mentioned in the warehousing section, it can also be
applied to transportation process. In the transportation process of healthcare logistics, RFID technology can provide temperature monitoring within temperature-controlled trucks (Li and Chen, 2011). RFID tags can be used for temperature measurements, which are collected by temperature recording instruments and uploaded to transport centers for real-time monitoring (Abad et al., 2010). Another advantage of RFID technology is that each packet can be individually tracked and identified, and a notification signal will be sent when the temperature condition is abnormal (Garfinkel and Holtzman, 2006).

**Geo-fencing technology**

Geo-fencing is a technique for dividing a region on a map. Through computer processing, Geo-fencing technology can draw a virtual border on the map, when a truck equipped with a sensor enters or leaves the area, there will be a notification or warning being sent (Marder, 2017). In healthcare logistics, there are some types of pharmaceutical products, such as Oxycodone as anesthetic and psychotropic drugs, which need to ensure the safety of transportation routes to prevent illegal activities.

### 3.1.4 Distribution network of of pharmaceutical product

As mentioned by Jonsson (2008), the general definition of the distribution is a tying together flow of materials and information transferred between manufacturing companies and consuming customers (Jonsson, 2008). And as defined by Taylor et al. (2004), distribution network of of pharmaceutical product includes different phases, different roles, and the value transactions process of the medicines, between pharmaceutical companies and patients, and the aim of the distribution network of pharmaceutical product is to make everyone could be reasonable access to quality medicines (Taylor et al., 2004). From a theoretical perspective, as mentioned by Jonsson (2008), there are three main types of the distribution channel for industrial goods, with different numbers of intermediaries, the first one is from manufactures to customers directly; The second one is from manufactures to industrial distributors and then to customers; And the third type is add in the involvement of the representatives
agent in the second process and before the industrial distributors (Jonsson, 2008). Although there are different types, but normally the involved character can be the manufactures, customers, and intermediaries. The distribution network for pharmaceutical products are usually complicated. The time required for medicines from R&D to production and then to the market is usually takes around 15 years Schönsleben, et al. (2016). There are also many links and functions involved, because this paper mainly discusses the healthcare logistics which doesn’t contains the production stage of the product, so based on different literature, the paper summarizes the two patterns of distribution network of of pharmaceutical product.

According to Schönsleben, et al. (2016), typical distribution network of of pharmaceutical product could have five stages, primary manufacturing producing the active pharmaceutical ingredient (API), secondary manufacturing formulating the product, such as producing the tablet, packaging functions, distribution center, and to the customers organizations (Schönsleben, et al., 2016), as shown in figure 6 below.

*Figure 6: Typical distribution network of pharmaceutical product*
3.2 Third party logistic

Third party logistics (3PL) are also called outsourcing logistics or subcontracting logistics (Berglund, 1997). Based on the definition of Virum (1993), third-party logistics refers to the behavior of the third-party company that is independent from the production provider and production customer, and to completes the logistics function activities based on the signed contract within a certain period of time (Virum, 1993). More companies are beginning to realize that the strategic value generated by the logistic function is as important as the company's core business itself, which makes the strategic position of the logistic function gradually improved (Mohammed and Chang, 1998). Nowadays, third-party logistics service are widely used by companies worldwide (Kabir, 2012).

3.2.1 Types of 3PL providers

Third-party logistics providers can usually be divided into two categories: asset-based third-party logistics providers and non-asset-type third-party logistics providers. For asset-based third-party logistics companies, they have their own transportation equipment and warehouses, that can directly provide customers with transportation and warehousing services. Non-asset based third-party logistics providers are more tend to be the resources service provider companies. They do not have their own fixed assets such as transportation tools or warehouses. Therefore, this type of third-party logistics company cannot provide services such as transportation or warehousing for customers, but it can provide advanced technologies through advanced management methods, abundant resources and high-quality human resources (Berglund, 1997).

3.2.2 Reduction of operational costs

Third-party logistics services can help reduce the operating costs of the company, mainly through two aspects. First, asset-based third-party logistics companies usually have complete transportation equipment and warehouse facilities, that can provide
comprehensive warehousing and transportation services for their customer, while non-asset third-party logistics companies can usually provide relevant resource to help companies find the most suitable transportation equipment and storage facilities (Berglund, 1997). Therefore, for companies using third-party logistics services, the operational cost and capital investment such as salary of logistics personnel, employees training costs, and purchase of transportation trucks, and warehouse construction (Long, and Lin, 2011). The second aspect is that the integration function of information technology of third-party logistics providers can help reduce the operating costs of enterprises (Rahman, 2011; Zacharia, Sanders and Nix, 2011). According to Han (2005), the integration of information system by third-party logistics providers can greatly reduce information asymmetry and reduce transaction costs. There are many unnecessary distributors in the circulation link which leads to an increase in operational costs. The integration of information system is mainly aimed at on-time production, warehouse management, customer order management, and goods transportation, through the information system integration function of third-party logistics companies, the reduction of distributors will increase profits for the upper-stream companies. And since the information system is attached to the computer network, it also avoids costly mistakes (Han, 2005). Qualified third-party logistics providers, from another perspective, can contribute to reducing company’s operating costs. The rapid flow of information through third-party logistics, as well as modern logistics technology, can help companies achieve JIT production and delivery. As a result, companies can organize the production and delivery according to the order, so that the storage capacity of the warehouse can be greatly reduced and the inventory cost can be saved (Kreng and Wang, 2005).

3.2.3 Simplification of distribution channels

Third party logistic providers can help the company do the simplification of distribution channels, in essence, an enterprise which has an advantageous distribution network will enhance its competitive advantage (Zacharia, Sanders and Nix, 2011).
According to Langley et al., (2009), in the aspect of third-party logistics participating in the simplification of distribution channels, there are usually four important roles exist, as suppliers, manufacturers, distributors and customers, and the behaviors included material flow from suppliers to manufacturers, as well as manufacturer-to-distributor, distributor-to-customer flow of finished goods, and warehousing behavior at all stages. Among these behaviors, third-party logistics providers do not only provide storage and transportation activities for goods but need to play an active role in the integration of supply chain networks (Langley et al., 2009). For simplifying the distribution channel, third-party logistics providers can often simplify the links by replacing the role of distributors, naturally, third-party logistics providers need to undertake warehousing and transportation activities among them. (Yi and Wei, 2004).

3.2.4 Integration of information system

According to Yan, Gui and Sun (2006), in traditional logistic type supply chain, there are some obstacles and drawbacks during the transmission of information, which requires a third party logistics provider to intervene and integrated the information (Yan, Gui and Sun, 2006). As more and more economic integration is being presented, more and more companies have chosen to use advanced management tools for information integration from third party logistics providers to improve their competitiveness. For the entire supply chain, third-party logistics providers with advanced information technology can link information networks between suppliers, manufacturers, wholesalers, and retailers in both upstream and downstream supply chain. This kind of link and convergence can simplify the overall supply chain, and also bring a strong competitive advantage for the company (Sinkovics and Roath, 2004). Third party logistics plays an important role in the transmission and integration of the information system, with advanced information systems, the transmission of information can be accelerates, according to Lan (2004), many companies are linking the information of transportation, warehousing, loading, unloading, processing, and
distribution, through the integrating of information system, it led to a significant increase in product flow efficiency (Lan, 2004). Also, advanced information systems better enables the information sharing among enterprises. Third party logistics providers has a high degree of information sharing with their customers, information regarding different logistics process can be transparently exchanged and shared (Berglund, 1997). Third party logistic providers have more advanced information technology regarding the logistic functions, these advanced information systems can help companies improve efficiency (Van, 2008). Some advanced information technologies can help third-party logistics providers to integrate information more efficiently. Some advanced information technologies such as Electronic funds transfer (EFT), financial EDI, and other auxiliary programs, which Electronic funds transfer (EFT) is a technology that can realize quick payment. It can speed up the input of information, for example, the rapid recognition of bar code, or the realization of growth for online transactions (Yan, Gui and Sun, 2006). These advanced information systems have a very positive effect when the third-party logistics integration of the information system network, and help third party logistics to achieve low error rate of information handover.

3.2.5 Improve core competitiveness

With the changes of the market environment, the competition between companies are gradually intensifying. For the company itself, if they want to strengthen their own core competitiveness, they need to strengthen the management of the supply chain network (Lan, 2004). For the traditional first party and second party logistics form, can no longer meet this demand. For the product flow, information flow and capital flow in the supply chain, some non-core business affairs such as the logistic functions will make it difficult for the company to focus on the development of its core business (Long, and Lin, 2011). Whether to the asset-based or non-asset-based 3PL providers, companies which using 3PL service that can outsource the logistics functions that are not their core business. Through three points above, the reduction of operational costs,
the simplification of distribution channels, and the integration of information systems will both help the company's core business to become more efficient. The benefits for third-party logistics providers for the company is their professional transportation equipment and storage facilities, to helps the company handle their logistics-related functions. And, according to Jung (2017), third-party logistics companies usually have lots of investment in employee training and internal learning, not only for the professionalism of the company and the guarantee for future development, but also for the employees career development from the perspective of social sustainable (Jung, 2017). So third party logistics providers could help company to keep more attention on their core business and better manage supply chains to achieve their strategic goals (Rahman, 2011; Zacharia, Sanders and Nix, 2011).
4. Case description

This chapter contains the information about the current situation of Chinese healthcare sectors, through the description of current pharmaceutical distribution channel and different characters involved, and helps investigating the research questions. Furthermore, the description of policy factors and the status of 3PL providers in Chinese market has been presented.

4.1 Current pharmaceutical distribution network in China

Based on the data of October 2017, the revenue of China's pharmaceutical manufacturing industry in 2017 was 24102 billion yuan (approximately 3170 billion Euros), which has an increase of 13.10% compared to the year 2016. The total profit was 2713 billion yuan (approximately 356 billion Euros), which was an increase of 18.20% compared to the year 2016 (CHYXX, 2018). So it can be seen that the rapid development of Chinese pharmaceutical industry.

In the following section, paper will discuss the current situation of three different character, pharmaceutical manufacturers, pharmaceutical distributors, and hospitals in Chinese pharmaceutical distribution network, thus to get a better understanding the entire distribution network.

4.1.1 Pharmaceutical manufacturers

For pharmaceutical manufacturers in China, there are usually use two kinds of distribution methods which the first one is to distribute directly from manufacturers to hospitals, and the second one is to distribute the pharmaceutical products to the distributors. In these two distribution methods, pharmaceutical manufacturers not only take care of the manufacture activities themselves, but also take care of the warehousing, transportation, and distribution functions. As mentioned by Yang et al. (2005), after China's accession into World Trade Organization (WTO), more and more
pharmaceutical manufacturers believe that there are huge gap between themselves and some multinational pharmaceutical manufacturing companies, such as pharmaceutical innovation, technology development and some core production operations (Yang et al., 2005). In terms of logistics related costs, based on the investigation of China Association of Pharmaceutical commerce (CAPC), in 2016, the average logistics cost of Chinese pharmaceutical manufacturing companies is about 10% of the total cost, while the profit margin was only 0.6% to 0.7% for logistics functions, compared with the level of developed countries, the Chinese pharmaceutical manufacturing companies have very low return on investments of logistics function (CAPC, 2016). According to Hong and Neng (2011), Chinese pharmaceutical companies' innovation capability is significantly lower than that of developed countries. For the same pharmaceutical raw materials, Chinese pharmaceutical companies can produce an average of five types of drugs, and this data in the United States, is 23 types of drugs that can be produced from each raw material (Hong and Neng, 2011).

The two major categories of distribution methods currently used by Chinese pharmaceutical manufacturers are divided based on the type of medicines, which generally classified into two categories: ordinary type drugs and vaccines. ordinary type drugs can be divided into prescription drugs, which need to be purchased on the basis of prescriptions from the doctor or doctor's assistant; and Over-the-counter drugs (OTCs), which do not require a prescription, patients can make purchases on their own discretion (Yu et al., 2016). For prescription drugs and over-the-counter drugs, they will be produced by the manufacturer and sent directly to multiple distributors in various provinces in China, and then distributed by provincial distributors to the municipal level distributors or lower level distributors, and finally to various hospitals or retailers (AT Kearney company, 2012). The second type of pharmaceutical product is vaccine products, for this type of product, there are two distribution models based on the type of the vaccine. The first type of the vaccines are free provided to the public, as shown in figure 7, this type of vaccines will be transferred directly from the manufacturer to provincial disease control centers and then distributed to municipal
level disease control centers or lower level disease control centers. The second type of the vaccines which refers to the kind of vaccines customers need to pay for, it will be distributed through the municipal or provincial Centers for disease control (CDCs) at all levels and then distributed based on prescription or over-the-counter classifications (AT Kearney company, 2012).

![Diagram of vaccine distribution]

**Figure 7: Pharmaceutical distribution from manufactures (AT Kearney company, 2012)**

### 4.1.2 Pharmaceutical distributors

In current Chinese healthcare sector, the second character in the distribution network is pharmaceutical distributors. According to (Yu et al., 2016), the role of pharmaceutical product distributors are built as a bridge between the pharmaceutical factory and the patient (Yu et al., 2016). For developed countries market, based on data from 2010, there are 75 large wholesalers of pharmaceutical products in the United States, and the top three of these wholesalers account for more than 85% of the total market share. This data in Japanese market is approximately 147 different distributors, and the top three of them accounted for about 74% of the market share. Based on the survey from AT Kearney company, China had a total number of more than 13,000 pharmaceutical distributors in 2010 (AT Kearney company, 2012).

The sales channels for pharmaceutical products in the Chinese market are usually
delivered through 2-3 intermediaries, and even six different distributors are required for some special products or prescription medicine. Therefore, the complexity of the links has led that, in Chinese market, the distribution costs for pharmaceutical products are more higher compared to other developed countries, according to Kwo (2003), the distribution cost of pharmaceutical product in chinese market is normally higher than 40% of the total cost (Kwo, 2003). In China, these different distributors and wholesalers usually obtain profits through medicine price markups and rebates from manufacturers. The rise in product prices, which is usually 5-10% increase of the original price, in each level of intermediaries (Booz & Company, 2012). Based on the investigation from AT Kearney company, the average price markups of about 8% per distributor is usually divided into different contents. As shown in figure 8, the cost of transportation and warehousing activities, financing operations costs, other overheads, and also about 1% of the profits were added to the product price at each level of intermediaries (AT Kearney company, 2012).

![Figure 8: Composition of an 8% price markup (AT Kearney company, 2012)](image)

Based on the survey named "Pain in the Chain" from UPS, in Chinese market, pharmaceutical products have a high risk of expired and a high risk of failure, in the process of long-term transportation (UPS, 2015). Besides the high risk during long term transportation, other types of the risk are carried out by personnel with lack of
professional skills. In 2016, in Shandong Province, China, there was a group of vaccine products worth about 75 million Euros. During the distribution process, the cold chain transportation which carry out by the personnel which has lack of professional logistics knowledge and experience, has result the vaccine product were not been transport within the required temperature, the transportation process were not carried out in accordance with the prescribed standards, resulting in unqualified products entering the market (National Business Daily, 2016). A survey done by AT Kearney company (2012) shows that, although most of the distributors in the Chinese market announced having different kinds of advanced information technology and systems, but in the sales and logistics function activities, due to the problem of implementation costs and the technical of personnel, these information technologies and systems was not being used, but their existence is just for meet the requirements put forward by the Chinese government or organization, which leads to the product's higher uncertainty and security risks, (AT Kearney company, 2012), such as the occurrence of illegal vaccines case in Shandong province.

4.1.3 Hospital as the retailer

According to Enyinda, et al. (2010), due to the instability and unstable of the infrastructure, social and political factors, for developing countries such as China, there are more uncertainty and weakness part of healthcare sector, including the pharmaceutical product distribution and supply (Enyinda, et al. 2010).

In China, healthcare resources are divided unevenly. Most large hospitals and good medical equipment are distributed among big cities, and over 50% of high-end innovative medicines can only be obtained through these large hospitals. On the other hand, medical centers in small cities and rural areas are usually equipped with poor equipment, medicines, and lack experienced doctors, so this leads to the choice for the most of patients tend to be large hospitals in big cities (Booz & Company, 2012). For the Chinese market, patients' preference place for purchasing over-the-counter (OTC) medicines are hospital rather than retail stores, because they believe that the hospital's
quality of medicines are higher than those of retail stores, so the choice of patients also increases the sales amount and profits of hospital. The profit from medicines has become a major source of income that accounts for more than half of the hospital's total income. Therefore, the stable supply of medicines and the guarantee of the quality of medicines are important factor to the hospital (Yu et al., 2016). However, the reality is that, there is however not enough supply of high-end medicines or new medicines in some large hospitals. Most large Chinese hospitals are unwilling to open their information systems to let the others intervene (AT Kearney company, 2012), but as mentioned by Shao and Ji (2006), the inventory of logistics will directly affect the rapid response and reliability of delivery (Shao and Ji, 2006).

4.2 Current situation of 3PL providers in China

4.2.1 Policy of Chinese healthcare sector

“Two invoice system”

In January 2017, the State Council of the People's Republic of China, together with eight other government departments, jointly issued a new rules for the reform of the healthcare sectors, which called “Two invoice system”. Before the rule was established, as mentioned last section, because of the complexity of the distribution network of pharmaceutical products in the Chinese market, there are often 2-3 or even more than 6 intermediaries in the distribution process, and each intermediaries will result an invoice. From the perspective of invoices, “Two invoice system” rule stipulated the distribution of the pharmaceutical product should be simplified as far as possible into a “two invoice” processes. The first invoice refers to when the medicine was delivered from the manufacturer to the distributor, and the second invoice refers to the invoice when medicine was delivered from distributors to the medical providers, such as hospital or pharmacy. The policy stipulates the number of invoices generated, which is kind of limit the number of middlemen in medicine circulation. The government has stipulated that some large hospitals should first comply with the
“Two invoice system” rule and encourage other organizations to follow (China State Council Medical Reform Department, 2017).

**“Good Supply Practice (GSP)”**

Due to the distinction between specific nature of healthcare logistics and traditional logistics (Yoon, 2014), there are usually special requirements for transportation and warehousing of pharmaceutical products (Blandine, Smail, and Michael, 2018), so special regulations are required for restricts. As mentioned in the Chapter 1, World Health Organization (WHO) has established two regulatory and implementation guidelines for the healthcare sectors, named GDP and GMP (World Health Organization, 2010). Based on these two guidelines from WHO, in 2012, Chinese government has revised its own industry standards and rules which named “Good Supply practice (GSP)”, and implemented since June 2013 (Gov.cn, 2012). Based on the WHO's regulations and combining with the conditions of the Chinese market, the original intention of establishing the GSP specification is to solve the issues related to the quality of medicines in the Chinese market (Gov.cn, 2012). As described by Sun and Jing (2015), the introduction of the GSP standard in the medical field are aiming to improve the access threshold for the healthcare sector and foster the formation of a number of large-scale pharmaceutical circulation enterprises within the country. This means that some small-scale enterprises in the pharmaceutical distribution field are facing to be eliminated or merged (Sun and Jing, 2015). For the third-party logistics providers in Chinese market, the GSP standard is the current access standard for the healthcare logistics industry which must be subject to compliance. Based on the summarize of authors, the provisions of the GSP standard for warehousing and transportation generally include the following aspects:

**For warehousing:**

- The equipment for automatic monitoring and recording of the temperature & humidity of the warehouse; data must be updated in every minute.
- The scale of cold storage that is suitable for the scale and variety of the business,
and the vaccine business should be equipped with more than two special warehouses for medicines.

- The warehouse is divided into shaded warehouses, which the temperature should be no more than 20°C; the cold storage places which the temperature should between 2-10°C; and normal commodities area, which the temperature should between 10-30 °C.

- The relative humidity of stored medicines is between 35%-75% (Gov.cn, 2012).

**For transportation:**

- Refrigerated trucks and truck-mounted refrigerators or incubators are needed.

- Sealed trucks should be used to transport vaccine products.

- Cold transport temperature should between 2-8°C; freezing transport temperature should between -10 to -25°C.

- Before loading, check the start-up and running status of the refrigerated truck, after reaching the specified temperature, the truck can be loaded (Gov.cn, 2012).

### 4.2.2 Multinational 3PL providers in Chinese market

In Chinese market, there are many third-party logistics providers, including Chinese domestic companies, and multinational companies such as UPS. As the world's largest parcel delivery company and the world's major professional transportation and logistics provider, UPS has been involved in the field of healthcare logistics since 2001. Therefore, UPS has a very rich experience in healthcare logistics. For example, for cold chain related business, UPS's Temperature True service will conduct full temperature control monitoring, and the temperature data will be transfer into the global control center. At present, UPS has established more than 50 dedicated pharmaceutical warehouses worldwide, with a total area of 1.8 million square meters (UPS, 2018; Parcelindustry, 2012).

For Chinese market, aAt present, UPS has established 2 dedicate medical storage
.center. In terms of warehouse construction, UPS has collaborated with Global Logistic Properties Ltd., for the construction of the liquid-hardened ground technology, and the high level of the 100,000-grade medicine storage clean-room that exceeds Chinese GSP standards. Just as one of the important principles of UPS: “All jobs are related to Patient, but not just a package” (UPS, 2018; Parcelindustry, 2012).

**Pharma-Port 360**

Pharma-Port 360 is one of the representative container technology created by Cool Containers company for UPS (See Appendix 2.3). It is a container with temperature control function and is battery-powered, it can continuously control the temperature for up to 100 hours. Pharma-Port 360 is equipped with integrated environmental sensors and GPS communications capabilities, that can help the user to monitoring internal temperature during the process of transport of pharmaceutical products, in 24/7 (UPS.com, 2018).

**Geo-fencing technology**

As mentioned by Markarian (2015), UPS was using Geo- fencing technology to pre-set the truck's transportation route to ensure the accuracy and security of the pharmaceutical products transportation process (Markarian, 2015).

### 4.2.3 Domestic 3PL providers in China

While multinational 3PL providers company entered Chinese healthcare logistics market, due to policy support, it give more and more domestic third-party logistics providers chance to obtained qualifications for healthcare logistics operations (China State Council Medical Reform Department, 2017). As mentioned in the introduction chapter of the paper, domestic third-party logistics companies in China are very vulnerable. There are few third-party logistics companies that have really begun to operate healthcare logistics. In the current market, SF Express is the only large-scale 3PL provider which started its healthcare related business (SF Express, 2018).

According the description in chapter 1, Chinese market has a large demand for 3pl. So
it is not enough for just having one big scale 3PL providers operating healthcare logistics business. With obtained qualifications for healthcare logistics operations, more 3PLs can be enter into healthcare sectors. Therefore, based on the research questions of the paper, different types of 3PL providers need to make different improvements or adaptations in order to better adapt to the current healthcare sector. In the next section, two different types of companies will be selected as the case company for doing the data collection and analysis.
5. Empirical findings

This chapter contains the empirical data gathered from the selected companies. The selected companies will be introduced, and followed by the data obtained, which such data will serve as the foundation and the support of the answering the research questions.

As the focus of the paper is on the third-party healthcare logistics in China, and the adjustments, opportunities and challenges faced by third-party logistics providers in China, in order to do the analysis of the research questions more comprehensively, the collection of the empirical data was divided into two parts, and in each part, a case company was selected as the representative. In the first part, the paper is aiming to select a Chinese third-party logistics provider, which has already involved in the business of healthcare sector, and in the initial stage of business; In the second part, the paper is aiming to select a Chinese third-party logistics provider, which has never been involved in the healthcare logistics business. These two companies have different characteristics, which can ensure that the research questions are analyzed from different perspectives. This chapter will be divided and present into two parts according to two selected companies.

5.1 SF Express: initial stage healthcare logistics business

5.1.1 Background of SF Express

SF Express is a leading company in Chinese express industry. It was established in Guangdong, China in 1993. SF Express headquarter is located in Shenzhen, China. Company are mainly operating domestic and international express delivery and related businesses. SF Express are in the forefront of domestic Chinese market, serving individual express delivery service, postal service, air transportation service, and cold chain transportation. SF Express are actively developing and introducing more advanced information technologies, and gradually improves the automation
level of their operation. 35 express related information systems with industry-leading level were developed and established by SF Express, which played a important role in optimizing the delivery network. Unlike most express companies in Chinese market, based on differentiation strategy, the main business of SF Express is not only aimed at e-commerce, but is mostly commercial customers and high-end service businesses (SF Express, 2018). Based on the statistics from China State Post Bureau in 2017, SF Express ranks first among all 10 selected 3PL providers, in terms of express delivery timelines, full time limits, and service satisfaction rates (CSPB, 2017).

5.1.2 Reason of choosing SF Express as the case company

There are two reasons of choosing SF Express as the case company. The first reason was, based on the data from 2017 mentioned in chapter 1, SF Express are in the first rank among the top five leading third-party logistics companies, with a market share of 15.4%. Therefore, SF Express has a high status and is an representation company in Chinese market. The second reason is based on the research topic of the paper. SF Express has established their healthcare logistics department in 2014, but it has not actually operate then. With the implementation of “two invoice system” by the Chinese government in 2017, SF Express accelerated it’s pace of entry into healthcare logistics market, and began to operate their business in recent years. Authors plan to analyze and answer research questions of the paper, from the perspective of a 3PL providers with their initial stage of healthcare logistics business.

5.1.3 Warehouse facilities of SF Express

SF Express's warehouse coverage can covered most of the cities in China, while their cold chain transport network can cover 56 cities and surrounding areas. SF Express's cold business includes fresh food and healthcare logistics. For fresh foods, 59 food cold storage facilities were established and 71 transportation trunk lines were included. The total area was approximately 130,000 square meters (SF Express, 2017). For pharmaceutical product warehousing, as mentioned by Mr. Fang (2018), there are
currently three medical warehouses in Guangzhou, Chengdu and Nanjing. These three cities have developed rapidly in recent years and have a large market for pharmaceutical products, therefore, SF Express have chosen these three cities as the first step to carry out their healthcare logistic business, and the total area of medical warehouses is approximately 50,000 square meters (Mr. Fang, 2018). Mr. Fang (2018) mention that there are another 20 transit points are serve as the warehouses of pharmaceutical product, these transit point’s warehouse are with mixed category of storage, with pharmaceutical product areas. These kind of warehousing area for pharmaceutical product is about 25,000 square meters till 2018 (Mr. Fang, 2018).

Before providing customers with warehousing services for pharmaceutical products, the company will sign the agreement named “Logistics and Logistics Assistance” with their customers. Its content is to promise to provide all services based on GSP regulations and to ensure the safety of the medicines stored by customers (Mr. Fang, 2018). The contents of SF Express and the customer's agreement embody SF Express's self-confidence in its professionalism and its emphasis on the interests of its customers.

As mentioned by Mr. Fang (2018), for the sake of medicine safety and timeliness, SF Express's medical warehouses and warehousing area in the transit points are both independent and dedicated. In each warehouse, SF Express has strict requirements for the storage conditions, because it is related to people's health. Different temperature controlled zones with different conditions are used to deal with different medicine storage conditions, and both warehouse are 24-hour temperature monitored. Monitor the humidity in the warehouse (Mr. Fang, 2018). Based on the data from SF Express official website, for the storage of pharmaceutical products, it is divided into cold storage (2 to 10°C), frozen area (≤ -18°C), cool storage (2 to 20°C), and regular temperature storage (10 to 30°C). SF Express's medicine warehouses are also humidity controlled, the humidity range is usually 35% to 75%, which are inline with China's GSP standards (SF Express, 2018).
5.1.4 Warehouse technologies and information system of SF Express

**ERP system**

In recent years, SF Express has invested RMB 300 million (Approximately 40 million Euros) in company's ERP system development, for the integration of information systems of the entire business process (SF Express, 2017). SF Express named the ERP system they invests and name it as “Asura”. According to Mr. Fang (2018), “Asura” are belongs to the company’s internal system, only employees with certain levels can access into it, so more detailed information cannot be discussed. However, as same as the basic function of the ERP system, “Asura” system enhances the overall information transfer efficiency of SF Express, from the perspectives of recording and transmission of inbound information, inventory management, and outbound information management (Mr. Fang, 2018).

**Bar code technology**

According to Mr. A (2018), in the warehouses of SF Express, including warehouses for pharmaceuticals, and various integrated warehouses which called transfer point of medicines within the company, different warehouse-related technologies were used. First of all, for the warehousing of pharmaceutical products and the storage of other common commodities, SF Express has incorporated the use of bar code technology (Mr. A, 2018). In SF Express company's warehouse, many links from the unloading entrance of warehousing goods to the loading of outbound goods include the application of bar code technology. Mr. A (2018) pointed out that, the use of bar code technology enhances the overall efficiency of the work in the company's warehouse (Mr. A, 2018).

**EPP circulation incubator**

Based on the information from Mr. Fang (2018), through the market investigation of the cold chain business, SF Express discovered the problems and the expectations of the customers. In 2015, company independently developed a shipping and storage
container for cold chain products, called “EPP Circulation incubator”. Based on the information obtained by the authors, the full name of the EPP is Expanded polypropylene, which is an environmentally friendly material and complies with food safety regulations. The EPP circulation incubator developed by SF Express has different sizes to meet the needs of different cargoes, placing ice boxes to reduce the temperature of the contents. On the surface of the EPP circulation incubator, labels with bar code and content information are attached, which are well applied in the process of storage, sorting, and scanning. At present, such transportation and storage containers are widely used in the cold chain-related business of SF Express (Mr. Fang, 2018).

5.1.5 Transportation equipment of SF express

According to Mr. Fang (2018), for refrigerated trucks, SF Express now owned about 500 units (497 units according to official website), of which 225 are GSP certified (227 units according to official website). SF Express also have a great advantage in air transport, 36 self-owned aircraft and 15 rented aircraft, covers 35 primary and secondary airports including Hong Kong and Taipei of China (SF Express, 2018).

5.1.6 Transportation monitoring system of SF express

GPS technology

During the transportation process of SF Express, the headquarters monitored the trucks through advanced information systems and GPS technology. Based on the information from Mr. Fang (2018), SF Express has GPS system installed on its transportation trucks. Through the data adapter, the location information of the truck is transmitted to the monitoring center, so the company can ensure the safety of the product (Mr. Fang, 2018).

Resource Scheduling System “SCH”

In SF Express's transportation dispatch center, a resource scheduling system called
SCH is integrated into the company's overall information system. Its main role is to arrange and schedule transport capacity including transport trucks and transport aircraft, to ensure the availability of transport resources (Mr. Fang, 2018).

**Risk Management System (RMS)**

In SF Express's transportation process, a complete risk management system was incorporated into SF Express's “Asura” system. This set of risk management system is mainly applied to air transport. It has not yet been applied in healthcare logistics business, but it is planned for the future. The RMS system detects the status of product through each scanner's hand-held terminal (HTT) at each transit site, such as the product shelf life recorded by the barcode. Once the shipment has met the warning feature, the information will be transferred to the Ashura's overall information system at headquarters for archiving and seeking solutions (SF Express, 2018).

5.1.7 Transport network coverage of SF Express

SF Express has a nationwide express delivery network. Till March 2017, SF Express delivered network can cover 331 cities, which 13,000 self-operated service point has been established, 97% of the country has been covered by SF Express’s service (SF Express, 2017). In road transport, SF Express opened more than 9,600 transport trunk lines and more than 68,000 transport branch lines throughout the country. In air transport, SF Express has well-established air transportation networks covering 24 countries and regions including China, Hong Kong, Taiwan, and overseas (SF Express, 2017). In terms of healthcare logistics, SF Express's current pharmaceutical product transportation can accept normal temperature pharmaceutical product transportation in more than 300 cities across the country, as well as cold chain transportation orders for pharmaceutical products in more than 23 cities (SF Express, 2018).

5.1.8 Employees training of SF Express

Based on the information provided by Mr Fang (2018), SF Express places great
emphasis on the development of its employees. In order to cultivate the work level of employees in various departments with different positions, SF Express established the “SF University” in the company for the training of internal personnel in 2016. From management employees to professional warehousing employees, transportation employees, all participate in the company's internal training and learning courses. The company's goal is to ensure the professionalism of the company's logistics related business and the company's future development. Therefore, SF Express attach great importance to the training of their employees (Mr. Fang, 2018). Based on the SF Express annual report in 2016, the total cost of SF Express's employee training was approximately 300 million RMB (SF Express, 2017).

5.1.9 Successful healthcare logistics case of SF Express

- The first successful healthcare Logistic case of SF Express was the distribution of vaccines to Tibet. In March 2017, SF Express received a transportation order of send 580,000 newborn vaccines products to Tibet. SF Express adopts a GSP-compliant transportation truck and plans to transport the goods to the destination in a state of 2-8 degrees. During the transportation, the company encountered an unexpected road collapse accident. SF Express immediately launched an emergency plan to switch to air transportation. Due to the special aviation conditions in the region, after the vaccine was sent into the airport, the refrigerated truck continued to maintain its cooling status, in case that once the flight was canceled, the goods can be returned to the refrigerated truck, so as to ensure the temperature state. Ultimately, SF Express deliver these products safely and in a timely manner to the destination (SF Express, 2018).

- The second successful case of SF Express was the delivery of biological products to the Xinjiang region. In May 2017, SF Express received an urgent biological product transportation order which needed to complete 5,300 km of biological product transportation to Xinjiang in 7 days. Through comprehensive analysis and consideration of transportation plans, route planning, and complex road
conditions in Xinjiang, SF Express eventually adopted the model of direct transportation by car, using GPS tracking technology through trucks, dual temperature control solutions for refrigerating truck refrigeration packaging, as well as the two driver's rotation driving, after 119 hours transportation, deliver the product safely and timely to the destination, under a 2-8 degree temperature control whole time (SF Express, 2018).

- Another successful healthcare logistics business case of SF Express is the cooperation with international pharmaceutical giant Sanofi. From February 2016, Sanofi Pharmaceuticals began its visit and inspection of the SF Express. After 10 month inspection, Sanofi Pharmaceuticals fully affirmed the ability of SF Express to operate in the cold chain, information systems and its professional standards. Finally, in November 2016, SF Express and Sanofi signed an agreement of the cooperation in the pharmaceutical transportation, distribution, and warehousing business in Chinese market. The cooperation between the two parties is mainly directed at pharmaceutical drugs now, and Sanofi Company stated that as the business advances, they hopes to give their vaccine-related business to SF Express also (SF Express, 2018).

5.2 YTO Express: Not involved in healthcare logistics

5.2.1 Background of YTO Express

Yuan Tong company, which has its English named YTO Express Co., Ltd. It is a famous private company in express industry in China. YTO Express company was founded in the year 2000 in Shanghai, which has become the leading company nowadays. YTO Express company are doing the main business in mainland China, and also business in other countries. Their main business includes personal express delivery, postal service, air transportation, with these service, their main business area are in e-commerce business area. Company’s service also cover the area such as warehousing, distribution and value-added services, etc. With the company’s vision
and goal, to become “Choice of the Chinese”, the company has been at the forefront of the industry in areas such as distribution network coverage, operational capacity, total business volume, public satisfaction, customer service quality and so on. In 2017, YTO express has launched their cold chain related services, and it’s mainly for foods and fresh products, the scope of services are currently just conducted in Shanghai and covers most of Shanghai (YTO express, 2018).

5.2.2 Reason of choosing YTO Express as the case company

There are two reasons for choosing YTO Express in this paper. First, based on the research questions, YTO Express has not yet entered the field of healthcare logistics so far in 2018. Authors hopes to analyze the research questions from the perspective of a company with no healthcare logistic sectors experience, to see what adjustments needs to be done, as well as their opportunities and challenges. The second reason is that, based on the data from 2017, YTO Express, as a third-party logistics provider in China, has a market share of 13.05%, which is the second among top 5 in the industry (CRIFI, 2018). Therefore, based on the company's reputation and market share, authors choose YTO Express as a representative company that has not yet entered the field of healthcare logistics.

5.2.3 Warehouse facilities of YTO Express

Based on information from Mr. Luo (2018), YTO Express currently has a total number of 101 warehouses in 50 cities in China, with a total area of more than 500,000 square meters. For the current cold chain business, it is only conducted in Shanghai. YTO express has it’s warehouse area in Shanghai for 18,000 square meters, but for the area of the cold storage warehouse there is no specific data (Mr. Luo, 2018).
5.2.4 Warehouse technologies and system of YTO Express

**ERP system “King Kong” and “Lohan”**

YTO express has developed an integrated information system with independent intellectual property rights on the basis of ERP system since 2009. It is called “King Kong” and “Lohan” in the company (YTO express, 2018). According to Mr. Luo (2018), from the external of the company, the company's overall information system are docking with some famous e-commerce website, fro the internal the company, through the information recorded from warehouse staff's hand-held PDA bar code scanning equipment, company's overall information system was docking with internal WMS (Mr. Luo, 2018).

**EDI**

YTO Express's warehouse system are mainly serves e-commerce companies or individual businesses. Internally, the company uses EDI technology to generate accepted business documents, such as orders and invoices. The information is then passed through the network between business partners or customers. YTO Express maintains systematic access and information interaction with many business partners. EDI systems improve the efficiency of company information processing and reduce errors occurred rates of customer orders (Mr. Luo, 2018).

**Sorting robot**

For YTO Express, since most of the business is for e-commerce customers, so most of the company's warehouses do not have large automatic sorting equipment (Mr. Luo, 2018). In April 2017, YTO Express in conjunction with HIKVISION (A safety and security equipment company), developed a small automated sorting robot. This sorting robot uses camera and two-dimensional code technology, as well as red infrared, and ultrasonic obstacle avoidance technology to ensure its own movement, and accurate sorting of goods. This automatic sorting robot has been used in some warehouses and is planned to expand its using scope of application in the future (YTO
express, 2018).

5.2.5 Transportation equipment of YTO express

YTO express has 10 aircraft in the Chinese market and 8 are actually operating, and the company plans to reach 30 aircraft by 2020. And about 36,000 transportation trucks serve the land transportation business. In addition to some domestic brand trucks, the company purchased and updated a large number of trucks such as Volvo and Mercedes-Benz this year. High-quality trucks not only enhanced the company's brand image, but also consolidated its transportation security and efficiency (Mr. Luo, 2018).

5.2.6 Transportation monitoring system of YTO express

In addition to the "King Kong System" and "Lohan System", a transportation management system (TMS) consisting of a "walker system" and a GPS truck monitoring system was also developed. The main functions of “walker system” include truck scheduling, distribution, management, and the deployment and management of transportation-related personnel. The GPS truck monitoring system can help YTO express to complete the remote monitoring of transport trucks, such as the location of the truck (YTO express, 2018).

5.2.7 Transport network coverage of YTO express

By the end of 2016, YTO express has 62 self-operated hub centers in China, 37,713 service point and 3,475 land transport routes. The coverage of the county-level cities or above reaches 96.10% (YTO express, 2017). YTO express's cold chain business are currently operates only in Shanghai, covering the entire Shanghai area except Chong-Ming island. For air transportation, till the end of 2016, company's airline coverage reached 113 cities and 1,373 routes (YTO express, 2017).
6. Analysis

Based on the theory from literature review and the collection of empirical data, this chapter presents an analysis for both three research questions for this paper, in the context of the combination of theory and empirical data gathered.

6.1 Analysis of research question 1

There are different problems exist in current Chinese healthcare sectors. For the first research question author want to analysis and find out how different problems exist in Chinese healthcare sectors can be solved from Chinese third party logistic provider’s involvement. Section 6.1 will start with both the analysis of the existing problem within distribution channels and the analysis of the existing problem within traditional healthcare logistics in the Chinese market, to point out existing problems and followed by the effect and contribution of Chinese third-party logistics providers. The research question 1 of the paper is:

What could be the predictable contribution of Chinese 3PL providers to Chinese healthcare sectors?

6.1.1 Current Chinese Pharmaceutical Distribution Channels

Based on the introduction of China's distribution channel in chapter 4, China's healthcare logistics are still remains in the form of traditional healthcare logistics. In particular, for pharmaceutical industry, a good distribution channel enables everyone to obtain good quality medicines (Taylor, 2004), so the distribution channel is particularly important. However, Chinese current distribution channels within traditional healthcare logistics are too complicated. In the current distribution channels, the distribution of medicines generally requires the passage of 2-3 distributors, and for some products or prescription medicines even 6 distributors are involved (AT Kearney company, 2012). Complex and excessive circulation links
greatly reduce the efficiency of pharmaceutical product distribution, such as the slow circulation of products and the slow flow of information. As mentioned in Booz & Company's survey, pharmaceutical distributors in Chinese market can make huge profits through price markups and kickbacks from manufacturers (Booz & Company, 2012). Therefore, due to the huge benefits, more and more small and medium-sized distributor companies have joined the distribution channel, based on the survey conducted by AT Kearney company in 2012, more than 13,000 small and medium-sized pharmaceutical distributors are in Chinese market, which is far higher than those in the United States, Japan, and other developed countries (AT Kearney company, 2012). As shown in Figure 9, distributor 1 till distributor n in the distribution channel shows the complexity and confusion of Chinese healthcare sector.

**Figure 9: Chinese pharmaceutical distribution channel before integration**

In recent years, as described in the background description within the first chapter, the development prospect of the Chinese healthcare sector is very good, so with the rapid development of the pharmaceutical industry, it can be imagined that the number of distributors will only increase. Therefore, whether it is from the perspective of product flow or information flow, a healthy distribution channel is urgently needed in the Chinese healthcare sectors.
6.1.1.1 Problem exist: High medicine prices

In the context of the Chinese traditional healthcare logistics model, based on the description of Yang (2005), many pharmaceutical manufacturers in China only pay attention to internal adjustments and improvements, such as the development of their own logistics-related functions (Yang et al., 2005). Therefore, the neglect of upstream and downstream integration in the overall supply chain has gradually brought the complexity to the pharmaceutical distribution channels in China. Based on Booz & Company's survey, in the Chinese market, 5-10% of drug markups are added to drug prices at each level of intermediaries (Booz & Company, 2012). Therefore, when medicines are sent from manufacturers to hospitals, after passing through 2-3 or even 6 distributors, and after the 5-10% price markup per layer, the price of medicines will have significant increase. However, this high price of medicines does not due to its own cost, but comes from the increase in the price of each level of distributors. The interests of these distributors are added to the final consumers unnecessarily. As the 13,000 small and medium-sized pharmaceutical distribution companies are operating pharmaceutical products distribution in different regions across the country, the current problem of high medicine prices has a certain degree of generality in overall Chinese market.

6.1.1.2 Problem exist: Low medicine delivery efficiency

According to UPS's "Pain in the Chain" survey, medicines in the transportation process have a high risk of expiration and a high risk of failure, so in long-term transportation, the effectiveness of different types of drugs can hardly be guaranteed (UPS, 2015). Compared with traditional goods, pharmaceutical products have more stringent requirements for the efficiency of transportation, delays in the transportation process or product quality problems can cause harm to the health and even threat the life of patients (Markarian, 2015). In China, the distribution of medicines is usually sent by manufacturers to provincial dealers, and then to municipal and lower-level distributors. There are different numbers of distributors among each level. And for
Chinese market, pharmaceutical distributors are in relatively complex environment, wholesalers, distributors, and even hospitals, all play as the role of intermediaries, which makes Chinese distribution network not only complex but highly competitive. Therefore, this further extends the time of medicines in the transportation process and increases the risk. Based on the classification of drugs in the Chinese market, such as prescription drugs, over-the-counter drugs, and vaccines, there are different distribution routes. According to figure 7, we can see that there are three distribution modes for prescription drugs and non-prescription drugs, and two different distribution modes for the vaccine (AT Kearney company, 2012). Therefore, it is difficult for real-time tracking and monitoring of some products that require high timeliness, such as blood products, biological products, or vaccines (Roodbergen et al., 2014). Due to the long time and low efficiency of medicine delivery in Chinese market, the quality of these medicine is difficult to maintain at the best level.

6.1.1.3 Problem exist: Inadequate supply of medicines

In Chinese market, the complex distribution channels of the pharmaceutical products also seriously affected the efficiency of information transfer. In the process between medicine manufacturer to hospitals or retail stores, many levels and different numbers of distributors are involved in the transfer of information. Different distributors are independent, so there is no interaction of information systems between them, it leads to the resistance of information transmission and matching between different distributors (Yang et al., 2005). Therefore, excessive distribution channels severely reduced the efficiency of information transmission in the Chinese healthcare sector.

At the same time, the uneven medical resources in China has resulted in the incompleteness of equipment and medicines in small cities and rural areas and the lack of experienced doctors. Therefore, more than half of new type medicines and high-end medicines can only be purchased in large hospitals, so most patients are willing to choose going to large hospitals in big cities, and most of the patients think that the hospital's medicine is of higher quality than retail stores (Booz & Company,
2012). So for the hospital, stable and adequate medicine supply have to be considered. However, based on the AT Kearney company's survey, some new types or high-end medicines have not been adequately supplied in the Chinese market (AT Kearney company, 2012). Therefore, we can see that in the case where the efficiency of information transmission is affected by the distribution channel, the hospital's medicine supply cannot be stable guaranteed.

6.1.2 The Role of Chinese 3PL Providers for pharmaceutical distribution channels

Based on information from the literature review, 3PL providers is sufficient to integrate and simplify the supply chain (Langley et al., 2009), and can help companies streamline distribution channels by replacing distributors' roles (Zacharia, Sanders and Nix, 2011; Yi And Wei, 2004). The involvement of third-party logistics has brought new possibilities to Chinese healthcare logistics and healthcare sectors. The simplification of distribution channel could be done through the replacement of multilevel distributors. According to Yang et al. (2005), the coverage of the third-party logistics provider's distribution network will affect business expansion and limitations (Yang et al., 2005). For the two companies selected in this paper, SF Express's market positioning is mainly targeted at mid-to-high-end customers as well as commercial customers. It has 97% coverage in the Chinese market, which means that their business can cover most cities in China. The construction of the transportation network is also very complete, SF Express has 13,000 self-operated sites and has opened more than 9,600 transport lines throughout the country (SF Express, 2017). Since the establishment of the healthcare logistics department in SF Express in 2014, the transportation of normal temperature pharmaceutical product has covered more than 300 cities in China, and cold chain transportation has covered 23 cities (SF Express, 2017). The development of SF Express in the field of healthcare logistics is very rapid. For another case company within the paper, YTO Express, which has not entered the field of healthcare logistics. The business coverage rate of YTO Express in
Chinese market is 96.10%. The other data is that there are 62 self-managed hubs and 37,713 service points, and 3,475 land transportation lines (YTO express, 2017). For Chinese pharmaceutical product distribution channel, Chinese third-party logistics providers have a very good performance both in terms of network coverage and the integrity of the transportation network. Therefore, it is not difficult to see from these angles that Chinese third-party logistics providers have the ability to make improvements and contribute to the complex pharmaceutical distribution channels in Chinese market.

![Distribution channel diagram]

**Figure 10: Chinese pharmaceutical distribution channel after integration**

### 6.1.2.1 Predictable contribution of Chinese 3PL providers: Reducing medicine Prices

With the simplification of the Chinese pharmaceutical product distribution channel by Chinese 3PL providers, multiple distributors in the distribution channel have been merged and replaced by 3pl providers, so the 5% to 10% of medicine price markup increase will no longer exist. After losing the influence of the increase in prices, the prices of medicines in the Chinese medicine market will gradually decrease. Therefore, one of the predictable contribution is Chinese 3PL providers is will make their own effort to the reduction of medicine prices in Chinese market.
6.1.2.2 Predictable contribution of Chinese 3PL providers: Improve medicine delivery efficiency

Due to the peculiarities of pharmaceutical products, effectiveness must be guaranteed in the transportation process. The time of transportation will have a direct impact on the effectiveness of the medicines (Kafmann, et al., 2005). Due to the complexity of the distribution network, many unnecessary links are carried out, so long-term transportation cannot ensure the timeliness of different pharmaceutical products. When Chinese third-party logistics providers integrate and streamline the distribution channel, the medicine transportation links will be reduced and transportation time will also be greatly reduced, which will help to keep the effectiveness of medicines. The case company SF Express has made many efforts to ensure the efficiency of product transportation. According to the “China Express Service Test Results” issued by the China State Post Bureau in 2017, SF Express ranks first among all third-party logistics providers in terms of total transportation time and transportation processing time (CSPB, 2017). According to the information gathered with Mr. Fang (2018), SF Express has a deep understanding of the risks of failure or deterioration of pharmaceutical products during transportation. To avoid these risks, SF Express has a stable transportation efficiency and professional route planning, as well as a comprehensive risk management system (RMS), and resource scheduling system (SCH) system, so SF Express has never had an unexpected situation for transportation truck in the transportation of pharmaceutical products during these years (Mr. Fang, 2018). According to the case of SF Express's transportation of Sinkiang biological products introduced in chapter 5, through the analysis of the complex routes, geographical conditions and air transportation plans in the region, SF Express has successfully completed 119 hours and 5,300 kilometers of medical product transportation (SF Express, 2018). This can be shown that the company's emphasis on the timeliness of pharmaceutical products and its professionalism in terms of transport efficiency. Chinese third-party logistics providers are qualified and have the ability to ensure the efficiency of pharmaceutical products in the transportation process, so as
the ability to make their own contributions to safeguarding the effectiveness of medicines in Chinese market.

6.1.2.3 Predictable contribution of Chinese 3PL providers: Ensure stable medicine supply

Third-party logistics can not only integrate and simplify distribution channel, but also make information transfer more efficient. When Chinese third-party logistics providers simplify the distribution network, multiple distribution links are reduced, which also brings smooth information flow. Based on Lan (2004), through the accelerated transmission of information and the integration of information systems, the efficiency of product flow can be significantly increased (Lan, 2004). For two case companies selected in the paper, SF and TYO, both have their own ERP systems, and they are upgraded and improved on the original of ERP, such as SF Express's “Asura” system is mainly aimed at the management of inventory information and the management of transportation information to improve the efficiency of the overall information transmission of the company (Mr. Fang, 2018). The "King Kong" and "Luo Han" systems used by YTO Express also serve as the company's overall information system to help companies improve the efficiency of information transmission (Mr. Luo, 2018). When Chinese third-party logistics provider integrate information transmission in distribution channels, a unified information system platform will also bring greater information sharing. As mentioned by Berglund (1997), the level of information sharing between third-party logistics providers and customers is high, and they can transparently exchange and share information within logistics processes (Berglund, 1997). Due to the reduction of circulation, when hospitals and pharmaceutical retail companies suffer from medicine shortages, through the rapid information transmission between upstream and downstream information by third-party logistics providers, information on product inventory will be timely transferred, so more timely procurement behavior can be carried out. With the efficient flow of information, the shortage of medicines in hospitals will be
ameliorate significantly. Predictably, Chinese third-party logistics providers can make their own contribution to the shortage of medicines in Chinese healthcare sectors, to help more patients get access to high-end medicines or new medicines.

6.1.3 Traditional healthcare logistics in Chinese market

Based on the description of the paper, currently in Chinese healthcare sectors, healthcare logistics are in an early stage (Xiao, 2006), which means most of the logistics function of pharmaceutical products are processing in a traditional healthcare logistics form (Yang et al., 2005), based on the scope of this article, which is the logistics form without the involvement of third-party logistics providers. For pharmaceutical companies, their core competitiveness is coming from their main business, which is the production of pharmaceuticals. In the form of traditional healthcare logistics, pharmaceutical companies usually need to develop their logistics related function, and to deal with the business of healthcare logistics itself. For example, based on the investigation from AT Kearney company, there are two distribution method for pharmaceutical companies dealing with their finished goods, either to the distributors or to the hospitals (AT Kearney company, 2012). The logistics related activities within the process including the warehousing of finished goods, and the transportation of finished goods. So, most of the pharmaceutical manufactures need to make investment to develop their logistics functions. The development of the logistics functions is always led to the increasing investment in logistics functions, including procurement of warehousing and transportation equipment. After China's accession into World Trade Organization, the vision of the pharmaceutical manufactures has been gradually extended to the international scope, so more and more Chinese pharmaceutical manufacturers have gradually recognized the huge gap between multinational pharmaceutical manufacturing companies, from the perspective of innovation and production technology (Yang et al., 2005). Because the division of the company's overall resources into both main business and logistics functions, it has bring disadvantages to Chinese pharmaceutical manufactures, and
also brings limitations to the development of them in a certain degree. For Chinese pharmaceutical manufactures, the outsourcing of logistics-related functions is essential to get rid of traditional healthcare logistics forms.

6.1.3.1 Problem exist: Low professionalism in logistics functions

Due to the peculiarities of pharmaceutical products, the requirements for logistics activities are often different from other products (Yoon, 2014). healthcare logistics often has special regulations and requirements for warehousing and transportation (Blandine, Smail and Michael, 2018). For the storage of medicines, different temperature or humidity conditions are often required to maintain the effectiveness of medicines (Roodbergen et al., 2014). This also puts forward different requirements for warehouse employees' knowledge than the storage of common goods. For the transportation of pharmaceutical products, due to the peculiarities of pharmaceutical products, its transportation process are also different from other products. For example, based on the GDP or GSP guidelines proposed by the World Health Organization and the Chinese Health Department, some vaccine products require specific temperature ranges, and some are flammable and explosive risky from product collisions (World Health Organization, 2010; Gov.cn, 2012). These high transport requirements, need transportation-related personnel who have high logistics expertise and the understanding of the pharmaceutical product itself, so to ensure the quality and safety of the pharmaceutical products during transportation (Jung, 2017).

In traditional healthcare logistics, for pharmaceutical manufacturers, it is hard to ensure the efficiency and quality of each phase at the same time from a professional point of view, since they are take care of the logistic function and their main business at the same time (Yang et al., 2005). As mentioned above, current healthcare logistics distribution channels in China are complex, complicated circulation links and longer transportation time, which further enhances the demand of pharmaceutical manufacturing for high-technical and trained professional employees. For example, in
the case of the illegal vaccine incident in Shandong province in China mentioned in Chapter 4, the negligence and slackness of pharmaceutical factory personnel who did not possess logistics-related professional skills resulted in a large number of unqualified and invalid vaccine products entering the market (National Business Daily, 2016). Therefore, we can see that the logistics-related professional employees in healthcare logistics is an urgent need for the Chinese pharmaceutical manufacturers.

6.1.3.2 Problem exist: Low innovation capabilities for Chinese pharmaceutical manufacturers

Based on the introduction of the current status of China's healthcare sectors, it can be seen that among the traditional healthcare logistics forms, most pharmaceutical manufacturers in China are taking care of the main business and logistics-related functions at the same time, resulting in the dispersion of corporate cost resources and human resources (Yang et al. 2005). Based on statistics from the China Association of Pharmaceutical commerce (CAPC) in 2016, the average logistics cost of Chinese pharmaceutical manufacturing companies accounted for about 10% of the total cost of pharmaceutical products, while the pharmaceutical manufacturing company's logistics profit margin was only 0.6% to 0.7% (CAPC, 2016), it indicating that in the field of traditional healthcare logistics, pharmaceutical manufacturing companies cannot get benefit from the logistic-related function, but conversely, it need more non worthy investment. The investment and resource allocation for logistics functions includes the purchase and maintenance of transportation trucks, the construction and maintenance of pharmaceutical-related warehouses, and the training of personnel expertise or the recruitment of logistics professionals (Schönsleben, et al., 2016). The increase in the cost of these logistics functions has led to an increase in the overall operating costs of pharmaceutical manufacturing companies. Because the total cost is limited, pharmaceutical manufacturers who spend a lot of their expenses on logistics-related functions, which will inevitably affect the company's investment in its core business. Based on Hong and Neng (2011), the ability of Chinese indigenous
pharmaceutical manufacturers to innovate in products is low. The average type of medicines that can be produced from the same pharmaceutical raw materials is 5 types, which is obviously lower than that of the United States of 23 types, the main reason behind this is the lack of related equipment and technologies (Hong and Neng, 2011). From the perspective of cost, innovative medical equipment is very expensive for pharmaceutical companies (Hong and Neng, 2011). As stated above, the investment in logistics-related functions has limit some of the Chinese pharmaceutical manufacturer’s investment in new medicine’s R&D, or the introduction of new technologies and new equipment, which resulting a lower core competitiveness of their main business. Therefore, from the perspective of logistics function, we can see that the stripping and saving of logistics-related costs are urgently needed by Chinese domestic pharmaceutical manufacturing companies.

6.1.4 The Role of Chinese 3PL Providers for traditional healthcare logistics

Based on the current model of traditional healthcare logistics, pharmaceutical companies in Chinese market always deal with logistics functions and main business at the same time, so there is a problem of decentralized resources. Chinese third-party logistics providers have the ability and conditions to help pharmaceutical companies, through the out sourcing of logistics activities, to deal with their logistics-related functions. Therefore, the outsourcing of logistics functions can help pharmaceutical companies optimize the allocation of their resources and focus more on their main business (Yang et al., 2005). Based on this, from the perspective of logistics function, for Chinese healthcare sectors, it can be foreseen that Chinese third-party logistics providers can also make their own contributions in different aspects, which will be analyzed in this section.
6.1.4.1 Predictable contribution of Chinese 3PL providers: Ensure medicine quality through high professionalism in logistics

As a professional logistics company, third-party logistics providers usually have professional logistics-related personnel and technologies. Based on Jung (2017), third-party logistics companies usually have high investment in organizational learning and employee training to consolidate and guarantee the professionalism of entire company (Jung, 2017). For example for the case company SF Express. In 2016, SF Express established their SF University and spent about RMB 300 million in employee training in 2016 financial year. Therefore, we can see that usually in third-party companies, whether it is management or grassroots employees, will attend professional skills training to maintain the company's overall professional standards in a certain level. Based on the information gathered from the interview, an agreement named “Logistics and Logistics Assistance” proposed by SF Express will be signed with their customer when providing the transportation or warehousing services for the pharmaceutical products (Mr. Fang, 2018). In the agreement, SF Express will make commitments to customers, for example to comply with GSP standards, and to ensure the quality and safety of drugs through GSP compliant cold chain transport trucks and GSP compliant pharmaceutical warehouses. At the same time, in the process of transportation, SF Express have their risk management system (RMS) that can avoid the problem of medicine quality in a timely manner. For pharmaceutical manufacturers in the Chinese market, through the outsourcing of logistics functions to third-party logistics providers, to help maintain the quality and efficiency of medicines from the perspective of logistics, through high employee quality, excellent logistics professionalism, and commitment service quality. For Chinese healthcare sectors, Chinese third-party logistics providers can, from a professional perspective, adopt professional logistics expertise to largely avoid the occurrence of similar incidents such as illegal vaccine cases in Shandong, thus provide a healthy environment for the Chinese healthcare sectors. And the predictable contribution is to ensure medicine quality through 3PL's high professionalism in logistics.
6.1.4.2 Predictable contribution of Chinese 3PL providers: Enhance the innovation ability of pharmaceutical manufacturers

Based on the description above and data support of operational cost issues, we can foresee that outsourcing of logistics functions by Chinese pharmaceutical manufacturing companies could contributes to the development of their core business. The construction of logistics functions by pharmaceutical companies has seriously affected their innovation capabilities. The use of third-party logistics capabilities can help companies solve these problems in two different aspects.

First of all, for two case 3PL providers selected in the paper, they both have a complete transportation network and professional transportation equipment and warehouse facilities. For example, SF Express has three pharmaceutical warehouses with a total area of approximately 25,000 square meters; 227 GSP compliant cold chain transport truck; and 51 transport aircraft can be used in the field of healthcare logistics (Mr. Fang, 2018; SF Express, 2018). It can be say that, for pharmaceutical companies, the cost of purchasing, construction and maintenance of these hardware facilities is high. For the second aspect, 3PL provider’s professional warehouse management system (WMS) can pay attention to inventory and delivery conditions in real time, it could provide effective help for the operation of the company (Scioscia, 2014; Jonsson, 2008). Professional 3PL providers can use advanced WMS and information systems to help pharmaceutical companies achieve Just in time (JIT) production and delivery. For manufacturing companies, JIT production can effectively avoid the backlog of goods and inventory, and greatly reduce the inventory cost (Kreng, and Wang, 2005). So, for pharmaceutical companies, 3PL provider's help on savings their inventory costs is an important factors. Through the help of 3PL providers of reducing the operational costs for pharmaceutical manufacturing companies, they can have more investment in their main business, including the development of new medicines, the introduction of advanced technology and equipment, thereby enhancing their core competitiveness. For the Chinese healthcare sectors, from the perspective of logistics, predictably, 3PL providers can help
pharmaceutical companies to reduce operating costs and enhance their innovative capabilities, so the degree of innovation and advancement of pharmaceutical technologies in the Chinese market can be brought closer to the level of developed countries as soon as possible.

6.1.5 Summary of predictable contribution of Chinese 3PL providers

Based on the analysis of research question 1, the predictable contribution of Chinese 3PL providers to Chinese healthcare sectors has been presented and summarized in the table below.

<table>
<thead>
<tr>
<th>Current situation</th>
<th>Problem exist</th>
<th>Reason</th>
<th>Effect of Chinese 3PL providers</th>
<th>Predictable contribution of Chinese 3PL providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity of distribution channel</td>
<td>High medicine price</td>
<td>Overmuch number of small and medium scale distributors</td>
<td>Simplification of distribution channel</td>
<td>Reduce the price of medicines</td>
</tr>
<tr>
<td></td>
<td>Low medicine delivery efficiency</td>
<td>Price markup in each layer of intermediaries</td>
<td></td>
<td>Ensure stable medicine supply</td>
</tr>
<tr>
<td></td>
<td>Inadequate medicine supply</td>
<td></td>
<td></td>
<td>Increase delivery efficiency</td>
</tr>
<tr>
<td>Traditional healthcare logistics</td>
<td>Low professionalism in logistics leads to medicine quality problems</td>
<td>Pharmaceutical manufacturers are taking care of both main business and logistic functions</td>
<td>outsourcing of logistic functions</td>
<td>Guaranteeing drug quality through professional logistics skills</td>
</tr>
<tr>
<td></td>
<td>High operational costs lead to low innovation capacity of pharmaceutical companies</td>
<td></td>
<td></td>
<td>Enhance pharmaceutical companies innovation capabilities and core competitiveness</td>
</tr>
</tbody>
</table>

*Figure 11: Summary of predictable contribution of Chinese 3PL providers*
6.2 Analysis of research question 2

Based on the study of literature and empirical data gathered, Chinese 3PL providers can be better adapt to the field of Chinese healthcare logistics, with the improvement and adjustments in the aspects of warehousing and transportation. So the research question 2 of the paper is:

**How can different types of Chinese 3PL providers better adapt to healthcare logistics in China?**

The analysis of research question 2 will be conducted based on different types of companies. The paper divides the third-party logistics providers in the Chinese market into two major types for analyzing, just as the two case companies selected by the paper, SF Express and YTO Express. SF Express represent the companies that have already entered the healthcare logistics sectors and are in the initial stage of the business; YTO express represents the type of companies that have not entered the field of healthcare logistics. So research question 2 are divided into RQ2a and RQ2b. The author will analyze these two types of companies based on the selected case companies, and provide different improvements and adjustments that can be made from the perspective of transportation and warehousing, for different types of 3PL providers to better adapt to Chinese healthcare logistics sectors.

6.2.1 Analysis of research question 2a

The research question 2a (RQ2a) of the paper is:

**What improvements can be made by Chinese 3PL providers, which has already entered healthcare logistics sectors?**

The first type of Chinese 3PL providers which represented by SF Express, the improvements can be make for this type of company, are defined in two way. Based on the description of the technology in the literature review chapter, and the description from case description chapter for UPS companies, which has advanced
experience in healthcare logistics sectors. The paper will analyze how SF Express can make improvements in warehousing and transportation aspect. So RQ2a are divided into RQ2a-1 (for warehousing) and RQ2a-2 (for transportation).

6.2.1.1 RQ2a-1: What improvements and progress can be made in warehousing?

**Warehousing facilities**

For SF Express, based on the information gathered from the interview, it currently has approximately 50,000 square meters of medical storage area and three dedicated medical warehouses (Mr. Fang, 2018), so from this point of view, SF Express has fulfilled the requirements within GSP. For the area division in the warehouse, in addition of meeting the GSP standard requirements of area, and the temperature range of them, SF Express also have frozen area built, with the temperature conditions of less than or equal to -18 degrees. At the same time, the SF Express's pharmaceutical warehouse is monitored at a 24-hour temperature (Mr. Fang, 2018), which is also in line with GSP standard.

At present, SF Express has three dedicated medical warehouses, based on this the improvement that can exist is the establishment of more dedicated pharmaceutical warehouses, which will expand the company's healthcare logistics business in Chinese market. For warehouse construction, more advanced experience comes from UPS can be used for reference. Based on the case description part for UPS company, during the construction of the Hangzhou medicine storage center in cooperation Global Logistic Properties Ltd., the construction of the liquid-hardened ground technology guarantees the wear resistance and cleanliness of the ground, and the high level of the 100,000-grade medicine storage clean-room also exceeds the scope specified by the GSP standard (UPS, 2018). Therefore, in Chinese market, UPS has not only meet the requirements of GSP, but has even done better in some aspects. Therefore, for SF Express, in the construction of dedicated pharmaceutical warehouses, the configuration of the liquid hardened ground technology and the 100,000-grade
medicine storage clean-room can become a kind of improvement and progress, also, Walk in cold room technology mentioned by WHO can also be implemented (WHO, 2012). So, after the GSP’s requirements are reached, the standards can also be exceeded. Furthermore, it can help SF Express to operate their healthcare logistics businesses better and increase the professionalism in the field, to obtain more customers and expand the healthcare logistics business in Chinese market.

**Technology in warehousing**

For SF Express, before the company starting the healthcare logistics business, there have been many years of logistics-related activities and business for the company. Therefore, for SF Express, which has just entered the healthcare logistics market, some technologies are used in normal goods logistics are still being used in healthcare logistics-related activities. According to Mr.A (2018), most of SF Express's warehouses for pharmaceutical-related products, bar code technology is most commonly used for storage to transportation (Mr.A, 2018). Based on Mr.A (2018), bar code technology can improve the overall efficiency of warehouse work, and can ensure the accuracy of inventory. For recent years, RFID technology which is more efficient than bar code technology has been widely used in the logistics field as it has been developed and innovated. RFID technology can lead to greater efficiency and less staff involvement (Garfinkel and Holtzman, 2006). RFID tags can be settled with each product, or on each tray, when the tags are scanned by the antenna, and the remote reading of the information within the tag can be realized. On another hand, for bar code technology, the scan of the code are rely on the hand-held terminal by employees, this feature also means that the use of bar code technology requires more manual assistance. Therefore, an feasible improvement for SF Express is to upgraded from bar code technology to RFID, because it eliminates the need for manual scanning, so the personnel within the warehouse can be reduced, and the efficiency will be greatly enhanced, also, the effectiveness of the pharmaceutical product can be better ensured.
Based on the theoretical foundation of the paper, another technology in warehousing that could be an contribution to SF Express is Auto Guided truck (AGV). At present stage, three dedicated medical warehouses of SF Express are approximately 50,000 square meters, the area of each warehouse is quite large, and a larger warehouse means more staff and more activities will be carried out at the same time. So, the realization of rapid and accurate movement of goods is being needed for each warehouse. According to Mr. Fang (2018), SF Express have not currently use Auto Guided truck (Mr. Fang, 2018). The introduction of this ‘smarter’ material handling system could greatly enhance the efficiency of the SF warehouse. Different from ordinary forklifts, AGV is an unmanned handling system, the use of AGV will no longer require employees to carry out full operations, but will automate the handling process according to established routes (Fazlollahtabar and Mehrabad, 2015). Auto Guided trucks will effectively improve the efficiency of goods handling in warehouses, and greatly reduce the error rate of operation. Therefore, the implementation of AGV is an feasible improvement for SF Express, both for enhance the efficiency in the warehouse and reduce the labor costs of the company.

6.2.1.2 RQ2a-2: What improvements and progress can be made in transportation?

*Transportation equipment and route*

From transportation equipment perspective, 497 land transport trucks are currently used by SF Express and 227 of refrigerated trucks that are GSP certified, which means that the temperature range of SF Express trucks meets the refrigerated transport conditions of \(2^{\circ}\) C to \(8^{\circ}\) C and \(-10^{\circ}\) C to \(-25^{\circ}\) C conditions. In addition, SF Express has great advantages in air transport. 51 transport aircraft cover normal temperature medical transportation in 300 cities and cold chain pharmaceutical products transportation in 23 cities, which as an expand of the GSP standard (SF Express, 2017). Based on the air transport equipment of SF Express, SF Express's air transportation network can better ensure the timeliness of medicines. Based on the
advancement of warehouse facilities, more pharmaceutical dedicated warehouses can be constructed. From the perspective of transportation equipment, there can be an improvement that can be accompanied by the construction of dedicated pharmaceutical warehouses, more air transport equipment, and more air transport routes, to cover the cold chain pharmaceutical transport for more than 23 cities, thereby an feasible improvement from transport equipment and route aspect can be achieved.

**Technology in Transportation**

First, based on the requirements of the GSP, incubators or containers are needed for refrigerated transport (GOV, 2012). The EPP circulatory incubator developed by SF Express is used as a container for SF pharmaceutical cold chain logistics. Expanded polypropylene material can blocking the temperature transfer at a higher degree than ordinary containers, ensuring the stability of the product temperature. Therefore, the EPP circulation incubator is used by SF Express for storage and transportation of pharmaceutical products (Mr. Fang, 2018). Compare to the Pharma-port 360 technology used by the UPS company mentioned in Chapter 4, there are still a lot of space for SF Express to be improved. Pharma-port 360 container are currently used by UPS in healthcare logistics, which uses electricity as the energy source to cool the interior, and can monitor the temperature in real time through the built-in temperature detection equipment during transportation process (UPS, 2018). UPS are kind of transplanted the temperature monitoring system in the warehouse “into a little box”. This practice is a good example for SF company. Therefore, from the perspective of transport containers, a feasible improvement is to increase the R&D and investment in transport containers, and develop a temperature-controlled container as soon as possible instead of the current thermal containers, to better ensure the timeliness of medicine transport.

Secondly, RFID technology can also be applied into the transportation process, especially for the transportation of pharmaceutical products. According to Li and
Chen, RFID technology can provide temperature detection and monitoring for temperature-controlled trucks (Li and Chen, 2011). For healthcare logistics, the most obvious difference with common products is some products need to be stored and transported in a special condition. For example, vaccines or biological products will have serious consequences once the temperature exceeds a predetermined range. Through the information transmission between the truck temperature detection instrument and the RFID tag, RFID can be used for individual tracking and identification of each package (Garfinkel and Holtzman, 2006). The data collected by the recorder will be uploaded to the transport center for a real-time monitoring (Abad et al., 2010). According to Mr. Fang, SF Express have once used temperature-controlled trucks to transport insulin (Mr. Fang, 2018), but the real time temperature is hard to monitored in the truck, so when SF Express integrate RFID technology into transportation process, the temperature of insulin can be well detected during transportation. When an abnormal temperature occurs, the control center will be notified. Therefore, it will help ensure the effectiveness of medicine in the transportation process. A feasible improvement for SF Express is the use of RFID technology during the transportation process, which can help the company better monitoring the temperature state of the product. From the perspective of transportation information records, RFID technology can also greatly accelerate the company's transportation processing time.

Thirdly, based on Mr. Fang (2018), SF Express used GPS technology to monitor the real-time location of the truck during transportation, to ensure the safety of transportation (Mr. Fang, 2018). Compared to UPS, according to the introduce from case description chapter, UPS company has incorporated the use of Geo-fencing technology in the medicine transportation process. Geo-fencing technology can pre-set the truck's transportation route to ensure the accuracy and security. Before the start of the transportation process, the most reasonable transportation route can be set in advance. During the transportation process, if the truck leaves the pre-set route or is about to reach the destination, the control center will receive the relevant notice.
For SF Express, based on the current SCH system of SF Express, for ensuring both stable transportation route arrangements and reasonable truck resource allocations, a feasible improvement can be the implementation of using Geo-fencing technology on the basis of GPS, so as to better determine the location and ensure the safety of transportation, at the same time better guarantee the quality of medicine.

6.2.2 Analysis of research question 2b

The research question 2b (RQ2b) of the paper is:

*What adjustment and adaptation need to be made by Chinese 3PL providers, for entering healthcare logistics sectors?*

The second type of Chinese 3PL providers which represented by YTO Express, which have not involved in healthcare logistics sectors in China. Based on the chapter of case description, the implementation of two-invoice system has open the door for Chinese 3PL providers for entering healthcare logistics sectors. 3PL providers who want to enter the field of healthcare logistics, the minimum level that should to be met is to meet the requirements within GSP. The paper chooses YTO Express as the representative to analysis what adjustment and adaptation are needed, for both warehousing and transportation aspect. As the same logic with research question 2a, the analyze will be conducted in both warehousing and transportation aspect, and RQ2b are divided into RQ2b-1 (for warehousing) and RQ2b-2 (for transportation).

6.2.2.1 RQ2b-1: What adjustment and adaptation need to be made in warehousing?

**Warehousing facilities**

Based on the GSP standard, two or more independent pharmaceutical dedicated warehouses are necessary if companies want to operate vaccine transportation and vaccine storage-related businesses. However, if there are no operation of
vaccine-related business, the medicine storage area which in line with the scale of its own business is required (Gov.cn, 2012). Based on Mr. Luo (2018), currently, YTO express has their cold chain related business operated only in Shanghai (Mr. Luo, 2018), so for YTO Express, the existing food refrigerated warehouse in Shanghai can be used, but the transformation in line with the GSP standard should be done. The storage conditions of pharmaceuticals are different from the food cold chain, and relatively high standards are required. For example, it should be a clear divided of the temperature area within the warehouse, including normal temperature area, the shadowed area, the refrigerated area (Gov.cn, 2012), and a freezing zone established by SF express are also recommended and may also be established. These areas are divided according to temperature conditions and need to be equipped with 24-hour real-time temperature and humidity monitoring equipment, keep the relevant information updated every minute. For other place outside of Shanghai, which YTO doesn’t has their cold chain business, YTO Express will need to establish the warehouse dedicated for medicine. Therefore, from the perspective of warehouse facilities, for the 3PL providers that have not yet entered the healthcare logistics sectors, the first adjustment that they face when it comes to entering the field of healthcare logistics is the construction of the pharmaceutical product dedicated warehouse that meets the GSP standard. For YTO Express, the adjustments that need to be made for entering the healthcare logistics include the transformation of existing food refrigerated warehouses in Shanghai, and the construction of dedicated pharmaceutical product warehouses in various regions in China.

**Technology in warehousing**

From the perspective of technology in the warehouse, first of all, as a widely used information collection technology, bar code technology can be meet the standard and requirements for the operation of healthcare logistics. Because there is no clear standard and requirements for warehouse technology in the GSP regulations, so, for 3PL providers that has not entered the healthcare logistics, the adjustments in the
technical point of view within the warehouse should be based on the existing technical level of the company. For the third-party logistics companies that do not use bar code technology, due to the peculiarities of healthcare logistics, the processing of medicine storage requires a certain amount of timeliness. Therefore, this article suggests that bar-code technology be used as a threshold for the operation of healthcare logistics to ensure that information-gathering technologies have a certain degree of efficiency. For YTO Express, for example, based on the information obtained and presented in the empirical chapter, in the warehouse of YTO Express, the bar code technology used in conjunction with the employees' hand-held scanning terminals, that can be applied to healthcare logistics. As with SF Express, YTO Express is a 3PL provider with a certain level of technology and scale, so they can also seek to the implementation of RFID technology, instead of the existing bar code technology, as an “can-be” improvement but not a “need-to-be” adjustment.

The sorting robot developed by YTO Express in conjunction with HIKVISION in 2017 is currently being used in some warehouses of YTO Express (YTO express, 2018). Sorting robot technology can also be applied to healthcare logistics. Similar to AGV kind of automatic technology, the advantages of sorting robots also lie in the reduction of human operations of warehouse staff, and the reduction of operational error rate. Through the use of camera with two-dimensional code technology, and red infrared, ultrasonic obstruction avoidance technology, sorting robot of YTO can ensure the collection of the information and movement of goods (YTO Express, 2018). The application of sorting robot into healthcare logistics can greatly improve the speed of the product processing, in order to better maintain the timeliness of the medicines.

6.2.2.2 RQ2b-2: What adjustment and adaptation need to be made in transportation?

*Transportation equipment*
For the transportation equipment, first of all, for the data gathered from interviews and annual reports, there is no specific number of refrigerated trucks for YTO Express. The author analyzes the possible reason for this is because YTO Express only has their cold chain related business operated in Shanghai. Since YTO Express's cold chain-related business are focus into the fresh food sector, the company should have a portion of the refrigerated trucks for doing transport. For the transportation of pharmaceutical products, based on the GSP standards, first of all, trucks should be equipped with temperature control function, and the temperature of refrigeration transportation should be between 2~8 °C, and the freezing transport temperature should between -10 to -25 °C. YTO Express can be retrofitted the pharmaceutical transport truck on the basis of food refrigerated truck, such as the replacement of refrigeration facilities in cars, to ensure a more comprehensive range of temperature control. For ordinary trucks, it can also be retrofitted to a refrigerated truck under line of the GSP-compliant, such as through the installation of the air conditioning system for refrigeration and the modification of the structural insulated panel (SIP) compartment wall (Ahmed et al., 2010).

And when it comes to the transportation of vaccine products, GSP stipulates that sealed trucks should be used to transport vaccine products (Gov.cn, 2012). So YTO Express's current food transport refrigerated trucks cannot meet the standards set by GSP. So, in relation to the shipment of vaccine products, the YTO needs to deal with the purchase of sealed cold-chain transport trucks. As SF Express, YTO Express also exceeds the GSP regulations and has certain advantages in air transport equipment. Based on Mr. Luo (2018), 8 of the 10 aircraft are currently being used in YTO Express for air transportation (Mr. Luo, 2018). The air transportation coverage network includes 113 cities and 1,373 routes (YTO express, 2017). With SF Express as a precedent, YTO Express can also apply equipment for air transport in the field of healthcare logistics as an efficient medicine delivery method.

*Technology in Transportation*
Based on the GSP standards regulation, truck-mounted refrigerators or incubators are needed for the transportation of pharmaceutical products (Gov.cn, 2012). For YTO express’s fresh food cold chain transportation sector, no refrigerators or incubators that meet GSP standards are presented has been presented. Therefore, in order to enter the field of healthcare logistics, YTO Express should increase the research and development of cold chain transport refrigerators or incubators technology. Take the EPP Circulation incubator developed by SF Express as an example (Mr. Fang, 2018), for YTO Express and other Chinese 3PL providers that have not yet been involved in the field of healthcare logistics, the paper suggests that to start the development with the investigating of the material of the incubator, for example, the application of expanded polypropylene (EPP), which is an insulation material, to develop their own refrigerators or incubators technology, so to applied it into the transportation of pharmaceutical products within healthcare logistics.

For other technologies in transportation, GSP standard as industry entry barriers do not give clear requirements. Therefore, for Chinese 3PL providers that have not yet involved in the field of healthcare logistics, including YTO Express, the adjustment and adaptation should been taken based on their own existing technological level, and seek the use of more advanced technology in transportation. Taking YTO Express as an example, some technological advances that go beyond the GSP regulations can be achieved. Like SF Express, RFID technology can be used instead of the existing bar code technology to further enhance the collection and delivery efficiency of information (Garfinkel and Holtzman, 2006); and For the use of Geofencing technology, combined with the existing GPS technology to better manage and planning the transport route (Markarian, 2015).
6.2.3 Summary of research question 2: the improvements for SF Express and adjustments for YTO Express

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Improvements of SF Express</th>
<th>Adjustments of YTO Express</th>
</tr>
</thead>
</table>
| Warehousing facilities             | Build more dedicated pharmaceutical warehouses include the following technologies for the sake of improvement:  
                                         • 100,000-grade medicine storage clean-room  
                                         • Liquid-hardened ground technology                                                   | Build two or more dedicated pharmaceutical warehouses that meet the GSP standard       |
| Technology in warehousing          | • Use RFID to replaces the existing bar code technology  
                                         • Implementation of the emerging AGV technology in pharmaceutical warehouses           | Current level of technology is in line with pharmaceutical logistics operations  
                                                                                              • Application of existing automated sorting robot technology with pharmaceutical warehouses  
                                                                                              • Implemente RFID can make an improvement                                               |
| Transportation equipment and route | • Expand more air transportation coverage for cold chain related healthcare logistics business | Modification of existing food refrigerated vehicle  
                                                                                              • Purchase sealed refrigerated vehicle for transport of vaccine products               |
| Technology in Transportation       | • Use Geo-fencing technology to replaces existing GPS technology  
                                         • Develop more functional transport containers similar to the Pharma-port 360           | Develop own transport container through the use of expanded polypropylene material  
                                                                                              • The use of RFID technology and Geo-fencing as an improvement                         |

*Figure 12: Improvements for SF Express and adjustments for YTO Express*

From a holistic point of view, for Chinese 3PL providers, for companies that have already entered healthcare logistics sectors, they can make improvements and better operating healthcare logistics business through the technological progress and learned from advanced experience. For the 3PL providers which have not yet entered the field of healthcare logistics, the required adjustments do not need to be one-step to the top, but should first focus on meeting the requirements of GSP standard as the entry threshold.
6.3 Analysis of research question 3

Based on the description of the current status of Chinese healthcare logistics and Chinese 3PL providers, as well as the analysis of the first two research questions, the third research question will be presented. From the perspective of Chinese 3PL providers, the entry of Chinese healthcare logistics sector will bring different development opportunities for them, similarly, various challenges will also be faced. For the analysis of research question 3, will be present in three different perspectives and factors, which are healthcare sectors and healthcare logistic in China, policy factors, and technology factors. The research question 3 of the paper is:

*What are the opportunity and challenges for Chinese 3PL providers within Chinese healthcare logistic sectors?*

6.3.1 Healthcare sectors and healthcare logistic in China

*Opportunity 1:*

In recent years, the Chinese healthcare sectors is rapidly developing. In recent years, the number of investment cases in the Chinese pharmaceutical industry has gradually increased. In 2017, there were 342 investment cases (CRIFI, 2018). The increase of the number of investments means that it will drive the economic growth of the pharmaceutical industry. According to DBS Group's forecast, China's pharmaceutical sales growth rate will be 9-10% in 2018 (DBS, 2017). Of course, the development of an industry cannot be separated from the strong support of the government. Since 2009, Chinese government has increased its investment in building a complete public healthcare system (Gusmano et al., 2011). Until today, the “Made in China 2025” project in the 10-year strategic plan formulated by the Chinese government clearly shows that the government will vigorously develop biomedical and high-tech medical devices during this decade, heralding the emergence of a good prospects for the development of the industry has been drawn (Miit.gov.cn, 2015).
Compared with the pharmaceutical industry, which is expanding continuously and has great development prospects, the shortcomings of traditional healthcare logistics are strongly demand the involvement of Chinese 3PL providers, just as the analysis of Chinese healthcare sectors research question 1. As a result, a complex distribution network has emerged with traditional healthcare logistics and is accompanied by a variety of problems that will directly affect the development of the Chinese market. For Chinese third-party logistics providers, they need to maximize their own advantages and plan and integrate China's healthcare logistics distribution network, so as to stabilize the market's medicine prices, and ensure the effectiveness of products through the improvement of transport efficiency, or through the integration of information to ensure a good supply and demand relationship between pharmaceutical factories and hospitals, these actions will bring an active pharmaceutical environment for China. For those pharmaceutical manufacturers that take care of both their main business and the logistics functions, the arrival of Chinese third-party logistics companies will undoubtedly bring benefits to them, whether through the qualified personnel to ensure the quality of the products, or reducing operational costs through outsourcing of logistics functions, to achieve the increase of the company's core competitiveness (Scioscia, 2014; Jonsson, 2008; Kreng & Wang, 2005). No matter from which perspective, the demand for 3pl providers in Chinese healthcare sectors is huge, so this will also be a very good opportunity to enable Chinese 3PL providers to successfully enter the field of healthcare logistics.

**Opportunity 2:**

For healthcare sectors in China, the traditional healthcare logistics model dominates the mainstream. How China's 3pl transforms companies' ideas of using the traditional model has become the first battle for survival in the Chinese healthcare sectors. For some successful cases, it can be shown that a good 3PL provider must not only have enough professionalism in the field of logistics, but also need to respond to some unexpected situations in a timely manner. For example, in the chapter 5, the description of the successful case of SF Express healthcare logistics, such as the case
of the distribution of vaccines in Tibet, we can see that there is an experience of 3pl's experience in the risk of transportation, and the handling of unexpected conditions. For the transportation of biological products in Xinjiang, SF Express also showed that the quality of the delivered products is controlled. This is reflected in the preparation before transportation, the planning of the transportation plan and the route planning with the comprehensive analysis of road conditions (SF Express, 2018). The successful case of SF Express also demonstrated that a qualified 3PL providers has the ability to enter the field of healthcare logistics, which has provided inspiration for other 3PL providers that have not yet entered the field. On the other hand, the cooperation between SF Express and international pharmaceutical giant Sanofi also has set an example for other 3PL providers. This is an opportunity for Chinese 3PL providers to prove that they can have a good development in Chinese healthcare logistics and contribute to the field of healthcare sectors.

**Challenge 1:**

For Chinese 3pl providers, one of the challenges stems from the deep-rooted traditional healthcare logistics model, which has existed for a long time, so which pharmaceutical manufacturers and distributors have maintained a stable relationship. When 3PL providers want to enter the field, they need to break the existing network or relationships. The order from the pharmaceutical factory also means that Chinese 3PL providers can really enter the field of healthcare logistics. As the information gathered from the interview, at present stage, only 5 out of an average of 200 orders from SF Express are pharmaceutical-related orders (Mr. A, 2018). And according to the SF Express two major customer types mentioned in emerge, according to Mr. Fang (2018), most of the medical orders now come from individual customers, that is, drug transportation between family and friends, but there are fewer orders from the pharmaceutical manufacturers (Mr. Fang, 2018). It can be seen that in the market environment dominated by traditional healthcare logistics, 3PL providers need to make their own efforts. Therefore, the deep-rooted traditional healthcare logistics model in the Chinese market is one of the challenges facing by Chinese 3PL
Challenge 2:

As discussed in research question 1, one of Chinese 3PL’s predictable contributions to the healthcare sectors is the integration of distribution channels and the integration of information, which can speed up the efficiency of the entire supply chain and ensure the supply of medicines. It can be seen from figure 9, that the flow of information before the integration of the distribution channel, there is a problem exists, from hospital to the manufacturer, when there is a medicines shortage in the hospital, the response from the upper-level distributor to reaching the manufacturers will go through various levels. After the integration of distribution channel, as shown in figure 10, the flow of information has also become two-way, which means establishing a transparent and open information network to accelerate the flow of information. However, the actual situation is that, the supply shortage of some high-end drugs or new drugs comes from the reluctance of most hospitals, for sharing their information systems (AT Kearney, 2012). This also increases the difficulty of information integration for 3PL. The information system closed by the hospital brings the fact that inventory cannot be monitored in real time, and also makes the flow of information in the entire supply chain slower. So for Chinese 3pl providers, the integration of information, and reluctance of most hospitals for sharing their information systems become a challenge which can not be ignored.

6.3.2 Policy factors

Opportunity 3:

According to Kwo (2003), the average distribution cost of pharmaceutical products in Chinese market accounts for more than 40% of the total cost, so the status of an unhealthy distribution channel is detrimental to the development of pharmaceutical industry (Kwo, 2003). As one of the priorities of the Chinese government's health care reform, the simplification of the overall distribution network and the introduction of a healthier healthcare sectors are among the goals of the government. Based on the case
description in chapter 4, the two-invoice system was formally implemented in the Chinese market in 2017. For the third-party logistics providers in China, the implementation of the two-vote system has opened the door for them to enter the field of Chinese healthcare logistics. For pharmaceutical companies and hospitals, they are encouraged to take the lead in implementing the two-invoice system (China State Council Medical Reform Department, 2017). From a policy aspect, the number of intermediaries in distribution channels also makes more pharmaceutical companies tend to outsource the distribution of medicines. Therefore, for a policy factors, the implementation of the two-vote system is a great opportunity for China's third-party logistics providers to enter the field of healthcare logistics and the development prospects of third-party healthcare logistics in China.

**Challenge 3:**

Based on the description above, the implementation of two-invoice system has brought more opportunities for third-party logistics companies to enter the field of healthcare logistics (China State Council Medical Reform Department, 2017). Along with this, a potential and predictable phenomenon is that more multinational third-party logistics providers, large third-party logistics providers in China, and small and medium-sized third-party logistics providers in China are entering the market. Therefore, based on the good development prospects of the third-party healthcare logistics industry, more companies involvement will also lead to increased competition in the market. Therefore, the support and opening up of policies is a chance and challenge for Chinese third-party logistics providers. How to gathered more market share among numerous competitors and fierce market competition is another challenge that Chinese 3PL providers will face, and is the furthered question that needs to be considered.

**6.3.3 Technology factors**

**Opportunity 4:**

A good opportunity for China's 3PL, is the entry of multinational companies. Due to
the vigorous development of the Chinese healthcare sectors and the strong support from the government, a huge market will bring more opportunities and profits, many multinational logistics companies are also targeting the Chinese market. Just like UPS, a professional third-party logistics provider, entered the Chinese healthcare sector after the more opening of the policy. UPS has entered the field of healthcare logistics as early in 2001, and began to deploy healthcare logistics in China since 2012. UPS has 17 years’ experience of operating healthcare logistics related business globally, and there may be more advanced technologies and more advanced business models which UPS will bring into Chinese market (UPS, 2018). Therefore, multinational company with rich experience will undoubtedly be an inspiring and progressing target for Chinese 3PL providers. Even though Chinese 3pl provider has started healthcare logistics business relatively late, it also eliminates the barriers to move forward, through the developed and advanced technologies. As the analysis of research question 2, many advance technologies and experience can be learned and be an improvement for Chinese 3PL providers. Therefore, the learning and growth within the market, could be an opportunity for Chinese 3PL providers.

**Challenge 4:**

More advanced technologies usually bring higher costs, so the high cost of new technologies is also a challenge that Chinese 3PL providers must face. The participation of multinational companies is like a double-edged sword. With the participation of multinational corporations such as UPS, it will also bring enormous competitive pressure to Chinese 3PL providers. For example, for SF Express, which is the first domestic third-party logistics company entering the field of healthcare logistics, with the late start and lack of accumulated experience, when these multinational companies with advanced experience and technology are bound to bring a strong impact on Chinese 3PL providers. UPS International President Jim, Ba Boer once said that "China is one of the most important markets for UPS, and it is also true for customers," (Parcelindustry, 2012), UPS's technology for healthcare logistics hardware facilities, such as the construction of warehouses or developments of
technologies are far more advanced than Chinese market standards, after 17 years accumulated experience, it is foreseeable that more advanced technologies with higher standards will be taken into the Chinese market in the future, which will helping them for occupy more market share. So, huge competition comes from multinational companies is a big challenge for domestic Chinese 3PL providers.

6.3.4 Summary of the opportunity and challenge of Chinese 3PL providers

Based on the analysis of question 3, the article summarizes the opportunities and challenges presented by the Chinese third-party logistics providers in the following table.

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Challenge and opportunity of Chinese 3pl providers</th>
</tr>
</thead>
</table>
| Healthcare sectors and healthcare logistic in China | **Opportunity** :  
  • The urgent needs of 3PL provider by healthcare sectors  
  • Inspiration from the successful cases of Chinese 3PL providers  

  **Challenge** :  
  • The ingrained position of traditional healthcare logistics in China  
  • Reluctance of hospitals for open access of their information system |
| Policy factors                           | **Opportunity** :  
  • The implementation of two-invoice system bring more opportunities to Chinese 3PL providers  

  **Challenge** :  
  • The opening of policies increased the competition in third-party healthcare logistics market |
| Technology factors                       | **Opportunity** :  
  • Opportunity of learning and developing for advanced technologies  

  **Challenge** :  
  • Multinational companies in Chinese market with advanced technologies and experience |

*Figure 13: Summary of the opportunity and challenge of Chinese 3PL providers*
7. Conclusion

In this chapter, the conclusion of both three research questions will be presented, as a conclude and answering of research questions. Additionally, the contribution of the paper within the theory and social perspective, the self Criticism, and suggestions for further studies have also been presented.

7.1 Conclusion of research question 1

Research question 1: What could be the predictable contribution of Chinese 3PL providers to Chinese healthcare sectors?

For research question 1, the paper have summarizes the two major problems existing in the current market through understanding and studying the current status of the Chinese pharmaceutical industry, which is the complexity of distribution channels and the long existed traditional healthcare logistics forms in China. Through the data collection of case companies and the study of the literature on third-party logistics, the paper have analyzes the predictable contribution that China 3pl provider can make to Chinese healthcare sector.

For the first problem, the complexity of distribution channels. Based on the theoretical perspective, third-party logistics providers can simplify and integrate distribution channels. For China 3pl providers, taking the two case companies selected by the article as examples, there are three predictable contributions to the Chinese healthcare sectors. First of all, Chinese 3PL providers can integrated the product flow of pharmaceutical products with a complete transportation network coverage and eliminate medicine price markup within distribution channels. Therefore, it can be predicted that Chinese 3pl providers can make their own contribution for the decline of medicines prices in Chinese market. Secondly, Chinese 3PL providers can improve the efficiency of the medicine transportation process by its well-established transportation network coverage and professional logistic related skills. It can be
foreseen that Chinese 3PL providers can make their own contribution to the timeliness and quality assurance of medicines in terms of transportation. Thirdly, Chinese 3PL providers can use advanced information systems to integrate information flow of pharmaceutical products, thereby increasing the delivery efficiency of demand information at both ends of the supply chain, that is, between hospitals and pharmaceutical manufacturing companies, thereby increasing the supply efficiency. Therefore, it can be foreseen that Chinese 3PL providers can make their own contribution to a more stable medicine supply in Chinese market.

For the second problem, is the traditional healthcare logistics model existing in the Chinese market. Based on theoretical perspective, manufacturing companies can enhance the company's main business performance and core competitiveness through the outsourcing of logistics-related functions. For Chinese 3PL providers, taking the two case companies selected by the article as examples, there are two kinds of predictable contributions to Chinese healthcare sector. First of all, for Chinese pharmaceutical companies, the professionalism of logistics related personnel and the perfection of logistics equipment cannot be comparable with professional third-party logistics providers.

Therefore, through the outsourcing of logistics related functions, Chinese pharmaceutical companies can ensure that medicines are transported and storage more professionally for ensure the high quality, thereby eliminating the recurrence of the illegal vaccine incident in Shandong province which described in section 4.1.2. Therefore, it can be foreseen that Chinese 3PL providers can make their own contribution to the protection of pharmaceutical quality in the Chinese healthcare sector through professional logistics-related skills. Secondly, Chinese 3PL providers can reduce the cost of warehouse construction and the cost of transportation equipment procurement for pharmaceutical companies by fulfilling their logistics activities. Moreover, through a complete information system and resource planning, Chinese 3PL providers can help pharmaceutical manufacturers to achieve JIT production, thereby reducing their inventory cost. With the stripping of
logistics-related costs, Chinese pharmaceutical companies will have more invest in advanced technologies and equipment, so it can be foreseen that Chinese 3PL providers can make their own contribution to the improvement of pharmaceutical product innovation capabilities in Chinese healthcare sector.

Based on the article's analysis of research question 1, five predictable contributions of Chinese 3PL Providers to Chinese healthcare sector were summarized and presented in figure 11.

### 7.2 Conclusion of research question 2

**Research question 2: How can different types of Chinese 3PL providers better adapt to healthcare logistics in China?**

To the analysis of research question 2 “How can different types of Chinese 3PL providers better adapt to healthcare logistics in China”, the paper have classified research question 2 into RQ2a and RQ2b based on different types of companies.

**RQ2a: What improvements can be made by Chinese 3PL providers, which has already entered healthcare logistics sectors?**

RQ2a is aimed at the companies in Chinese market which have already entered the field of healthcare logistics, which is the case company selected SF Express. The analysis will be conducted on warehousing and transportation, of how SF Express can better operate the business of healthcare logistics, with the implementation of new technologies or learned from advanced experience.

First of all, in the perspective of warehousing, which is the analysis of RQ2a-1. From the perspective of warehousing facilities, SF Express currently has warehouse facilities that comply with the GSP standards. The improvements that can be made include the construction of more specialized warehouses for pharmaceutical products. Moreover, in the process of the construction of special pharmaceutical warehouses, the introduction of advanced technology can enhance the professionalism of the company's pharmaceutical warehouses. For example, the implementation of
liquid-hardened ground technology and 100,000-grade medicine storage clean-room can be a exceed of GSP standard, as company's improvement. From the perspective of technology in warehousing, SF Express can use RFID technology to replace the current used bar code technology, as well as the introduction of emerging AGV technologies, to improves the overall operational efficiency of the warehouse.

Secondly, from the perspective of transportation, which is the analysis of RQ2a-2. From the perspective of transportation equipment and routes, SF Express's current 227 GSP-certified transport trucks and 51 transport aircraft have met and exceed GSP standards. For the improvement which SF Express can perform, can be within the transportation route aspect. With the construction of dedicate pharmaceutical warehouses, more than the existing 23 air transport routes can be constructed, so that from the perspective of air transport, the efficiency and coverage of the company's healthcare logistics can be improved; From the perspective of transportation technology, currently, GPS truck positioning systems, which are widely used in SF Express, which can be replaced by a more advanced Geo-fencing technology for a better monitor and route planning. In the same way as warehousing, RFID technology can also be well applied in the process of transportation, so that more accurate temperature information can be collected and transmitted, and manual scanning time can be saved, which will improving the efficiency of medicine delivery. For the EPP circulation incubator currently used by SF Express, although it meets the requirements for the transportation of pharmaceutical products, there is still room for improvement. For example, UPS's Pharma-port 360 container, which have the functionality of adjusted and monitored for the temperature inside. SF Express can increase its R&D in transportation containers so as to better improve the timeliness of pharmaceutical products in their transportation process.

RQ2b: What adjustment need to be made by Chinese 3PL providers, for entering healthcare logistics sectors?

RQ2b is aimed at the companies in Chinese market which have not yet entered the field of healthcare logistics, that is the case company selected YTO Express. The
analysis is conducted both in warehousing and transportation perspective, to see what adjustment need to be made based on GSP standard, for them to entering the field of healthcare logistics in China.

First of all, from the perspective of warehousing, which is the analysis of RQ2b-1. Based on the GSP standard, for operating vaccine products in healthcare logistics, there are requirements of two or more dedicated pharmaceutical warehouses. Therefore, for YTO Express, the construction of a dedicated pharmaceutical warehouses which meets the GSP standards is the primary adjustment they need. From the perspective of technology in the warehouse, because the current infrastructure of YTO Express has already met the standards for operating healthcare logistics, what the company needs is not an adjustment that must be made, but is an improvements that can be made as a progress, such as the replacement of bar code technology with RFID, and the use of company's existing automated sorting robot into the healthcare logistics business.

Second, from the perspective of transportation, which is the analysis of RQ2b-2. From the perspective of transportation equipment, YTO Express does not currently have GSP-certified pharmaceutical cold chain transport trucks. For the transportation of low-temperature drugs, YTO Express can modify the existing food refrigerated trucks, such as adding a wider range temperature control air-conditioning system, or through the installation of the structural insulated panel (SIP) compartment wall to the ordinary truck, to use it in healthcare logistics business. However, for vaccine products, since GSP standard require the sealing trucks for the transportation of vaccine products, YTO Express's food refrigerated trucks cannot be used. This brings another necessary adjustment for the purchase of sealed refrigerated trucks. From the perspective of technology in transportation, GSP stipulates that medicine need a special cold storage container during transportation, and YTO Express does not have the insulation box which fulfill the standard, so the adjustment required by the company is the development of refrigerated incubators. The EPP circulation incubator currently used by SF Express can be a good inspiration for YTO Express. The
company can start with the R&D to the use of expanded polypropylene (EPP) materials and develop their own refrigeration container. The replacement of GPS and bar code technology in the transportation process with Geo-fencing technology and RFID technology is kind of improvements which can be made for YTO Express, but it is not necessary for meeting the GSP standard and entering the field of healthcare logistics.

Based on the adjustments and improvements that various types of companies need to or can be made, the paper summarizes and presents these improvements and adjustments in Figure 12, to better illustrate the answers to research question 2.

### 7.3 Conclusion of research question 3

**Research question 3: What are the opportunity and challenge for Chinese 3PL providers within Chinese healthcare logistic sectors?**

Through the overall description of the article and the combination of the first two survey questions, the author analyzed the opportunities and challenges faced by Chinese 3pl providers in the field of healthcare logistics sectors, from three perspectives.

The first perspective is healthcare sectors and healthcare logistics in China. Due to the problems in the Chinese market summarized in RQ1, it shows that the Chinese market has strong demand for 3pl providers with professional logistics experience, so this will be an opportunity for Chinese 3PL providers. Then through the description of the successful case of SF Express in the field of healthcare logistics, it can brought inspiration for the other 3PL providers which has not yet entered the field, and also proved that the domestic 3pl providers has the ability of entering the field of healthcare logistics. More opportunities also mean more challenges. The traditional healthcare logistics model is entrenched in Chinese market, which brings huge challenges. When China's 3PL providers are willing to enter the healthcare logistic sectors, there needs more self-improvement. And due to most of the hospitals are
reluctant to disclose their information systems, Chinese 3PL providers are facing a huge challenge for the integration of information system.

For the second perspective, is technology factors. Multinational companies in Chinese market is like a double-edged sword. Firstly, they are bringing advanced technologies and business models into Chinese market, which can be learned and used as a reference by Chinese domestic 3PL providers, which is an opportunity for Chinese 3pl providers. In the future, multinational companies with years of experience in healthcare logistics sectors will also bring more advanced technologies into Chinese market, so this is undoubtedly a huge challenge for Chinese 3PL providers who started late in the field.

For the third perspective, is policy factors. The implementation of two-invoice system has give Chinese 3PL providers more opportunities to enter the field of healthcare logistics, but at the same time the opening of the policy has bring more competitors into the market, so how can Chinese 3PL providers improve their own competitive advantage and grab more market share has become another challenge.

Based on different opportunities and challenges faced by Chinese 3PL providers, the paper has made an summarizes and presents in figure 13, to show the answer of research question 3.

7.4 Generalization of the paper

From the perspective of Chinese 3PL providers, how to adjust to enter the field of healthcare logistics, or how to improve themselves to better adapt to healthcare logistics are issues that need to be considered by the Chinese 3PL providers. From the method of combining theory with practice, through interviews with case companies, suggestions for improvements and adjustment for different types of Chinese 3PL providers has been made, to provide as an reference opinions for Chinese 3PL providers. The opportunities and challenges that Chinese 3PL providers will be faced in the field of healthcare logistics has been presented, it is also a question that needs
to be considered by the Chinese 3PL providers in the reality.

7.5 Implications for society

First of all, for the topic of the thesis, the pharmaceutical industry and healthcare logistics have important meaning for the whole society. The quality, price, or supply of medicines are also closely related to human health. The article limits the scope of the research into Chinese market. There are many problems exist in Chinese healthcare sectors, by analyzing the improvements that Chinese third-party logistics providers can make, and the adjustments that need to be made, more third-party logistics companies will be able to better adapt to and enter the field of healthcare logistics, and contribute to and solve the problems existed from different aspects, so that a healthier market environment in China will be established.

7.6 Criticism of the paper

Due to the time limit, the creation of the thesis is limited in some aspects. First of all, the title of the research is healthcare logistics, but during the, there is no interviews with pharmaceutical companies to obtain primary data, which is sort of limits the concepts of “logistics”. For research question 2, the technical progress suggested in the paper has certain limits. Naturally, more advanced technologies exist and are worthy of analysis and discussion. For research question 3, the paper has analysis different challenges faced by Chinese 3PL providers, due to time constraints and the number of the companies interviewed, the article does not provide recommendations or solutions on how to overcome these challenges.

7.7 Further studies

First of all, because this research is conducted in the field of healthcare logistics, authors suggest to investigate this issue from a more comprehensive perspective, such as getting contact and interviews with pharmaceutical manufacturers for further
studies. Secondly, because healthcare logistics has very important practical significance, so in addition to the investigation of Chinese market, the author proposes to investigate and study the healthcare logistics sectors in more countries, especially in other developing countries. Thirdly, for UPS's 17 years experience in the field of healthcare logistics, it is also worth studying and investigating.

Authors will also present own opinion with the difficulties encountered during writing the thesis. Firstly, it usually takes longer time for contacting Chinese third-party logistics companies for the permission of interview. Since in China there is not a good environment for thesis creation as it is in Sweden, some companies are not used to receiving interviews from students and researchers. Secondly, because the pharmaceutical field is unfamiliar to most people, lot of medical-related professional knowledge or vocabulary needs to be learned from the beginning.
Reference list


AT Kearney company. (2012). *China’s pharmaceutical distribution: poised for change*. Available online:


A. Hermanns, V. Flegel (n), *Handbuch des Electronic Marketing*, Beck Verlag,
Muenchen.


China State Council Medical Reform Department. (2017). About implementation of "two-invoice system" in drug procurement in public medical institutions. Available online:http://www.nhfpc.gov.cn/tigs/s2906/201701/b64ca4c3d5c64a4e860316437d6eb787.shtml


http://www.chyxx.com/industry/201802/613576.html


CSCMP, CSCMP Supply Chain Management Definitions and Glossary. Available online: https://cscmp.org/

CSPB. (2017). China Express Service Test Results 2017. Available online:


Gov.cn. (2012). *Pharmaceutical quality management practices.* Available at: http://www.gov.cn/gongbao/content/2012/content_1907093.html


Han, G., Dong, M. (2017). Sustainable Regulation of Information Sharing with


https://www.simplypsychology.org/sampling.html


http://www.miit.gov.cn/n973401/n1234620/n1234622/c4409653/content.html


Pharmaceutical Enterprises after the Implementation of the New Version of GSP. 


UPS. (2018). *Cold Chain Solutions*. Available online:


Appendix 1: Research onion model by Saunders et al.

Appendix 2: Interview guide and question lists

Appendix 2.1 Interview guide and question lists for YTO Express

Cold chain business
1: Is there any cold chain-related business for YTO Express at present?
2: What do you think is the most important difference between the cold chain business of the food industry and the cold chain business of pharmaceutical products?
3: We have seen that the coverage of YTO Express of cold chain has basically covered the whole of Shanghai. Why did you choose Shanghai as the main service location for cold business?

Warehouse related
1: How many warehouses does YTO Express have in Shanghai? Is there an independent warehouse for cold storage?
2: In YTO Express's current cold storage, what is the usual temperature control range?
3: In YTO Express's current warehouse, is there monitoring equipment/instruments for humidity conditions?
4: Does YTO Express incorporate the use of RDIF technology in the warehousing process?
5: What technologies are currently included in YTO Express's warehouse management system?
6: What is the current classification and retrieval system for goods in YTO Express's warehouse?

Transport related
1: How many trucks do YTO Express have for transporting? How many trucks are in charge of cold chain transportation?
2: How much is YTO Express's investment in refrigerated trucks and the cost of maintenance?
3: What is the refrigerating temperature range of YTO Express's cold chain transport trucks?
4: How does the transport center usually monitor the temperature conditions during the cold chain transport? How do these monitoring data transferred?
5: Does YTO Express incorporate the use of RDIF technology in the transportation
process?

6: How YTO Express usually plan a reasonable path for cold chain transport? Is the use of Geo-fencing technology incorporated in the transportation process?

7: How do YTO Express usually deal with cold chain transportation orders from remote areas?

Appendix 2.3 Interview guide and question lists for SF Express

Warehouse related

1: How many warehouses of SF Express are there, and how many of them are warehouses for pharmaceuticals?

2: In SF Express's current cold storage, what is the usual temperature control range?

3: In SF Express's current warehouse, is there monitoring equipment/instruments for humidity conditions?

4: Does SF Express incorporate the use of RDIF technology in the warehousing process?

5: What technologies are currently included in SF Express's warehouse management system?

6: What is the current classification and retrieval system for goods in SF Express's warehouse?

Transport related

1: How many trucks does SF Express have responsible for transporting? How many trucks are in charge of cold chain transportation?

2: How much is SF Express's investment in refrigerated trucks and the cost of maintenance?

3: What is the refrigerating temperature range of SF Express's cold chain transport trucks?

4: How does the transport center usually monitor the temperature conditions during the cold chain transport? How do these monitoring data transferred?

5: Does SF Express incorporate the use of RDIF technology in the transportation process?

6: How do SF Express usually plan a reasonable path for cold chain transport? Is the use of Geo-fencing technology incorporated in the transportation process?

7: How do SF Express usually deal with cold chain transportation orders from remote areas? How to ensure product quality during transportation?

8: Has there ever been an unexpected situation where the refrigerated truck is not
cooled or the route exceeds the temperature control time during transportation?

**Third-party healthcare logistics**

1: How do SF Express ensure the integrity of your medicines in transit, especially for some medicines that require temperature control?

2: We see that SF Express current healthcare logistics services are mainly targeted at Guangzhou, Chengdu and Nanjing. Why did SF Express choose these cities as the first batch of medical transportation?

3: What do you think is the most important link for the healthcare logistics business in the Chinese market? Such as product transportation, storage links, or policies and regulations, and operating qualifications, etc.?

4: In your opinion, what is the main difference between the cold chain business of pharmaceutical industry and the cold chain of food industry?

**Appendix 3: Different technologies and equipment**

*Appendix 3.1: Typical refrigerated truck (Ahmed et al., 2010)*
Appendix 3.2: Typical refrigerated truck
From: https://supremecorp.com/truck-bodies/kold-king/

Appendix 3.3: Pharma-Port™ 360
From: WWW.UPS.COM