Evaluating Different Last Mile Logistics Solutions

A case study of SF Express

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Abstract

Compared to the highly developed logistics industry in USA, the Chinese logistics industry is still underdeveloped because of poor infrastructure and ineffective management capability. In terms of these realities, the most important bottleneck of the Chinese logistics industry is the last mile delivery problem, which holds the highest cost in the whole logistics process. To find ways to solve the problems with last mile delivery has become significant and urgent for Chinese logistics service providers.

The purpose of the study is to deepen and enrich the knowledge on last mile logistics in China. This is carried out with the help of the case companies SF Express and Property Management Company together with an investigation of last mile delivery alternatives in China. Related to the research question, a case study was carried out focusing on one business process. The data collection methods used include: interview, telephone or email contact, and survey.

Intelligent locker and the pick-up delivery solution could solve last mile logistics problems by different ways, especially with specific limitations in Chinese market. These delivery alternatives are highly possible to be adopted and generalized by different logistics service providers in China if not concerned about the cost or density of orders.

The current business mode of supermarket in China cannot fulfill the demand from an overwhelming number of customers. Costs for both pick-up stations are acceptable, and the cost is a positive factor for pick-up station mode.

The higher density of orders, the higher possibility of different time-window may require, and high competitive advantage of intelligent locker can be achieved. The high density of orders for intelligent locker is a positive factor. The cost for intelligent locker is a very negative factor, which seriously limits the popularization of this delivery alternative.

Keywords: Last mile logistics, Intelligent locker, Pick-up station, Delivery alternatives
# TABLE OF CONTENTS

1. Introduction ....................................................................................................................... 1  
   1.1 Background ................................................................................................................... 1  
   1.2 The Research Area ....................................................................................................... 1  
   1.3 Problem Definition ....................................................................................................... 2  
   1.4 Purpose ......................................................................................................................... 2  
   1.5 Research Questions ....................................................................................................... 2  
   1.6 Limitations .................................................................................................................... 2  

2. Theoretical Framework ....................................................................................................... 4  
   2.1 Distribution ................................................................................................................... 4  
   2.2 Response Time ............................................................................................................ 4  
   2.3 Vehicle Routing Problem ........................................................................................... 5  
   2.4 Last Mile Delivery ....................................................................................................... 6  
   2.5 Stock and Warehouse ................................................................................................. 8  
   2.6 Different Solutions in Last Mile Delivery ................................................................... 9  
   2.7 Relation of Logistics Facility and Logistics Factors .................................................. 10  

3. Methodology ...................................................................................................................... 12  
   3.1 Research Methodology .................................................................................................... 12  
   3.2. The Research Approach in this Thesis ...................................................................... 13  
   3.3 Collection of Data ......................................................................................................... 15  
   3.4 Validity .......................................................................................................................... 18  
   3.5 Reliability ...................................................................................................................... 19  
   3.6 Presentation of the Case Company ............................................................................... 20  
   3.7 Ethical Issue .................................................................................................................. 22  

4. Empirical Study .................................................................................................................. 23  
   4.1 The Incredible Growth of China’s E-business .................................................................. 23  
   4.2 High Density Population Affects Last Mile Delivery in China ...................................... 25  
   4.3 Last Mile Delivery Alternatives ................................................................................... 27  
   4.4 The Result of Interviews ............................................................................................... 36  

5. Analysis and Discussion .................................................................................................... 38  
   5.1 Pick-up Station ............................................................................................................... 38  
   5.2 Intelligent locker Delivery Solution ............................................................................. 44  

6. Conclusions ....................................................................................................................... 54  
   6.1 Research Question ......................................................................................................... 54  

7. Reference ............................................................................................................................ 56
1. Introduction

1.1 Background

First period of rapid development of China’s e-commerce started from 1999, when there were over 300 e-business websites established in that year, and this amount of e-business websites increased to 700 in 2000. The rise of e-commerce has opened an entirely new front in which the Chinese economy must catch up (Daly & Cui, 2003).

The rapid expansion of E-commerce is the main reason that directly activated and motivated the logistics industry in China. Several express companies and other logistics service providers have been fast developing after the e-commerce business began. China as a fast developing country in the world is still regarded as a “third world country”, especially considering its rural areas. Third-world countries usually stay at lower levels of industrialization and per-capita income when compared to the advanced countries (Wood et al., 2002).

Last mile delivery, also called the home delivery, is growing rapidly since the rise of online shopping, which has become an attractive market for logistics service providers (Visser et al., 2014). The last mile in a B2C environment is currently regarded as one of the more expensive, least efficient and most polluting sections in the entire logistics chain (Gevaers et al., 2014). The “Last Mile” in logistics delivery process or the “First Mile” in the case is a common logistics collection/distribution problem under urban condition. The nearer to the aggregated point (delivery destination), the more cost and higher loss in capacity and efficiency. This last process of the supply chain may face serious constraints in fulfillment, higher social, environmental and economic costs and increased complexity in operational arrangement. Last Mile delivery obstacle may be attributed to dynamically interacting but poorly understood reasons (Souza et al., 2014).

1.2 The research area

This thesis considers the case of SF Express Company, which is faced with the problem of last mile logistics and tries to cooperate with retailers to facilitate its promotion. In China, the cost of last mile delivery process occupied more than half of the whole logistics cost. Therefore many delivery alternatives were designed to deal with this limitation. The research in this thesis is to evaluate and analyze these different delivery methods with the currently practical situation.
1.3 Problem Definition

Many problems in logistics industry are inevitable, like obstacles for every logistics service provider. And the distribution problem is incurred by several reasons like the logistic infrastructure, costumer characteristics and management ability, so finding a way to solve this problem and adopting a set of applicable methods will facilitate the companies to gain competitive advantages in Chinese logistics market.

This thesis is mainly focusing on logistics problem in last mile delivery process in China. Last mile logistics in China remains a big obstacle for every logistics company especially for those who provide internal-city delivery service.

High cost is the reason why last mile delivery process becomes so serious for logistics industry in China. Christopher (2011) is concerned that last mile cost has become a inevitable problem for those online retailers when the cost would affect company’s benefit. Dynamic vehicle routing and schedule tools will reduce the influence of this problem, but what methods or technology could resolve this problem is now being discussed in China.

1.4 Purpose

The purpose of this thesis is to enrich and strengthen the knowledge related to last mile delivery, which is carried out with help of case companies SF Express and Property Management Company together with an investigation of last mile delivery alternatives in China.

The paper aims at clarifying specific limitations and conditions about different delivery alternatives. Furthermore, evaluating and analyzing how do logistics factors affect these solutions is also the purpose of this thesis.

1.5 Research Questions

The following question is important for raveling answers and related knowledge in this thesis:

- How do the high density of orders and cost affect delivery alternatives in last mile logistics in China?

1.6 Limitations

There is little research focusing on pick up station service, and no investigation has
been made for predicting potential business value of this specific area in China. So far, there are few empirical studies about adoption and mobility effects of collection-and-delivery points as well. As a matter of fact, this new delivery alternative is relatively new. There will be more empirical literatures about these delivery solutions in the future (Weltevreden, 2008).

As there is no example about the proposal to refer to in China, so the shortage of practical data would be the main limitation. Besides, due to the tense competition of last mile logistics in China, some critical data (e.g. price information) needed for this research are confidential.

Pick-up station and intelligent locker system as the delivery alternatives will be focused in this study.
2. Theoretical Framework

This part is to collect and arrange relative theoretical works together

2.1 Distribution

The process where the products moving from the supplier stage to the customer stage is called distribution process, which is a significant index of profitability since it affects both supply chain cost and the customer experience (Chopra & Peter, 2001). Distribution is the most important process in final part of logistics service, especially in China. Warehouse management, distribution center and last mile delivery make up the highest cost hard to reduce in Chinese logistics industry.

In the normal situation, express companies usually are concerned about how to distribute orders to different destinations of receivers in a reasonable delivery route, which should cover main service regions and be as short as possible (Simchi-Levi et al., 1997).

2.2 Response Time

The time period between when a customer makes a delivery order and when he or she receives his or her product delivery is called response time. Order visibility is a very important ability in delivery process since customers could track their order from placement to delivery, which would affect customer experience (Chopra & Peter, 2001).

Response time in Logistics service strongly is connected to logistics lead-time, which consists of customer order cycle and lead-time gap. Martin Christopher proposed a concept about lead-time gap in his book that logistics service time is usually longer than the time that customers expect to wait for. The logistics lead-time consists of customer’s order cycle and lead-time gap (Christopher, 2011).

2.2.1 Lead-time Gap

Figure 2.1 demonstrates customer’s order cycle in logistics lead-time. The length of the time that customers prepare to wait is called order cycle, and the time from when the order is started delivery to when it be received is called logistics lead time. In some cases this may be measured in months but in others it is measured in hours (Christopher, 2011).
Finding out a way to expand the customer’s order cycle and reducing the lead-time gap would improve the customer experience of logistics service.

2.2.2 Delivery with Time-Windows

For some delivery orders, customers would ask the express company to send their parcels in a specific time period, like 10-12 am. This 2-hour period is called Time-Windows.

A main problem in home deliveries happens when there is no reception or pick up station for parcels that are not prearranged, the failure rate of delivery due to “customer not at home” will be high. For the same reason, the parcel may cause 2 or 3 times for redelivery. On the other hand, a pre-arranged time-window will influence and impact delivery efficiency (Gevaers et al., 2014).

2.3 Vehicle Routing Problem

When express companies arrange a delivery they have to set up specific routes for carriers, and the route problem is another one during the delivery process, which is called VRP – Vehicle Routing Problem (Christopher, 2011). Reliable vehicle routing in urban area needs to take traffic condition into consideration. City logistics tend to provide fast and reliable transportation of goods in terms of efficiency and environmentally acceptable delivery tours (Ehmke & Mattfeld, 2012).

Current logistics systems in urban area are usually unable to delivery products with full delivery efficiency. The delivery activities increase the number of freight carriers or trucks in city region, which leads to congestion and other traffic issues in cities. Customers will not pay the full cost caused by the inefficiency of transport system (Casey et al., 2014).

The reason to introduce VRP concept here is because when considering constrains of
last mile delivery, logistics companies usually need to consider these two factors at the same time, and that makes things quite complicated.

2.4 Last Mile Delivery

It should be emphasized the “last mile” should be defined. The delivery process from the moment the parcel is shipped (from the last distribution center) to the moment it is received at customer’s home or a collection station is called the last mile in the whole delivery operation (Gevaers et al., 2014).

In a complete supply chain of a company, few processes in distribution directly make contact with costumers, which represent the quality of a company and enhance consumption experience. Unfortunately, so many companies seem to downplay it and regard customer-contact as an after-thought. A summarized definition is as follows:

“Last mile logistics is the last part of a B2C delivery process. It takes place within a predefined delivery area (e.g. urban area); including the upstream logistics to the last transit point until the destination point of the parcel. It involves a series of activities and processes, of critical value to all the involved stakeholders (e.g. Customer, Industry and Institution) within the delivery area” (Wohlrab et al., 2012)

Last mile logistics is the last process in a delivery service, which includes several activities and procedures that are necessary from the distribution center to the final receive point of a supply chain (Lindner, 2011). Also the human force is a key performance of last mile delivery, as is in normal case the courier who brings the product to the door is the only person that a consumer may meet during the online shopping service. An online shopping experience can be easily influenced by a poor delivery experience (Donegan, 2000). To make a home delivery, an express company should achieve a balance among cost, reaction customer service and profits.

Last mile distribution problem occurs much more seriously in highly developed e-commerce countries. For example in UK in 2010, as much as 30% of all UK-EU trade is done through UK online retailers, which is much higher than any country in Europe. A result of that is UK is facing serious distribution problem (Kuo, 2013).

Now that the e-commerce is such an important element for last mile delivery problem to appear, so could the rapid growing e-commerce market be a strong motivation to urge logistics companies to improve their last mile distribution? As a result of investigating this reality, let us see the logistics performance in UK around 2004: logistics providers report that 30% of small packages dispatched to customer homes fail to be delivered at the first time, resulting in poor customer service and avoidable logistics inefficiencies (Fernie & Mckinnon, 2004). Turning into 2006, the data showed that about 12 percent home delivery fail to be delivered, and around 50–60 percent of UK households have no one at home during the working time (IMRG,
There is a long empty window period that no one could stay at home to receive the parcels, in order to solve this problem, a very inspiring idea appears since this problem occurred to use the unattended reception to solve the delivery problem, and this solution will be focused in analysis part.

Figure 2.2 shows logistics cost per parcel about different processes in China, and the data collection shows that the cost of last mile logistics occupied more than half of overall logistics service. The general residential forms in China are usually high-density tenants, which means the most complicated distribute assignment is not from the distribution center to the end point, but the end point to the costumer’s door, so if any logistics company could figure out the solution to this part, then it would save a lot of costs during the final mile delivery. In China, logistics cost in final distribution is much higher than in line haul as the picture showed.

The yellow line in figure 2.2 below shows the relation between average cost of each parcel and total amount of all parcels in self-owned logistics service, and the white line represents the same relation with outsourced logistics service cost. Both results follow same standard that in one city and in one day.

Figure 2.3 shows the relation between service price and service amount for Last mile (intra-city) delivery.
The delivery cost in last mile logistics of outsourced service is consistent, but for self-owned logistics company, the cost is reduced to 2 Yuan per parcel ever since the total amount reaches 10,000 cases each day in one city. Therefore referring to this prediction, an express company can get the lowest cost in last mile delivery part if it covers the largest customers.

2.4 Customer Service

Since the last mile delivery companies directly face customers, customer service is also important for them. Some e-commerce sellers want the final delivery express company to represent their service quality, to show good expressions to their customers, and therefore they consider the consumer service of express company as a big matter. Delivery frequency, reliability, stock level and order cycle time would all be important elements when evaluated as customer service (Christopher, 2011).

2.5 Stock and Warehouse

High performance and punctual warehouse system provides a stable base for warehouse scheduling, fast customer response and supply chain management. The rapid growth of B2C e-commerce business generates a tremendous number of small orders of irregular items (Hu & Chang, 2010).

In order to make faster reactions in market, companies should always prepare extra products waiting for customers’ orders, and these products on shift should be kept as stocks. Stock is like a buffer between manufacture and the customer, which is
necessary but also expensive (Waters, 2003).

Logistics is a significant factor for online retailers’ strategies. It is necessary to have storage on a specific site when the number of stock keeping units (SKU) for e-commerce is large and when the online activity is frequent (Durand & Gonzalez-Feliu, 2012).

In order to achieve higher respond in on-line purchase business, some companies would prefer restoring products in local place as stock, preparing for those potential orders in foreseeable future. Organizations and corporations feel under pressure from business market and therefore they are constantly looking for the possibility of improving their operation processes and gaining a competitive advantage (Waters, 2003).

2.6 Different Solutions in Last mile Delivery

Fernie and McKinnon (2004) indicated that the delivery process could be divided into 2 different types, secured and unsecured delivery. In usual cases, dispatchers would leave the delivery parcel outside the house when there is no one at home to receive, which is called “door stepping” in UK and it is unsecured. Even though leaving parcel without receiving could reduce the second-time delivery, it causes risks to the order of stealing and damage.

Fernie and McKinnon (2004) summarized 4 ways to solve this delivery problem that no one is receiving order when dispatching it, and 2 of them are corresponding with my research prospective in this thesis:

- “Placing the order at a home-based reception box” (just as an intelligent locker to keep parcels)
- “Leaving it at a local collection point” (just as an manual-service pick up station)

Since Automated Storage/Retrieval Systems (AS/RSs) can not only reduce labor costs but also increase safety and enhance efficiency, therefore AS/RS are considered as good alternatives for logistics problems (Hu & Chang, 2010).

There are four main solutions for last mile delivery in the current logistics market, and more detailed subdivisions are listed in Figure 2.4.
2.7 Relation of Logistics Facility and Logistics Factors

The intelligent locker can be regarded as a micro warehouse, and logistics companies would distribute these lockers in different delivery terminals. By applying this technique as a pick-up point, customer could pick or send their orders by themselves, which integrate their actions into the whole delivery process, as figure 2.5 shows below:

![Diagram showing classification of unattended delivery forms](image)

Figure 2.4: Classification of the main forms of unattended delivery that have so far been developed (McKinnon & Tallam, 2003)

![Graph showing relationship between desired response time and number of facilities](image)

Figure 2.5: Relationship between desired response time and number of facilities (Chopra & Peter, 2001)
The more facilities arranged, the less response time (the closer to terminal, the faster reaction of logistics system, like one intelligent locker in one community). The relations between these two factors are showing in figure 2.6

![Figure 2.6: Relationship between number of facilities and logistics cost (Chopra & Peter, 2001)](image)

When the number of facilities increases, the cost of transportation decreases in a certain stage, and then increases after the critical point (this cost just covers from distribution center to terminal, but it does not include from terminal to customer’s door). This trend is shown in figure 2.7

![Figure 2.7: Variation in Logistics Cost and Response Time with Number of Facilities (Chopra & Peter, 2001)](image)

When the number of facilities increases, the total cost begins to decrease and reaches the lowest cost at critical point, and after the point, total cost will begin to rise. The response time is always decreasing as the facilities increase.
3. Methodology

There are different types of research methods in this thesis, which includes descriptive research and empirical research. The data used in this thesis will also be displayed by specific types, primary data and secondary data.

3.1 Research Methodology

Research needs to be designed and guided by a plan to make it follow the objective. The most significant decision is the choice of research approach, since the research design determines how the information will be obtained. A research design is the detailed plan that aims to lead a study to approach its objectives, which involves many decisions (Aaker et al., 1995).

The choice of research approach is most important, and this is because the research methodology decides how to impel the thesis research and how to confirm the thesis structure (Aaker et al., 1995).

3.1.1 Objective of Research

The goal of research should be decided in the first place since it will guide the research direction, and also determines how to collect data and information. A research design is the specific plan used to guide a research study towards its objectives. The design of the process involves many decisions that are interrelated. The most important decision is the choice of research approach, since the research design determines how the information will be obtained (Aaker et al., 1995).

In this thesis, research objectives in this study are already existing, so all research and investigate are based on empirical data from current situation, but not subjective speculation. Follow this principle, the data collections are all strictly related to research purpose.

3.1.2 Different Types of Research

In this thesis research mainly involves descriptive research, like observations, case studies and surveys with case companies. Descriptive research can be quantitative or qualitative. The quantitative descriptive research tends to describe data and characteristics about the phenomena under research but not to offer reason for the situation. However, a qualitative descriptive research study may deliver answers for
the current situation. Descriptive research may include statistical surveys, sampling and interviews. For example, descriptive research is describing ideas from interested sections about levels of health service provision in a given area. This kind of research can be answered by quantitative or qualitative methods or even both in a combined way (Offredy & Vickers, 2010).

### 3.1.2.1 Descriptive Research

Descriptive study is used in order to discover and describe the characteristics of the variables of objectives in a certain situation. The goal is to describe relevant aspects of the phenomena of interest to the researcher from an individual, organizational, industry-oriented or other perspective (Sekaran, 2000).

### 3.1.2.2 Empirical Research

Looking at the world rather than thinking about it can usually answer questions of empirical research. The study of empirical question is dominated by the Rules of Looking rather than the Rules of Thinking (Nothnagel, 2008).

In this thesis, empirical study includes different sides of data, conclusion and comparison. Empirical research relies on direct and indirect experiments and observation gained from investigation, and these results could be used as analyze materials. Many data and information come directly from the market and case company, and the analysis on them are derived in empirical ways.

Pick up station: Study of this logistics service involves similar logistics solution processing in different situations. A comparison of this logistics service between different logistics conditions in Sweden and in China will be introduced, which shows the different patterns of the same logistics in these two different circumstances.

### 3.2 The Research Approach in this Thesis

The main approach in this thesis is implemented by case study. There will be several evaluations about different innovative delivery alternatives, taking different factors like cost, time consume, geographical and order quantity as indexes to find out how logistics performance would be affected by these innovative solutions. The paper estimates the future development of these two logistics solutions and possible business modality as they are applied in China.

### 3.2.1 Case Study

Case study is one kind of different science research, which includes experiments, surveys, histories, and economic and epidemiologic research. Case study research includes both single and multiple case studies. All kinds of case studies focus on
demonstrating reasons of decisions—why and how to implement them to get the expected results (Yin, 2009). In this thesis, the purpose of introducing the case study is to reveal theoretic outcomes with practical data, evaluating and verifying scientific knowledge by experiments.

A case study is often introduced in an exploratory study, when the researcher proposes to test the possibility under conditions that he/she did not know before the study. The most general application will be in a descriptive study or causal study where the researcher has the area of problem fairly clear from the beginning. A case study is most often qualitative (Lekvall & Wahlbin, 1993).

In this thesis, the writer chooses a case study with SF Express Company that faces the last mile logistics problem directly and frequently, which makes it possible to use data and internal materials from the case study company. The company itself has accumulated a great amount of experience about last mile delivery but also requires new thoughts and idea to solve or improve this process.

Since every package the Property Management Company receives would require courier to fill record into document, the explicit data can be collected. Property Management Company is the last transfer station in the whole delivery process, functioning as a distribute center. Most packages went through the last mile delivery would cross this station. Therefore Property Management Company is the key to acquire critical data, which allows data analysis about last mile delivery.

There will be interviews with employee in Property Management Company to collect data from parcel records, which will get subjective and objective information for the case study. Figure 3.1 below shows how Property Management Company works with a courier from express company.

![Figure 3.1: Dispatcher from Express Company is filling record at Property Company](image-url)
The second part of research in this thesis is empirical research. Since SF Express’s current last mile logistics solutions are known, the author will find related limitations and conditions according to these solutions to evaluate them.

There will also be introduction for the special current situation in China by using empirical research, like the characteristics of Chinese logistics customer and the business structure in China for last mile delivery service. The final outcome will be meaningless without specific conditions like author mention in empirical study part.

After getting a general understanding of SF Express’s solution and all related information, the author will need to evaluate those solutions more clearly by using observation and data collection, and to express the result of these observation and data descriptive research will applied.

In Analysis part the author will calculate the primary data collected from interview and compute density of parcel delivery by observation. Certain amounts of parcels that come from case company will be summarized and calculated, and then we will know the density and pressure of parcel delivery in specific time frame in last mile logistics. The price of facilities and time cost in last mile delivery process will be calculated and summarized, and therefore the comparison between current delivery alternative and innovative one will be made.

3.3 Collection of Data

3.3.1 Primary Data

Primary data is gained directly from first hand resource, by interview. These data have never been published by anyone else except the researcher, and will be used in new research or study.

Primary data are collected especially to address a specific research objective (Aaker et al., 1995). Primary research is based on original primary data, which is usually appearing in different research types, like academic, market and economics, and the result of primary research is also derived from primary data that been analyzed and collected. Primary data could be qualitative and quantitative. Qualitative investigation works as a case study with samples. Qualitative data consist of detailed descriptions of situations (Merriam, 1994).

3.3.2 Primary Data in this Thesis

The methods used in this thesis to collect primary data included: one interview with
manager in Property Management Company to acquire operation records, and another interview with courier in SF Express.

Changsha is a second tier city I live in China, which has 5 million populations and locates in the middle of China. In order to investigate the condition to apply intelligent locker in Changsha, I took a month to collect data in a sample housing community. The property management company of this community would collect the parcels from express companies for tenements.

In order to get the cost of SF Express company for each parcel delivery and distribution arrangement, the author made telephone interviews with SF Express’s courier who in charge of the sample community delivery (See appendix I).

Interview with property Management Company in China provides me the express parcels record for sample period, and data of sample residential community (See appendix II).

### 3.3.3 Secondary Data

Secondary data is cited from other research that already existed, from records, articles or investigation reports from other organizations and companies. Analyzing secondary data would support the arguments in thesis and promote quality of research, by using secondary data could also save a lot of time for the writer. To create a large data from writer himself is impossible in a short time, and the lack of data would also limit the writer’s research.

The secondary data used in this thesis includes: A.T. Kearney, a global management consulting company, which has trusted advisors on the most mission-critical issues to the world’s leading organizations across all major industries and service sectors (A.T. Kearney, 2014). Bain Company, an American global management-consulting firm, which provides advisory services to many of the world's largest businesses, nonprofit organizations, and governments (Bain & Company, 2014).

In this thesis, Kearney Consulting Company provides evaluation of local logistics service companies and information of Chinese logistics industry, like the ranking list of Chinese express companies, and the cost structure per parcel in last mile delivery in China. Bain Company demonstrates estimation about China’s e-business growth.

Also, part of information about SF Express comes directly from SF forum, which is established by SF Express Company in its official website, a place for people to share and acquire information including some data and discussion and data about SF Express.
3.3.4 Individual Interviews

The interview seems self-evident. The interviewer coordinates a conversation aimed at obtaining desired information. The respondent provides the answers she or he usually well understands. The respondent is obligated not to raise queries, but to provide information from his or her personal experiential knowledge (Guberium & Holstein, 2001). In this thesis, the author needs to know information from interviewers’ experience and subjective views to reveal facts and practical outcomes about specific research area.

The advantage of individual interview is that it allows the interviewer to ask all kinds of questions, and the questions could be extensive and subjective under conditions that is preconceive for the interviewees (Lekvall & Wahlbin, 1993).

Because it is unlikely to arrange several interviews with the same sample, so most individual interviews should be set directly and effectively to get as much useful information as possible. It is possible to reveal interviewee’s preference, attitude and perspective. All of these materials can be used into research.

3.3.5 Interviews in this Thesis

The case companies tend to be conservative and protective about their information, so the individual interviews in this thesis are more like meetings. The purpose of the meetings is to understand and clarify these interviewees’ subjective opinions about new delivery alternatives (do they feel positive or negative about different delivery methods), but not to acquire specific data from them, because detailed data will be obtained from business records.

Individual interviews in this thesis include: an interview with manager in Property Management Company in Changsha, China and an interview with a SF Express courier. There is a distribution center of SF Express located 1 km away from sample community, and the author went there and had a meeting with courier of SF Express.

The Property Management Company is in charge of the sample community’s property maintenance work, like electricity, water supply, waste treatment and parcel receiving. An interview with general manager in the Property Management Company will get critical information about what employees’ experience and opinion are about current last mile delivery model.

Examples of interview questions with SF Courier are:

How many delivery times each day the most for a single parcel, in order to satisfy customers’ need?
Will you transfer the parcels to property management company if customer is not at home when you delivery the order?

Do you think it is profitable to arrange a pick-up station? Do you think it will facilitate your work?

**Examples of interview questions with Property Management Company are:**

How many households are there in this community? How many people here?

How many parcels on average every day?

What are the main express companies who would delivery parcels to this community?

Is there any different between SF Express’s service and other companies?

### 3.4 Validity

Yin (2009) mentioned 3 validity tests commonly used in case research in his book:

- **Construct validity:** clarifying the current study methods for the concepts being studied are accurate.

- **Internal validity:** building up correlative relation, follow the certain conditions to find other expected conditions, and find out the fabricated relation.

- **External validity:** Identifying the research’s outcomes and verifying if it can be popularized (Yin, 2009).

Construct validity is one type of validity evidence. One method of establishing this type of validity is by analyzing factors; another method of establishing construct validity is verifying the test is relevant to other constructs in manners that are consistent with theory (Ravert, 2008). Related to this thesis, the data from interviews can support the construct validity. Keeping research measurement to thesis questions will maintain construct validity of this case study; therefore to ensure the study method used in thesis is correct and correspond to research questions are important. In order to increase the validity in the thesis, the author collects data by extracting it only from case company, which focuses on research questions.

Internal validity and external validity correspond to different phenomena. External validity focuses on the generalizability of general causal statements. Internal validity
is concerned with specific statements that do not lead generalizing to new cases. Compared to external validity, a study refers to internal validity only shows causality in the past within the specific conditions, which leads to no extrapolation with less dependence on outside assumptions (House, 2010). Internal validity is mainly suitable for explanatory case studies, scientific study and research. Validity would facilitate a study toward a right way to focus on the research questions that need to answer. Validity is a key to select the suitable calculation method used in a thesis, and confirm the significant of the analytic method. In the empirical study and analysis part, the author is building a connection between results and different conditions that rely on data. Like the parcel collection record from the Property Management Company, from which the author can know the amount of parcel delivery service everyday and the frequency of it would involve the case company. Different geographic store distributions of pick up station in Sweden and China would demonstrate the disparity of last mile delivery process in these two countries. All these studies need to be explained very discreetly following the logic that will lead to a valuable result.

External validity deals with the problem that makes sure if a study's findings are generalizable beyond the current case study (Yin, 2009). Each reader may explain a case study in different ways, since each reader has his or her personal opinion of cases for comparison. The reader can see similarities and differences based on his or her own experience and understanding to draw a self-owned interpretation. Therefore, the more naturalistic the case study, the more it relies upon its audiences to find its own generalizations (House, 2010). In this case, in order to make the result of case study generalizable, author will introduce standard data for the case research, to eliminate the subjective judgment and stochastic interference that may disturb the generalizability of results. For example, the cost of intelligent locker has to be a reasonable and common price, which will be directly selected from Chinese manufacturer. Once any other research involves the same factor, it will use the same data to proceed. Besides that, in order to increase the external validity, author will enlarge the amount of sample in calculation, which could make the data more varied and reduce random errors. Current business construction about last delivery process in China is common in most residential areas, and therefore the comparison between different deliveries alternatives in this case study will also accord with the current situation. In order to improve the reliability for the study method, the author will expand sample data from Property Management Company from 10 days to 20 days to decrease the influence of weekend days that usually generates more parcels than ordinary times, trying to reduce bias and balance the data from Express companies.

3.5 Reliability

Reliability is a factor that means the method of study like data collection can be adopted in other studies, and the operations of research is repeatable with the same results that will be obtained (Yin, 2009).
Reliability is working for accuracy and continuity of a research and to maintain a high reliability during adopting research methods that would generate stable and valuable results.

After the interview with an employee of Property Management Company, the author applied to acquire the parcels amount information from Property Management Company, and it will be directly quoted from the company’s business records. Other research methods in this thesis like data collection will follow ordinary standard.

According to this requirement, the parcels record from Property Management Company have been carefully summarized and added up. Since there are clear records of each single parcel by the time it turns in and turns out, the author summarizes any specific parcel that stays in the Property Management Company for how many days. The calculation processes are set up in a clear manner if any other researcher wants to sum up parcel information and intends to obtain Maximum and Minimum value, they can introduce this process to calculate. However it is easy to get affected by some ways during a research processing, therefore other researchers should follow detailed description of this case study to increase the validity.

3.6 Presentation of the case company

![The competitive landscape for domestic B2C parcel delivery providers](image)

Figure 3.2: Evaluation of China’s main current express companies (Goh et al, 2011)

“Shunfeng” in figure 3.2 is SF Express Company in Chinese pronunciation spelling, which shows that not only the service range but also the service quality of SF Express gets a very high evaluation. SF Express is now the best express company in China,
not with the largest scale but the most efficient.

Figure 3.2 shows the service standard and coverage range of different express companies in China, the X-axis represents service range provided by an express company, and Y-axis represents service quality provided by an express company.

SF Express would also face serious delivery problems, as figure 3.3 and figure 3.4 shows how bad it looks. There are 2 distribution centers of SF Express, which have been paralyzed by the overwhelming amount of parcels.

Figure 3.3: Overwhelming numbers of parcels, too many parcels to restore (SF Forum, 2011)

Figure 3.4: Some parcels were moved from warehouse to underground parking garage (SF Forum, 2011)

Chaos like this has strictly limited China’s last mile delivery, which also brings motivation and pressure to improve logistics service system in China.

To solve these problems of SF Express, the author picked SF Express as the case
study object.

3.6.1 SF Express Corporation

Headquartered in Shenzhen, China, SF Express (Group) Co., Ltd. (hereinafter referred to as SF Express) have been providing domestic and international express delivery solutions to a wide array of customers since it was established in 1993 (SF Express, 2012).

S.F. Express has been investing heavily in the company’s infrastructure, and continually improving the end-to-end express delivery procedures that span monitoring, tracking, enquiry, and resource allocation, to ensure its continuous improvement not only in service quality but also in customer satisfaction (SF Express, 2012).

3.6.2 Main service of SF Express

Since its establishment, S.F. Express has been committed to improving service quality and to satisfying market demands. It has built an extensive business unit covering research and development center, logistics, pickup & delivery network, which spans the nation (including Hong Kong, Macau, and Taiwan). At the same time, its international network has been actively expanding; its service network now covers South Korea, Singapore, Malaysia, Japan, and the United States (SF Express, 2012).

3.7 Ethical Issue

It is necessary to declare that the research participants have been treated with respect and care. Research ethical issues are not always easy to solve, and it is naturally complex and diverse. People usually have different opinions about manners they are addressed, which mean they should be considering with sensitivity about their status (Oliver, 2008). In this thesis, the author will demonstrate the same information to different people in 2 different interviews. Questions in all meetings with them will not offend their job demands about confidentiality.

Anonymity and confidentiality relate to each other in many ways. The person providing data and information would prefer not to be identified in the thesis (Oliver, 2008). In this thesis, by acquiring the permission of interviewees, the author could be able to present their last name in the thesis. However the author will not mention the interviewees’ name in the final thesis, because it is difficult to guarantee that all people who may read the data in thesis have been clarified.
4. Empirical Study

Empirical research relies on direct and indirect experiments and observations gained from investigations, and the results will be used as analysis materials.

4.1 The Incredible Growth of Chinese E-business

Rapid development of Chinese E-business, especially online shopping, generates tremendous orders and packages for local logistics providers, which motivates and reveals problems in last mile delivery process in China. There is a demonstration about Chinese E-business development and its scale.

One main obstacle for the E-business development in China is the traditional way of Chinese business culture. Yu et al. (2003) explained this characteristic with his colleagues.

“A typical trait of Chinese business culture is its traditional way of marketing. It is face-to-face communications for developing and sustaining interpersonal relations with clients that constitute the basis of a successful business transaction and more deals in the future. This method, however, has never been challenged so much in extreme as after the breakout of SARS” (Yu et al., 2003).

A favorable turn happened in early 2003, when a rapid infectious disease called SARS (Severe Acute Respiratory Syndromes) broke out in south of China. People were so afraid to go out for shopping that the majority of people were stuck inside their house and cannot get what they want by normal purchase like going to the supermarket (China Daily, 2003). The only way to purchase without going out was depending on the e-commerce, so more and more people started to try shopping online and relied on it. People began to realize the safety and convenience of e-commerce and accepted that, so after 2003, China’s e-commerce industry began its tremendous evolution from then on and still influences everyone in China nowadays.

A prospective from Kearney Company is that after the price war between online retailers in China, the online retailers are going to consider customer loyalty and fit changed shopping requirements, which means the competition of logistics became more important than ever. Currently, the majority e-commerce model in China is the consumer-to-consumer (C2C) industry, taking about 85% of the market in 2009 and established the foundation of Taobao’s early successes, but B2C e-commerce is also developing very well, which is expected to achieve 40% of the whole market by 2015 (A.T. Kearney, 2014).
“As C2C consumers gain more e-commerce experience, they are moving to B2C sites searching for higher-quality products and services.” (A.T. Kearney, 2014)

As China’s remarkable growth continued, both hardware and software of the e-commerce business keep improving. But logistics, as an important factor to support the online shopping and provide customer service, stays a big bottleneck for e-commerce operators. If the logistics industry is falling behind the e-commerce’s rapid expansion, will it drag down the development of e-commerce in China? Just in the recent five years, China’s e-commerce generates almost 90% business-to-consumer (B2C) of its overall market. The worth of the Chinese e-commerce market is estimated to be €175 billion in 2014 (A.T. Kearney, 2014). On the other hand, fast-paced development of China e-commerce also generated requirement and problem for last mile logistics. Another analysis from Hoffmann (2012) shows the similar estimation in figure 4.1 about China’s e-commerce growth in 2013-2014.

![Image of China e-commerce growth](image)

Figure 4.1: China e-commerce is expected to grow fast, fueled by a surge in the B2C segment (Hoffmann et al., 2012)

E-business and logistics activities can be integrated. Especially, the information integration relates to the sharing of information across all participants along the supply chain. Furthermore, demand information, inventory status, capacity plans, production schedules, promotion plans, demand forecasts, and shipment schedules are shared. Ideally, such information can be accessible by the appropriate parties on a real-time, on-line basis without significant effort (Harrison et al., 2004). In figure 4.2, the relation between e-commerce amount and the cities that are popular with this service has been described.

![Image of Figure 4.2: Relation between e-commerce amount and cities](image)
Figure 4.2: Top e-commerce cities today are along the coast (Goh et al, 2001)

4.2 High Density Population Affects Last Mile Delivery in China

Improvement of logistics performance is also urgent in other countries like Japan and France, especially in metropolitan areas, where such improvement is necessary, because the large concentration of population and activities are with limited scale of geographical area. In urban region, the large amount of coexisting activities leads to a series of consequences like serious congestion, environment pollution issues (Diziain et al., 2014).

High-density housing is the most obvious characteristic in China that influences the market and business. For logistics industry, high density of resident mean high density of orders, and it has both advantages and disadvantages.

Because of the large population of China, the modern housing pattern in China expresses as different residential communities, these communities are usually exclusive and enclosed, and only the homeowners get access to enter these communities. Figure 4.3 shows a typical Chinese residential community.
4.2.1 High-Density Housing can be a Good Thing

According to Laseter et al. (2000), a significant factor for logistics is that high-density sales could bring advantage for delivery economics, the density of orders should be big enough to cover the drive and delivery cost for each distribution.

“Even if online consumer sales volume grows to twice that of catalog sales today, it won’t provide enough sales density to alter fundamental delivery economics.” (Laseter et al., 2000)

He also illustrates an example that Japan got very success from the extremely high delivery density over a relatively small area. Therefore the high-density housing model in China could be an opportunity for last mile delivery.

4.2.2 Conflict Led by High Density Housing

In China the most difficult problem for civilian economy is not technology but the argument about interest. Conflict of interest—dispute about profit is difficult to solve smoothly.

In this case, when the property management fee does not cover their management cost, Property Management Company would refuse to offer arrangement service like receiving and restore parcels, and hand it over to home owners. A result of this
influence is that, in 2012, over 400 property management companies declared that they would stop to receive parcels from express companies any more, and dispatchers are not allowed to get access into their communities directly without reservation (SF Forum 2011). Also, when the rush hour comes, the capacity is not enough for the growing amount of new deliveries, both for the property companies and express companies.

### 4.3 Last Mile Delivery Alternatives

In order to resolve the limitations in last mile delivery, many delivery methods have been created and developed. In this thesis, the author focuses on intelligent locker system and pick-up station system that are mainly adopting by Chinese logistics participants. First there is a demonstration about pick-up station and its transformation mode.

#### 4.3.1 The Pick-up Station

The representative mode of original pick-up station is run by Posten post office in Sweden. Posten post office applied last mile delivery solution called pick-up station all over Sweden, which is quite similar as the delivery model that combines Express company with convenient stores. The author lists the limitations and advantages of Posten’s distribution system, trying to acquire valuable results from it.

##### 4.3.1.1 The Pick-up Station with Supermarket

In Sweden, there is a normal type of pick-up station that is run by Swedish royal post office (Posten), and it is like a combination of micro warehouse and mini post office. Almost every pick-up station in Sweden is monopolized by Posten, which owns over 3000 stations all over different cities in Sweden.

Posten’s pick-up station operates as a tiny distribution center that provides manual-service. In order to avoid deficit when operating over 3000 stations, Posten started to cooperate with supermarkets in Sweden and share space and employees with different supermarkets. Here is a picture about what Posten’s pick-up station looks like in figure 4.4
After the author investigates in Posten’s service stations located in Stockholm, he summarizes that there are 50 pick-up service stations in Stockholm, 30 of which located in the central area of Stockholm (Östermalm, Norrmalm, Gamlastan, Södermalm and Stadshagen), and other 20 stations surround in the external area.

This service only applies to consignments delivered through the Royal post office’s own carrier system. In Posten’s pick-up stations, workers also sell merchandises like cigarette, lottery, and beverages, and all of these goods are FMCG (fast-moving consumer goods) that facilitates Posten to recovery and reduce cost of operating pick-up stations.

Figure 4.5 shows all these stations mark on the satellite map, after I marked them on Google map by each address we would see the distribution tactic and density of these pick-up stations.
Every pick-up station relates to a local supermarket, which allow Posten post office to share the best logistics location of each community (Each supermarket covers reasonable area that balance cost and business scale). Posten post office even outsources the labor service in each pick-and-send station to those supermarkets that are located together with stations.

4.3.1.2 Pick-up Station with Convenient Stores
SF Express Company cooperated with 7-11 Convenient Chain Stores to combine its delivery and send services into 7-11 outlets, and more than 100 stores of 7-11 have started to implement this collaboration in 2011. Since the service range of 7-11 CVS is not big enough to cover SF Express’s customers, SF Express started to establish its self-own CVS in 2011 in Beijing and Shenzhen (SF Forum, 2011).

However, since the business of convenient stores is too complicated to arrange for an express company, the majority of SF Express’s self-owned CVS shut down or canceled their retail service. This is because running this service not only incurs deficit but also expands service range and time cost. This is how this SF Express CVS looks like in Figure 4.6.
The cooperation relationship between express companies and CVS are not secure mainly because the benefit argument, parcels service in China is usually overwhelming busy, which would probably interrupt and hinder the work in CVS. How to cover this part of cost is still an unavoidable issue for both sides.

4.3.1.3 Pick-up Station with Property Management Company

The Property Management Company in China provides a series of management service that includes electricity, water supply, security and so on. It is more like doing Property maintenance work, which may look after the entire housing estate of properties. The management company would employ technicians or companies to provide maintenance services.

Figure 4.7 shows the look of a normal Property Management Company, which would be hired to manage different operations for each residential community.
Since the e-commerce purchase in China has boomed in recent years, the amount of parcels increased a lot. The Property Management Company has to undertake this part of business, and also take the cost for arrange these waiting parcels.

This type of pick-up station is the only mode that operates success and applies by most community with its Property Management Company. In analysis part, there will be calculation with data about this type of pick-up station.

4.3.2 The Intelligent Locker

*Intelligent locker could also be understood as collection-and-delivery points (CDP) with digital management.*

In the era of e-commerce, logistics informatization is the inevitable requirement of e-commerce. The logistics process informational includes the commercialization of logistics information, logistics information collection database, electronic logistics information processing, logistics information transfer and standardization. Logistics process of informational will greatly improve the efficiency of logistics management to maintain a low-cost operation of logistics enterprises.

Logistics informatization is an inevitable tendency for e-commerce. The logistics informational includes the commercialization of logistics information, logistics information collection database, electronic logistics information processing, logistics information transfer and standardization. Logistics informatization will increase the efficiency and decrease the cost of logistics operation (Xianglian & Hua, 2013).

Many independent CDP systems carrying more complicated storage and retrieval
techniques failed or stagnated in Europe, after the initial stage (Fernie & Sparks, 2009). Nowadays, less money is invested into logistics facilities. Some companies downplay the last mile problem and some other focus on B2B market rather than B2C to avoid high-density home deliveries (Foley et al., 2003). However, in the foreseeable future, CDP is still the best solution for commercial viability. To find the critical point that when customer convenience, delivery efficiency and security perform relatively best. The CDP strategy could also combine B2B and B2C material flows to scale merit (Fernie & Sparks, 2009).

As the home delivery is increasing fast by e-commerce, an innovation solution for home delivery becomes popular. This new alternative delivery solution can be called as “intelligent locker” or “self-service pick up station”. To apply this approach for home delivery, a sophisticated IT system and transport planning system is needed. Supported by good infrastructure, high efficiency of this alternative will be achieved.

Key benefits of Intelligent Locker (Forkert & Eichhorn, 2007)

- “Improves the quality of life: more independence for users as delivery time and location can be adjusted to personal routine”
- “Improves transport efficiency: less congestion in the inner-city”
- “Improves efficiency routing: less stops, avoidance of unsuccessful delivery attempts, reduction of last mile costs, lower energy consumption”
- “Provides more alternatives for private individuals (open 24 hours 7 days, and choice of location).”

One big advantage and innovative side of intelligent locker system is that it integrates consumers’ action into part of the system’s process, the order picking process. Order picking is a labor-intensive and expensive part of a warehouse and distribution center. It is, therefore, given special attention during the planning and operation of such systems (Hompel & Schmidt, 2007). That is why the CDP could acquire big advantages from this innovative solution.

Locker system also has disadvantages compared to pick-up station with manual service. For example, pick-up stations offer more payment options than locker system like cash payment. Also, the locker system may bring inconvenience experience to certain customers like elder people, whereas at a pick-up station the store personnel will provide service for customers. Moreover, intelligent locker system is more sensitive about the size of parcels, because its storage space is preset. Pick-up stations are more flexible about different shapes and sizes of parcels, as all parcels will be stored in a warehouse in the store (Weltevreden, 2008).
4.3.2.1 Representative Model - Bufferbox

Bufferbox is a most representative technology of new last mile delivery solutions, and it is a Canadian initiated company from Waterloo University and was co-founded by Jay Shah, Aditya Bali and Mike McCauley (Bufferbox, 2013). It is a service offering users a temporary parcel pickup station for packages ordered online. Google acquired Bufferbox on November 30, 2012 (Lewis, 2012).

Pick up and Send in is normal function of this technology, the real core competence of Bufferbox is that it establishes a network covering different intelligent boxes and connects these boxes with local distribution system. Therefore the express company could utilize the information gathered from the “box network” and make arrangement for distribution process.

Figure 4.8 shows an example of Bufferbox applied in a university library, and this innovative delivery solution is actually working well in North America.

4.3.2.2 Intelligent Locker from the case company - SF Express

SF Express adopts a self-owned business model, which fully possess over 2000 logistics locations with reliable and fast service. Unlike other major logistics firms expanded by franchising or subcontract and providing basic logistics service, SF Express insists to achieve a reliable and fast standard (Goh et al., 2001).
Figure 4.9 shows SF Express deploys its intelligent locker in China.

Figure 4.9: Locker of SF Express Company (SF Forum, 2011)

Figure 4.10 from SF Express’s internal materials demonstrates its place and order system. Delivery orders are received from telephone and internet, and all orders would be analysed and calculated at the Internet center. After this process, SF Express will arrange delivery. This is how the SF Express’s intelligent locker really looks, deployed besides one of SF Express’s outlets.
From the process figure 4.10 we can see, introducing intelligent lockers would not impact SF Express’s current procedure, no matter through the telephone order receiving or the internet order receiving. The influence is only on the order recording and transport capacity dispatching. We can imagine that SF Express does not need to change its current ordering model, and the order information flow and capital flow will be transferred by Internet. After that period, SF Express will provide material flow by using a unique code to open one intelligent box by customer in this system. Information can enable logistics providers to run logistics efficiently, reducing the cost of deliveries. The internet can receive and move information through the whole supply chain. Logistics service providers who invested heavily in information technologies often make that progress and improvement happen (Lee & Whang, 2001).

In order to maximize the efficiency of this intelligent locker system, lockers should work on both order sending and receiving sides, which requires a high standard of information technology. SF Express introduces IBM to promote its IT level both in hardware and software. The advantage of SF Express on hardware and IT capability will truly become its core competence.

However, when we examine SF Express’s self-owned business model deeper, we could find something different and interesting—SF Express divides its distribution
area into different fields, deploys and assigns its employees respectively into those fields. When the delivery processes begin, each courier takes the responsibility of their own field. This strategy is like a landlord distributes its farmland to different farmers, so each farm should take care of their own position and make fortunes as much as they can, but the landlord is just the one who collects his land rents termly. SF Express does not subcontract its orders to other local logistics providers, but subcontract to its own individual employees. Based on this strategy, SF Express not only gained an overwhelming speed in its expansion, but also kept a relatively high quality service standard (SF Forum, 2011).

### 4.4 The Result of Interviews

The pick-up station with Property Management Company and Intelligent locker are 2 solutions that perform well in last mile delivery in China. Pick-up stations with CVS and supermarket are not successful in China, which were introduced before. Therefore the interviews in this thesis aim at pick-up station with Property Management Company and intelligent locker.

#### 4.4.1 SF Express Courier

SF Express’s courier is not allowed to leave the parcels to any place else except the final customer, so they usually deliver directly to customer’s home, unless the customer asks them to leave the package at property manage company.

One of SF Express’s couriers told me, usually they will deliver 3 times for one community in one day, so if any parcel failed to be delivered early today, they will try to deliver it one or two times again.

The Courier of SF Express thinks a pick-up station near community will highly reduce their work pressure, and decrease the cost of resend the package, so he thinks a pick-up station will help to make profit.

#### 4.4.2 Property Management Company

Based on the records of Property manage company, the author has Parcel information in 20 days as below.

Basic data of this community is as follows:
1. Number of residents: 1200 households, 3600 residents.
2. In each month, the Property Company would collects 80% parcels averagely, and only 20% parcels would be delivered directly to tenements.
3. Proportion of business volume of different express companies: ST 20%, ZT 20%,
YT 20%, Yunda 15%, EMS 10% and SF Express 5%. Other companies (TT, Amazon, HT) 10%.

The manager of Property Management Company told me that she thinks SF Express provides higher service quality than other express companies, because they usually deliver parcels directly to the customers and rarely leave parcels at property company unless when the customer asks them to do so.

There is a figure table that shows parcel record from Property Management Company for 20 days; different information is showing in each column.

Table 4.1: Received parcels from Express Company in 20 days

<table>
<thead>
<tr>
<th>September Date</th>
<th>Parcels Number</th>
<th>Hamper the property company operation?</th>
<th>Parcels form SF Express company everyday</th>
<th>Parcels from other express companies everyday</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65</td>
<td>Yes</td>
<td>5</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>51</td>
<td>No</td>
<td>3</td>
<td>48</td>
</tr>
<tr>
<td>3</td>
<td>68</td>
<td>No</td>
<td>2</td>
<td>66</td>
</tr>
<tr>
<td>4</td>
<td>72</td>
<td>Yes</td>
<td>3</td>
<td>69</td>
</tr>
<tr>
<td>5</td>
<td>63</td>
<td>No</td>
<td>4</td>
<td>59</td>
</tr>
<tr>
<td>6</td>
<td>55</td>
<td>No</td>
<td>4</td>
<td>51</td>
</tr>
<tr>
<td>7</td>
<td>62</td>
<td>No</td>
<td>5</td>
<td>57</td>
</tr>
<tr>
<td>8</td>
<td>85</td>
<td>Yes</td>
<td>8</td>
<td>77</td>
</tr>
<tr>
<td>9</td>
<td>72</td>
<td>Yes</td>
<td>3</td>
<td>69</td>
</tr>
<tr>
<td>10</td>
<td>58</td>
<td>No</td>
<td>0</td>
<td>58</td>
</tr>
<tr>
<td>11</td>
<td>51</td>
<td>No</td>
<td>2</td>
<td>49</td>
</tr>
<tr>
<td>12</td>
<td>65</td>
<td>Yes</td>
<td>4</td>
<td>61</td>
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<td>Yes</td>
<td>0</td>
<td>55</td>
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<td>14</td>
<td>75</td>
<td>Yes</td>
<td>5</td>
<td>70</td>
</tr>
<tr>
<td>15</td>
<td>58</td>
<td>Yes</td>
<td>3</td>
<td>55</td>
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<td>55</td>
<td>Yes</td>
<td>2</td>
<td>53</td>
</tr>
<tr>
<td>17</td>
<td>67</td>
<td>No</td>
<td>3</td>
<td>64</td>
</tr>
<tr>
<td>18</td>
<td>78</td>
<td>No</td>
<td>4</td>
<td>74</td>
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<tr>
<td>19</td>
<td>63</td>
<td>No</td>
<td>2</td>
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</tr>
<tr>
<td>20</td>
<td>82</td>
<td>No</td>
<td>3</td>
<td>79</td>
</tr>
<tr>
<td>Average</td>
<td>65</td>
<td>Yes ∈ 9/20</td>
<td>3.25</td>
<td>61.75</td>
</tr>
</tbody>
</table>

All these information will be used in analysis part, which would tell us how many days parcels may be deferred at the property manage company averagely, and how many parcels per day staying in the company would disturb their daily business.
5. Analysis and Discussion

In this part, the analysis will be given based on empirical study presented in chapter 4

5.1 Pick-up Station

Delivery operation under urban logistics condition remains a field that needs more analysis in order to understand the implications of innovative developments and changing practices. Evaluating different experiments could make major contributions to our understanding and knowledge about last mile delivery in urban logistics, both to assess the efficiency and to find the important features that may need to be changed to make them transferable in last mile delivery (Patier & Browne, 2010).

5.1.1 Pick-up Station with Supermarket

Since the pick-up stations are operating with supermarkets in Sweden, the author will discuss if there is similar service in China. Looking at normal supermarkets in China, they usually have a much larger service range and cover much more customers than in Sweden. These are the main supermarkets in Changsha, which is shown at figure 5.1 (A city is chosen to compare):
High density of orders and customers is an important factor when considering logistics layout design. In order to prove the model efficient, you need to create market demand before you invest in costly infrastructure (Fernie & Sparks, 2009).

There are only 15 supermarkets in Changsha’s center place, which is much fewer than in Stockholm (30 in center area). Changsha is a city with 3 million people in the urban area. These stations are just simply too few and small to apply a pick-up system in them. Compared to Posten’s pick-up system in Stockholm in figure 5.2, there are more service stations distributed to cover the same size of region. Huge supermarkets are divided into many little ones, and their locations are more balanced in distance with each residential area and benefit more residents. The outcome is shown even clearer on the digital map in figure 5.2. All stations distribute averagely and neatly all over Stockholm central area and such a sophisticated logistics service system maintain a high level of last mile delivery performance in this city.
People might think that larger retailers are responsible for more delivery activity based on their sales area, and then they would be able to carry out better logistics service. Results from the 2008 Winchester study suggested that there did not appear to be a strong connection between store scale and the number of deliveries received per week. A rational explanation is that larger retailers like supermarkets may tend to use larger vehicles and consolidate load to service huge number of customers (Cherrett et al., 2012). As such a high-density of customers in Changsha, those markets there were built in a very huge scale, which means it would gather a large number of customers. If logistics service providers deploy pick-up stations in such supermarkets to serve customers, both cost and scale of station will increase, especially that the scale of each service station will become oversize, and it can not fulfill the demand from an overwhelming number of costumers.

“One of the most important aspects of logistics is deciding where to locate new facilities such as retailers, warehouses or factories. These strategic decisions are a crucial determinant of whether materials will flow efficiently through the distribution system.” (Simchi-Levi et al., 1997).
In summary, the current business mode of supermarket in China cannot fulfill the demand from an overwhelming number of costumers, if logistics providers deploy pick up stations with these supermarkets. Moreover, these markets cannot offer accepted distance for general customers. This reason mainly describes the current business situation in tier 2 cities in China, and also demonstrates the impossibility of establishing pick-up station with supermarkets in China.

5.1.2 Pick-up Station with CVS

The third type of last mile delivery solution is to operate by cooperating with local CVS. Like the introduction before about those huge supermarkets in China, these supermarkets are still not enough to meet such a big demand from large population. As a result of this, thousands of individual convenient stores come up to supplement the gap. We can see these convenient stores distribution in figure 5.5. Therefore, SF Express cooperates with these small CVS to establish delivery points at their stores.

As we introduced in the introduction part, Vehicle Routing Problem (VRP) is an inevitable problem for logistics companies. In many logistics areas, customers have specific requirements, like exactly the load that has to be delivered to it and a certain period of time (time window) that the delivery must be implemented (Simchi-Levi et al., 1997). In order to solve the time window restriction and VRP problem, local logistics service providers look for partners to make cooperation to strength their delivery capability.

The location as a factor in retail industry is very important which is reflected by retailers. Location is also a distinctive dimension for this industry, not so many industries involve such a various and dispersed type of outlet network. Location as an identified characteristic of the retail trade, retailers must have penetrating insight and deep understanding about it (Gustafsson et al., 2009). The significance of location also comes from logistics pressure and material supply demand. Therefore in some level it satisfied the distribution require of logistics facilities, like mini stations and micro distribution center.

The distribution of individual stores in Changsha is shown in figure 5.3, where each small read point represents a convenient store.
When we are thinking about the location of CVS, one very important factor is that local consumers and business culture should support the retailer, which allows retailers to afford the location where it is retailing. (Gustafsson et al., 2009).

SF Express tried to establish its self-owned CVS in Beijing in 2012, and the whole plan was implemented quietly. Although SF Express canceled the plan and closed those stores because this project had not gone well, no matter the result is good or bad, it is still a very good innovative attempt (China Business Herald, 2012).

Generally, the goal of facility distribution is to locate a series of functional points so that the total cost can be minimized, which may face some limitations like:

“Each warehouse has a capacity which limits the area it can supply.

Each retailer receives shipments from one and only one warehouse.
Each retailer must be within a fixed distance of the warehouse that supplies it, so that a reasonable delivery lead time is ensured.” (Simchi-Levi et al., 1997)

Every CVS store can be regarded as a mini warehouse or distribution center, and therefore they should also conform to these constraints.

5.1.2.1 Limitation of Local Convenient Stores

In this case, each CVS store is functioning as a logistics facility, which means its geographical distribution needs to be considered as well. There are both CVS and individual-operated supermarkets in Changsha and did not follow a common standard with which it is hard to make cooperation. As figure 5.3 showed that thousands of local convenient stores are distributing all over the city, which covers almost all residential communities and business districts. But many individual stores are usually run by different self-employed entrepreneurs who are not chain-store operations, and therefore they could not provide common service. Cooperation between express companies and convenient stores requires standard operation quality and unified management.

Another worry about collaboration with convenient stores is security issues. Express companies provide logistics service that sometimes carries valuables objects for customers. Safety of parcels becomes a significant matter in concern when such cooperation with local stores transfers the duty of parcels from express companies to those stores. How to define and distinguish each other’s responsibility from different processes and different services would be an issue for mutual.

5.1.2.2 Advantage of this Cooperation

Logistics service providers tend to develop delivery points at local CVS, and compared to other 2 types analyzed before, cooperating with local CVS is relatively the best solution in practical situation.

Similar to the intelligent lock system, by adopting this service SF Express could locate its delivery and receive points close to different communities, solving the time-window problem from customers very well, and customers could choose suitable time they want to pick their orders. Total cost of delivery would also decrease since the time-window and vehicle routing problems have been solved.

Protecting customers’ privacy can change the delivery destination from home address to CVS, so customers no longer need to worry about their personal addresses being leaked to someone else. They do not have to provide their personal information but the CVS to on-line sellers.

SF Express could also use these delivery points to receive dispatch orders from customers who need just walk outdoor to the nearest convenient store to send their parcels. It is a big saving in both in manpower and materials resources.
5.1.2.3 Opportunity of this Business

For the CVS’s side, joint cooperation with SF Express would bring them more customer flow every day, depending on SF Express’s high developed digital processing system. They would not raise much power of work, and orders would manage by computers and distribute automatically. Therefore, cooperation between CVS and SF Express could be a win-win situation for both of them, and this is the motivation and opportunity for this business.

5.2 Intelligent Locker Delivery Solution

Urban freight delivery usually processes by vans that send goods directly to the customers. The logistics providers usually arrange deliveries by separate distribution potions in city area. Warehouse or distribution center are usually located outside the city center. In case of failed delivery, the customer needs to go to the warehouse to pick their parcels (Amico & Hadjidimitriou, 2012). A new delivery alternative is able to solve this problem by transforming and moving those warehouses to the end of delivery chain.

5.2.1 DHL did a Research about its Intelligent Locker System in Germany

The research is about performance of intelligent locker in Cologne at 2003, and results of this research are quite simple: to arrange these facilities not only saved mileage of transportation but also allocated distribution schedule to avoid rush hour, in favor of both Express companies and customers. We can see the intelligent lock from in this research from DHL in figure 5.4.
Esser (2008) initiated an investigation with DHL about intelligent lockers in Germany, which indicates that compared with normal direct-home delivery service, customer pick-ups from temporal distribution balances average package amount that transfer in unit interval. We can see the change in Figure 5.5.

Comparing with the finding part in this thesis, the effect of extending service hours and reducing “rush hour” phenomenon are coincident, and both trips volume and
traffic volume are reduced as the analysis in this thesis. We can see the influence in figure 5.6.

Figure 5.6: Data by introducing pickup point locker system gained relatively lower delivery mileage than home delivery (Esser, 2008)

Besides that, the reduction of the acceptance level of different delivery methods from customers was summarized by data. Interesting thing is that, even though the ordinary home delivery is the most popular method in Esser’s survey, but locker system delivery solutions got much higher preference votes than the number that used it to delivery. Customers probably would try this innovative solution in the future when they are familiar with how to use it. We can see the acceptance of different alternatives in figure 5.7.

Figure 5.7: Acceptance of delivery concepts from different city areas (Esser, 2008)
From the analysis in this thesis we know that intelligent locker system is more suitable for high-density city area. Concentrated customers and delivery orders bring more benefit motivation for this delivery facility. In contrast of that and Esser’s (2008) research, the results are consistent. Pick up station and intelligent locker systems are highly required in the center area of cities.

However, Esser (2008) did not combine the cost to establish an intelligent locker system, which did not show if the market pressure is strong enough to push this innovative solution. In this thesis, the author related the price of intelligent locker from Chinese Manufacture Company and made comparison to the cost of current final delivery process. In analysis part of this thesis, the price of intelligent locker was provided from a local manufacture that is almost the cheapest price that can be found in China.

Besides that, Esser’s (2008) research did not focus on specific residential areas, but summarized the parcel data and information from Property Company, so this study shows more details about final process and finds more valuable results about the characteristic of customer.

5.2.2 Discussion about intelligent locker with logistics conditions in China

5.2.2.1 Data of delivery parcels received by Property Company

Portion of SF Express company in all parcel delivery business is:

\[ X_{SF} = \frac{3.25}{61.75} \approx 5\% \]

There are 9 days of 20 that staff in Property Company felt disturbed to receive parcels from express companies:

\[ R_{pc} = \frac{9}{20} = 45\% \]

5.2.2.2 Data of how many parcels temporary storage in Property Management Company each day

Storage capability is important Property Management Company, since it needs to keep parcels for customers temporarily.

Since parcels stay averagely 3 days at the property company, so the same data can be used to make a rough calculation. Any logistics facility functioning as a warehouse or distribution center would face storage issue and the uncertainty in stocks. In the practical condition, uncertainty in stocks almost always happen, like prices rising with
inflation will influence the amount of inventory, supply chain are changed, and other reasons (Waters, 2003). That is the reason why the author needs to know the change of the amount of packages stored in Property Management Company for a specific period. In this case study, the author sets the time period as 20 days.

Here is a table 5.1 with text to introduce table 5.2 – 5.4

Table 5.2: Introduce with text of table 5.2 – 5.4

<table>
<thead>
<tr>
<th>Table</th>
<th>Text</th>
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</thead>
<tbody>
<tr>
<td>Table 5.2: Received parcels record in 20 sample days</td>
<td>The parcels received by Property Management Company would averagely stay in storage for 3 days before tenants pick them up by themselves. So the author uses each day’s new parcels as an average value for later calculation. The parcels arriving at Property Management Company are shown in the column.</td>
</tr>
<tr>
<td>Table 5.3 Sum of received parcel number in each sample day</td>
<td>In order to get the maximum value of parcels that stay in the storage room of Property Management Company, and because new parcels would averagely stay before collection for 3 days, the author uses 3 days as a period to make a calculation that add up all parcels in it. By this calculation, the peak value of parcels will be shown in table 5.3.</td>
</tr>
<tr>
<td>Table 5.4 Scatter diagram of parcel number in every 3 days</td>
<td>After putting the result of table 5.3 into a scatter diagram, all values are represented by a single point in table 5.4. It is easier for readers to realize the variation of these numerical values.</td>
</tr>
</tbody>
</table>

Here, in order to make a comparison between intelligent locker system and the Property Management Company about their cost, the author summarizes the number of parcels received by Property Management Company each day, and then obtains the sum of every 3 days to get the peak value of parcels that need temporary storage.
Hereby this calculation, the author will know the scale of intelligent lockers that match the same capability of Property Management Company. As the scale of intelligent lockers is known, by the price information from the intelligent locker manufacturer, we can have the total cost for intelligent locker in this community if we need to adopt this alternative to replace the current model.

All parcels that stay in Property Management Company have been recorded in documents. Therefore the number of days it stays in the Company of any package can be seen. When parcels are stored in the Property Management Company for over 1 day, then the parcels coming in the next day should be counted together.

Total amount number of parcels for each day is showing in the table below:

Table 5.2: Received parcels record in 20 sample days

<table>
<thead>
<tr>
<th>Day1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
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<td>55</td>
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</tbody>
</table>

Now, the number of parcels for each day can be calculated, the author uses the average days that every sample parcel left in the property company as a standard factor to count. There may be little deviation about specific delay time for certain parcels but final result would be correct enough to express the information. In order to
measure the peak value of parcels number, the author adds up the deferred parcels number in each time column.

The total amount number of parcels for each day is shown in the table below:

Table 5.3: Sum of received parcel number in each sample day

<table>
<thead>
<tr>
<th>Day</th>
<th>Parcel Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>65</td>
</tr>
<tr>
<td>Day 2</td>
<td>65+51</td>
</tr>
<tr>
<td>Day 3</td>
<td>65+51+68</td>
</tr>
<tr>
<td>Day 4</td>
<td>51+68+72</td>
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<tr>
<td>Day 5</td>
<td>68+72+63</td>
</tr>
<tr>
<td>Day 6</td>
<td>72+63+55</td>
</tr>
<tr>
<td>Day 7</td>
<td>63+55+62</td>
</tr>
<tr>
<td>Day 8</td>
<td>55+62+85</td>
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<tr>
<td>Day 9</td>
<td>62+85+72</td>
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<tr>
<td>Day 10</td>
<td>85+72+58</td>
</tr>
<tr>
<td>Day 11</td>
<td>72+58+51</td>
</tr>
<tr>
<td>Day 12</td>
<td>58+51+65</td>
</tr>
<tr>
<td>Day 13</td>
<td>51+65+55</td>
</tr>
<tr>
<td>Day 14</td>
<td>65+55+75</td>
</tr>
<tr>
<td>Day 15</td>
<td>55+75+58</td>
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<tr>
<td>Day 16</td>
<td>75+58+55</td>
</tr>
<tr>
<td>Day 17</td>
<td>58+55+67</td>
</tr>
<tr>
<td>Day 18</td>
<td>55+67+78</td>
</tr>
<tr>
<td>Day 19</td>
<td>67+78+63</td>
</tr>
<tr>
<td>Day 20</td>
<td>78+63+82</td>
</tr>
</tbody>
</table>

The parcels staying in Property Management Company can be seen as an inventory or stocks for the company. Stocks can be very expensive, and therefore the more parcels are stuck in the Property Management Company the more cost needs to be paid. Corporations and organizations obviously look for different methods and alternatives to reduce their cost as much as possible. However, they are often left with high costs for stock (Waters, 2003).

Putting this result into a scatter diagram in table 5.1 to see it clearly, most results appeared around 200 parcels each day, beside the first 2 days and the last day, all results are robust and stable. Now the storage demand from customers’ packages left in Property Management Company is known.
Most results are around 200 parcels each day, and the highest record is 219 parcels that happened in Day 9, which means the storage power of intelligent locker for this community should match this value. Therefore a locker with more than 200 storage boxes would be barely enough without considering the potential growth of delivery requirement in the future. Regardless of the first and second day because of no overlap parcels data previously, still 10 of 20 records occur around 200 parcels each day created by those parcels deferred of receiving at Property Company.

Following the index value shows if these storage parcels disturb staff’s regular work in Property manage company, from the interview the author knows that 9 of 20 days those staffs felt interrupted from interview survey. This result would support that helping receive parcels for house owners from express companies did raise the cost of manage work, which could be a pressure for property manage companies to refuse this operation in the very near future.

### 5.2.2.3 Cost Analyze of Intelligent Locker for this Sample Community

By investigating into a logistics equipment manufacturer in Guangzhou named GKP, which is almost the cheapest price offering in China, the regular prices for intelligent locker are shown below:

- **Type 1:** GKP-IC40
- **Size:** W1200*D350*H1900 (MM)
- **Box Size:** W190*D340*H160 (MM)
- **For 40 boxes,** price 15,000kr
Type 2: GKP-IC24  
Size: W1600*D450*H1800 (MM)  
Box Size: W280*D450*H260 (MM)  
For 24 boxes, price 9,000kr

Locker Type2 has a larger box size with a higher price per unit, in order to have more box sizes for different parcels, and the author combines two types together to meet the logistics requirement of this community. That would be:

\[
4 \times \text{Type1 (40)} + 2 \times \text{Type2 (24)} = 208 \text{ boxes}
\]

Storage power as 208 boxes is barely enough for the requirement of this sample community, which covers the most frequent volume of parcels around 200 each day. The price for these lockers would be:

\[
4 \times 15,000 + 2 \times 9,000 = 78,000kr
\]

Therefore, to reach the requirement of this community, the locker almost costs 78,000kr for 6 lockers including electronic devices, operation cost is not included but that could be barely ignored.

5.2.2.4 Benefit Argue Dilemma

More and more property manage companies start to charge express company for receiving parcels for them, normally costing 1 Yuan for one package (equal to 1 krona).

As the figure above the author has shown that, the property company receives 65 parcels each day averagely. If this community starts to charge the package service fee and cost 1 kr for each order, then:

\[
65kr \times 30 = 1950kr \text{ (each month)}
\]

\[
1950kr \times 12 = 23400kr \text{ (per year)}
\]

Cost for a set of intelligent lockers in China is about 78,000kr, besides the related operation cost, in order to balance the investment of intelligent locker, then:

\[
78,000kr / 23400kr = 3.33 \text{ (years)}
\]

To break even, 3 years of well functioning is necessary. This means the logistics providers need at least 3 years to recover the cost of these lockers not even including operation cost.

Another characteristic of intelligent locker operation is exclusiveness. In order to
coordinate the locker delivery system into express company’s own operate system, the locker needs to be set a specific IT device, which means different locker systems cannot share their information with each other but only respond to their owner companies. Therefore, this characteristic of intelligent locker drives the cost of this alternative even higher in China.

Despite the IT problem, locker system as an infrastructure needs high investment at the start period. Dividing the cost for different express companies is difficult unless the local government would support and pay for this project.

SF Express is regarded as the best local express company in China but just covers such a low share of business in sample data, which is because SF Express’s operation tactic mainly focuses on high-end customers like documents or contracts delivery for companies but not for on-line shopping. That explains why SF Express does not own a high share of parcels delivery.

Specific to this matter, the sample data of parcels are collected from different express companies. SF Express only holds 5% of it. 3.25 parcels per day averagely cannot support to build an intelligent locker for SF itself in this community, and this situation will remain in the near future.

5.2.2.5 Advantage from Reducing Time-window Affection

As the author demonstrated in the literature framework part about time-window in delivery process, different customers may require different time-windows to arrange the final delivery. Therefore express companies may not finish sending parcels with the same destination at one time, which brings extra cost and vehicle routing problem.

However, the intelligent locker system could solve this problem well, with its combination service of storage and hand out. Customers need not order delivery at a specific time. They just pick up their parcels when they are free. Locker system covers all their potential time-window require, and the express company just needs to transfer their parcels to these lockers as soon as it arrives in nearest distribution center. Therefore, the higher density of orders, the higher possibility of different time-window may require, and high competitive advantage of intelligent locker can be achieved.
6. Conclusions

In this chapter, a summary will be given to clarify different discussions in analysis part and also make clear the link between research and thesis purpose.

6.1 Research Question

- How does the high density of orders and cost affect delivery alternatives in the last mile logistics in China? (Pick-up station & Intelligent locker)

Right now in China, the main stream innovative solutions for last mile delivery are pick up station and intelligent locker system, which are actually being used and be generalized in China.

According to the research in analysis part, intelligent locker’s performance and benefit-cost ratio have been proved strongly related to order density; intelligent locker needs a relatively high density of order as a basement. Therefore, the higher density of customers, the higher possibility of different time-window requirement and high competitive advantage of intelligent locker can be revealed. Therefore, considering SF Express’s main business structure and the characteristic of intelligent locker system, by deploying these lockers in high-density order areas would be the optimal choice, like university town, CBD and companies cluster. The higher density of customers, the higher possibility of different time-window requires, and solving this problem can reveal high competitive advantages of intelligent locker.

In summary, both the intelligent locker and the pick-up delivery solution could solve last mile logistics problems by different ways, especially with specific limitations in Chinese market. These delivery alternatives are highly possible to be adopted and generalized by different logistics service providers in China if not concerned about the cost or density of orders.

For the Pick-up Station

As the calculation and discussion in analysis part, there are some factors can influence and shape the final mode of delivery solutions in China. Especially the high density of order and the cost would become the most important elements for these delivery alternatives.

As what we have discussed in the analysis part, due to the big difference of society in Sweden and China, it is hardly possible to build up same delivery solutions in China as Posten does in Sweden. One main reason is the population here in China is much larger than that in Sweden so customer density is relatively higher too, which gives
much pressure for different solutions in Chinese cities.

The delivery solution in China is that logistics service provider runs a transformative pick-up station service, not by cooperating with supermarkets but with local CVS. In analysis part we discussed about the types of last mile delivery solution, which proved to be effective and efficient. Although service like this still has bottlenecks to break through, focus is on delivery business for residential community, and this is currently the optimal solution since it not only helps logistics service providers to achieve what it wants but also facilitates CVS’s benefit.

In summary, the current business mode of supermarket in China cannot fulfill the demand from an overwhelming number of customers. The high density of orders for pick-up station with supermarkets in China is a negative factor. Moreover, this factor determines the pick-up station with supermarket mode cannot be generalized in China. Only the pick-up station with CVS and Pick-up stations with Property Management Company will succeed in Chinese logistics market, because these delivery alternatives disperse the whole orders by different communities. Costs for both pick-up stations are acceptable, and therefore cost is a positive factor for pick-up station mode.

**For the Intelligent Locker System**

Despite the technology problem, locker system as an infrastructure needs high investment at the start period, dividing the cost for different express companies is difficult to unless the local government supports and pays for this project.

Another characteristic of intelligent locker operation is exclusiveness. In order to coordinate the locker delivery system into express company’s own operate system, the locker needs to set a specific IT device, which means different locker systems cannot share their information to each other but only respond to their owner companies. Therefore in normal residential communities there is not enough business volume to support the cost of establishing intelligent locker system. Therefore, this characteristic of intelligent locker drives the cost of this alternative even higher in China. Overall, the cost for intelligent locker is a negative factor.

In summary, the higher density of orders, the higher possibility of different time-window may require, and high competitive advantage of intelligent locker can be achieved. The high density of orders for intelligent locker is a positive factor. The cost for intelligent locker is a very negative factor, which seriously limits the popularization of this delivery alternative.
7. Reference


