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# A FARM-TO-DOOR DELIVERY MODE FOR ORGANIC VEGETABLES UNDER MOBILE COMMERCE IN METROPOLISES OF CHINA

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## **Abstract**

*This paper presents a farm-to-door delivery mode for organic vegetables, which connects farmers and customers directly, under the circumstance of mobile commerce (M-commerce). In recent years, the need of organic vegetables is growing constantly in China. Meanwhile, the farm-to-door delivery mode widely spread in metropolises as people there barely have time to go to food markets on weekdays. However, the terrible traffic condition makes it impossible to conduct the delivery in day time. So vegetables have to be delivered very early in the morning (usually 3:00-7:00 A.M.), which makes the owner unable to attend delivery. And in the traditional delivery mode, the absence of delivery may lead to the package missing in China. Aiming at solving these practical issues in China, an SMS-based interaction system is integrated in the delivery mode for informing, endorsing, confirming, tracing and complaining. Intelligent cupboards are used as a buffer to realize the asynchronously endorsement. This is a new business mode that extends the frontiers of the M-commerce. It can greatly reduce the intermediate links of vegetable distribution and simplify the food purchasing in people's daily life. This application of mobile technology would have a huge potential in market.*

*Keywords: Farm-to-door Delivery Mode, M-commerce, China*

# 1. Introduction

In the middle of 2011, an organic vegetable online sale mode called farm-to-door mode became popular in some large cities of China, such as Peking, Shanghai, and Shenzhen. Instead of buying vegetable through food markets, this new mode connects customers and farmers directly. A customer can place his/her order with farmers online, and then the vegetable will be picked up from the farms and delivered to the customers on the day as they want. A simplified process for explaining the farm-to-door mode is shown in Figure 1. The emergence of this new mode is motivated by the changes of people's life from the following three aspects.

- People in metropolises usually live a busy daily life, and they have strong demand for buying vegetables in a more convenient way instead of going to shops on workdays.
- The development of wireless broadband access technology and mobile devices makes it possible to shop online through mobile devices everywhere anytime. According to the report presented by China Internet Network Information Center (CNNIC, 2012), till December 2011, the total mobile user group has reached 3.56 hundred million, and the number is still growing.
- The terrible traffic condition in these big cities offers people enough time for placing orders by mobile devices when they are on the way to work or home. Taking Peking for example, the commute time is 116 min on average (Niu et al., 2010).

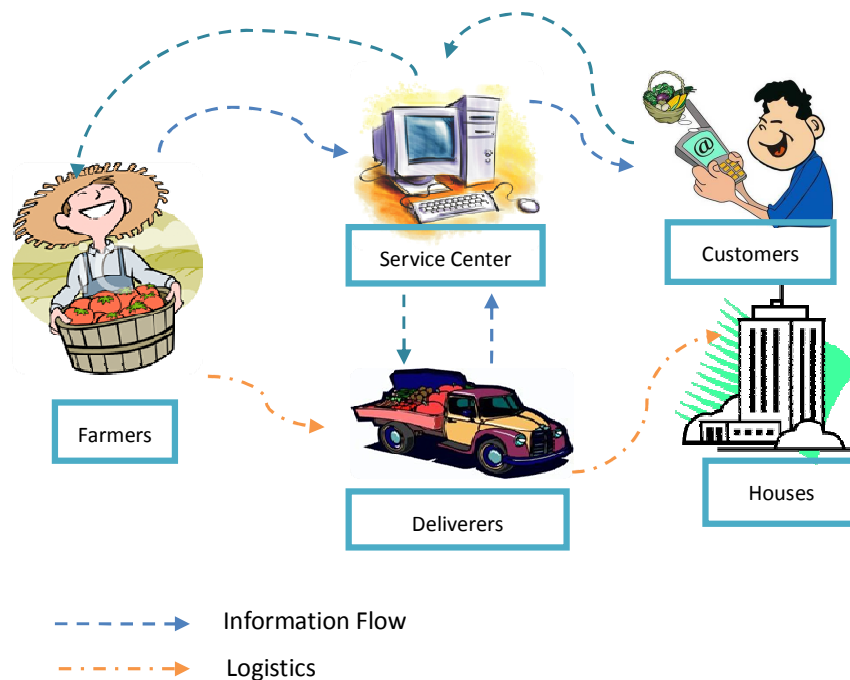


Figure 1. The structure of the farm-to-door delivery mode of e-business for organic vegetables.

As the reasons above, the farm-to-door mode becomes popular and spreads quickly among groups, who think highly of food safety and eating healthily (Trienekens and Zuurbier, 2008; Wolfert et al., 2010). Under this situation, the farm-to-door delivery mode for organic vegetables under M-commerce is grown up and becomes a promising field in some big cities of China, as it can provide convenient, fresh and harmless vegetables.

Although the business mode of farm-to-door delivery for e-business commerce has already been established, there are still some problems to be solved in the process of the daily operation. According to our direct contact with the company in Peking, the key issue is how to deliver the vegetables to the customers properly and safely when they cannot endorse the goods personally. The delivery of vegetables is usually processed in the early morning (for example 3:00-6:00 A.M) because of the terrible transportation conditions in day time. And most people are asleep at the time. As the situation in China, people in metropolises usually live in apartment and the goods leaving at door has a high risk of been stolen or replaced. Moreover, the B2C logistics service in China lacks of standards and supervision, the complaints rate for error packages, damage package and missing package is rather high. It is quite different with that of west counties, where deliverers can leave the goods at the yard when no one is at home. In China, the goods have to be handed to their owners face to face, and endorse after being checked. How to complete the delivery and receipt process without disturbing the normal period of rest has become a problem becomes problematic for both the deliverers and customers. And this dilemma is also the most powerful restraining factor for the development of the mode.

In this paper, we focus on designing a farm-to-door delivery mode under M-commerce for organic vegetables. Practically, intelligent cupboards are used as a buffer and the vegetables can be endorsed asynchronously by SMS-based service. Though the application, not only the enterprises can complete “the last mile” in farm-to-door delivery of organic vegetables, but also set an example for the B2C online sale to other fresh commodities under M-commerce. The remaining parts of the paper are organized as follow. In section 2, we list and review the related work. The framework of farm-to-door delivery mode is discussed in section 3 and following by the details for the design and application of the intelligent cupboard. Conclusions and discussions of our research are given in section 5.

## **2. Related work**

### **2.1 Agri-food business mode**

Although there is wide variety of agri-food business modes across the world, they have received only little attention in the literature, as well as agri-food supply chain management (SCM). The reason may be the agri-food business mode has been established and modified since the age of barter transaction. And agri-food SCM is too complicated due to its specific product and process characteristics. And these characteristics have often also limited the possibilities for supply chain integration in food supply chains (Rong, Akkerman, and Grunow., 2011). However, there is plenty of research focusing on agri-food supply chain governance structures from different aspects. (Williamson, 1999; Raynaud et al., 2005;

Zaharieva et al., 2003) And according to the governance structures, practical agri-food business mode can be classified into 5 categories: self-marketing, direct sale, cooperation auction, contract farming (CF), and wholesale-based multi-stage marketing.

The history of self-marketing can from the age of barter transaction. Currently, it is still vital among suburb or rural autarky growers in China. But in metropolises or even cities, this mode is almost vanished because of the impact from large supermarkets and professional markets. Similar with self-marketing, direct sale is an advance version, which appeared in last decade in Japan. It is established to help rebuild marketing channel for autarky growers (Xu, 2008). Till 2009, there have been almost ten thousand direct sale stores in Japan and the total revenue has exceeded 600 billion yen (Yuan, 2009). Anther business mode that dominates the marketing of fresh agri-food is cooperative auction (Bijman and Hendrikese, 2003). It was first used in Netherland for selling flowers in 1887. (Bijman, 2006) Besides flowers, other kinds of perishable agri-food like beef, fruits, vegetables and so on are also distributed through auction. Currently, it is also widely used in Japan and western European (Leat and Revoredo-Giha, 2008). Contract Farming (CF) is the result of large scale mechanized farm (Zhang and Aramyan, 2009). According to FAO, it refers to agricultural production carried out according to an agreement between a buyer and farmers (FAO, 2008). Currently, this mode is widely applied in Africa, America, New Zealand, Senegal, and so on (Warning and Key, 2002 Maertens and Swinnen, 2006). As to say the wholesale-based multi-stage marketing, it is the most agri-food business mode in China. And it is also widely applied in East Asia region, where the growers are mainly consist of millions of smallholders (Zhang and Aramyan, 2009). In China, every city owns a nationalized wholesale. And the produces supplying for a city will be procured by its wholesale from the grower cooperatives, then sold to the retails, super markets or its inferior wholesales. In detail, the flowing along a typical agri-food marketing channel in China is illustrated in Figure 2 (Zhao and Sui, 2007; Randy et al., 2009). This mode caters for the supply chains that upstream and downstream members are spread and tiny.

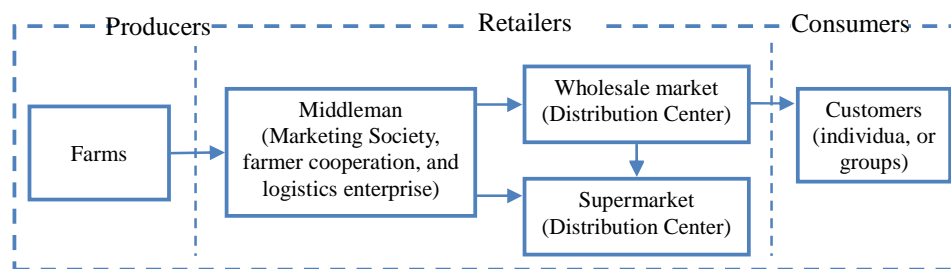


Figure 2. The traditional agri-food marketing channel in China

In summery, the agri-food business modes are developed along with the innovation of technology and organization form of producing. And they all have their own potentials. Self-marketing, direct sale and wholesale-based multi-stage marketing fit for the smallholders, and cooperation auction and CF are designed for large scale growers. And form the aspect of marketing channel (Figure 3), self-marketing, direct sale have a much fewer linkages than wholesale-based multi-stage (Bijman , 2006).

For the fresh agri-food, the long chain may damage its freshness, as the vegetables and fruits would be unloaded, stored, and loaded on each stage. According to the Ren (2008), the loss rate of the vegetables and fruits on transporting process in China is 25%-30%, while that in America is only 1%-2%. Meanwhile, the price of the produce would be doubled or even more, as the price hikes for five to ten percent on each stage (Zhang, 2012). And too many linkages will also decrease the feedback efficiency of the market demand information, which is the reason of produce blindness.

Realizing these problems in fresh agri-food supply chain, Chinese government has made efforts in reducing the distribution linkages, improving the logistics facilities and exploring new business mode. In 2005, a B2B website for produce trading is online at Shouguang in Shandong Province (<http://www.shucaio01.com/>). By now its annual sales has reached 12 billion. At the end of 2008, a policy was proposed by Ministry of Commerce of People's Republic of China (MCPRC) that impels the practise of "farm plus supermarket" business mode in China. It encourages the large chain supermarkets to make a contract with fresh agri-food growers or grower cooperatives (Miyata et al., 2009). According to Spokesperson of MCPRC, by the end of 2011, there has been more than 8 hundred of large supermarket and 15.6 thousand of grower cooperatives taking part in contract farming (Yu, 2012). Early in this year, agri-food auction debuts in China at Shandong Province (MCPRC, 2012). By now, it is still under tests. In sum, there are indeed some improvements of the agri-food supply chain in China. However, none of new business mode modes consider of modifying the linkage between the retailer and consumers. Especially in metropolises, people are usually too busy to go to supermarkets for vegetables and fruits every day. So to develop home-delivered agri-food business mode with shorter marketing channel linkages is very meaningful.

## **2.2 Applications of M-commerce**

In the traditional delivery mode of E-commerce, the absence of the customer for delivery may lead to the package lost in China, or the delay of delivery will result in labour waste. Thank to the huge developments of M-commerce technologies and SMS-based services in China, it has been verified it is appropriate to utilize an SMS-based M-commerce system to realize the interaction between customers and the service centre while delivering fruits or vegetables.

M-commerce has been a major driving force for the next wave of electronic commerce (E-commerce). As a subset of e-commerce, M-commerce refers to "any transaction with monetary value that is conducted via a mobile network" (Ngai and Gunasekaran, 2007). And the biggest advantage of M-commerce is the anytime-anywhere accessible of mobile devices, which provides enormous opportunities for business process innovation and location sensitive service (Zwass, 2003). M-commerce covers a wide range of applications, including mobile financial applications, mobile advertising, locating and shopping for products, mobile distance education, etc. (Varshney and Vetter, 2002; Coyle, 2001). As a consequence of that, people can place their order, interaction with others, and complete the transaction easily aiding the mobile devices. Because the message collected by SMS can act as substantial data, some M-commerce systems combined with SMS gain success, (Goh and Liew, 2009; Susanto and Goodwin, 2006; Boukas, Kambourakis and Gritzalis, 2009; Hu et al., 2011). As China

has large group of SMS user, it offers the M-commerce strengthen by SMS a great opportunities.

In summary, it is feasible to incorporate a SMS-based interaction M-commerce system to the delivery mode of organic vegetables for informing, endorsing, confirming, tracing and complaining. The new delivery mode benefits the online selling of agricultural products.

### 3. A FARM-TO-DOOR DELIVERY MODE OF ORGANIC VEGETABLES UNDER M-COMMERCE

In this section, we focus on designing a farm-to-door delivery mode strengthened by SMS. Its framework is illustrated by Figure 4. Every day, customers place their orders to the service centre through Internet or mobile Internet. At the beginning of a delivery cycle, the service centre will gather orders within a predefined time period, and then dispatch a vehicle and assign a cupboard for each one. Usually, the intelligent cupboards are settled at the basements or halls of buildings. Once the vegetables arrive at the cupboard, the service centre will send a message including the code for opening the cupboard to their owner to informing them of the delivery. After the customers reach home, they can take out their vegetables according to the code they have received. Finally, customers can endorse the goods by sending a confirming message to the service centre and complete deals. If there is anything wrong with the goods they have received, they can trace them and appeal to the service centre for more information or explanation. In detail, a flow chart of the delivery mode is shown in Figure 5.

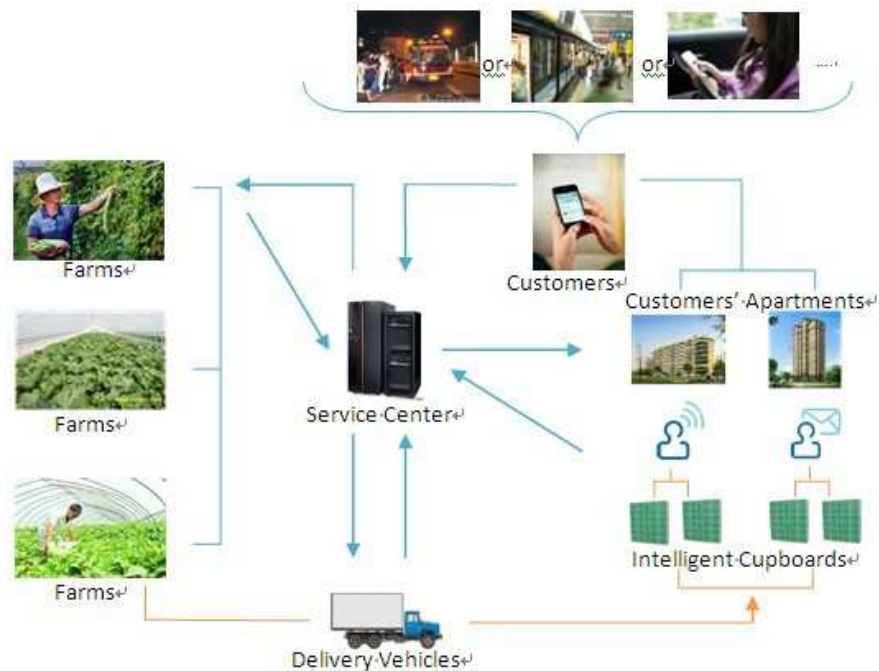


Figure 4. The framework of the farm-to-door delivery mode for organic vegetables under M-commerce.

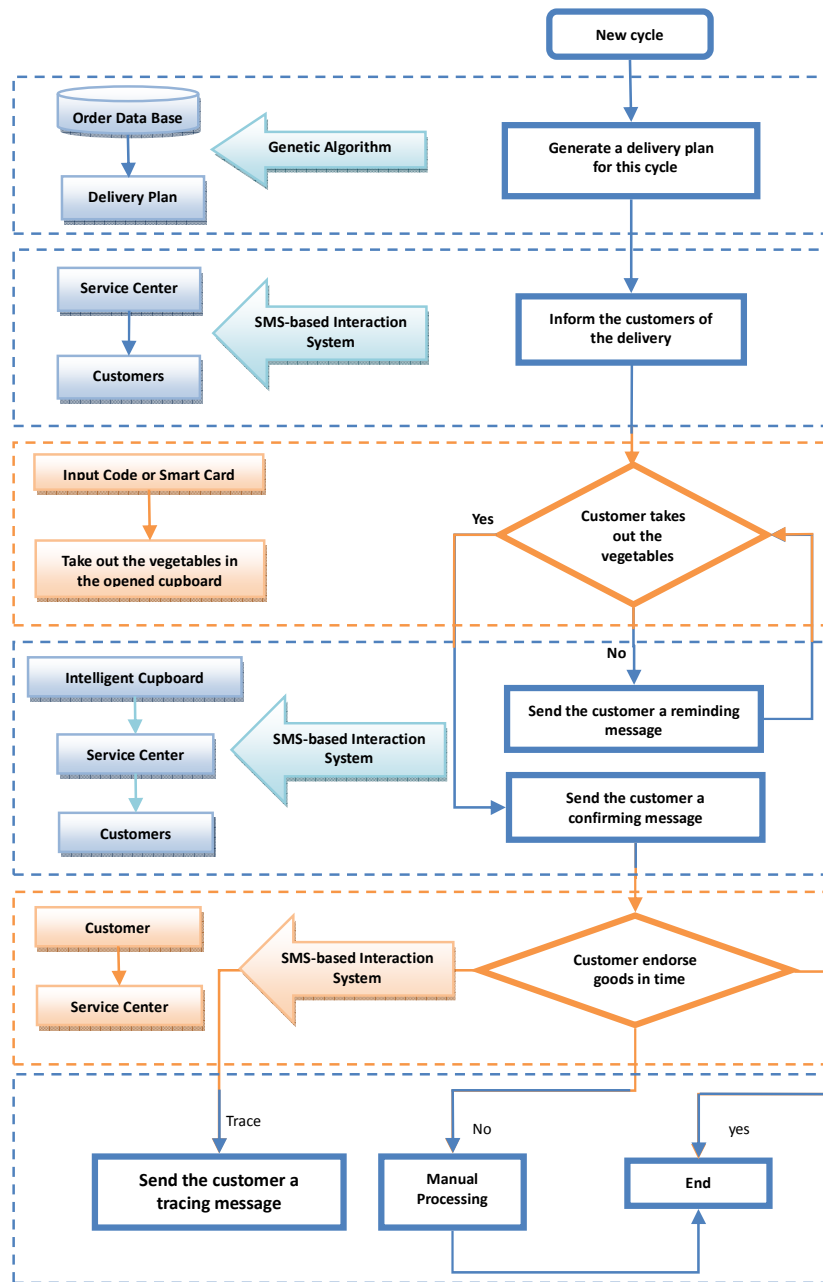


Figure 5. The flow chart of the farm-to-door delivery mode for organic vegetables under M-commerce.

What deserves special mention is that a genetic algorithm is integrated in the system for generating a proper delivery plan, as the logistics cost is another bottle neck of the mode. Comparing with other commodities, vegetables have lower price, shorter purchasing period, higher sensitivity of delay of delivery, and shorter delivery distance. So design a proper delivery mode is very important to B2C vegetable online selling.



As it pointed out that the service centre has to generate a detailed plan for all the orders, assigning vehicles for goods, routings for vehicles, and intelligent cupboards for customers. Obviously, making a daily delivery plan falls into the category of VRP, which is a NP-hard problem. When the amount of order grows larger, the solution space increases exponentially. It is impossible to find the optimal solution within acceptable time. Moreover, as a model usually simplifies the reality too much, sometimes the optimal solution obtained with it is not a feasible solution in practice. So we integrated a genetic algorithm, which is good at solving the combination optimization problem.

## **4. The intelligent cupboard function designing and its application**

For every delivery cycle, orders are diverse on delivery addresses, vegetable species and quantities, so the delivery plan is different in each period. As mentioned above, it is a waste of resource for reserving a fixed intelligent cupboard for each customer, so the cupboards should also be assigned dynamically. According to this requirement, we design the intelligent cupboard. Its structure and function are described in 4.1. Then in 4.2, we will explain how the cupboard applied to the farm-to-door delivery mode.

### **4.1 The design of the intelligent cupboard's function**

The intelligent cupboard looks like a locker, which is common in the supermarkets or libraries to store the bags. Usually, a cupboard is composed of thirty lockers with a sensor in each of it. And the cupboard is connected with the wireless Internet, so the service centre can collect the real-time information of all the lockers. In order to open the door of a locker, a code or a smart card is needed. When a locker is assigned to a customer, the service centre will send it a message including the code for opening the door and smart card number of the customer. After the vegetables are put into the specified locker, its owner will get a message of delivery information. When he/she arrives at the cupboard, he/she enters the code or slides the smart card, and the locker assigned to him/her would open. Once the locker opened, the code will be valid. And the locker can be reassigned to customers. The sketch of the design is shown in Figure. 5.

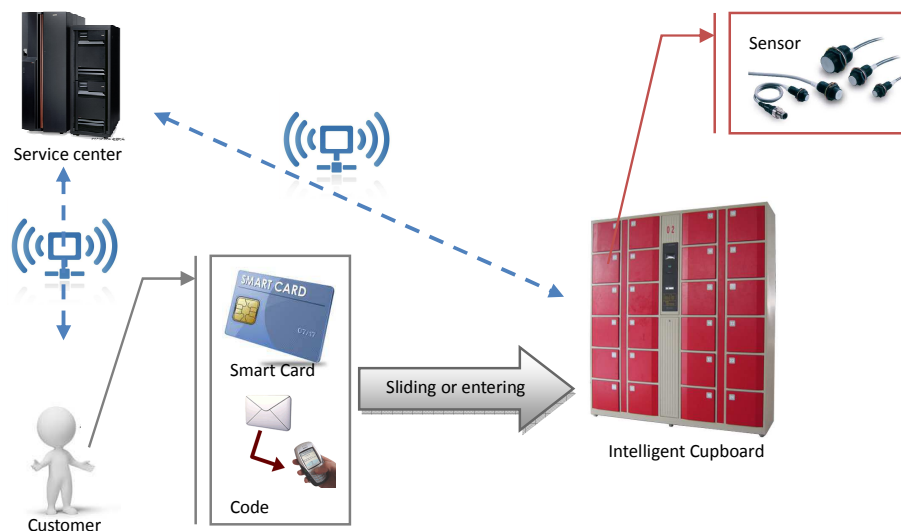


Figure 6. The sketch of the design for intelligent cupboard

#### 4.2 The cupboard's application in the farm-to-door delivery mode

Every day, the deliverers will distribute the goods according to the plans. When a piece of goods is put into the cupboard, the intelligent cupboard will send the service centre a signal. Then the owner will be informed of the cupboard number, its code and the delivery details through messages by the service centre. The detail of the message is show in Figure 7. When the owner arrives at the cupboard, he/she can open the door by scanning the code or sliding the smart card. When the door is opened and emptied, the service centre will send him/her a reminder message for the confirmation.



Figure 7. An example of Delivery Information (A— English Version ; B— Chinese Version )

## 5. Business Case

Our research is supported by an agri-food produce and marketing company in China, Beijing Haoyushenyang Incorporate of Agriculture Technology. It is a high-tech enterprise who committed to provide consumers all series of organic food and personalized service. The firm was founded on December 2008, and completed the organizing conversion in 2010. Currently, it owns 1,000 acres of organic produce base, and 40,000 acres of pollution-free produce base. In 2011, the firm launched E-business market by putting up an online store – Biyuan Organic Vegetable Store (<http://www.hyshenyang.com/>), and began to run B2C farm-to-door business mode. Till the end of 2011, the number of registered members has reached 5,000, and annual income sums up to 500,000 RMB.

Most of the home delivery tasks are conducted by the company-owned vehicles. And by using the delivery mode proposed in this paper, deliverers can complete their work without customers' attendances. Currently, this service only covers 6 residential areas due to the limited vehicle and intelligent cupboard quantities. And when the amount of orders went large, third-party logistics service would be needed. However, goods delivery by them should be endorsed face-to-face, as the third-party deliverer has no authorization to access the intelligent cupboard. So in the future, we will refine the proposed delivery mode for practical details. As to the cooperative, they would focus on enlarging the producing scales, market space.

## 6. Conclusions

In this paper, we design a farm-to-door delivery mode under M-commerce of organic vegetables, which is strengthened by SMS. Firstly, in the delivery stage, SMS are used for informing the customers of the delivery information for fetching their goods. Then, the customers could confirm and complete the deal through SMS. Meanwhile, they can also appeal to the service centre, if there is something wrong with the delivered goods.

The mode presented by the research introduces a new application field of B2C M-commerce. Meanwhile, according to the realistic situations in China, this mode can realize asynchronization of the delivery and endorsement, which offers an opportunity for selling the fresh food online in China. Furthermore, the farm-to-door mode reduces distribution intermediate links, and decrease the cost of transiting and storing, which is also a key issue for both Chinese government and researchers. It is expected that the farm-to-door delivery mode proposed in this paper may contribute to the development of the new distribution style of vegetables and fruits in China.

For the further study, we will focus on the pricing policy of the proposed mode considering the balance of the company's profits and the customers' behaviours. Meanwhile, the time factor and security issues of it (e.g. service policies for goods return, service policies for refund for goods rejection at different time, priorities for VIPs etc.) would also be considered.

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