

# Analysis on Influencing Factors of Community Logistics Development Based on ISM

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**Abstract**—By means of literature analysis and experts evaluation grading, this study concludes 17 major factors affecting the development of community logistics and establishes the interpretative structural model(ISM) of influencing factors of community logistics development by interpreting structure. The influencing factors have been classified with the help of MICMAC analysis. The hierarchy relations and driving force - dependence degree of these factors are finally obtained. The primary and secondary causes have been determined and the relevant suggestions have been proposed.

**Keywords**—Community logistics, Influenced factors, Interpretative Structural Model

## I. INTRODUCTION

In recent years, with rapid development of China's various social causes and level of the national economy, improving people's livelihood has become a hot topic of the times. One of which is community logistics service that concerns vital interests of the residents is becoming increasingly urgent as urbanization program and e-commerce business booms in China.

Community logistics is community-oriented service and refers to a terminal logistic mode that deliver goods or services to the community residents or store, such as home electric appliance recycling, processing and distribution of fruits, vegetables, food and daily necessities, newspapers and periodicals subscription, etc. It is also named “the last 100 meters of logistics” as it directly face to the terminal consumers completing the last step from “thing” to “man”. At present, community logistics are carried out in most large and

medium cities in China and various large logistics and e-commercial companies have entered the “blue ocean”. However, it is beset with difficulties due to requirement of high degree of streamline and complexity in the community logistics, the operation cost of logistics such as warehousing, manpower is high while the consumers cannot alter their spending patterns in a short time. Faced with huge potential and resistance in the process of development, exploring the factors affecting the development of community logistics in our country is an important topic to improve its development.

Therefore, the author will build the index system of influence factor of community logistics development by adopting Interpretative Structural Modeling Method(ISM) to form a multi-level structure, analyze the factors affecting the development of community logistics and their relations and put forward relevant suggestions with MICMAC method.

## II. ANALYSIS ON INFLUENCING FACTORS OF COMMUNITY LOGISTICS DEVELOPMENT AND THEIR RELATIONS

The development of community logistics has direct or indirect relationship with service providers, relevant governments departments, the community business, community management institutions and consumers. It is a quite complicated system conditioned and influenced by various factors. By means of literature analysis and combining the experiences in the community logistics and the comments of experts, this paper determines 17 factors affecting community logistics development in terms of the basic conditions, policy conditions, operating conditions and environmental conditions, as shown in Table 1.

TABLE I. INDEX SYSTEM OF INFLUENCING FACTORS OF COMMUNITY LOGISTICS DEVELOPMENT

category	Influencing factors	symbol	category	Influencing factors	symbol
Basic conditions	Logistics network	S <sub>1</sub>	Operation conditions	Service level	S <sub>10</sub>
	Supporting facilities	S <sub>2</sub>		Stock control	S <sub>11</sub>
	Information level	S <sub>3</sub>		Coordination ability	S <sub>12</sub>
	equipment technology	S <sub>4</sub>		Cost control	S <sub>13</sub>
	human resources	S <sub>5</sub>			
Policy conditions	Standard building	S <sub>6</sub>	Environmental conditions	urbanization level	S <sub>14</sub>
	Industrial structure	S <sub>7</sub>		Residents' living standard	S <sub>15</sub>
	Preferential policy support	S <sub>8</sub>		Consumption idea	S <sub>16</sub>
	Restrictive conditions	S <sub>9</sub>		Community management institutions	S <sub>17</sub>

Basic conditions include four factors: the logistics network construction (S<sub>1</sub>) involving transportation route planning, transportation nodes setting and distribution of; supporting facilities building(S<sub>2</sub>) involving city municipal infrastructure and road building, community logistics terminal settings, logistics district and supporting infrastructure; information level (S<sub>3</sub>) including application and upgrading of logistics information technology, information infrastructure investment, logistics network platform construction, etc.; logistics equipment technology (S<sub>4</sub>) refers to the requirement for the logistics equipment in development process of community logistics including logistics equipment update, the application of cold chain logistics technology, fast sorting, loading and unloading, packing and so on; logistics human resources (S<sub>5</sub>) including numbers of logistics professionals and high level talents. In terms of policy conditions include four factors: the standard building (S<sub>6</sub>), namely industry standard specification prescribed by the government or industry association; industrial structure (S<sub>7</sub>), including related region or city industry structure; preferential policy support (S<sub>8</sub>) such as tax, capital support policy that the national or local government give to community logistics; restrictive conditions (S<sub>9</sub>) which city logistics vehicle weight limit line of the community, management fee, etc. Operating conditions refer to some basic operation elements of community logistics, including four factors: the service level (S<sub>10</sub>) including logistics service level and logistics service quality, timeliness and loss rate, service attitude, etc.; inventory control (S<sub>11</sub>) which refers to the community logistics inventory quantity control, economic order quantity and inventory structure adjustment, cycle time optimization, etc.; synergy ability (S<sub>12</sub>) which refers to the status of collaborative production innovation, enterprise cooperation and scale economic benefit, etc; logistics cost control (S<sub>13</sub>) which refers to the cost control in the process of logistics optimization.

Environmental conditions also include four factors: the level of urbanization (S<sub>14</sub>) namely population proportion in the urban; residents living standards (S<sub>15</sub>) including the income level of residents, consumption level and structure; consumption idea (S<sub>16</sub>) referring to attitude and value judgment of the community consumers to provided goods or services; community management institutions opinion (S<sub>17</sub>) namely attitudes and actions of community management institutions to the logistics business.

The relationship among the factors affecting the development of community logistics is quite complex that is mutual influenced and conditioned. Based on the analysis of system engineering and repeated discussion of ISM panel, binary relation graph of the factors that affect community logistics development is concluded, as shown in Figure 1.

### III. CONSTRUCTION OF INTERPRETATIVE STRUCTURAL MODEL

#### A. Procedure Of ISM Construction

Explanative structural modeling is a kind of method of processing complex system in system engineering by dividing the intricate system into several subsystems. The model possesses multi-hierarchical structure by disaggregating the fuzzy thinking and ideas into visualized and well-structured relations.

Firstly, related variables of the complicated system of ISM and relevant factors of concerned problem are defined, and binary relation of each variable is determined through the Delphi method; then establish adjacency matrix in line with the correlation among each factor and build structure model after decomposition of the matrix; finally explanative structural model is established based on the structural model.

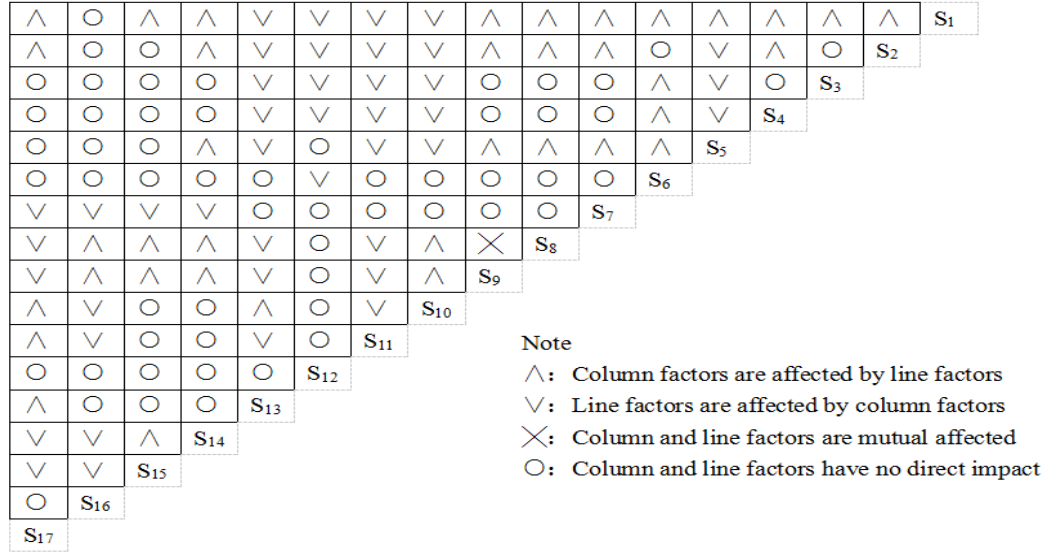


Figure 1. Binary relation graph of the factors affecting community logistics development

### B. Establishing Accessible Matrix

According to binary relation graph (Figure 1) and the following principle, the adjacency matrix is obtained, denoted with A, dereferencing values with its elements  $a_{ij}$ .

$$a_{ij} = \begin{cases} 1 & S_i \text{ affects } S_j \\ 0 & S_i \text{ doesn't affect } S_j \end{cases}$$

The adjacency matrix as following:

$$A = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \end{bmatrix}$$

According to the adjacency matrix, establish the accessible matrix R ( $R = [r_{ij}] n \times n$ ). It describes the degree of each node passing a certain length in line-connected diagram via MATLAB software programming, as shown below:

$$R = \begin{bmatrix} 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \end{bmatrix}$$

### C. ISM Of Influencing Factors of Community Logistics Development

According to accessible matrix, analyze reachable set R ( $S_i$ ) and the advanced set B of each element. Mathematical expression is:

$$R(S_i) = \{S_j \in S | r_{ij} = 1\}$$

$$B(S_i) = \{S_j \in S | r_{ji} = 1\}$$

Take the intersection of reachable set and advanced set of all the elements, the similar element of accessible set and intersection is the highest element of the interpretative structure model C ( $S_i$ ).

$$C(S_i) = \{S_j \in S | R(S_i) \cap B(S_i) = R(S_i)\}$$

When the highest element is acquired, put it into the lines and columns within the accessible matrix and obtain the high element of the left matrix with the same method, taking turns iteratively, denoting the marked level with L(S), C ( $S_i$ ):

$$L_1 = \{S_{12}\};$$

$$L_2 = \{S_1, S_2, S_5, S_8, S_9, S_{10}, S_{11}, S_{13}, S_{16}, S_{17}\};$$

$$L_3 = \{S_3, S_4, S_{14}\};$$

$$L_4 = \{S_{15}\};$$

$$L_5 = \{S_6, S_7\}.$$

By disintegrating the accessible matrix and dividing by levels, the interpretative structural model of factors of community logistics development is obtained, as shown in Figure 2:

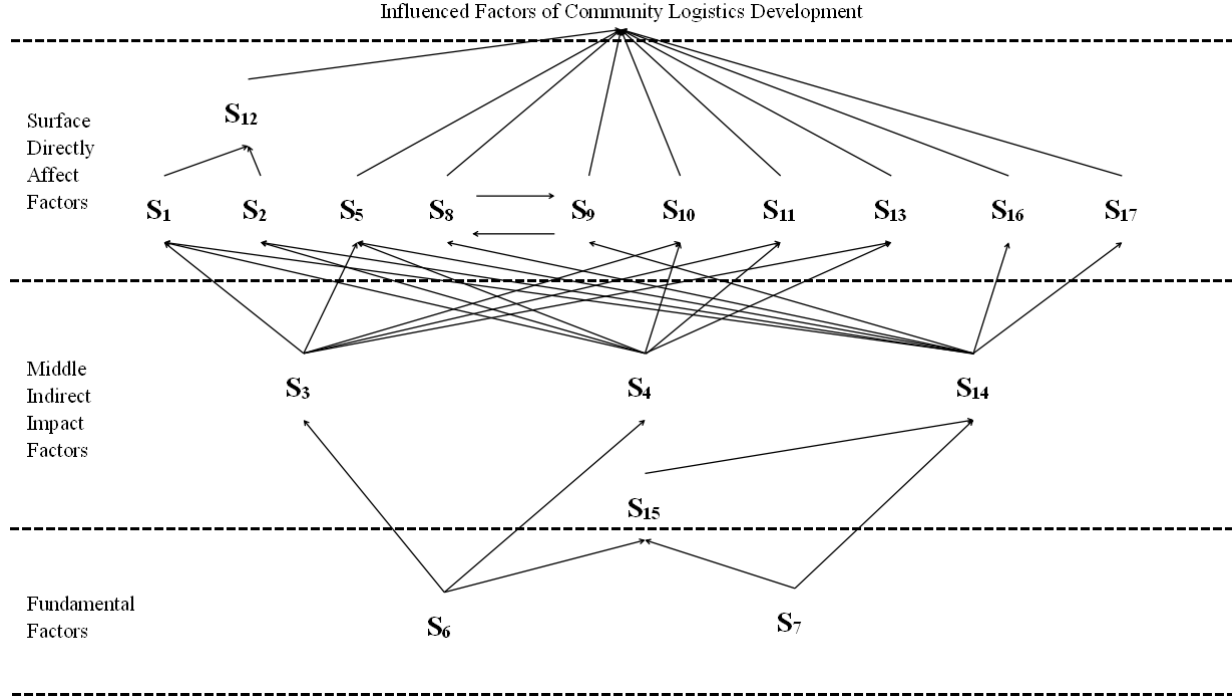


Figure 2. ISM of factors of community logistics development

#### IV. MICMAC ANALYSIS ON FACTORS OF COMMUNITY LOGISTICS DEVELOPMENT

By establishing the explanative structural model, we layer the factors affecting community logistics development and find out the fundamental cause impacting on the development of community logistics, as well as the affecting degree of other relevant factors. MICMAC refers to multiplication of cross-influenced matrix by measuring the drive force and dependency of each factor in the accessible matrix to analyze the degree of influence dependence of the elements in the complex system. MICMAC analysis on the influence factors of the logistics development of community will further determine its inherent correlation and importance of the influential factors to find the key point of management and intervention.

In MICMAC analysis, all the elements are divided into four clusters. The first cluster of autonomous elements are made up of those driving force and dependence are both weak that these elements have no or only a little association with the system; the second cluster dependence element consist of those driving force is weak but dependence is strong; the third cluster association elements consist of those driving force and dependencies are both strong. Because any actions related to these factors will affect other elements, vice versa, these elements are unstable; the fourth cluster drive elements consist of those driving force is strong but dependence is weak. Via calculating the driving force and dependence degree of each factor in the matrix, MICMAC analysis on the influence factor of logistics community development is shown as in Figure 3.

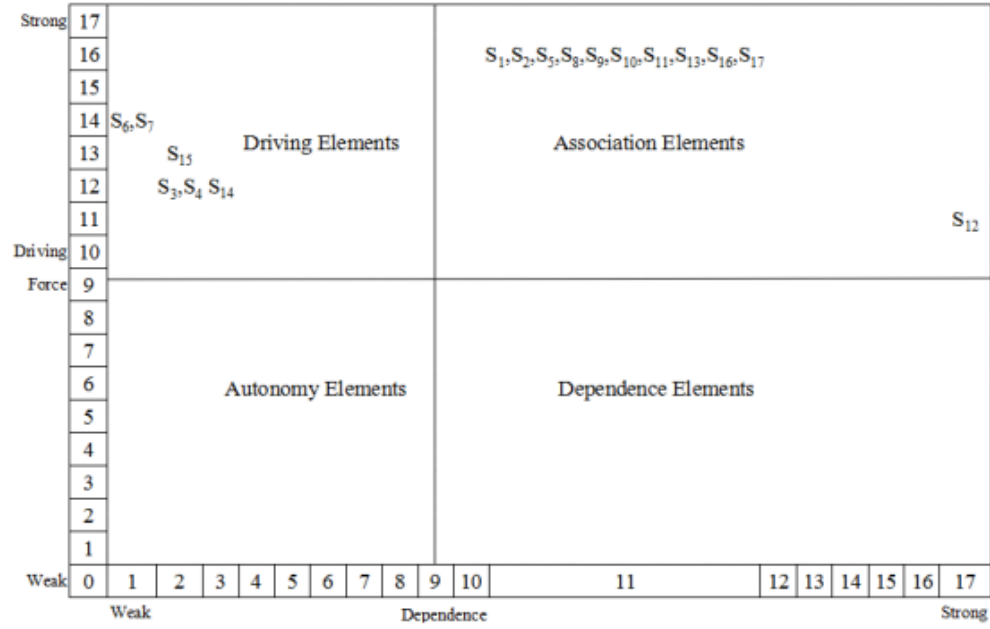


Figure 3. Classification of influential factors of logistics community development based on MICMAC analysis

The above figure 3 shows that elements  $\{S_3, S_4, S_6, S_7, S_{14}, S_{15}\}$  belong to drive elements with the characteristics of high driving force and low dependence corresponding to 3~5 layers in the structure model; elements  $\{S_1, S_2, S_5, S_8, S_9, S_{10}, S_{11}, S_{13}, S_{16}, S_{17}\}$  belong to contact elements with the characteristics of high dependence and driving force corresponding to layer 1 and layer 2 of the structure model.

## V. ISM AND MICMAC RESULTS ANALYSIS

According to ISM and MICMAC results, the influence factors of community logistics development are conclude as following.

(1)Standard construction and industrial structure are the fundamental cause affecting community logistics development with the characteristics of high driving force and

low dependence, exerting high influence on other factors whereas other factors have low impact on them in the process of community logistics development. Thus, more emphasis should be laid on them by logistics enterprises.

Presently, China's industrial structure is faced with obvious differentiation that traditional heavy industry like steel, petrochemical, etc. are declining while new leading industry represented by high-end manufacturing and modern service industry are growing rapidly. Especially with the boom of Internet technology, the development of community logistics is faced with high challenge. Comparing the figures of cumulative express delivery business and added value of the tertiary industry between January 2000 and January 2015, a high positive correlation can be found in both of them, as shown in Figure 4.

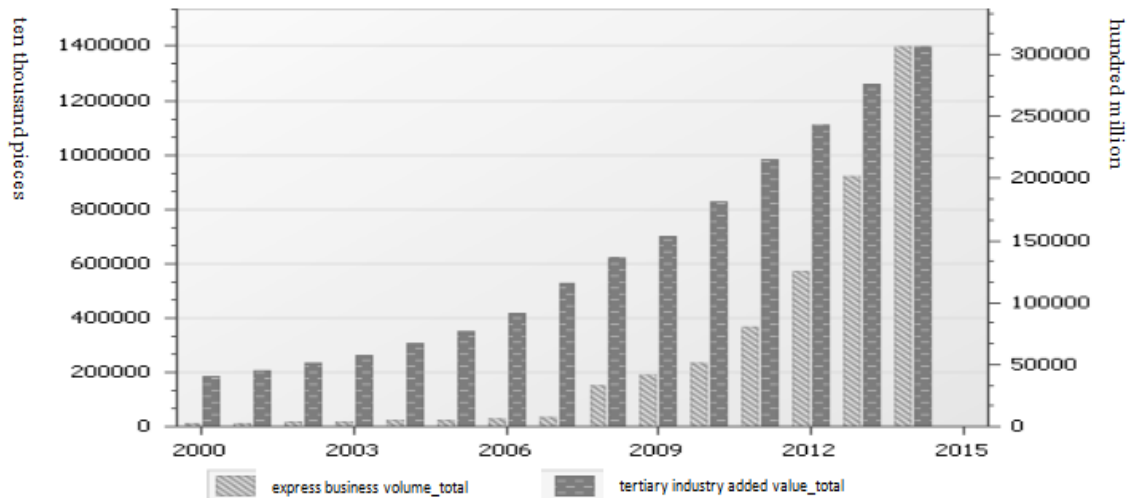


Figure 4. Comparison on cumulative volume of express business and added value of the tertiary industry (2000.1-2015.1)

Large domestic logistics enterprises used to be stymied in community logistics highlights the urgency of the standardized construction in community logistics development. Standard construction effectively promote the development of community logistics by lowering the logistics cost, pushing economy progress of logistics scale, improving service quality and standardizing logistics evaluation index.

(2) Middle influenced factors of community logistics development include informationization level, equipment technology, the level of urbanization and residents' living standard. They are influenced by the fundamental factors. On the other hand, they also affect the surface factors. In MICMAC analysis, these factors belong to driving factors with the characteristics of high driving force and low dependence. They are also the key factors affecting the development of community logistics.

Informationization level and logistics equipment technology are the key to the development of logistics industry, community logistics is hard to get through the bottleneck of the development of logistics without their technology support. With the development of new technology, the logistics industry tends to informationization, intellectualization and high-technicalization. Various information processing platform and implementation of key technology strengthen the functions of transportation, storage, loading and unloading, packaging, delivering, etc., improve the efficiency of the community logistics.

The living level of residents and urbanization level directly affect needs of the community logistics. There is a relatively stable equilibrium relationship between them, as people's living standard improves quickly and urbanization proceeds, the community will increase in numbers and expand in scale and become the basic unit of the People's daily life. Strengthening and integrating of the functions of community make a bigger market and require a higher standard of the logistics industry.

(3) The surface influenced factors of community logistics development involve several aspects such as companies, government, consumers which belong to association factors with high driving force and strong dependency that are unstable having mutual influences with other factors. The managers and implementers of the community logistics enterprise should be real-time monitoring of these factors, avoiding risk and grasping the opportunity.

As the principal subject of community logistics services, self-factors of the logistics enterprise have great influence on the development of community logistics. They should construct logistics network construction properly, improve the service level, control inventory and logistics cost, strengthen the human resources management, as well as establish a good relationship and cooperate with relevant government departments, industry associations and other related enterprises and departments.

The government plays a primary role in every aspect of community logistics. Municipal road construction, logistics area planning and related infrastructure construction directly

affect overall arrangement of courses and nodes of community logistics. The favorable and restrictive conditions as the government's policy of community logistics development have interaction relations with each other. At present, repeated tax, bridge tolls, varied fine and check and improper charge are ubiquitous, and for the sake of city management, the limitation on the loading, unloading, distribution for logistics enterprise block the development of community logistics. In the mean time, some cities have introduced a series of positive policy in promoting development of community logistics.

Consumers are service object of community logistics, their consumption idea also have important influence on the development of community logistics. In respect of the definition of community logistics, it directly face the terminal consumers, provide daily life services. The majority of service objects in our daily life are often middle-aged and old people with little knowledge about internet and community logistics and low enthusiasm for their application. In the aspect of quality consumers lack faith in the products logistics companies provided. The logistics enterprises and suppliers should jointly strengthen propaganda to guide consumers to change ideas.

The opinions of the community management agencies shall not be ignored as well. In China, the community management departments are mainly composed of street agency, residents' committee or the owners' committee, property companies, etc., their opinion also has a certain influence on the development of community logistics. Logistics enterprises should keep good relationship with the management institution, observing the rules and regulations of the community management, strengthening the management of logistics personnel, providing good services for the community.

## VI. CONCLUSION

By adopting the methods of Delphi and literature survey, this paper concludes 17 factors affecting the development of community logistics and determines their relationships. Based on explanative structural model, the explanation structure model was established, the influencing factors of community logistics development are divided into three levels: surface direct influencing factors, middle indirect influencing factors and fundamental factors. Also, the driving force and dependency of these factors have been determined via MICMAC method and relevant suggestions for community logistics development have been proposed in line with the analysis results. However, qualitative analysis research of this study is one-sided to a certain extent, quantitative analysis shall be adopted to evaluate the above 17 factors affecting the development of community logistics and their relationships in the future research.

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