

Intelligent transaction: definition, modes, and research directions

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Abstract

Purpose – In the crowd intelligence networking era, the smart connections of human, machines and things enable point-to-point trustable transactions and distributed efficient collaboration; the smart connections among government, enterprises, organizations and the public would enable active participation of the public in society management and decision-making and improve the efficiency of government management and services. All interactions among various agents can be viewed as the transaction activity. The social division of labor system drives the evolution of transaction. The transaction mode also differentiated into different patterns with the development of human society. What will be the intelligent transaction in the crowd intelligence networking era? What will be the transactions modes and rules in the crowd intelligence networking era? The answers to these questions are of great importance to the future development of transactions.

Design/methodology/approach – The authors review the evolution of traditional transaction and transaction modes and analyze the driving forces of it. They attempt to give the definitions of intelligent transaction and intelligent transaction mode. They also review the traditional transaction modes and rules, analyze the characteristics of the intelligent transaction and classify the intelligent transaction modes.

Findings – The authors find the intelligent transaction is mainly reflected in the intellectualization of transaction subject, transaction object and transaction process. They summarize the characteristics of intelligent transaction and develop four modes for the intelligent transactions based on the modularization level of the transaction objects and the quantity of transaction subjects, including the demand side and the supply side. The authors also show representative examples to further illustrate rules and features of these transaction modes and point out the potential research directions.

Originality/value – This study is among the first to analyze the characteristics of the intelligent transaction, and the proposed division framework of the intelligent transaction modes could not only add value to the future research of intelligent transaction modes and rules but also help to guide the transactions in the crowd intelligence network.

Keywords Crowd science, Crowd intelligence network, Intelligent transaction, Transaction mode, Transaction rule

Paper type Conceptual paper



1. Introduction

With the breakthrough and continuous development of the new generation of information technology, such as internet of things, cloud computing, big data and artificial intelligence, the future society is becoming an intelligent interconnection system, which is open, ecological, large-scale and self-organized, known as “crowd intelligence network” (Chai *et al.*, 2017). The crowd intelligence network is a fusion system comprised with physical space, information space and conscious space. Due to the interactions of the above components that conform to different laws of movement, the behavioral results of crowd intelligence networks express the following characteristics: the unity of stability and mutation, the unity of order and disorder, the unity of determination and randomness, the unity of heter-organization and self-organization, the unity of knowable and unknowable and the unity of controllability and uncontrollability. These changes will have subversive effect on the future industrial structure and industrial forms, resulting in the individuation of products, the decentralization of production, the miniaturization of government and the publicity of means of production.

In the crowd intelligence networks, all kinds of interactions between intelligent agents can be regarded as some form of transaction (Chai *et al.*, 2017). Compared with traditional transaction, transactions in crowd intelligence networks express the following characteristics. The first one is the diversity of transaction subject. In addition to individuals and institutions, the intelligent goods are taking a more and more important role as emerging transaction subject. The second one is the richness of transaction object. Under crowd intelligence networks, the transaction object includes both product and service, and information and conscious. The third one is the variety of transaction forms. Most of the traditional transactions are between individual and individual. While, the transactions under crowd intelligence networks include both the interactions among individuals and transactions between individual and crowds, and transactions among crowds. The above characteristics may breed different transaction mode and transaction rules, which consequently bring different transaction structure, transaction efficiency and transaction effect. Since now, the study of crowd intelligence networks is still in the exploration stage, and there is no consensus on the universally mechanism or law behind various crowd intelligence phenomena. What’s more, discussion on the transaction modes and transaction rules under crowd intelligence networks is still blank.

To better understand the transactions in the crowd intelligence networks, this paper reviews the evolution of transaction and finds the driving force of transaction evolution is the social division of labor system. We review the transaction modes and discover the differentiation mechanism of them underlies in the transaction cost, efficiency and risk. Based on them, we attempt to give the definitions of intelligent transaction and intelligent transaction mode. The intelligent transaction is mainly reflected in the intellectualization of transaction subject, transaction object and transaction process.

Focusing on the modes and rules of intelligent transaction in crowd intelligence networks, this study also innovatively proposes the concept on the division of transactions, and further uses this concept to deconstruct the connotation of “crowd.” We divide the mode of intelligent transaction into four categories, which are single-demand- single-supply mode (S-S), single-demand-multi-supply mode (S-M), multi-demand- single-supply mode (M-S) and multi-demand-multi-supply mode (M-M). Furthermore, this study discusses the general and special transaction rules for different transaction modes and provides further illustrations in combination with

representative examples. This study tries to extend the discussion of transaction modes and rules to the crowd intelligence networks and to provide a basis for the further research on transaction structure and transaction efficiency.

The remainder of this paper is arranged as follows: Section 2 reviews the driving force of transaction evolution. Section 3 analyzes the differentiation mechanism of transaction mode. Section 4 defines the intelligent transaction and intelligent transaction modes. Section 5 introduces the classification framework and rules of intelligent transaction mode in the crowd intelligence networks. Section 6 is the research conclusion and prospect.

2. The driving force of transaction evolution

2.1 The definition of transaction

In general, transaction is an act in which one party gives one right in exchange for another (He, 2010). The above definition implies that there are three elements in a transaction: the subject of transaction, the object of transaction and the process of transaction.

The subject of transaction refers to the individuals or organizations involved in a transaction. Traditionally, there are two kinds of subjects in a transaction: the buyer and the seller. But in modern times, the technological progress promotes multi-agent collaboration, which results in the diversification trend of subjects of transactions.

The object of transaction refers to the things exchanged by the subjects of transaction. Essentially, the object of transaction is a kind of value or right, but it has different forms of expression. Traditionally, they are physical goods or services; while at present, most of them are digital goods or information.

The process of transaction defines how the object of transaction transfers from one party to another. It includes a wide range of connotations, such as how to match the supply and the demand, how to determine the price, whether through an intermediary and so on.

2.2 The evolution of transaction

In the long history of human society, transaction is not the inherent social behavior. In the primitive society, it was only a casual exchange between tribes. And for quite a long time, transactions are carried out in the form of difficult barter exchange, until money was created and widely used as a trading intermediary. At present, transaction has become the frequent social behaviors among individuals or organizations and has developed into a convenient commodity circulation. Through the review of the history, we conclude that the evolution of transactions is mainly carried out in the following three aspects.

The first is that the scope of the transaction subjects is becoming wider and wider. In primitive and agricultural societies, transactions are mainly carried out within the nearby regions. While after the great geographic discovery, transactions began to break through the geographical restrictions. And today, a global trading system has been fully established.

The second is that the types of transaction objects are becoming more and more abundant. Traditionally, the objects of transaction are mainly physical commodities and services. While in nowadays, various transaction objects are emerging, such as information, knowledge, emotion and so on. In short, all things with value have the potential to become transaction objects.

The third aspect is about the transaction process. Different from the above two aspects, there is no fixed trend in the evolution of transaction process. In some area, the process is becoming simpler (such as e-business commerce), while in other area, it is becoming more complex (such as modern financial derivatives). For some transaction, the degree of intermediation is getting higher and higher (such as the external audit), while for other transaction, it shows de-intermediation tendency (such as P2P lending). But there is still some consensus, especially in the era of digital economy, including intellectualization, personalized, visualization credibility and dynamic.

2.3 The driving force of transaction evolution

Reviewing the history of transaction, one interesting question would be: what drives the evolution of transaction? The answer to this question will help us to understand the development of transaction in the future.

We believe that the core driving force determining the evolution of transaction is the social division of labor system, which is determined by the social productivity. In the primitive society, the extremely under-developed productivity led to the situation that human beings can only survive in the way of group cooperation, production and consumption had not yet been separated, and transaction was in the embryonic state. During the period of agricultural revolution, the progress of productivity brought about three social divisions of labor (animal husbandry, handicraft and commerce separate from agriculture). For the first time, the production and consumption of commodities were separated, resulting in the need for exchange among individuals with different skills to survival. Since then, transactions have sprung up. During the period of commercial revolution, the progress of compass and shipbuilding technology promoted the great geographical discovery, which led to the integration of America, Africa, Asia and Oceania into the global division of labor system, and the indeed international trade was rising. During the period of industrial revolution and electric revolution, the progress in science and technology continuously promoted the development of social productivity, which further expanded the scope and depth of social division of labor, resulting in the enrichment of transaction content and diversification of transaction modes. The social productivity and division of labor system will form the transactions in the intelligence era.

3. The differentiation mechanism of transaction mode

Another phenomenon we have observed is that under a given system of productivity and division of labor, different groups have different transaction modes for different goods/services. To understand the differentiation of transaction patterns, we need clarify the following issues.

3.1 The definition of transaction mode

What is transaction mode? Although there are many appellations in business world, there has been a lack of clear definition in academia. One of the closest terms comes from the management discipline, that's business mode, which is defined as the way enterprises create and deliver value to their customers (Johnson, 2010). But the emphasis of business mode is completely different from that of transaction mode. We try to define the connotation of transaction mode using reductionism method.

First, what is mode? Mode is the general way of subjects' behavior, which has the characteristics of generality, simplicity, stability and structure. At the philosophy level,

mode is a subjective explanation of the structure of things, and it is an abstract summary of phenomena. Referring to the above definition, transaction mode is the subjective summary of the structure of transactions. According to the viewpoint of systematics, structure is the organizational mode of elements. While, the elements of transaction include transaction subject, transaction object and transaction process. Hence, transaction mode can be defined as the way by which value exchanges between transaction subjects. It is a formal summary of the transaction structure.

3.2 Typical patterns of transaction mode

Because transaction elements include transaction subject, transaction object and transaction process (pricing method, delivery time, contract relationship, etc.), the specific form of transaction mode can be summarized from three dimensions: transaction subject, transaction object and transaction process.

As to transaction subjects, transaction mode can be classified into B2B, B2C, C2C and some variant mode, such as C2M, C2B2C and B2B2C. The B2B mode refers to the transactions between the enterprise and the enterprise. The B2C mode refers to the transactions between the enterprise and the individual. The C2C mode refers to the transactions between the individual and the individual (Brynjolfsson and Smith, 2000). C2M (transaction between individual and manufacturer), C2B2C (transactions among individual and enterprise) and other variant mode are extended based on the specific characteristics of the transaction subject and the characteristics of the transaction process.

As to transaction objects, transaction mode can be divided into wholesale mode and retail mode (Kotler and Armstrong, 2010). The wholesale mode refers to the transaction of goods or services that are bought for the purpose of reselling or for the specific use of enterprises. The retail mode refers to the transaction of goods or services that are bought by the end consumers, for non-commercial purposes.

As to transaction process, transaction mode can be divided through different dimensions:

- According to whether there is platform intervened in the transaction process, transaction mode can be divided into platform mode and non-platform mode. The platform mode refers to transactions that supply side and demand side reach a transaction through the matching and security mechanism provided by the online virtual platform (Choudary *et al.*, 2016).
- According to the difference of delivery time of goods and services, transaction mode can be divided into spot transaction, forward transaction and future transaction (Baba *et al.*, 2012). Spot transaction refers to the way of buying or selling a commodity, security or currency for immediate settlement. Forward transaction refers to the transaction between buyers and sellers who sign a forward contract and stipulate a transaction at a certain time in the future. Future transaction refers to a standardized and legal agreement to buy or sell something at a predetermined price at a specified time in the future.
- According to whether there is a change of the real right of the transaction object, transaction mode can be divided into ownership transaction and usage right transaction. The ownership transaction refers to the transaction which is accompanied with the transfer of rights of possession, usage, benefits and disposition. The traditional trade of goods and services are mostly belonging to the ownership transaction. The usage right transaction refers to the transaction that only transfers the right to use the transaction object, while the right of possession, benefits and disposition are still belong to the initial

owners. The emerging sharing economy is mostly belonging to the usage right transaction (Sundararajan, 2016).

- According to the difference of pricing methods, transaction mode can be divided into static pricing transaction and dynamic pricing transaction. The static pricing transaction refers to the transaction that the price of goods or services does not vary with the fluctuation of supply and demand. The dynamic pricing transaction refers to the transaction that the price is changing dynamically with variety of the supply and demand, and the typical representative is auction. An auction is a process of buying and selling goods or services by offering them up for bid, taking bids and then selling the item to the highest bidder (Myerson, 1981).

3.3 The differentiation mechanism of transaction mode

Essentially, the driving forces behind the differentiation of transaction mode may include the following three categories.

The first one is transaction cost. Transaction cost mainly examines the effect of transaction from the economic dimension. For example, in the period of commercial revolution, the expansion of transaction scope and scale made the cost of long-distance transportation of currency rising rapidly. To reduce transaction cost, bill business replaced cash business as the mainstream form of cross-regional transactions.

The second one is transaction efficiency. Transaction efficiency mainly examines the effect of transaction from the time dimension. For example, in the period of agricultural revolution, the development of productivity and social division of labor increased the frequency of trade and the inefficiency of traditional barter trade resulted in the emergence of exchange medium, currency. As a general equivalent, currency greatly improved the efficiency of transaction matching and ultimately promoted the transformation of transaction mode from direct transaction to indirect transaction.

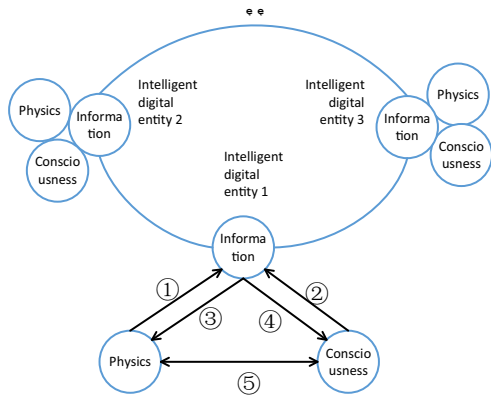
The third one is transaction risk. Transaction risk mainly examines the effect of transaction from the dimension of uncertainty. For example, the expansion of production scale leads to the rapid increasing of transaction scale, and the procurement cost of raw materials becomes a major burden for enterprises. And the price fluctuation of spot transactions becomes unbearable. To avoid price risk, various forward contracts have been created, and the mode of commodity trading has been changed from spot transaction to forward transaction.

4. Intelligent transaction

Intelligent transaction is defined as the process of realizing intelligent matching between supply and demand interaction activities among transaction subjects. Intelligent transaction is mainly reflected in the intellectualization of transaction subject, transaction object and transaction process.

The intellectualization of transaction subject refers to the improvement of intelligence of individuals, enterprises, institutions and governments. Individuals, enterprises, institutions and governments have become the intelligent digital entities in the crowd intelligence space by means of mapping. The formation of intelligent digital entity is the process of merging the physics, consciousness and information of the transaction subject. Figure 1 illustrates the intellectualization of transaction subject. The transaction subject as the basic attributes (e.g. gender, age, height, weight, location, intelligence level; scale, rating, position, structure, etc.) and ability attributes (e.g. skills, physical strength, price, product capacity, production

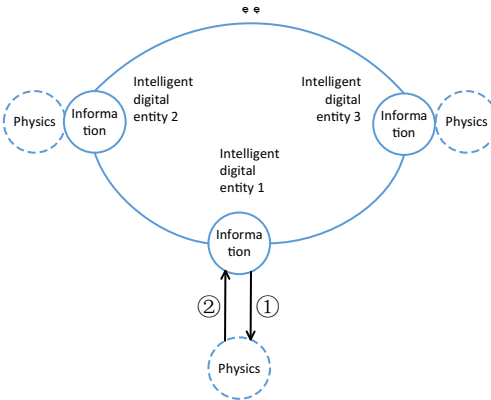
Figure 1.
The
intellectualization of
transaction subject



arrangement, function, etc.) of the physical entity realize informatization in the crowd intelligence space by means of mapping. At the same time, the consciousness of the transaction subject also realizes informatization in the crowd intelligence space by means of mapping. The consciousness is represented by the preference attributes, including quality, speed, price, friend evaluation and so on. The informatization of the physical and conscious characteristics of the transaction subject is integrated with its information characteristics to form an intelligent digital entity. As the intelligent digital entities carries out transaction activities in the crowd intelligence space, its intelligence realizes spiral promotion, which in turn reshapes and improves the physical entities and learns and corrects the consciousness preference. The physical entity of a transaction subject is interdependent with its consciousness preference.

The intellectualization of transaction object refers to the improvement of physical objects, services, virtual (or digital) products, which is embodied in the intellectualization of object generation, production and matching transaction subjects. Figure 2 illustrates the intellectualization of transaction object. The physical attributes of the transaction object form an intelligent digital entity in crowd intelligence space by means of mapping. Take physical products as an example, including location, materials, price, color, function and evaluation; take digital products as an example, including price, function, format and

Figure 2.
The
intellectualization of
transaction object



evaluation; take service products as an example, including location, price, function and evaluation. The feedback of intelligent digital entity modifies the transaction object, including the description of the modified attributes and modifying evaluation.

The intellectualization of transaction process refers to the intellectualization of transaction search, negotiation, implementation and supervision. Figure 3 illustrates the intellectualization of transaction process. The first step to realize intelligent transaction is the intelligent identification of the transaction subject by the intelligent digital entity, and the accurate identification of the fuzzy demand and supply of the transaction subject, which is embodied by clarifying the basic attributes, ability attributes and preference attributes of the transaction subject. Intelligent digital entity can play both the role of demand side and the role of supplier to achieve accurate intelligent matching of comprehensive information in crowd intelligence space. As a supplier, the intelligent digital entity collaborates to realize intelligent production and generate transaction object. Then, the intelligent logistics system forms an optimal path decision to implement intelligent delivery of the transaction object. Intelligent feedback and evolution, which automatically provides feedback to all transaction stakeholders based on transaction evaluation information and promotes the evolution of the entire crowd intelligence network.

5. Intelligent transaction mode

In the crowd intelligence networks, the interaction among various agents can be attributed to a certain transaction activity or behavior. Compared to the traditional transaction, intelligent transaction presents significant differences in the three aspects of transaction, including transaction subject, transaction object and transaction process. First, the intelligent transaction subject is more pluralistic. In the traditional transaction mode, the category of the transaction subject is limited to the individual and the enterprise. In the crowd intelligence networks, however, the individual, the enterprise, the organization and the goods are all transaction subjects with independent portals, which can play the role of both supply and demand side in the specific intelligent transaction.

Second, the intelligent transaction object is more abundant. The connotation of traditional transaction is narrow. It commonly refers in particular to economic transaction and appears as the buying and selling of goods and services. However, the transaction object in the crowd intelligence networks includes not only goods and services but also any

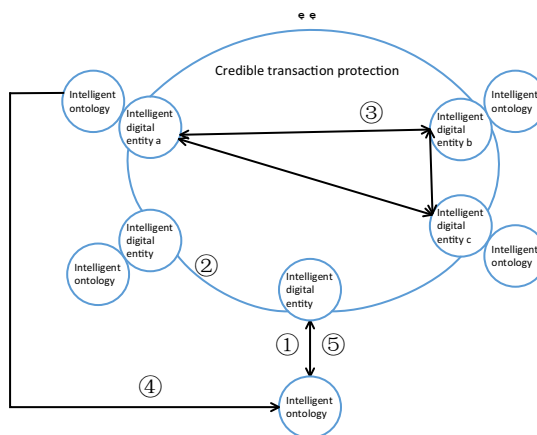


Figure 3.
The intellectualization of transaction process

other interactions among the intelligent agents, such as information exchange, emotion interaction, public affairs and political consultation. Some of the transaction object is indivisible and not accumulative, e.g. the quality of air. The production or delivery of the transaction object can be divided to certain extent into different modules, which is so called the modularization. Different transaction objects have different modularization level according to different indivisibility in the production or delivery of them.

Third, the intelligent transaction process is more intelligent. The intelligentization of transaction process in the crowd intelligence networks is embodied in two levels. One is the intelligentization of a single transaction, which mainly refers to the adoption of the new generation of information technology, such as the internet of things, cloud computing, big data, etc., to reduce transaction cost and improve transaction efficiency. The other is the intelligentization of multiple transactions, which mainly refers to the intelligent coordination when single agent processes multiple transactions concurrently. At this level, the optimal problem is raised from the local transaction to the overall transactions.

Existing literature has conducted a lot of discussion on the transaction mode and formed some common agreement on transaction modes. However, these transaction modes are based on the traditional transaction environment, and we encounter some challenges when extend the previous findings to the crowd intelligence networks. First, in the existing literature, the word “transaction” usually refers to economic activities. While in the crowd intelligence networks, transaction means all the interactions between intelligent agents (Chai *et al.*, 2017). Therefore, the division of transaction mode should include not only economic activities but also non-economic activities, such as corporations and public affairs. Second, the existing classification of transaction mode excessively depends on specific scenarios, and there is no general classification framework. While in the crowd intelligence networks, we will need a more universal framework to guide our analysis of transaction structure and efficiency.

5.1 Division framework of intelligent transaction modes

In the intelligent transaction, the essential relationship between various agents (individuals, enterprises, institutions and goods) in the crowd intelligence networks is still supply and demand, while the challenges lie in the distinguishing features of transaction subject, transaction object and transaction process. Because the transaction subject is more pluralistic, their organization forms are more complicated and the evolution from single intelligence to crowd intelligence needs to be considered. Because the transaction object is more abundant, which includes not only the economic area but also politics, social interactions, social management, etc., the non-accumulative and indivisible characteristics needs to be considered. Because the transaction process is more intelligent, the coordination and the dynamic switching between the transaction modes need to be considered.

This study analyzes the intelligent transaction mode from two aspects: the organization form of the buyer and the supplier and the modularization of the demand and supply. For the organization form, we mainly consider the quantity, and we divide the transaction subject into two categories, which are single-agent and multi-agent. Because of the indivisible characteristic, different transaction objects have different modularization levels. According to the high and low modularization level, we divide the demand and supply into two categories, which are single-supply and single-demand and multi-supply and multi-demand.

From the demand perspective, when the demand side is a single agent in the intelligent transaction, and the modularization level of the demand is high, this demand is classified as single-demand. When the demand side is a multi-agent in the intelligent transaction, and the

modularization level of the demand is low, this demand is classified as multi-demand. From the supply perspective, when the supply side is a single agent in the intelligent transaction, and the modularization level of the supply is high, this supply is classified as single-supply. When the supply side is a multi-agent in the intelligent transaction, and the modularization level of the supply is low, this supply is classified as multi-supply. The pair-wise combination of the demand and supply forms four types of intelligent transaction modes: single-demand-single-supply (S-S), single-demand-multi-supply (S-M), multi-demand-single-supply (M-S) and multi-demand-multi-supply (M-M). Figure 4 shows the classification framework of the intelligent transaction modes.

Same as the traditional transaction, the intelligent transaction also includes the parts of demand, supply, matching, pricing, fulfilling, evaluating and guarantee. Thus, the intelligent transaction modes share some general rules, which include description rules of supply and demand, search rules, matching rules, goods and service delivery rules, awards-and-penalties rules, etc. However, the transaction rules also vary with the intelligent transaction modes, which require special rules for different intelligent transaction modes. S-S intelligent transaction mode, taking the new generation of e-commerce as an example, may require some special rules on the management of market power polarization. S-M intelligent transaction mode, taking intelligent collaborative innovation as an example, may require some special rules on participation incentive rules and labor-division-and-cooperation rules. M-S intelligent transaction mode, taking the intelligent management of public affairs as an example, may require some special rules of procedure among the multi-demand side in the deeply integrated ternary space of physical, consciousness and information. M-M intelligent transaction mode, taking intelligent logistics information service as an example, may require some special rules on cost-sharing and responsibility-sharing among multi-demand and multi-supply as well as the regulation of market power polarization.

5.2 Representative examples and research directions

In this section, we take a representative example of each intelligent transaction mode to further illustrate features of these transaction modes and potential research directions.

5.2.1 S-S intelligent transaction mode: the new generation of e-commerce. The representative example of S-S intelligent transaction mode is the new generation of e-commerce, as the transaction objects are usually divisible and have high modularization level, and the

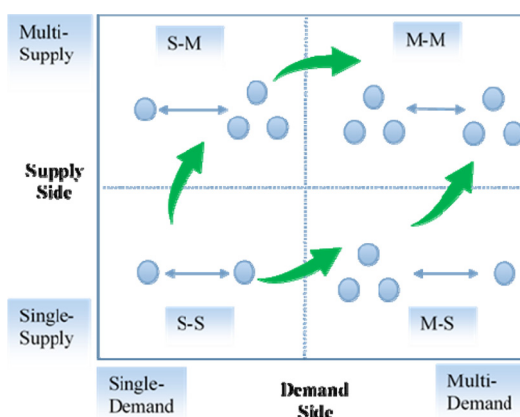


Figure 4. Division framework of intelligent transaction modes

transaction subjects involved are single-agent, either individual, enterprise or institution. The main difference of the new generation of e-commerce from the traditional e-commerce is disintermediation. It removes all the intermediaries and connects the consumers and producers directly. There are mainly two intelligent e-commerce transaction modes: demand-driven transaction mode and supplier driven transaction mode.

Traditional e-commerce treats consumers as passive product recipients. However, intelligent transactions recognize that consumers will play multiple roles in the transactions as consumers, investors and producers. Consumers have a wide range of choices and tend to put forward personalized needs and their demand might be fuzzy. Thus, on the intelligent e-commerce, we would:

- study the rules of the direct connection between consumers and goods or services;
- accurate identification methods of fuzzy demand;
- distinguish the supply driven transaction mode from multiple perspectives, e.g. distinguish the internet community-driven demand and the professional marketing patterns; and
- discuss the specific process and operating mechanism of the demand-driven transaction mode; etc.

5.2.2 S-M intelligent transaction mode: intelligent knowledge seeking. The representative example of S-M intelligent transaction mode is knowledge seeking, as the transaction objects are usually to certain degree indivisible and have medium level of modularization, and the demand side is usually single-agent, like individual, enterprise and institution, but the supply side is usually multi-agent. For example, the scientific research for knowledge creation. It usually needs existing knowledge from different knowledge suppliers and also requires research teams to collaborate closely to finally supply the new knowledge to the demand side.

Decisions in daily life and work need to be made based on specific accumulation of knowledge and information, such as whether a health check of new method is needed or whether a new project should be launched. Knowledge seeking includes knowledge transferring and knowledge production. Knowledge transferring requires high cost of search and transferring (including time and money), and knowledge production requires high investment costs and production costs, as well as the incentive and supervision costs of knowledge innovation with non-exclusiveness. The main goal of the knowledge seeking research in the intelligent network is to reduce the transaction cost through rules and techniques and to encourage the innovation of knowledge to improve the quality and efficiency of knowledge seeking. Thus, on the intelligent knowledge seeking, we would:

- study the rules, methods and techniques to reduce the cost of search and negotiation with the self-learning of the digital twin in the crowd intelligent networks, to quickly organize and integrate a lot of knowledge from the suppliers, and to quickly present the high-quality knowledge report to the demand side;
- build knowledge tank and study the knowledge transferring mechanism based on crowd intelligence network;
- develop intelligent collaborative innovation technologies in the knowledge production side, such as crowdsourcing technology; and
- develop the knowledge storage technology based on block chain technique to improve the existing priority system and intellectual property system in the field of knowledge production.

5.2.3 M-S intelligent transaction mode: intelligent management of public affairs. The representative example of M-S intelligent transaction mode is intelligent management of public affairs, as the transaction objects are usually to certain degree indivisible and have medium level of modularization, and the demand side is usually multi-agent, like the whole public including individuals, enterprises and institutions, but the supply side is usually single-agent. For example, the requirement of clean air. The demand side is the whole public, and the supply side is usually the government.

The greatest challenge for the management of public affairs is the free-riding problem of the demand side, forming the “Silent Majority” and eventually leading to the “Tragedy of the Commons.” The main goal of intelligent management of public affairs is to reduce transaction costs through rules and technologies to improve the efficiency of public regulation and decision-making. Thus, on the intelligent management of public affairs, we would:

- study the rules of procedure of the demand side in the crowd intelligent networks;
- from the supply side, develop the intelligent pollution detection technology for major air pollution sources, including vehicle exhaust, factory exhaust, private heating emission and establish a precise pollution warning system and intelligent remote-control technology, like remote locking technology; and
- research on the pricing of public goods considering the multi-agent demand and the single-agent supply.

Because the expenditure of public goods management is often covered by taxes or fees paid by the demand side, the intelligent ladder type pollution tax (pollution fee) pricing system might be developed by the government.

5.2.4 M-M intelligent transaction mode: intelligent logistics information service. The representative example of M-M intelligent transaction mode is intelligent logistics information service, as the transaction objects are usually indivisible and have low level of modularization, and the demand side is usually multi-agent, including individuals, enterprises and institutions that require the logistics information, and the supply side is also usually multi-agent.

Different from the existing logistics service for traditional commercial transactions, intelligent logistics information service provides the demand side with real-time and customized logistics information, including price, service, traffic, weather, transportation, etc., as well as the optimal logistics scheme. Government, logistics enterprises, users and goods work together to provide immediate or periodical logistics information. Lack of the demand information would affect the quality of the logistics information supplied to all the users, so intelligent logistics information is relatively integral and not in-completed. Thus, on the intelligent logistics information service, we would:

- study the consistency and difference of demand from different demand side and develop the measurement method of modularization degree to identify the demand of low modularization level; and
- study the coordination and cooperation mechanism between multiple suppliers and explore the interconnection and intercommunication mechanism between the online supply and the offline supply.

6. Conclusion

In this paper, we review the definition of transaction and transaction mode, analyze the driving forces of the evolution of them and develop and summarize the definition and

characteristics of intelligent transaction and intelligent transaction mode in the crowd intelligence network. In the crowd intelligent networks, all interactions among various agents can be attributed to a certain transaction activity or behavior. The concept of intelligent transaction is broader. The intelligent transaction subject is more pluralistic; the intelligent transaction object is more abundant; and the intelligent transaction process is more intelligent. We develop four modes for the intelligent transactions based on the modularization level of the transaction objects and the quantity of transaction subjects, including the demand side and the supply side. The four intelligent transaction modes are S-S, S-M, M-S and M-M. We also take a representative example of each intelligent transaction mode to further illustrate rules and features of these transaction modes and point out potential research directions.

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