

The Study of the Supply Chain Cooperation Mechanism Based on the “Information Economic Man Assumption”

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Received May 6th, 2013; revised June 6th, 2013; accepted July 6th, 2013

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ABSTRACT

Widely accepted social regulations are playing an important role in influencing human cooperation, which largely reduces the demand for information and helps in forming a stable cooperation partnership. Based on this, we put forward a rational and social consistent economic agent mode—The “Information Economic Man Assumption”. Taking Field Theory for reference, we established the organizational information mode and introduced the concept of capital vector. Also the capital vector of economic organization and value orientation are taken as core variables, thus we analyze the basic condition of cooperation maintenance from economic, cultural and moral factors at the same time.

Keywords: Information Economic Man Assumption; Capital Vector; Organizational Information Field Mode; Cooperation Mechanism; Dynamic Supply Chain; Stable Supply Chain

1. Introduction

Being a core problem in supply chain management, the collaborative relationship among relative enterprises of the supply chain, which is also called the supply chain collaboration mechanism, determines the collaboration efficiency of supply chain [1]. So far, this is a hotspot for research on supply chain management. Furthermore, the research results are mainly concentrated on the establishment and the evaluation and option of supply chain partnership [2-5].

The research on the nature of supply chain cooperation is mainly based on the Rational Economic Man Assumption of Western Economics, using Non-Cooperative Game Theory as its basic method of economic analysis. But this kind of analysis can't explain all the phenomena of supply chain cooperation, because it considers economic interest as the only one variable that has influence on the supply chain cooperation mechanism. The management type that follows this analysis is “Equity First” Management. However, this type of management has restrained the development of major multinational corporations in some way. For example, the “Equity First” Management of the Royal Dutch Shell Company encountered a terrible crisis in the 1990s. Its relationship with major stakeholders like environmental organizations,

consumers, the public and communities had been deteriorating, which therefore rapidly caused the austere reputation and business crisis [6]. It was the growing contradiction between the company and the different stakeholders that forced the company to rethink profoundly about its traditional management mode and approach and gradually carry out reforms of it. Finally in 1997, a management mode based on stakeholders was proposed by the company, bringing with it overall adjustments and modifications of its original commercial principles. The Shell General Business Principles (1997) consisted of ten parts. Of these, “Introductory Theory”, “Target”, “Responsibility”, “Health, Safety and Environment” and “Community” these five parts fully embody stakeholder management concepts [7], which broke through “Equity First” Management and provided the basic system for the development and improvement of the Stakeholder Management. Yet the corresponding innovative basic theory of Stakeholder Management didn't have a significant breakthrough, the theory still continued to use the classical economic analysis method based on the Rational Economic Man Assumption, transforming the demand of diversified interest from every stakeholder to simplex economic interest index and further more optimize it.

With the trend for economic globalization, the cultural background of the parties involved in the supply chain

differed, which might cause interest diversification; therefore it exerts an effect on the cooperation of supply chain. In this situation, if we still use the Rational Economic Man Assumption and try to convert all the influencing factors of supply chain cooperation mechanism into a single economic interest index, it will be difficult for the final analysis results to achieve a satisfactory, real explanation. Thus, it's necessary to study the supply chain cooperation mechanism beginning with the most fundamental way of analysis, seek to breakthrough on basic theories in order to achieve a satisfactory explanation.

2. The Predicament of Rational Economic Man Assumption in Supply Chain Cooperation Mechanism

2.1. The Modern Predicament of Rational Economic Man Assumption

The basic meaning of the Rational Economic Man Assumption assumes self-interest and the principle of maximizing it. However, this classical meaning has encountered an un-surmountable modern crisis [8]. The main problem is that Rational Economic Man has infinite capacities and ethical dilemmas [9]. The development of modern economic theories necessitates a new interpretation of this problem. For instance, Simon's Bounded Rationality [10] and Williamson's Contracting Man Assumption [11,12] have given a necessary correction of the capacities of the Rational Economic Man Assumption, which also have taken the influence of information limitation into account but without any correction of the basic principle self-interest assumption. Therefore the ethical dilemma problem of the Rational Economic Man Assumption has not been solved, and it is still limited, especially in the explanation of the human cooperation mechanism and cooperation decisions.

Modern economic society has the high degree of division and close coordination, and cooperation is one of the basic behavioral traits. According to the research results of other subjects apart from Economics, the main social norms for humans in social activities don't include the principle of utility maximization based on individual ration. Especially when the information is incomplete, people infer principles depending on limited intuition [13]. Keynes indicated that, most or all the events can be decided by a general principle of simple intuitive judgment [14]. Among these intuitive inferences, the moral factor plays an important role. As far as all the evidence available is concerned, virtue is at the core of human behavior [15]. This shows that there are human interactive models which are highly opposed to each other among different subjects. Economics traditionally considers individuals as rational and self-centred profit maximizing people. In contrast, Sociology thinks that

individuals are a highly socialized, self-less and virtuous force attempting to play a social role and having high regard for the recognition and self-esteem of others [16].

2.2. The Predicament of Rational Economic Man Assumption in Supply Chain Cooperation

In other words, self-regard is an instinct in human beings that live in groups. However, this is not the only instinct. As beings living in groups, cooperation is another human instinct. Whereas, the individualism of Rational Economic Man Assumption rooted in western culture is against collectivism and the idea of harmony of eastern Confucian culture. Thus, many scholars gave incisive criticism to the Rational Economic Man Assumption. Basically speaking, the Rational Economic Man Assumption with its excessive preference of human nature and its ignorance of the nature of society misinterprets humans and human society [17]. The domestic and foreign scholars have created many other kinds of economic man models [18], such as Mayo's Social Man Assumption, Maslow's Hierarchy of Need, Maigret's Hypothesis of Dual Human Nature, Peter's Duality of Human Assumption, Schein's Four Hypothesis of Human Nature, as well as Changhong Li's Hypothesis of the Real Man [19]. But these assumptions have a limitation, that is to say, that lacking strong logic and explanatory power, they haven't reached the general applicability of Rational Economic Man.

Meanwhile, empirical research results of the cooperation among enterprises can't always be consistent with the Rational Economic Man Assumption and the principle of utility maximization in Economics. This is because the stability of supply chain cooperation can't be realized only by the individual utility maximization of each enterprise. Also the equality of income distribution of each member of the supply chain should be guaranteed. Some scholars have studied supply chain cooperation focusing on non-profit factors such as enterprise cultures [20]; nonetheless they didn't ultimately put forward the Economic Man Assumption model as corresponding to the phenomenon of supply chain cooperation.

Although the present popular Rational Economic Man Assumption originated from the classical Economics of Adam Smith, there are essential differences between the two. The economics theory introduced by Adam Smith is originally a science that studies treasure and human. When modern economics developed into a science that purely studies the distribution of scarce resources, its essence is to separate human economic action which can provide a convenient analysis of economic function by using a simple mathematical mode, but it also radically left out the most basic moral restraint that economic man might have. It can be said that the development of mod-

ern economic analysis methods obviously deviate from Smith's original insights [8]. Therefore, it's necessary to look back on and analyze the methods of modern economics analysis, especially classical economic analysis methods, to explore the scientific and rational ones which provide a theoretical basis for the analysis of the supply chain cooperation phenomenon.

3. Analysis of Human Cooperation Mechanism Based on Classical Economics

According to Classical Economics initiated by Adam Smith, economic man has two instincts rationality and sociality at the same time. The former emphasizes on self-interest and utility maximization, yet the latter concentrates on other-interest and active operation awareness. Smith pointed out in *The Wealth of Nations* (1776) that, "It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest". This saying is always considered as the elemental description of rationality, however, just on the same page of this book, Smith added "Give me that which I want, and you shall have this which you want, is the meaning every such offer" [21]. Consequently, from Smith's point of view, the pursuit of self-interest is built on the foundation of fair trade which more accurately aims to balance self-interest and other-interest. In *The Theory of Moral Sentiments* (1759), Adam Smith further stated the sociality of man. "How selfish so ever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it expect the pleasure of seeing it" [22]. Moreover, Smith believed "Man, according to the Stoics, ought to regard himself, not as something separated and detached, but as a citizen of the world, a member of the vast commonwealth of nature. To the interest of this great community, he ought to at all times be willing that his own little interest should be sacrificed" [22]. There are still some scholars contending that "Smith's fundamental thesis is that human beings tend to build up a hierarchical model and an introverted social structure. Thus they are willing to obey the etiquette and pursuit higher social status because they are motivated by the desire of social recognition." This desire, which material self-interest subordinated to, is immaterial [23]. Above all, the utility maximization target that individual rationality pursues is social. Therefore, human rationality is closely associated with sociality. From another perspective, since rationality and sociality exist in the same individual, the two should be consistent. Further more, people adjust individual behavior patterns mainly focusing on society and then rationality because the basic means of development is cooperation.

Now we try to analyze the conditions under which so-

ciality and rationality can reach cooperative agreement and maintain a cooperative relationship, from different angles.

3.1. Analysis of the Cooperation Mechanism under Bounded Rationality

Based on Game Theory, self-interested individuals can reach Pareto cooperation equilibrium under complete information and infinitely repeated games. However, in the real world, there is some extent of incomplete information, which affects the personal, rational expectation of future income. Then it has an influence on the result of the game and causes difficulty in reaching Pareto cooperation equilibrium.

The higher the sharing degree of social information in time and spatial dimension, the more definite the future income will be. Rational pursuit results in concern about long term benefit, consequently stable cooperative relationships will be formed easily. Conversely, incomplete information sharing caused by the like of geographical and time limitations can result in uncertainty of future benefit. Thus rational pursuit can lead to the fact that individuals emphasize more their immediate interest rather than long-term interest, which makes stable cooperation difficult.

Therefore, in the view of rationality, information is the key variable for cooperation. In other words, the degree of information sharing directly determines the results of cooperation. Due to limited individual capacities, people can only live in society with mutual help. It is a simple view of rationality, that only with complete social information sharing can people realize a win-win situation and cooperation. In contrast, people tend to harm each other if social information sharing is incomplete, which thereby is a threat to the survival and development of human society.

Sound social system helps increase social information sharing, consequently making it possible for people to cooperate. If the present cooperation might not reach the expected goal, quitting it and looking for new cooperation opportunities will be another rational option. However, even a perfect system can not meet the all the needs of the complete information Game Theory because social information sharing is always limited never mind human analyzing and calculating ability. Basically, only when we are faced with an uncomplicated situation can we make decisions according to the derivations of rational analysis. Yet when facing a complicated situation, if we simply depend on rationality, no solutions will be offered. Thus, in view of the need for human survival and development, the problem of the lack of individual rationality and information sharing should be improved. What we can do is to construct reasonable social norms, cultivate citizens' moral consciousness and strengthen individuals'

awareness of society, which further contribute to the efficiency of human cooperation, and social development.

3.2. Analysis of Effect Mechanism of Sociality on Cooperative Behavior

As recent research studies show, most human co-operations are not due to the Reciprocal Behaviors of Repetitive Game Theory but sociality, which means individual behavior not only works under the principle of self-interest but also the premise that humans usually care about others' benefits and feelings [24]. A study of neuron Economic experiment indicates, men's instinctive than rational behavior can form an intuitive and emotional mechanism for making decisions [25]. In society, intuition depending on individual decision-making has its regularity to conform to and the former is originated from an individual's code of conduct. As a result, as long as we make a comparison between present information and its related code of conduct then we can determine what action to take. An individual's code of conduct is the result of education during their formative years, and is closely related to the social environment where individuals grow up. Society consists of moral values passing from generation to generation. These values are realized through the internalization [26].

Therefore, sociality means that an individual's code of conduct is consistent with the social norm, making each game party reduce the need for information in decision making within the common social norm, then it rapidly develops into relative game balance and forms a stable cooperation. Obviously, the stability of cooperation is directly determined by how relative social norms are recognized by individuals. Only social norms widely accepted by members of society can become coordinators among members. That is to say, an individual's cooperative information threshold based on social norm is an important factor to cooperation.

3.3. Analysis of Interaction between Rationality and Sociality

In the cooperative behaviors of human beings, rationality and sociality play important roles and they become complementary to each other. In the ideal condition, the exploration of rationality by individuals leads to the result of social behavior. In other words, the emergence of cooperative behavior is caused by the pursuit of self-interest. The shortage of information and the defect of individual rational ability are improved and made up by the social norm, so that it can guarantee the possibility of cooperation with rational individuals in reality. In this situation, individual utility maximization is ensured by common social norms. In addition, social norms are to keep social utility maximization in the long term by co-

ordinating individual behaviors, and indirectly maintaining individual utility maximization.

Meanwhile, rationality and sociality are relatively separated. Especially, the formation and perfection of social norms, which are widely agreed by the social members, can not be deduced by the interaction of the rational agent model. Society being an organic system, its characteristics can not be explained by the individual characteristics which are at the lower level. Obviously, the Rational Economic Man Assumption in modern economics is a one-sided analysis of human economic behavior under ideal conditions. Accordingly, it can only infer a mechanical and low-level social norm, which is different from realistic social structure.

The formation and improvement of social norms can be explained by genes—a Socio-biological mode of culture common evolution [27]. Or it can be explained by the emergent properties of Complexity Theory. In terms of the development and history of human society, the advanced social norm is usually designed. The designers are supposed to see thing beyond limits and to be more concerned with a long-term vision in both space and time dimensions. Only in this way, can they design a perfect social norm like the founder of Eastern Confucian culture Confucius and the founder of Western Christianity Jesus.

What we need to point out is that the basic premise for individuals to survive in a complicated environment is a concern for the self-interest of individual rationality. Thus sociality can help improve the shortage of individual rationality but not replace totally. Otherwise, the survival of individuals would remain a problem. Like sociality, individual rationality has its own independent evolution and development. Certainly, the evolution and development of rationality and individual rationality act and react upon each other, which is also an interrelated interaction. However, we still lack incomplete theory analysis, especially brief mathematical mode analysis. Therefore, it is necessary to seek theoretical innovation that is based on coordination between individual rationality and sociality. In order to achieve the real explanation and compatibility with Confucian culture, it starts with individual sociality and brings ethical and cultural factors into the theoretical analysis of economic activity.

4. Organization Information Field Mode Based on Information Economic Man Assumption

As mentioned before, individuals try to seek cooperation opportunities in social interaction by constantly searching for and comparing various kinds of massive and incomplete information. Meanwhile, the target individuals seek is not always a single one economic one. That is why we cannot realize an optimized decision of individual rational target while only relying on personal ability

to analyze and calculate. The existence of social norms has largely simplified the improvement of individual decision-making and lowered the cost of the realization of individual cooperation, which leads to a win-win situation for both sides. Thus, to highlight the function of social norms in Economic Man Assumption Mode is necessary because it makes the explanation of economic man's decision-making in reality more accurate. Nonetheless, individual social norms vary and individual abilities differ a great deal. To give a more clear explanation of these problems, an economic man action mode is required to be set up from the view of information, taking capital factors and value orientation factors as core variables. Under this premise, we analyze the individual cooperation mechanism then the cooperation mechanism of enterprises within the supply chain.

In consideration of the Space Effect of information spreading, the concept of field in Physics is taken to build up the Cooperation Information Field. The word field is a Physics concept abstracted from a great deal of physical phenomena, which are closely related to a certain Physics variables. The word field refers the distribution of physical quantity in space area. If every point of the whole space or part of the space has a certain corresponding value, then the field of this kind of physical quantity is confirmed in this space. If this kind of physical quantity is a mathematical quantity, we call this field a scalar field. If this kind of physical quantity is a vector, we call this field a vector field [28]. Because capital and value orientation factors must be taken into account, the Cooperation Information Field should be described as a vector field.

4.1. Information Economic Man Assumption

In order to simplify the analysis, we assume that society consists of different organizations which consist of individuals. Organization here means the general economic organization whose major function is to coordinate collaborative relationships among individuals including market, enterprises and the osculant organizations between market and enterprises. Individuals can only play a role in organizations and participate in activities but not independently work in economic activities without organizations. But individuals can participate in more than one economic activity of organizations. Supposing the individuals have the basically coherent code of conduct and also some differences, then we call the common part of individual behavior, the organization standard. Likewise, there are differences in the code of conduct of every organization which forms society and similarities that are called the social norm.

In social interaction, Information Economic Man follows the five basic rules below.

1) Active Cooperative Principle

Information Economic Man has obvious pro-social characteristics and obeys the organizational rules and regulations naturally showing active cooperative awareness in economic activities.

2) Rational and Social Principle

Economic agents and economic organizations are free to choose each other. They can decide to cooperate or not. Choosing not to cooperate means to withdraw the organization. Once an economic agent decides to join a certain organization, he will cooperate positively in that organization.

3) Information Field Principle

Information Economic Man keeps sending cooperation messages to the environment around, this is vector information whose size is capital amount information, reflecting the cooperative ability of individuals. Its direction is value orientation information, reflecting the degree of differences and similarities of individual behavior standards and organizational and social rules and regulations, and then self-centered information files are built up. Information Economic Man in the meanwhile is in the information field formed by other economic men and organizations.

4) Information Comparison Decision Principle

Information Economic Man selects action strategies by collecting environmental information and his code of conduct information (threshold information). Action Strategies include cooperation and quitting.

5) Dynamic Adjustment and Stability Principle

During the process of information dynamic searching, Information Economic Man will adjust his cooperative threshold and search the area in order to guarantee the uniqueness and existence of the solution. Meanwhile, there is relay characteristic in information economic man's cooperative information threshold judgment and a corresponding returning threshold to every action threshold to ensure the stability of the system.

In terms of the basic principles above, we can build up a mathematical model of economic organization based on Information Economic Man Assumption.

4.2. The Mathematical Mode of Organizational Information Field

In the space, between two economic organizations (or economic men), there is an interactional information field force, which is in direct proportion to the product of their capital amount, in inverse proportion to the square of their information distance, and is related to the difference of their value orientation. The nature of the force also depends on the consistency of their value orientation. If their value orientations are basically the same, they are mutually attracted; if their value orientations are basically opposite, they are mutually exclusive. The mathematical model is shown as below [29]:

Let us define the following notation: Q : capital of organization, q : capital of individual. Q and q relatively stand for the capital amount of the organization and of the individual. Their directions represent their value orientation. The force of organization information field is shown as below:

$$F = k \frac{Q \cdot q}{r^2} \cdot \cos \alpha \cdot r \tag{1}$$

In this equation, k is the information field constant and depends on environment conditions, such as information publishing and dissemination as well as environmental interference with information. r is the information distance between the organization and economic man (r reflects the variation of information transmission resulting from the change of location between organization and individual), α is space angle between the organization capital vector Q and the individual capital vector q , $0^\circ \leq \alpha \leq 180^\circ$, r , a unit vector, is the direction of the field force, which lay their force on the ligature between them. The nature of r is determined by the relationship of the space angle between Q and q . It means the sign bit of $\cos \alpha$ determines the direction of r . When $\cos \alpha$ is positive, r points toward the opposite side, the field force becomes attraction. When $\cos \alpha$ is negative, r turns backward the opposite side, the field force becomes repulsive force. **Figure 1** portrays several typical situations of the space angle.

According to Equation (1) and **Figure 1**, when $0^\circ \leq \alpha < 90^\circ$, F is positive (see **Figures 1(a)** and **(b)**), economic organization and man attract each other, their direction acts on the connection of the two vectors; when $\alpha = 90^\circ$ (see **Figure 1(c)**), $F = 0$; when $90^\circ < \alpha \leq 180^\circ$ (see **Figures 1(d)** and **(e)**), F is negative, they face away from each other, their direction also acts on the connection of the two vectors.

This mode uses the Electrostatic Field Theory of Coulomb for reference, but the biggest difference is the multi-dimensional aspects of the individual and organization. The value orientation of different dimensions is not only a favorable but also an unfavorable factor for cooperation, and some value orientation is irrelevant to the economic cooperation. For the convenience of the analysis, this mode simplifies the value orientation of

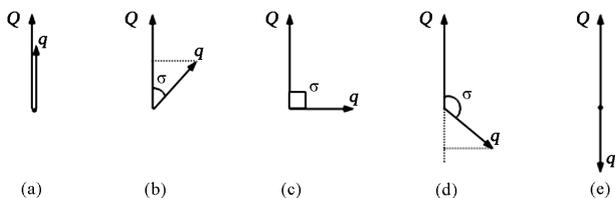


Figure 1. Unit vector relation of value orientation between economic organization and economic man.

every economic man and economic organization as a unit vector, but the relationship between different economic men and economic organizations can differ as to arbitrary space angle. $\cos \alpha$ is a projection of the vector q onto the vector Q , which describes similarities and differences of value orientation between economic man and the organization. Obviously, only when $0^\circ \leq \alpha < 90^\circ$ can cooperation be accomplished.

It can be seen that there is not only mutual attraction but also mutual exclusion between the organization and individual. The actual result is that under other unchangeable conditions, higher levels of convergence of value orientation between parties will lead to more teamwork while lower levels of convergence of value orientation between parties will lead to less teamwork. As the difference of value orientation reaches a certain level, it will be difficult to achieve cooperation. Thus it can be seen that organic coordination of capital factor, its basic power of organization cooperation and the value orientation difference of factor owners are a balancing force in organization cooperation, which make the organization maintain a dynamic steady state, so that every organization should have a suitable size.

Because of this balancing power, sufficient cohesive force is needed to assure that an organization works properly. In order to analyze this capability, we introduce organization information field intensity E , which only relates to capital Q and its location. Its direction is the value orientation of the organization, capital vector Q , which is expressed by unit vector r_Q . E can then be written as follows:

$$E = k \frac{Q}{r^2} \cdot r_Q \tag{2}$$

Organization information field intensity represents a measure of cooperation information capability sent to all nodes around the organization. Equation (2) indicates that only if the organization has enough capital can it construct cooperation information field and attract more partners to join in. When economic man enters the scope of organization information field, he will be affected by cooperation information field E and get cooperation information about the capital and value orientation. If the level of information exceeds the defined threshold, economic man will try more to communicate, *i.e.* information distance r in Equations (1) and (2) is reduced to increase the field power and field intensity. If field power exceeds cooperation threshold, substantial cooperation will happen.

5. Analysis of Organizational Information Field Mode of Supply Chain Cooperation

The fundamental assumption of the Information Economic Man is that an individual actively seeks coopera-

tion with other individuals and organizations, and selectively cooperates in terms of their capital amount and value orientation information. Cooperative individuals make up an organization, the capital amount and value orientation information comprehensively reflects the related information of all the cooperators. In an organization, it's impossible for individuals' capital amount and value orientation to be exactly homogenous, so the effect of every individual on the organization is different, and there is also a great difference between individuals in cooperation. Therefore, it's necessary to firstly build up the enterprise internal organizational information field mode, then confirm the capital vectors of business organizations according to their different features, which can establish the foundation for the research of supply chain cooperation.

5.1. The Information Field Structural Mode of General Economic Organizations

According to the degree of cooperation between individuals in the organization, it is considered that economic organization is layered consisting of the core layer, middle layer and peripheral layer using the Organizational Information Field Mode. **Figure 2** is Organization Structure and its Information Field [29].

1) The Core Layer of the Organization

The core layer of the organization consists of closely cooperative individuals who have exactly the same value orientation and enough capital amounts. Alternatively, we may say, the core layer consists of the individuals who totally agree with the organization's values. For instance, the initiator of an organization is often the elementary member of the core layer. The core layer sets the task, goal and confirms the value orientation. Meanwhile, its capital amount basically determines the range of action of the Information Field.

It's certain that there may be tiny differences in value orientation among actual members of the core layer. The information distance r between members is negligible for

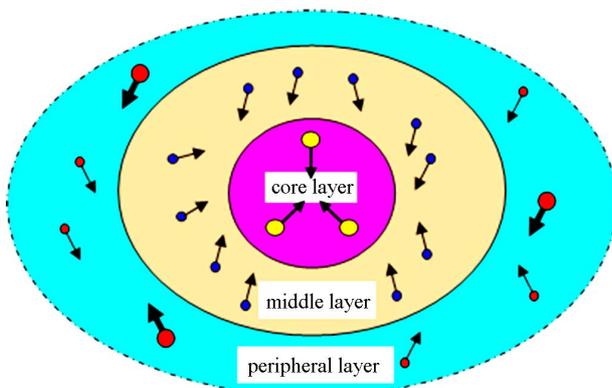


Figure 2. Organization structure and its information field.

the closeness of the structure because they are closely related. According to the definition of the Organizational Information Field as well as the Analytic Geometry Vector Projection Theorem, the conclusion can be deduced by Equation (1) (the deduction is shown as Appendix A). The capital vector of the core layer Q_c can be arrived at by adding together all the members' capital vectors q_{ci} . That is:

$$Q_c = \sum_{i=1}^n q_{ci} \quad (3)$$

As Equation (3) shows, the closer the value orientations of core layer members are, the more efficient the collection of the capital will be. Otherwise, it will result in the reduction of the actual capital amount and the difficulties in forming the close core layer. It will even influence the stability of the organizational operation. In spite of the effect exerted by the middle layer and peripheral layer, it's difficult to accurately calculate the limiting influence of this effect. Thus, the capital vector Q_c of the organizational core layer approximately represents the enterprise capital vector which can be calculated using Equation (3).

2) The Middle Layer of the Organization

The middle layer is made up of lots of individuals whose value orientation is close to that of the organization. These individuals have a certain amount of capital that is needed to implement the organizational function. For instance, the individuals who join in the economic organization by employment contract are often the main members of the middle layer. They are the backbone of the organization and the main function is implemented in this layer.

Under many circumstances, it's not enough to achieve organizational goal only depending on the core layer. It needs the joint effort of lots of cooperators. With many participants in an organization, it's impractical to require the value orientation of all the participants to be the same as the organization's value orientation. Therefore, the individuals who have a similar value orientation to the organization are attracted by the core layer to form the middle layer. Obviously, the individual capital amount and the conformance of their value orientation to that of the organization determine how individuals and organizations cooperate. The larger the individual capital amount is, the closer its value orientation is to that of the organization and the cooperation force is also stronger. The closer their cooperation is, the closer the individuals' location to the core layer will be. Then the smaller the numerical value of r in Equation (1) will be. Otherwise, the individual will be further away from the core layer.

In the middle layer, a reasonable management mechanism can provide convenient communication of information between neighboring individuals. Meaning, the

shorter the information distance r is, the stronger the cooperation of the inner organization will be. The strengthening of information communication makes the organization more flexible in adjusting assignments and adapting to changes in the external environment. The middle layer will reinforce the information field force and enlarge the influence of the organization. However, the influence that can not be increased is limited for the difference between the value orientation of the middle layer and that of the organization. However, there are value orientation differences between the middle layer and the organization, the influence of the latter on the former is limited. A stable middle layer is the basic guarantee of the organizational function. Thus, the formation of a stable middle layer is the basic requirement for the information field force intensity. That is, in the Equation (2), when r reaches the periphery of the middle layer, the field intensity E still has enough strength and clear direction.

3) The Peripheral Layer of the Organization

The peripheral layer consists of individuals and other economic organizations whose value orientations are different from that of the organization and which have certain complementary interest. Between individuals and organization, there is a loose and uncertain cooperation relationship. For instance, economic organizations have long-term, short-term, or even one-off cooperation with other individuals and organizations by various contracts.

The cause for the generation of the peripheral layer is that with the expansion of the organization, the major middle layer will create more administrative levels, which lengthen the overall path of information transmission. So the increase of r will definitely decrease the intensity and strength of the information field. Therefore, due to the different managements of middle layers and the unequal capital of various core layers, the organization has a reasonable boundary. But besides the middle layer, the organization still has the need to cooperate and communicate with other individuals and organizations. That is the way to form the peripheral layer where with the increase of the information distance r , the intensity of the organization E will be weakened and its direction will be blurred too. As a result, there will be more difficulties for the cooperation. However, the existence of the peripheral layer, where the cooperation is started, definitely expresses the openness and cooperation of the economic organizations. Therefore, a successful economic organization must try to keep enough intensity of the cooperation information field in the peripheral layer.

Apparently, this is just a generalized structure mode. The practical structure mode of the economic organization has different kinds of variants. For example, there are great differences in the structural proportions of the core layers, middle layers and the peripheral layers of

different enterprises. The market, as a loose economic cooperation organization, can be considered as an organizational form only with the peripheral layer.

5.2. Analysis of Organization Information Field Structure Mode in Supply Chain Cooperation

The supply chain cooperation mechanism focuses on the cooperation relationship among enterprises. Thus, the basic unit individual in the analysis can be turned into enterprise. To simplify the problem, we can assume an enterprise is an inseparable basic unit that has a certain amount of capital and clear value orientation. Under these similar circumstances, the capital vector Q_c in Equation (3) can be used to describe the basic features of an enterprise.

With the development of enterprises, supply chain cooperation mode is gradually improved. In the early development of modern enterprise, the rapid rise of many enterprises was accomplished by the cooperation between commercial capital and handwork workshop. That was the first outsourcing business. Essentially, this was the rudiment of supply chain cooperation. The cooperation scale was small in this period and there were only core layer and peripheral layer in this early supply chain organizational structure. That is, commercial capital is in the core layer and the handwork workshop is in the peripheral layer. Though the organizational function is focused on the peripheral layer, the scale of the organization is not large. In this case, the core layer can still coordinate effectively to ensure the organizational function. However, after the expansion of the organization, the information that needs the coordination of both the core layer and peripheral layer is rapidly increased, which results in the efficiency lowering. Therefore, after having sufficient capital, the core layer will establish a strong and tight-knit middle layer to replace the original peripheral layer's function, which forms vertical integration of the enterprise development. In the middle layer, the strengthening of the layer's coordination capability and the obvious convergence of the value orientation make information transmission more efficient. When the organization goes through a second expansion, some problems of information coordination will arise, and as a result, the second outsourcing phenomenon comes into being. Under this circumstance, some of the functions previously implemented in the middle layer are shifted to the peripheral layer. Accordingly, enterprises improve their own market competitiveness and organization operational efficiency by stripping-out non-core business. It is along with the popularization of the second outsourcing that the modern supply chain cooperation mode becomes the dominant mode of economic cooperation. At

present, the enterprise organizational mode is going through a climate where integration is transforming to strategic alliance.

Outsourcing can be categorized as standardized homogeneous product or service provided by market trade, and professional product or service supplied by sub-contractors. The supply chain structure corresponding to these two outsourcing is mainly divided into stable supply chain and dynamic supply chain. A stable supply chain with strong stability is based on a stable and unitary market demand while a dynamic supply chain is based on relatively frequent changes and complicated market demands [30].

The cooperative relationship of a dynamic supply chain is relatively loose and not that stable. Its cooperative relationship is more like a market trade relationship, whose content is parallel to that of standardized, homogeneous products and services. The organization structure of the dynamic supply chain is a loose structure pattern which only has a core layer and a peripheral layer. The core enterprises of the dynamic supply chain are surely in the core layer of the supply chain while other, related cooperative enterprises are in the peripheral layer. In this kind of cooperative relationship, the information distance between those enterprises is relatively longer and it's not easy to cooperate. Furthermore, because the contact among the enterprises is not close enough, the main factor which influences the cooperation between enterprises is the coordinate situation of the capital and ability between them. But if there isn't any stringent requirement of a similar corporation value and as long as both parties can comply with the basic regulations of fair trade, they can attain a dynamic cooperation relationship. The dynamic supply chain is able to react to market demand in a timely manner. Its cooperative relationship is relatively simple and the construction of the supply chain is comparatively easy. However, the dynamic supply chain can not guarantee the effectiveness of the supply chain. When the quality and cost-control requirement of the product is high, a stable supply chain tends to be adopted.

Stable supply chain cooperation is relatively close and the cooperation relationship is closer to a vertically integrated relationship. The cooperation is about professional products and service. The organizational structure of a stable supply chain which lies in the middle layer of supply chain organization with downstream cooperative enterprises which cooperate with core enterprises, is a close cooperation mode that consists of the core layer and the middle layer. Because of the short information distance and the close association between core enterprises and cooperative enterprises, the matching degree of capital endowment is not the only factor that influences the cooperation. There is a high standard for the similarities

and differences in value orientation between enterprises. In long-term cooperation, instead of only following the simple principle of fair trade, it's essential to set up the development blueprint and cultivate supply chain culture shared by the partners. Only in this way can we structure a stable supply chain and ensure its validity. Thus, in order to stabilize the supply chain, there is a high standard for the cooperation relationship. In the supply chain of a basic industry such as the petrochemical industry or the agricultural industry, to ensure the quality of the product and control the cost of production, it's necessary to establish a stable supply chain and ensure a stable cooperation relationship.

6. Conclusions

Supply chain cooperation, one of the categories of the economic organization cooperation relationship, is an extensive cooperation interval between market cooperation and enterprise vertical integration cooperation. The dynamic supply chain and the stable supply chain analyzed in this thesis are just two typical representatives of the extensive cooperation interval.

As we can see in organizational information field mode, one of the restraining factors in the development of economic cooperation is the existence of information distance. For greater cooperation benefit, it's necessary to constantly improve the key factors that influence the economic cooperation. There are three main aspects:

1) Social Information Transmission Condition

The social information transmission condition reflects the influence of the social information sharing mechanism and technological means on cooperation efficiency. If the social information sharing mechanism is improved, the technology will be more advanced and the cost will be lower. That means the information filed constant K is bigger so the cooperation efficiency is higher too. Furthermore, when the information field constant K is bigger, it can offset the effect of the information distance r , so that the economic cooperation can be achieved in a wider space. There is often a good information sharing mechanism in the stable supply chain, which also proves the significance in this condition.

2) The Capital Amount of the Cooperation Participants

The capital amount of each cooperation participant reflects the competence of the individual. Obviously, higher competence can make it easier to achieve cooperation. However, instead of equivalent competence, the organic coordination of every participant's cooperation ability is required. It should be pointed out that if we analyze the cooperation relationship in terms of the capital amount, only those enterprises with equivalent or approximately equivalent capital amount can have a relatively fair cooperation relationship. If one's capital amount is much stronger than the other enterprise's, it's

also difficult to guarantee the fairness of the cooperation. Without fairness, it's very difficult to maintain the long-term stability of the cooperation relationship. However, in reality, this kind of supply chain cooperation relationship has both successful and unsuccessful cases, which shows that it's not comprehensive enough to analyze the supply chain cooperation mechanism only in terms of the capital amount.

3) The Consistency of the Cooperation Participants' Value Orientations

This consistency reflects the participants' attitude towards the social norm. If the participants have exactly the same value orientation, they will achieve the highest cooperation efficiency. But in practice, it's hard for the individuals to have the same code of conduct even though they are from the same social environment. There must be some differences in their value orientations. Thus, there will be a greater difference in value orientation among individuals from different social environments, which will definitely have an effect on the cooperation efficiency. Therefore, internally, every organization will form the uniform code of conduct and coordinate the cooperation efficiency of the members by establishing its organizational and enterprise culture. Externally, they will have cooperation needs and the widely-acknowledged social norm will become the guarantee for the increase in cooperation efficiency. In the stable supply chain, the construction of culture has become an important means of maintaining the stable cooperation of this chain, which has become more and more obvious, especially in such times of diversified supply chain capital structure.

The Information Field Force F is the comprehensive manifestation of all factors related to cooperation. As long as the numerical value of F exceeds the cooperative threshold of the specific items, the cooperation can be achieved, and a greater F implies a more steady cooperation.

It should be noticed that in terms of current technology, only some proper improvement rather than radical solutions can be achieved. For example, we can only offer necessary information at a reasonable cost. Therefore, we need to promote the construction of social culture and ethics, not only the construction of the enterprise and organizational culture, but also of the social core value system, then a sense of identity can be increased among the members of the organization or even the members among the whole society, which can help establish the high efficiency of the cooperation mechanism and improve the sound development of the economy. Meantime, only after an advanced social regulation is widely accepted by the society can it play its due role. Thus, a good social regulation and civil social regulations need careful maintenance.

7. Acknowledgements

The authors gratefully acknowledge the following individuals for their assistance with translation and proof-reading: (UK) David Jackson (Department of Economic and Management, Huizhou University), Ling Zhang, (Department of Economic and Management, Huizhou University), Bei Chen (Department of Economic and Management, Huizhou University), Xiling Cai (Department of Foreign Language, Huizhou University), Jiana Weng (Department of Foreign Language, Huizhou University).

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Appendix A. Calculate Capital Vector of Economic Organization Core Layer

Suppose that there are n economic men in economic organization core layer and the capital vectors are $q_{c1}, q_{c2}, \dots, q_{cn}$. And there is an economic man whose capital vector is q_0 , and its angles with $q_{c1}, q_{c2}, \dots, q_{cn}$ is $\alpha_{10}, \alpha_{20}, \dots, \alpha_{n0}$. The distance between q_0 and numbers of economic organization core layer are $r_{10}, r_{20}, \dots, r_{n0}$. The information field power which can be perceived by economic man q_0 is

$$\begin{aligned}
 F_{c0} &= k \frac{q_{c1} \cdot q_0}{r_{10}^2} \cdot \cos \alpha_{10} \cdot r_{10} + k \frac{q_{c2} \cdot q_0}{r_{20}^2} \cdot \cos \alpha_{20} \cdot r_{20} \\
 &+ \dots + k \frac{q_{cn} \cdot q_0}{r_{n0}^2} \cdot \cos \alpha_{n0} \cdot r_{n0} \\
 &= k q_0 \left[\frac{q_{c1}}{r_{10}^2} \cdot \cos \alpha_{10} \cdot r_{10} + \frac{q_{c2}}{r_{20}^2} \cdot \cos \alpha_{20} \cdot r_{20} \right. \\
 &\quad \left. + \dots + \frac{q_{cn}}{r_{n0}^2} \cdot \cos \alpha_{n0} \cdot r_{n0} \right] \tag{A1}
 \end{aligned}$$

Ignoring information distance of numbers of economic organization core layer, we can get that $r_{10} = r_{20} = \dots$

$= r_{n0} = r_{c0}$, and their direction, which can be presented by r_{c0} , are in the same line. Equation (A1) can be written by

$$F = k \frac{q_0}{r_{c0}^2} r_{c0} [q_{c1} \cdot \cos \alpha_{10} + q_{c2} \cdot \cos \alpha_{20} + \dots + q_{cn} \cdot \cos \alpha_{n0}] \tag{A2}$$

Argument of Equation (A2) is summation of projection of $q_{c1}, q_{c2}, \dots, q_{cn}$ in r_{c0} . According projection theorem, the projection of finite number of sum of vectors equals the sum of the projection of every vector [31], so that the argument of Equation (A2) can be replaced by the projection of Q_c in r_{c0} . The Equation (A2) is written by

$$F = k \frac{q_0}{r_{c0}^2} r_{c0} [Q_c \cdot \cos \alpha_{c0}] = k \frac{Q_c \cdot q_0}{r_{c0}^2} \cdot \cos \alpha_{c0} \cdot r_{c0} \tag{A3}$$

where $\cos \alpha_{c0}$ is the angle between Q_c and q_0 , Q_c is capital vector sum of numbers in economic organization core layer. That is

$$Q_c = \sum_{i=1}^n q_i \tag{A4}$$