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Research on the Dynamic Mechanism of Characteristics of Upper Echelons

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ABSTRACT

The dynamic mechanism of characteristics of upper echelons has not been discussed in depth. This article analyzes the dynamic mechanism of cognitive and emotional characteristics deeply based on the connotation and dynamic properties of them. Through analysis by introducing the relevant theory of topology, the existence of partial equilibrium and general equilibrium in the dynamic interaction between top echelons' characteristics has been found. The paper reveals the dynamic mechanism of characteristics of upper echelons.

1. Introduction

Research in the area of characteristics of upper echelons has got a lot of attention in the past. However, the connotation and dynamic mechanism of them have not been discussed in depth. At the beginning of upper echelons theory's creation, the founders, Hambrick and Mason [1] have pointed out that characteristics of upper echelons is the concentrated reflection of their complicated interaction process ,and through the study of the characteristics, people can "catch a glimpse of" executives' interactive decision-making situation so as to predict the decision or the corporation performance. But with the development of research, the voice of discussing the interaction process has grown stronger and stronger. A majority of these studies, however, have just explored the interactive decision-making itself. For example, in the study of conflict mechanism, the characteristics research and the interaction process are out of line while the characteristics' dynamic properties with themselves are ignored. Therefore, from the perspective of characteristics' dynamic properties of upper echelons, we discuss the interaction process further and analyze the achievement of equilibrium.

2. The Definition and Roles of Characteristics

Characteristics, which are the main important part of multi-polar subjects' communication structure, are not only the medium of human communication, but also the characterization of information content. On one hand,

people shape their own structure of communicative action by means of characteristics; on the other hand, they form a unique system about characteristics in the communication. It has both vector-properties and culture-properties. As a carrier, it is materialization and facilitation of knowledge and information; while as a culture, inherent meanings of characteristics restore what they are in the process of cognition and communication, reflecting the quality of their interaction the quality of their interaction. Characteristic interaction represents human bounded rationality or rational limitation. In front of complicated information, especially when faced the individual who is "unpredictable person", one cannot fully understand this complex individual, only using the "leopard in a hole" way to relieve the anxiety and tension under the intricate condition.

"What is characteristic?" People's answer to this question tends to fall into a rigid frame of definition easily, regardless of thinking about a higher viewshed. Characteristics are not only some fixed lexical fields, such as age or gender, but also a kind of observation chunk. That is to say, every fragment observed by each individual is possible to become a characteristic which belongs to him and contains his own unique interpretation. It has a strong subjective projectiveness, which is defined as the subject's attention projection to the external object, and it is known as "intention" in English. Our understanding of human bounded rationality is derived from this; that is, at a given time interval, the attention people can give to-

wards outside signals is limitary [2]. These interval "chunks" of different lengths are just individual's observed characteristic and behavior symbols. To put this all in a nutshell, upper echelons characteristic are playing the role of symbol for every engager to peer at the inside interaction of top group.

Symbolic interaction theory, first created by Mead (Goerge Mead) and developed by Bloomer (Herbert Blumer), has offered a statement of symbols' core position in interpersonal communication. Wang Dingding, a scholar in China, who applying economics in this indepth analysis of Sociological Theory, has promoted it, which has attracted much attention. Symbolic interaction theory suggests that symbols have profound meanings behind the specified things, not just referring to the superficial of them. Mead, a behavior psychologist widely praised by western academe and founder of symbolic interaction theory, reporting as early as 1934, that the individual consciousness came into being by internalizing Interpersonal dialogues into internal dialogue [1]. Mead's thinking, which has greatly broadened the horizons of social scientists, points out the relationship between individual consciousness and interpersonal communication and the subjective manifestation of interpersonal interaction on individuals, and then leads to the symbols' bridging character in the process of their subjective transformation. Mead, in his theory, strongly highlights the symbolic role of language. He thinks that: 1) Individuals associate with each other by means of symbols; 2) The individual's interpretation of the symbol is a "free choice" and not subject to social norms. Bloomer, developing the theory further, suggests that: 1) The individual's ego and alter ego attempt to find the significance of behavior before his response to the outside world. However, the significance comes from symbolic interaction, so the symbolic interaction is the premise of human interaction. Symbols provide symbolic "meaning" for social behavior game, and if there is no symbolic interaction there will be no social game [2,3]; 2) The individual initiatively offers personalized interpretation of the traditional symbols in order to conform to social communication norms and to achieve the balance of individual and social groups. However, their studies only focus on the discussion of abstract symbols. Characteristics, this "observation chunk" type of symbols, have received relatively scant attention in the past. Characteristics are special and different from symbols on a abstract level. They tend to have relatively objective and perceived body, such as education, work experience and differences of characteristics. In human communication, the individual will actively look for a variety of characteristics information of whom he is communicating with so as to reduce the anxiety stemming from lack of infor-

mation. At this time, the characteristics of various appreciable characteristics become the most important dependent objects.

Not a simply entity concept, characteristics belongs to a category of relations, and reflects the unity relations between "A can refer to B" and "A refers to B". It might not be regarded only as a formalized mark or sign, regardless of its meaning. Thus, upper echelons' various features will permeate through each cell of their interaction process in the form of signal which delivers information that has been processed with the trustee's strong subjective sense. The approaches to penetration can be roughly summarized into two categories: the cognitive and the affective. For almost every characteristic, the trustee often treats them with the two kinds of viewshed.

3. Dynamic Mechanism of Cognitive and Emotional Characteristics

In the interaction process, participants, starting from their own information state, present what are the meanings of others' characteristics and acquire more comprehension from others' statements and further actions, thus achieve a merged horizon, which is defined as a cognitive characteristic. The process that top echelons make decisions is one that information and knowledge are highly collected. Based on their human capital, each executive understand and absorb kinds of information features that show in the high echelons' decision-making "knowledge pool", from which they extract information and knowledge that are hidden behind the features so as to complement and develop their own human capital database. At the same time, each executive put a certain amount of information characteristics into the "knowledge pool". Through characteristics the senior echelons contribute their own human capital to the decision-making process. Then, upper echelons integrate their human capital during the interaction process during which characteristics are regarded as the media, and when the level of integration meets requirement of solving the problem, the decision-making problem will be resolved. These characteristics possessing cognitive penetration can be referred to as cognitive ones.

Different individuals in top echelons may have different characteristics, which represents difference in their interpretation mechanism for things and the extent of mastering information. This can provide material basis for information conformity. According to information engineering, the capacity of information processing firstly lies in the "bandwidth" of information channel [3,4]. Each executive has his own channels to receive, process and deliver all kinds of relevant information. The greater difference in the channel, the more possibility

there is to bring more and more extensive information "bandwidth" to senior echelons. This information channel differences make "bandwidth" a scarce resource in the top echelons' decision-making process. The entire decision-making performance of upper echelon will depend on the size of the "bandwidth" union, or rather, the size of the shared "bandwidth" union and the emergence of information exchange brought about by the "bandwidth".

However, the affective process is another one that cannot be ignored in the decision-making interactive communication. It controls the size of characteristic flow like a valve. When one of the members sends negative feelings to the other, his inputs of cognitive characteristics will be reduced, or even the cognitive characteristic valve that is beneficial to decision-making will be turned off, and the valve with misleading nature may be opened to release negative emotions. On the contrary, if sending positive emotions, the sender will have more positive psychological factors than negative ones, and gain access to a subjective sense of happiness which makes executives more willing to devote and help others. Thus, it's good for enhancing the level of decision-making "knowledge pool". Another benefit of delivering positive emotions is that it is easy to produce a shared-feeling effect of "courtesy calls for reciprocity" in order to obtain feedback with positive emotions which can create a good group atmosphere, forming a virtuous cycle. What executives input in this process is known as emotional characteristics.

The impact of emotional characteristics on the decision-making interaction process can be summed up as two mechanisms; one is the noise mechanism, the other is the filtration mechanism. The former is for information characteristic delivered. When an executive have negative emotions to the team, he tends to throw "noise" into the decision-making "knowledge pool" to damage the team decision-making; the latter, for the receptor, appearing in the information exchange process characterized by feature as a medium, means that senders and receivers will perceive information through their own filtering systems. Filtering systems are not only affected by years of experiences, and also influenced by attitudes and feelings at that time. How the individual senses the information characteristics others of the group send will inevitably be "dyed" by the filtering system, so the top executives influenced by affective characteristics will "dye" the filtering system in different emotional colors. For the same message characteristics, people with different senses of emotion have different directions and levels of absorbing information characteristics.

Smith *et al.* (2007) has pointed out that team members would bring personal feelings and emotional experience

of various characteristics into the team for explicit and implicit sharing. They would infect and show each other in the interaction to reach to emotional integration. The emotional and cognitive integration processes are mixed together, and affected each other. [5] In the process of the individual and team shaping each other, emotions play an important role, like a catalyst, speeding up the response process. If the top management team want to get the maximization of recognition revenue, they must guide the members positively to interpret the emotional characteristics released by all members, so that the emotion can be a positive catalyst.

4. Equilibrium Analysis of Dynamic Mechanism of Upper Echelons' Characteristics

The roles of upper echelons' characteristics in organizational outcomes such as strategic decision-making have been the focus of debate about research on upper echelons [6,7]. Some scholars believe that upper echelons' characteristics are positively associated with corporate performance [8,9] or negatively [10,11]. But other scholars have reported an unstable relationship between characteristics and performance [12], and there is no equilibrium point. Therefore, from the mathematical perspective, this article takes a research on dynamic mechanism of upper echelons' characteristics, and examines condition of its partial equilibrium and general equilibrium.

4.1. Analysis of Partial Equilibrium

Now we will take two individuals i and j in upper echelons to analyze. **Figure 1** presents their dynamic mechanism.

To any individual i, assuming his knowledge of decision-making, information and affection are $K_i = \{k_1, k_2 \cdots\}$, these knowledge or information can be expressed by their characteristic set $X_i = \{x_1, x_2, \cdots, x_n\}$, which includes cognitive and affective characteristics. At the cognitive level, the executive i puts certain cognitive characteristics into the knowledge pool during the decision-making process, and understands what other members (supposing he is executive j) put in the pool, getting a supplement to his own knowledge repository. In the above-mentioned process, Affective characteristics work through noise and filtration mechanisms. Executive i interprets affective characteristics which executive j sends and makes appropriate affective responses. On the one hand the responses of executive i have an impact on the delivery of the cognitive characteristics through the noise mechanism; on the other hand, on the absorption through the filtration mechanism. Similarly, executive j has an analogous process. The two individuals together
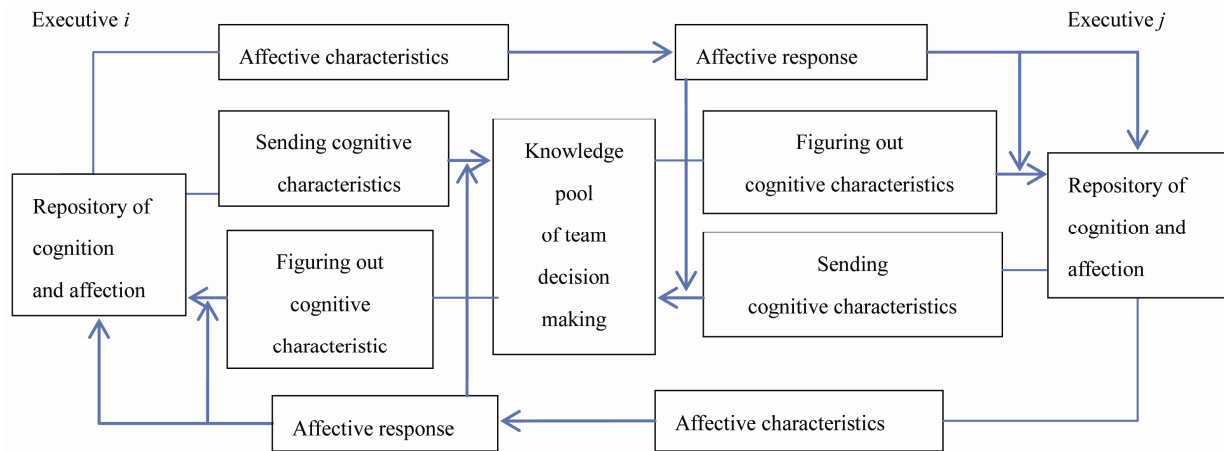
Figure 1. Dynamic mechanism of upper echelons' characteristics.

constitute a partial equilibrium model of upper echelons' characteristic interactive mechanism.

However, given a certain moment, the individual only has part of all the characteristics he owns. The knowledge, information and affective characteristics as well as the corresponding characteristics of individual i will increase with his learning and association with other members, and may decrease in some circumstances, such as a frustration of experiencing a decision, which makes him so doubtful about his knowledge and experience that he "gives up" some knowledge and reduces the volume of characteristics. Hence, at some moment his characteristics is fixed and limited, assuming that the characteristic set of individual i at this time is $C_i = \{x_1, x_2, \cdots, x_L\}$, L is the maximal number of characteristics for the moment.

Supposing the set of upper echelon members is $I \equiv \{1, 2, \cdots, N\}$, for the individual $i \in I$, his characteristic set, $C_i = \{x_1, x_2, \cdots, x_L\}$, can generate a lots of different topologies (that is different strategies of sending characteristics) to form his own decision-making model. Because in different decision-making contexts (simple or complex), the individual i exchanges with other members, and according to their own judgments they deliver a certain volume of cognitive and affective characteristics to "knowledge pool". The individual may select the most suitable topology from his characteristic set to send.

Definition 1. For the individual i, supposing that there are two different topologies in C_i, τ_1 and τ_2, τ_1 is more finer than τ_2 if each open set of τ_2 belongs to τ_1, that is, $\exists ß_1$, $ß_1 \in \tau_1$, $\forall ß_\alpha$, $ß_\alpha \in \tau_2$ and there is $ß_1 = \bigcup_\alpha ß_\alpha$ ($ß_1$ and $ß_\alpha$ are respectively open sets in their topology).

As shown in definition 1, among all the different topologies generated by characteristic set C_i of individual i, there is the finest topology $\tilde{\tau}$, that is $\exists ß$, $ß \in \tilde{\tau}$, $\forall \tau_k$, $\forall ß_k \in \tau_k$, there is $ß = \bigcup ß_k$ (τ_k is any one of the topologies based on characteristic set C_i; $ß$ and $ß_k$ are

respectively open sets in $\tilde{\tau}$ and τ_k.) This indicates that individual i can take full advantage of his own characteristics to form the most suitable decision-making model, or the finest topology.

The partial equilibrium analysis of dynamic mechanism of top echelon characteristics is as follows: for any member i of the upper echelon, given the finest classification in characteristic set C_i, and for another information characteristic sender $j \neq i, j \in I \equiv \{1, 2, \cdots, N\}$, the latter puts in "pieces of information" (cognitive features) R_{ij}. For i:

He has human capital yield $B^{ij}(R_i, D_i)$ originated from understanding R_{ij} and human capital get capital loss $W^{ij}(E_i, D_i)$ coming from the filter mechanism of i's emotional response to j and the noise mechanism of j's emotional response to i.

Among this, Vector $D_i \equiv \{D_{i1}, D_{i2}, \cdots, D_{iN}\}$ signifies the level of individuals' understanding about the characteristics of the depth or the characteristics' refinement. Vector $E_i \equiv \{E_{i1}, E_{i2}, \cdots, E_{iN}\}$ represents individuals' overall emotional reaction, including the reactions of i to j and j to i and the negative impact they have on i (positive impact is expressed by the negative of E_i). If the individual knows more about the characteristics, he understands the information released by others better, so he obtains human capital yield more greatly. As for the loss, when the individual has a more in-depth understanding of the characteristics, he sends more and will lose more, from the negative emotions. Thus, $B^{ij}(R_i, D_i)$ and $W^{ij}(E_i, D_i)$ are both an increasing function of D_i, namely:

$$\frac{\partial \left(B^{ij}(R_i, D_i) \right)}{\partial D_i} \geq 0 \tag{1}$$

$$\frac{\partial \left(W^{ij}(E_i, D_i) \right)}{\partial D_i} \geq 0 \tag{2}$$

a) The net yield of i is

$$NB^{ij}(R_i, E_i, D_i) = B^{ij}(R_i, D_i) - W^{ij}(E_i, D_i) \quad (3)$$

which shows the difference between the human capital gains when i understands the cognitive characteristics and the losses occurs during this process. Cognition to the characteristics is associated with emotional understanding, as the following shows:

$$F(R_i, E_i) \equiv 0 \quad (4)$$

b) The optimization problem is:

$$\max NB^i(R_i, E_i), F(R_i, E_i) \equiv 0 \quad (5)$$

The formula meets with the condition in which the extreme value exists.

The gains i gets from understanding j's characteristics has an upper bound, and the maximal human capital the bound R_{ij} contains has a yield curve concaving to the origin and gradually converging to 0 because of its decreasing marginal revenue. Assuming the emotional losses of executives are also limited, and their marginal losses are increasing, so the marginal loss curves will go to infinity with the deepening understanding. Then there is the equilibrium point as shown in **Figures 2(a)-(b)**, which makes the executive i's marginal revenue equal the marginal loss.

4.2. The General Equilibrium Analysis of Upper Echelons' Dynamic Mechanism on Characteristics

As known as Definition 1, the characteristic set C_i of i is serially ordered set dependent on the degree of crudeness or fineness, that is to determine the extent of the totally ordered set, that is, any two topologies of characteristics can be compared according to their degree of understanding thickness. Because of existing the finest topology, an arbitrary nonempty subset of the totally ordered set has at least one upper bound $\tilde{\tau}$, which is the maximal element of C_i. This makes C_i be constructed into a flock of pairwise disjoint non-empty sets, according to Zermelo's axiom of choice, there is a set of M satisfying the following two conditions:
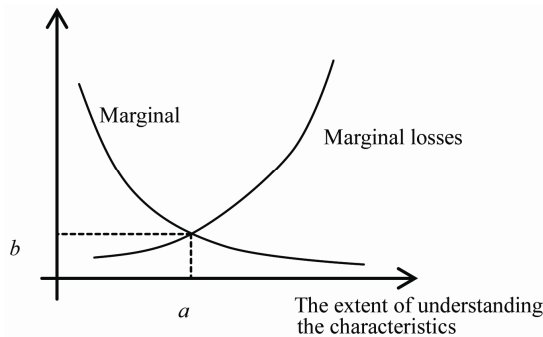

Figure 2. Marginal revenue and marginal losses.

a) $M \subset \bigcup_{\tau \in C_i} \tau$

b) The Set M and each topology τ in C_i have and only have one common element.

Executive i will classify his own characteristics, assuming the classification is complete enough to have the characteristics after classified show different information respectively (in theory, as long as we construct according to the maximal element the condition of pairwise disjointedness can be achieved). Thus, on the basis of conditions (2) above, M can be viewed as a mapping to itself: $\varphi_i : \tilde{\tau}_i \to \tilde{\tau}_i$, and from the condition (1) we know $\varphi_i(\tilde{\tau}_i) \subseteq \bigcup_{\tau \in C_i} \tau$. In other words, when there is the smallest topology in C_i, we can determine at least a mapping existing, so that each executive is not beyond the range of the last choice, which is of great significance for the general equilibrium analysis.

Definition 2. Supposing common characteristic set is $S = \bigcup_{i \in I} \bigcup_{m \in M} \beta_m$, and upper echelon members set is $I \equiv \{1, 2, \cdots, N\}$, M is the number of open sets in the decision-making model(the finest topology) of i, then we can get that S is common information characteristic set in a upper echelon, as well as the element in S indicated by s.

$\forall i \in I$, i interacts with other team members, and makes what member $j \in I$ understands about s be s_{ij} based on his own decision-making model $\tilde{\tau}_i$. Mark ΔS_i as the simplex generated by $S_i \equiv \{s_{i1}, s_{i2}, \cdots, s_{iN}\}$, that is $\Delta S_i \equiv \left\{ \sum_{j=1}^{n} \lambda_j s_{ij} \mid \lambda_j \geq 0, \sum_{j=1}^{n} \lambda_j = 1 \right\}$, which expresses the state of interaction among the characteristics. The topological space $\tilde{\tau}_i$ where ΔS_i exists is a polytope space. Suppose that there is a mapping $\varphi_i : \tilde{\tau}_i \to \tilde{\tau}_i$ to meet:

1) $\varphi_i(T)$ is a convex subset of the subset T in $\tilde{\tau}_i$, $\forall T \in \tilde{\tau}_i$;

2) If there is a sequence set $\{T_k\}$ converging to T_0, $\{\varphi_i(T_k)\}$ converging to L_0, then $L_0 \in \varphi_i(T_0)$ (that is, G_{φ_i} is closed.) $G_{\varphi_i} \equiv \{(x, y) \mid x \in \tilde{\tau}_i, y \in \varphi_i(\tilde{\tau}_i)\}$ is the graphics of set-valued mapping $\varphi_i : \tilde{\tau}_i \to \tilde{\tau}_i$ map, and it is a subset of $\tilde{\tau}_i \times \tilde{\tau}_i$.

Based on the above assumptions, we can see the fixed point theorem—Kakutani theorem applies here. There is $T^* \in \varphi_i(T^*)$, which is a Nash Equilibrium reached in the interaction of any characteristic $s \in S$ during the decision-making process in which N executives participate in. That is $P \subseteq \prod_{i \in I} \Delta S_i$, $\varphi(P) \subseteq P$, here $\varphi \equiv \{\varphi_1, \varphi_2, \cdots, \varphi_N\}$.

For any cognitive characteristic R, each executive interprets according to their own understanding of comprehension sets and emotional reaction, and sends this understanding to other executives as some characteristics in the

decision-making process. For executive i, when he receives understanding about the feature R from other executives, he will choose a set that is sufficient to cover a variety of interpretations, that is the simplex generated from the understanding of all the executives on R. Then he selects the most appropriate subset as a new interpretation of the characteristic R based on emotional reactions of every executive. This selection process, as mentioned in front, is the self-mapping, from a rich and enough "fine" characteristic topology to the appropriate topology that is dealt with and adjusted through the executives' affection. After the executive i sends the selected topology to other executives, they will correct their selections according to the new understanding, and then pass them out. The cycle repeats itself like this, until there is no person having any further reason to choose a different understanding with the previous selection, then the general equilibrium will be achieved.

5. Conclusions

The upper echelon with a variety of characteristics, brings information and ideas to business decisions, and in the interactive process, incessant emergence of new knowledge, plays an important role in the optimization of the enterprise decision-making. Meanwhile, the characteristic diversification also makes emotional factors in interaction more complex, which may have adverse effects on cognition. The cross-cutting roles of the two different dynamic nature, cognitive characteristics and affective characteristics, finally will make high echelons' decision-making achieve a balanced state. In this decision-making process, decision-making knowledge transmits cognitive and emotional information related to decision-making with characteristics as the medium. Each executive will go on interactive gaming according to messages delivered by characteristics, receive and release the characteristic information on the basis of characteristics other executives issue and their possible responses, and finally reach Nash equilibrium after repeated game. The process to reach a balanced decision-making is not a simple exchange of feature information, but the one of continuous refinement, organization, attraction and creation for characteristics. Any characteristic released by executives may have a different meaning and function for each one, so that personalized information becomes things in common under the common "treatment" by various members. Upper echelons' effectiveness lies in the ability of effectively handling the conflict between cognition and emotion, with which differentiated information will be integrate towards the unified direction of echelon's decision target to disperse out of the intellectual pool of individuals, at the aim of the formation of decision-making intellectual force. This not only depends on top echelons' effective leadership process, but also are inseparable from the formation of efficient decision-making culture.

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