

# Study on Properties of Corporate Marketing Network

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**Abstract.** Actual corporate marketing network tend to have a large and complex network structure, which affect the operation of enterprises and even dominate marketing network. Based on complex network theory, this paper define stability and effectiveness of corporate marketing network, and establish a endogenous formation models of corporate marketing network, also analyze of effective marketing network and stable marketing network must satisfy conditions, and an example is to proof its validate. The conclusion shows that star topology network marketing is not only stable but also is effective. The conclusions have significance guiding for enterprises to build stable and effective marketing network.

## Introduction

Corporate marketing network is the members interrelated and interact to form the network structure, this structure dominates the operation and even affect the marketing network operating [1]. Actual corporate marketing network tend to have a large and complex network structure, however, it is assumed that corporate marketing network has a simple network structure as completely or star-connected by the classical economic theory, so in previous economics studies, corporate marketing network structure has neglected. Which perhaps one of the reasons causing the classical economic theory often lack the ability to explain the real corporate marketing network [2, 3].

This paper proposes the definition of stability and effectiveness of corporate marketing network, analyze the nature of effective marketing network and a stable marketing network. Empirical analysis and numerical examples.

## Definition Availability and Stability of Corporate Marketing Network

Consider a finite individuals (to participate in corporate marketing activities of organizations or individuals) consisting of marketing network, with nodes represent participation in corporate marketing activities of organizations or individuals (marketing network member). If the two nodes  $i$  and  $j$  between product supply and demand if there is relationship or transaction information exchange relations, the establishment of an even edge which denoted  $e_{ij}$ , while the right is used  $w_{ij}$  to indicate, with a trade volume of the weight or information flow between the nodes  $i$  and  $j$  to represent, so corporate marketing network to abstract complex network .Use  $V = \{1, 2, \dots, n\}$  to representation all collection nodes of corporate marketing network, all nodes number denoted  $N$ ; set  $G = \{e_{ij} | i, j \in V\}$  record network all side remember that all side remember is  $e_{ij} \in G$ . All side remember denoted  $M$ .

Consider a subset  $S \subseteq V$  of the set of nodes, we can define the network  $G|_S$ , it satisfies the conditions " $e_{ij} \in G|_S \Rightarrow i, j \in S$  and  $G|_S \subseteq G$ .  $G|_S$  is limited to nodes  $S$  the subset of network. Then define a fully connected network  $G^V = \{e_{ij} | i, j \in V\}$ , all the nodes of the network that is connected to each other, fully connected network  $G^V$  representation exists product supply and

demand transaction or information exchange between corporate sales and marketing network in any organization or individual, then there must be  $G \in G^V$ . Since we note  $G$  in the collection of  $G^V$  all subsets, that this is all  $G \in G^V$  for all possible network composed by a set of nodes  $V$ . In addition, we use  $G^f$  to indicate an empty network connection that all its nodes are isolated, that is, there is no corporate marketing network [4].

The formation of enterprise marketing network is the result of market economy organization or individual (economic actors) rational decision-making behavior, which can be considered to form a network of corporate marketing organization or endogenous process of individual economic activity, can be used similar *Nash* Equilibrium as a starting point for analysis of corporate marketing network formation process modeling [5]. By giving each enterprise marketing network nodes  $i$  (node represents corporate marketing organization or a network) function  $u_i : C \rightarrow R$  to make some kind of reward for each organization or individual can make a rational policy choice, and thereby induce some across the entire network species total utility function. If the marketing network in the presence of a pair of late with two nodes connected by an edge, wherein at least one node is considered to delete this side will be better for him; or if there is a pair of two individuals not connected by an edge, they are consider adding an edge will both be better for both of them; then the business marketing network thus formed is unstable otherwise it is stable pairs. This shows that, during the formation of corporate marketing network nodes in why some transactions or the establishment of product supply and demand relationship and exchange of information to other nodes and maintain this relationship, and some have established product supply and demand information exchange transaction or node can not sustain this relationship species relationship. Effective business marketing network referred to when business marketing network to achieve optimal total utility function, and effectiveness is used to measure of the formation of whether an indicator of optimality. Without loss of generality, so that the total effect of corporate marketing network to meet the normalization conditions:  $u_i(G^f) = 0$ , So the total utility function of corporate marketing network  $G$  is all nodes utility total, namely:

$$U(G) = \sum_{i \in V} u_i(G) \quad (1)$$

Definition 1: In corporate marketing network  $G \in G^V$ , if there is no one pair of network members want to build product supply and demand transaction or information exchange relations, but also did not want to disconnect any network members and other network members established product supply and demand transaction or information exchange relations, then the marketing network  $G$  called stable, stable marketing network to meet the following two conditions [5,6]:

- (1) "  $e_{ij} \notin G$ , Then  $u_i(G - e_{ij}) \geq u_i(G)$  and  $u_j(G - e_{ij}) \geq u_j(G)$
- (2) "  $e_{ij} \notin G$ , in case  $u_i(G + e_{ij}) > u_i(G)$ , certainly has  $u_j(G + e_{ij}) < u_j(G)$

Definition 1 Description: In a stable business marketing network in neither one willing to Wang Yuan disconnect between their existing trading relationship between supply and demand of products or information exchange relations, nor a pair of network members are willing to build products between them supply and demand relationship or transaction information exchange relations [7,8].

Decree:

$$u_{e_{ij}} = \frac{1}{2} \begin{cases} u_i(G) - u_i(G - e_{ij}), e_{ij} \notin G \\ u_i(G + e_{ij}) - u_i(G), e_{ij} \in G \end{cases} \quad (2)$$

The formula gives the utility value between the node  $i$  and the node  $j$  product supply and demand information exchange trading relationship or the relationship obtained. So for is a stable marketing network situation, there were  $e_{ij} \in G$ , and there was  $u_{e_{ij}} \geq 0$ , then  $u_{e_{ij}} \in G$ ,  $u_{e_{ij}}$  and  $u_{e_{ji}}$  both have at least one less than zero. Wherein the utility between  $u_{e_{ij}}$  and  $u_{e_{ji}}$  represent the node

$i$  and node  $j$  product supply and demand relationship or transaction information exchange relations were obtained respectively.

**Definition 2:** If the utility value of corporate marketing network  $G \dot{=} G^v$  network members consisting of the same marketing network is the largest, then  $G$  is called the effective marketing network marketing network. Effective marketing network to meet the following conditions:

$$U(G') \leq U(G), \quad \forall G' \neq G$$

Effective corporate marketing network is not unique. For example the set of enterprise marketing network  $G$  utility function for each network members depends only on contact with the other circumstances of the members but nothing to do with the specific network members, all with the topology of the same marketing network marketing network  $G$  and  $G'$  has the same total utility [9].

### Effective and Stable Corporate Marketing Network Features

**Theorem 1.**  $\forall e_{ij} \neq G$ , effective corporate marketing network marketing network formed by the endogenous model, there are:

When  $c_{ij} > l_{ij} + \frac{n-1}{2} l_{ij}^2$ , the empty network is the only effective corporate marketing network.

Indicates the absence of the corporate network, the company's products can not be sold on the market;

When  $l_{ij} - l_{ij}^2 < c_{ij} < \frac{n-1}{2} l_{ij}^2$ , the star structure marketing network is the only effective marketing network. Indicate the presence of a central network marketing network member, the remaining networks are occurring product supply and demand transaction or information exchange through the network;

When  $c_{ij} < l_{ij} - l_{ij}^2$ , the fully connected marketing network is the only effective network. Product supply and demand shows that there are transactions or any exchange of information between network members.

**Theorem 2.** (Stability)  $\forall e_{ij} \neq G$ , stable marketing network formed by the endogenous model, there are:

Stable marketing network at most only one non-empty sub-network;

When  $c_{ij} < l_{ij} - l_{ij}^2$ , then fully connected network  $G^v$  is only stable network;

When  $l_{ij} - l_{ij}^2 < c_{ij} < l_{ij}$ , then star network  $G^*$  is a pair of stable network, but it is not necessarily the only stable network;

When  $c_{ij} > l_{ij}$ , then any non-empty and stable marketing network each node it's degree at least 2, and this marketing network is invalid [10].

### Examples Analysis

Consider a simple corporate marketing network. Assuming that all network members are equally spaced around a central network members, they form into a star-shaped structure. Here network members can be organizations or individuals.  $c_{ij} = c \cdot d(i, j)$ , to order  $d(i, j) = 1, \dots, i, j, \dots, vi, j$ , and to examine marketing network form case when  $c_{ij} < l_{ij}$ ,  $\forall i, j$ .

Let  $n = 9$ , these network members are equally spaced around a central network member, thereby forming a star topology marketing network  $G^*$ , center network number is 1, followed 8 network numbers by sign numerals 2-9, wherein each side weight  $w_{ij}$  has been marked on each side as shown in Fig. 1 (a).

$$u_1(G^*) = 8w_{ij}l_{ij} - 8c_{ij}, i, j \in [1, 9]$$

$$u_j(G^*) = w_{ij}l_{ij} + 7w_{ij}l_{ij}^2 - c_{ij}, \quad \forall j \in 1$$

Then

$$U(G^*) = \sum_{j=1}^9 u_j(G^*) = 16w_{ij}l_{ij} + 56l^2 - 16c_{ij}, \quad i, j$$

Now examine numeral 2-9 network members changes in product supply and demand immediate transaction or information exchange relations, that network add a new edge  $e_{ij}$  between  $i$  and  $j$ , where  $i$  and  $j$  are not centers members, there are:

$$u_i(G') = u_j(G') = 2w_{ij}l_{ij} + 4w_{ij}l_{ij}^2 - 2c_{ij}, \quad e_{ij} \notin G^*$$

$$u_i(G') = 8w_{ij}l_{ij} - 8c_{ij}$$

$$u_o(G') = w_{ij}l_{ij} + 7w_{ij}l_{ij}^2 - c_{ij}, \quad o \neq i, j$$

$$U(G') = 18w_{ij}l_{ij} + 50w_{ij}l_{ij}^2 - 14c_{ij}$$

Then consider fully connected marketing network  $G^v$ , there are:

$$u_1(G^v) = 8w_{ij}l_{ij} - 8c_{ij}$$

$$u_j(G^v) = 3w_{ij}l_{ij} + 3w_{ij}l_{ij}^2 - 3c_{ij}, \quad j \neq 1$$

$$U(G^v) = 32w_{ij}l_{ij} + 18w_{ij}l_{ij}^2 - 24c_{ij}$$

Then when  $c_{ij} > l_{ij} - l_{ij}^2$ ,  $i, j$ , because  $U(G^*) > U(G') > U(G^v)$ , so the star structure marketing network not only stable but also is an effective marketing network.

## Conclusion

This paper have defined stability and effectiveness of corporate marketing network, and have established a endogenous formation models of corporate marketing network, also, have analyzed of effective marketing network and stable marketing network must satisfy conditions, and have proofed its. The studies have shown that: star topology network marketing is not only stable but also is effective. The conclusions have guiding significance for enterprises to build stable and effective marketing network.

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