Research of the Power in the Supply chain

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ABSTRACT:

With the recent advent of computer-based communication technologies, communication networks have become an important factor in global interaction. The world in the information age may be described as being connected by a lattice of networks. The analysis of the communication network in the supply chain is one of the major goals in the project currently in research at the Faculty of Maritime Studies Rijeka, Croatia.
Network analysis begins with data that describes the set of relationships among the organisations - members of a system. The goal of analysis is to obtain from the low-level relational data a higher-level description of the structure of the system. The higher-level description identifies various kinds of patterns in the set of relationships. These patterns will be based on the way individual organisations are related to other organisations in the network. Some approaches to network analysis look for clusters of firms who are tightly connected to one another; some look for sets of firms who have similar patterns of relations to the rest of the network. The power of each organisation in the network is also calculated and discussed.

INTRODUCTION

The supply chain management has carried the integration function concept out of the organisation, since it comprises the chain of participants from suppliers to customers. The organisation itself is part of the whole process, which needs the interaction and contribution of all components. Such an external integration has highlighted the importance of electronic trade and the efficient consumer response techniques. With the recent advent of computer-based communication technologies, communication networks have become an important factor in global interaction. The world in the information age may be described as being connected by a lattice of networks. In fact, information technologies now provide the basic infrastructure for an interdependent world, leading theorists to characterize the world as a "global village".

The goal of analysis is to obtain from the low-level relational data a higher-level description of the structure of the system. The higher-level description identifies various kinds of patterns in the set of relationships. These patterns will be based on the way companies are related to other companies in the network. Some approaches to network analysis look for clusters of individuals who are tightly connected to one another; some look for sets of individuals who have similar patterns of relations to the rest of the network.
Using the social network approach one can determine following :
The structural position of a company determines its potential for development and its interaction patterns. The relationships among the companies in the network are relatively stable, changing only as the distribution of the modes of production change.

UNITS OF ANALYSIS

Units of the analysis are documents (relations) and companies (actors). Relations are characterized by content, direction and strength. The content of a relation refers to the resource that is exchanged. One or multiple relations between a pair of actors is called a tie. Pairs may maintain a tie based on one relation only, e.g., as members of the same organization, or they may maintain a multiplex tie, based on many relations, such as sharing information, giving financial support and attending conferences together. Thus ties also vary in content, direction and strength.

Relation Categories. Relation categories were derived from a content analysis of the documents interchanged in the transport and supply chain. From more than 200 different documents , 103 are used in model.

Network Structure.. Network is structured with 103 from 552 possible ties, having thus an average tie density of 19%, with standard deviation of 0,65 indicating heterogeneous distribution of the tie densities in the network. Analyzing transport network alone, the average tie density is increasing to 30% with standard deviation of 0,86. Comparing this data one can infere that the transport part of the network is tightly coupled than sales part of the network.

Degree of Hierarchy. The notion of degree of hierarchy is based on the idea that all complex systems, including informal organizations, have a certain level of hierarchy . Krackhardt (1994) developed the measure of degree of hierarchy that indicates the extent to which relations among the individuals in the organization are "ordered," and there is little, if any reciprocity. Krackhardt's measure of degree of hierarchy is defined as $D_H = 1-[V/\max V]$, where *V* is the number of unordered or reciprocated links in the organization (A is linked to B and B is linked to A), and *Max V* is the number of unordered pairs of points (A is linked to B or B is linked to A). A graph that is completely hierarchical will have no "reciprocated" or symmetrical links. Degree of hierarchy in a completely hierarchical network graph will be 1, whereas a completely non-hierarchical graph will be indicated by a score of 0. The hierarchy of the transport and supply chain network is 0,8991, indicating low level of hierarchy.

Centralization. Another measure of structure is centralization. Centralization refers to overall integration or cohesion of a network graph. Centralization indicates the extent to which a graph is organized around its most central point. From the centrality one can find the distribution of the power in the network. There are few different measures of the centrality indicating different kind of measures in the network.

Degree Centrality: Actors who have more ties have greater opportunities because they have choices. This autonomy makes them less dependent on any specific other actor, and hence more powerful. The more ties an actor has then, the more power they (may) have. For example if actor A has more ties, and actor B is tied only with A, if B elects to not provide A with a resource, A has a number of other actors to go to get it, but if B elects to not exchange with A, then B will not be able to exchange at all. One can distinguish in and out degree centrality, depending of the number of the received and despached documents. Using this description*1 there are three actors that have biggest centrality : agent , freight forwarder and seller, having normalised out and in degree centrality of 78.26 , 60.87 ; 69.57, 60.87 and 65.22 , 60.87 respectively.

Betweenness Centrality: Actor who lies *between* other pairs of actors, and no other actors lie between it and other actors has big advantages. For example if A wants to contact B, it may simply do so if it is connected with it. If C wants to contact B, they must do so by way of A who lies on the way between them. This gives actor A the capacity to broker contacts among other actors -- to extract "service charges" and to isolate actors or prevent contacts. The third aspect of a structurally advantaged position then is in being between other actors. . Using this description there are three

*1 Formulas are listed in addendum 1

actors that have biggest closeness centrality : seller, agent and freight forwarder, having normalised closeness centrality of 65.09 , 45.22 and 36.79 respectively.

CONCLUSION:

Network analysis focuses on the relations among actors, and not individual actors and their attributes. This means that the actors are usually not sampled independently, as in many other kinds of studies (most typically, surveys). The results represent clear view in the structure of the transport communications network, enabling to describe contribution of network position to the importance, influence, prominence and power of an actor in a network

Network analysis methods provide some useful tools for addressing one of the most important (but also one of the most complex and difficult), aspects of network structure: the sources and distribution of power. The network perspective suggests that the power of individual actors is not an individual attribute, but arises from their relations with others.

The results of the analysed transport and supply chain network indicate that the network is not hierarchical, thus feasible for construction of the virtual organization. The network should be designed between three most powerfull actors – seller, freight forwarder and agent.

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Addendum 1.

Degree Centrality.

$$C_D(p_k) = \sum_{i=1}^{n} a(p_k p_i)$$

Where n – number of actors

$$a(p_k p_i) = \begin{cases} 1 \text{ if } p_i \text{ and } p_k \text{ are connected} \\ 0 \text{ if } p_i \text{ and } p_k \text{ are not connected} \end{cases}$$

2 .Betweenness centrality

$$C_D(p_k) = \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{g_{ij}(p_k)}{g_{ij}}$$

Where: g_{ij} – number of shortest connections between p_i and p_j.