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The Relationship Structure of a Transnational, Ego-centered, and Innovation-Oriented Network

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Abstract

This study identifies the relationship structure of an ego-centered network by examining a transnational organization in the telecommunications sector that is oriented toward innovation. The study considers the dimensions of density, centrality, structural equivalence, and relationship content. Following the literature, we correlate the underlying concepts of network innovation substantiated through the technique of network analysis as a research method. The results suggest that the position of organizations in relation to the distance and pathways to other organizations in the network can influence the network's capacity for innovation, conditioned by the strategic positioning of the focal company. This does not seem to be the case with the company considered by this study, as the strategic positioning of the matrix considers only innovative products with a worldwide scope, and not those with a more limited, local, or regional interest. The main contribution of this study is the identification of the relationship structure of a transnational, ego-centered, and innovation-oriented network with the aid of a statistical tool.

Keywords: interorganizational network, innovation network, telecommunications sector

1. Introduction

Networks can be analyzed from the perspective of their structural or morphological characteristics and can be treated either comprehensively—according to the totality of the network—or by separating the connections between actors, as in the analysis of pairs (dyads) in this study. These characteristics play a significant role in the construction of scientific knowledge, as they provide a general overview of the network based on density, centrality, equivalences, and structural holes; thus, allowing for an understanding of the content flowing through the relationships in an organization's network (Gilsing et al., 2016).

Social Network Analysis (SNA) allows treatment from different perspectives and can be considered a metaphor, theory, or method (Powell; Smith-Doerr, 1994; Reinert; Maciel, 2012; Mäntymäki & Riemer, 2016). The network analysis used in this study is not fundamentally a research strategy but rather a set of techniques typically used in the treatment of relational data (variables of ties between social actors) at different levels. These techniques can be used with several designs (Reinert & Maciel, 2012).

This article identifies the relationship structure of an ego-centered network in an innovation-oriented organization by considering the dimensions of density, centrality, structural equivalence, and relational content. The telecommunications sector comprises firms with a global perspective, capacity for innovation, and that are immersed in an extremely connected context. This context exerts a significant influence on their strategies, and thus, on other sectors of the global economy due to its inherently transformative nature. This is especially true in light of the advent of the Internet, which, according to Ohmae (2006), seems to be the best evidence that national borders have become much less restrictive. In addition, innovation at an interorganizational level seems to be a

key factor in the survival of organizations operating in this market, especially for transnational organizations, as this market's field of business has rarely been limited to domestic markets.

The company in the ego-centered network examined in this study was chosen not only because it is one of the largest global players in telecommunications, with operations in 150 countries and annual revenue of 14 billion euros in 2011, but also because it is positioned with a focus on innovation and with perspectives related to global performance. The various classifications of ego-centered networks and networks in general can be used in an interrelated way, as the analysis of the data on a complete network has an ego-network with each of the relationships measured. Thus, the network formation in this research is egocentric, but the network data are analyzed in terms of dyadic (peer) relations. In addition to the focal organization, the network includes 18 companies considered strategic and fundamental in the development of its activities, selected based on the technique of snowballing (Biernacki & Waldorf, 1981). These include eight subsidiaries located in six different countries: Argentina, Singapore, Colombia, Mexico, China, and Brazil. The network also consists of two categories of organization: five suppliers and four logistics partners, with headquarters in different countries, such as France, the US, Switzerland, Colombia, Slovenia, and Brazil. Germany is also part of the network because, although it is not the headquarters of the joint venture, it is considered part of the network as a parent company as it owns half the shares of the entity created by a merger between the companies.

Network analysis was used to identify the configuration of the ego-centered network and its relational content, with an emphasis on the information base, products innovation, and entry into new markets. All data were statistically treated using UCINET, a software program for network analysis developed by Borgatti, Everett, and Freeman (2002). The boundaries of the ego-centered or self-centered networks are defined during data collection using the naming technique (Marsden, 2005). The network of relationships was defined based on input from a focal organization of the telecommunications sector formed by a joint venture between two companies based in Finland and Germany.

This paper is divided into five sections. After a brief introduction, including the purpose of the study, its theoretical basis is described with regard to the relationship structure and innovation in interorganizational networks. The methodological and analytical procedures underpinning the data analysis are then presented. Afterwards, the research results are discussed and final considerations are presented, along with a discussion of the limitations and recommendations of the research.

2. Literature Review

Studies on interorganizational networks are occupying an increasingly significant space in the academic field (Balestrin, Verschoore, & Reyes Junior, 2010), and include various theoretical perspectives and currents of thought. The emphasis on an empirical–theoretical framework is supported by Wasserman and Faust's perspective (1994). They argue that methods related to network analysis can be categorized into structural properties, roles, and positions, as well as statistical analyses of relationships and innovation from the network perspective.

2.1 Relationship Structure in Interorganizational Networks

Network analysis at the interorganizational level considers its own relationships as components of a structure of relationships within a social order (Matinheikki et al., 2016). Nelson (1984) argues that the structure of relationships "allows us to study the interactions between formal and informal relationships, as well as other types of relationships, which is a long recognized need, but for which no methodology existed" (p. 151). Nelson (1984) suggests that the most elaborate definition of "structure" is the one that deals with interconnected behaviors. The key to this definition is the repetition of interdependent, but not necessarily reciprocal, relationships of a cyclical nature that persist over time, such as frequency, degree of symmetry, configuration, content, and the nature of relationships.

One of the difficulties concerning network analysis is the definition of the network boundaries and the resultant configuration of the structure, especially when the network is considered as a whole (i.e., in full network design). For ego-centered networks, the boundaries are defined during data collection using name generation (Marsden, 2005) or, as in this study, by analyzing a focal organization. According to Wasserman and Faust (1994), an ego-centered network consists of a focal actor (the "ego"), a set of other actors with ties to the ego, and the measurements of the bonds between these actors.

The various classifications of ego-centered networks and networks as a whole can be used in an interrelated way. According to Kirke (1996), when an ego-centered network is considered dense, the entire network can be built through egocentric data. Marsden (2005) argues that the data analysis of a complete network has ego-networks

with each of the relationships measured. Thus, the formation of a given network may be egocentric, but the analysis can be developed from dyadic (peer) relationships.

Scott (2000) points out some important measures of centrality provided by the network analysis technique: centrality of degree, centrality of proximity, and centrality of intermediation. The centrality of degree is measured as the number of an actor's connections; it is not restricted to indirect relations, since degrees can be "indegrees" and "outdegrees." The original concept of centrality, based on degrees, treats connections as symmetrical—that is, the relationships are reciprocal (Knoke, 1994; Gilsing et al., 2016).

The measure of centrality of proximity allows one to go beyond direct relationships and consider the minimum number of steps an actor needs in order to establish contact with other actors in the network. From this perspective, the more central the actor is, the more likely the actor is to reach other actors in the network. Centrality of intermediation emphasizes the actors that serve as links between actors in the network. This is an important measure, since the identification of central intermediate actors allows one to determine how much they can influence the structure of the network, since they can control the routes through which resources and information pass among other actors. The degree of intermediation is represented by the *Betweenness* measure and reflects a node's capacity to intermediate the communications between pairs of nodes (Scott, 2000; Araujo et al., 2016).

Another important measure of centrality is the *Eingenvector*, which is usually used to find the centrality of each actor. The fewer the connections to nearby actors, the lower the actor's prestige in the network. In addition to the centrality measures mentioned above, *Effsize* is a measure of "structural holes," a term coined by Burt (1995). A structural hole is the space between actors, which, in this study, can indicate that an organization in the ego-centered network lacks a relationship with sources of resources or information.

Wasserman and Faust (1994) emphasize the importance of structural equivalence in the analysis of positions in the network, such that two social actors are structurally equivalent when they have identical ties with other actors in a network.

2.2 Innovation in Interorganizational Networks

Innovation seen from the perspective of interorganizational networks presupposes a complex process of interaction and cooperation that goes beyond the limits of the intraorganizational dimension and the limits created by an exclusive focus on technology or research and development. Smolka and Côrtes' (2006) research on cooperation networks for innovation in products in technology-based companies (TBCs) indicates that a network analysis provides important inputs for an extensive understanding when considering other organizations immersed in the network of relationships. Smolka and Côrtes (2006) revealed important relationships between TBCs and universities or research centers but identified few cooperative initiatives among the TBCs themselves. In addition, other actors with regulatory roles that configure the network, such as regulators, governmental agencies, and congressional bodies, influence the innovation of the TBCs by having levels of centrality that are more elevated and differentiated than are those of other agents in the network, providing them with a special understanding of the innovative environment.

Innovation is a multidimensional process that requires novelty, highlighting the need to combine three important research chains: internationalization, innovation, and networks (Chetty & Stangl, 2010). Freire, Baldi, and Lopes' (2010) work on innovation networks describes the innovative process as being collectively created based on interorganizational relationships at the local, national, or global levels, based on the convergence of social ties (Granovetter, 1973) and innovation networks (Hage & Hollingsworth, 2000; Veiga et al., 2016).

This approach to innovation networks is justified by the growing need to understand and promote processes of innovation in competitive global networks, which are configured as forms of governance of new patterns of interorganizational relationships. This approach is visualized in the work of Weymer (2013), who noted that innovative ideas and products from the subsidiaries of an interorganizational telecommunications network are seen as legitimate only if they are aligned with the parent company's overall strategy.

Innovation goes beyond the structural aspects and the combination of objectives, resources, and people; it also brings to the fore an analysis that goes beyond organizational and geographical limits and emphasizes the content flowing in social relationships. This does not mean one can neglect the importance of innovation in favor of intraorganizational aspects. On the contrary, an analytical understanding of the internal context is the basis for understanding innovation from the network perspective and within the global context.

Although the term "globalization" is sometimes used indiscriminately due to the somewhat reductionist perception of a single economy regulated by a new and unprecedented economic system, the world is clearly

generating a "new global economy" based on a dynamic of its own, in which national borders are becoming much less restrictive (Ohmae, 2006). It is within this highly complex context that extending cross-cultural research to deepen understanding of the value of collaboration across domestic boundaries is urgently needed, particularly considering partnerships between organizations (Hillman, 2009; Matinheikki et al., 2016).

3. Methodological Procedures

The analysis of networks in this study consists of a set of techniques most often used in the treatment of relational data (variables of ties between social actors) at different levels. According to Reinert and Maciel (2012), such techniques can be employed with various designs and are not solely characterized as a research strategy.

3.1 Characterization of the Research

Although the starting point is a subsidiary company, this study employs surveys as a research tool as various agents from several organizations were considered. These provided 342 possible relationships, including partnerships and subsidies, for subsequent descriptive analyses. The degrees of importance of the 342 connections generated a 19 × 19 square matrix (minus the focal organization, as it cannot relate to itself). With this information, the UCINET software generated the representative sociogram of the ego-centered interorganizational network.

3.2 Population and Sample

The population consisted of all organizations that maintain relationships with the focal organization, and the sample consisted of the organizations named by the subsidiary. The level of analysis was thus interorganizational due to the network of relationships of the subsidiary, which is considered a focal organization. The unit of analysis was each organization in the network, represented by key actors (individuals).

The criteria for choosing the focal company were the following: it had to be a transnational company with a subsidiary in Brazil; one of its main objectives had to be innovation for internationalization; it had to be a global player; and it needed to be willing to provide information about its network of relationships. After identifying the company, three professionals at the strategic level of the subsidiary located in Curitiba, Paraná, Brazil, were identified. The confidentiality of the focal organization identity was a condition of the data collection and formally communicated to all organizations interviewed.

The three professionals, considered *gatekeepers*, were interviewed so that they could describe the scenario in which the company was immersed and its strategic positioning at a global level. During the interview, the gatekeepers listed the primary organizations they considered fundamental for innovation and described these organizations' activities. This led to the generation of additional contacts that were contacted and who named other organizations. Finally, this produced 19 network actors, including the Curitiba subsidiary.

Among these companies, eight are subsidiaries located in the six countries, namely Argentina, Singapore, Colombia, Mexico, China, and Brazil), two São Paulo subsidiaries (one with an emphasis on development), and one subsidiary from Rio de Janeiro, in addition to the subsidiary in Curitiba, the focal company. Germany is also part of the network as a parent company, despite not being home to the joint venture's headquarters, because it owns half the shares of the entity created by a merger between the companies. The network was composed as shown in Table 1.

As Table 1 shows, all the network organizations pursue international activities involving 10 countries, including Brazil. Some of these organizations are large global players, with revenues exceeding US $5 billion for logistical partners and US $720 million for the company with the highest revenues in 2011. Considering that communication with most of the companies was conducted in English, it was decided to present terminologies and acronyms in that language, which will be used later in the network configuration analysis. The network also consists of two categories of organization: five suppliers and four logistics partners, with headquarters in countries such as France, the US, Switzerland, Colombia, Slovenia, and Brazil.

Table 1. Organizations in the network

Country	***Code***	***Field of activity***
1. Subsidiary_Argentina	S_Arg	Telecommunications - Subsidiary Argentina
2. Subsidiary_Singapore	S_Sin	Telecommunications - Subsidiary Singapore
3. Subsidiary_Colombia	S_Col	Telecommunications - Subsidiary Colombia
4. Subsidiary _Mexico	S_Mex	Telecommunications - Subsidiary Mexico

5. Headoffice_Germany	H_Ale	Telecommunications – Germany
6. Subsidiary_China	S_Chi	Telecommunications - Subsidiary China
7. Subsidiary_Brazil_CWB	**S_CWB**	**Telecommunications – Focal Company**
8 Subsidiary_Brazil_Rio de Janeiro	S_RJ	Telecommunications - Subsidiary RJ
9. Subsidiary_Brazil_São Paulo	S_SP	Telecommunications - Subsidiary SP
10. Subsidiary_Brazil_Academy	S_Aca	Telecommunications - Subsidiary Academy
11. Supplier 1 (Matrix: Brazil)	Sup_1	Information technology
12. Supplier 2 (Matrix: Brazil)	Sup_2	Teaching and research
13. Logistic Partner 1 (Matrix: Switzerland)	LP_1	Logistic operator
14. Logistic Partner 2 (Matrix: Switzerland)	LP _2	Logistics services
15. Logistic Partner 3 (Matrix: USA)	LP _3	Logistics services
16. Supplier 3 (Matrix: Colombia)	Sup _3	Telecommunications services
17. Supplier 4 (Matrix: Brazil)	Sup _4	Information technology
18. Logistic Partner 4 Matrix: France	LP _4	Consulting and transport
19. Supplier 5 (Matrix: Slovenia)	Sup _5	Information technology

Source: Survey data

3.3 Data Collection

The questionnaire produced structured data in a matrix, constructed based on the theoretical foundation and focus area of this research. Prior to the referral, the questionnaire underwent a validation process with eight professors with doctorates in administration studies.

As all the companies in the network are transnational and eight of the respondents are located in other countries, the questionnaire was translated into English and sent by e-mail, with frequent follow-up by telephone. A six-month response period was employed for two reasons: (1) transnational corporations must follow legal protocols when releasing data, and (2) only three of the companies were located in Curitiba/Paraná, with the other companies located in foreign countries (eight companies) or in other states in Brazil (eight companies).

From these data, it was possible to identify the measures of centrality and structural holes, as well as the relational content, with an emphasis on the exchange of information, product innovation, and entry into new markets.

4. Presentation and Data Analysis

The starting point for the network configuration was choosing as the focal company a transnational firm in a position of global leadership in telecommunications services and a focus on innovation. The focal company has a complete portfolio of mobile, fixed, and convergent network technology, as well as professional services, including consulting and systems integration, set-up, maintenance, and managerial services. It operates in 150 countries and is one of the most important companies in the world in this sector, with annual revenue of 14 billion euros in 2011. The company was formed through a joint venture announced in 2006 between two large companies with headquarters in Germany and Finland; their total stock was divided in half between the companies.

The term “transnational” is based on the work of Bartlett and Ghoshal (1998), who suggest that many global industries have transformed since the 1980s, when there were traditional categories of global, multinational, or international corporations. The more current, transnational form requires companies operating globally to simultaneously deal with the configuration of assets and capacities, the role of operations abroad, and the development and diffusion of knowledge to remain competitive.

The analysis treated the network symmetrically-that is, without considering the directional differences in the relationships, known as the “indegree” and “outdegree.” According to Scott (2000), “the indegree of a point is the total number of other points that have lines directed to it; the outdegree is the total number of other points to which it directs lines” (p. 69). As this study seeks to identify flows from relationships regardless of reciprocity, the degree satisfies this need, since it indicates the number of direct relationships among actors (in this case, network organizations), as well as one of the elements for the calculation of centrality (Borgatti, Everett, and Freeman, 2002). The network of relationships among the 19 organizations of the ego-centered network, originating from the S_CWB organization (a subsidiary in Curitiba), can be illustrated as in Figure 1.

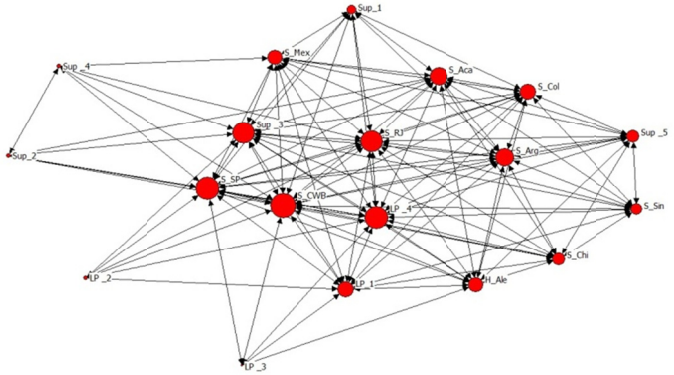

Figure 1. Ego-centered network

4.1 Density of the Network

The measurement of density is one of the most common in network analysis. It is problematic when used with value data, however, and it varies along with the size of the network (Scott, 2000). Density is a measure of the potential flow of information, not of the actual flow. It is the quotient produced by dividing the actual connections between the actors in the network by the total number of possible connections between them, using binary data (1 indicating that it has a relationship and 0 indicating otherwise). The average density of relationships in the network, obtained by the real number of relationships (226) divided by the possible number of relationships (342), is 0.6608. Thus, from the total possible interactions resulting from crossing the columns with the rows, relationships exist in 66.08% of the cases, showing that the network is dense. The possible number of relationships was identified by the size of the network, defined as the number of rows and columns arranged in a matrix. In this case, the network is composed of 19 organizations, with up to 342 potential relationships among them. According to Hanneman (2001), "in any network there are (k*k-1) unique pairs of actors, so AB is different from BA, where k is the number of actors" (p. 41).

The density of the network under analysis could be low because it is ego-centered: other organizations named by the focal organization as being more important may not necessarily be considered important to other organizations in the network. However, there is clearly a substantial flow of relationships, justified by the strong tendency toward innovation, as noted during the interviews with professionals at the strategic level. In addition, the density calculation considers only direct relationships between actors and does not consider intermediate actors, which are important for their ability to intermediate in communications between pairs of nodes, as is the case of *Betweenness*, which is considered below.

4.2 Central and Peripheral Organizations in an Ego-centered Network

Using a symmetric matrix, it is possible to divide the central and peripheral actors of the network into blocks. The matrix simultaneously adjusted the core/periphery model of the network and identified which organizations in the ego-centered network are part of the center and which are part of the periphery, as shown in Figure 2.

		1 S	2 S	3 S	4 S	5 H	6 S	7 S	8 S	9 S	10 S	11 S	12 S	13 L	14 L	19 S	16 S	18 L	17 S	15 L
1	S_Arg		1	1	1	1	1	1	1	1	1	1		1		1	1	1		
2	S_Sin	1		1			1	1	1		1			1		1	1	1		
3	S_Col	1	1		1	1		1	1	1	1	1		1		1	1	1		
4	S_Mex	1		1				1	1	1	1	1		1		1	1	1	1	
5	H_Ale	1		1			1	1	1	1	1			1		1	1	1		1
6	S_Chi	1	1			1		1	1	1	1			1		1	1	1		
7	S_CWB	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1
8	S_RJ	1	1	1	1	1	1	1		1	1	1		1	1	1	1	1	1	
9	S_SP	1		1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1
10	S_Aca	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1		
11	Sup_1	1		1	1			1	1	1	1						1	1		
12	Sup_2							1		1	1						1	1	1	
13	LP_1	1	1	1	1	1	1	1	1	1					1		1	1		1
14	LP_2							1	1	1				1			1	1		
19	Sup_5	1	1	1	1	1	1	1	1	1	1							1		
16	Sup_3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	
18	LP_4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1
17	Sup_4			1				1	1	1		1				1				
15	LP_3				1			1		1			1					1		

Figure 2. Central and peripheral organizations in the ego-centered network

The matrix is divided into four blocks: (1,1), relationships among central actors; (1,2), relationships of the central actors with peripheral actors; (2,1), relationships of peripheral actors with central actors; and (2,2), relationships of peripheral actors among themselves. The result of the matrix points to the concentration of central actors in the network, with only two organizations identified as being peripheral (Sup_4 e LP_3) , which may be explained by which may be justified by the fact that they are considered important for a focal organization located in Brazil, but not for other organizations. network. In this case, the two organizations may be part of the competition for "global purchasing power," as pointed out by Leontíades (2001) for a focal company, but may not have the same weight in the ego-centered network.

4.3 Structural Equivalence

Methods of positional analysis based on structural equivalence seek to identify actors that are approximately equivalent. In order for two actors to be structurally equivalent, the entries in their respective rows and columns of the adjacency matrix must be identical, and the Euclidean distance (for actors *i* and *j,* the distance between rows *i* and *j* and columns *i* and *j* of the adjacency matrix) will be equal to zero. To the extent that these two actors are not structurally equivalent, the Euclidean distance between them will be greater (Weymer, 2005).

Wasserman and Faust (1994) define a position as "a set of individuals in relationship networks" and a role as "patterns of relationships established between actors or positions" (p. 348). In Figure 3, the ego-centered network organizations that are structurally equivalent are grouped at the points of intersection between the lines indicating the level of structural equivalence. At these points, patterns of connections emerge that are similar to those of the total network.

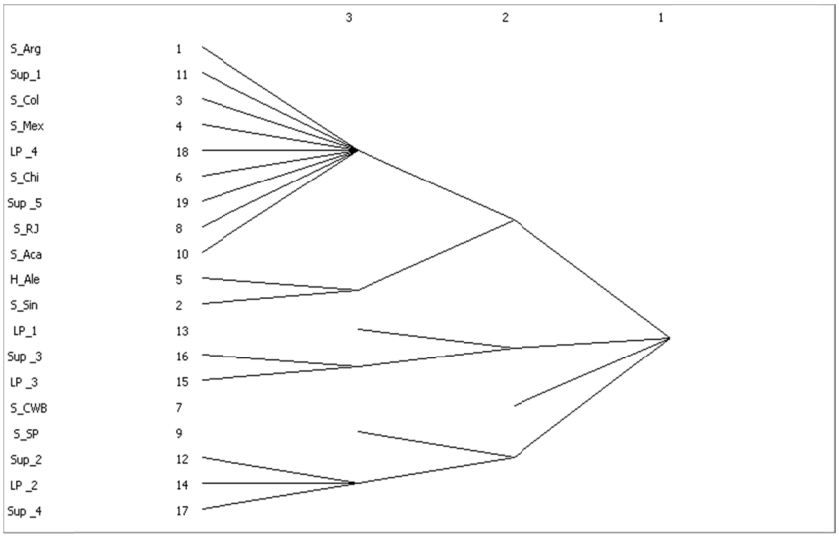

Figure 3. Structural equivalence

4.4 Centrality

Centrality is related to the access of a certain actor to the other actors in the network, considering the distribution pattern between them. A specialized reading offers different ways of calculating this in order to obtain comprehensive information about the situation under study, especially in ego-centered networks (Scott, 2000). Thus, measures of centrality and structural holes were calculated based on the symmetric matrix of relationships, as in Table 2.

The measure of degree of centrality based on symmetric connections (Knoke, 1994) indicates that subsidiary *S_CWB* was named by all the organizations, reflecting its strong relationship of influence on the other organizations of the network. Moreover, though some organizations were not named, the measure of centrality of proximity indicates that their probability of reaching other organizations in the network is high, since the number of steps an organization needs to reach them is low.

The degree of intermediation represented by the *Betweenness* measure shows that there are central intermediate organizations with the capacity to influence the structure of the network. They do this by controlling resources and information paths and mediating communication between pairs of nodes. The *Eingenvector* measure indicates that the *Sup_4* organization has less prestige in the network, perhaps because it is a supplier that is important for the focal organization but does not necessarily offer common inputs to the other subsidiaries of the network.

The *Effsize* measure is considered a measure of structural holes, as mentioned. The *Effsize* measure suggests that there are spaces between actors, which may mean the absence of a relationship between an organization in the ego-centered network and sources of resources or information. This is particularly observable in the adjacent relationships of the subsidiaries.

Such measures of centrality offer a way to evaluate the influence of certain organizations on the network structure through direct and indirect relationships, as well as relationships of proximity. In statistical terms of network analysis, the results obtained offer important ways to relate the degrees of centrality with dependent variables according to various data of interest.

Table 2. Independent variables of the ego-centered network

	Measures of Centrality				***Measure of Structural Holes***
Organization	*Degree*	*Closeness*	*Betweenness*	*Eingenvector*	*Effsize*
S_Arg	77.78	81.82	1.02	37.71	3.00
S_Sin	55.56	69.23	.24	28.29	1.80
S_Col	72.22	78.26	.79	35.50	2.69
S_Mex	66.67	75.00	1.25	32.31	3.00
H_Ale	66.67	75.00	1.22	32.53	2.83
S_Chi	61.11	72.00	.31	30.97	1.91
S_CWB	100.00	100.00	7.54	42.41	7.44
S_RJ	88.89	90.00	3.73	40.17	5.25
S_SP	94.44	94.74	6.52	40.38	6.88
S_Aca	77.78	81.82	2.01	36.52	3.86
Sup_1	50.00	66.67	.0	26.58	1.00
Sup_2	33.33	60.00	.22	16.62	1.67
LP_1	72.22	78.26	2.27	33.36	4.08
LP _2	33.33	60.00	.0	18.22	1.00
LP _3	27.78	58.06	.0	14.62	1.00
Sup _3	88.89	90.00	4.56	39.17	5.59
Sup _4	33.33	60.00	.22	16.24	1.67
LP _4	94.44	94.74	5.60	41.25	6.41
Sup _5	61.11	72.00	.40	30.63	2.09

4.5 Relationship Content in the Ego-centered Network

In the network under study, the focal organization has a strategic positioning focused on innovation and characterized by the nature of its telecommunications business. Although it is not possible to identify the information related to the innovation that flows in the network, the organizations in the network recognize the importance of informational exchange, as can be corroborated by the responses obtained about activities that are carried out jointly, as shown in Figure 4.

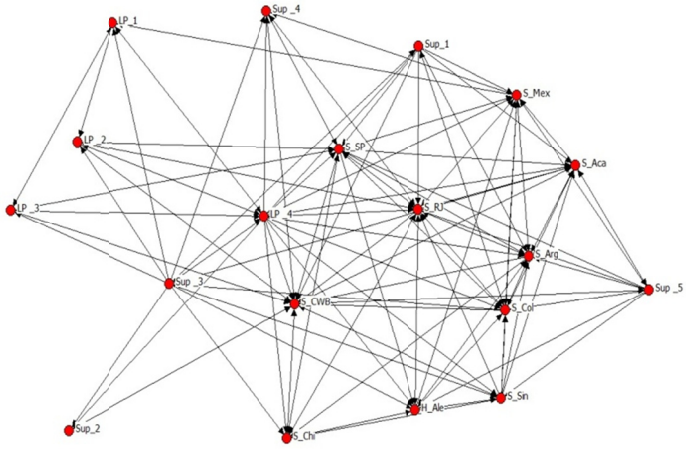

Figure 4. Activities carried out together: informational exchange

Table indicates that the organizations named most frequently are those considered important sources of informational exchange. These organizations occupy more central places in the network and can be better visualized in Table 3.

Table 3. Informational exchange

		Degree	NrmDegree
18	LP_4	17.000	94,444
9	S_SP	14.000	77,778
7	S_CWB	14.000	77,778
8	S_RJ	14.000	77,778
1	S_ARG	12.000	66,667
4	S_MEX	12.000	66,667
3	S_COL	12.000	66,667
16	Sup_3	12.000	66,667
2	S_Sin	11.000	61,111
10	S_aca	11.000	61,111
5	H_Ale	10.000	55,556
11	Sup_1	9.000	50,000
19	Sup_5	9.000	50,000
6	S_Chi	8.000	44,444
17	Sup_4	9.000	50,000
14	LP_2	6.000	33,333
13	LP_1	6.000	33,333
15	LP_2	5.000	27,778
12	Sup_2	3.000	16,667

Source: Survey data

According to Borgatti, Everett, and Freeman (2002), *the degree* indicates the number of direct relationships between organizations. It is also one of the elements for calculating centrality. The third column, represented by *NrmDegree*, indicates the degree of centrality divided by its possible maximum value, expressed as a percentage. In this case, of the first 10 companies in the ranking, eight are subsidiaries, one is a supplier, and another is a logistics partner.

The presence of subsidiaries in the top 10 seems to be a natural trend for organizations that are linked to a parent company and that have common long-term global goals. It is worth mentioning here that the company most frequently named concerning information exchange was logistics partner *LP_4*.

This centrality can be explained by the fact that the company is a global player, is of French origin, operates in the logistics field, and serves almost all the organizations in the network (94.44%) in the international arena. As it is a logistics services provider, the content of information exchange is related more to negotiation than to the integration of knowledge, which has implications for the adaptations of partner organizations concerning innovative activities.

Another important piece of complementary data is related to the contribution of relationships to product innovation for each company.

Table 4. Contribution to product innovation

Very low	33%
Low	28%
Mid-range	23%
High	8%
Very high	8%

Considering the total number of effective relationships in the network, the perception of each company when dealing with its peers has little direct influence on the innovation of new products (61% of survey responses were between “low” and “very low”). Only the subsidiaries from Singapore and Germany acknowledge receiving high levels of contributions from certain Subsidiaries. Additionally, worth considering is the organizations’ influence on entry into new markets, which can be visualized in Figure 5.

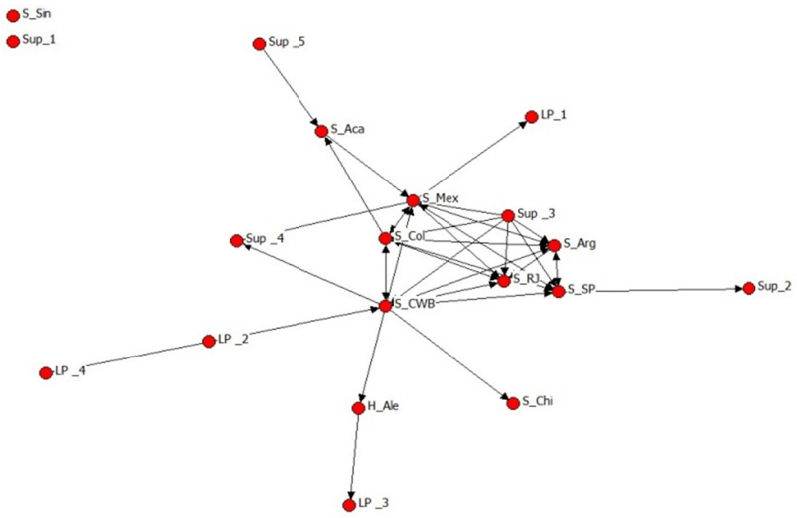

Figure 5. Entry into new markets

There is significant dispersion in the network. The exploration of new markets is concentrated in South and Central America. This finding requires a caveat, since this survey question was related to the variable "joint activities," which presented options of policy action, information exchange, cost reduction, social activities, and entry into new markets. The subsidiaries in Curitiba/Brazil, Mexico, and Colombia received ten, nine, and seven identifications, respectively, as important partners for entry into new markets.

According to the primary data, one of the companies held approximately 65% of the cellular market in Brazil before the joint venture, with two factories in Manaus and three work shifts, in addition to distributing products to the rest of Latin America. Despite this significant participation in relative terms, the company represented only 5% of the global market overall, and therefore, shut its operations.

5. Conclusions

This article aimed to identify the relationship structure of an ego-centered network by examining a transnational focal organization in the telecommunications sector with an orientation toward innovation, through the dimensions of density, centrality, structural equivalence, and relational content. The capacity for innovation with global perspectives seems to be a crucial factor for telecommunications companies, which are immersed in an extremely connected context, in terms of their strategies and their impact on other sectors of the global economy due to their inherently transformative nature. In this scenario, network analysis is useful as a comprehensive way to understand the complexity that permeates the process of innovation, beyond the borders of the organizations themselves and beyond their local markets.

Organizations are so enmeshed in relationships with other organizations that their behaviors are continually influenced by their social relationships. In this sense, the main theoretical contribution of this study is identifying the relationship structure of a transnational ego-centered network oriented toward innovation, with the aid of a statistical tool that allowed for objectivity. We examined the underlying concepts of network innovation with network analysis used as a research method.

It is important to note that information sharing is not always a decisive factor in innovation from the network perspective. The reason seems to relate to the global strategic positioning of the matrix, which may consider the most innovative products to be those with worldwide scope and not just with local/regional interest. Moreover, the position of organizations with regard to distance and pathways to other organizations in the network can influence the network's capacity for innovation, conditioned by the strategic positioning of the focal company, as was the case for the company examined in this study.

Although these findings are subject to limitations of their statistical and methodological generalization, especially with regard to the boundaries of interorganizational networks, their analytical perspective could be deepened and broadened via critical reflections suggested by this study. Replicating this study using more qualitative data could improve the level of analysis through the triangulation of data and a deeper exploration of the content that flows in social relationships.

Another recommendation is to expand the number of organizations in the network, including clients and other

organizations in the same social context. This would allow for not only an analysis of dyads but also a structural analysis enabling the inclusion of other relevant information available from the network analysis technique. The structural properties of the network could be considered independent variables and be related to other variables, according to the interest of the researcher.

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