# Exploring the Dynamics of Information and Knowledge Sharing in Intraorganizational Networks: A Longitudinal Study of a Brazilian Organization

**Elaine Dias¹, Joaquim Fialho², Marcos Cavalcanti¹**

¹Reference Center for Strategic Intelligence (CRIE), Federal University of Rio de Janeiro, Rio de Janeiro, Brazil
²Center for Research in Social Work and Social Intervention (CLISSIS) of Lusíada University, Lisboa, Portugal
Email: elainecfdias@gmail.com, Joaquim.fialho@gmail.com, marcos@crie.ufrj.br

## Abstract

The specificities of Knowledge Networks in organizations influence the flows of data and information, as well as the creation of knowledge. This study aimed to identify whether the network of a Brazilian non-profit organization, along with its structural and relational representation, can be considered facilitators of the flow of information and knowledge, with a special focus on institutions working in public education and their political and institutional challenges. We conducted a longitudinal study between 2021 and 2023, utilizing Social Network Analysis to reveal invisible patterns of information flow and collaboration among key strategic stakeholder groups. Data collection was performed through an online survey, and responses were analyzed using Ucinet Windows software and visualized with NetDraw. The results, obtained from metrics of network centrality and density, highlight three main roles of actors: Central Connectors, Intermediaries, and Peripherals. These roles are crucial in facilitating knowledge dissemination across different areas, which can be achieved through information sharing and experience exchange among members. Therefore, it is essential for the organization to map and monitor the density and reciprocity metrics of the existing social network. This assessment can identify links that exhibit high, low, or no exchange of knowledge, which is beneficial for understanding the dynamics of organizational behavior. This study highlights that understanding and enhancing organizational behavior is essential for enhancing overall productivity and effectiveness within the organization. By fostering a culture of collaboration and open communication, organizations can address the dynamics that influence how information is shared and utilized among members. While effective knowledge management practices

are important, they should be viewed as part of a broader organizational behavior framework that encompasses the development of relationships, trust, and engagement among employees.

## 1. Introduction

Education is a fundamental right and at the same time one of the pillars of human development from a social, cultural, political, and economic point of view. Much of the difference between countries' long-term economic growth rates can be explained by differences in the quality of education offered to their population.

This can be observed in the Brazilian reality, where complex challenges exist for schools to ensure that students can learn and develop to face their life projects. According to recent data from the Brazilian Institute of Geography and Statistics (IBGE) (2022), approximately 3.6 million children and adolescents aged 4 to 17 were not enrolled in school in 2022, highlighting a significant issue in access to education. Additionally, many public schools contend with inadequate infrastructure, a lack of qualified teachers, and limited resources, which further hinders the quality of education provided.

Faced with this reality, the mobilization of civil society is crucial. Several non-profit organizations (NPOs) in the education sector scattered across the country provide fundamental services to address these gaps. These organizations play a pivotal role in developing educational programs, offering training for teachers, and creating innovative learning opportunities for students. By collaborating with schools and government entities, NPOs work to enhance educational outcomes and foster community engagement.

Moreover, the political and institutional challenges that these organizations face, such as bureaucratic hurdles and fluctuating public policies, necessitate a strong and well-structured network. Through coordinated efforts and the sharing of best practices, NPOs can better navigate these challenges, promote effective educational reforms, and ultimately contribute to a more equitable education system in Brazil. Thus, strengthening the networks of these organizations is essential not only for improving their own effectiveness but also for ensuring that they can better serve the educational needs of Brazilian youth.

Non-profit organizations working in education are very specific entities, holders of a wealth of knowledge acquired over the years as a result of the social and educational transformations that have occurred in Brazil. Today, for a variety of reasons, these organizations are compelled to develop strategies that foster creativity and resilience to effectively respond to the educational challenges they face.

From the perspective of organizational behavior, understanding the intra-organizational dynamics within a non-profit organization is essential, as it sheds light on how these dynamics influence the sharing of information and knowledge through informal networks. Knowledge sharing, a key component of successful knowledge management strategies (Eidizadeh et al., 2017), is characterized by behaviors involving the exchange of task-relevant ideas, information, and suggestions within and between teams (Elrehail et al., 2018). These interactions and relationships among individuals within the organization can significantly impact organizational effectiveness and innovation.

The NPO aims to develop and evaluate solutions for educational management, producing and disseminating knowledge about these solutions based on empirical evidence and scientific information. The empirical study presented was conducted in a Brazilian non-profit organization focused on public education that has been active in the country for more than 30 years. This long-standing presence allows the organization to leverage its insights and adapt to evolving educational needs, further emphasizing the importance of organizational behavior in fostering an environment conducive to collaboration and knowledge sharing.

As a third-sector organization focused on promoting reciprocity and free-flowing interactions that engage all participants, the analysis of organizational social networks was deemed important by the company itself.

Most organizations take little advantage of relational capital management (Cross & Parker, 2004). Organizational leaders recognize the importance of informal networks when it comes to influencing behavior but fail to understand when these networks are effective and when they are not. Thus, they have great difficulty in discovering how networks work beyond their connection points.

The relationships and connections between actors, as well as the roles that each one assumes within the network, establish interactions that contribute to the formation of the social structure and a high degree of complexity. Through network interactions, bonds between members are strengthened and an actor can gain access to the resources of other actors. Social interactions between different sectors of the organization can blur boundaries and stimulate the formation of common interests, which allows actors to have more opportunities to exchange or combine their resources with others.

One way to understand how these existing relationships between formal and informal organizations are configured is through the analysis of social networks, which involves mapping the network, analyzing its characteristics and types of connections (network topology), and visualizing structures with central and peripheral actors. Social Network Analysis (SNA) is an approach derived from Sociology, Social Psychology, and Anthropology (Freeman, 1996).

By studying the relational ties between social actors, this approach allows simulation of the effects on productivity and creativity indices if key personnel leave the organization, offering early warning signals. Networks are, by their very nature, the most complex systems, and nodes and links deeply permeate all strategies

aimed at approaching this interconnected universe (Barabási, 2002).

This study investigates how the structure of a Brazilian non-profit organizations' network influences the flow of information and knowledge, specifically focusing on the sharing of data and evidence within the context of public education. The research examines how effectively the network's structural and relational components facilitate data and evidence exchange to improve educational outcomes.

The COVID-19 pandemic underscored the need for organizations working with public education information to strategically leverage knowledge and capabilities to address digital inequalities among students and other challenges, we conduct periodic analyses of the knowledge network. To this end, we conducted periodic analyses of the internal knowledge network, with mapping efforts undertaken in 2021 and 2023.

## 2. Literature Review

In recent years, there has been a profound organizational transformation: from a structure focused on the organization, it has moved to a network structure. The network configuration facilitates the fulfillment of the specific needs of the client and makes it possible to increase the flexibility of the organization, improving its ability to adapt to changes. Thus, large vertical organizations reconfigured themselves and began to network and behave with few hierarchical levels and with a high degree of flexibility.

The term "Networks" has been arousing interest in different areas, such as computer science, biology, psychology, physics, and administration. Research has been carried out to analyze the relationships and connections between the actors the role that each one assumes within the network and their interactions that contribute to the formation of the social structure (Borgatti, Mehra, & Labianca, 2009).

To understand the relevance of knowledge networks (KN) for organizations, it is necessary some definitions of data and information, elements directly related to organizational knowledge. Data are the raw material of information, which during the process of understanding, contextualization, reflection, and synthesis of information turns into knowledge. Knowledge is a dynamic blend of experience, values, context, and insights that shapes how individuals interpret and apply new information. It resides not only in formal records but also within organizational practices and routines (Davenport & Prusak, 1998).

Furthermore, knowledge is a step further because it involves understanding and the ability to make use of data and information to answer questions, solve problems, and make decisions (Borgatti, Everett, & Freeman, 2005).

Evidence, on the other hand, is facts, data, or information that support or corroborate a statement, theory, or argument. They are used to validate or refute propositions. In the scientific context, for example, evidence can be experiments, observations, or study results that support or contradict a hypothesis.

In summary, data are the basic elements, information is the organization and context of data, knowledge is the understanding derived from information, and evidence is the elements that support statements or arguments. They are interconnected components that play different roles in the acquisition, application, and sharing of knowledge.

From the perspective of KN, knowledge sharing among people can be constant because network actors often like to share what they know and feel valued when others are interested in knowing about their expertise (Tomaél & Marteleto, 2006).

Each actor has a lot of information about his situation but usually has no information about other situations (Dixon, 2000). To reduce uncertainty and consolidate the partnership, actors need to have more reliable information from their partners. In this way, everyone wins, because each actor builds foundations and develops new actions based on the shared information (Yu, Yan, & Cheng, 2001).

The willingness to share and the efficient sharing of information between actors in a network ensure gains, because each participant improves, using the information to which they have access, and that can reduce uncertainties and promote mutual growth (Tomaél & Marteleto, 2006).

Learning and the creation of new knowledge occur through the interactions achieved in networks; communication between individuals is one of the central elements in these networks. Encouraging network actors to the task of stimulating and sharing knowledge presupposes the trust of its members (Tomaél, Alcará, & Chiara, 2008).

The learning and individual actions resulting from networks can determine how organizations adapt to rapidly changing environments, in addition to innovating to meet the challenges and demands that arise. They represent project teams, research groups, consulting networks, professional communities, and communities of practice or even support groups providing individuals with the opportunity to learn and acquire new knowledge (Johnson, 2011).

The effective interaction between actors and the sharing of information and knowledge in KN are its driving elements. It is through the interactions, sharing, and quality of this information that a network can achieve effectiveness in its processes (Wang et al., 2014).

The expression knowledge network KN has been used to designate various models of cooperation work, such as knowledge management networks, strategic alliances, expert networks, information networks, communities of practice, and virtual KN, among other elements and forms of cooperation networks (Pugh & Prusak, 2013). KN can be seen as "groups of individuals who come together across organizational, spatial, and disciplinary boundaries to create and share knowledge. The focus of these networks is generally the development, distribution, and application of knowledge" (Tomaél, 2008).

Within the context of organizational behavior, the effectiveness of knowledge networks is influenced by the interpersonal relationships, communication styles,

and cultural dynamics present within and between organizations. The behaviors and motivations of individuals in these networks play a crucial role in fostering collaboration, trust, and the willingness to share information. Understanding these behavioral aspects can help organizations design more effective knowledge networks that not only facilitate knowledge sharing but also enhance overall organizational performance and innovation.

The growth and strengthening of the network are related to two main factors related to the actors of the network (Tomaél, 2008; Marteleto, 2001) generates a feeling of being rewarded and contributing by sharing and receiving information and knowledge that they did not have, and the size of the network (the growth in the number of actors that make up the network can be seen as a result of effective actions of sharing and receiving information), pointing to the effectiveness of the network, that is, its size will naturally increase as long as it is fruitful in its actions.

In this way, through network interactions, ties between members are strengthened and an actor can gain access to the resources of other actors. Social interactions between different areas of the organization can blur boundaries and stimulate the formation of common interests, which makes it possible for an actor to have more opportunities to exchange or combine their resources with other actors.

One of the ways to understand how these existing relationships between formal and informal organizations are configured is through social network analysis (SNA), with the mapping of the network, its characteristics and types of connection (network topology), and the visualization of structures with Central, Intermediate and Peripheral actors.

SNA is an important instrument for understanding the relationships that foster the sharing of tacit and explicit knowledge through the creation of new ties and the structuring and maintenance of social networks. The authors emphasize the importance of studying social networks in segments in which collaboration is a necessary tribute to information sharing and knowledge generation (Cross, Borgatti, & Parker, 2001; Fialho, 2014).

In this sense, it highlights the need to understand the dynamics of relationships and to decode information flows in order to comprehend the mechanisms and actors that influence power in complex environments (Cross & Parker, 2004).

The use of the methodology of Social Network Analysis (SNA) has been expanding in recent years and encompasses several areas of knowledge. SNA focuses on the study and understanding of the different types of interaction/behavior observed between individuals, organizations, or even countries and has its origin in several theoretical currents, with the influence of researchers from different areas of knowledge. More than analyzing actors in isolation, the SNA perspective understands that actors are immersed in networks of relationships that provide opportunities, as well as generate restrictions on the performance of those involved (Kenis & Oerlemans, 2008).

Most organizations do not take advantage of and do not manage relational

capital. Leaders of organizations recognize the importance of informal networks when it comes to influencing behavior, but they fail to understand when these networks are effective and when they are not. Thus, they present great difficulty in discovering how networks work beyond their connection points (Cross, Borgatti, & Parker, 2001; Cross & Parker, 2004).

What cannot be seen is usually not measured, and what is not measured is hardly managed. The social networking perspective enables decision-making and simplifies collaboration requirements, allowing you to see where information blocking exists within an organization. SNA allows you to simulate what would happen to productivity and creativity rates if key players left the organization, providing early warning signs (Hanneman, 2005).

The way social networks operate is similar in its principles to those that govern living systems, being distinguished from spontaneous and natural networks by their intentionality of relationships and objectives established between the various elements that interact in them. Numerous types of networks are revealed, based on different types of relationships. In this way, the main network typology results from the form and content of the relationship, the form being the property of the relationships and having as main constituent aspects: the intensity or strength of the bond established between the actors and the level of commitment that is assumed in certain activities (Fialho, 2014).

Social networks "are systems of nodes and links; a structure without Borders; a non-geographic community, a support system or a physical system that looks like a tree or a network". The social network represents "a set of autonomous participants, uniting ideas and resources around shared values and interests". They are social subjects, connected through links motivated by common interests, these links being essential for understanding the relationship (Marteleto, 2001; Wang et al., 2014).

Another characteristic is the absence of hierarchy in traditional patterns and the emphasis on an informal structure that values relationships, allowing each actor free association. The power relationship is not visualized through organizational charts but through the number of relationships that an actor maintains with others, which, depending on their position in the network, and their degree of centrality, tends to stand out. A network, which is a nonlinear, decentralized, flexible, dynamic structure, without defined limits and self-organizing, is established by horizontal relations of cooperation (Tomaél & Marteleto, 2006; Cross et al., 2006).

In this case, the presence of groups that utilize data and evidence contributes to the formation of a social network, leveraging the information possessed by each employee. To understand the structure of the network, it is essential to identify three basic elements: a) nodes or actors; b) links or relationships; c) flows. Nodes or actors are people or groups of people who are driven by a common goal. The sum of the nodes represents the size of the network, and the links are the ties that exist and are established between two or more nodes and are represented by lines.

The flow indicates the direction of the bond and can assume several designations: unidirectional or bidirectional (Fialho, 2014).

Some concepts related to SNA served as a basis for understanding the data obtained in the research and the understanding of the configuration of social networks as a whole (Wasserman & Faust, 1994; Granovetter, 1973):

1) Centrality: It is the position of an individual about others, considered as a measure of the amount of links that are placed between them. An actor is central to a network if he has a large number of connections to others. There are three basic centrality metrics: Degree centrality (in-degree and out-degree): the number of times an actor has with other actors in a network, taking into account only adjacent relationships, i.e. the actors' local centrality. Proximity centrality (closeness): proximity between the actors, being obtained through the sum of the Geodetic distances between all the actors. It makes it possible to demonstrate the global centrality of the actors. The lower the index, the closer an actor is to everyone else. Centrality of intermediation (betwenness): considers an actor as a means to reach others, since it is in the Geodetic paths between other pairs. The mediator can control the flows in the network and the path they travel.

2) Density: It is the number of existing connections, divided by the number of possible connections. It reveals the percentage of relationships present in the network about all relationship possibilities. Through density, it is possible to classify bonds as strong or weak. Granovetter approached the concept of strong and weak bonds in 1973, considering weak bonds with low density, in which many possibilities of relationship are absent. On the other hand, the strong connections are closer and present a greater involvement between the actors.

3) Reciprocity: These are the relationships that occur mutually between individuals, that is, the relationship is bilateral and the structural configuration of the network presents bidirectional arrows.

Cross, Borgatti, & Parker (2001) identify the relationship patterns as:

1) Central connectors or hubs are actors that have a disproportionate number of relationships in the network. When a network actor fits this type of pattern he is either an expert or a bottleneck for the network.

2) Information intermediaries or Information brokers are actors who are closest, even indirectly, to all members of the network. Information brokers have a great influence on the flow of information in the network, so they are the people indicated to start the dissemination of information and also promote an increase in connectivity in the network.

3) Peripheral people are actors with few connections within the network. People who are in this role, in most cases, should have their number of connections increased since they represent little-used resources.

Social network analysis provides valuable insights into the flow of information and knowledge within a group. By examining these networks, it becomes possible to identify key actors who have the critical competencies for the organization.

## 3. Research Methodology

In order to investigate potential flow of information and knowledge within an organization, a longitudinal study was conducted using the SNA methodology in March 2021 and repeated in March 2023. Specifically, the objective is to map the networks of consultation and sharing of data and evidence for daily activities within the organization. This includes examining how collaborators interact in obtaining and sharing information, as well as identifying the external nodes of the network. This research is classified as applied in nature, a type of research focused on acquiring knowledge for application in a specific situation. The research focuses on information and knowledge networks within the context of relationships within the Organization, providing support for structuring processes that facilitate these relationships and promote the emergence of new knowledge networks.

The centrality of actors measures not only their accessibility but also the number of communication paths that pass through them. Based on these measurements, inferences can be made about actors who play critical roles within the network and those who have fewer connections as peripheral actors.

The quantitative research strategy is justified by the characteristics of the research instrument and the work strategy, which allowed for the generation of metrics for the structural analysis of the studied network. The instrument used for data collection was developed in ArcGIS Survey 123, a tool that allows users to create, share, and analyze surveys. It can be used to collect data using mobile or web devices, even when offline.

The survey was piloted by five members and refined and reformatted in response to their comments. People listed as members of the NPO, as of January 2021 (n = 44), were invited to survey in March 2021, with each member receiving a link to the online survey. We repeated the same questionnaire in 2023 and sent the link to members (n = 106).

A structured questionnaire was used, allowing for easier quantification of data by asking the same questions to all respondents, thereby reducing bias (Alreck & Settle, 2004). The online survey method was chosen to meet budget constraints and minimize non-response bias while ensuring a sufficient number of respondents. The questionnaire consisted of three sections: Section A covered demographic information (name, job position, department and duration of employment), Section B comprises two open research questions about information flow, and a cover letter was included to explain the study's purpose and ensure confidentiality and anonymity, fostering trust between respondents and the researcher.

In both studies, informed consent was obtained from respondents, who were assured anonymity (identifiers replaced with codes).

To maximize the response rate, emails reminders were sent to non-respondents over four weeks. Before the final reminder, the General manager also requested that research group leaders encourage their team members to participate.

The links of the internal network were designed based on each employee's indication of up to three names of people with whom they maintained contact to

consult and share information for their work activities.

Responses to the questionnaires were collected and organized into Excel files. Following the recommendations of Borgatti, Everett, & Freeman (2005), ties were represented as (0) absent or (1) present, calculated simply from a binomial relationship (existence or absence of ties) through a quadratic matrix.

At this stage, the SNA methodology was applied through the creation of various adjacency matrices, the calculation of network metrics and indicators, as well as the design of graphs using Ucinet and NetDraw, software tools for analyzing relational structures.

Furthermore, it is worth highlighting that the sociometric analysis used in this study was adopted as an analytical tool to examine the patterns of interactions among the NGO's collaborators, focusing on the social relationships between the actors rather than their attributes.

## Data Gathering

Data collection occurred through individual responses to an electronic survey. The application of SNA allowed for the estimation of the size of the network in terms of perceived participation by its members and the density of connections. These data were used to calculate other network measures such as the centrality of degree of entry and exit, centrality of intermediation, and centrality of prestige/power.

Upon tabulating the survey results, the data were processed using UCINET 6.528, a system specifically developed for the quantitative analysis of social networks, through which the structural metrics of the network were calculated. Subsequently, NetDraw 2.174 was employed to automatically generate a visual representation of the network (Borgatti, Everett, & Freeman, 2005).

The first analysis performed was the network density metric found in UCINET through the operational routine: Network/Cohesion/Density/Density Overall. And then the measure of reciprocity is calculated: Network/Cohesion/Reciprocity.

The centrality metrics allowed the visualization of relationships: how each actor sees the others and how they are also seen by the other nodes of the same network. The centrality made visible the roles that each actor plays in their networks. Through the centrality metrics, the main actors and the types of roles (central connectors or Hubs, Information brokers or intermediaries, and Peripheral people or peripherals) that play in the consultation and sharing networks were identified.

The results of the centrality metric were found in Ucinet through the operational routine: Network/Centrality and Power/Degree.

The intermediation centrality or Betweenness visualizes how much the people of a social network depend on a certain actor, to make more connections with others and how these people mediate communications between the other nodes. The results were found in Ucinet through the operational routine: Network/Centrality

and Power/Freeman Betweenness (Node Betweenness).

The closeness metric was calculated to verify the ability of a node to connect to all other actors in the network and to demonstrate bi-directionality between actors. The results were found in Ucinet through the operational routine: Network/Centrality/Closeness.

## 4. Research Findings

### 4.1. Network Topology in 2021

In the first stage of the research, we applied an online survey in 2021. When information is assimilated, it becomes knowledge. Thus, the following question was formulated: "I consult these people when I need to use information to carry out my activities." This network had 37 actors, indicating the possibility of 1332 potential relationships (n = 44/response rate = 84%). "The greater the number of links between the actors, the denser the network is considered" (Tomaél & Marteleto, 2006).

However, it was found that the density of the network is 0.061, which is low, meaning that only 6.1% of the potential relationships are being used. The network metrics also revealed a degree of reciprocity of 0.038, indicating that only 3.8% of the connections are bidirectional and some actors seek others for information but are not remembered by them in the same situation. In this case, the low reciprocity level is acceptable because "A" may have information to provide to "B", but "B" will not necessarily have information to meet "A's" needs.

Figure 1 shows the configuration of the network from the perspective of obtaining information between internal actors (2021). Each point (actor) represents a respondent, and each line (tie) represents a collaborative link. The structure of this network was analysed using Ucinet software.

In the In-degree metrics, actors A16 and A11 presented a higher level of evidence in obtaining information because the largest number of actors cited A11 and A16 as principal contacts. The sum of in-degree and out-degree reveals the capacity of articulation in the network, and in this case, it was observed that the actor with the highest level was A11, who, like A16, is in the same work area ("Data Lab").

The Information Broker is the actor closest, even indirectly, to all members of the network. In the analyzed network, actor A16 presented the highest closeness value (0.52), demonstrating a high informational capacity, probably due to his work area (Data and information) and the time working in the organization (more than 8 years), making him a direct contact for questions related to data and evidence about public education.

On the other hand, actor A26 presented the lowest articulation capacity since it has the lowest sum of in-degree and out-degree, configuring itself as a Peripheral Broker. In the specific case of A26, little home time was identified (only 1 year and 3 months), which may justify the result.

The metric of intermediation centrality or Betweenness visualizes how much people in a social network depend on a certain actor to make more connections
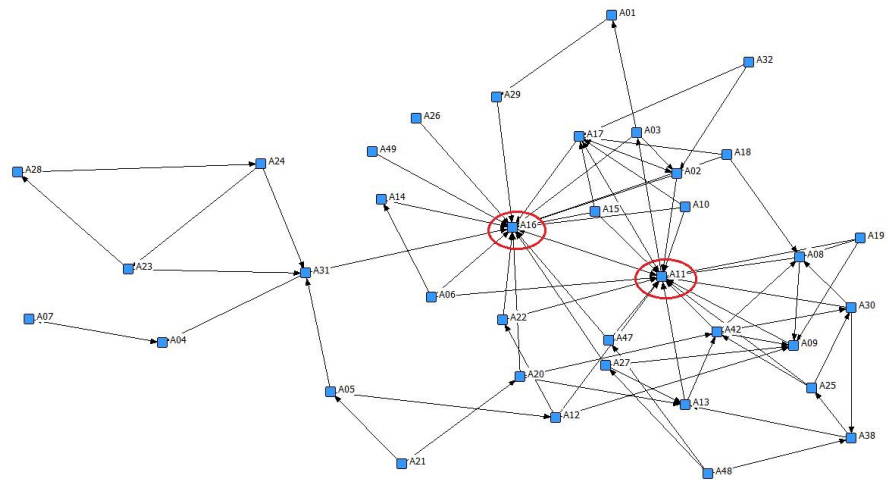
**Figure 1.** Knowledge consultation network (2021).

with others and how these people mediate communications between the other nodes. The actor that holds the highest degree of intermediation is A11. This metric shows the potential of a node as a control agent in the network. In this way, an actor with a high centrality of intermediation represents a link between indirectly connected actors, being able to play a broker role.

The second perspective analyzed dealt with the question "These people share essential information needed to perform my tasks", in which each participant freely and spontaneously chose up to three names of internal actors, as in the first perspective. **Figure 2** shows the configuration of the studied network from the perspective of sharing information in 2021. In the In-degree metrics, actors A16 and A11 presented a higher level of evidence in obtaining information.
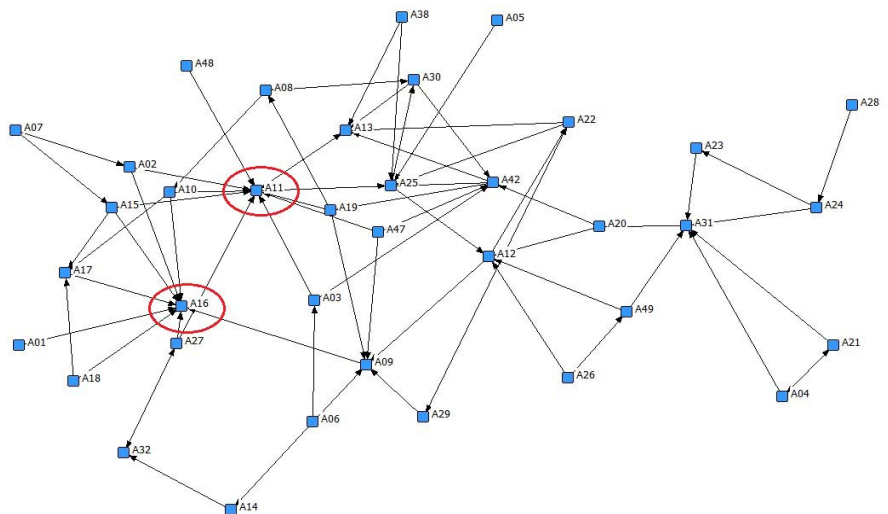


**Figure 2.** Knowledge sharing network (2021).

Network metrics revealed a density of 0.053 i.e. only 5.3% of connections present, which means that there is a high potential of elevation in the level of

information sharing in this network. The degree of reciprocity is 0.0923, i.e., 9.23% of the connections are bidirectional.

The metric for each actor, in the sharing of information, showed that the actor A11 has more evidence on the network, by being quoted, as who shares the most information, by the largest number of actors. Actor A11 has a high degree of centrality in both networks. The more control the individual has over the resources circulating on the network, the more centrality it will have. An individual has a high degree of centrality to the extent that it is directly connected with many others in the network and this is part of its "social capital", because social relations have an influential productive value in this process, being a good indicator of leadership (Koput, 2010).

The fact that A11 is also an Information Broker, in terms of the perspective of sharing information on the network, can be explained by its activity in the sector that generates and provides managerial information to the Organization. This activity systematizes the flow of information (data and evidence), which makes it a formal agent of dissemination of information in the network. The actors A1, A5, A28, and A48 represented the lowest sum of in and out-degree and their network-sharing relationships should be intensified.

The diagnosis of network mapping was corroborated by the resignation of a central network actor (A16) in early 2021, exposing the fragility of the network with the output of critical knowledge and the need for urgent actions to mitigate this risk.

This situation emphasizes the importance of mapping knowledge risks to enhance understanding of knowledge management, as the departure of such an influential figure could lead to significant knowledge loss and disrupt the flow of information essential for the organization's success (Durst & Malgorzata, 2019).

### 4.2. Network Topology in 2023

To understand the dynamics of the internal network with changes in the organizational structure and the entry and exit of employees, a new network mapping was started in 2023 with same questions. Over this 2-year period, the network size grew from 44 employees, to 106 and the response rate was 74% (79 answers). Analyzing this network, it was identified that only 215 of 8742 connection possibilities are carried out, characterizing a density of 2.46% of this network, a low density rate as in 2021 where the potential of connections is not being used.

The network metrics also revealed the degree of reciprocity of 1.9%, which means that few connections are bidirectional when some actors seek others to obtain information but are not remembered by them in the same situation.

Analyzing the network topology and the existing relationships, the actors B18 and B01 showed a higher level of evidence in obtaining information, as the largest number of nodes cited them as contacts. The sum of in-degree and out-degree reveals the ability to articulate in the network and this case, it was observed that the most central node was B18, a data analyst at the NPO with more than 5 years,

and can be considered a hub or a bottleneck in that network. B01 had already been one of the most central actors in the mapping of the network in 2021 (as actor A11), maintaining its position of high centrality in the informal network of information and knowledge sharing. Figure 3 shows the configuration of the network from the perspective of obtaining information between internal actors (2023).
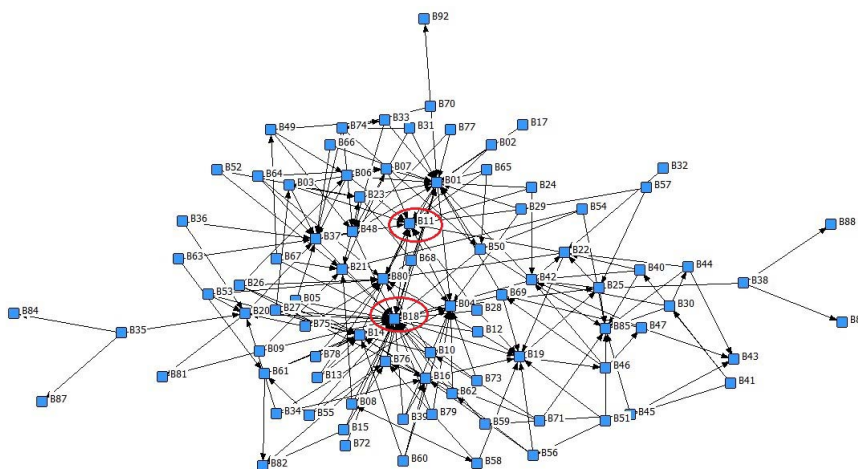


**Figure 3.** Knowledge consultation network (2023).

On the other hand, some actors showed less ability to articulate, since they have low values in the in-degree and out-degree sums, configuring themselves as Peripheral Brokers, such as actors B24, B34, and B68. These actors may have little time for activity in the NPO and, therefore, are not remembered by others as a source of consultation and/or do not have access to information. However, B68 has been with the NGO for more than 4 years and its very low centrality, an actor with whom other actors do not proactively engage.

In the network analyzed, actor B80 had the highest value for the closeness metric (0.808), followed by B18 (the most central actor in the network) with 0.803. The degree of proximity (closeness) between actors is the ability that an actor has to reach other actors, that is, the ability of a node to connect to all actors in a network. The identification of the B80 actor with this high degree of proximity demonstrates an informational capacity, probably due to the activity carried out by him as a focal point in the main system of the Organization. The Betweenness Centrality visualizes how much people in a social network depend on a certain actor to make more connections with others and how these people intermediate communications between the other nodes. This metric shows the potential of a node as a control agent in the network. In this way, an actor with high Intermediation Centrality represents a link between indirectly connected actors, being able to play the role of Broker. The actor with the highest degree of intermediation is B18, once again its role within the network is highlighted.

The second question, as in the 2021 survey, questioned who were the people who shared the data or evidence needed to carry out the activities at work and

once again, each employee could indicate up to three actors (B18, B01 and B37). **Figure 4** shows the network configuration studied from the perspective of knowledge sharing in 2023.
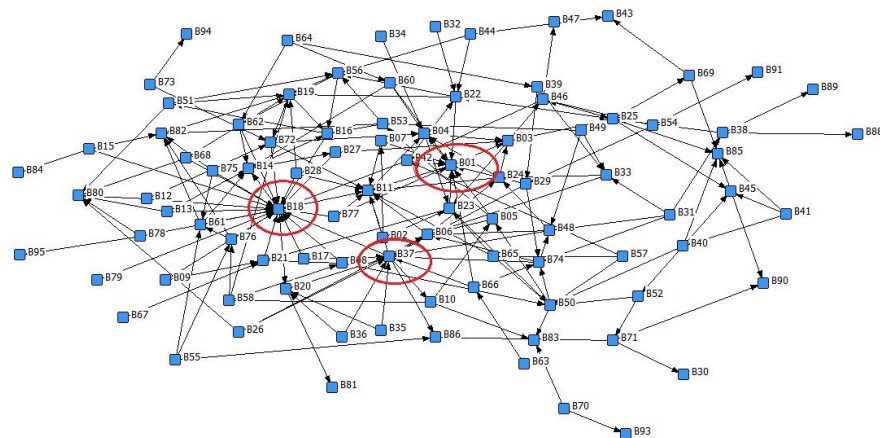


**Figure 4.** Knowledge sharing network (2023).

Network metrics revealed a density of 0.023, i.e. only 2.3% of connections exist, which means that there is a high potential for elevation in the level of information sharing in this network. The degree of reciprocity is also low being only 0.031; that is, 3.1% of the connections are bidirectional in the sharing network.

Analyzing the centrality of the actors, it is observed that the positioning of an actor in the network actively interferes with constraints and opportunities. Actors who face fewer constraints and have more opportunities than others find themselves in more favorable structural positions. Actor B18 once again occupies the most central position in the network, reinforcing its previously verified central role as the actor with high input centrality.

The fact that B18 is also an Information Broker, in terms of sharing information within the network, can be explained by its activity as an educational data analyst. Engaged in the systematization of the flow of information within the organization, B18 acts as a formal agent of information dissemination in the network. This positioning not only highlights the importance of individual behaviors and roles within the organizational framework but also illustrates how such dynamics can influence overall organizational behavior. By facilitating communication and knowledge sharing, B18 contributes to a more adaptive and informed organizational culture.

However, it is noted that the B01 was once very central along with B18 in the consultation network, in this network, B01 is in the third position, being overtaken in the number of connections by the B37, the second most central actor of this network and who exercises the position of data analyst in the Research and Innovation Management.

On the most peripheral actors in the network, we have cited as examples the actors B67, B79 and B34, who participated in the survey but were not quoted by

any other actor as regards the sharing of data and evidence and who need to have their network sharing relationships intensified.

## 4.3. Discussions and Implications

The results of the network analysis in the education non-profit organization highlight critical issues related to the internal flow of information, communication, and the channels through which sharing occurs. It is emphasized that each network can cultivate its own characteristics and unique elements based on its objectives and the agreements established among its actors, reflecting the distinct nature of every network. This diversity influences organizational behavior significantly, as the methods employed for sharing and communicating information can alter collaboration, trust, and overall performance within the organization. Understanding these dynamics can pave the way for more effective strategies aimed at enhancing engagement and fostering a positive organizational culture.

In a broader context, these findings hold substantial implications for the field of knowledge management. They suggest that tailored approaches to managing information flow and communication can enhance the effectiveness of knowledge networks across various organizational settings. By recognizing the unique dynamics of each network, organizations can develop targeted strategies that facilitate better knowledge sharing and cooperation among diverse stakeholders. It is essential to create a culture focused on sharing information and knowledge, as well as to provide a free space for dialogue and multi-directional communication (Morrison, 2011; Johnson, 2011).

While the study provides practical recommendations for information governance, availability, and network strengthening, it could delve deeper into how these recommendations can be effectively implemented in similar organizational contexts. For example, exploring case studies of other non-profit organizations that have successfully enhanced their knowledge networks could offer valuable insights into best practices. Detailed frameworks and step-by-step guidelines for fostering a culture of sharing and dialogue can also be beneficial for organizations seeking to replicate these strategies. By addressing these aspects, the study could contribute more comprehensively to the field of knowledge management, offering actionable insights that align with the diverse needs and structures of various organizations.

## 5. Conclusion

The contributions of this study underscore the significant insights gained regarding the network's dynamics. Based on the analyzed metrics, the study identifies that the network possesses considerable potential for developing relationships and establishing a greater number of ties. It highlights the importance of recognizing central actors within the network who can influence the flow of information, disseminate knowledge, and, above all, foster interactions that enhance the sharing, discussion, reflection, and construction of knowledge.

Facilitating knowledge dissemination across different areas can be achieved through information sharing and experience exchange among members, making it crucial for the organization to map and monitor the density and reciprocity metrics of the existing social network. This assessment can identify links that exhibit high, low, or no exchange of knowledge, which is beneficial for understanding the dynamics of organizational behavior.

When comparing the results of the centrality metrics and the analysis of network topology in 2023, the same dynamics observed in 2021 were confirmed: high centrality among a few actors poses an institutional risk due to the potential spontaneous loss of knowledge from these employees and a high centralization of information. Actor B01, an employee who has been with the organization for over nine years, remains a central figure in the 2023 network, reaffirming the prominence previously noted. Conversely, Actor B18 now exhibits high centrality in both networks in 2023, which may position them as a specialist or a bottleneck within the network.

The representation of network topology underscores critical issues, particularly the high centrality of B18, which reflects a situation identified in 2021 with central actor A16. The departure of A16 resulted in a significant loss of critical knowledge, emphasizing the vulnerabilities associated with having a few central actors in informal knowledge networks.

This study highlights that understanding and enhancing organizational behavior is essential for enhancing overall productivity and effectiveness within the organization. By fostering a culture of collaboration and open communication, organizations can address the dynamics that influence how information is shared and utilized among members.

Identifying structures that promote trust and recognizing unofficial "decision-makers" are essential for understanding the flow of information (Granovetter, 1973) and assessing the degree of autonomy within a system, which directly impacts its performance. As interpersonal relationships are dynamic and evolve with the network's structure, dependence on these relationships can reduce autonomy. Management that fails to balance dependence and autonomy may encounter unsatisfactory performance. Additionally, changes in individual movement can affect this dynamic, challenging the system's resilience and influencing the flow of information (Grossetti, 2004).

Effective knowledge management practices must be seen as part of a broader organizational behavior framework that fosters the development of relationships, trust, and employee engagement. This proactive approach supports not only the retention and codification of knowledge but also strengthens the social fabric of the organization, thereby reducing the risks associated with knowledge loss. By prioritizing these behavioral dynamics, organizations can cultivate a responsive and adaptive environment that encourages sustained learning and innovation.

To further contribute to the understanding of intraorganizational knowledge networks, future research should explore social networks created within virtual environments that promote knowledge sharing, such as forums and email

exchanges among employees and external stakeholders. Additionally, analyzing relationships between organizations and external entities will provide deeper insights into knowledge dynamics.

While this study provides valuable insights, it is important to acknowledge its limitations as a single case study within a non-profit organization. Future research could test the concepts presented here in diverse contexts, enriching the discourse on organizational behavior. The complexity and variety of metrics and concepts used warrant further investigation.

Furthermore, a suggestion for future research is to conduct longitudinal mapping studies over time to capture multiple "snapshots" of networks at different points. This approach would enable researchers to observe shifts in actor dynamics and deepen their understanding of intra-organizational processes and behaviors.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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