# COMMUNICATION NETWORKS: DISASTER IN PARACATU DE BAIXO

Bruna Burkhardt Furlani, Marcia, Universidade de Brasília Marques,
Marcelo Souza de Jesus, Fiocruz Brasília

## REDES DE COMUNICACION: DESASTRE EN PARACATU DE BAIXO

## RÉSEAUX DE COMMUNICATION : CATASTROPHE À PARACATU DE BAIXO

**ABSTRACT**

*This paper observes the flow of information established on the communication on the event of Samarco's mining company toxic waste dam rupture to the residents' network in Paracatu de Baixo, second site to be hit by the muddy flood. The accident occurred in November 5th 2015 in the region next to the city Mariana, in the state of Minas Gerais (MG), Brazil. The study involved two trips to Paracatu de Baixo, a Monsenhor Horta's subdistrict. The research was made with the application of questionnaires, of personal interviews with 10 local families, and talks with other 40 people involved on the historical context. Altogether, the networks counted with the participation of 186 actors. The results pointed out that the population was not prepared to the risks and that the main information issuers were spontaneous community leaderships (the majority being teachers of the school in the subdistrict). At the location, word of mouth communication was more efficient than that made via Information and Communication Technologies (ICT) because people were close to one another during the disaster and also because of the community's low access to technology.*

**RESUMEN**

*Este trabajo observa el flujo de información establecido en la comunicación de la ruptura de la presa de resíduos tóxicos de la minera Samarco a la red de residentes del distrito de Paracatu de Baixo, segundo sitio afectado por la inundación fangosa. El accidente ocurrió el 5 de noviembre de 2015 en la región cercana a la ciudad de Mariana, en el estado de Minas Gerais (MG), Brasil. El estudio incluyó dos viajes a Paracatu de Baixo, un subdistrito de Monsenhor Horta. La búsqueda fue hecha a partir de la aplicación de cuestionarios, entrevistas personales con 10 familias locales y conversaciones con otras 40 personas involucradas en el contexto histórico. En total, las redes tuvieron la participación de 186 actores. Los resultados señalaron que la población no estaba preparada para los riesgos y que los principales emisores de información fueron liderazgos comunitarios espontáneos (la mayoría son maestros de la escuela del subdistrito). Allá, la comunicación de boca en boca fue más eficiente que a través de las Tecnologías de la Información y Comunicación (TIC) porque las personas estaban cerca una de la otra durante el desastre y también debido al bajo acceso de la comunidad a la tecnología.*

**RESUMO**

*Este trabalho observa os fluxos de informação estabelecidos na comunicação do rompimento da barragem de resíduos tóxicos da mineradora Samarco à rede de moradores do distrito de Paracatu de Baixo, segunda localidade a ser atingida pela enxurrada de lama. O acidente ocorreu em 5 de novembro de 2015, na região perto da cidade de Mariana, no estado de Minas Gerais (MG), no Brasil. O estudo incluiu duas viagens para Paracatu de Baixo, um subdistrito de Monsenhor Horta. A pesquisa foi feita com base na aplicação de questionários, entrevistas pessoais com 10 famílias locais e conversas com 40 outras pessoas envolvidas no contexto histórico. No total, as redes contaram com a participação de 186 atores. Os resultados indicaram que a população não estava preparada para os riscos e que as principais fontes de informação eram lideranças comunitárias espontâneas (a maioria deles são professores da escola subdistrital). No local, a comunicação boca a boca foi mais eficiente que a feita via TIC porque as pessoas estavam mais próximas umas das outras durante o desastre e também pelo baixo acesso da comunidade às tecnologias.*

**KEYWORDS: COMMUNICATION, NETWORKS, ICT, SAMARCO, PARACATU DE BAIXO**

**PALABRAS CLAVE: COMUNICACIÓN, REDES, TIC, SAMARCO, PARACATU DE BAIXO**

**PALAVRAS-CHAVE: COMUNICAÇÃO, REDES, TIC, SAMARCO, PARACATU DE BAIXO**

## Flow of Information on the disaster

This paper presents the research results that observed the flow of information between authorities and the residents of Paracatu de Baixo, a Monsenhor Horta county subdistrict, during and after the environmental disaster of Fundão's dam, belonging to Samarco mining company, on the region of Mariana, Brazil, November 5th 2015. The site was the second to be hit by the muddy flood. Nothing remained at the site and all residents were transferred to Mariana.

With the support of the quantitative methodology Social Network Analysis – SNA – the research goal was to observe the flow of information and the communication on the environmental disaster that was established between institutional networks – mainly firefighters and Civil Defense – and residents' community of Paracatu de Baixo, a site completely destroyed by the toxic muddy flood as the result of the dam rupture from the mining company Samarco, in the state of Minas Gerais. As qualitative complementation, interviews were conducted to better understand the weight of ICT use in this process.

To observe the flow of information and the dimension of technology use in the accident communication process, the analysis involved three aspects that oriented the search for data: digital, geographic and social network. It is worth mentioning that this research was produced, initially, to the monograph "Rotas da informação: Estudo das relações estabelecidas em Paracatu de Baixo na comunicação do maior desastre ambiental brasileiro" (Furlani, 2016) which translates into "Routes of information: A study of the relations established in Paracatu de Baixo on the communication of the major Brazilian environmental disaster" and the present paper is its offspring, with new thoughts about the data obtained.

## A digitally and socially excluded city

Paracatu de Baixo was a Monsenhor Horta subdistrict (Minas Gerais state), located at 53km from Bento Rodrigues, 34km from Mariana and 9km from Monsenhor Horta. In the site, the entire population – a little more than 100 families – were able to save themselves after the dam rupture, contrary to Bento Rodrigues, which was the first site to be hit by the environmental disaster. According to residents, the mud flood took about four to five hours to reach the location. By the fact of the subdistrict being low populated and essentially rural, there are not enough documents nor recent ones that have information on the aspects of that region's population. Only 30% of the community had access to the internet inside their houses when the accident happened. The subdistrict had low government presence, counting only with a school as public equipment.

The analyzed community profile was composed by a population of: 70% of black people with half the habitants with a family income between two and three minimum wages; 40% of the adults between 36 and 66 years old with incomplete elementary school; 50% of families composed of five or more members.

## A territorial network pulled out of its place

The main objective is to observe the flow of information established in the disaster and the transformations provoked by the disaster in the life of those residents who did not have a choice with the change of city. The applied research was done around the Paracatu de Baixo residents

network and involved two field trips to Mariana city, where all were transferred to. The trips occurred between July and October 2016. Ten out of 103 families that lived at the site were researched. The sampling used was that of clusters. For that, the site residents were divided according to their last names (Gil, 2012).

The idea of working with 10 families came from the last data offered by 2010 census (performed on a national level) and by information produced by groups that study on that region. Because of the lack of specific information on Paracatu de Baixo subdistrict, it was decided to make use of the census analysis below:

> *"The Paracatu de Baixo rural village does not correspond itself to a census sector being inserted into one of three Monsenhor Horta district census sectors with a total population of 1,740 habitants. The census sector where Paracatu de Baixo is located (on 314000135000002) is the most extensive in area and totals a population of 421 habitants in 2010. Paracatu de Baixo, however, seems to be the biggest populational cluster in this census sector. According to estimates published by Mariana's Major, Duarte Júnior, by the means of the press, the Paracatu de Baixo village counts with approximately 300 habitants, that is, about 71.2% of Monsenhor Horta's rural population"(PoEMAS, 2016:3)*

In addition to the 10 families interviewed during the research, more than 40 subdistrict people also answered to questions through WhatsApp, to deepen the understanding, solve doubts, ask new non-structured questions. These other people were selected because they warned the interviewed people about the disaster. The study also counted with the participation of actors external to the community, such as, for example, Civil Defense's coordinator, Paracatu de Baixo Municipal School principal and a historian who gave support on the development of a local post disaster newspaper. In total, 186 people (actors) composed the analyzed network. The names of the interviewed were not published to safeguard their identities.

For data collection, a questionnaire was used with a script of direct questions based on Marques' (2015) model and had as goal to look for answers related to three observation aspects: the community profile; personal data about the residents' relationship with the use of ICT on digital networks; and data regarding the environmental disaster caused by the Samarco company.

The research merged methodologies in the search to cover the different aspects that involved the communication, especially on the proportion the disaster had on the Fundão's dam rupture. It involved study cases, field trips and quantitative and qualitative analysis of the relationship between the actors involved to ensure a larger amount of information as well as different points of view about the same topic. The process of interviews occurred in two ways: structured and face-to-face/internet (Gil, 2012).

The study involved the application of closed questions, as well as open ones so that the interviewed had more freedom to answer on the subject. To comprehend the social, economic and technological context in which the residents were part of, around 95% of the interviews were conducted in their homes. It is worthy to highlight that the interviews were conducted in their new homes because Paracatu de Baixo did not exist anymore.

## SNA and the gatekeeper figure

Present time is marked by intense flow of information and communication through global telematic networks, between people and system networks, in a mixture of human and non-

human (Latour, 2000), in fluid relations, such as defined by Bauman (2009) by coining the term "liquid modernity". Observing relations implies observing networks and, in the present context, it becomes essential to "think in networks" and to "understand the complexity" as defended by Barabási (2008) since the networks represent the structure of the complexity. To describe society, we need to coat the links of social network with intersubjective real dynamic interactions.

## Communication actions take place within networks

The society is structured into highly connected clusters, circles of friends in which everyone knows each other are, in general, closed groups (Barabási, 2008), they are the external bonds that do not allow the isolation of cohesive groups. The Network Analysis has as main goal to comprehend the impact and in what manner the connections established in societies reflect the structure of the system.

The methodological discussion of these complex relations occurred with the application of the SNA methodology that with the use of statistics it allows to visualize the flows of information exchanges and of communication. The statistical data reduced to five the types of roles performed by the actors in network relations. In this article, we use the role of the gatekeeper. Nooy et al (2011) offered a representation model in which the gatekeepers are key actors who receive information from the external environment, filter the contents to the network and establish relations with other individuals and institutions. In addition, they are provided with skills and tools that will be passed along to other actors in the network (Barzilai-Nahon, 2008). This kind of role is investigated in different fields of knowledge such as Communication and Information Science, all of them linked to the question of the flow of information, it is the actor that controls the flow of information, that facilitates the access and organize this information.

Nooy et *al* (2011) used SNA to observe the flow of information by the means individuals position and functions showing the results in graphs – a relational representation of the data. This study had the specific goal of analyzing the gatekeeper's role, responsible for controlling the flow of information external to a given group in the relationship with other members of the network.

Albernaz (2012), on a thesis defended on the field of Information Science, remarks that the importance and notoriety of the gatekeeper in a network is related to the fact that the actor has easy access to resources and the capability to handle the equipment which not everyone in the community have or is accustomed to. For this reason, with the skills and privileged information, this actor is able to establish contact networks that are wider and more cohesive between the external and internal environments as well as obtaining higher influence between the actors.

Information Science guides the research about the gatekeeper to the study of the invisible schools, which are the group of researchers who work together but not necessarily in the same geographical site, not even the same institution. In this sense, the gatekeeper is seen as a determinant element of a scientific community by being the key element on the transfer of scientific information (Norte, 2010).

The gatekeepers are actors who, oftentimes, do not represent pre-established formal leaderships in the community but people or institutions that arise spontaneously and represent crucial role on

the extension and amplification of the flow of information (Albernaz, 2012).

## Before and during the disaster

Before the mud flood, Paracatu de Baixo residents had a very close relationship to one another both physically and emotionally. In order for them to communicate it was only necessary to walk up to the neighbor's house or even yell on the streets. The use of communication technologies, especially mobile devices such as smartphones and cell phones, was not made necessary on everyday life. For this reason, the ICT were only used to talk to relatives and friends who lived in Mariana or other cities. The data presented below are referent to research results that range from the flood period and what occurred immediately after the mud arrived in Paracatu de Baixo. Altogether, 68 people received the questionnaire and 58 collaborated with the study.

Paracatu de Baixo was a reflex on inequalities on the access to technology: 70% of the population did not have access to the internet in their homes, which denotes the difficulty on communication and the exclusion from digital means; no family had land telephones and only 40% of the residents had a rural antenna inside their houses (an antenna that allows the use of telephones in rural areas which are farther from urban areas), which was enough to communicate with people who lived outside the district.

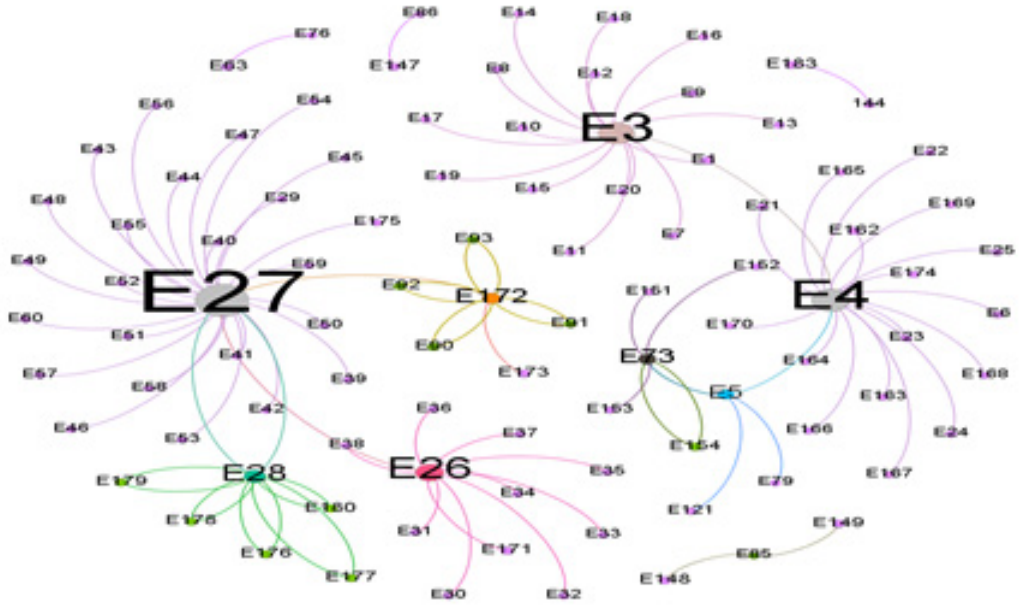
From the ten interviewed families (in general, two members of each family), all of them told to have cell phones but only 30% reported to use them intensely. Beyond that, 60% of the residents had access to and used to watch television very often; 60% did not have a computer in their homes; 40% had difficulties handling technological gadgets and only 40% had a smartphone and used it intensively.

The applied questionnaire also showed that half the interviewed had their first contact with a computer through their school and that were able to access the internet through the school wireless network. Furthermore, 30% stated to have never used the internet.

With the objective to observe the paths of information and identify the central actors and socially isolated people on that network, the study "reconstructed" from interview statements the possible social networks that were formed during the disaster. For that, it was taken in consideration the answer to two questions: 1. Cite the names and the number of people who told you about the dam rupture and 2. Who did you warn after receiving news about the disaster.

The assembly of the graphs that represented the networks during the Paracatu de Baixo disaster was done by the means of the Gephi software. To safeguard the identity of the interviewed, each actor is represented through numbers in the network. With the intention of detailing the sub-networks that were formed and to demonstrate the possible differences in communication cohesion and efficacy the research divided the network into two parts: those created by the means of ICT use and those created by the means of word of mouth communication.

The first network analyzed depicts the manner how the communication was established through ICT (graph 01) such as, for example, telephones, etc. From data analysis, it is possible to perceive, on a targeted manner, that it is a dense network because it presents 98 actors (nodes) and 103 links (edges). Dense networks are those in which its members all relate to each other.




Graph 01 – Targeted network(for whom the information was targeted to and wanted to reach)

Source: Own authorship.

The network centrality, that is, the node that has the most answers to the message sent is represented by the vertex E27, which is the principal of the Paracatu de Baixo Municipal School. In the disaster, she rises as a figure of spontaneous community leadership who acquired a fundamental role due to the networks contacts she had, beyond the ease on handling technological devices such as the smartphone.

The node which transmitted the most information were from the actors E3 and E4 (Minas Gerais Civil Defense employees who received the official information by phone) and lastly, from the actor E27, the principal who received the information from a cousin through a Whatsapp group message and that retransmitted the external information. These three people received the information that the dam has been ruptured and that "some kind of water" would come to the city and then tried to warn the most number of people and institutions possible.

Since E3, E4 and E27 established a large amount of connections to alert the population, they were fundamental agents to guide people during the disaster. For this reason, they could be recognized as nodes of major influence and as leaders who helped to amplify the information from the center of the network to its periphery.

The analysis also allowed to observe that the actors from the periphery are represented by nodes of a smaller size because they received the information but opted by not passing it along because they did not believe that the information was real or because when they tried to do so the Fire Department was already in the city. So, the peripherical nodes kept a larger contact with the center than with the neighbors, as also seen in this graph.

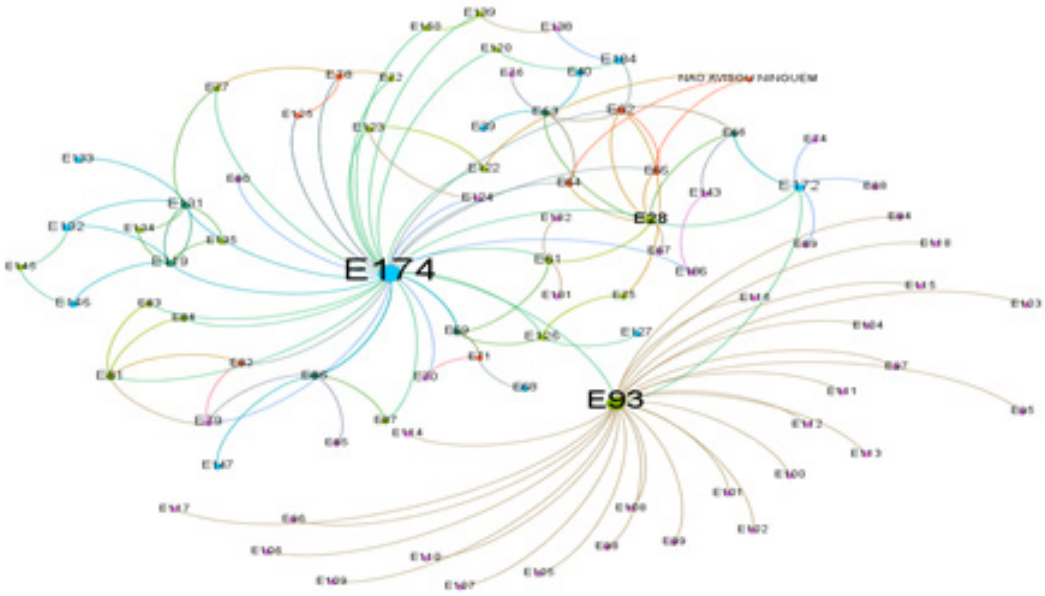
The research also revealed that the blue nodes, identified by the teachers from the only school in the city, passed along an information and it returned right after. In other words, the information went through the same path twice to pass along the message from the source to the other actors and vice versa.

From the data analysis, it is possible to realize that part of the informational flow occurred in the following way: E3 (Civil Defense Department) received the information about the dam rupture

from a Samarco employee (E1). On this, E3 warned E4 (Civil Defense coordinator) and repassed the warning to the 12 existing departments in Mariana. As one of the responsible for the most propagation of warnings, E4 spread the information. He warned radio stations, asked help to health departments, warned city hall offices and requested that a municipal police car went to Paracatu de Baixo to verify the situation and warn the rural population (Graph 01).

The other part of the informational flow began on vertex E171 (first to receive the warning). After the alert, he warned E26 (who acted as a mediator) and had the idea of passing the information through a Whatsapp group. In the group, was the school principal (E27). In turn, she opted to spread the information to the most number of people and warned the Whatsapp groups she was part of with other principals from neighbor counties and Paracatu de Baixo teachers.

This second network (Graph 2), built on communication through word of mouth, is a lot more cohesive than previous one through ICT. In it, there is a higher number of connections between different actors and institutions such as the Municipal Guard and the Fire Department. Besides that, it is possible to perceive that the information circulated more quickly. The analysis in Graph 02 allows to verify that the management of information occurred on a more efficient manner because since people were closer they shouted or quickly warned relatives, friends and neighbors who were around.




Graph 02 – Word of mouth communication network

Source: Own authorship

Two points are prominently featured in Graph 02: actors E174 and E93. The first is a central node and a gatekeeper. Actor 174 is the Fire Department and corresponds to the point that received the most amount of answers to the information that was passed and that presents the connection with thicker lines, that is, the person warned and soon after had an answer. On the day of the disaster, a Fire Department helicopter landed on Paracatu de Baixo. The presence and the warning from the firefighters made people leave their houses.

The Fire Department was responsible for receiving the information from the Civil Defense (E3)

and from the rescue coordinator (E4) and go to the subdistrict to warn everyone. It is important to highlight that only after the warnings were made by the firefighter that the community finally believed on the information about the disaster.

Actor E93 is the husband of one of the teachers (actor E172) and also had prominence during the process of warning local population. He was warned by the wife that the dam has been ruptured and then, at her request, went to the bar and to one of the main streets of the subdistrict to warn that "some kind of water" was coming. By his actions, E93 represented a spontaneously risen community leadership and had a fundamental role on the spread of warnings, as can be seen on Graph 02.

The people who received the warning from E93 were only receptors and did not pass it along. In the same way, there are the presence of three actors who were warned but did not pass on the alert. The reason is in the fact that when leaving their houses, the firefighters were already there informing everyone that they had only a few minutes to look for shelter on the top of the hill.

## Final considerations

On a rural location and with low use of ICT, the research shows that word of mouth communication was more effective because people were next to each other and could shout (in other locations there were deaths, which did not occur in Paracatu de Baixo). At the same time, the communication through ICT made the information arrive through word of mouth dissemination. The main information emitters were the teachers – the school was the only public equipment – and the firefighters, who made the last warning. Site residents did not have any preparation – neither from Samarco nor from the Civil Defense – to recognize the risks.

According to data obtained from the questionnaires, 70% of the residents did not even know they lived close to dams and half the population stated that they were warned from people of neighbor regions, as shown in the graph. The study also shows that the Municipal School principal and the Civil Defense coordinator acted as gatekeepers during the disaster, so they received the information from external sources and spread it to their social networks. The coordinator, with his contacts only with the institutional network – which involves the principal – and the principal, with the diffusion of warnings to the local teachers' network.

On the ICT network, the individuals who propagated information the most were non-elected figures and not even traditional leaderships. Besides that, they were people who had access to the news first hand and used the ICT to reach a large number of people in less time. The main aid differential in Paracatu de Baixo was the time taken for the warning to arrive, since the mud took around four to five hours to reach the site. There, the Civil Defense built a strategy more calmly to help rescuing.

The answers and data obtained from the questionnaires showed that the transfer to another city generated deep changes in the community. The interviewed E33 states that, in Paracatu de Baixo, the transfer to a bigger city (Mariana) resulted on the ICT acquiring a fundamental role on the reestablishment of the link people had in Paracatu de Baixo before the tragedy occurred on the subdistrict. Furthermore, with the change, 90% of the families started to have access to the internet in their homes, with more ease and speed. However, a good part of the older population remained with difficulties to handle technological devices as tablets, laptops and smartphones.

## Bibliography

Albert-Laszlo Barabási, *Linked: A nova ciência das redes*, Leopardo, 2008.

Antônio Carlos Gil, *Métodos e técnicas de pesquisa social*. São Paulo: Atlas, 2012.

Bruna Furlani, *Rotas da informação: Estudo das relações estabelecidas em Paracatu de Baixo na comunicação do maior desastre ambiental brasileiro* [en línea] http://bdm.unb.br/bitstream/10483/16601/1/2016_BrunaBurkhardtFurlani_tcc.pdf (Consultado el 20 de junio de 2017).

Bruno Latour, *Ciência em Ação: como seguir cientistas e engenheiros sociedade afora*. Editora UNESP, São Paulo, 2000.

Cláudia Albernaz. *O secretário executivo como gatekeeper da informação* [en línea] http://repositorio.unb.br/bitstream/10482/10089/1/2011_ClaudiaBorgesLima%20Albernaz.pdf (Consultado el 20 de junio de 2017).

Karine Barzilai-Nahon, Toward a theory of network gatekeeping: a framework for exploring information control, *Journal of the American Society for Information Science and Technology*,[en línea] http://onlinelibrary.wiley.com/doi/10.1002/asi.20857/pdf (Consultado el 20 junio de 2017).

Márcia Marques, *Modelo de ação comunicativa e de informação para redes sociais em ambientes digitais,* [en línea] http://repositorio.unb.br/bitstream/10482/18143/1/2015_MarciaMarques.pdf (Consultado el 20 de junio de 2017).

Mariângela Norte, *Glossário de termos técnicos em ciência da informação: Inglês/português,* [en línea] https://www.marilia.unesp.br/Home/Publicacoes/glossario.pdf (Consultado el 20 de junio de 2017).

PoEMAS, *Antes fosse mais leve a carga: avaliação dos aspectos econômicos, políticos e sociais do desastre da Samaraco/Vale/BHP*, iGuana, Marabá, 2016.

Wouter de Nooy, editado por Mark Granovetter, *Exploratory Social Network Analysis with Pajek : Structural Analysis in the Social Sciences,* 2. ed. New York: Cambridge University Press, 2011.

Zygmunt Bauman, *Confiança e medo na cidade*, Zahar, 2009.