Disponível em: www.univali.br/periodicos ISSN: 1983-716X

Revista Alcance

BETA TECHNOLOGY INNOVATION PARK: THE IMPORTANCE OF COOPERATIVE NETWORK INTERACTIONS FOR SUSTAINABLE DEVELOPMENT IN BRAZIL

PARQUE BETA DE INOVAÇÃO TECNOLÓGICA: A IMPORTÂNCIA DAS INTERAÇÕES DAS REDES DE COOPERAÇÃO PARA O DESENVOLVIMENTO SUSTENTÁVEL NO BRASIL

PARQUE BETA DE INNOVACIÓN TECNOLÓGICA: LA IMPORTANCIA DE LAS INTERACCIONES DE LAS REDES DE COOPERACIÓN PARA EL DESARROLLO SOSTENIBLE EN BRASIL

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Submitted on: 11/03/2014
Approved on: 07/28/2016

Doi: alcance. v23n3.p329-351

ABSTRACT

The informational economy is the basis of the network society, and promoted the creation of big technological parks, located at Silicon Valley in the USA, Sophia-Antipolis in France, and Cambridge in the UK, in the late 20th century (CASTELLS, 2003). This paper studies the Beta Technology Innovation Park, its actors, and the relationships between them. The study is relevant when it comes to local development of Brazil, especially after the 2008 03/08 CMC (*Conselho do Mercado Comum* – Common Market Council), signed by Mercosur countries,

when the legal landmark Science, Technology and Innovation 2008 – 2012 began. Regulation SC@2022 reinforces the State-of-the-art Innovation Program of the state of Santa Catarina, where the Beta Technology Innovation Park is located, and which encourages the goal of transforming the state into a reference of innovation in sustainability in Brazil and worldwide. This paper uses the quantitative methodology of study through the UCINET system. The aim of this paper is to define the main actors involved, their relationships and the degrees of relationships. Through the analysis, it was possible to outline the typology of the Beta Park network and the source and intensity of relations between the actors, according to the indicators: centrality, density, intensity, importance, and degree. These results will assist with integration strategies, strengthening, expansion and development of networks.

Key words: Technology Parks, Cooperation Networks, Sustainable Development

RESUMO

A economia da informação é a base da sociedade de redes e promoveu a criação de grandes parques tecnológicos localizados no Vale do Silício, nos EUA, Sophia-Antipolis na França e em Cambridge, no Reino Unindo, no final do século XX (CASTELLS, 2003). Este artigo estuda o Parque Beta de Inovação Tecnológica, seus atores e o relacionamento entre eles. O estudo mostra relevância em relação ao desenvolvimento local do Brasil, especialmente após o 2008 03/08 CMC (Conselho do Mercado Comum) assinado pelos países do Mercosul, quando passou a vigorar o marco legal de Ciência, Tecnologia e Inovação 2008-2012. A regulamentação SC@2022 reforça o Programa Inovação Estado da Arte do estado de Santa Catarina, no qual está localizado o Parque Beta de Tecnologia e Inovação que promove a meta de transformar o estado em uma referência de inovação na sustentabilidade do Brasil e global. Esse artigo usa a metodologia quantitativa de pesquisa, por meio do sistema UCINET. O objetivo do artigo é definir os principais autores envolvidos, seus relacionamentos e os níveis de relacionamentos. A análise permitiu descrever a tipologia da rede do Parque Beta e a fonte e intensidade das relações entre os atores, de acordo com os indicadores: centralidade, densidade, intensidade, importância e nível. Tais resultados ajudarão nas estratégias de integração, fortalecimento, expansão e desenvolvimento das redes.

Palavras-chave: parques tecnológicos, redes de cooperação, desenvolvimento sustentável.

RESUMEN

La economía de la información es la base de la sociedad de redes y promovió la creación de grandes parques tecnológicos ubicados en el Valle del Silicio, en los EUA, Sophia-Antipolis en Francia y en Cambridge, en el Reino Unido, a fines del siglo XX (CASTELLS, 2003). Este artículo estudia el Parque Beta de Innovación Tecnológica, sus protagonistas y la relación entre ellos. El estudio muestra relevancia en relación al desarrollo local de Brasil, especialmente después de 2008 03/08 CMC (Consejo del Mercado Común) firmado por los países del Mercosur, cuando entró en vigor el marco legal de Ciencia, Tecnología e Innovación 2008-2012. La reglamentación SC@2022 refuerza el Programa Innovación Estado del Arte del estado de Santa Catarina, en el que está ubicado el Parque Beta de Tecnología e Innovación que promueve la meta de transformar al estado en un referente de innovación en la sostenibilidad de Brasil y global. Este artículo usa la metodología cuantitativa de investigación por medio del sistema UCINET. El objetivo del artículo es definir los principales autores involucrados, sus relaciones y los niveles de esa relación. El análisis permitió describir la tipología de la red del Parque Beta y la fuente e intensidad de las relaciones entre los actores, de acuerdo con los indicadores de centralidad, densidad, intensidad, importancia y nivel. Dichos resultados ayudarán en las estrategias de integración, fortalecimiento, expansión y desarrollo de las redes.

Palabras clave: Parques tecnológicos; Redes de cooperación; Desarrollo sostenible.

1. INTRODUCTION

The information economy is the basis of the network society, and promoted the creation of big technological parks, such as Silicon Valley in the USA, Sophia-Antipolis in France and Cambridge in the UK in the late 20th century (CASTELLS, 2003).

Innovation cannot be based on single individual or on a singular organization; it must be the result of knowledge and involvement of the society as a whole (CUNHA et al., 2009). It forms links between an entrepreneurial environment (incubators, technology parks, innovation systems), where learning and innovation occur in a network inter- and intra- organizations, and knowledge is transformed into a process of social learning. This entrepreneurial environment is sustained through the establishment of an institutional apparatus that consolidates the relations of cooperation and sustainability.

The accumulation of technological capabilities of the different actors depends on the existence of an innovative environment. According to Cunha et. al. (2009), innovative companies seek environments that are conducive to the formation of business networks, corporate networks and universities/research institutions, through a regulatory system of encouragement and protection of entrepreneurial and innovative actions, sources of funding for the creation and development of innovative companies, policies to support technological development, and macroeconomic policies that promote development in the medium and long terms.

For ANPROTEC (2011, p. 04), "technology parks are a model of concentration, connection, organization, coordination, implementation and promotion of innovative projects that aim to strengthen this segment within a perspective of globalization and sustainable development".

There have been successful park developments in Europe and the United States. Developing countries, like Brazil, have mirrored these, to develop and deploy technology parks nationwide, with the incentive of the economic bloc of which Brazil is a part.

The structure of national or regional innovation systems strongly influences the propensity to innovate new ventures in emerging countries. Concerned with technological development, sustainable mutual member countries of the Mercosur Economic Bloc, to which Brazil belongs, after the signing of the document CMC 03/08, started the program called legal landmark Science, Technology and Innovation 2008-2012.

This program encourages the creation and fostering activities of technology parks and incubators in the sectors of biotechnology, energy, nanotechnology, water resources, and information society, and aims to popularize science and technology and technological development and innovative. This agreement purposes to encourage the generation and dissemination of technology and the generation of innovations in each participating member country, with each country being responsible for its promotion and national development.

Consequently, Brazil's quest for development occurs in partnership with its state governments. Proof of this statement is regulation SC@2022, seen as a law reinforcing the State-of-the-art Innovation Program in force in the state of Santa Catarina, where the technology park studied is located, and which aims to transform the state innovation policy into a reference for sustainability in Brazil and worldwide.

The aim of this paper, therefore, is to study the Beta Technology Innovation Park, analyzing the role of the actors and the connections between them, and the training and development of the Beta Technology Innovation Park. We used primary data sources, through interviews with managers of the incubated companies, and managers of the technology park, as well as secondary sources such as websites and documents. The questionnaire included questions about the relationship between the incubated companies and participating educational institutions, and also the relationships with other incubated companies.

This paper uses the methodology of quantitative study of social networks and the UCINET 6 software to identify the actors, their relationships and characteristics: network size, network density, importance of the network, compromising relations, and importance of contacts. It was also possible to outline the type, source and intensity of relations between the actors, according to the indicators: centrality, density, intensity, extent, and modal degree.

The results of the research contribute to improved management of the Beta Technology Innovation Park, and the defining of strategies and policies for technological development, acting as support for technology parks in Santa Catarina, Brazil and Latin America.

2. COOPERATION NETWORKS, PARKS AND SUSTAINABLE INNOVATION

The network society has great relevance in the globalized world as a way to increase knowledge and opportunities, and strengthen organizations.

According to Castells (2003), knowledge management and information processing are essential to the performance of organizations. Innovation is paramount in an economic system; the multiplication of sources of innovation takes place through the establishment of bridges to transform knowledge in the form of networks.

The performance of a network depends largely on its connectivity and consistency. Castells (2003) also believes that the economic organization is rooted in cultures and institutions, corroborating, in this particular aspect, with Levy's work (1999) when he states that "open and cooperative attitudes become moral standards. National boundaries, linguistic, professional, cultural and disciplinary action will be overcome".

Thus, technological cooperation networks facilitate the acquisition of technology for the design and manufacture of products (BARQUERO, 1999). Therefore, it appears that the new mode of organization in networks allows us to highlight the state and regional niches of innovation, and helps realize the potential of networks that can enhance the development process.

Scientific progress can be analyzed as a result of the long-term efforts of multiple actors, each pursuing specific objectives, but integrated with each other.

This environment is structured in terms of productive and technological links between responsible agents (DIAS, 2011). Networks are designed as an interorganizational model in cooperative practices that straddle the Triple Helix comprised of governments, institutions/universities, and companies.

From this perspective, it is stressed that the analysis of networks of cooperation is complemented by Tálamo (2008, p.34) who states that "the actors in the cooperation network establish links between themselves, and this connection is what defines the structure network form and taxonomy. In other words, we conjecture that the key aspect for understanding networks of cooperation lies exactly in the pattern of connections between the actors [...] it is this pattern of connection or interaction that enables the flow of information and consequently, the flow of knowledge and learning".

System connections give importance to the number of rows there are, the degree of interconnection, the amount of information conveyed; the capital investment, and the quality and quantity of available knowledge (SCHILLER, 2008).

The notion of the development of cooperation networks is perceived by Scherer and Zawislak (2007, p. 4) based on three stages: formation, the phase marked by "prospecting efforts to achieve cooperation, establishment and legal formalization of the network", the consolidation phase, in which the focus is on efforts to "qualify procedures for the management of operations" and the administrative process, and finally the evolution stage, by which time the network "has a consolidated management system in place, and a coordination process to ensure effective cooperation between the partners".

Among the various habitats created to stimulate innovation, technology parks represent an attempt to reproduce the phenomenon of Silicon Valley (FIGLIOLI, 2007).

Silicon Valley in the United States, and Sophia-Antipolis in France, and Cambridge in the UK, as quoted by Castells (2003), are Science Parks that, through their interconnections and technological partnerships, especially in areas of technology, developed in a surprising way, breaking paradigms. The development of these Parks led to the region in which they were inserted becoming surprisingly developed, significantly modifying the existing processes and creating new relational structures.

These structures are often large, even going beyond national barriers, fostering further global processes of globalization, according to Barquero (1999), which leads to another sphere of competitiveness, driving adjustments of production processes, disseminating innovation, strengthening relationships with other cities, and forming industrial spaces.

Technology Parks also alter the urban centers included under a broad form of development, based on economic and also social relations. Their flexibility, reversibility, reciprocity and trust make these new forms of network structures highly attractive.

Barquero (1999, p.247) states that the basic elements of Technology Park Network are:

> "[..] to produce new strategies for innovation through collaboration, without erasing the identity and distinctive personality of each of the participants," where" it only becomes cooperative when they provide a dynamic process of developing resources and expertise, based on three basic aspects: extension

> of the act of cooperation spheres of production and development processes and products; generalization of a learning effect based on mutual bilateral relations, interpenetration between organizations participating in the Agreement to coordinate actions".

These actions can be coordinated in addition to encompassing the economic, the social, and also the environment. This means that innovation must be sustainable.

The word sustainable is used in the traditional sense i.e. the company's ability to remain competitive in the markets it serves. On the other hand, it is defined as a measure that replaces polluting production processes, and wasteful, and unhealthy and dangerous ways of working, promoting production that uses cleaner methods that spare the natural resources (MAÇANEIRO and CUNHA, 2009).

It may also be said that innovation constitutes a fundamental factor for organizations to establish standards of sustainability in the dimensions mentioned; however, these innovations should have a systematic basis. They must also be fair, and must support the use of natural resources, introducing new products that meet the multiple dimensions of sustainability (BARBIERI, 2007).

But the strategic behavior of firms, in their search for higher yields and better market positioning, is continually transforming the structure of markets. It was Schumpeter who recognized that innovation is a process that is conditioned by the innovative results obtained in the market, and that it occurs under dynamic competition and imperfect market conditions.

According to neo-Shumpeterian analysis, innovative behavior is characterized by the ability to learn, expressed in a process of accumulating knowledge from internal experiences or collective production and marketing of goods or services.

Thus the politics of eco-innovation clearly fall within the range of policies that adopt a broader perspective, with the aims of improving quality of life and respecting the natural environment, and not just on increasing competitiveness and economic growth. It is also multi-sectorial, which means that innovation processes are universal and ecological (MAÇANEIRO; CUNHA, 2009).

2.1 Public Policies for the development of the Triple Helix

It appears that the quest for innovation and technology in Technological Parks is achieved through the development of the Triple Helix, which involves companies, universities/research institutions and public policies.

It is important to emphasize the public policies that support and promote the development of technology parks in Brazil. An important action in this area is the signing of the CMC 03/08 by the Mercosur member countries, a document that marked the start of the legal landmark program Science, Technology and Innovation 2008-2012.

This program encourages the creation and fostering activities of technology parks and incubators in the biotechnology, energy, nanotechnology, water resources, and information technology sectors, and aims to popularize science and technology, as well as technological development and innovation (MERCOSUR, 2008).

This agreement, signed on June 30, 2008, in San Miguel de Tucuman in Argentina, states that "it is necessary to strengthen, provide and enhance opportunities for scientific and technological collaboration between the States Parties" and that "The construction of a space of Science, Technology and Innovation in the Mercosur will encourage the consolidation of sustainable technological scientific development in each of the member countries" (CMC 03/08).

The agreement aims to encourage technological innovation and generation in each participating member country. Each country is responsible for its own promotion and development. The strategic objectives, as stated in the CMC 03/08 (MERCOSUR, 2008), are:

> "To generate and extend the capabilities in science, technology and innovation of the States Parties referred to the formation of human talent, the creation, strengthening and equipping scientific infrastructure and set of technology platforms required for the technological development of the Member States; to promote the formation of knowledge networks on strategic issues in sustained regional reference centers, such as fundamental problems of the people, in

> order to increase the efficiency of policies that have a real impact on the solution of regional problems and locations that are presented by different agents and sectors of the countries; to promote the use of information and communication technologies (ICT) in the democratization process and coordination of networks of knowledge, as a strategic mechanism for disclosing massive and systematic knowledge of science, technology and innovation, promote training, technological innovation and production and social responsibility activities of micro, small and medium enterprises or other organizational arrangements, which become better positioned for the establishment of exchange relations with national counterparts, both regionally and internationally. "

Brazil is a party to the agreement, starting in 2008, initiating the implementation of several actions involving the Triple Helix, for the success of the signed agreement. Some actions are carried out through partnerships with state governments to support and encourage technological development, innovative regional development, national and international scholarships for students and researchers, and tax incentives for companies.

In the area of partnerships with state governments, there is a state regulation, SC@2022, called the Brazilian State-of-the-art Innovation Program, which is applicable to the state of Santa Catarina, where the studied technology park is located.

The Secretariat of Sustainable Development in Santa Catarina coordinates regulation SC@2022, the aim of which is to unite governments, business entities, educational and research institutions and NGOs, to carry out viable actions in the technology, innovation and sustainability sectors. Its goal is to generate qualified labor, diversify the economy, and create centers of technology entrepreneurship within the State of Santa Catarina (SDS, 2011). The ultimate goal is also to transform the state in a reference to the policy of technological innovation with sustainability in Brazil, Mercosur and worldwide.

The SC@2022 plans also include incentives for business centers linked to the green economy, and special programs for cities with lower Human Development Indices, while encouraging the development of products that do not exist in the Production Chain of Santa Catarina (13 342 LAW / SDS 05, 2011).

Interestingly, the alliance between the public and private sector allows the development of actions to align common goals for the best investments of the state and national resources, thereby promoting the financial, social and technological development of the state of Santa Catarina. (OLIVEIRA et.al. 2015)

3. METHOD OF SOCIAL NETWORKS ANALYSIS

Through the use of qualitative and quantitative data, the social network methodology enables reflection, in order to explain the network structure, both as a whole and in each of its components (ALEJANDRO and NORMAN, 2005).

Social network analysis (SNA) uses the mathematical graph technique that shows structures made of knots, or vertices, which are the actors of social networks interconnected by a set of lines that correspond to links between the actors. The SNA emphasizes the connections between the links; the actors and their links comprise the unit of observation (ROSSONI, HOCAYEN-DA-SILVA, FERREIRA JR, 2008).

Wasserman and Faust (1994, p. 20) group the methods related to network analysis into the following categories:

> • Structural properties, such as measures of centrality, density, transitivity and cohesion;
>
> • Roles and positions, such as the analysis of structural equivalence, regular and local cluster analysis and block models;
>
> • Statistical analysis of relationships, used to test theoretical propositions about the relational properties.

The choice of method to be used depends on the purpose of the Analysis of Social Networks, and may use and/or combine the statistical metrics with qualitative methods of content analysis and discourse.

As the aim of this paper is to analyze the role of actors and their connections, and the training and development of the Beta Technology Innovation Park. It uses primary data sources through interviews with managers of the incubated companies and of the technology park itself, as well as secondary sources such as websites and documents. The questionnaire included the relationship between the participating incubated companies and educational institutions, and the relationship with other companies in the region.

This paper uses the methodology of quantitative study of social networks, and the UCINET 6 software to identify the actors, their relationships and characteristics: size, density and importance of the network, commitment, and the importance of contacts. It was also possible to map the relationships between the actors, and the source and intensity of relations between the actors, according to the indicators: centrality, density, intensity, extent, and modal degree.

Armed with the statistical analysis of social networks, the constituent elements of networks, in relation to the broad categories that underpin the relations between actors in technology parks, were highlighted.

4. BETA TECHNOLOGY INNOVATION PARK

The Beta Technology Innovation Park development project began in 2007. After the purchase of land in 2008/2009, and conducting strategic studies and project design for its implementation, the Beta Park started its activities in 2010.

Initially, six companies were selected and incubated. But the project is designed to receive a further 84 companies in the future.

The areas of activity of the incubated companies come under the high-tech sector, i.e. Bio-Technology, Design, Materials, Environment, Metal-Mechanical, Information Technology and Chemical-Pharmaceutical.

The Beta Technology Innovation Park goes beyond the concept of economic development, and brings with it the concept of a very strong social and environmental interaction, which is essential for the approval of projects. The purpose of the Beta Technology Innovation Park is to create an environment among universities, businesses and governments that will enable them to face regional challenges, and to promote sustainable regional development.

The actors involved in the technology parks can be classified into four groups with different motivations: universities and research institutes, government, entrepreneurs, and financiers. The following components can be identified in the Technology Park: basic infrastructure, buildings, business, technology infrastructure and green areas of society. It may also consider the infrastructure of partner educational institutions located around the park.

4.1 Social network analysis of the Beta Technology Innovation Park

The questionnaire covered the relations between companies, between companies and universities and between companies and suppliers. It was sent out on three different occasions and answered by three of the six companies currently incubated in the Beta Technology Innovation Park. Each of the three responding companies belongs to a different niche market.

Company 1 belongs to a Biotechnology and Environment niche, company 4 belongs to the metal-mechanical niche, and company 6 belongs to the Information Technology and Communication niche.

Through the responses received from those companies that responded to the questionnaire, we found out that they had no suppliers in common, as was expected, since each company is operating in a different area of activity.

During this observation, conducted in 2011, the analysis of the responses also led to the design of a network weighted for each dimension included in the questionnaire, considering the weight assigned by the respondent companies to the relations maintained with other incubated companies and educational institutions, with the following intentions: exchange of knowledge, innovation, internationalization, environmental responsibility and management practices. It was also possible to obtain the consolidated data, considering the sum of the weights assigned to the importance of each relationship.

For each of these networks, it was possible to measure three aspects, using the software UCINET NETDRAW and the network topology: degree of centrality, degree of mediation (betweenness), and degree of proximity (closeness).

The degree of centrality, according to Alexander and Norman (2005), refers to the number of actors to which each actor is directly connected. These connections may be output or input. Output connections consider the interactions that actors have with others, while input connections consider the interactions that others have with the actor.

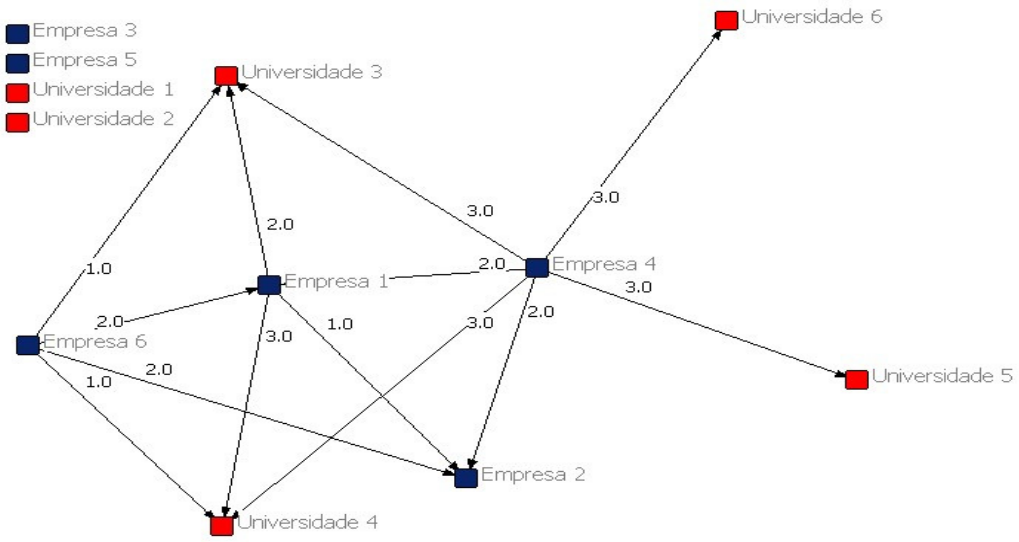
The degree of intermediation, according to Alexander and Norman (2005), refers to the importance of node, reflecting the extent to which a node can mediate the relationships between other pairs of nodes.

The degree of proximity reflects the ability to connect a node to all other network actors, represented by the geodesic distance between two actors (ALEXANDER and NORMAN, 2005).

Innovation

This figure represents the diagram obtained from the tabulation of responses regarding the importance attached by the respondent companies to relations with different universities and with other companies in order to innovate.

Figure 1. Networks of Innovation



Source: Authors

The chart below represents the degree of centrality (centrality) found for the nodes represented in the diagram above.

Chart 1. Freeman's Degree of Centrality Measures

		OutDegree	InDegree	NrmOutDeg	NrmInDeg
4	Company 4	16.000	0.000	48.485	0.000
6	Company 6	6.000	0.000	18.182	0.000
1	Company 1	6.000	4.000	18.182	12.121
2	Company 2	0.000	5.000	0.000	15.152
5	Company 5	0.000	0.000	0.000	0.000
3	Company 3	0.000	0.000	0.000	0.000
7	University 1	0.000	0.000	0.000	0.000
8	University 2	0.000	0.000	0.000	0.000
9	University 3	0.000	6.000	0.000	18.182
10	University 4	0.000	7.000	0.000	21.212
11	University 5	0.000	3.000	0.000	9.091
12	University 6	0.000	3.000	0.000	9.091

Source: Authors

The chart below represents the degree of proximity to the nodes represented in the diagram above.

Chart 2. Closeness of Centrality

		inCloseness	outCloseness
10	University 4	11.111	8.333
2	Company 2	11.111	8.333
9	University 3	11.111	8.333
1	Company 1	10.000	11.111
11	University 5	9.091	8.333
12	University 6	9.091	8.333
7	University 1	8.333	8.333
8	University 2	8.333	8.333
3	Company 3	8.333	8.333
4	Company 4	8.333	16.667
5	Company 5	8.333	8.333
6	Company 6	8.333	12.500

Source: Authors

The diagram shows the innovation network and the framework of centrality; it is notable that company 4 assigns greater weight for output relationships for the purpose of innovation than companies 6:01. An interesting point is that the input relations with universities 4:03 show values greater than the input relations with other companies. The degrees of centralization were obtained: Network Centralization (Outdegree) = 45.179% and Network Centralization (indegree) = 15.427%.

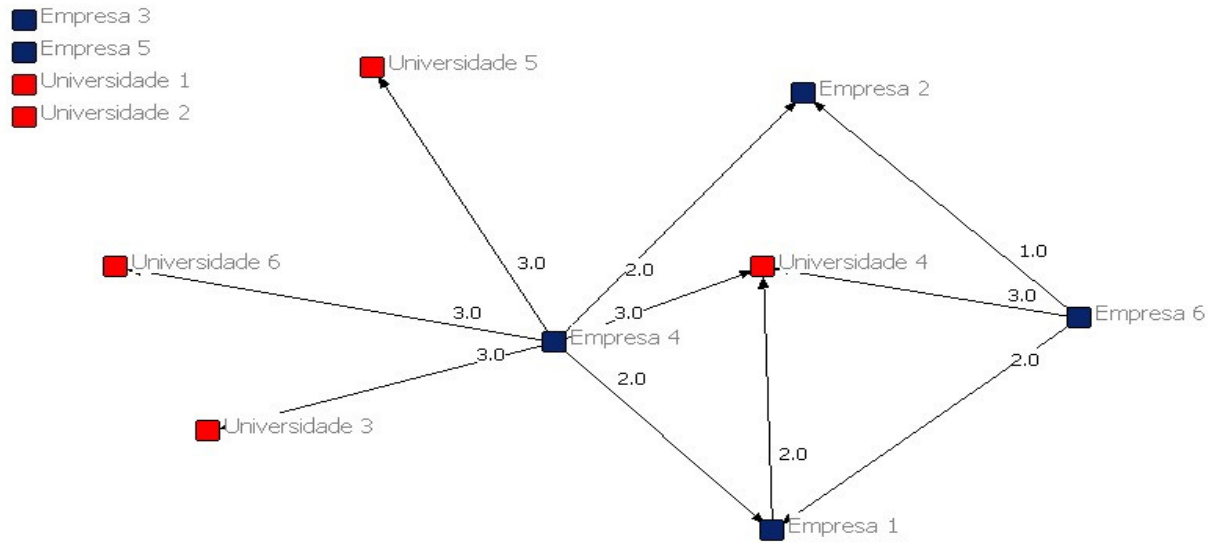
For this network, the degree of interference calculated using the program was UCINET Network Centralization Index = 0.00%. This means that none of the actors in a position to mediate the relationship between the other points with regard to innovation. The average density was found to be 0.2121, with standard deviation of 0.6857.

Looking at the picture of proximity (closeness) we find that the respondent companies have greater proximity output, which is to be expected. It is interesting to notice that in terms of proximity of entry, universities and company 3:04 2 present the most significant numbers.

Internationalization

This figure represents the diagram obtained from the tabulation of responses showing the importance attached by the respondent companies to relations with different universities and with other companies in order to internationalize.

Figure 2. Networks to Internationalize



Source: Authors

The chart below represents the degree of centrality (centrality) found for the nodes represented in the diagram above.

Chart 3. Freeman's Degree of Centrality Measures

		OutDegree	InDegree	NrmOutDeg	NrmInDeg
4	Company 4	16.000	0.000	48.485	0.000
6	Company 6	6.000	0.000	18.182	0.000
1	Company 1	2.000	4.000	6.061	12.121
2	Company 2	0.000	3.000	0.000	9.091
5	Company 5	0.000	0.000	0.000	0.000
3	Company 3	0.000	0.000	0.000	0.000
7	University 1	0.000	0.000	0.000	0.000
8	University 2	0.000	0.000	0.000	0.000
9	University 3	0.000	3.000	0.000	9.091
10	University 4	0.000	8.000	0.000	24.242
11	University 5	0.000	3.000	0.000	9.091
12	University 6	0.000	3.000	0.000	9.091

Source: Authors

The chart below represents the degree of proximity to the nodes found represented in the diagram above.

Chart 4. Closeness of Centrality

		inCloseness	outCloseness
10	University 4	11.111	8.333
2	Company 2	10.000	8.333
1	Company 1	10.000	9.091
9	University 3	9.091	8.333
11	University 5	9.091	8.333
12	University 6	9.091	8.333
7	University 1	8.333	8.333
8	University 2	8.333	8.333
3	Company 3	8.333	8.333
4	Company 4	8.333	16.667
5	Company 5	8.333	8.333
6	Company 6	8.333	11.111

Source: Authors

For this network, the degree of interference calculated from the program was also UCINET Network Centralization Index = 0.00%. This means that none of the actors was in a position to mediate the relationship between the other points with regard to internationalization.

The diagram shows the network, centrality, and framework of internationalization. It is perceived that companies 4:06 attach higher value to output relations relating to internationalization, while the most significant values of input relations are presented by University 4 and Company 1.

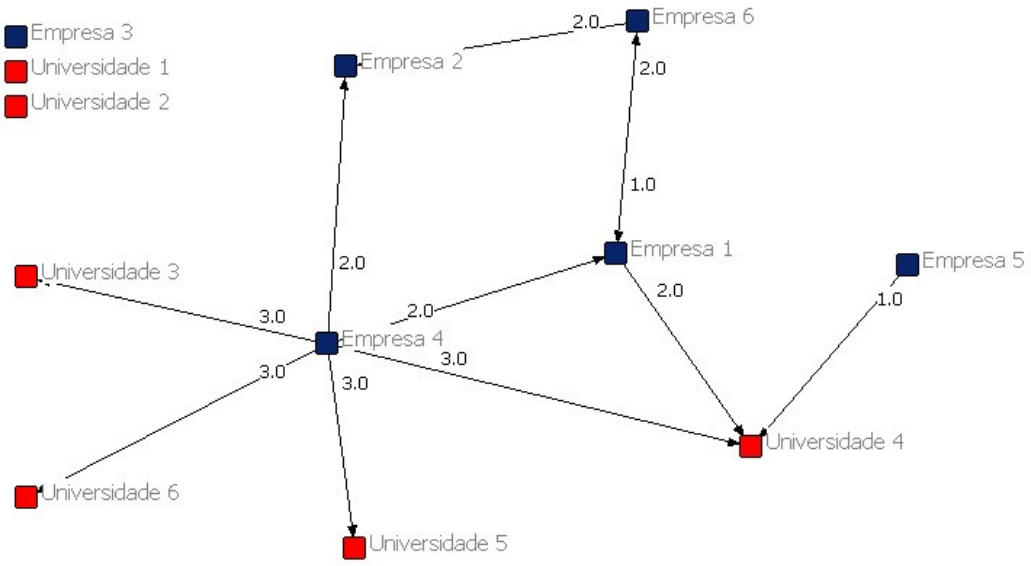
The degrees of centralization were obtained: Network Centralization (OutDegree) = 46.281%. Centralization Network (inDegree) = 19.835%. The average density was 0.1818, with standard deviation 0.6608.

Looking at the picture of proximity (closeness) we see that companies present 4:06 proximity output, while University 4, and Companies 1 and 2 have greater centrality of entry.

Management practices

This figure represents the diagram obtained from the tabulation of responses showing the importance attached by the respondent companies to relations with different universities and with other companies for the purpose of improving management practices.

Figure 3. Networks for Management Practices



Source: Authors

The chart below represents the degree of centrality (centrality) found for the nodes represented in the diagram above.

Chart 5. Freeman's Degree of Centrality Measures

		OutDegree	InDegree	NrmOutDeg	NrmInDeg
4	Company 4	16.000	0.000	48.485	0.000
6	Company 6	4.000	1.000	12.121	3.030
1	Company 1	3.000	4.000	9.091	12.121
5	Company 5	1.000	0.000	3.030	0.000
2	Company 2	0.000	4.000	0.000	12.121
3	Company 3	0.000	0.000	0.000	0.000
7	University 1	0.000	0.000	0.000	0.000
8	University 2	0.000	0.000	0.000	0.000
9	University 3	0.000	3.000	0.000	9.091
10	University 4	0.000	6.000	0.000	18.182
11	University 5	0.000	3.000	0.000	9.091
12	University 6	0.000	3.000	0.000	9.091

Source: Authors

The chart below represents the degree of interference found for the nodes in the diagram above.

Chart 6. Freeman's Betweenness Centrality

		Betweenness	nBetweenness
1	Company 1	2.000	1.818
6	Company 6	1.000	0.909
2	Company 2	0.000	0.000
4	Company 4	0.000	0.000
5	Company 5	0.000	0.000
3	Company 3	0.000	0.000
7	University 1	0.000	0.000
8	University 2	0.000	0.000
9	University 3	0.000	0.000
10	University 4	0.000	0.000
11	University 5	0.000	0.000
12	University 6	0.000	0.000

Source: Authors

The chart below represents the degree of proximity to the nodes found represented in the diagram above.

Chart 7. Closeness of Centrality

		inCloseness	outCloseness
10	University 4	12.360	8.333
2	Company 2	11.000	8.333
1	Company 1	10.000	11.000
6	Company 6	9.910	11.000
11	University 5	9.091	8.333
9	University 3	9.091	8.333
12	University 6	9.091	8.333
7	University 1	8.333	8.333
8	University 2	8.333	8.333
4	Company 4	8.333	19.643
5	Company 5	8.333	9.091
3	Company 3	8.333	8.333

Source: Authors

For this network, the degree of interference calculated from the program was UCINET Network Centralization Index = 1.74%. This means that only companies 1 and 6 have some ability to mediate the other points of the relationship with respect to management practices. This data is very is interesting, considering that the company failed to respond to one questionnaire.

The diagram shows the innovation network and the framework of centrality. It is evident that Company 4 considerably assigns a value for the highest output relationships related to management practices. The values of input relations are the most significant presented by University 4 and Companies 1 and 2, which did not respond to the questionnaire.

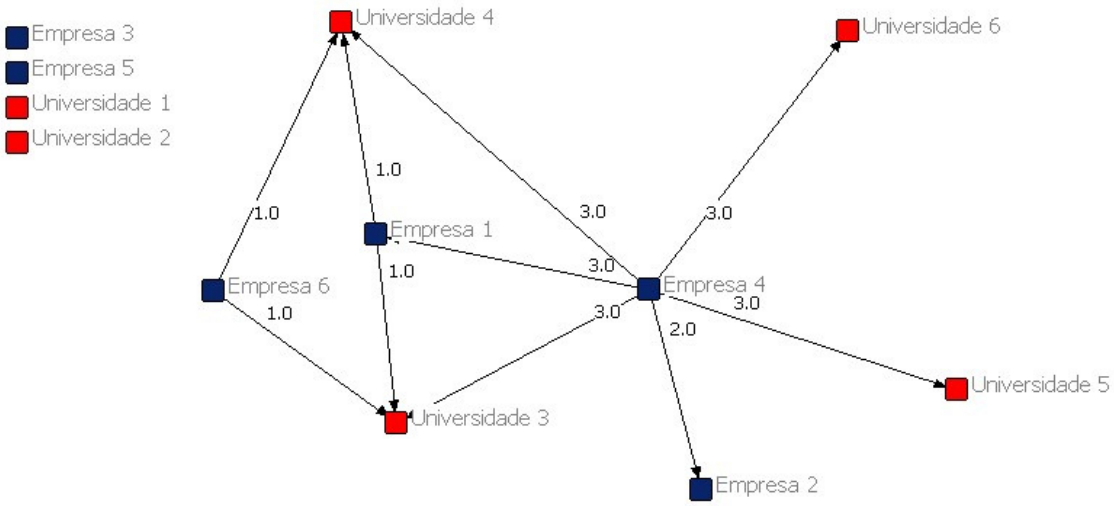
The degrees of centralization were obtained: Network Centralization (Outdegree) = 46 281% and Network Centralization (indegree) = 13.223%. The average density was 0.1818, and the standard deviation was 0.6374.

Looking at the picture of proximity (closeness) we see that the respondent companies have greater proximity output, which is to be expected, while company 4 assigns greater weight to this relationship. It is interesting to note that in terms of input proximity, universities and company 3:04 2 present the most significant numbers.

Environmental Responsibility

This figure represents the diagram obtained from the tabulation of responses regarding the importance attached by the respondent companies' relations with different universities and with other companies in the interests of environmental responsibility.

Figure 4. Networks in the Interests of Environmental Responsibility



Source: Authors

The chart below represents the degree of centrality (centrality) found for the nodes represented in the diagram above.

Chart 8. Freeman's Degree of Centrality Measures

		OutDegree	InDegree	NrmOutDeg	NrmInDeg
4	Company 4	17.000	0.000	51.515	0.000
6	Company 6	2.000	0.000	6.061	0.000
1	Company 1	2.000	3.000	6.061	9.091
2	Company 2	0.000	2.000	0.000	6.061
5	Company 5	0.000	0.000	0.000	0.000
3	Company 3	0.000	0.000	0.000	0.000
7	University 1	0.000	0.000	0.000	0.000
8	University 2	0.000	0.000	0.000	0.000
9	University 3	0.000	5.000	0.000	15.152
10	University 4	0.000	5.000	0.000	15.152
11	University 5	0.000	3.000	0.000	9.091
12	University 6	0.000	3.000	0.000	9.091

Source: Authors

The board below represents the degree of proximity to the nodes represented in the diagram above.

Chart 9. Closeness of Centrality

		inCloseness	outCloseness
10	University 4	11.111	8.333
9	University 3	11.111	8.333
2	Company 2	9.091	8.333
1	Company 1	9.091	10.000
11	University 5	9.091	8.333
12	University 6	9.091	8.333
7	University 1	8.333	8.333
8	University 2	8.333	8.333
3	Company 3	8.333	8.333
4	Company 4	8.333	16.667
5	Company 5	8.333	8.333
6	Company 6	8.333	10.000

Source: Authors

For this network, the degree of interference calculated from the program was also UCINET Network Centralization Index = 0.00%. This means that none of the actors is in a position to mediate the relationship between the other points with respect to environmental liability.

The diagram shows the network of environmental responsibility and the establishment of centrality. It can be seen that the company 4 assigns a greater weight to output relations related to environmental responsibility, while the values of the most significant input relations are shown by universities 3:04.

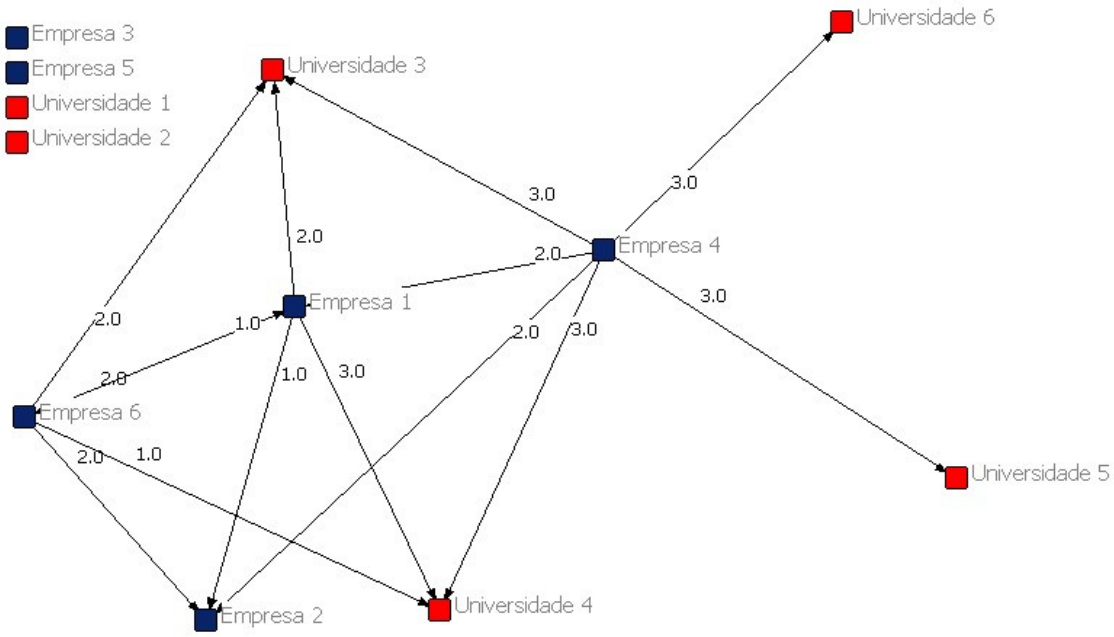
The degrees of centralization were obtained: Network Centralization (Outdegree) = 50 413% and Network Centralization (indegree) = 10.744%. Average density was 0.1591 and standard deviation was 0.6134.

Looking at the picture of proximity (closeness) we find that the respondent companies have greater output proximity, which is to be expected. Of these companies, Company 4 assigns more weight to relationship. In terms of input proximity, the most significant values are shown by universities 3 and 4.

Exchange of knowledge

This figure represents the diagram obtained from the tabulation of responses regarding the importance attached by the respondent companies to relations with different universities and with other companies for the purpose of exchanging knowledge.

Figure 5. Networks for the Purpose of Exchanging Knowledge



Source: Authors

The chart below represents the degree of centrality (centrality) found for the nodes represented in the diagram above.

Chart 10. Freeman's Degree of Centrality Measures

		OutDegree	InDegree	NrmOutDeg	NrmInDeg
4	Company 4	16.000	0.000	48.485	0.000
6	Company 6	7.000	1.000	21.212	3.030
1	Company 1	7.000	4.000	21.212	12.121
2	Company 2	0.000	5.000	0.000	15.152
5	Company 5	0.000	0.000	0.000	0.000
3	Company 3	0.000	0.000	0.000	0.000
7	University 1	0.000	0.000	0.000	0.000
8	University 2	0.000	0.000	0.000	0.000
9	University 3	0.000	7.000	0.000	21.212
10	University 4	0.000	7.000	0.000	21.212
11	University 5	0.000	3.000	0.000	9.091
12	University 6	0.000	3.000	0.000	9.091

Source: Authors

The chart below represents the degree of proximity found for the nodes represented in the diagram above.

Chart 11. Closeness of Centrality

		inCloseness	outCloseness
10	University 4	11.111	8.333
2	Company 2	11.111	8.333
9	University 3	11.111	8.333
1	Company 1	10.000	12.500
6	Company 6	9.910	12.500
11	University 5	9.091	8.333
12	University 6	9.091	8.333
7	University 1	8.333	8.333
8	University 2	8.333	8.333
4	Company 4	8.333	19.643
5	Company 5	8.333	8.333
3	Company 3	8.333	8.333

Source: Authors

The chart below represents the degree of interference obtained:

Chart 12. Freeman Betweenness Centrality

		Betweenness	nBetweenness
1	Company 4	1.000	0.909
2	Company 6	0.000	0.000
3	Company 1	0.000	0.000
4	Company 2	0.000	0.000
5	Company 5	0.000	0.000
6	Company 3	0.000	0.000
7	University 1	0.000	0.000
8	University 2	0.000	0.000
9	University 3	0.000	0.000
10	University 4	0.000	0.000
11	University 5	0.000	0.000
12	University 6	0.000	0.000

Source: Authors

As shown by the results, for this network, the degree of interference calculated from the program was UCINET Network Centralization Index = 0.91%. This means that only one company, which did not respond to the questionnaire, is in a position to mediate the relationship between the other points in regard to the exchange of knowledge.

The diagram shows the network of exchange of knowledge and the framework of centrality. It can be seen that Company 4 assigns greater weight to relationships of knowledge exchange, while the values of the most significant input relations are shown by universities 3:04.

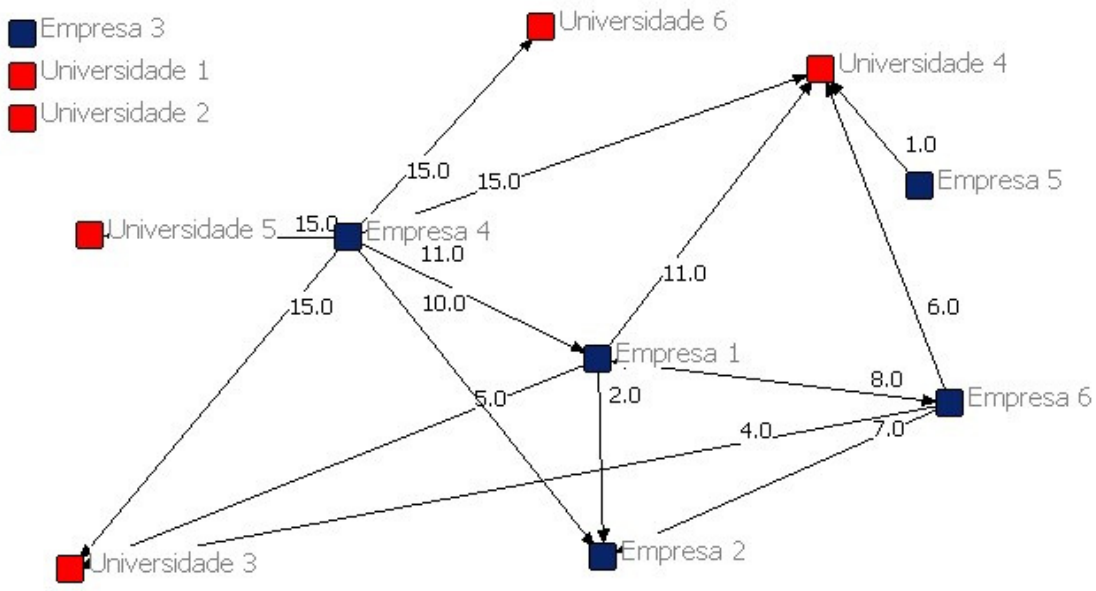
The degree of centralization were obtained: Network Centralization (Outdegree) = 44 628% and Network Centralization (indegree) = 14.876%. The average density of 0.2273, 0.7027 and standard deviation.

Looking at the picture of proximity (closeness), we see that the respondent companies, once again, have closer output, which is to be expected. In terms of proximity of entry, universities and company 2 3:04 present the most significant numbers.

Consolidated

This result was obtained from the sum of the weights assigned by the companies that responded to all the dimensions covered in the survey. This figure represents the diagram obtained from the consolidated information.

Figure 6. Networks the Consolidated Information



Source: Authors

The chart below represents the degree of centrality (centrality) found for the nodes represented in the diagram above.

Chart 13. Freeman's Degree of Centrality Measures

		OutDegree	InDegree	NrmOutDeg	NrmInDeg
4	Company 4	81.000	0.000	49.091	0.000
6	Company 6	25.000	2.000	15.152	1.212
1	Company 1	20.000	19.000	12.121	11.515
5	Company 2	1.000	0.000	0.606	0.000
2	Company 5	0.000	19.000	0.000	11.515
3	Company 3	0.000	0.000	0.000	0.000
7	University 1	0.000	0.000	0.000	0.000
8	University 2	0.000	0.000	0.000	0.000
9	University 3	0.000	24.000	0.000	14.545
10	University 4	0.000	33.000	0.000	20.000
11	University 5	0.000	15.000	0.000	9.091
12	University 6	0.000	15.000	0.000	9.091

Source: Authors

The chart below represents the degree of proximity found for the nodes represented in the diagram above.

Chart 14. Closeness of Centrality

		inCloseness	outCloseness
10	University 4	12.500	8.333
2	Company 2	11.111	8.333
9	University 3	11.111	8.333
1	Company 1	10.000	12.500
6	Company 6	9.910	12.500
11	University 5	9.091	8.333
12	University 6	9.091	8.333
7	University 1	8.333	8.333
8	University 2	8.333	8.333
4	Company 4	8.333	19.643
5	Company 5	8.333	9.091
3	Company 3	8.333	8.333

Source: Authors

This chart represents the degree of centrality found for the nodes represented in the diagram

Chart 15. Freeman's Betweenness Centrality

		Betweenness	nBetweenness
1	Company 1	1.000	0.909
2	Company 2	0.000	0.000
3	Company 3	0.000	0.000
4	Company 4	0.000	0.000
5	Company 5	0.000	0.000
6	Company 6	0.000	0.000
7	University 1	0.000	0.000
8	University 2	0.000	0.000
9	University 3	0.000	0.000
10	University 4	0.000	0.000
11	University 5	0.000	0.000
12	University 6	0.000	0.000

Source: Authors

For this network, the degree of interference calculated from the program was UCINET Network Centralization Index = 0.91%. This means that only one company, which did not respond to the questionnaire, is able to mediate the relationship between the other points.

By observing the network diagram and consolidated picture of centrality, we see that the respondent companies are those with higher values of output, which is expected. Company 4 attaches great importance to these relations, while Company 1 attributes lesser importance. Concerning the values of input relations, the most significant values are found in relationships with Universities 3 and 4.

The degrees of centralization were obtained: Network Centralization (Outdegree) = 46.556% and Network Centralization (indegree) = 14.821%. The average density was 0.9621, and standard deviation was 3.1609.

Looking at the picture of proximity (closeness), we see that the respondent companies have greater proximity output, which is to be expected. Companies 1 and 6 attribute the same weight to these relations, while company 4 attributes greater weight. In terms of proximity of entry, university 2 and companies 3 and 4 present the most significant figures.

5. CONCLUSION

It appears that the development of an Economic Block and a nation network of innovation needs the support of the Triple Helix, which requires the involvement of governments, universities/research institutions and existing firms.

This triple helix is a network of relationships which promotes the social, economic and financial stability of a given nation, region or sector.

This paper therefore analyzes the Beta Technology Innovation Park, its actors and the relationships between these actors. This is relevant when it comes to the local development of Brazil, especially after CMC 2008 03/08, signed by the Mercosur countries, giving birth to legal landmark Science, Technology and Innovation 2008-2012. As reinforced by regulation SC@2022, State Maximum Innovation in the state of Santa Catarina state, where the Beta Technology Innovation Park is located, encourages the goal of transforming the state into a reference for innovation with sustainability in Brazil and worldwide.

The aim of this paper is to define the main actors involved, their relationships, and the degree of relationship between them. Through the analysis, it was possible to draw the typology of the Beta Park network and the source and intensity of relations between the actors, according to the indicators: centrality, density, intensity, importance, and degree.

When looking at the diagram of the network of environmental responsibility and the establishment of centrality, we see that the company 4 attributes a greater weight to output relations related to environmental responsibility, while the values of the most significant input relations are shown by universities 3:04.

For this network, the degree of interference calculated from the program was UCINET Network Centralization Index = 0.91%. This means that only company 1, which did not respond to the questionnaire, is able to mediate the relationship between the other points.

By observing the network diagram and consolidated picture of centrality, it is evident that the respondent companies are those with higher values of output, which was expected. Company 4 attributes great importance to these relations, while Company 1 attributes lesser importance. Concerning the values of input relations, the most significant values were found in the relationships with Universities 3 and 4.

These results show us that the respondent companies value relationships with universities more than relationships with other companies. This may be due to the fact that the respondent companies belong to different market niches. Further studies are needed, to deepen understanding of this kind of behavior.

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