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# Relationships and Centrality in a Cluster of the Milk Production Network in the State of Parana/Brazil

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**Abstract.** The objective of this research is to evaluate the relationships of the network formed by the important milk cluster in the city of Umuarama, State of Parana (PR)/BRAZIL, using the Social Network Analysis (SNA) focusing on the collective gains and competitive advantages of this cluster. The methodology used was qualitative and quantitative. Questionnaires were applied to the network for the characterization of the existing relationships between them, and also to present the analysis of network measures using the UCINET software and the graphics schemes of networks. It was found that this milk production network appears to be diffuse, and that there are few solid relationships, which have no central coordination; the network did not present governance relationships nor a defined empowerment with significant transaction costs relationships. The relevance of this paper is to present a procedure of study in networks that can be reproduced in future researches.

**Keywords:** Clusters. Networks . Simultaneous Networks . Relationship. Milk

## 1 Introduction

The advent of globalization and the internationalization of the economy made the competitive advantages be seen as essential to the business management [1, 2, 3]. Therefore, studies are needed to clarify new forms of regional operations in niche markets, due to their increasingly competitiveness, creating sustainable competitive advantages in that niche.

This process requires the actors to implement a development policy and seek new concepts of organization of products and services in micro and macroeconomic terms, to favors a more flexible structure supported by new technologies [2], [4].

One of these new technologies used to increase the competitiveness of organizations is the approach by the concepts of Business Networks, mainly regarding the relationships between the actors and the centrality of the network [4].

However, the large number of actors involved makes it difficult to conduct a study of the agents' role in the structure of these networks. Thus, some studies have been

developed by analyzing the company networks from the perspective of social networks using softwares such as UCINET and NetDraw [5].

The studies of Roy and Sarkar [6] proposed a method to rank the stock indices from across the globe using social network analysis approach; Söylemezoglu and Doruk [4] clearly confirm that the clustering approach has positive results in regional development and also values the cluster.

The aim of this study is to evaluate the network relationships of the milk production network, using Social Network Analysis (SNA) in the city of Umuarama-PR/BRAZIL, focusing on the collective gains and competitive advantages for the cluster of milk producers in the city

For this, a survey was applied to agents of the milk production network through an analysis of the simultaneous networks (physical, value and business) [7], in three dimensions: relationship, governance and distribution of power and cost transaction. It is inferred that, when the relationships between the actors of a network are dense, the cluster becomes more competitive, allowing a local and regional growth.

## **2 Theoretical Background**

### **2.1 Networks Analysis**

In the relationships that occur within the organization between their individuals, it can be argued that the interactions between the various types of actors are understood and studied by the analysis of the theory of companies networks. [8, 9, 10, 11, 12]

The concept of business network is shown as a collection of individuals or organizations connected through relationships of various kinds, and that a network consists of nodes and links (lines or edges) that connect the nodes based on bilateral relations between two actors. [13]

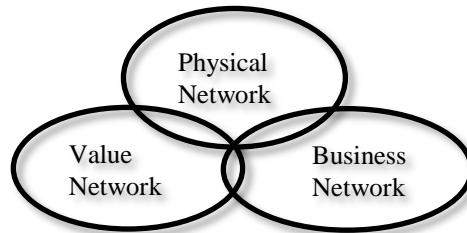
In a network there is a central actor joining many other actors not connected to each other that helps to lead the actions of the group. This centrality describes the degree of the position where the individual can be found in this network. It is noteworthy that many are the quantitative indicators that measure and reflect the power of the actors. [4]. [13] [14].

The centrality emphasizes the positive effects of dense and consistent ties in a regulatory environment. Such ties facilitate trust and cooperation between individuals, and in return, provide benefits, such as information and knowledge sharing.

The existence of structural holes in a network represents business opportunities, in which an actor can join to complete the network [11], [15], [16]. A network can be characterized for its general structure and by the way it establishes the links between the actors. A business network is dense when the maximum of information takes place between the actors. On the contrary, the business network is considered diffuse when the relations between the actors are weak. [17]

## 2.2 Networks Companies

In the study of the key attributes of companies networks it can be considered the existence of three sub networks that interact with each other, called Simultaneous Networks. These networks are divided into (a) physical network, (b) value network and (c) business network, as can be seen in Figure 1 [7]:



**Fig. 1.** Simultaneous networks (Source: Adapted [7])

The physical network is responsible for the activities or delivery functions of raw material supplies; from suppliers to the places of their effective use, it is there that the physical production of goods and/or services can be checked.

The value network is the place where occurs the alternative development activities to obtain the conditions for meeting the needs that customers consider important.

The actors of value networks are companies with areas of projects connected with the achievement of a particular item of value, such as universities, research centers, among others.

The business network is composed of agents that assess or measure the needs dictated by a given market; it is meant to discover them and pass on to their business partners; it should develop commercial activities, and is responsible for implementing activities that facilitate customer access to products and services [7], [8], [18].

In this study it was proposed a conceptual model of simultaneous networks, whose dimensions are shown in Figure 2.

		Dimensions of the Milk Production Network		
		Relationship	Governance and Power Distribution	Transaction Costs
The simultaneous networks	Physical	Enable the free flow of products, services and information.	Enable the reduction in operating costs by creating a more favorable working environment.	Are reduced in a cooperation environment due to the confidence of the members.
	Value	Enable greater access to information and innovations to support the activities of the agent.	Enable efficiencies gains and make clear the network value creation processes.	More efficient operations and more credibility between the partners; generate lower transaction costs.
	Business	Enables a better understanding between the agents and joint works for the network performance.	Enables more partnerships and more agility in decision making, identifying new opportunities, generating business.	Transparency, credibility and trust generate advantages in the search for new partnerships.

**Fig. 2.** Conceptual research model (Source: adapted [7])

### 2.3 The Milk Production Network in Brazil and in the State of Parana

The milk production network is one of the most important agro-industrial activities, and in the economic and social development process in Brazil it has an important role, given that milk production in Brazil, from 2009 to 2013 obtained a percentage growth of 17.67%, starting in 2009 from 29 billion liters to 34 billion liters in 2013.

The milk production in the state of Parana/Brazil has increased year after year; for example, in 2009 the production came from 3,3 billion liters, reaching 4,3 billion liters in 2013, a percentage growth of 30.19%. Compared with the national growth, the state of Parana stood out greatly, as shown in Table 2.

**Table1.** Evolution of milk production. (Source: adapted [19])

Year	Brazil	Parana State	%
	Quantity (1 000 liters)	Quantity (1 000 liters)	
2013	34,255,236	4,347,493	12.69%
2012	32,304,421	3,968,506	12.28%
2011	32,091,012	3,819,187	11.90%
2010	30,715,460	3,595,775	11.71%
2009	29,112,024	3,339,306	11.47%

While all domestic production grew 5,1436 billion liters, the production in Parana grew more than 1 billion liters, which means that 19.60% of the national production growth between the years 2009 and 2013 were from Parana.

The milk production network in the state of Parana presents distinct aspects from the producing regions. For example, in the southern state, in the cities of Carambei, Castro, Palm and Arapoti (Ponta Grossa's region), some dairy cattle are among the best in the country, with the average yield in the region of about 4,000 liters/cow/year; however, in these regions it is not uncommon to come across properties that hit the mark 8,000-10,000 liters/cow/year.

## 3 Methodology

The study was conducted in the city of Umuarama, located in southern Brazil, in northwestern Parana region.

It was chosen a case study with descriptive approach with quantitative and qualitative methodology [16], using a survey research that is more appropriate for this type of approach [08], [13] [14].

The agents considered active participants in the milk production network are called:

- [AG1] Cooperatives - Cooperatives of farmers operating in the city of Umuarama, headquartered in this city or not;

- [AG2] industry and trade of machinery and equipment - milking equipment and other technologies used in the management of dairy cattle, operating in the study region, directly or through resellers;
- [AG3] industry and animal feed trade and veterinary products - supply of feed for dairy cattle nutrition and veterinary products for animal health of dairy cattle, in the study region;
- [AG4] milk producers (with herd of considered dairy breeds) – producers of cow milk, with properties located in the city of Umuarama - PR, which have herd of considered dairy breeds;
- [AG5] EMBRAPA – Brazilian federal agency of agricultural research, which seeks to develop technologies for agricultural production;
- [AG6] SEAB/EMATER - State government agency that looks for the management and collection of information about the operations performed in the market of the state (regulatory body) and extension member (technology transfer and technical assistance), that operates providing technical and managerial support to producers in the region;
- [AG7] universities - higher education units that prepare professionals to work in agribusiness (especially Agronomy, Veterinary, Food Engineering, Food Technology and Management), mainly those operating in the region (UNIPAR and UEM);
- [AG8] industries for processing and dairy - intermediate industry, which operates processing the fresh products produced by the farmer, turning them into finished products for final consumption;
- [AG9] commercial banks and credit unions - private or public financial agents, who work in the milk production network, and provide credit to its various links;
- [AG10] IAPAR - State Institute of Agricultural Research, active in agricultural research and technological development of the municipality;
- [AG11] producer associations - milk producers associations operating in the city of the study.

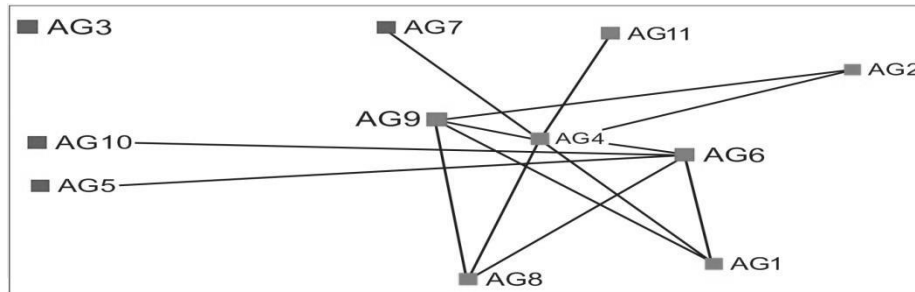
To collect data, questionnaires and interviews with participants in the milk network agents in the city of Umuarama – PR were made. The data were tabulated and it was attributed a value of 1 (one) when a particular agent relationship was appointed by the respondent, and attributed 0 (zero) when a particular agent relationship was not appointed by the respondent, forming with this an analysis matrix

The tabulated data were processed using the software UCINET to compute various metrics of interest for network analysis patterns and relationships [5], [9], [13].

## **4 Results and Discussion**

### **4.1 Relationship Dimension**

The first dimension by which the production network has been examined is the Relationship Dimension [RD], as can be seen in Figure 3.



**Fig. 3.** Relationship Dimension Network

In Figure 3 the data analysis showed that the physical network is represented by the agents AG1, AG2, AG4 and AG8. The nodes AG3, AG5, AG7 and AG10 represent the value network, but may also belong to the physical network. The nodes AG6, AG9 and AG11 indicate the business network and may also be a participant of the physical network and of the value network.

The analysis showed that only AG4, AG6 and AG9 had significant factors in the relationship dimension, so the others are not the focus of consistent relationships.

This configuration shows that the network focuses its relationships at key points, but they fail to prioritize agents that could help in the development of the sector in the region, such as universities, dairy and producer association and industries.

The calculated density of this network was approximately 0,26; so, the physical network in the relationship dimension is considered diffuse [13], [17], what indicates that they are unprepared to reach the goal of a free flow of goods, services and information.

#### 4.2 Governance and Distribution of Power Dimension

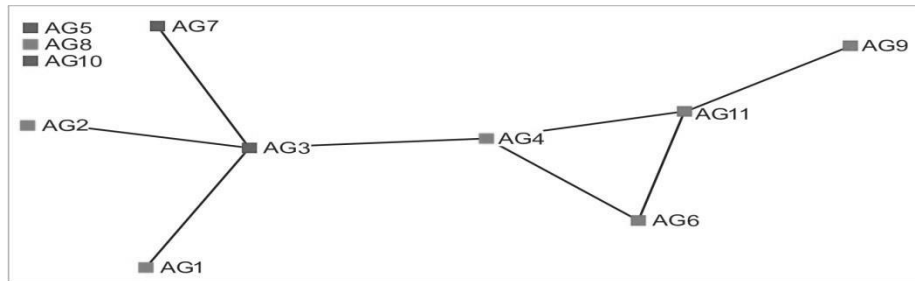
To demonstrate the adequacy of factor analysis [20] it was used the MOK (Meyer-Olkin Kaiser) test and the Bartlett's test of sphericity to study the governance and distribution of power dimension [GDPD].

The results showed that the relationship matrix performed wholly void, composed only of zeros, that is, without relationships, suggesting that the network is not being managed, and none of the concurrent networks is being governed in order to develop the sector as a whole.

As the relationship dimension has performed diffuse, the governance and distribution of power dimension performed similarly diffuse, as one is linked to the other.

#### 4.3 Transaction Costs Dimension

The transaction costs dimension [TCD] has an important analysis parameter in relationships related to agribusiness. Figure 4 shows this dimension in the milk production network.



**Fig. 4.** Networks in Transaction Costs Dimension

Through the network graph analysis in the transaction costs dimension, the agents [AG3], [AG11] are part of the physical network and of the value network, simultaneously, and the agents [AG6], [AG9] are simultaneously part of the value network and of the business network

The agent [AG3] with four significant ties of relationships shows that this agent is of greater impact in the transaction costs. This indication may be due to the purchase and handling of veterinary products

The agent [AG6] is related to this dimension due to regulatory issues and supervision exerted by the SEAB. The dairy market is a regulated market by the Brazilian Federal laws.

The questionnaires applied to the financial institutions that represent the agent [AG9] indicate a significant relationship of transaction costs with the agent [AG11]. Another important result showed that the farmers also point the agent [AG11] as focus of the relationship in this dimension.

## 5 Conclusions and Outlook

The analysis carried out in the simultaneous networks (physical, value and business) have shown unexpectedly that the current configuration of the existing relationship network in this production network is inadequate to promote collective gains and competitive advantages to its agents. Even making the analysis for three different dimensions they confirmed the lack of solid relationships to promote coordination of significant collective actions that could lead to a reduction of transaction costs and to collective gains for the participants in the milk production network, showing a diffuse network.

However, the research, and in particular the analysis of the relationship dimension, indicated significant ties - centrality indicators - in three agents, namely: milk producers, EMATER/SEAB, and financial institutions, representing respectively the production, the regulation and propagation of knowledge, and the finance and credit in the production network.

The connection between the three agents shows that they may be responsible for the beginning of a strategic policy of sectorial development, if encouraged to fulfill this function. The research reaffirms also the importance of integration among the supply network agents, in an organized way for better competitive benefits.



For future studies it is suggest the study of other networks, focused on their density and determination of continuous improvement factors using this same procedure.

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