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COMPETITIVE RESOURCES CONFIGURATIONS FOR INNOVATIVE TECHNOLOGICAL PERFORMANCE IN INTERORGANIZATIONAL RESEARCH NETWORKS

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1 Introduction

The Resource-Based View (RBV) sustained by authors as: Wernerfelt (1984), Barney (1991) and Peteraf (1993), analyses the nature of company´s competence and value as source for competitive advantages. The RBV has its precedents in Penrose (1959). To Penrose (1959), a company is more than an administrative unit, is also a collection of productive resources on which the different managers can take various decisions. This theory arises from dissatisfaction of structure-conduct-results paradigm, from the Industrial Economy, to explain the foundations of business competitiveness (Porter, 1980).

Reality showed that, within the same sector of activity there are companies with different performances. With the RBV, the sector structure ceases to be determinant of competitive advantage of companies and, by extension, the performance differences among them, showing the importance of the company's internal elements. Thus, the RBV shifts the source of competitive advantage of positioning of products and companies to the market for inputs. In this sense, instead of the markets of outputs, the imperfections of those market of inputs are the justifiers of profitability acquisition. The RBV is also useful in identifying resources that provide the generation or the sustainability of competitive advantage, including all attributes that enable networks to define and implement strategies (Barney, 1991). A company has a sustainable competitive advantage when it is implementing a strategy to create value that is not being simultaneously performed by current or potential competitors (Barney & Hesterly, 2011).

In the context of organizations focused on innovation, the challenges they face today are global and cannot be solved only by science. To address these challenges, resources, motivation and commitment are crucial elements (Gattaz et al., 2012). Innovation means the one where the technology should hit the market or society (Schumpeter, 1997; OECD, 2005). To Huggins (2010), the strategy of resource networks through the formation of knowledge networks are more likely to be positively related to better performance.

We study the complementarity of resources within interorganizational networks for innovative performance technologies and we find in literature only researches that evidence the influence the isolated influence of resources in agribusiness context to explain innovation in research and development (R&D). However, nor any work has investigated all physical, human, financial and organizational resources contained in inter-organizational R&D networks (Barney, 1991; Pike, Roos & Marr, 2005), which effectively explain on parsimonious configurations the success of innovation in the agricultural sector. This work aims to explore this gap with support by the Most Similar Conditions and Different Outcome (MSDO) and Qualitative Comparative Analysis (QCA) methods.

Thus, the objective of this work was to evaluate which competitive resources influence the innovative technological performance in interorganizational research networks. So, we performed a comparison work in 26 innovation networks in the agricultural research sector in those two countries. Brazil is notoriously global stood out in food production; and Spain is the European country with the largest area of agricultural production intended for the plant genetic improvement programs with genetically modified organisms (James, 2015). Innovative technologies analyzed in this study are both conventional and transgenic.

2 Theoretical Background

The last decades were marked by the advent of a considerable number of studies focusing on contacts between organizations (Garcez,, Sbragia, & Kruglianskas, 2014), so that special attention has been given to links promoted through interorganizational networks (Binder, 2009;. Castro, Bulgacov & Hoffmann, 2011). Based on "the movement of innovation and the rapid changes in the knowledge economy, organizations have been going through a new wave of revolutionary operations and management strategy transformation" (Gattaz et al., 2012, p. 13).

Various classifications of company´s resources and capabilities can be found, being the more conventional classification the one which distinguishes between tangible and intangible resources (Wernerfelt, 1984). The formers are characterized by being easily identifiable and classifiable. Simply, we could say that tangible would be those resources that could be found in the market of production factors, while the intangibles do not appear neither on the balance sheet of the company. These latter are more difficult to identify and assess, as they are not frequently bought or sold, for also they are more difficult to defend property rights.

A company has a sustainable competitive advantage when it implements a strategy to create value that is not simultaneously executed by current or potential competitors, along with the inability of those competitors in duplicating the benefits of that strategy (Barney, 1991). The resource-based view (RBV) "is a performance model with focus on the resources and capabilities controlled by a company as sources of competitive advantage" (Barney & Hesterly, 2011, p. 58).

The company is a set of resources and capabilities that will become the real source of their competitive advantages. The resources that meet those requirements are recognized as critical resources (Wernerfelt, 1984), strategic factors (Barney, 1991) or strategic assets (Amit & Schoemaker, 1993).

If we are based on the idea that revenues are generated by the imperfections of markets of inputs, those imperfections should be a consequence of various resources. A review of the literature in this regard shows that there is no unanimity among the various authors on the requirements that must be met to acquire its strategic character, being the degree of coincidence only partial, as shown in Table 1.

Table 1 - Requirements of strategic resources

Barney (1986, 1991)	**Peteraf (1993)**	**Amit & Schoemaker (1993)**
Valuable Scarce	Heterogeneity	Durability Scarce
Irreplaceable Inimitable: • Trajectory Reliance • Causal Ambiguity • Social Complexity	Limits *ex-post* to competence: • Inimitable • Irreplaceable	Inimitable Irreplaceable
	Limits *ex-ante* to competence Imperfect mobility: • Resources imperfectly mobile • Revenues shared	Not marketable Complementary (Specific) Suitability

Source: Authors own elaboration.

So, the very nature of tangible resources will prevent them from contributing fully to the creation and sustainability of competitive advantage. On the contrary, the intangible resources can contribute greatly to support to competitive advantages and, therefore, for business success. In this way, Barney (1991) and Pike *et al.* (2005) distinguished four types of resources: physical, financial, human and organizational.

Thus, the condition of resource heterogeneity explains the different results within the industry when understanding that the companies with the best results have valuable and scarce resources. However, for this situation to continue over time heterogeneous endurance is required, and that depends on the duration of the scarce and valuable resources (Amit & Schoemaker, 1993). If those resources disappear or lose value, the revenues that they provide to companies will disappear with time.

Considering that a set of companies, grouped in a single structure and operating collectively, form a new organization (Balestrin & Verschoore, 2014) and that an organization is a collection of resources (Penrose, 1959). For Amit and Schoemaker (1993), the organization's competitiveness is influenced by the complementarity of its strategic resources. In this sense, Lavie (2006) reinforces the traditional view of RBV, arguing that the contribution of complementarity of resources is not only intraorganizational, but that the scope of competitive advantage is given by the complementarity of interorganizational resources, i. e., by the capacity to benefit the complementarity of network resources.

The relational resource-based view postulates that differences in the firm´s performance can be explained for internal resources and also by the maintenance and development of relationships with external partners (Wang & Li-Ying 2015). Furthermore, it was also evidenced the causal complexity underlying performance differences among innovative organizations (Freitas et al., 2011). Strategically relevant resources, however, may be located not only at the enterprise level, but also outside it, that is, in interorganizational networks or even at the level of innovation systems (Musiolik, Markard & Hekkert, 2012).

In addition, the sharing of resources may occur, and the collaborative relations have a beneficial effect for the competitiveness of companies (Bulgacov, Arrebola & Gomel, 2012), providing the potential generation of sustained competitive advantage by the interplay of resources (Barney, 1991).

The spatial dimension of the collaborative networks working in the regional innovation system show that the complementarity of resources is also in networks of knowledge, whose actors may be territorially dispersed (Belussi & Porcelatto, 2012) or agglomerates in regions (Laviola et al., 2014).

Besides that, “the implication is that firms are likely to improve their innovation performance as they increasingly reconfigure their resource-base” (Kamasak, 2015, p. 1330). So innovation performance can be explained as combination of assets and resources (Rajapathirana & Hui, 2018). Thus, in this work, it is understood that the operation of the network depends on the set of internal resources shared and combined, so that their complementarity allows to achieve a better innovative performance.

3 Methodology

Taking into account the phenomenon investigated, the Qualitative Comparative Analysis method (QCA), which offers to the research compared a systematic method, precise and based on Mathematics (Boolean algebra) and in formal logic (Ragin, 1987), was adopted. According to Wagemann (2012), the QCA method is a technique that allows you to analyze a median number of cases, which might be too high for the use of techniques employed in case studies, but, at the same time, too low to develop a parametric statistical analysis. Furthermore, in Latin America the QCA has been little used (Ariza & Gandini, 2012; Wagemann, 2012), being this an additional motivation for the choice of technique.

More specifically Crisp-Set Qualitative Comparative Analysis (csQCA) was used, a method of analysis that is used in binary datasets (Ragin, 1987), where 1 (one) symbolizes the presence of indicator and 0 (zero) the absence. The analysis of Boolean algebra was carried out

with the aid of Tosmana software - Tool for Small-N Analysis (https://www.tosmana.net/). The center of the QCA method is on the issue of sufficient and/or necessary restrictions (or combinations that meet these characteristics) to a result (outcome). In this way, the outcome or variable depends on this study which is an innovative performance that is represented by 1 (one), and its backward, or innovative bad performance, represented by 0 (zero).

As recommended by Ragin (1987) the MSDO/MDSO analysis is a preliminary step to the QCA. This method is intended to reduce the number of explanatory causal variables of performance differences between two sets of cases with different performances. In addition, that method is primarily used in situations where the number of variables studied are numerous, which limits the QCA analysis (Dias & Pedrozo, 2015). This step of the method was carried out with the support of the MDSO MSDO software.

Qualitative comparative analysis (QCA) is a research strategy to investigate parsimonious configurations that explain a given result of interest in small-N populations applied for organizational and innovation performance (Freitas et al., 2011). The choice of method of analysis guided the definition of the number of cases in the study. The use of Qualitative Comparative Analysis (QCA) is usually set to an intermediate N, whose most applications is in the range of 10 to 50 cases (Rihoux & Ragin, 2009).

Thus, the empirical research was carried out in 26 inter-organizational networks derived from P, D&I projects, supported by two public organizations: Embrapa-Brazilian Agricultural Research Company, in Brazil (successful 9 and failed 9), and INIA - *Instituto Nacional de Investigación y Tecnologia Agraria y Alimentaria*, in Spain (successful 8).

Thus, for the research a combination of sources including both primary data, as secondary, was used. For the documentary analysis were used public equipment from Embrapa and INIA, also not accessible to the public, as reports and digital files of both institutions. In addition to the consultation in public databases. The analysis of the data from those documents enabled the judicious selection of the study cases, that is, inter-organizational networks which have developed cultivars (technologies) of success and failure in terms of innovation.

In Brazil, for the selection of cases of success and failure, the study prepared by the Consultancy of Strategic Management (CSM) of the Ministry of Agriculture, Livestock and Food Supply (*MAPA*) was applied, showing the agricultural income expressed in Gross Value of Production (GVP), to define the main species/cultures. Then, a screening of successful technologies and those that were not successful through the collection of royalties over the last years (2010-2015) was carried out, in addition referring to the date of the cultivar protection, that represents its patent, at the MAPA website, to identify the researchers who are leaders in the research network.

The selection of successful cases in Spain, in the segment of plant breeding of the agricultural research sector, was set through the collaboration of the Department of International Scientific Affairs, of the Deputy Head of the Multilateral Affairs of INIA, that systematized a table with information (crops, leading researchers, institutions and contacts) of the more successful Spanish cases in the field of study. The cases of failure in Spain were not studied, because there was no information available and, also, because the objective of the research was, after the comparative analysis between the cases of success and failure in Brazil, to include the cases of success of Spain not to restrict the networks which had innovative performance to possible endogenous resources of a given country (empirical diversity limited to Brazil).

Later, as a technique for gathering primary data for Qualitative Comparative Analysis (QCA), online questionnaires were applied in 2015. The categories present in the questionnaire were elaborated on the basis of the literature, that is, the types of resources in the context of Research and Development organizations (R&D), according to the classification of Pike et al. (2005), detailed in Chart 1.

Chart 1 – Level of Resources.

Group of Resoures	Scope
Human	Capacities of R&D, commercial alignment, management capacity, partnership capacities, learning.
Organizational	Intellectual ownership, processes, organizational culture, trademark and image, organizational structure and organizational strategy.
Physical	Facilities, products and materials, equipment and service infrastructure.
Monetary	The company's cash or another financial asset equivalent that can be converted into money.

Source: adapted from Pike et al. (2005, p. 115).

Beyond this scope to the group of organizational resources, Gonçalves, Coelho and Souza (2011) add the "detailed information on the market", because, despite the resource based view owning internal emphasis on companies is essential to competitive intelligence practices and the interpretation of their external environment and information of their competitors to use them strategically.

To evaluate innovative inter-organizational networks performance was rated the performance in the creation of a tangible product that has reached the marketplace, which can be measured by direct monitoring from obtaining the information of the marketing or royalties collected by the technology in analysis (Andreassi, 2007).

And, then, to improve the ability of that instrument, two attributes were important: the validity and reliability (Villavicencio, 2011). For its operation, the questionnaire was submitted to be assessed by judges, as experts in the scientific content and in the method adopted or in preparation of data collection instruments (Villavicencio, 2011). This research included the participation of 10 judges of Brazil and Spain's Universities, chosen on the basis of the criteria of notorious knowledge on theme and/or research method, five to the validity step and another five for reliability, involving qualitative procedures (opinions for improvements) and quantitative (Cronbach's Alpha).

There was need for the adaptation of the instrument to another language. So, to ensure adaptation of a questionnaire form methodologically correct, the five stages were followed: (i) initial translation; (ii) synthesis; (iii) translation back to the original language; (iv) review by a committee or expert; and (v) realization of a pre-test. The pre-test was conducted in Brazil and in Spain, with workers from the research target-institutions, which resulted in new adjustment.

4. Results and Discussion

MSDO/MDSO analysis aims to identify the main variables that explain the performance differences between two sets of cases with different performances. This is a preliminary stage in the implementation of the QCA method, especially when the variables studied are numerous, which limits the QCA analysis.

In this analysis, cases are researches in Brazil and Spain. In Spain there are 8 cases, all successful, and in Brazil there are 18 cases, being 9 of success and 9 of failure. Success or Failure is the measure of Performance (outcome) and are represented by the numbers 1 (success) and 0 (failure).

Figure 1 - Dichotomized data of causal variables and the performance of the 26 networks analyzed

```
Outcome

1111111111111111 000000000

Category 1: 4 variables
1111111111110101 111111111
1111111011110101 111111111
1101111011111110 001101111
0111101110100101 110111111

Category 2: 5 variables
1111111111111111 111111111
0110111111001100 000001010
0100010110000100 0 100000011
1111111111111110 011111111
0001110110100010 0 000100010

Category 3: 4 variables
1011001010010100 1 010110110
0000100000000000 0 001000000
1000000000010000 0 010000000
0100111101100010 1 101001111

Category 4: 7 variables
1001101001011110 1 010111111
1111110110111000 1 110101101
0101010000001001 0 011100000
1000111100000000 0 001011111
0011000000100000 0 000101000
0101001110000000 0 111100110
1111010000100000 1 110101001
```

Source: elaborated on basis of research data

The first string (outcome) represents the performance of the networks (17 successful = 1; and 9 failed = 0). The casual variables were represented by 4 categories (c*luster*s).

- Cluster 1 are the Physical Resources and are subdivided into 4 variables: Physical Facilities (RFis1), Equipment (RFis2), Material Products (RFis3), Service Infrastructure (RFis4).
- Cluster 2 are the Human Resources and are subdivided into 5 variables: Capacity of R&D (RHum1), Management Capacity (RHum2), Commercial Alignment (RHum3), Partnership Capacity (RHum4), Learning (RHum5);
- Cluster 3 are the Financial Resources and are subdivided into 4 variables: Institution Financing (Embrapa or INIA) within the maximum limit set as reference in their notices/calls (RFin1), Institution Financing much higher than the maximum limit set as reference (RFin2), Financing exclusively from external organizations (RFin3) and Both internal and external financing (RFin4).
- Cluster 4 are the Organizational Resources ad are subdivided into 7 variables: Intellectual Ownership (ROrg1), Organizational Structure (ROrg2), Processes (ROrg3), Image and Trademark (ROrg4), Organizational Culture (ROrg5), Market Information (ROrg6), Organizational Structure (ROrg7).

From the analysis of the primary data there was a table with the data of 26 networks researched (Figure 1). The analysis begins with the typing of dichotomized table in the MDSO MSDO software, noting that typing should start by success stories and must observe the separation of groups (categories).

Each column represents the unit of data obtained from one of the networks researched. Once the table was dichotomized, it was possible to perform the analysis MSDO/MDSO. The analysis was carried out with support of MDSO/MSDO software (Gisèle De Meur and Jean-Christophe Beumier. 2015. MDSO/MSDO [Computer Programme], Version 1.1. URL: http://www.jchr.be/01/v11.htm.).

The first partial result (Figura 2) provided by the software are the distance matrices, which consist in aggregating the sums found to each comparison between pairs of each variable. For each agglomeration (1, 2, 3, 4 categories) the software calculates a distance matrix. To exemplify this partial result, below the distance matrix for Category 1.

Figure 2. Pairs of networks with MSDO/MDSO

```
Dist and prox for Cat 1 (4 var)
     1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 1718 19 20 21 22 23 24 25
2 :  1 Zona 1
3 :  2 1
4 :  1 0 1
5 :  1 0 1 0
6 :  0 1 2 1 1
7 :  1 0 1 0 0 1
8 :  1 0 1 0 0 1 0
9 :  3 2 1 2 2 3 2 2
10 : 0 1 2 1 1 0 1 1 3
11 : 1 0 1 0 0 1 0 0 2 1
12 : 0 1 2 1 1 0 1 1 3 0 1
13 : 0 1 2 1 1 0 1 1 3 0 1 0
14 : 2 3 4 3 3 2 3 3 3 2 3 2 2
15 : 1 0 1 0 0 1 0 0 2 1 0 1 1 3
16 : 2 3 4 3 3 2 3 3 3 2 3 2 2 0 3
17 : 2 1 0 1 1 2 1 1 1 2 1 2 2 4 1 4
Zona 3
18 : 2 3 4 3 3 2 3 3 3 2 3 2 2 0 3 0 4
19 : 2 3 4 3 3 2 3 3 3 2 3 2 2 0 3 0 4 0 Zona 2
20 : 4 3 2 3 3 4 3 3 1 4 3 4 4 2 3 2 2 2 2
21 : 3 4 3 4 4 3 4 4 2 3 4 3 3 1 4 1 3 1 1 1
22 : 2 3 4 3 3 2 3 3 3 2 3 2 2 0 3 0 4 0 0 2 1
23 : 3 4 3 4 4 3 4 4 2 3 4 3 3 1 4 1 3 1 1 1 0 1
24 : 3 4 3 4 4 3 4 4 2 3 4 3 3 1 4 1 3 1 1 1 0 1 0
25 : 3 4 3 4 4 3 4 4 2 3 4 3 3 1 4 1 3 1 1 1 0 1 0 0
26 : 3 4 3 4 4 3 4 4 2 3 4 3 3 1 4 1 3 1 1 1 0 1 0 0 0
```

You can see the presentation of 3 Zones in the matrix. The Zone 1 represents the comparison between the cases with the same result (outcome), more precisely the comparison between cases who obtained the outcome 1 (success). The Zone 2 also represents the comparison between the cases with the same result (outcome), more precisely the comparison between cases which obtained the outcome 0 (failure). The Zone 3 represents the comparison between the cases with outcome 1 (success) and the case with outcome 0 (failure).

The definition of the number of levels to be identified is based on the proposition of creating a cut-off as being equal to half the number of variables associated with category (Meur, Bursens & Gottcheiner, 2006).

As a final result, the software provides the most different and the most similar pairs in 3 different zones (Figure 3).

Figure 3. Pairs of networks with MSDO/MDSO

Outstanding pairs
«h» - written down once only

```
Zona 1
D0: h=1 (1,5) (3,7) (7,11) (3,14) (3,16) (6,17) (8,17) (9,17) (14,17) (16,17)
D1: h=3 (4,14)
D2: h=3 (1,9) (8,16)
D3: h=3
D4: h=3

Zona 2
D0: h=1 (19,20) (18,21) (21,22) (18,23) (20,23) (18,25) (19,25) (20,25)
(22,25) (24,25)
D1: h=2 (20,21)
D2: h=2 (19,23)
D3: h=2
D4: h=2

Zona 3
S0: h=4 (4,21)
S1: h=4 (4,19) (7,22) (7,24)
S2: h=4 (2,18) (17,18) (5,23) (11,23) (17,23) (12,24) (7,25) (8,25) (10,25)
(15,25) (6,26)
(17,26)
S3: h=4 (2,20) (3,21) (17,21) (17,22) (6,23) (10,24) (15,24) (17,24) (7,26)
(8,26) (10,26)
S4: h=4
```

Source: elaborated on basis of research data

In Zones 1 and 2, the software provides us with the greatest difference between the causal variables (maximum difference, similar result – MDSO) from the comparison performed among the pairs of the same innovative performance. In Zone 3, the software provides us with the most similar pairs between the causal variables (maximum similarity, different results – MSDO) from the comparison performed among the pairs of networks with different innovative performance). The "S" (S0, S1, S2, S3, S4) and "D" (D0, D1, D2, D3, D4) indicators indicate the degree of similarity or difference between the pairs respectively. For example, "0" has a higher degree of similarity or difference than "4".

It was considered that MSDO pairs are best used in small samples, since the comparison of pairs can lead to a narrowing of the causal variables, and thus makes it possible to identify variables that can possibly be responsible for different result between the cases studied (Rihoux & Ragin, 2009). For this reason, the Zone 3 pairs were used, to make the identification of the variables that could explain the performance differences between successful and failed research networks. Likewise, the option was to get a narrowing in the number of pairs, and consequently in the number of variables for evaluation by analysis of similar pairs, that is, with degrees of similarity S0 and S1. After comparing pairs, in Figure 4, the explanatory variables of the innovative performance differences found through MSDO method were highlighted in yellow.

Figure 4: Explanatory resources of differences between the success and failure performance

	4	21	4	19	7	22	7	24
Casos	BR_Suc_4	BR_Ins_4	BR_Suc_4	BR_Ins_2	BR_Suc_7	BR_Ins_5	BR_Suc_7	BR_Ins_7
RFis1_Instalacoes	1	1	1	1	1	1	1	1
RFis2_Equipam.	1	1	1	1	1	1	1	1
RFis3_Prod_Mater	1	1	1	0	1	0	1	1
RFis4_Infra_Servic	1	1	1	1	1	1	1	1
RHum1_Capac_P&D	1	1	1	1	1	1	1	1
RHum2_Capac_Gest	0	0	0	0	1	0	1	0
RHum3_Alin_Comer	0	0	0	0	0	0	0	0
RHum4_Cap_Parcer	1	1	1	1	1	1	1	1
RHum5_Aprendizag	1	1	1	0	0	0	0	0
RFin1_Inst_limite	1	1	1	1	1	1	1	1
RFin2_Inst_Acima	0	0	0	0	0	0	0	0
RFin3_Externos	0	0	0	1	0	0	0	0
RFin4_Inter_Exter	0	0	0	0	1	0	1	1
ROrg1_Propr_Intelec	1	1	1	1	1	1	1	1
ROrg2_Estrut Orgniz	1	1	1	1	0	0	0	1
ROrg3_Processos	1	1	1	1	0	0	0	0
ROrg4_Imag_Marca	0	0	0	0	1	1	1	1
ROrg5_Cult Organiz	1	1	1	0	0	0	0	0
ROrg6_Info_Mercad	1	1	1	1	1	0	1	1
ROrg7_Estrateg Org	1	1	1	1	0	0	0	0
			(+) restrita S0+S1					

A inclusão de mais um nível implicaria em adicionar muitos outros pares

Source: elaborated on basis of research data

So, as observed in Figure 3, the explanatory variables for differences in innovative performance were: the physical resource 'products and materials'; the human resources 'management capacity' and 'learning'; the financial resources 'financing exclusively from external organizations' and 'project financing, bot external and internal'; and the organizational resources 'organizational structure', 'organizational culture' and 'detailed information on performance marketplace'. The RBV supports these results from the theoretical premise that the heterogeneous performance of organizations results from resources regarded as strategy (Wernerfelt, 1984).

The analysis made by QCA method, seen through the eyes of the explanatory variables of the differences in the innovative performance of networks, made it possible to discern situations that configured sufficient and/or necessary conditions for success in innovative performance, explaining the logical equation minimized with the help of the Tosmana software (Figure 5).

The result of the influence of the explanatory variables of the differences in the innovative performance of the networks for the innovative great performance (*outcome* 1) highlights five sets of alternative combinations of resources that result in success for the various networks of R&D in Brazil and Spain, as follows:

RFis3_Prod_Mater{1} * RFin4_Inter_Exter{0} +
RHum5_Aprendizag{1} * ROrg2_EstrutOrgniz{1} +
RHum5_Aprendizag{1} * ROrg6_Info_Mercad{0} +
ROrg2_EstrutOrgniz{1} * RFis3_Prod_Mater{0} * ROrg6_Info_Mercad{0} + RHum2_Capac_Gest{1} * RHum5_Aprendizag{0} * ROrg5_CultOrganiz{0}

Figure 5: Resources in the Brazil-Spain networks for innovative performance

Tosmana Report

Algorithm: Graph-based Agent
File:

Settings:
Minimizing Value 1
including C R

Truth Table:

v1: RFis3_Prod_Mater v2: RHum2_Capac_Gest
v3: RHum5_Aprendizag v4: RFin3_Externos
v5: RFin4_Inter_Exter v6: ROrg2_EstrutOrgniz
v7: ROrg5_CultOrganiz v8: ROrg6_Info_Mercad

O: Desemp_Inova id: Casos

v1	v2	v3	v4	v5	v6	v7	v8	O	id
0	0	0	0	1	1	0	1	0	BR_Ins_1
0	0	0	1	0	1	0	1	0	BR_Ins_2
1	0	0	0	1	0	0	1	0	BR_Ins_3
1	0	1	0	0	1	1	1	C	BR_Ins_4,BR_Suc_4
0	0	0	0	0	0	0	0	0	BR_Ins_5
1	1	0	0	1	1	1	0	0	BR_Ins_6
1	0	0	0	1	1	0	1	0	BR_Ins_7
1	1	1	0	1	0	0	1	0	BR_Ins_8
1	0	0	0	1	1	0	0	0	BR_Ins_9
1	0	0	1	0	1	0	0	1	BR_Suc_1,ES_Suc_4
1	1	0	0	1	1	0	1	1	BR_Suc_2
0	1	0	0	0	1	1	0	1	BR_Suc_3
1	1	1	0	1	1	0	0	1	BR_Suc_5,BR_Suc_6
1	1	0	0	1	0	0	1	1	BR_Suc_7
1	1	1	0	1	1	0	1	1	BR_Suc_8
0	1	1	0	0	1	0	1	1	BR_Suc_9
1	1	0	0	1	0	0	0	1	ES_Suc_1
1	1	1	0	1	1	1	0	1	ES_Suc_2
1	0	0	0	0	1	0	0	1	ES_Suc_3
1	1	0	0	0	0	0	0	1	ES_Suc_5
1	1	1	0	1	0	0	0	1	ES_Suc_6
1	0	0	0	0	0	0	0	1	ES_Suc_7
0	0	0	0	1	1	0	0	1	ES_Suc_8

Result: (all)

RFis3_Prod_Mater{1}RFin4_Inter_Exter{0}+ RHum5_Aprendizag{1}ROrg2_EstrutOrgniz{1}+
RHum5_Aprendizag{1}ROrg6_Info_Mercad{0}+
RFis3_Prod_Mater{0}ROrg2_EstrutOrgniz{1}ROrg6_Info_Mercad{0}+
RHum2_Capac_Gest{1}RHum5_Aprendizag{0}ROrg5_CultOrganiz{0}
(BR_Suc_1,ES_Suc_4+ES_Suc_3+ES_Suc_5+ES_Suc_7)
(BR_Suc_5,BR_Suc_6+BR_Suc_8+BR_Suc_9+ES_Suc_2) (BR_Suc_5,BR_Suc_6+ES_Suc_2+ES_Suc_6)
(BR_Suc_3+ES_Suc_8) (BR_Suc_2+BR_Suc_7+ES_Suc_1+ES_Suc_5)

Created with Tosmana Version 1.302

Source: elaborated on basis of research data

These results, according Freitas et al. (2011), is a concrete application of the configurational perspective's contribution for refining the investigation about the determinant factors of innovation performance heterogeneity. In a general analysis of the equation minimized, the expression highlights that no resource alone is sufficient or necessary by itself for the innovative performance, as the interpretation of Boolean analysis (Ragin, 1987). Thus, for the performance of innovation there is complementarity of inter-organizational networks (Wang & Li-Ying 2015), because the networks facilitate access to existing resources and to

complementarity (combine or share) of resources available (Rajapathirana & Hui, 2018) in the network (Bulgacov et al.; 2012; Gattaz et al., 2012).

Thus, the high presence of ´physical resource products and materials` or ´human resource learning` or ´organizational resource organizational structure` or ´human resource management capacity` combined with the absence (or low presence) of other resources [´information about the market, products and materials`, ´learning` and ´organizational culture`] influence innovative performance.

So, the first combination highlights five cases of innovative success, success in Brazil 1 and Spanish networks 3, 4, 5 and 7 (BR_Suc_1, ES_Suc_4 + ES_Suc_3 + ES_Suc_5 + ES_Suc_7), which had exclusive characteristic of those networks the presence of physical resource products and materials, highlighting the importance of that resource, especially for the success of the networks in Spain.

The second and third combinations show that the high degree of human resources ´learning`, that is, the presence of this resource combined with the presence of organizational resource ´organizational structure` or absence of organizational resource ´information about the market` influence the innovation performance in 7 cases of success. Successful networks in Brazil 5, 6, 8 and 9 and the Spanish network 2 (BR_Suc_5, BR_Suc_6 + BR_Suc_8 + BR_Suc_9 + ES_Suc_2) with the second combination of the equation minimized, showing the importance of the simultaneous presence of the resources ´learning` and ' ´organizational structure` to the success of various networks in Brazil. And, yet, the innovative networks in Brazil 5 6 and in Spanish 2 and 6 (BR_Suc_5, BR_Suc_6 + ES_Suc_2 + ES_Suc_6) with the third combination of logical equation.

It is observed that the second combination, presence of ´learning` and ´organizational structure`, explains the success of six cases of successes and that three of those cases (BR_Suc_5, BR_Suc_6 and ES_Suc_2) can also be influenced by the third combination, presence of ´learning` combined with the low grade/absence of ´market information', however, the Spanish network 6 case only reached the success exclusively with the third combination of resources.

The fourth and fifth combinations showed that the presence of resources ´organizational structure` and ´management capacity`, respectively, concomitant with absence/low presence of other two resources in each combination influence the success of the cases investigated, being two successful networks influenced by the presence of the resource ´organizational structure, combined with the absence of the resource ´products and materials` and with the absence of ´market information` (fourth combination); and, for the fifth and final combination, four networks have succeeded with the presence of ´management capacity`, combined with the absence of the resource ´learning` and combined with the absence of the resource ´organizational culture`, that is, those characteristics are exclusive of those networks and show that some cases with low presence of specific resources need to be combined with high presence of other resources vital to achieve innovative performance.

Therefore, when analyzing the resources individually, it was observed that, among the determinant resources, there is the physical resource of products and materials (inputs in experimental fields, laboratories etc.) as very important for the development and validation of technologies in the agricultural sector, especially for details in various biomes and regions of both countries (Laviola et al., 2014).

With regard to human resource learning, it has been found that it is a distinctive resource to research and development organizations (R&D). It should be noted that the industry of agricultural research networks is more related to the complementarity of knowledge between various organizations (national and international). One Belussi and Porcelatto (2012) study scored a similar result in the region of Emilia-Romana (Italy), where the knowledge networks

were established in biomedical sciences, involving researchers from the region, but also beyond, just in function of their need for complementarity of knowledge.

In the case of organizational resources, the highlight is for ´organizational structure`. According to the resource-based view, organizations must be organized to exploit their resources, whose formal structure, management control systems (formal and informal), remuneration policies etc. are components of an enterprise organization that are often called complementary resources because they have, in isolation, limited capacity to generate competitive advantage. However, when combined with other resources, they allow an enterprise to take advantage of its potential for technological capabilities (Kamasak, 2015) and competitive advantage (Barney & Hesterly, 2011).

The human resource ´management capacity` was also stood out on the networks that succeeded. Castro et al. (2011) noted, in their research, that the management capacity is more connected with the ability of its members to open and manage the network itself, since it is an obstacle against the establishment of networks. That is, in that work, Castro et al. (2011) indicated that the lack of dedication to network management is an obstacle for it to reach its goals. Thus, the results of this study showed the resources that affect performance in Brazil and Spain.

5. Final Comments

This work has reached the general objective, that is, to evaluate which competitive resources influence the innovative performance in agricultural research. In addition, as a contribution of this research three main points must be highlighted. First, Barney (1991) seminal article on resources does not list the resources contained in his categorization of physical, human, financial and organizational resources. This study classifies and indicates twenty resources under research and development organizations (R&D) and identifies which of them may be responsible for the different result between the pro-innovation cases through MSDO method.

Then, there are five possible combinations to explain the innovative success of inter-organizational networks of research and development, in which specific resources need to be combined with others to achieve the performance of innovation, going to the theory, as it is required a set of different types of resources to a competitive advantage (Barney, 1991) and a complementarity of resources contained in the network (Wang & Li-Ying 2015), which applies to innovative performance, as evidenced by the present study.

Finally, the competitive resources in R&D networks whose high degree of their presence influence the performance of innovation in agricultural research sector of Brazil and Spain, are: physical resource of products and materials, human resource of learning, human resource of management capacity and the organizational resource of organizational structure.

Regarding the limitations of this research, statistical methods are based on correlations between two or more variables and, thus, it is possible to establish whether the dependent variable increases or decreases relative to the variation of the independent variable, by itself or how interacts with other. And Qualitative Comparative Analysis (QCA) cannot inform those aspects, however, it is possible to model the logical relationships between the variables on the sufficiency, necessity or special circumstances, such as when the variable (condition) is necessary, but it is insufficient by itself to explain the result or the reverse (is enough for the result but is not required). So while QCA can inform about aspects of sufficiency and necessity, those claims are not easy to be verified with statistical methods.

As future research suggestions, it is noteworthy that empirical research studied the agricultural research sector networks in the context of plant breeding programs, fact that

although makes impossible the generalization of results, can be complemented with other reviews of research in different contexts in the same sector and in research of distinct sectors. And, yet, it is suggested field application in a large number of cases, without concern for the importance of the case itself, to measure the correlations between the variables, in order to specify the degree of interaction between the independent variables and the dependent.

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