# Evaluating engineered networks: the effects of structure and process on the outcome of the Brazilian small-firm networks

Ingridi Bortolaso*

Department of Business Administration,
UNISC University,
Av. Independência, 2293 – Bairro: Universitário,
Santa Cruz do Sul, 96.815-900, RS, Brazil
Email: ingridibortolaso@unisc.br
*Corresponding author

Jorge Renato Verschoore and
Eduardo Henrique Rigoni

UNISINOS University,
Av. Unisinos, 950, Bairro Cristo Rei,
São Leopoldo, 93.022-750, RS, Brazil
Email: jorgevf@unisinos.br
Email: erigoni@gmail.com

**Abstract:** This paper focuses on the evaluation of engineered networks created and supported by a public policy, namely cooperation networks program (CNP), guided by the Government of Rio Grande do Sul State, in Brazil. Since the year 2000, the CNP fostered the establishment of more than 200 SFNs in the region, turning this state into the main empirical field of studies on interorganisational networks in Brazil. This context raises questions regarding the SFNs genesis and its consequences. The paper, thus, seeks to answer the following question: can it be affirmed that structure and process influence the Brazilian engineered SFNs outcome? To do so, a quantitative research was conducted with the CNP networks based on the categories structure, process, and outcome. The results indicate that through an adequate network evaluation, it is possible to measure and compare results, besides facilitate intervention decisions for course corrections and obtain the targeted collective gains.

**Keywords:** evaluation; cooperation networks; management.

**Reference** to this paper should be made as follows: Bortolaso, I., Verschoore, J.R. and Rigoni, E.H. (2019) 'Evaluating engineered networks: the effects of structure and process on the outcome of the Brazilian small-firm networks', *World Review of Intermodal Transportation Research*, Vol. 8, No. 1, pp.63–77.

**Biographical notes:** Ingridi Bortolaso has a Post-PhD in Production and Systems Engineering, PhD in Business Administration and Master in Production and Systems Engineering by UNISINOS. She is a specialist in Production Management by University of Santa Cruz do Sul – UNISC and Bachelor in Accounting Sciences by UNF. She is a Professor-Researcher of the

Postgraduate Program in Administration (PPGA) and Professor of the Department of Administrative Sciences at the University of Santa Cruz do Sul (UNISC).

Jorge Renato Verschoore is a Professor and Researcher at the Business and Management School of Unisinos University. Currently, he is the Leader of Geredes/CNPq (Brazilian Group for Interorganisational Network Studies). Regarding intellectual production, he has written books and articles on the social science field, concerning strategy, cooperation, and networks. His main interest nowadays is related to network governance, cooperative strategy, inter-organisational relations, and social network analysis.

Eduardo Henrique Rigoni received his Bachelor in Computer Science from the Federal University of Rio Grande do Sul. During the doctoral period, held was part of his studies at the Stevens Institute of Technology, USA. From 2011 to 2016, he participated in the postdoctoral program at the University of Vale dos Sinos River, focusing on the development of economic sectors through virtual business communities mediated by digital platforms. He carried out practical studies in the flower and plant sectors in the states of Rio Grande do Sul and Santa Catarina, resulting in a patent and trademark registration (CNFlores®).

This paper is a revised and expanded version of a paper entitled 'Evaluating engineered networks: the effects of structure and process on the outcome of the brazilian small-firm networks' presented at The 28th EGOS Colloquium, Helsinki – Finlândia, 5–7 July 2012.

## 1 Introduction

Small-firm networks (SFNs) have been a fertile field for science publications since the 1990s (Perrow, 1992). Over the last decades, scholars have been devoted to understanding the antecedents, structural features, consequences and results of this kind of collective action (Grandori and Soda, 1995; Human and Provan, 1997; Thompson, 2003; Todeva, 2006; Verschoore et al., 2017). More recently, scholars have been concerned with identifying sources and with the use of social capital in small business growth. Thus, the studies examine the relationship between the human capital of small enterprises, the resources and strategy on the sources of social capital used and their impact on the growth of small enterprises in employment (Obeng, 2018; Acquaah, 2011; Ng and Rieple, 2014). Some contributions in this direction have focused on the genesis, the evolution, and the outcome of emergent networks and of policy-implemented networks (Verschoore et al., 2017; Wegner et al., 2017). In the emergent or organically developed networks, the associated members join efforts in order to pursue collective gains and create themselves the conditions for the emergence of cooperation (Kreiner and Schultz, 1993; Kilduff and Tsai, 2003). Alternatively, the whole or engineered networks are formally established and goal directed rather than occurring serendipitously (Huggins, 2000; Lundberg and Johanson, 2011; Provan et al., 2007).

More recently, a number of studies have highlighted the evaluation of networks as a growing topic in the interorganisational field (Sydow and Windeler, 1998; Provan and Milward 2001; Sydow, 2004; Knoben et al., 2018). For those scholars, the evaluation gives researchers meaningful comparisons of networks. The evaluation of networks also facilitates the managers' decisions about what kinds of structure and process are more likely to deliver the best results (Provan and Sydow, 2008). The contributions of such studies have made possible the evaluation of studies on different types of networks.

In this context of network evaluation, the dimensions of structure and processes stand out. However, there are few studies that aim to identify the effect that structure and process have on results. Many researches develop works focused on the analysis of governance, on mechanisms of coordination and on punishment. This context raises questions regarding the SFNs genesis and its consequences. The paper, thus, seeks to answer the following question: can it be stated that structure and process influence the Brazilian engineered SFNs outcome? On the one hand, there is the structure understood as the ties and connections created among the members of the networks. On the other hand, there are the processes understood as the actions and activities developed by the network that can turn into effective results to the associated companies. As a consequence, the results represent the benefits and advantages that the member companies' access due to the ties and connections generated and the actions and activities executed to reach these differentials. Therefore, an analysis of the effect of structure and processes on results is necessary.

The complexity of this theme gains differentiated contours when it comes to an induced network created from a governmental program. The fact that all the networks participating in the research have the same induction strategy allows for the comparison and the application of a quantitative study. To do so, a quantitative research was conducted with the CNP networks based on the categories structure, process, and outcome proposed by Provan and Sydow (2008). This paper focuses on the evaluation of engineered networks created and supported via a public policy, namely cooperation networks program (CNP), guided by the Government of Rio Grande do Sul State (Rio Grande do Sul, 2009). Since the year 2000, the CNP fostered the establishment of more than 200 SFNs in the region (Bortolaso et al., (2010), turning the State of Rio Grande do Sul into the main empirical field of studies on interorganisational networks in Brazil (Verschoore and Balestrin, 2011). Besides this introduction, this article is divided into four sections. This article addresses the effects of structure and process on the results of small and medium-sized enterprise networks. The article begins by examining the fertile study field on small and medium-sized networking firms. Then, the topic engineered networks was developed. This section addresses the main concepts and seeks to present a consistent review. Subsequently, a section for network evaluation was elaborated. This section presents and develops the three categories used in the article: structure, process and outcome. After presenting the theoretical basis of the article, the design of the research with its adopted procedures is outlined. In the sequence, the main contributions of the study are presented. Finally, the final considerations and limitations of the research are presented.

## 2 Engineered networks

The growth of the numbers of interorganisational networks has been significant in recent times. Notwithstanding, some researches identify two main perspectives on the formation and development of networks: the emergent network and the purposive network. On the one hand, networks emerge from occasional interactions among actors (Kreiner and

Schultz, 1993). In this perspective, the network formation and development depends mainly on the serendipitously collective action without any external support (Kilduff and Tsai, 2003; Moliterno and Mahony, 2011). On the other hand, purposive networks are the result of conscious efforts, i.e., they are created and designed to achieve specific goals defined by their members (Human and Provan, 1997; Kilduff and Tsai, 2003). This kind of network is also called by some authors as engineered network (Huggins, 2000) or whole network (Provan et al., 2007). In engineered networks, there is the intervention of an external actor in the formation of the network, so that the network formed has a greater chance of success. Intervention is defined here as the deliberate actions taken by a third party to influence the formation, design, or process of interaction among partners (Gray, 2008). Engineered networks require intervention from a triggering entity. The triggering function can be performed by individuals, companies, protection agencies, governments or environmental events (Andrésen et al., 2012).

At the same time that this scientific knowledge on the engineered networks evolves, an increasing number of interorganisational network initiatives also appear with external support, which has led to an increasing interest in supporting policies to the business cooperation in several countries (Huggins, 2000). In general, the networks engineered by those policies feature, as their target, small firms due to two reasons: first, for the need of small firms to expand their production or performance range. This obstacle can be quickly overcome through the link with other firms when mediated by an independent third party; second, for the need of instrumental knowledge for the formation of a network which, invariably, small firms do not have.

Therefore, the growing number of initiatives has occurred mainly by the increasing policy interest in stimulating business cooperation in a number of initiatives (Huggins, 2000). The success of the Danish and Finnish policies in the 1990s (Zeffane, 1995; Korhonen, 1996; Gelsing and Nielsen, 1997) has stimulated the establishment of public policies for the formation of SFNs to the present (Jack et al., 2010). In developing countries, one of the experiences of SFNs best documented was undertaken in Central America by the United Nations Industrial Development Organization (UNIDO). Assuming that small firms play a key role for a sustained and balanced growth, UNIDO directed most of its resources to programs that trigger the competitive potential of such ventures. The network program of UNIDO followed that direction, allowing the possibility of small firms to overcome their isolation and achieve competitive advantages through cooperation (Ceglie and Dini, 1999).

In the initiatives mentioned, the formation of SFNs featured as a trigger the specific policies of external actors, both public and private (Korhonen, 1996). There is evidence in several parts of the world of an active role from public and private actors regarding the support to set up networks (Huggins, 2000). The intervention of external actors stimulates the cooperation among the companies and also plays an intermediary role, through brokers, at different stages in the formation and development of the networks (Gray, 2008). As a result, a large number of existing SFNs are purposive-engineered networks, just like the networks created and supported by the CNP addressed in this study (Verschoore and Balestrin, 2011). Therefore, the issue of SFNs evaluation becomes not only relevant to the academic perspective, but also to the practitioners, in order to legitimate their policies. The next section covers the theoretical groundings of network evaluation.

## 3 Network evaluation

The evaluation of networks can be understood as "a process of interaction in which managers, by reflexively monitoring the contextual embedded activities and their effects, try to control the outcome and, eventually, the process of organizing with respect to particular criteria" [Sydow and Windeler, (1998), p.269]. For the last ten years, interorganisational networks have been evaluated in several studies by means of different categories, different measures, and different levels of analysis (Provan and Milward, 2001; Sydow, 2004; Child et al., 2005; Mandell and Keast, 2007, 2008). This paper presents a network level of evaluation, which is also considered a measurement of the network effectiveness as stated by Provan and Milward (1995). Considering the complexity of the network level of evaluation Provan and Sydow (2008) developed a method that explores the various approaches used to evaluate interorganisational networks. The approaches were organised into three categories that access the network effectiveness: structure, process, and outcome. These three categories are input-output oriented measures and, moreover, as the authors claim, they are "(…) sequential, both in terms of time and complexity of evaluation, and each provides data and an understanding of effectiveness" [Provan and Sydow, (2008), p.696].

The first category comprehends the *structure*, which evaluates the connections among the network members. The networks encompass a wide group of horizontal connections among the members (Gulati et al., 2000) and the structural constructs measure basically the density and multi-plexity of such connections. The density is measured by the sum of the real relations that are established among the internal members of a network, divided by the maximum number of connections that are possible among the members. The density describes the general level of connections among all actors in a network (Scott, 2000) and sets up a framework that allows to evaluate the cohesion of the network regarding the relations among the participants (Todeva, 2006). The multi-plexity, on the other hand, is the extent to which two actors of a network are connected by more than one type of tie (Kilduff and Tsai, 2003). It may be measured by the number of different kinds of relations among two or more network members (Provan and Sydow, 2008). Thus, the density indicates the connectivity among the members and the multi-plexity indicates the intensity and the variety of the established relations in the network. In the structural evaluation of the network, other measures may also be used, such as centrality, prestige, reciprocity, and clicks (Wasserman and Faust, 1994; Knoke and Yang, 2008).

The second category embraces the *process*. These measures are aimed to evaluate the actions and activities that can be transformed into effective benefits for the network. The processing constructs are composed of the measures of learning, trust, legitimacy, power, and fairness. In the measure of learning, the network is considered a place for common problem solving and collective learning (Powell, 1998). The measure of trust is bound to the mechanisms of integration that are essential to promote the network effectiveness. Legitimacy refers to the validation of the network credibility before its members and the society. When related to measure of power, it is seen as a capacity of a social actor to influence others' actions and behaviours in an intentional some authors also characterise way and it as a capacity of influence, control, or resistance (Huxham and Beech, 2008). The latter measure, named fairness, represents the appropriate distribution, among the members, of the benefits provided by the participation in the network. For Provan and

Sydow (2008), a distribution of interorganisational value is considered as being fair or reasonable if the involved actors receive the proportional benefits to their contributions.

The third category comprehends the *outcome*, which evaluates the network effectiveness based on the extent of its objectives. This category embraces the measures of performance, survival, and innovation. The measure of performance is evaluated focusing on finance, which covers the network account statements, and by the non-financial benefits, which considers aspects, such as quality, satisfaction, and agility. The measure of survival is bound to the development and maintenance of the network activities. The last measure refers to innovation, in which the network is considered the locus of generation of new solutions, products, and services (Nooteboom, 2008). Because of this, it is a measure that is found on the limit between the categories process and outcome. According to Provan and Sydow (2008), the Outcome and, especially, the performance can be considered the Holy Grail of the research on networks and interorganisational relations.

**Table 1** Summarises the categories proposed by Provan and Sydow (2008), along with their description and the constructs that comprise each category

| *Category* | *Description* | *Constructs* |
|---|---|---|
| Structure | Evaluate the connections among the network members. | Density; multi-plexity; centrality. |
| Process | Evaluate the actions and activities that can be transformed into effective results for the network. | Learning; trust; fairness; legitimacy; power. |
| Outcome | Evaluate the network effectiveness based on the extent of its objectives. | Innovation; performance; survival. |

Note: Framework for network evaluation

*Source:* Adapted from Provan and Sydow (2008)

The categories described and their measurements may be used to evaluate both the whole network and the organisations that are part of it. In the category structure, for example, measurements as density and centrality are more appropriate for the evaluation of the whole network, whereas multi-plexity is more suitable for the evaluation of organisations. Nevertheless, the three categories and their measures should not be evaluated separately, due to the interrelationships among them. The authors themselves point out for this fact: “We have presented each indicator as though they were separate, although in practice, it is often difficult to disentangle the effects of one on the other” [Provan and Sydow, (2008), p.706]. Therefore, measurements of Structure have effect on measures of process and vice versa. Even more relevant is that both affect the measures of outcome on the network. The understanding of the interrelationships among the categories of network evaluation enhances its accuracy, allowing to identify, for example, which structure and process are more likely to turn out in the success of the network and the participating organisations.

Once the categories of network evaluation and the interrelationship among them are discussed and highlighted, the main objective of the article is resumed: evaluate whether structure and process influence the Brazilian engineered SFNs outcome. In order to achieve this goal, the conceptual model proposed by Provan and Sydow (2008) was used in the empirical field of Brazilian engineered SFNs. The methodology adopted to conduct this study and the procedures performed in the research are presented in the next section.

## 4 Methodology

This study follows a quantitative exploratory approach based on a previous qualitative exploratory research. The unity of analysis consisted of the three categories by Provan and Sydow (2008): structure, process, and outcome. The research was motivated by the need to understand the interrelationship of those categories of evaluation and their influence on the outcomes of SFNs. Based on work by Provan and Sydow (2008), the gathering data instrument was elaborated, consisting of a questionnaire divided into three categories, which were ungrouped into constructs of evaluation and these were detailed in blocks of evaluation questions. This set of categories, items, and questions was validated by six experts in the field, such as researchers of the subject, government officials, representatives of networks, and participating companies (Bortolaso et al., 2010). This gathering data instrument, validated by the experts, was structured based on the three categories that grouped 28 questions altogether. A nominal scale of five evaluation levels was adopted, in which the value five indicates the highest level of development.

The empirical field of study is represented by SFNs from southern Brazil, which benefit from a local public policy that supported the establishment of more than 200 SFNs in the region (Verschoore and Balestrin, 2011). This extensive and diverse field of SFNs has fostered several studies addressing business cooperation, changing the region into one of the main locus of research on this subject in Brazil (Balestrin et al., 2008). Among more than two hundred networks, 60 respondents were selected considering their industry, the number of members, and length of existence of the network. The data were collected in face-to-face interviews and then exported to a spreadsheet of SPSS to perform multivariate analyses. In SPSS the responses went through a process of data treatment. It was noticed that the database resulting of the survey featured four missing values in the same variable and three outliers that, according to Hair et al. (1998), can be negligible, so they were kept on.

The first test performed was of normality which, according to Corrar et al. (2007), seeks to identify if the variables feature a univariate normality corresponding to a normal distribution. The test of homoscedasticity assumption was also performed, which aims to check the equality of variances among the variables. In this type of test, the dependent variables should exhibit equal levels of variance across the range of prediction, which means the variance of residues must be constant. Finally, the last assumption test performed was of linearity. For Hair et al. (1998), this test shows the extent to which a model features the properties of additivity and homogeneity. The test result indicated that the values of model variables fell into a straight line showing the validity of data.

The first used technique was the modelling of structural equations (SEM). SEM:

1 provides a direct method for dealing with multiple relations while simultaneously providing statistical efficiency

2 its ability to evaluate relations in general and to provide a transition from exploratory analysis to confirmatory analysis (Hair et al., 1998).

However, the application of the SEM technique to the model was not shown to be significant. We set out for a second technique: multivariate statistical factorial analysis. The factorial analysis is a generic name given to a class of multivariate statistical methods whose main purpose is to define the underlying structure in a data matrix. Factorial analysis addresses the problem of analysing the structure of interrelationships (correlations) among a large number of variables, defining a set of common latent dimensions, called factors (Hair et al., 1998). Of this factorial analysis, three constructs were extracted (structure, process and results). The three factors presented an acceptable explained variance (> 50%).

A multiple regression was performed with all three factors. This is a general statistical technique used to analyse the relationship between a single dependent variable and several independent variables (Hair et al., 1998). Figure 1 aim to illustrate the methodological procedures. The results and contributions of the study are presented below.

## 4.1 Independent variables

### 4.1.1 Structure

The below presented topics explain the structure factor.

Network management anticipating the needs and expectations of its members; the marketing, negotiation, expansion and innovation teams being active; there is assiduous members participation in general assemblies; network leadership sharing power and proactivity; members who take the lead of the network adopting an open to dialogue attitude; the board meets formally and discusses new corrective actions for the network; the councils of the network (example: ethics, tax, administration) meet periodically; the network has a formal process of dissemination of information such as: guidelines, negotiations and policies; the network uses as informal communication vehicles: internal communication, e-mails, MSN, land VoIP, Skype and intranet for information dissemination; associates are aware of the actions in progress, and receive information routinely; members contribute with improvements to the development and growth of the network; annual social integration events are held among members; All members provide the same intensity of cooperation on the network; associates are involved in the process of relationship with the network's direction implementing proposed actions; members meet regularly outside meetings to discuss and resolve network issues.

### 4.1.2 Processes

The below presented topics explain the processes factor.

Networking has allowed the sharing of strategic information among members; network relationships have generated learning's that help solve common associates' problems (example: ideas bank, best practices); the relationships in the network have been providing new knowledge for the management of the companies; networking has enabled the development of new products or services; the network's brand has enabled greater visibility and recognition of the associated companies by the market; the network configuration has contributed to minimise the entry of new competitors; networking has provided greater bargaining power; network initiatives have been contributing to improve the quality of the products offered by the network.

## 4.2 Dependent variable

### 4.2.1 Results

The below presented topics explain the results factor.

Collaboration in the network has contributed to the expansion of the commercial relations (new suppliers); network actions have made it possible to reduce costs; networking has led to the division of risks; network organisation has allowed for an increase the product mix; network configuration has been providing access to new markets.

## 5 Result presentation

The recent growth of SFNs encouraged by policies from both public and private organisations raises the need to evaluate whether the structure and process established by networking initiatives were effective in achieving the desired results or not. The evaluation of networks allows to understand this issue and to point out what kind of structure and process are more likely to reach the goals established by the engineered networks. The data gathered from the SFNs in southern Brazil made possible to determine the stage of development of such networks in the three categories evaluated and to measure the influence of the organising activities in the particular category outcome (Sydow and Windeler, 1998).

Initially, the SFNs from southern Brazil were evaluated under the model by Provan Sydow (2008), i.e., for each of the three categories a scale rating of five evaluation levels was adopted, in which the value five indicates the highest level of development. The results of the analysis point that the SFNs evaluated are in an intermediate level of structure, process, and outcome. The structure, which measures the connections among the network members, was evaluated with an average of 2.3 in a maximum of 5, in the 60 questionnaires applied. The process in the SFNs received an average evaluation of 2.7, demonstrating that this category, although a little higher than the Structure evaluation, is also in an intermediate level. The category outcome presented the highest average in the network evaluation, reaching the average of 2.9. Table 2 shows a summary of the evaluation of SFNs in each category.

**Table 2** Summary of the evaluation of SFNs from southern Brazil

| *Category* | *Description* | *Average* | *Evaluation* |
|---|---|---|---|
| Structure | Evaluate the connections among network members. | 2.3 | Intermediate level |
| Process | Evaluate the actions and activities that can be transformed into effective results for the network. | 2.7 | Intermediate level |
| Outcome | Evaluate the network effectiveness based on the extent of its objectives. | 2.9 | Intermediate level |

The measures presented in Table 2 represent an evaluation of the whole network. The average values show the capacity of network effectiveness (Provan and Milward, 1995). Thus, it is possible to assert that the evaluation of the categories structure, processes, and outcome show that the SFNs in study are still developing their action competencies together, and that their effectiveness in achieving the objectives can be expanded. Under another perspective of analysis, the values also reveal some lack of supporting tools for the engineered networks (Huggins, 2000), a fact that makes it hard to conduct intervention actions by the actors involved. Based on those numbers, two contributions can be highlighted.

From the management point of view, the evaluation points to a necessity of continuing improving the instruments of intervention of public policy and the engineered SFNs organisation itself (Gray, 2008). From the academic point of view, the higher average evaluation of the category outcome, in relation to the others, may indicate that the effects of the engineered Structure and the engineered process in the SFNs outcome are not so direct or even possible to anticipate on the network design (Huggins, 2000; Lundberg and Johanson, 2011).

In order to better understand the effects of structure and process in SFNs' outcome, a model was designed to bring together a set of questions grouped into three constructs. The central issue is to understand the influence of structure and process on SFNs' results. The first proposed model (influence of structure and processes on results) was tested and did not prove to be significant through the use of the modelling technique of structural equations (Figure 1), as explained in the methodology.

**Figure 1** Structural equations (see online version for colours)

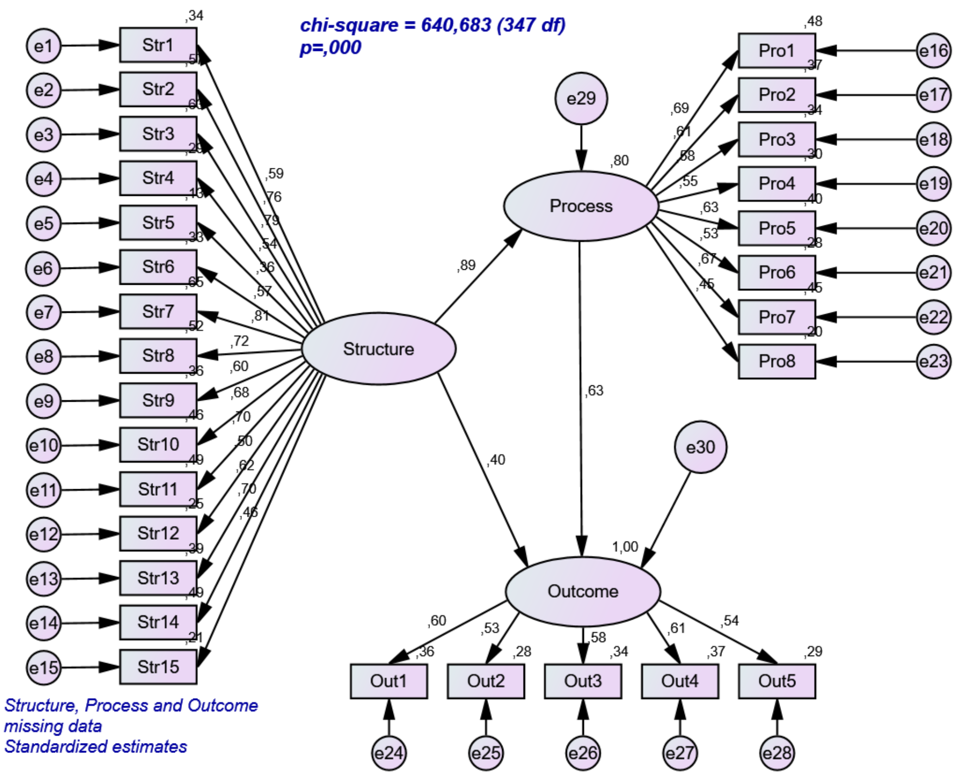



**Table 3** Parameters' estimation

| | *Estimate* | *S.E.* | *C.R.* | *P* | *Label* |
|---|---|---|---|---|---|
| Outcome ← structure | 0.539 | 0.117 | 4.611 | *** | par_1 |
| Outcome ← process | 0.309 | 0.117 | 2.648 | 0.008 | par_2 |

Through the data collected from SFNs, it is possible to analyse the simultaneous influence of the structure and process categories in the result category. Given that, we have decided to move to a factorial analysis, which allowed us to extract the three factors. For this purpose, the multiple regression technique was used. Considering the main objective of the article, the dependent variable category adopted was result and the independent variables categories used were structure and process. The parameters' estimation is presented in Table 3.

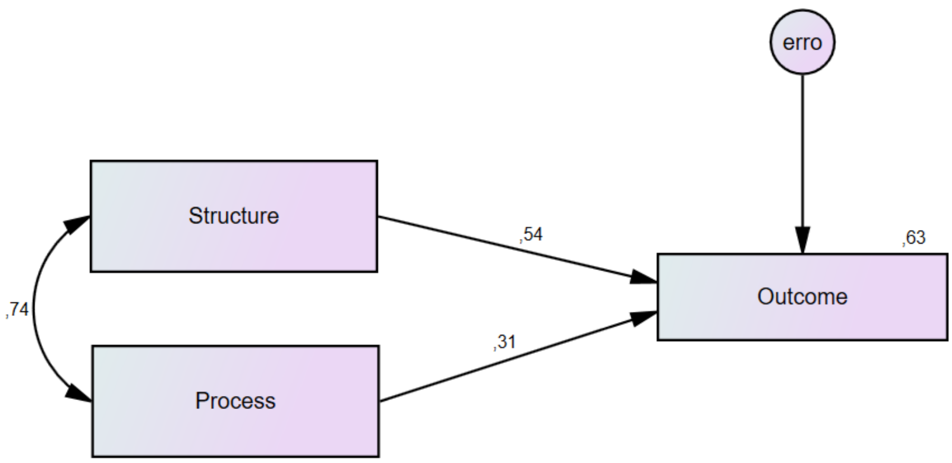
The estimate 0.539 (outcome ← structure) means that the result is significantly (p-value < 0.001) influenced by the structure. For each additional unit in the structure, the expected value of the result will increase by 0.539. The estimate 0.309 (outcome ← structure) means that the Result is significantly influenced by the process (p-value = 0.008). For each additional unit in the process, the expected value of the result will increase by 0.309.

These values indicate an effect of the SFN structure in its result and are in line with the assumption of the network evaluation model adopted in this research (Provan and Sydow, 2008). In addition, the results indicated that the constructs of the framework, such as density, multi-plexity and centrality (Gulati et al., 2000; Scott, 2000; Todeva, 2006; Kilduff and Tsai, 2003; Provan and Sydow, 2008; Wasserman and Faust, 1994; Knoke and Yang, 2008), have a greater influence on the results of the projected networks than on the constructions of the processes category. These values may explain, in part, the fact that the structural constructs received more attention from the actors involved in the network and, in particular, from policy makers. It can be said that the deliberate intervening actions of the actors in engineering networks (Gray, 2008) find shelter in structural constructions. Table 4 evidences the covariance and correlation estimate between independent variables.

**Table 4** Covariance and correlation estimate between independent variables

| | *Estimate* | *S.E.* | *C.R.* | *P* | *Label* |
|---|---|---|---|---|---|
| Structure ← process | 0,724 | 0,159 | 4,553 | *** | par_3 |

**Figure 2** Multiple regressions (see online version for colours)



The covariance between structure and process is significant (p-value < 0.001), which generates a correlation coefficient of 0.736; according to the literature, this is a strong and positive correlation, which allows us to say that the two grow in the same direction. $R^2 = 0,631$, informs us that the structure and process factors (latent variables) are able to explain 63% of the variability of Result. From the above statement, we have the chi-square test of the model's absolute adjustment, along with its degrees of freedom and probability value (p-value). Note that p-value < 0.05 indicates that we should reject the null hypothesis, that is, the model is significant. The results of the multiple regressions are presented on Figure 2.

Those research results reverberate not only in the practical field, but also in the theoretical one. Concerning the contributions for the SFNs and the public policy management, it was evident that the network Outcome can be promoted by the Structure and the process and, mainly, that there is a way to measure the stimuli effectiveness (Provan and Milward, 1995). However, as the research results refer to the engineered SFNs, they demonstrate the designers' difficulties of whole networks in achieving the intended objectives (Kilduff and Tsai, 2003).

With regard to the theory, the contributions of the article are more provocative. If, on the one hand, the numbers confirm the structure and process effects on the network's result, on the other hand, they demonstrate a greater influence of the structure. Such a research finding may be related to the fact that the authors of the model argue that some process (learning) and outcome (innovation) constructs are found within the limits of each criterion, making their evaluations difficult (Provan and Sydow, 2008). In spite of this question, the results also indicate a tendency in SFNs to evaluate those aspects that are closer to their intended goals rather than aspects related to the Structure of the relations between the members (Human and Provan, 1997; Lundberg and Johanson, 2011).

To end, the values of the evaluation performed raise questions to the proposed model by Provan and Sydow (2008). Although it may be affirmed that structure and process influence the Brazilian engineered SFNs outcome, it was equally perceived that there must be other factors that also influence the network effectiveness, besides structure and process only. In this sense, studies demonstrate that the practices across boundaries (Bechky, 2003) and the routines among the organisations (Pentland and Feldman, 2008) influence the interorganisational relations. The incorporation of those and other factors, as well as the clearer delimitation among the measures of categories process and outcome, are, therefore, possibilities for improvement of the networks evaluation in their future trajectory.

## 6 Concluding remarks

Recurring initiatives of SFNs have appeared as a result of policies that foster entrepreneurship and regional development. A great deal of the established networks is found in competitive markets that instigated and motivated the joint of individual efforts. The objectives pursued by SFNs are hardly obtained without Process and without a relationship structure suitable for such. For this reason, the evaluation of networks has become an issue in evidence. Through adequate network evaluation, it is possible to measure and compare results, besides facilitate intervention decisions for course corrections and obtain the targeted collective gains.

This paper concentrated on the evaluation of engineered networks, created and supported via CNP policy, and followed a quantitative and exploratory approach, with the unity of analysis being the SFNs constituted by such policy. The analysis focused on the three categories of interorganisational evaluation proposed by Provan and Sydow (2008): Structure, Process, and Outcome. The results obtained indicated that the SFNs constituted are in an intermediate level of development in the three categories evaluated. The results also pointed to a positive correlation between the categories structure and process with the category outcome. Such results demonstrated that structure and process influence the Brazilian engineered SFNs outcome, although it may have pointed out the possibility of other factors also influence the effectiveness of the network. The contributions of the article enlighten the pathways to an improvement of the public policy and the SFNs evaluated, as well as issue a challenge to the development of the interorganisational network evaluation.

Finally, it is worth to point the scope of this study. The evidence considered SFNs in southern Brazil. Due to local dynamics specific to that region, the observations may suffer of a bias in the context categories structure, process, and outcome. Furthermore, the contributions are grounded in a small sample of the existing SFNs in the region. Therefore, new empirical research on a broader evaluation sample of those networks is encouraged. Likewise, further studies are stimulated to make progress in a clearer boundary among the constructs of the category process and constructs of the category outcome, as well as incorporate new elements to the model proposed by Provan and Sydow (2008), in order to make it an even better tool for the evaluation of networks.

## References

Acquaah, M. (2011) ‘Business strategy and competitive advantage in family businesses in Ghana: the role of social networking relationships’, *Journal of Developmental Entrepreneurship*, Vol. 16, No. 1, pp.103–126.

Andrésen, E., Lundberg, H. and Roxenhall, T. (2012) ‘Designing for commitment in regional strategic networks’, *Management Research Review*, Vol. 35, No. 6, pp.531–552.

Balestrin, A., Vargas, L.M. and Fayard, P. (2008) ‘Knowledge creation in small-firm network’, *Journal of Knowledge Management*, Vol. 12, No. 2, pp.94–106.

Bechky, B.A. (2003) ‘Sharing meaning across occupational communities: the transformation of understanding on a production floor’, *Organization Science*, Vol. 14, No. 3, pp.312–330.

Bortolaso, I.V., Verschoore, J.R. and Antunes, J. (2010) ‘Avaliação da gestão de redes de cooperação empresariais’, in Antunes, J., Balestrin, A. and Verschoore, J.R. (Eds.): *Práticas de Gestão de Redes de Cooperação*, Ed. UNISINOS, São Leopoldo.

Ceglie, G. and Dini, M. (1999) *SME Cluster and Network Development in Developing Countries: the Experience of UNIDO*, PSD Technical Working Paper Nº 2, Vienna.

Child, J., Faulkner, D. and Tallman, S. (2005) C*ooperative Strategy: Managing Alliances, Networks and Joint Ventures*, Oxford University Press, Oxford.

Corrar, L.J., Dias Filho, J.M. and Edilson, P. (2007) *Análise Multivariada*, São Paulo, Atlas.

Gelsing, L. and Nielsen, K. (1997) *Promoting Inter-Firm Networks in Industrial Policy – Danish Evidence*, Danish Research Unit for Industrial Dynamics, Copenhagen.

Grandori, A. and Soda, G. (1995) ‘Inter-fim networks: antecedents, mechanisms and forms’, *Organization Studies*, Vol. 16, No. 2, pp.183–214.

Gray, B. (2008) 'Intervening to improve inter-organizational partnerships', in Cropper, S., Ebers, M., Huxham, C. and Smith-Ring, P. (Eds.): *The Oxford Handbook of Inter-Organizational Relations*, Oxford University Press, Oxford.

Gulati, R., Nohia, N. and Zaheer, A. (2000) 'Strategic networks', *Strategic Management Journal*, Vol. 21, No. 3, pp.203–215.

Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (1998) *Multivariate Data Analysis*, Prentice Hall, New Jersey.

Huggins, R. (2000) 'The success and failure of policy-implanted inter-firm network initiatives: motivations, processes and structure', *Entrepreneurship & Regional Development*, Vol. 12, No. 2, pp.111–135.

Human, S.E. and Provan, K.G. (1997) 'An emergent theory of structure and outcomes in small-firm strategic manufacturing network', *Academy of Management Journal*, Vol. 40, No. 2, pp.368–403.

Huxham, C. and Beech, N. (2008) 'Inter-organizational power', in Cropper, S., Ebers, M., Huxham, C. and Smith-Ring, P. (Eds.): *The Oxford Handbook of Inter-Organizational Relations*, Oxford University Press, Oxford.

Jack, S., Moult, S., Anderson, A.R. and Dood, S. (2010) 'An entrepreneurial network evolving: patterns of change', *International Small Business Journal*, Vol. 28, No. 4, pp.315–337.

Kilduff, M. and Tsai, W. (2003) *Social Networks and Organizations*, Sage, Thousand Oaks, CA.

Knoben, J., Oerlemans, L.A.G., Krijkamp, A.R. and Provan, K.G. (2018) 'What do they know? The antecedents of information accuracy differentials in interorganizational networks', *Organization Science*, Vol. 29, No. 3, pp.471–488.

Knoke, D. and Yang, S. (2008) *Social Network Analysis*, 2nd ed., Sage, Thousand Oaks, CA.

Korhonen, K.J. (1996) 'Finland: a history of networking', in *OECD*, Networks of Enterprises and Local Development, Competing and Co-Operating in Local Productive Systems, Paris, LEED/OECD.

Kreiner, K. and Schultz, M. (1993) 'Informal collaboration in R&D. The formation of networks across organizations', *Organization Studies*, Vol. 14, No. 2, pp.189–209.

Lundberg, H. and Johanson, M. (2011) 'Network strategies for regional growth', in Johanson, M. and Lundberg, H. (Eds.): *Network Strategies for Regional Growth*, Palgrave Macmillan, Houndmills, Basingstoke, UK.

Mandell, M.P. and Keast, R. (2007) 'Evaluating network arrangements: toward revised performance measures', *Public Performance & Management Review*, Vol. 30, No. 4, pp.574–597.

Mandell, M.P. and Keast, R. (2008) 'Evaluating the effectiveness of interorganizational relations through networks: developing a framework for revised performance measures', *Public Management Review*, Vol. 10, No. 6, pp.715–731.

Moliterno, T.P. and Mahony, D.M. (2011) 'Network theory of organization: a multilevel approach', *Journal of Management*, Vol. 37, No. 2, pp.443–467.

Ng, W. and Rieple, A. (2014) 'Special issue on 'The role of networks in entrepreneurial performance: new answers to old questions?', *International Entrepreneurship and Management Journal*, Vol. 10, No. 3, pp.447–455.

Nooteboom, B. (2008) 'Learning and innovation in inter-organizational relationships', in Cropper, S., Ebers, M., Huxham, C. and Smith-Ring, P. (Eds.): *The Oxford Handbook of Inter-Organizational Relations*, Oxford University Press, Oxford.

Obeng, A.B. (2018) 'Strategic networking and small firm growth in an emerging economy', *Journal of Small Business and Enterprise Development* [online] https://doi.org/10.1108/JSBED-01-2018-0035.

Pentland, B.T. and Feldman, M.S. (2008) 'Designing routines: on the folly of designing artifacts, while hoping for patterns of action', *Information and Organization*, Vol. 18, No. 4, pp.235–250.

Perrow, C. (1992) 'Small-firm networks', in Nohria, N. and Eccles, R.G. (Eds.): *Networks and Organizations: Structure, Form, and Action*, Harvard University Press, Cambridge.

Powell, W.W. (1998) *Learning from Collaboration: Knowledge and Networks in the Biotechnology and Pharmaceutical Industries*, California Management Review, Spring.

Provan, K.G. and Milward, H.B. (1995) 'A preliminary theory of interorganizational network effectiveness: a comparative study of four community mental health systems', *Administrative Science Quarterly*, Vol. 40, No. 1, pp.1–33.

Provan, K.G. and Milward, H.B. (2001) 'Do networks really work? A framework for evaluating public-sector organizational networks', *Public Administration Review*, Vol. 61, No. 4, pp.414–423.

Provan, K.G. and Sydow, J. (2008) 'Evaluating inter-organizational relationships', in Cropper, S., Ebers, M., Huxham, C. and Smith-Ring, P. (Eds.): *The Oxford Handbook of Inter-Organizational Relations*, Oxford University Press, Oxford.

Provan, K.G., Fish, A. and Sydow, J. (2007) 'Interorganizational networks at the network level: a review of the empirical literature on whole networks', *Journal of Management*, Vol. 33, No. 3, pp.479–516.

Rio Grande do Sul (2009) 'Secretaria do desenvolvimento e dos assuntos internacionais', *Redes de Cooperação: A Força da União*, SEDAI, Porto Alegre.

Scott, J.P. (2000) *Social Network Analysis: A Handbook*, Sage Publications, London.

Sydow, J. (2004) 'Network development by means of network evaluation? Explorative insights from a case in the financial services industry', *Human Relations*, Vol. 57, No. 2, pp.201–220.

Sydow, J. and Windeler, A. (1998) 'Organizing and evaluating interfirm networks: a structurationist perspective on network processes and effectiveness', *Organization Science*, Vol. 9, No. 3, pp.265–282.

Thompson, G.F. (2003) *Between Hierarchies and Markets: The Logics and Limits of Network Forms of Organization*, Oxford University Press, Oxford.

Todeva, E. (2006) *Business Networks. Strategy and Structure*, Routledge, London.

Verschoore, J.R. and Balestrin, A. (2011) 'Outcomes in small-firm networks: a quantitative study in the southern Brazilian context', in Johanson, M. and Lundberg, H. (Eds.): *Network Strategies for Regional Growth*, Palgrave Macmillan, Houndmills, Basingstoke, UK.

Verschoore, J.R., Balestrin, A. and Teixeira, R. (2017) 'Network management and associated firms' outcomes: multilevel analysis in the southern Brazilian context', *Journal of Management & Governance*, Vol. 21, No. 1, pp.211–232.

Wasserman, S. and Faust, K. (1994) *Social Network Analysis: Methods and Applications*, Cambridge University Press, Cambridge.

Wegner, D., Zarpelon, F.M., Verschoore, J.R. and Balestrin, A. (2017) 'Management practices of small-firm networks and the performance of member firms', *Business: Theory and Practice*, Vol. 18, No. 1, pp.197–207.

Zeffane, R. (1995) 'The widening scope of inter-organizational networking: economic, sectoral and social dimensions', *Leadership and Organization Development Journal*, Vol. 16, No. 4, pp.26–33.