Association of information sharing with the risk and performance of cooperatives' strategic alliance

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Abstract

Objective: This study analyzes the association of information sharing with the risk and performance of cooperatives' strategic alliance, mediated by knowledge sharing and information leakage.

Method: A survey research was conducted in agricultural cooperatives listed in the Organization of Brazilian Cooperatives [OCB] (2018), involving managers (manager, supervisor, coordinator and controller) registered in the LinkedIn network. The questionnaire was sent through the SurveyMonkey platform to the 516 managers who accepted the invitation and the final sample totaled 96 valid responses. To test the research hypotheses, the structural equation modeling technique was applied.

Results: The results showed that information sharing is directly associated with knowledge sharing, but the association of variables is not observed in the interaction between information sharing and information leakage. Information leakage is directly associated with the risk of the strategic alliance, as is knowledge sharing with alliance performance. Knowledge sharing presented partial mediation in the relationship of strategic alliance risk-information sharing and alliance performance, while information leakage did not meet the mediation requirements.

Contributions: The study contributes by highlighting the association of information sharing with knowledge sharing in cooperatives' collaborative environment. It also provides indications on the consequences of information sharing and information leakage. It also highlights the importance of strengthening strategic alliances to reduce risk and increase performance.

Keywords: Information Sharing; Risk of strategic alliance; Alliance performance.

1. Introduction

Information is seen as a source of power in the business world, and deciding which information to share or not can lead the organization to gain competitive advantages or disadvantages (Fawcett, Osterhaus, Magnan, Brau & McCarter, 2007). For Connell, Kriz, and Thorpe (2014), information is an important element in the process of creating environments aimed at collaborative and innovative development. This importance increases when all partners involved can gain from information sharing situations (Cheng, 2011).

Research shows that when greater integration and more information sharing exist between alliance partners, there is better collaboration and coordination and, hence, the alliance performs better (Goodhue, Wybo & Kirsch, 1992; McLaren, Head & Yuan, 2002). Wu, Chuang, and Hsu (2014) found that collaboration plays an important role in the performance of alliance partners through information sharing, while information sharing is directly reflected in the performance of alliance partners.

Information sharing among cooperation members contributes to knowledge generation and socialization among organizational partners. By sharing knowledge, organizations encourage mutual understanding, enabling the construction of an environment of trust (Ahmed, Ragsdell & Olphert, 2014). When organizations decide to explore collaboration to expand their knowledge, stakeholders can benefit from increased performance-driven information (Massaro, Moro, Aschauer & Fink, 2019).

On the other hand, one should be aware that, by sharing information, its leakage may be encouraged. Tan, Wong and Chung (2016) describe that information leakage can be seen as an incentive to obtain monetary benefits, acquire technology, gain reputation, explore better competitive advantage and guarantee a higher sales volume. When misused, however, information leakage can result in opportunistic behavior that undermines the goals of strategic alliance members (Massaro et al., 2019).

Alliances are important strategic mechanisms for organizations, but with risky configurations and high percentages of failed alliances (Christ & Nicolaou, 2016). Such failures are associated with the risk of strategic alliance when cooperatives provide each other with access to private and proprietary information, such as costs, demands, and customer lists, which is likely to be used for harmful purposes (Christ & Nicolaou, 2016).

In the literature, it is observed that the reflections of information sharing in constructs, such as the risk and performance of the strategic alliance, are not yet sufficiently clarified, indicating a research gap to be explored. Thus, we seek to answer the following research question: How is information sharing associated with the risk and performance of the strategic alliance of cooperatives and what are the effects of mediation of knowledge sharing and information leakage in this relationship? It is assumed that this type of organization, through the guiding cooperative principles, experiences the daily sharing of information.

The results of this research contribute to the existing literature on information and knowledge sharing as it reveals an association between these constructs, which corroborates the benefits of social interactions for strengthening strategic alliances (Hueth & Marcoul, 2006; Ritala, Olandera, Michailovab & Hustedb, 2015). Sharing skills and experiences, joint problem solving, and other possible interactions reinforce the benefits of sharing information and knowledge on the performance of alliance partners (Wang & Hu, 2017).

The risks to the strategic alliance in case of information leakage outweigh the expected benefits of information sharing (Marshall, 2015; Tan et al., 2016). Situations of loss of competitive advantage, inability to identify the causes of the problem, lack of knowledge and information handling skills are risks that can stimulate or mitigate a strategic alliance (Das & Teng, 1996; 2001; Ahmed et al., 2014 ; Christ & Nicolaou, 2016). This dichotomy appears in the literature and requires unraveling through theoretical-empirical research on arrangements in the form of strategic alliances.

In practice field, research can contribute to the cooperatives under analysis by highlighting the benefits of the collaborative environment and, at the same time, the risk of information leakage in this context. Mojo, Ficher and Degefa (2015) perceive information sharing as the main benefit, noting that the impact of cooperatives on their members' share capital may be related to frequent meetings and subsequent information sharing by different means, which may enhance members' trust, commitment and participation.

2. Literature Review and Background of Hypotheses

2.1 Information sharing and knowledge sharing

The purpose of information sharing is to ensure that all stakeholders in the process obtain information of interest to them in a timely manner, considering the heterogeneity of each member's needs (Hu, Xu, Zhang & Liu, 2017). Tomaél and Marteleto (2006) warn that information and knowledge can represent different aspects of the same situation, considering that knowledge can be interpreted as information processed by the brain, and that, when the individual articulates knowledge for the sake of transmission, this becomes information.

In the absence of information sharing, according to Khan, Hussain and Saber (2016), stakeholders will independently determine, for example, the selling price, the number of deliveries per cycle or period and the size of the shipment. In an information sharing situation, the buyer and supplier may also share information about potential yield losses, production uncertainty, lack of capacity, equipment problems, quality issues and / or insufficient inventories (Khan et al., 2016).

Hueth and Marcoul (2006) modeled information sharing between different future situations that may occur in companies. Among the results, they showed that information sharing tends to outweigh the profits for producers by inducing stronger competition between intermediary companies. This is true even when companies face the dilemma of not reporting their information. This can be avoided if companies enter into an ex ante contract that requires full disclosure of the information as soon as the signals have been received.

Evans and Weninger (2014) applied Nash's Bayesian equilibrium to a fishermen's cooperative to analyze the dynamics of information sharing, with uncertainty about payoffs and competitors' fishing locations. The modeling results confirmed that uncooperative fishermen engage in an inefficient search for information. When information is shared among a group of cooperated fishermen, however, there is the benefit of sharing information about fishing locations. Thus, simultaneously, the sharing of knowledge occurs.

Khan et al. (2016) presented a mathematical formulation for the reduction of buyer unit price and supply chain improvement due to information sharing. They noted that sharing information resulted in improved annual profit for all involved. On the other hand, they found that this gain depends on the unit price and on the environmental and social cost parameters the buyer takes into account. This suggests knowledge of the elements associated with environmental and social cost.

An initiative commonly mentioned in the literature is information sharing among partners in a supply chain (Lee, So & Tang, 2000). Fawcett et al. (2007) alert though that for a supply chain to benefit from information integration and sharing, there needs to be a high degree of participation by all stakeholders. This can also favor knowledge sharing among participants.

From this perspective, one can see the extension of the concept of information sharing. For Alves and Barbosa (2010), this is a voluntary process on the part of the knowledgeable individual, able to promote integration between those involved, open to continuous learning and the mutual transmission of concepts and skills, to promote knowledge and innovation. From this perspective, the first hypothesis of the research was formulated:

- **H$_1$**: Information sharing is directly and positively associated with knowledge sharing.

2.2 Information sharing and information leakage

From an intraorganizational perspective, Ansari (1977) alerted to the limited research available in the literature regarding the amount of information shared between managers and subordinates about a given event. Moreover, it is unclear how this information affects the relationship between the parties, and which are the impacts on the choice of structural features, such as the number of points at which information is transformed before it reaches its destination, and how information actions are integrated at various levels of the organization.

Similar concerns can be observed in interorganizational relationships. Information sharing is expected to help save costs by reducing inventories and lot size, productivity gains, and other measures (Marshall, 2015). Strategic alliances tend to gain competitiveness, access to resources from partners, markets, technologies, capital and people (Van den Abbeele, 2016). On the other hand, depending on who receives the information or the circumstances in which it is transmitted, leakage may occur, intentionally or unintentionally, to an unauthorized party, favoring potential opportunistic behavior.

By sharing information with alliance partners, such as cost, demand, and customer lists, companies become vulnerable to potential opportunistic behavior by their partners (Christ & Nicolaou, 2016). Marshall (2015) exemplifies the leak as the tendency of the manufacturer to leak the information shared by the retailer to other competing manufacturers. The pursuit of organizational incentives can also drive the leakage of critical and confidential information to third parties for monetary benefits, technology acquisition, reputation gains, exploitation of competitive advantage, and so on. (Tan et al., 2016).

Tan et al. (2016) warn that information leakage and improper knowledge sharing cause companies to lose competitive advantage in their respective fields or even lead to the inability to identify the causes of the problem, due to lack of knowledge and skills in information handling. Unsurprisingly, most serious information security breaches occur because of the failure to combine information that is exposed to technologies, people, and processes (Ahmed et al., 2014).

Among the factors that influence information leakage in a strategic alliance, Tan et al. (2016) highlight the sharing of information. For the authors, the greater the sharing of information between alliance partners, the greater the confidential information exchanges, and this combination can lead to greater risks of information leakage. That is, when sharing information, a member of a relationship may (consciously or not) be leaking information (Tan et al., 2016).

In a case study conducted with five companies, Tan et al. (2016) found that former employees who had information from internal information systems leaked it to their competitors and thus caused them to lose competitive advantage. In this perspective, the second hypothesis was formulated:

- **H$_2$**: Information sharing is directly and positively associated with information leakage.

2.3 Information leakage and risk of the strategic alliance

In designing the information sharing platform between members of a strategic alliance, when failures occur in the design of the control system, with faults and vague boundaries, there is a great possibility of information leaking beyond the collaborative environment (Tan et al. , 2016). The author warns that such failures are usually due to limited resources for monitoring and controlling information sharing platforms. Information leakage, whether due to technological, human or hybrid problems, is a risk of the strategic alliance.

Concerns about information leakage are growing in organizations, especially due to privacy aspects and information disclosure online (Gopal, Hidaji, Patterson, Rolland & Zhdanov, 2018). But alliances are efforts with some degree of risk. Thus, trust in the cooperation and knowledge of partners is necessary to achieve the objectives of the alliance (Das & Teng, 1996; 2001). Alliance conflicts can occur when alliance members' goals are achieved at the expense of the alliance, and similarly when alliance objectives are incompatible between different partners and conflicts exist between the participants in the strategic alliance (Christ & Nicolaou, 2016).

Companies may be reluctant to share information due to the negative effects on their revenues and profits as a result of the potential risk of confidential information leakage (Kong, Rajagopalan & Zhang, 2013). Tan et al. (2016) add that information leakage is usually described as the dark side of integration data. In this sense, Fawcett et al. (2007) point out that even when an organization has sufficient capacity to share information, managers may not be willing to do so for issues related to lack of trust in alliance members.

Research does not clearly show how managers perceive and assess the risk of information sharing (Tran, Childerhouse & Deakins, 2016). These authors also point out that little research addresses how organizations deal with such risks, and that studies tend to examine aspects of risk management and information sharing separately. Relational risk may increase due to partner opportunism (Christ & Nicolaou, 2016) and the risk of intentional data sharing (Lechler & Wetzel, 2017), among other factors.

Among the various proposed relationships, Chist and Nicolaou (2016) investigated the impacts of perceived risks on information exchange in the strategic alliance risk. The authors define perceived risk of information exchange as the possibility that one partner will use the information opportunistically (for example, by leaking it), leading to the inability of the other party to use that information appropriately. The survey results indicated that the higher (lower) the risk of information exchange, the greater (lower) the risk of the strategic alliance.

This study focuses on the risks of information exchange between strategic alliance partners, situations of failure to achieve cooperation objectives, misinterpretation and communication, as well as unavoidable failures. Such risks show whether partner companies opportunistically use information to promote internal objectives as a form of conflict with alliance partners (Christ & Nicolaou, 2016). Given the above, the third hypothesis of the research was formulated:

- **H$_3$**: Information leakage is directly and positively associated with the risk of the strategic alliance.

2.4 Knowledge sharing and performance of the alliance

Christensen (2007) defines knowledge sharing as the process of exploiting existing and accessible knowledge, transferring and applying this knowledge in search of improvement, making the process of solving specific tasks faster and cheaper. Knowledge sharing can be related to the creation of new knowledge through different combinations of existing knowledge or by improving the exploitation of existing knowledge (Christensen, 2007).

According to Riege (2005), knowledge sharing is acknowledge as a practice that can provide companies with a competitive advantage, helping to achieve business objectives, often serving as a key component of knowledge management programs. Chen, Chuang and Chen (2012) highlight that knowledge management is crucial to improve performance, gain competitive advantage and innovation by sharing learning that leads to continuous improvement of the company, allowing the integration of resources and capabilities.

Cruz-González, López-Sáez and Navas-López (2015) point out that supply chain partners, for example, can gain information, know-how and perspectives from each other, and that knowledge sharing acts as a mechanism that assists in the process of realizing the benefits of collaborative knowledge for performance and innovation. Given reciprocity, trust and respect in a collaborative environment, knowledge sharing can yield long-term benefits, which improves innovation performance and profitability (Wang & Hu, 2017).

For Wang and Hu (2017), in an environment where there is knowledge sharing, the development of new skills and the management of knowledge assets of the supply network take place. In this sense, shared information can be used to diagnose and monitor alliance performance by enabling the identification of potential failures (Christ & Nicolaou, 2016). Failures in the performance of the alliance may be due to poor communication issues, ineffective management or difficult market conditions.

Greater integration and sharing of information between alliance partners results in better alliance coordination and performance (McLaren et al., 2002). According to Sheu, Yen, and Chae (2006), when information sharing and collaboration are closely related to alliance success, in the case of the supply chain, it is important to identify the fundamentals of contributions to partnership exchange beliefs.

Ritala et al. (2015) found in their research that knowledge sharing is beneficial for companies' innovation outcomes by providing improvements in innovation performance. For these authors, this relates to the principles of positive reciprocity, which argues that the more the company shares knowledge, the more knowledge the company will receive in return. Thus, the fourth hypothesis was formulated:

- **H$_4$**: Knowledge sharing is directly and positively associated with alliance performance.

2.5 Knowledge sharing and information leakage as mediators of the interaction between informationg sharing and performance/risk of the alliance

Hueth and Marcoul (2006) noted in their research that information sharing can offer benefits to consumers and producers by allowing them to increase the accuracy of the future demand. Khan et al. (2016) highlight the sharing of information as a basis for the development, maintenance and strengthening of the process of managing the environmental and social impacts of the supply chain.

Information sharing enables better integration of information systems, which can have positive and negative effects on risk among the allied members of the supply chain and consequently affect the alliance performance (Christ & Nicolaou, 2016). It can also be useful to improve supply chain efficiency, especially by reducing inventory costs and reducing inventory shortages when demands are correlated (Lee et al., 2000).

According to Das and Teng (2001), problems with alliances may occur, such as lack of cooperation, risk of poor performance, alliance or partners. The opportunistic behavior of the stakeholders in the alliance can lead to conflicts due to differences of opinion, or individual interests not matching those of other partners (Das & Teng, 2001). Even if alliances are perceived to be relevant to the organizational strategy, partnership formation presents risks and a high probability of failure due to inefficient communication, inefficient management or difficult market conditions (Christ & Nicolaou, 2016).

Information leakage can be reflected in partnership performance. It involves the disclosure of competitor-sensitive information about strategy and performance by both alliance partners and individuals working in the company (Massaro et al., 2019). Information leakage can happen unintentionally (Von Rheinbaben & Ruckes, 2004) as a result of employee frustration with the organization in terms of policies, organizational barriers, lack of trust (Casimir, Lee & Loon, 2012), or due to of interests of unfaithful and unethical workers / partners (Massaro et al., 2019).

In the same sense, there is knowledge sharing, which involves the risk of uncertainty about the behavior of individuals and their business partners, so that the recipient may harm the issuer, whether due to information leakage or abuse for its own benefit (Massaro et al., 2019). Thus, the fifth hypothesis of the research is formulated, segregated in two:

- **H$_{5a}$**: Knowledge sharing positively mediates the interaction between information sharing and alliance performance.
- **H$_{5b}$**: Information leakage positively mediates the interaction between information sharing and strategic alliance risk.

Figure 1 presents the theoretical research model, with the constructs and the direction of the hypotheses.
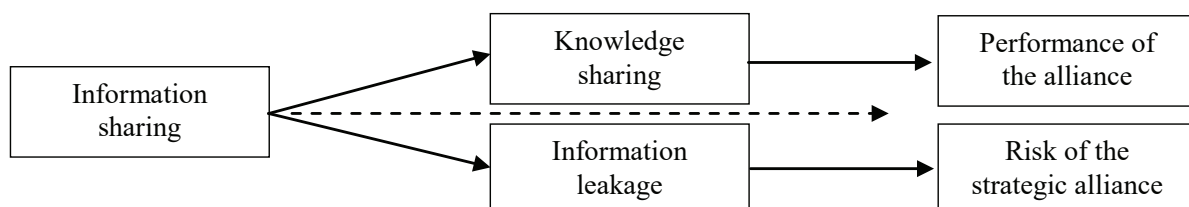

Figure 1. Theoretical model of the research
Source: elaborated by the authors.

According to Figure 1, the core issue of the research is the relationship of information sharing, given the relevance of this type of sharing to benefit the alliance performance. Based on information sharing, relationships were proposed with knowledge sharing and information leakage, which were related to alliance performance and strategic alliance risk. Finally, knowledge sharing and information leakage were related as mediators of information sharing with the performance and risk of the strategic alliance.

3. Research Method

This research was conducted based on a survey, using the Brazilian agricultural cooperatives listed in the OCB (2018) as the population. This sector was selected due to the cooperative principles (voluntary and open membership; democratic control of members; economic participation of members; independence, provision of education, training and information; cooperation between cooperatives; and concern for the community) highlighted by Mojo et al. (2015); aligned with characteristics needed to create a collaborative environment and which are presumed to stimulate information sharing and knowledge.

Of the 966 agricultural cooperatives listed in the OCB (2018), 278 cooperatives were identified with employees registered in the professional network LinkedIn. In this network, people with positions in these cooperatives were identified at the management level, searching for the terms: "manager", "coordinator", "supervisor" and "controller". In total, 1,255 people in any of these positions were identified and invited to participate in the survey. The 516 managers who accepted the invitation received the link from the survey instrument and obtained a total of 109 responses.

The questionnaire was sent through the SurveyMonkey platform from June to August 2018. Of the 109 answered questionnaires, 13 were incomplete, resulting in a valid sample of 96 respondents, suitable for analysis of the proposed theoretical model. The appropriate sample size was calculated using G * Power software (Faul, Erdfelder, Buchner & Lang, 2009). The evaluation of the sample size and statistical power of the analysis followed the criteria according to the predictor variable (information sharing) on the dependent variable (alliance performance and strategic alliance risk), with a mean effect size of 0.15, sample power of $1\text{-}\beta = 0.8$ and a significance level of $\alpha = 0.05$, which resulted in at least 68 responses. The research instrument consists of five blocks, with 20 assertions in seven-point Likert scale (Table 1), in line with the constructs of the theoretical model for this research. The research instruments were elaborated and validated by the authors indicated in the respective constructs. To ensure proper translation, the instruments were back-translated into English.

Table 1

Research construct and questions

Constructs	Statements
Information sharing (Tan *et al.*, 2016)	1. Mark your level of agreement with each of the statements below about your organization on a scale from 1 to 7, with 1=I completely disagree and 7=I completely agree.
	IS1.We share the proprietary and/or confidential information on our business units with the network/alliance partners (central and other cooperatives). IS2.Our network/alliance partners (central and other cooperatives) share their proprietary and/or confidential information with us. IS3. We and our network/alliance partners and/or other external parties exchange information that helps with the business planning.
Knowledge sharing (Wang & Hu, 2017).	2. Mark how frequently your organization has engaged in knowledge sharing activities with its partners, in the past five years, on a scale from 1 to 7, with 1=rare and 7=very frequent.
	KS1.We share our innovative work reports and technical documents with other members of the supply chain, upon their request. KS2.We share our manuals and methods with our suppliers or clients, upon their request. KS3.We frequently share our experience, know-how or new ideas of innovative work with other members of the supply chain.
Information leakage (Tan *et al.*, 2016)	3. Mark your level of agreement with each of the statements below about your organization on a scale from 1 to 7, with 1=I completely disagree and 7=I completely agree.
	IL1.We face problems with information leakage/losses to third parties. IL2. We face problems with information leakage due to technology-related incidents (such as company database invasion). IL3. We face problems with information leakage due to employee fraud (such as employees stealing or getting information without permission). IL4. We face problems with information leakage as a result of efforts to cooperate with external parties. IL5. We face problems with information leakage due to employees' moving to other organizations. IL6.It is highly probable that the external parties will benefit from the information that leaked. IL7.Severe interruptions in our daily operations and in the supply chain have happened due to information leakage/losses.
Performance of the alliance (Christ & Nicolaou, 2016)	4. Assess for each of the statements below the performance of your cooperative's strategic alliance with the central and the other cooperatives on a scale from 1 to 7, with 1=I completely disagree and 7=I completely agree.
	PA1.It has been very profitable to our cooperative. PA2.Our strategic competitiveness has improved. PA3.It has fully attended to our cooperative's expectations. PA4.We hope that the strategic alliance with the current partners will continue in the long term.
Risk of the strategic alliance (Christ & Nicolaou, 2016)	5. Mark your level of agreement with each of the statements below about your perceived risk of your cooperative's strategic alliance with the central and the other cooperatives on a scale from 1 to 7, with 1=I completely disagree and 7=I completely agree.
	RA1.The probability of not reaching the results is high. RA2.The probability of failure is high. RA3.It is highly probably that it will somehow result in failure.

Source: elaborated by the authors.

The analysis begins with factor analysis of the research instrument to identify observed relationships and common factors of the construct (Hair Jr, Babin, Money & Samouel, 2014). Still in the factor analysis, in order to verify the common method bias, Harman's Single Factor test was performed, as all variables were answered by the same respondents (Podsakoff, MacKenzie, Lee & Podsakoff, 2003). The results showed the presence of five factors, with the first factor representing 26.52% of the total explained variance, indicating that the common method bias does not present a threat to the data analysis, as postulated by Podsakoff et al. (2003).

Subsequently, the partial least squares were applied using Structural Equations Modeling (SEM) in SmartPLS 2.0 M3. Partial Least Squares (PLS) "combines aspects of multiple regression (examines dependency ratios) and factor analysis (represents unmeasured concepts - factors - with multiple variables) to estimate a series of interrelated dependency ratios simultaneously" (Hair Jr et al., 2014, pp. 468-469). In the analysis of mediation, the recommendations of Baron and Kenny (1986) were followed, namely: (i) in the first equation, the independent variable should affect the mediator variable; (ii) in the second equation, the independent variable must affect the dependent variable; (iii) in the third equation, the mediating variable must affect the dependent variable; and (iv) if these conditions are confirmed, then the effect of the independent variable on the dependent variable needs to be smaller in the third equation than in the second equation. According to Baron and Kenny (1986, p. 1177), "perfect mediation is valid if the independent variable has no effect when controlling for the mediator."

4. Description and Analysis of Results

4.1 Measuring model and descriptive statistics

The application of structural equation modeling initially requires the evaluation of the measuring model, testing the reliability (internal and composite) and validity (convergent and discriminant), as recommended by Hair Jr et al. (2014). This information is included in Table 2, along with descriptive data statistics (mean, mode, median and standard deviation).

Table 2
Measuring model and descriptive statistics

Description	IS	IL	KS	RA	PA
Information sharing (IS)	**0.898**				
Information leakage (IL)	0.090	**0.760**			
Knowledge sharing (KS)	0.377	0.227	**0.857**		
Risk of the Strategic Alliance (RA)	-0.027	0.549	0.006	**0.899**	
Performance of the Alliance (PA)	0.356	0.023	0.298	-0.251	**0.860**
Mean Extracted Variance >0.50	0.807	0.578	0.735	0.808	0.740
Cronbach's alpha >0.70	0.881	0.877	0.822	0.881	0.880
Compound reliability >0.70	0.926	0.905	0.893	0.927	0.919
Mean	3.76	3.04	3.34	3.40	4.56
Mode	5	2	1	2	5
Median	4	3	3	3	5
Standard deviation	1.72	1.76	1.75	1.61	1.56

Source: elaborated by the authors.

Convergent validity is obtained by the Average Variance Extracted (AVE), which establishes that the values of the latent variables are above 0.50 (Hair Jr et al., 2014). As shown in Table 2, the way that external loadings and latent variables correlate is fit.

Cronbach's alpha and composite reliability were used to determine the model reliability. According to Ringle, Silva and Bido (2014, p. 65), "they are used to assess whether the sample is free of bias, or whether the answers as a whole are reliable." In line with the criteria of Hair Jr et al. (2014), the reliability of the model is observed, as Cronbach's alpha and compound reliability obtained values higher than 0.70.

To ascertain whether one construct is distinct from the others (Hair Jr et al., 2014), discriminant validity was used. In this study, discriminant validity is acceptable according to the criterion of Chin (1998), as the values of the diagonal correlation coefficients are higher than the others. The square root value of the AVE is also higher than the absolute values of correlations with other latent variables, meeting the criteria of Fornell and Larcker (1981).

In the correlation, the 54% explanation percentage among the information leakage variables and risk perception of the strategic alliance is highlighted, which may be a sign of loss of confidence in the exchange of information between related parties. In research by Wu et al. (2014), it was observed that elements involved in social exchange (trust, commitment, reciprocity and power) precede information sharing and collaboration.

Also noteworthy is the negative correlation burden between perception of strategic alliance risk and perception of alliance performance, which suggests that the risk of strategic alliance is inversely proportional to alliance performance. In the study by Wu et al. (2014), collaboration has a mediating role in supply chain performance, while information sharing has a positive impact on supply chain performance.

There is a negative correlation between information sharing and the risk of strategic alliance, which may be justified by problems arising from lack of trust between alliance members, due to the possibility of information leakage or the use of information / knowledge to one's own benefit (Massaro et al., 2019).

In descriptive statistics, the mean between the variables studied ranged from 3.04 to 4.56, on the 7-point scale, with a standard deviation from the mean between 1.56 and 1.76. The median and fashion denote low signaling of the variables "information leakage", "knowledge sharing" and "risk of strategic alliance". This result reveals insecurity in the process of knowledge sharing due to the fear that this information may compromise some strategy.

Competitive strategies can be a differential for the cooperative and its related parties, and a lack of security or trust can lead to an unfavorable climate, which may cause friction between alliance members and hence the disruption of future alliances. Tan et al. (2016) recommend the adoption of 4Cs (Contain, Control, Contract, Cultivate) structures to mitigate information / knowledge leakage, suggested to counteract unfavorable situations.

4.2 Structural model

In the structural model, the values of the bootstrapping analysis are measured, which verifies the fit of the measuring model and the significance of the relationships between the latent variables (Hair Jr et al., 2014). In this analysis, the determination coefficient (R^2) is observed, which evaluates the variance portion of the endogenous variables, indicating the quality of the adjusted model. For social and behavioral sciences, an R^2 of 2% characterizes a small effect, 13% a medium effect and 26% a large effect (Ringle et al., 2014).

Ringle et al. (2014) also suggest the analysis of Relevance or Predictive Validity Q^2, which requires values greater than zero, to verify if the model presents accuracy and if the constructs are appropriate for the general fit of the model. In this study, the relevance or predictive validity was reached. Table 3 presents the results of the tests performed according to each research hypothesis.

Table 3

Results of the structural model – Direct effects

	Hypotheses	Structural coefficient	Standard error	T-value	P-value	Decision
H$_1$	Information sharing → Knowledge sharing	0.377	0.083	4.519	**0.000**	Accepted
H$_2$	Information sharing → Information leakage	0.090	0.087	1.028	**0.306**	Not accepted
H$_3$	Information leakage → Risk of the strategic alliance	0.556	0.065	8.555	0.000	Accepted
H$_4$	Knowledge sharing → Performance of the alliance	0.191	0.092	2.073	**0.041**	Accepted

Assessment of the Structural Model: R^2: Knowledge sharing = 0.142; Information leakage = 0.008; Performance of the alliance = 0.158; Risk of the strategic alliance = 0.307.
Predictive Relevance (Q^2): Knowledge sharing = 0.083; Information leakage = -0.001; Performance of the alliance = 0.086; Risk of the strategic alliance = 0.235.

Source: research data.

Table 3 shows that the model presents a determination coefficient (R2) with great effect for the risk of the strategic alliance, medium effect for alliance performance and knowledge sharing, and small effect for information leakage. In the Predictive Relevance (Q2), the results were above zero, which is in line with the recommendations by Ringle et al. (2014), except for the information leakage variable. The interaction of information sharing with knowledge sharing presented a positive correlation coefficient of 37.7% and a significance level of 1%, providing evidence for the acceptance of H1. This result indicates that the network/alliance partners and/or other external parties share information and generate knowledge sharing. The results offered no evidence to support H2 though, which predicts that information sharing is directly associated with information leakage.

Information leakage had a direct and positive effect on the strategic alliance risk, supporting the acceptance of H3. This result indicates that when information is leaked, there is a strong possibility that there will be a risk of alliance breakdown between network/alliance partners and/or other external parties. Likewise, there is statistical evidence that permits the acceptance of H4, with a direct and positive effect between knowledge sharing and alliance performance, at a 5% significance level. This result shows that the knowledge sharing generated in the strategic alliance leads to greater performance in operations. The fifth hypothesis of the study was subdivided into: H5a, which predicts the interaction between information sharing and strategic alliance performance, mediated by knowledge sharing; and H5b, which predicts the interaction between information sharing and strategic alliance risk, mediated by information leakage. To verify the mediation (Table 4), the recommendations of Baron and Kenny (1986) were followed.

Table 4

Direct, indirect and total effects of the mediation models

| Hypothesis H5a | Effect Non-mediated model | Mediation of knowledge sharing | | | |
		Direct effect	Indirect effect	Total effect	Mediation
Information sharing → Performance of the alliance	0.358***	0.284**	0.072*	0.356***	Partial mediation 20.2%
Hypothesis H5b	**Effect Non-mediated model**	**Mediation of information leakage**			
		Direct effect	Indirect effect	Total effect	Mediation
Information sharing → Risk of the strategic alliance	-0.115*	-0.077	0.050	-0.027	No mediation

Obs.: *p<0.10; **p<0.05; ***p<0.001.

Source: research dat.

Table 4 shows the effects of the structural model without mediation, as well as the direct, indirect and total effects of the mediating variables, which provides evidence to accept the partial mediation of hypothesis H5a, between information sharing and the performance of the alliance mediated by knowledge sharing. The evidence from the study led to the non-acceptance of hypothesis H5b though, due to the non-compliance with the mediation requirements proposed by Baron and Kenny (1986).

4.3 Discussion of the results

The analysis of the hypothesis test shows that information sharing is directly and positively associated with knowledge sharing, accepting H1. This result is consistent with the theoretical assumptions of the literature and the empirical research findings, which consider information sharing as the basis of the cooperative relationship (Fawcett et al., 2007), capable of supporting the coordination and control (Christ & Nicolaou, 2016), thus influencing the access to knowledge (Wang & Hu, 2017).

The information sharing process fosters the knowledge flows between the related parties, due to the exchange of experiences and skills between network/alliance partners and/or other external parties in their daily operations. Lin (2007) calls this process culture of social interactions. Knowledge sharing favors technical problem solving, brainstorming, setting new standards, and building new tools (Wang & Hu, 2017).

Tomaél and Marteleto (2006) add that knowledge is nothing more than processed information, which reinforces the relationship between information and knowledge. Studies in the cooperative environment, such as Galappaththi, Kodithuwakku and Galappaththi (2016), prove the evidence that sharing price, product quality, new technologies and competition information can promote stock adjustment, enabling better compliance among the network/alliance participants, which allows for optimal operations while maximizing overall economic returns.

The results did not confirm that information sharing is directly and positively associated with information leakage, which leads to the rejection of H2. Therefore, they do not corroborate the findings of Christ and Nicolaou (2016) and Tan et al. (2016). These studies found that information sharing can drive information leakage, causing vulnerability situations, as individuals can use information to excel opportunistically among related parties, also leading to a loss of competitive advantage and to the failure of the strategic alliance.

The rejection of hypothesis H2 provides interesting insights into the nature of relationships and information sharing channels adopted in the cooperatives studied. Tan et al. (2016) highlight that information sharing results in leakage when relationships between partners are top-down in nature and/ or when communication channels between them have failures. Based on the above and on the findings of the research, it is speculated that cooperatives act homogeneously with their partners, that is, horizontally, and that their communication channels were designed to prevent failures and prevent leakage.

Information leakage, in turn, exhibits a direct and positive association with the risk of the strategic alliance, leading to the acceptance of H3. This result reinforces the findings of Das and Teng (1996; 2001) and Christ and Nicolaou (2016) that, in the event of information leakage, there may be opportunistic behaviors regarding information, as well as conflicts in partnerships. For Hong et al. (2013), information leakage results in lost profit and reduced efficiency of collaborative relationships. In this scenario, loss of competitive advantage may occur due to the risks that information leakage causes in the strategic alliance as a whole.

H4, which foresees a direct and positive association of knowledge sharing with the performance of the strategic alliance, was also accepted. This supports the results of the studies by McLaren et al. (2002), Riege (2005), Ritala et al. (2015), Christ and Nicolaou (2016), Wang and Hu (2017), that knowledge sharing can be a determinant for benefits such as performance improvements and competitive advantage of alliance partners. In addition, they argue that by sharing information, it is possible to avoid or diagnose any failures due to a lack of communication.

Christensen (2007) argues that knowledge sharing is a practice resulting from the exploitation of existing knowledge and/or the combination of different knowledge sources, which results in the strengthening of ties between different partners. In this perspective, knowledge sharing is an essential factor to understand and respond to the challenges of competitive and collaborative environments, which contributes to the identification and understanding of the skills and preferences of other partners and, consequently, intensifies the performance of the company. alliance (Wang & Hu, 2017).

Finally, hypotheses H5a and H5b predict mediations between the studied variables. H5a results revealed partial mediation of knowledge sharing in the relationship between information sharing and alliance performance. This result confirms those presented by Wang and Hu (2017), that information sharing affects the alliance's performance mediated by knowledge sharing. Wang and Hu (2017), finding a mediating effect of knowledge sharing, described this as a mechanism by which partners in a relationship can turn their expertise (e.g., information) into higher levels of performance. The evidence failed to confirm H5b though, which predicted the mediating role of information leakage in the relationship between information sharing and alliance risk, as Baron and Kenny's (1986) mediation requirements were not met.

Possible explanations for the non-significant outcome for some of the hypotheses tested regarding the effects of information sharing may derive from the fact that, in cooperatives, the benefit of information exchange is not documented but assumed to be voluntary (Evans & Weninger). , 2014). The survey results indicate that policies based on the assumption of free information flows in cooperatives may not reduce the unwanted information gathering or solve management problems. It is noteworthy that there is concern about information security in the strategic alliance, as pointed out in the research by Ahmed et al. (2014). Thus, the cooperatives studied in this research may be adopting security practices in the information sharing process, in order to avoid information leakage.

5. Final Considerations

This study analyzed the association of information sharing with risk and strategic alliance performance in cooperatives, mediated by knowledge sharing and information leakage. The results of the hypothesis test showed that information sharing directly and positively impacts knowledge sharing, justified by the social interactions between alliances, due to the exchange of skills, experiences, resolution of technical aspects, manufacturing capacity, access to intellectual property, access to financing, among others (Lin, 2007; Christ & Nicolaou, 2016; Wang & Hu, 2017). In the interaction between information sharing and information leakage, the results contradicted the findings of the studies by Christ and Nicolaou (2016) and Tan et al. (2016). The non-interaction between these variables may arise from the fear that shared information may compromise some strategy of one or more alliance members, due to the possibility of leakage of confidential information.

The direct interaction between information leakage and strategic alliance risk presented results in line with that of Christ and Nicolaou (2016), that opportunistic behaviors between individuals involved in the alliance, loss of competitive advantage and conflicts between the parties involved can contribute to Information leakage risks the strategic alliance. The direct interaction between knowledge sharing and alliance performance has also been identified, which is consistent with the studies by Riege (2005) and Wang and Hu (2017) that knowledge exchange favors the performance and mitigation of possible communication problems.

By including the mediating variables, H5a and H5b, in the analysis of the interactions, we identified the partial mediation of knowledge sharing in the interaction between information sharing and strategic alliance performance. There was no statistical support for hypothesis H5b though, according to the criteria of Baron and Kenny (1986). This may be related to opportunistic stakeholder behaviors, which triggers negative consequences involving the risk and performance of the strategic alliance. What is important is not the volume of information shared between the members of the strategic alliance, but the quality and relevance of the information that is transmitted. Therefore, observing the influence of mediating variables is relevant for the investigated cooperatives.

The study contributed to the literature by evidencing the association of information sharing with knowledge sharing in the cooperative environment of cooperatives. It also provides guidance on information sharing and information leakage consequences. It also highlights the importance of strengthening strategic alliances to reduce risk and increase performance. The findings are expected to encourage researchers to further explore the interaction of information sharing with the risk and performance of the strategic alliance, particularly focusing on mediating knowledge sharing and information leakage.

As a limitation, it is pointed out that the same respondents reported the dependent and independent variables, so that the common method bias could occur, although Harman's single factor test did not indicate problems for data analysis. To suppress this limitation, other research designs, for example longitudinal studies, are recommended. This analysis is also recommended in cooperatives of other segments, for example, credit, health, labor, consumer, educational cooperatives, among others, as the results prompt further research, or companies with a head office and branches structure.

As the choice of variables for the composition of each construct implied disregarding the assertions used in related studies, it is recommended that future research work on information sharing interactions involving other elements, such as trust, innovativeness, collaborative innovation, practices to stimulate the development of a more collaborative environment and behavioral issues. It is speculated that these elements may influence the sharing posture in relationships in different organizational settings, seeking performance improvements, goal setting, the provision of feedback and conflict reduction.

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