Information and Knowledge Management, Intellectual Capital, and Sustainable Growth in Networked Small and Medium Enterprises

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Abstract
This paper aims to analyze the strategic effects of the association of small and medium-sized enterprises (SMEs) in knowledge networks (k-networks) on their information and knowledge management (IKM) and intellectual capital (IC). Taking as the object of study two innovative and successful Brazilian experiences, a descriptive survey with top-level executives (managing partners, presidents, and executive directors — henceforth CEOs) was held. Based on theories of management and economics, the findings revealed (i) that the network formation process (encompassing culture, context, incentives for information and knowledge sharing and especially strategy) is an important factor to explain IKM (for creating, systematizing and sharing data, information and knowledge) and IC in its three dimensions (human, relational and structural capital), promoting long-term sustainable growth (perceived by improvements in innovation, competitiveness and corporate results) for SMEs and their networks — a very relevant issue, but whose theoretical and managerial understanding is very incipient in international literature, especially in emerging economies.

Keywords Information and knowledge management · Intellectual capital · Networks · Small and medium-sized enterprises (SMEs) · Sustainable growth · Innovation · Strategy and competitiveness

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Introduction

In the knowledge-based economy, successful implementation of sustainable strategies in small and medium-sized enterprises (SMEs) involves intelligent information and knowledge management (IKM) practices and intellectual capital (IC) — which are critical to overcoming resource shortage and technological and managerial difficulties in SMEs (cf. Balestrin et al., 2008; Muhammad et al., 2011; Romiti & Sarti, 2011; Lin & Chen, 2016; Verbano & Crema, 2016; Jordão & Novas, 2017; Daña et al., 2020; Zakery & Saremi, 2021). Recent studies such as Brassell and Boschmans (2019), under the seal of the Organisation for Economic Co-operation and Development (OECD), highlight the challenges faced by SMEs alongside the relevance of IC as the factor responsible for their survival, growth and development.

Through cooperative relationships and networks, SMEs strategically manage to surpass their difficulties and combine competencies synergistically (i.e. knowledge, skills and attitudes) (Muhammad et al., 2011), creating, exploring or implementing new business opportunities (Romiti & Sarti, 2011), considered fundamental issues for their innovation and to create and sustain their corporate growth (Laperche, 2021).

When SMEs use inter-organizational networks to carry out joint actions enhanced by significant use of information and knowledge, they can become knowledge networks (k-networks), in line with Moslehi et al. (2014). According to Munier (2021), this type of network is viewed as a locus where knowledge is continuously built, managed, combined, tested and selected between all participants. In such networks, knowledge is the core aspect, both in terms of evolution, competition, nature and also strategic elements. According to Jordão and Novas (2017), k-networks have been identified in the international literature as central to the generation of innovation, knowledge and IC for SMEs, constituting a strategic alternative to prevail in the market, helping them not only to survive but to grow and develop over time.

However, despite the great importance attributed in the academic and business spheres to IKM and IC in SMEs and networks (e.g. Balestrin et al., 2008; Daña et al., 2020; Jordão et al., 2020), the challenge of understanding more thoroughly these relationships between IKM, IC and SMEs k-networks and their contributions to sustainable growth (perceived by improvements in innovation, competitiveness, and corporate results) remains to be analysed in-depth, as highlighted by Verbano and Crema (2016), Jordão and Novas (2017), Martínez-Costa et al. (2019) and Agostini et al. (2020), mainly in emerging economies like Brazil. So, the research problem can be summarized in the following question: How do the intervening factors of k-networks can foster IKM and IC to enable SMEs to grow and develop?

Recognizing this research gap, the objective of this paper is to analyze the strategic effects of the association of SMEs in k-networks on their IKM and IC. Taking as the object of study two innovative and successful Brazilian experiences, a descriptive survey with top-level executives (CEOs) was carried out in an attempt to
analyze such issues, also helping to understand the resulting effects on the sustainable growth of such companies.

The research justification comes from its social contributions, following Jordão et al. (2014). In this sense, besides the theoretical importance of the theme listed by Durst and Edvardsson (2012), Khalique et al. (2015), Jordão and Novas (2017) and Jordão et al. (2020), several international organizations such as the United Nations (UN) and the OECD draw attention to the key role of SMEs in economic and social development, particularly on job creation and income generation, also emphasizing the need to create forms and strategies for sustainable growth for these companies (OECD, 2010; UN, 2017).

From a theoretical perspective, this paper contributes to a greater understanding of the topic, examining the relationship between the four analysed variables: k-networks, IKM, IC and SMEs — an issue whose understanding is very incipient in the international literature and almost non-existent in emerging economies, offering several paths for future research and business, economic and legal improvement (Cf. Balestrin et al., 2008; Jordão & Novas, 2017; Mertins et al., 2010). The originality of the study and the methodological proposal developed and applied must also be emphasized.

As economical and managerial contributions, this study highlights how SMEs can and should use k-networks as a deliberate innovative strategy to overcome organizational and managerial difficulties through IKM practices and IC, generating sustainable growth for them (Cf. Munier, 2021). This study also shows how SMEs can use k-networks in practice to improve their IKM and IC, providing a benchmarking opportunity for companies and networks in similar situations.

This paper is structured in 5 sections, including this introduction. “Information and Knowledge Management, Intellectual Capital and Sustainable Growth in SME K-networks” presents the theoretical support platform. “The Research Protocol and Methodological Process” describes the research methodology. “Results” presents and analyses the results of the research. “Deepening of the Analysis and Discussion of the Results” discusses the results. “Conclusions” contains the final remarks in line with the initial research goal.

Information and Knowledge Management, Intellectual Capital and Sustainable Growth in SME K-networks

Inter-organizational networks are agents of strategic relevance in current competitive dynamics, principally when formed among SMEs (Belso-Martinez & Diez-Vial, 2018; Jardon & Martos, 2012; Jordão & Novas, 2017; Khalique et al., 2015; Mariotti, 2011; Pöyhönen & Smedlund, 2004; Romiti & Sarti, 2011). Such firms are characterized by organizational flexibility and a shortage of resources — which makes it difficult for SMEs to compete with larger companies (Marques Júnior et al., 2020). On the other hand, when SMEs are organized in k-networks, they are better able to implement continuous improvement systems and put their innovation processes into practice (Chaston & Mangles, 2000). According to Hilmersson and
Hilmersson (2021), the information, knowledge and temporal aspects of innovation processes in SMEs are influenced by the company’s network behaviour.

In the perspective of inter-organizational networks and K-networks, IKM corresponds to the basic supporting level of competitive advantage, relating fundamentally to the processes, structures, systems and technologies aimed at the creation, use, systematization and sharing of data, information and knowledge. Prior research (e.g. Jordão, 2015; Jordão et al., 2020; Khalique et al., 2015; Lin & Chen, 2016) has stressed the role of the business strategy, trust, cooperation, context and organizational culture in the formation of successful networks, concluding they are critical for IKM practices and IC creation, being at once a source of growth, resulting in innovation, competitiveness and performance for SMEs.

Jordão and Novas (2017) proposed a conceptual model to support future research regarding the contribution of five main intervening factors of inter-organizational relationships (network formation processes, organizational context, strategy, organizational culture and stimuli for knowledge sharing) on IKM (involving the creation, systematization, and sharing of data, information and knowledge) and IC (encompassing human, relational and structural capitals) in SMEs’ k-networks, providing organizational, innovative and competitive benefits for these companies. Such relationships are summarized in Fig. 1. Detailed information about the items comprising each intervening factor is presented in the Appendix (see Tables 7 and 8).

The first intervening factor relates to the k-network formation process. The international literature is truly eloquent in terms of how the formation of networks supports the continued operation of SMEs and the achievement of competitive advantages being not only a survival strategy but also a way of growth for the networked companies, allowing the emergence of opportunities that would not be accessible acting in isolation (Cf. Jardon & Martos, 2012; Laperche, 2021; Romiti & Sarti, 2011). As Jordão and Novas (2017) pointed out, the formation of SMEs k-networks intensifies the sharing of resources, business opportunities, information and knowledge, also facilitating the transfer of explicit knowledge by creating a shared language, information systems and a common culture, with methods understood and used by network participants. Besides, the transfer of tacit knowledge takes place in an unstructured way, through informal conversations, values or traditions, occurring more easily through the knowledge networks formed.

The second intervening factor in the model is the organizational context. The context refers to the specific environment in which the network is created and developed and the relationships within it. According to Caldas and Cândido (2013) and Zach and Hill (2017), the networked environment can stimulate the knowledge conversion dynamics because of its characteristics, such as cooperation, trust and social interaction, which collaborate to create and expand ideas, information and knowledge, in addition to enhancing the generation of innovation. Jordão (2015) has emphasized that to promote synergy and complementarities of knowledge into the network, it is necessary to create an environment in which trust and cooperation are at least superior to the opportunism and competition usually present in traditional economic relations.

Due to its effect on IKM and IC in SMEs networks, strategy is also defined as the third intervening factor. According to Castells (1996), one of the most important elements for a successful management strategy may be to position the
company within a network, which combines resources, capabilities and external factors in an attempt to generate competitive advantages and achieve objectives. In the view of Laperche (2021), a company’s formation and protection of knowledge strategy can provide crucial elements to understand the genesis of innovation. The development of collaborative strategies with other firms and institutions has considered central to maintaining and increasing the company’s innovation strength. According to Massaro et al. (2014), many SMEs still do not know how to establish analyses and strategies related to the exploitation of informational and cognitive resources, as well as with the use of different elements of the IC to

Fig. 1 Analytical research model. Source: based on Jordão and Novas (2017: 683)
improve organizational effectiveness, so networks can work as an instrument to fill these gaps.

The fourth intervening factor is organizational culture. Although organizational culture is known to produce effects on IKM and on the elements that make up the IC (Cf. Martins & Solé, 2013), many companies find it difficult to implement and develop a culture of cooperation that leads to the acquisition of new data, information and knowledge and/or the enhancement of existing data, information and knowledge. According to Mason et al. (2008), a more sustainable approach to IKM consists of establishing an organizational culture based on networked learning that allows the development of common interests and the sharing of information and knowledge, especially if there is an orientation towards trust, cooperation and knowledge sharing by the people and organizations that make up the network.

Stimuli also correspond to the fifth intervening factor as stimuli of knowledge sharing positively affect IKM and IC in networked SMEs. An essential aspect, at this level, is to understand whether stimuli are needed for the share of information and knowledge to potentiate the process of improving performance, establishing innovation and generating value (Bolade, 2021; Pöyhönen & Smedlund, 2004; Verbano & Crema, 2016), especially in SME networks consolidated as k-networks. On the other hand, the organizational network is formed as a result of interactions between actors, starting with the sharing of information, which is an important element that encourages the construction of knowledge (Jordão & Novas, 2017). Accordingly, the organization of the network structure must be thought of to promote an intense interrelation between individuals and between these individuals and their context.

In SME networks, Jardon and Martos (2012) postulate the need to look at IC in a dynamic perspective, meaning to understand that the share of IC of people — human capital — creates structural capital (IC within the organization), and this structural capital creates relational capital (IC with the environment). These authors argue that it is this circular relationship that is responsible for the basic process of knowledge generation and dissemination. Therefore, it can be considered that, in the context of SMEs networks, there is a deep and intense relationship between IKM with the IC, where one of these aspects positively affects the other and vice-versa — these are the factors that underwent the intervention.

Belso-Martinez and Diez-Vial (2018) examined how the evolution of k-networks and the strategic choices of companies affect innovation. The results indicated that the degree of involvement with these networks tends to increase the innovative capacity of companies over time. Moreover, as Balle et al. (2019) pointed out, contexts of cooperation are fertile ground for knowledge sharing. Likewise, SMEs need to adopt specific strategies for an effective exploration of IKM and IC in an attempt to generate competitive advantages and achieve business objectives, seeking to institutionalize people’s know-how in culture, routines and processes, stimulating individual and organizational learning processes. Finally, Xu et al. (2020) found that IC has a significant positive effect on the sustainable growth and performance of Chinese agricultural companies, suggesting that companies should invest in the development of human capital and effective IKM tools as a means to accumulate the necessary IC to grow and allow adaptation in environments of high changes.
All in all, the set of previous empirical studies revealed that the process of transforming inter-organizational networks into k-networks, the organizational context, the strategy, the culture and the incentives for sharing information and knowledge are the central aspects to increase IKM practices and expand the IC, resulting in performance, innovation, sustainability and competitiveness — aspects that can help to analyze organizational growth in networked SMEs.

The Research Protocol and Methodological Process

Taking as the object of study two innovative and successful Brazilian experiences, an explanatory and descriptive survey was carried out (Cooper & Schindler, 2006), aiming to collect data and information based on the perceptions of top-level executives (CEOs), following Richardson (2013). This investigation strategy was useful to test a theoretical model (cf. Figure 1) describing, simultaneously, the characteristics and relationships of this phenomenon in its context.

In an attempt to obtain a high level of accuracy, before the fieldwork, the state-of-the-art on the subject was mapped, involving the last 60 years — 1962 to 2021 (based on information from Web of Science and Scopus), covering four key elements (or variables): IKM, IC, k-networks (or inter-organizational networks) and SMEs. The analysis of these studies and the inferences derived formed the basis of theoretical support for the research, taking the model presented in Fig. 1 as the basis for analyses. Among the various sources of evidence in a study of a quantitative and qualitative nature (cf. Jick, 1979; Valkokari & Helander, 2007), questionnaires were applied. The questionnaires contained closed (using a 7-point Likert-type scale) and open questions — with variables extracted from the international literature (see Appendix, Tables 7 and 8).

The closed questions aimed for greater comparability between firms, while open questions sought to broaden the understanding of the problem and with freedom for further explanations, observing the need for qualitative methodologies to better explore the peculiarities of IC in the target population, as prescribed by Henry (2013).

The data-collecting instrument was pre-tested to find out ambiguous or unclear questions. The independent (corresponded to the intervening factors) and dependent (corresponded to the factors that underwent the intervention) variables were presented in the previous section and are summarized in Fig. 1. The criteria used to select the networks (cases) were (i) choosing networks that were already consolidated; (ii) indications that participant firms used formal or informal mechanisms for sharing data, information and knowledge, generating IC and (iii) access to high-level information — selection by typicality, according to Cooper and Schindler (2006).

The analysis focused on two SMEs’ k-networks — which, according to Munier (2021), are the most efficient type of network for the knowledge creation process. One of these networks received technical support and management training from the Brazilian Service of Support for Micro and Small Enterprises (SEBRAE) in the State of Espírito Santo (ES), directed towards an international business network (hereafter IBN), in line with Zakery and Saremi (2021). The other network — a pharmacy
network (hereafter PN) — is formed of SMEs grouped to face up to the enormous competitive pressure, in line with Brassell and Boschmans (2019). The characterization of each of the networks is presented in Table 1.

Of the 45 companies belonging to the first network, the initial survey indicated that only 28 could participate in the research (integrating the sample), but at the time of data collection, three CEOs of these companies were not present, thus making a total of 25 companies (making up 89.28%). In the second network, all 10 firms (100%), accounting for 27 branches, participated in the research. Thus, respondents from 1 to 25 refer to IBN, and respondents from 26 to 35 refer to PN. Names will be omitted according to the confidentiality agreement. The units of observation consist of the main executive (CEO) of each firm, following Richardson (2013)’s orientation.

The quantitative information was subject to descriptive and multivariate statistical techniques (using SPSS and Minitab® statistical software), including principal component analysis (PCA) and correlation analysis associated with applying simple and multiple linear regressions. A correlation analysis was performed to identify relationships between variables, followed by a simple linear regression analysis — allowing at confirming the results of the correlation analysis. A multiple linear regression analysis was also performed to understand the effects of the strategic association of companies in k-networks on the IKM and IC in SMEs. Each of the networks was then analysed separately, and then comparative analysis of the results of both networks was carried out.

The main sample was segregated into two subsamples to understand internal consistency and the different peculiarities of the two networks. Together, the carried-out analyses will allow a deeper understanding of the relationships investigated in this study — considering quantitative and qualitative information. In this sense, the analysis of open questions (see Appendix, Table 8), allowed a better understanding of the phenomenon and its relations observing the effects from the association of SMEs in k-networks on IKM and IC, and the resulting influence on the corporate results such as organizational performance, innovation, sustainability and competitiveness (cf. Jordão & Almeida, 2017) — aspects considered to understand their organizational growth.

Throughout data analysis, there was an alternation between induction and deduction (Eisenhardt, 1989; George & Bennett, 2005) with the latter predominating over the former, as the knowledge arising from the research derived from pre-established theoretical constructions and results. Seeking to increase the study’s internal consistency, the information gathered from the various sources of evidence was joined (triangulation process) (Jick, 1979). Therefore, whenever possible, the information from one source was compared with that from the others to confirm and validate it.

**Results**

This investigation focused on two SMEs’ k-networks: IBN and PN. IBN has been formed by SEBRAE to increase exportations, improve the volume and the quality of the businesses in SMEs and make them more competitive. The central premise of SEBRAE was the SMEs’ transformation to absorb the culture of internationalization and networking, through courses, visits and consultancies — which also increased the
Table 1 Characterization of IBN and PN networks

| Description                          | IBN network | PN network                                                                 |
|--------------------------------------|-------------|-----------------------------------------------------------------------------|
| Birth                                | 2008        | 1999                                                                       |
| Number of companies                  | 45 companies but only 28 can integrate the sample — of which 25 (89.28%) have participated in the study | 10 companies — all have participated in the study |
| Dimension (based on sales volume)    | 1 small-sized company (about US$2 M)  
24 medium-sized companies (> 3,7 M USD and < 21.2 M USD)  
1 big-sized company (> 21.2 M USD) | 4 small-sized companies (< US$1.5 M)  
6 medium-sized companies (> 3,7 M USD and < 21.2 M USD) |
| Dimension (based on number of employees) | 1 small-sized company (about 72 employees)  
24 medium-sized companies (> 100 and < 499 employees)  
1 big-sized company (> 500 employees) | 1 micro-sized company (< 10 employees)  
9 medium-sized companies (> 50 and < 99 employees) |
| Degree of formalization              | Formal (contractual) | Informal (trust relationships) |
| Governance structure                 | Coordination of SEBRAE with the network | Coordination by network members |
| Typology                             | Inter-organisational network of SMEs transformed into knowledge network | Inter-organisational network of SMEs transformed into knowledge network |
| Characteristics                      | Formed to meet the needs of export and internationalization, medium power asymmetry, high reciprocity, increasing efficiency, performance and dynamism, high stability and medium (increasing) legitimacy | Formed to meet the needs of buying medicines and coping with the high pressures of the pharmacy and drugstore market, low power asymmetry, high reciprocity, high efficiency and good performance and dynamism, medium stability and high legitimacy (albeit informal) |
| Partners type                        | SEBRAE, universities, suppliers, customers, unions and governments | Consulting companies, suppliers, customers and city hall |

Source: own elaboration, based on the research results
absorption of tacit and explicit knowledge. On the other hand, the SMEs that are part of the PN, instead of participating in a project that coordinated and supported their association, spontaneously grouped in an attempt to survive to a restructuring process in the pharmaceutical industry in Brazil, helping them become more competitive in front of the big competitors that dominate the market in which they operate. Although the initial idea of these companies was to make joint purchases, they gradually realized the benefits of being associated with and sharing data, information and knowledge. Thus, both the IBN and PN networks fall under the concept of k-networks by Moslehi et al. (2014). K-networks can be considered as a type of organizational innovation, according to the taxonomy proposed by OECD (2010), being a fundamental strategy to accelerate the pace of SME innovations (cf. Hilmersson & Hilmersson, 2021).

To analyze empirically the role of k-networks on the IKM and IC in SMEs, the research model was tested. Internal consistency of the questionnaires, constructs and the research model were assessed using Cronbach’s alpha. A value of 0.886 was obtained, which denotes good internal consistency (Cf. Hair et al., 1998).

### Descriptive Statistics of the Two Networks Together and Constructs Validity

Table 2 shows the aggregate result of the two networks together. Analysing the data structure, questions 3, 4, 5, 9, 10, 12 and 19 were seen to have a degree of significance greater than 5% (sig > 0.05), indicating they could be redundant by not differentiating respondents’ opinions. This uniformity of opinions may have been caused by the interaction between actors and sharing of data, information and knowledge, in line with the findings of Caldas and Cândido (2013), Khalique et al. (2015) and Vale et al. (2016), as the results served as an indicator of network consistency and maturity, revealing the systematization of new and old knowledge in a network asset.

Initial analyses cover basic estimates of the variables by group, through descriptive statistics (Hair et al., 1998), as presented in Table 2 in accordance with Appendix (see Tables 7). The results indicated that respondents agree with the questions to a greater or lesser extent, except for question 2, which revealed a feeling of almost indifference, and for questions 1 and 16, which showed low agreement and significant variability of understanding among respondents. In addition, to deepen the analysis of the constructs, their relationships and robustness, PCA was used (see Table 2), under Agostini et al. (2017). The PCA results revealed that the constructs forming the intervening factors present suitable reliability (except for Strategy, which was considered suitable by achieving more than 57% of explanation, but within the acceptable limit of 5%). The constructs subject to the intervention were not considered suitable — being a little below that minimum value.

Seeking to maintain the logical integrity of the constructs in line with the theoretical model chosen, it was not possible to improve the reliability of the scale by excluding indicators, and so qualitative indicators were used to a perfect understanding of the phenomenon. That decision was also justified as the software used in this analysis (Minitab®) accepted the formation of the constructs with the
variables suggested by the literature, confirming there was sufficient similarity among the questions. This approach is sufficiently sensitive to capture the complexity inherent to IKM and IC in SME networks according to Richardson (2013) and Agostini et al. (2017).

The third and final component in assessing the validity of constructs is known as the nomological chain and aims to contrast the data obtained with the assumptions found in the literature by analysing the research model. This was achieved by complementing previous analyses with Spearman’s correlation analysis between the constructs (described in Table 3), combined with the use of simple and multiple linear regressions (described in Tables 4 and 5), evaluating to what extent the constructs explain IKM and IC in SME k-networks.

### Table 2: Descriptive statistics and the results of principal component analysis are presented in the last two columns

| Intervening factors and items comprising each factor | Descriptive statistics | Principal components analysis (PCA) results |
|-----------------------------------------------------|------------------------|--------------------------------------------|
|                                                     | M         | SD      | Sig. test |                         |
| Process                                             |           |         |           |                         |
| 1                                                    | 4.60      | 1.36    | 0.015     | 0.621                   |
| 4                                                    | 5.86      | 1.19    | 0.122     |                         |
| 22                                                  | 4.91      | 1.15    | 0.000     |                         |
| Context                                             |           |         |           |                         |
| 16                                                   | 4.57      | 1.63    | 0.001     | 0.644                   |
| 17                                                   | 5.80      | 2.43    | 0.050     |                         |
| 20                                                   | 5.54      | 1.36    | 0.001     |                         |
| Strategy                                             |           |         |           |                         |
| 9                                                    | 5.51      | 1.61    | 0.177     | 0.607                   |
| 10                                                   | 5.77      | 1.35    | 0.131     |                         |
| 11                                                   | 5.89      | 0.99    | 0.050     |                         |
| 12                                                   | 5.26      | 1.34    | 0.065     |                         |
| Culture                                              |           |         |           |                         |
| 5                                                    | 5.40      | 1.52    | 0.457     | 0.668                   |
| 6                                                    | 5.69      | 1.39    | 0.004     |                         |
| 7                                                    | 5.11      | 1.02    | 0.000     |                         |
| 8                                                    | 5.49      | 1.01    | 0.006     |                         |
| Stimuli                                              |           |         |           |                         |
| 18                                                   | 5.51      | 1.54    | 0.047     | 0.780                   |
| 21                                                   | 5.43      | 1.24    | 0.032     |                         |
| 23                                                   | 5.06      | 1.59    | 0.000     |                         |
| IKM                                                  |           |         |           |                         |
| 2                                                    | 4.11      | 1.61    | 0.000     | 0.400                   |
| 3                                                    | 5.57      | 0.92    | 0.263     |                         |
| 13                                                   | 5.06      | 1.47    | 0.017     |                         |
| 19                                                   | 5.31      | 1.47    | 0.066     |                         |
| IC                                                   |           |         |           |                         |
| 14                                                   | 4.91      | 1.36    | 0.035     | 0.533                   |
| 15                                                   | 4.80      | 1.45    | 0.013     |                         |
| 24                                                   | 5.29      | 1.20    | 0.000     |                         |

Source: own elaboration, based on the research results.
Correlation Analysis

A correlation analysis was performed to identify relationships between variables (see Table 3).

Results of Table 3 show that Process, Context, Strategy and Stimuli are correlated to IKM, while Context, Strategy and Stimuli are correlated with IC. Moreover, several indirect effects on IKM and IC were also observed through correlations between these four constructs. A positive correlation between IKM and IC was also found. However, these results need to be interpreted in the light of the literature to reveal the causal relationships between the variables and support the inferences necessary to build a chain of evidence about the subject under study. In this sense, the results extend the findings of Pöyhönen and Smedlund (2004), López-Sáez et al. (2010) and Caldas and Cândido (2013), because most respondents understood that the network led to the creation of a shared language, facilitating the firms’ access to, and use of the information and knowledge built in IBN and PN.

It was found that partnerships supply some technical and managerial help, encouraging the retention of information and knowledge and that the SMEs benefit from the exchange of information, understanding that the relations between the different companies in IBN and PN facilitate the IKM process, partially confirming the results of Valkokari and Helander (2007) and Jardon and Martos (2012). It was also perceived that IBN and PN provide participant firms with competitive differentials, generating the competencies (knowledge, skills and attitudes) necessary to develop their business, thereby complementing Jardon and Martos (2012), Lin and Chen (2016) and Cerchione and Esposito (2017). Inversely, culture does not produce significant effects on IKM or IC, contradicting the previous findings of Cegarra-Navarro et al. (2011) and Martins and Solé (2013).

Finally, although the IKM and IC constructs were not very statistically robust, the literature and the software used to analyze the groups of variables that make up both constructs were largely supportive of such constructs. In both cases, the qualitative findings, analysed in the light of the international literature, showed that there

| Constructs | Process | Context | Strategy | Culture | Stimuli | IKM | IC |
|------------|---------|---------|----------|---------|---------|-----|----|
| Process    | 1       | -       | -        | -       | -       | -   | -  |
| Context    | 0.363*  | 1       | -        | -       | -       | -   | -  |
| Strategy   | 0.115   | 0.215   | 1        | -       | -       | -   | -  |
| Culture    | 0.356*  | 0.019   | -0.327   | 1       | -       | -   | -  |
| Stimuli    | 0.382*  | 0.385*  | -0.102   | 0.623** | 1       | -   | -  |
| IKM        | 0.378*  | 0.573** | 0.420*   | 0.107   | 0.433** | 1   | -  |
| IC         | 0.275   | 0.370*  | 0.448**  | 0.222   | 0.483** | 0.427* | 1  |

Source: Own elaboration, based on the research results
Correlation is significant at the *0.05 level (2-tailed) or **0.01 level (2-tailed)
is a strong link between IKM and IC, corroborating Jardon and Martos (2012) and Novas et al. (2017). Indeed, those questions concerning the sensitivity of the IKM and IC constructs could be better explained from the observations of Henry (2013), for whom IC involves tacit knowledge, and as such is a hidden dimension of knowledge which can often be ‘non-verbal’, or in some cases ‘unable to be verbalized’, being also intuitive and unarticulated. Because of this, it is more difficult to observe, capture and structure — which consequently hinders its management.

**Simple and Multiple Linear Regression Analysis**

The analysis of the simple linear regression, presented in Table 4, confirms the results of the correlation analysis, as Process, Context, Strategy and Stimuli can explain IKM, while Context, Strategy and Stimuli can explain IC.

In an attempt to deepen the understanding of the effects of the k-networks on the IKM and IC on these SMEs, linear regressions were analysed, performing a simultaneous test of the relationships of all the constructs presented in Table 5. The results revealed that only Strategy and Context, in that order, are predictive constructs of IKM, and that only Strategy and Culture, in that order, are predictors able to explain the behaviour of IC in the SME networks under analysis.

Analysis of Table 5, based on the multiple linear regressions, reveals that the Strategy construct, alone, can predict 35% of IKM, and when combined with Context, almost 56%, based on the variance analysis (ANOVA). Collinearity and multicollinearity tests showed that the tolerance levels of the explanatory model of IKM are completely suitable. A value of 0.982 was obtained for the first (values over 0.10 and closer to 1.00 are required) and a variance inflation factor (VIF) of 1.018 for the second (values under 5.00 and closer to 1.00 are required). Analysis of the multiple regression equation (IKM = 2.196 + 0.438 Strategy + 0.354 Context) indicates that a one-unit increase in Strategy and Context constructs can justify an increase of up to 0.438 and 0.354 units of IKM, respectively.

To prevent the model from supplying potentially misleading or incorrect results, the Cook distance parameters observed (minimum 0.000 and maximum 0.204) were shown to be suitable. Finally, taking the Anderson–Darling (AD) test as a basis to test the normality of residuals, where the $p$-value of this test must be greater than the level of significance chosen (in this case 0.05), completely valid results were obtained (AD 0.414 $>$ $p$-value of the test 0.318 $>$ 0.05), indicating that the errors behaved like a normal variable. Similarly, this analysis revealed that the strategy construct was able to explain, alone, the variability of IC by slightly over 40%, and by 67% when combined with the Culture construct, with extremely high statistical significance.

The collinearity tests of the explanatory model of IC were also completely suitable — 0.854 — as were the results of the VIF — 1170. Together, these findings revealed there were no problems in the multiple regression models of IKM and IC. Analysis of the multiple regression equation (IC = −5.830 + 0.837 Strategy + 0.556 Culture) shows the potential increase in IC derived from the one-unit increase in Strategy and Culture constructs. Finally, the parameters observed for the Cook
Table 4 Results of simple linear regression analysis (IBN and PN)

| Relationship of variables trough simple linear regression |
|----------------------------------------------------------|
| IKM  0.157* 0.285** 0.350** 0.015 0.164* – |
| IC  0.059 0.190** 0.233** 0.05 0.141* 0.355** |

| Regression equation |
|---------------------|
| IKM IKM = 5.680 + 0.4065 Process |
| IC IC = 6.302 + 0.2454 Context |
| IKM IKM = 6.075 + 0.4078 Context |
| IC IC = 5.928 + 0.3270 Strategy |
| IKM IKM = 4.377 + 0.4887 Strategy |
| IC IC = 4.567 + 0.3917 Culture |
| IKM IKM = 8.093 + 0.1047 Culture |
| IC IC = 7.787 + 0.0604 Culture |
| IKM IKM = 6.293 + 0.3120 Stimuli |
| IC IC = 5.789 + 0.2842 Stimuli |
| IC IC = 3.046 + 0.5847 IKM |

Source: own elaboration, based on the research results
Correlation is significant at the *0.05 level (2-tailed) or **0.01 level (2-tailed)
Table 5 Results of multiple linear regression analysis (IBN and PN)

Relationship of variables through multiple linear regression

| KM predictor          | Model summary | ANOVA  | Coefficients | Collinearity statistics | Waste test | Anderson–Darling Test |
|-----------------------|---------------|--------|--------------|-------------------------|------------|------------------------|
|                       | R²            | Sig    | Non-standardized | Tolerance | VIF | Cook distance | Test |
| Strategy              | 0.350**       | 0.000  | 0.438        | 0.982       | 1.018 | 0.000 (min) | **0.05** |
| Context               | 0.000         | 0.354  | 0.982        | 1.018       | 0.204 (max) | **0.01** |
| Strategy and context  | 0.560**       | 0.000  |              |             |      |             |      |

Dependent variable: KM
Regression equation: IKM = 2.196 + 0.438 strategy + 0.354 context
KM predictors (constant): strategy (a), context (b), strategy and context (c)

| IC predictor          | Model summary | ANOVA  | Coefficients | Collinearity statistics | Waste test | Anderson–Darling Test |
|-----------------------|---------------|--------|--------------|-------------------------|------------|------------------------|
|                       | R²            | Sig    | Non-standardized | Tolerance | VIF | Cook distance | Test |
| Strategy              | 0.406**       | 0.000  | 0.837        | 0.854       | 1.170     | 0.000 (min) | **0.05** |
| Culture               | 0.000         | 0.556  | 0.854        | 1.170       | 0.820 (max) | **0.01** |
| Strategy and culture  | 0.670**       | 0.000  |              |             |      |             |      |

Dependent variable: IC
Regression equation: IC = −5.830 + 0.837 strategy + 0.556 culture
IC predictors (constant): strategy (a), culture (b), strategy and culture (c)

Source: own elaboration, based on the research results
Correlation is significant at the *0.05 level (2-tailed) or **0.01 level (2-tailed)
distance, (minimum 0.000 and maximum 0.820) and AD (AD 0.462 > \(p\)-value of the test 0.243 > 0.05), were shown to be perfectly suitable. As a whole, three constructs (Strategy, Context and Culture) are seen to be explanatory factors of IKM or IC, with only the Strategy construct producing direct effects on both simultaneously. The results of analysing Tables 2, 3 and 4 had already revealed the constructs Context, Strategy and Stimuli as having direct effects on IKM and IC through the correlations between these aspects. The Process construct was found to influence IKM directly. Only the Culture construct did not have a direct impact on these aspects.

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The joint test of the constructs revealed that only the Strategy and Context constructs, in that order, are predictors of the behaviour of IKM and that only Strategy and Culture, in that order, explain the behaviour of IC in the SME networks analysed. This shows the preponderance of Strategy as the main factor in explaining the phenomenon studied. Nevertheless, a joint analysis of the results of the simple and multiple linear regressions reveals that all constructs have direct or indirect effects on IKM or IC. Furthermore, the IKM and IC constructs were found to influence each other. Therefore, there is alignment between the theoretical assumptions established in the premises of the model proposed by Jordão and Novas (2017) and the empirical results observed in the research described in this paper.

Deepening of the Analysis and Discussion of the Results

Based on the analysis of the answers to closed and open questions (cf. Appendix, Tables 7 and 8), in each of the networks, we sought to understand the influence of the association of SMEs in k-networks, as well as the effects of this process.

The statistical results indicate that the vast majority of SMEs in the two networks realized that the network constitution was relevant to improve the sharing of data, information and knowledge; expand communication and generate new skills. The analysis of the data of Table 6 reveals that the network formation process was successful since it allowed the creation of a shared language and the transfer of information and knowledge (explicit) in both networks, even though the results may have remained slightly below expectations, especially at IBN. Even so, the results are in line with the ideas of Nonaka and Takeuchi (1995) about ‘Ba’ as a space for the dissemination of knowledge, which are now extended to the context of SME networks.

Further details of the research results, bringing together descriptive and multivariate statistics (in particular the analysis of correlations and simple and multiple linear regressions), whose synthesis is presented in Fig. 2, reveal that all constructs are directly related either with IKM or IC, in addition to indirect relations with other constructs. The analysis of Fig. 2 reveals that direct statistical relationships were perceived between the Process construct and IKM, between the Culture construct and IC, and between the Context, Strategy and Stimulus constructs with both IKM and the IC.

Initially, some questions composing the constructs still have less agreement, and this could lead to questioning whether the formation of IBN and PN would be, or not, an impacting factor for IKM or IC. However, the set of qualitative results
strongly suggests that without these networks and without SMEs wishing and striving to share information and knowledge, k-networks would not emerge — which ended up having a positive impact on IKM and indirectly on SMEs’ IC. The qualitative results indicate that the network was central in the process of competence development needed for the business of both networks, although with greater uniformity in PN than in IBN — in which a group of IBN CEOs considers that the process has not reached a satisfactory level. This can be explained because some IBN SMEs were not satisfied with the process of forming the network and the benefits derived from it. These results seem to suggest that forming a network with companies of different sizes, in different sectors, or with different levels of maturity (in the same workgroup) can generate dissatisfaction among more mature companies due to the slow learning process of beginners. Therefore, it is confirmed that the formation of

Table 6  Descriptive statistics of the two analysed networks (IBN and PN)

| Intervening factors and items comprising each factor | IBN | PN |
|-----------------------------------------------------|-----|----|
|                                                     | M   | SD | Mo | Md | M   | SD | Mo | Md |
| Process                                             | 4.44| 1.39| 5  | 5  | 5.00| 1.25| 5  | 5  |
|                                                     | 5.80| 1.32| 7  | 6  | 6.00| 0.82| 6  | 6  |
|                                                     | 4.88| 1.01| 5  | 5  | 5.00| 1.49| 6  | 6  |
| Context                                             | 4.60| 1.55| 5  | 5  | 4.50| 1.90| 5  | 5  |
|                                                     | 7.00| 0   | 7  | 7  | 2.80| 2.90| 1  | 1  |
|                                                     | 5.40| 1.41| 6  | 6  | 5.90| 1.20| 7  | 6  |
| Strategy                                            | 6.08| 1.22| 6  | 6  | 4.10| 1.66| 5  | 4.5|
|                                                     | 6.08| 1.22| 6  | 6  | 5.00| 1.41| 6  | 5  |
|                                                     | 5.96| 0.93| 6  | 6  | 5.70| 1.16| 6  | 6  |
|                                                     | 5.36| 1.44| 6  | 6  | 5.00| 1.05| 6  | 5  |
| Culture                                             | 4.80| 1.38| 5  | 5  | 6.90| 0.32| 7  | 7  |
|                                                     | 5.40| 1.53| 6  | 6  | 6.40| 0.52| 6  | 6  |
|                                                     | 5.08| 1.08| 6  | 5  | 5.20| 0.92| 5  | 5  |
|                                                     | 5.12| 0.83| 5  | 5  | 6.40| 0.84| 7  | 7  |
| Stimuli                                             | 5.28| 1.37| 5  | 5  | 6.10| 1.85| 7  | 7  |
|                                                     | 5.20| 0.87| 5  | 5  | 6.00| 1.83| 7  | 6.5|
|                                                     | 4.92| 1.50| 6  | 5  | 5.40| 1.84| 6  | 6  |
| IKM                                                 | 4.56| 1.23| 5  | 5  | 3.30| 1.89| 3  | 3  |
|                                                     | 5.72| 0.68| 6  | 6  | 5.20| 1.32| 5  | 5  |
|                                                     | 5.08| 1.08| 5  | 5  | 5.00| 2.26| 5  | 5.5|
|                                                     | 5.08| 1.29| 5  | 5  | 5.90| 1.79| 6  | 6  |
| IC                                                  | 4.88| 1.27| 6  | 5  | 5.00| 1.63| 5  | 5  |
|                                                     | 5.16| 1.28| 5  | 5  | 3.90| 1.52| 5  | 4  |
|                                                     | 5.16| 0.69| 5  | 5  | 5.60| 2.01| 7  | 6.5|

Source: own elaboration, based on the research results

M mean, SD standard deviation, Mo mode, Md median
the network was positively impacting for IKM but not for IC, with a tendency to have facilitated the creation and transfer of explicit and tacit knowledge, in line with the conclusions of Moslehi et al. (2014).
In a similar and slightly more homogeneous way than the Process, the statistical results indicate that, in general, most CEOs agreed with the statements that explain the Context in which the k-networks are constituted. The importance of knowing the business process of other companies and taking advantage of the exchange of information from this knowledge as well as of the relationship between the different companies and their stakeholders was revealed, especially in the PN, with the creation and sharing of data, information and knowledge being necessary issues, considering the qualitative results, corroborating the findings of López-Sáez et al. (2010), Caldas and Cândido (2013) and Suárez (2013). Even so, quantitative results indicated that the contextual aspects were less important than expected in understanding the formation of k-networks. This also seems to suggest that some SMEs of both networks were not yet able to fully develop what the international literature calls Ba (Cf. Nonaka et al., 2000) considering open questions’ answers. In general, these Ba promoted by the network were considered a factor that stimulated IKM and IC, due to the greater flow of data, information and shared knowledge, as well as the feasibility of joint actions with partner companies, confirming the assumptions of Mertins et al. (2010), Santos-Rodrígues et al. (2012) Martins and Solé (2013) and Leal-Millán et al. (2016).

The statistical results still indicate that the respondents agreed with the statements that explain the analysed strategic factors, revealing the need to know and use their information, knowledge and skills as strengths to overcome their weaknesses and generate new business opportunities. However, IBN companies’ CEOs seemed much more aware of the skills and competencies needed to carry out its processes. The qualitative results also indicate that the networks generated competitive differentials for the participating companies, providing the knowledge needed for the development of their businesses.

Triangulated results confirm that the strategy (formal and informal) affected IKM and IC, revealing that networks have been used as a deliberate strategy to help SMEs assess their strengths, increase the opportunities presented in the environment and minimize the existing risks, going beyond the findings of Cegarra-Navarro et al. (2011), Mertins and Orth (2011), Khalique et al. (2015) and Marques Júnior et al. (2020), as this resulted in the strengthening of the IC’s component elements. These results also show that the vast majority of companies realized that the knowledge of the skills and necessary competencies in the performance of their processes can turn into corporate results, innovation and growth, confirming and expanding the classical ideas of Prahalad and Hamel (1990) and Montgomery and Porter (1991) that skills and competencies must be carefully developed to create and maintain competitive advantages.

As with contextual aspects, cultural elements seemed less important than previously thought. A possible explanation would be because as the k-networks consolidated, they stimulated shared forms of behaviour, routines, beliefs and values (cf. Cegarra-Navarro et al., 2011; Mason et al., 2008). This condition was central to stimulating IKM practices of SMEs, allowing these companies to form coalitions, reshape their own culture based on their needs and those of the group, develop
common interests, stimulating the creation of information centres and knowledge sharing, in addition to trying to improve the economic viability of enterprises through innovation, in line with the findings of Martínez-Costa et al. (2019). The findings reveal that the members of the network have promoted interactions that took place outside the formally planned moments in the network. CEOs of both networks, especially PN, agree that similar cultures, languages and shared experiences facilitated the dissemination of data, information and knowledge within the network. They also agree on the existence of a culture of passing practical knowledge from other companies to the network in the form of theoretical knowledge, which is then converted into practical knowledge when used by the companies in the network (however, this cultural element is a little more rooted in PN than in IBN). Finally, they agree that the network helped in forming a differentiated way of acting or in creating the group’s values. Despite this evidence, the relationship between organizational culture and IKM was only indirectly confirmed. Thus, considering qualitative results, it appears that cultural and social aspects helped to form and expand IC elements (i.e. human, structural and relational capitals), being indirectly important for practices related to information and organizational knowledge. Both networks demonstrated the role and relevance of stimuli for sharing data, information and knowledge within the network. The CEOs perceived network environment, intellectual honesty (i.e. people are authentic and make it clear what they know, or do not know, about the acquired experiences), authenticity in relationships and incentives to share knowledge and experiences as relevant factors for improvements in IKM and IC, aligning with López-Sáez et al. (2010), Mariotti (2011), Muhammad et al. (2011), Caldas and Cândido (2013), Verbano and Crema (2016) and Bolade (2021).

The set of results also indicated that the respondents generally agreed with the statements that explain IKM in networked SMEs, pointing out their relevance in the document, creation and sharing of information (although more intensely in PN), knowledge and know-how; that discipline, efficiency and incentive are fundamental to systematize this knowledge and that the existence of tools and access to information are factors that catalyse both processes. Taken together, the analysis of the results indicates that the configuration of the k-network seems to have provided the IBN and PN SMEs with favourable conditions to create and expand organizational knowledge, a true strategic knowledge community and the emergence of some types of Ba. Such networks seem to have favoured effective interaction between people, groups and organizations, stimulating the sharing of skills, experiences, emotions, information and knowledge through face-to-face communication and generating an intense climate for the sharing of tacit knowledge, in line with the findings of Richardson (2013) and Agostini et al. (2017), understanding k-networks as fundamental for IKM and learning and innovative processes.

Likewise, the results indicated that the respondents, in general, agreed with the statements that explain the elements of the IC. Quantitative and qualitative results indicate that the vast majority of companies in the two networks developed a physical and social environment (structural capital) to create knowledge after the network formation process. There was a high investment and incentive in terms of personal and professional training and qualification in each of the companies in
the networks (although more widely and intensely in the IBN network), resulting in human capital, corroborating Xu et al. (2020). Even so, and more expressively among PN CEOs, it was noticed that the relationships between members (relational capital) stimulated the creation and sharing of information and knowledge between the companies in both networks, implying learning and/or innovation processes in accordance to Jordão (2015). The result set allows confirming the stated deep and intense relationship between IKM and IC, going beyond the findings of Henry (2013), Vale et al. (2016) and Agostini et al. (2017), since the IC has a direct and indirect positive effect on IKM in both networks, and vice versa, even though there seems to be a circular relationship between IKM and IC, confirming the premises of Novas et al. (2017). The qualitative findings also extend the observations of Korbi and Chouki (2017), because it seems that the interaction between individual knowledge at the SME level has expanded in a knowledge spiral, dynamically rising from a low to a high ontological level, up to reach and consolidate at the level of the inter-organizational network. Besides, it was noticed that the k-networks generated new knowledge, high growth and sustainable competitive advantages for the participating companies. This seems to be related to greater performance and innovations in SMEs.

Aiming to deeper the analysis, data was triangulated to better understand how SMEs have used (or not) their IKM and IC to survive and to catalyse and sustain their organizational growth, going beyond the findings of Jordão et al. (2022). In this case, the qualitative findings were fundamental to understand the peculiarities of the IKM and IC in the studied k-networks, corroborating Valkokari and Helander (2007) and Henry (2013), since the IC involves tacit knowledge (which comprises ‘non-verbal’ or ‘non-verbalizable’ knowledge, being intuitive and disjointed). In both cases, it was realized that IC is central to SMEs’ results and sustainable growth, as can be seen in a CEO’s response.

The idea of transferring our data, information and knowledge throughout the network is rather difficult to accept at the beginning, as the firms that today are partners were our competitors and that encourages individualism and each one keeping information and knowledge for their own business. However, we realized at the beginning that it would be vital to share knowledge within the network if we wanted to be competitive, innovate, survive and grow. I think the results are good and that’s the greatest incentive (respondent 31) [our underlining].

These findings not only corroborate the results of Mertins and Orth (2011), Brassell and Boschmans (2019) and Xu et al. (2020) since the IC proved to be essential for survival, accelerated growth and the development of SMEs but also amplify previous findings since this aspect was perceived at both companies and the network’s levels. The set of quantitative and qualitative findings revealed that the association of SMEs in k-networks significantly stimulated IKM and IC, besides promoting long-term sustainable growth (Cf. Gupta et al., 2019; Jordão & Almeida, 2017), perceived by improvements in innovation, competitiveness, performance and value creation, for these companies and their networks.
The set of answers to the open questions revealed that in the PN, there was a percentage growth of SMEs not only well above the national and world GDP, but even higher than the most successful companies in the sector. Since the formation of the network, the founders have worked to achieve structured growth (in part through acquisitions), continuous improvement and the perpetuation of the brand, doubling the number of stores, quintupling revenue and tripling the number of customers served in about 10 years. The increase in average profitability, however, has been above 25% per year, reaching 50% in some periods (regardless of Brazilian or global crises such as Covid-19). The most expressive growth was in the non-medication category: which includes hygiene, perfumery and cosmetics items. These results are due to the greater professionalization of management and the intensive use of IKM — that helped them to generate greater sales volume, at the same time in implementing lean cost management, obtaining greater operational and administrative efficiency, resulting in better performance. The CEOs of the PN confirmed that:

Forming and constituting the network stimulated the process of creating, schematizing, and dividing information and knowledge among the firms, giving us much greater and more sustainable growth than that observed in the competition between independent firms (respondent 35)

Compared to firms in the sector that are not in the network, our results indicate high growth, reaching more than 60% in all these aspects: improvements in qualifications, experience, creativity, knowledge, skills, innovation capacity, and the task development of firm members (respondent 26) [our underlining].

At IBN, the k-network provided a realistic view of the market, to overcome the lack of resources and to achieve systematic growth in the market based on the vision, mission, values and principles developed in this network. In addition to the benefits observed in the PN (including revenue, profitability and customer growth), it was also possible to see IBN developing a set of knowledge that helped SMEs to grow and strengthen and competitively explore new business opportunities in international markets — which was a very significant contribution, considering the size of the companies, going behind the findings of Mertins and Orth (2011), Jardon and Martos (2012), Khalique et al. (2015), Rafique et al. (2018), Balle et al. (2019), Martínez-Costa et al. (2019), Agostini et al. (2020), Xu et al. (2020) and particularly Zakery and Saremi (2021) — who observed that international businesses play a significant role in the growth and survival of SMEs. The CEOs of the IBN confirmed that:

Before there was little focus, difficulty in distributing tasks, according to people’s competencies. There was a lack of a role defined by partners for collaborators. As well as the vision, the network helped SMEs to grow a lot, producing innovations in systems, structures, results, and behaviors, improving processes, productivity, responsibility, and team spirit (respondent 5).

I understand that the knowledge acquired from the network not only help us to survive but greatly facilitated periods of high growth and sustainable develop-
ment for all SMEs over the years, particularly due to the development of factors linked to the firm’s IC, including our major element: the relations, cooperation and trust we have with each other (respondent 21) [our underlining].

These results are in line with Mertins et al. (2010). In both networks, incremental (gradual improvements) and radical changes (revolutionary or drastic) were noticed — which boosted the competitiveness and performance of companies. It was found that the development of innovation in SMEs depends dramatically on their IC management and on their ability to enter collaborative and dynamic networks in open business environments.

The findings made it possible to verify four different types of innovation: in products, processes, organizational and marketing, in line with the OECD model (2010). Although innovation had initially been thought of as a consequence of the growth of companies, it was noticed that innovation had a relevant role in the competitiveness, survival and growth of SMEs. More than that, the research results go beyond the conclusions of Hilmersson and Hilmersson (2021) because the association of these companies in networks and their behaviour not only constitute, de per si, a form of organizational innovation (Cf. OECD, 2010), besides affecting the temporal aspects of the innovation processes but also catalysed several innovations in processes, structures, results and behaviours derived directly from the expansion of the IC and knowledge flows in SMEs and their networks. That is one of the most surprising findings of the research.

In aggregate, the analysis of Fig. 2 confirms the validity of the model proposed by Jordão and Novas (2017). Overall, the triangulation of results revealed that networks are capable of creating, absorbing, applying and disseminating data, information, knowledge and expertise, as well as successful practices and tools within SMEs and their networks, in line with Munier (2021). Moreover, the results indicate that the information and knowledge can be shared with all members having the network, and this can expand the stocks of IC, generating significant and profound contributions to economic and managerial practice.

Many institutions that deal with SMEs recognize these factors and call attention to the necessary care and effort so that they could retain, systematize and share their knowledge and create new ones to achieve continuous improvements in their products, services and processes, in addition to achieving corporate sustainable growth and value generation, in accordance to Jardon and Martos (2012), Xu et al. (2020) and Zakery and Saremi (2021). In general, this process was stimulated by k-networks, directly and indirectly, contributing to improvements in IKM and IC. In this sense, the results now observed can also serve as competitive benchmarking for other companies and networks in similar situations.

These issues gain special relevance in a competitive context in which authors (e.g. Brassell & Boschmans, 2019; Durst & Edvardsson, 2012; Jordão & Novas, 2017; Jordão et al., 2020; Khalique et al., 2015; Xu et al., 2020; Zakery & Saremi, 2021) and international organizations (e.g. UN and OECD) draw attention to the role of SMEs for the economies, governments and societies, emphasizing the growing
relevance of IC as the main factor responsible for the survival, growth and development of these companies.

As practical contributions, these results help to understand how SMEs can use the k-networks as a deliberate and innovative strategy to overcome their technical, organizational and managerial difficulties, using networks to improve IKM practices and to expand IC — generating corporate sustainable growth and development (Cf. Gupta et al., 2019; Jordão & Almeida, 2017), considering the improvements in innovativeness, performance and other organizational and competitive benefits observed in both networks.

From a theoretical point of view, the results help fill a research gap and shed light on the understanding of the relationships between k-networks, SMEs, IKM and IC, contributing to the expansion of knowledge on the topic, in line with the assumptions of Balestrin et al. (2008), Mertins et al. (2010) and Jordão and Novas (2017) — a great relevance aspect, but whose understanding is still incipient in international literature and almost non-existent in emerging markets, offering several paths for future investigation. In this sense, the study’s originality and its approach and contribution are highlighted.

This study advances the theory of economics and management by helping in the real understanding of the integration of these four elements, besides presenting, testing and validating variables that support the model proposed by Jordão and Novas (2017) in a valuable context — considering that Brazil is one of the world’s leading developing economies. So, the results of this research should and can be used to guide future studies in the form of cases or large-scale tests, as well as help to create, test or refine theories on the subject.

The findings of this study seek to advance the research flows that examine how the idiosyncratic resources resulting from the involvement of SMEs in k-networks can contribute to the success and high growth of this type of company. This paper also extends the literature on IC, IKM and corporate growth, noting the direct effects of the association of SMEs in a network on the first two factors and the indirect effect on the latter. It is relevant to mention that most of the previous research on SMEs and networks has studied companies from developed countries and ignored emerging economies. Likewise, in line with observations of Fallatah (2021), most studies on knowledge creation have focused on developed countries, where knowledge is more likely to be created, somewhat neglecting developing and emerging countries.

Taken together, the findings reveal that the transformation of SME inter-organizational networks into k-networks seems to have brought significant benefits concerning processes, people, and market relations, helping to create a shared language with methods understood and used by network partners. At both IBN and PN, this seems to have been fundamental for the co-evolution of members (SMEs), promoting greater engagement and commitment, improving the learning capacity and ways for networked SMEs to catalyse and sustain periods of high growth, as well as suggesting an increase in the means of access to information and knowledge and its creation, transmission, absorption and use,
in addition to improvements in performance, competitiveness and innovation — which seem to be directly or indirectly linked to the greater creation of IC within these networks.

Conclusions

The international literature stresses that in the knowledge-based economy context, SMEs find it difficult to exploit the potential of IKM alone, needing to act in networks to overcome their limitations and reach their goals. So, such enterprises establish inter-organizational relationships, through which they create, obtain, systematize and share information and knowledge and produce innovations. Strangely and paradoxically, even considering the great relevance of the subject, the challenge of understanding the effect of SMEs’ k-networks on IKM and IC has yet to be overcome, especially in emerging economies. Recognizing and exploring this research gap, this paper aims to analyze the strategic effects of the association of SMEs in k-networks on their IKM and IC.

The results of the study indicate that the processes of creating, systematizing and sharing data, information and knowledge in SME k-networks strengthen business projects and processes and the generation of IC in all its dimensions: human, structural and relational. In those networks, IC was heightened by practicing IKM and its underlying meanings in the scope of the SMEs and the networks themselves. Both networks were found to be successful, which is dependent on their actors’ ability to create, employ and circulate information and knowledge and generate IC, promoting long-term sustainable growth and producing innovations in processes, structures, systems, results and behaviours in addition to gains in competitiveness and corporate results.

The findings revealed that the network formation process alone did not imply improvements in IKM or greater IC. The views of network formation were generally positive. However, work methodologies; partnerships; ways of leading groups; systematization of data, information and knowledge and the SME organization were matters showing a greater need for improvement. The findings indicate that it is not enough for SMEs to be similar or situated together. There must be structures and established contexts, strategies, cultures and stimuli for the sharing of information and knowledge among the firms participating in such networks. The interactions and relationships both inside and outside the network were seen to be important catalysts of the process of sharing data, information and knowledge by SMEs. Furthermore, contextual and cultural aspects in isolation were found to be less important than indicated in the literature. However, when combined with other aspects (such as strategy or stimuli), effects were produced on IKM and/or IC.

The set of results led to the conclusion that context was less important in PN than in IBN, exactly the opposite of organizational culture. Within contextual
aspects, the importance of creating a Ba stood out. This seems to help companies and people to absorb the tacit and explicit knowledge acquired and/or built in the process, with culture and inter-organizational relations being relevant factors in this regard. These networks led to the creation of an own informational and cognitive base and own network culture to orientate and direct inter and intra-organizational relationships in the SMEs. Similarly, the networks generated a community of interaction at an ontologically higher level than exists in firms — going beyond the limits of inter-organizational networks. Here, the results suggest that IBN and PN formed a meta-organization characterized by a complex system providing the infrastructure or resources to help the other members. Strategic factors were essential for successful undertakings, generating improvements in SMEs’ business performance, especially in innovation and competitiveness. All CEOs considered this was strategically important to create, develop and apply data, information and knowledge, generating higher and more innovative performance. Findings also revealed that distrust was overcome by the commitment and intellectual honesty between network participants. These stimuli for good relations and greater trust inside and outside the network not only reduced uncertainties but also helped in exploiting new markets, products and technology, as well as encouraging learning and knowledge between people and SMEs, promoting long-term sustainable growth, perceived by improvements in innovation, competitiveness and corporate results for SMEs and their networks. Finally, it remains to be said that the strategy and stimuli implied a learning process and innovation in both networks, resulting in sustainability, competitiveness and business success. As a whole, findings revealed that the constructs of Context, Strategy, Culture and Stimuli were the four producing the most significant effects on IKM and/or IC, with the strategy being the most fundamental element in this process. Taken together, the results of the research confirmed the model’s conformity and internal consistency, in quantitative and qualitative terms, showing it to be valid and consistent.

The main limitation of the research is related to a low generalization due to the small size of the sample. This leads to suggesting large-scale studies about SME k-networks to corroborate the findings of this study, to refine the model’s results and to expand theoretical understanding of the topic. However, before going on to such studies, more case studies of a qualitative nature, either an individual or comparative, are necessary to refine the model and for a better perception of the particularities of the phenomenon.

All in all, it is hoped that, besides making contributions to theory by increasing understanding of k-networks’ effects on IKM and IC, these conclusions can also contribute to economic, legal and management practice, improving understanding of the importance and role of the strategic association of companies in k-networks for SMEs’ survival, growth and development, as well as providing owners and managers of SMEs in similar situations with a competitive benchmarking process.
## Appendix

### Table 7 The first column of the table presents the five intervening factors and the items comprising each factor; the second column presents the theoretical support of each item

| Intervening factors and items comprising each factor | Theoretical support |
|-----------------------------------------------------|---------------------|
| **Process** "Network formation promoted the creation and sharing of a language and methods among participants." | e.g. Nonaka and Takeuchi (1995); Jordão and Novas (2017) |
| "Network formation was fundamental in developing the necessary competences for your business." | e.g. Jardon and Martos (2012); Mariotti (2011); Romiti and Sarti (2011); Jordão and Novas (2017) |
| "Network formation allowed the firm to access and use the information and knowledge constructed in the network." | e.g. Balestrin et al. (2008); Mariotti (2011); Suaréz (2013); Jordão and Novas (2017); Balle et al. (2019) |
| **Context** "SMEs know the business process of other firms and benefit from that knowledge." | e.g. Romiti and Sarti (2011); Jordão and Novas (2017); Zach and Hill (2017) |
| "Network partnerships provide technical and management support, stimulating the creation and retention of information and knowledge." | e.g. Mertins et al. (2010); Caldas and Cândido (2013); Jordão and Novas (2017) |
| "The relations between the different firms in the network facilitate information exchange and the knowledge creation process." | e.g. Powell (1998); Caldas and Cândido (2013); López-Sáez et al. (2010); Suaréz (2013); Zach and Hill (2017) |
| **Strategy** "There is a high level of consensus regarding the firm’s strengths and weaknesses." | e.g. Andrews (1971); Jordão and Novas (2017) |
| "The firm is well aware of its opportunities and threats." | e.g. Andrews (1971); Durst and Ferenhof (2014) |
| "The firm is well aware of the competences necessary to carry out its processes." | e.g. Montgomery and Porter (1991); González-Loureiro and Dorrego (2012); Jardon and Martos (2012); Khalique et al. (2015); Jordão and Novas (2017) |
| "The network allowed competitive differentials, generating information and knowledge for the development of SMEs’ business." | e.g. Chaston and Mangles (2000); Romiti and Sarti (2011); Jardon and Martos (2012); Martins and Solé (2013); Massaro et al. (2014) |
| **Culture** "Network members have interactions besides those occurring formally in the network environment, facilitating the sharing of experiences." | e.g. Polanyi (1966); Jordão and Novas (2017) |
| "Similar cultures, languages and shared experiences help to create and spread knowledge within the network." | e.g. Cegarra-Navarro et al. (2011); Hofstede (1982); Jardon and Martos (2012); Jordão et al. (2014); López-Sáez et al. (2010); Martins and Solé (2013); Suaréz (2013) |
| "The existing culture stimulates the share, transformation and application of other SMEs’ theoretical and practical knowledge." | e.g. Davenport and Klahr (1998); Jardon and Martos (2012); Jordão and Novas (2017) |
| "The network helped in forming a differentiated way of acting or in creating the group’s own values." | e.g. Mason et al. (2008); López-Sáez et al. (2010) |
| Intervening factors and items comprising each factor | Theoretical support |
|--------------------------------------------------|---------------------|
| **Stimuli**                                      |                     |
| 18 – Network members make it clear what they know and also what they do not know about acquired experiences. | e.g. Ebers and Jarillo (1998); Valkokari and Helander (2007) |
| 21 – The network made it possible for firms to share data, information and knowledge. | e.g. Powell (1998); López-Sáez et al. (2010); Mariotti (2011); Verbano and Crema (2016); Balle et al. (2019); Xu et al. (2020) |
| 23 – There are incentives for individual knowledge to be shared with other network members. | e.g. Jarillo (1988); Jardon and Martos (2012); Verbano and Crema (2016) |
| **IKM**                                          |                     |
| 2 – There is discipline, efficiency and an incentive for the documentation of information, knowledge and know-how developed in the networks. | e.g. Mariotti (2011); Jordão (2015); Jordão and Novas (2017) |
| 3 – The network was able to create information and knowledge that could be absorbed and applied by the firms. | e.g. Mariotti (2011); Jordão (2015); Jordão and Novas (2017); Balle et al. (2019) |
| 13 – There are formal tools that help to spread knowledge and successful practices within the network. | e.g. Prahalad and Hamel (1990); Jordão (2015); Jordão and Novas (2017); Xu et al. (2020) |
| 19 – Information is shared and accessed by all elements of the network. | e.g. López-Sáez et al. (2010) |
| **IC**                                           |                     |
| 14 – The network association led to the development of a physical and social environment (structural capital) for the creation of knowledge. | e.g. López-Sáez et al. (2010); Nonaka et al. (2000); Balle et al. (2019) |
| 15 – There is investment in, and incentives for the training of network members, resulting in human capital. | e.g. Chaston and Mangles (2000); Muhammad et al. (2011); Novas et al. (2017); Xu et al. (2020) |
| 24 – The relationships between network members (relational capital) stimulated the creation and share of information and knowledge, learning and/or innovation. | e.g. Bengtsson and Kock (2000); Bhatt (2001); González-Loureiro and Dorrego (2012); Mason et al. (2008); Massaro et al. (2011); Mertins and Orth (2011); Pöyhönen and Smedlund (2004); Richardson (2013); Sauréz (2013); Belso-Martinez and Diez-Vial (2018) |
|   | Questions                                                                 | Theoretical Support                                                                 |
|---|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| I | Open Please describe (i) the situation of your company before, during and after its integration into the network, highlighting, (ii) the indicators used to assess the generated knowledge, (iii) the results obtained and (iv) the critical factors of the information and knowledge exchange process. | Grandori and Soda (1995); Mariotti (2011); Caldas and Cândido (2013); Martins and Solé (2013) |
| II| Open Did the formation and constitution of the network stimulate a process of creation, systematization and/or sharing of data, information and knowledge between companies? | Muhammad et al. (2011); Mariotti (2011) |
| III| Open Did the knowledge acquired with the network organisation facilitate the development of factors related to the company’s relational capital, such as: brand development, customer and supplier relations, company image, and ways of doing business and/or dealing with distribution channels? | Mason et al. (2008); Mertins et al. (2010); Mertins and Orth (2011); Mariotti (2011); Muhammad et al. (2011); Novas et al. (2017); Jardon and Martos (2012); Martins and Solé (2013); Massaro et al. (2014) |
| IV| Open Did the knowledge acquired through the network facilitate the development of factors related to the company’s human capital, such as: improvements in qualification, experience, creativity, knowledge, skills, capacity for innovation and/or to develop tasks of the company’s members? | Mason et al. (2008); Mariotti (2011); Muhammad et al. (2011); Novas et al. (2017); Jardon and Martos (2012); Martins and Solé (2013); Massaro et al. (2014) |
| V | Open Did the knowledge acquired through networking facilitate the development of factors linked to the company’s structural capital, such as: improvements in structure, design, technologies, methodologies, employed processes, business systems and/or information systems? | Mason et al. (2008); Mariotti (2011); Muhammad et al. (2011); Novas et al. (2017); Jardon and Martos (2012); Henry (2013); Martins and Solé (2013); Massaro et al. (2014) |
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**Consent for Publication** The manuscript has not been submitted for publication nor has been published in whole or in part elsewhere, and is not under consideration for publication in another journal at the time of submission. I attest to the fact that all authors have read the manuscript, confirm the validity and legitimacy of the data and its interpretation, and agree to its submission to The Journal of the Knowledge Economy, and that, if accepted, it will not be published elsewhere without the written consent of the copyright holder.

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