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ARTICLE

The Impact of Business Analytics on Collaborative Advantage: the mediating role of managing transaction costs

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ABSTRACT

The objective of the research was to verify the existence of the mediating role of Transaction Cost Management (TCM) in the relationship between Business Analytics (BA) and Collaborative Advantage (CA). Based on a quantitative approach, it was found that there is a partial mediation exercised by the TCM in the relationship between BA and CA. In addition, the results showed that the tested model was able to explain 69,30% of the CA variation. The article goes on to deepen the theoretical relationships between the variables that make up the research model, cooperating both for the evolution of the emerging field in BA, and for a reflection on the critical success factors of the organizational alliances. Furthermore, based on the proposed model, it is possible to revisit the Transaction Costs Theory, discussing its assumptions in the current scenario marked by the high production of data and information in corporations, suggesting that business analytics is a directly influencing element in management of transaction costs.

KEYWORDS

Business Analytics, Transaction Cost Management, Collaborative Advantage, Organizational Alliance

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1. INTRODUCTION

The current scenario, characterized by factors such as globalization, competition, legislation, new technologies and continuous technological innovations, and with consumers with ever more stringent requirements and in constant mutation, makes companies to adopt, increasingly, the alternative of forming alliances and strategic networks (Ferreira, Coelho & Moutinho, 2020; Gomes, 2020; Preusler, Costa, Crespi & Porto, 2020). This aims to group the resources needed to serve the market and create a sustainable competitive advantage, with a concern for investigating the factors that drive strategic collaboration in order to derive mutual benefits and make the relationship lasting (Gulati, Nohria & Zaheer, 2000; Zhang & Cao, 2018).

The development of strategic alliances is based on the search for “collaborative advantage” as opposed to the search for strict “competitive advantage” (Mamédio, Rocha, Szczepanik & Kato, 2019; Seo, Dinwoodie & Roe, 2016; Teng, 2003). Under the approach of collaborative advantage, it is necessary to consider that the business environment is composed by a network of relationships developed in an interdependent way and promoted through strategic collaboration with the objective of deriving mutual benefits (Chen & Paulraj, 2004; Zhang & Cao, 2018).

This approach is also based on the Relational View of the interorganizational competitor (Dyer & Singh, 1998), complementary to the company’s Resource Based View, considering the dyad / network, to the detriment of individual firms, as the unit of analysis. Thus, competitive advantage can be seen as a consequence of collaborative advantage, with collaboration being pursued as the initial objective when alliances are signed.

Within this relational perspective, it is worth highlighting the importance of transaction costs for organizations, being recognized as determinants in decision making, with respect to transactions (Ciborra, 1996; Ketokivi & Mahoney, 2020). According to Barringer and Harrison (2000) the theory developed about transaction costs is considered to be influential in explaining the relationships between firms. These costs can represent huge expenses associated with renegotiation, rework and investments in specific assets (Schniederjans & Hales, 2016; Cooper & Ellram, 1993). Thus, transaction costs are inherent to the activities necessary to manage the contracts that a company establishes with others with the most diverse transactional purposes. One of the ways to pursue the reduction of these costs is through its management, seeking measures to control the critical factors that increase these costs in the partnerships entered into.

In addition to seeking to reduce transaction costs, there is the fact that the survival and growth of organizations are linked to their ability to effectively use, in strategic and operational orientation, large volumes of data from different sources (Carillo, Galy, Guthrie & Vanhems, 2018; Frisk & Bannister, 2017; Popovič, Hackney, Tassabehji & Castelli, 2016; Trkman, McCormack, Oliveira & Ladeira, 2010). Dobre and Xhafa (2014) report that every day the world produces about 2.5 quintillion bytes of data, with 90% of this data being generated in the world in an unstructured way. Gantz and Reinsel (2012), in turn, estimate that by 2020, more than 40 zettabytes (or 40 trillion gigabytes) of data will be generated, imitated and consumed. In view of this panorama, it is observed that several corporations around the globe have adopted the analytical approach - also called Business Analytics - as a competitive differential in their operations (Baskin, 2020; Brown, 2020; Somers, 2020).

However, it is noted that currently there is a dependence on access and information sharing to minimize asymmetry, a scenario that differs from the context in which the theory of transaction costs was created. In the past, the difficulty of accessing information contributed to increasing the limits of the agents’ rationality, configuring itself in the essence of the asymmetry to be overcome. With the dissemination of information, especially with the arrival of the Internet and mobile

devices, there is evidence of the need to revisit the assumptions of the Theory of Transaction Costs (TCT), taking into account the current informational context of organizations, that is, based on the development and proliferation of new information technologies and capabilities in BA. Thus, the dynamics experienced by companies offer great potential for contributing to the densification and updating of neo-institutional theories. More specifically, it is supposed that the capabilities related to the processing of information, could be included in the understanding of TCT today.

In view of the above, we ask: **does the use of BA by the organization generate results in terms of collaborative advantage when it is mediated by the management of transaction costs?**

Therefore, the objective of this study is to verify whether, in a context of contract management, the company's ability to manage its transaction costs act as a mechanism to explain the impact of BA on collaborative advantage. The unit of analysis considered for a survey refers to contract management in the organizational dyads.

2. DEVELOPMENT OF HYPOTHESIS

Galbraith (1974) developed the information processing theory, which years later became one of the conceptual pillars on which the understanding of Business Analytics is based. According to the author, organizations are structured to better manage their information flows. Thus, organizations must focus their actions on expanding the dissemination of data between the various sectors of the company and analyzing them. Galbraith (1974) emphasizes that in order to expand the potential of data analysis by the organization, the adoption of measures such as the improvement of communication in the intraorganizational environment, the formation of groups, the decentralization of authority and the attribution of power must be taken into account among the other sectors, as well as employing computers and various combinations of man-machine. Thus, it is proposed that "the greater the uncertainty, the greater the amount of information that must be processed by decision makers during the execution of the task, in order to reach a certain level of performance" (Galbraith, 1974, p. 28).

Trkman, McCormack, Oliveira and Ladeira (2010, p. 318) define BA as the "application of several advanced analytical techniques to data to answer questions or solve problems". BA can also be understood, according to Varshney and Mojsilović (2011), as a broad umbrella that involves many problems and solutions, such as demand forecasting and conditioning, resource capacity planning, workforce planning, modeling and optimization of sales, revenue forecasting and customer/product analysis. BA is closely related to the extraction and use of data using statistical and informational methods, to support the most varied types of organizational decision-making processes (Sharma, Reynolds, Scheepers, Seddon & Shanks, 2010; Papas, Mikalef, Giannakos, Krogstie & Lekakos, 2018).

In this research, we used the theoretical delimitation and operationalization of the BA construct as proposed by Sincorá, Oliveira, Zanquetto-Filho and Ladeira (2018) in which the concept is understood from three dimensions: (i) statistical capabilities, (ii) business capabilities and (iii) information technology capabilities.

Statistical capabilities refer to the ability to develop logical, critical and analytical reasoning about organizational reality based on quantitative data. Business capabilities, in turn, are related to the ability to identify problems, formulate and implement solutions, and to conduct the decision-making process based on data and facts, developing expression and communication compatible with the business environment. Regarding the capabilities in information technology, the competence related to operating machines, information systems and working with computational

modeling is verified (Sincorá, Oliveira, Zanquetto-Filho & Ladeira, 2018; Sincorá, Carneiro & Oliveira, 2020).

In this way, the analytical capabilities of the decision maker potentially act as a mechanism by which information is processed, generating support for decision-making based on facts and data and, therefore, reducing the asymmetry between agents and assisting companies in the management of their transaction costs.

When analyzing the factors that precede the collaborative advantage, it is possible to identify indications that elements of BA provide for the emergence of relational performance, a common benefit that accumulates for the collaborative partners through the combination, exchange and development of idiosyncratic resources (Wiengarten, Humphreys, Gimenez & McIvor, 2016), that is, it is focused on the joint creation of value in the dyadic relationship. In this context, the partners work together towards common goals and obtain more mutual benefits than can be achieved through isolated actions (Pradabwong, Braziotis, Tannock & Pawar, 2017; Pappas, Mikalef, Giannakos, Krogstie & Lekakos, 2018).

Thus, it is understood that BA provides, as it supports the decision-making process, the reduction of uncertainty and an increase in the confidence of agents and, when using the databases of cooperative companies, it promotes the formation of a unique asset that can be used for the sake of the relationship. In this context, Pappas et al. (2018) explain how the different actors in an ecosystem can obtain collaborative advantages in producing and sharing data, from the analytical resources necessary to leverage that data towards desirable business results.

In line with this discussion, there is a suspicion that the impact of the use of BA in the generation of collaborative advantage, in a context of contract management, may not occur or be understood directly. The better visibility and processing of information, as well as the increase of the predictive capacity come from the analytical approach, which impacts three main distinct aspects: in the reduction of the opportunism of the agents involved in the relationship, in the asymmetry of the information and, in the costs of contract monitoring -, which impact on the generation of competitive advantage (Gold, Chowdhury, Huq & Heinemann, 2019).

For the development of the research, the concept and operationalization of the collaborative advantage construct proposed by Cao and Zang (2011) were used, in which, synthesizing previous studies, the collaborative advantage derives from the following subcomponents: (i) process efficiency, (ii) flexibility, (iii) synergy, (iv) quality and (v) innovation.

The efficiency of the process refers to how competitive a company's collaboration process with supply chain partners is in terms of costs between main competitors (Cao & Zhang, 2011).

As for the offer of flexibility, it is observed that it takes place as the supply chain partners support changes in the products or services marketed (for example, characteristics, volume and speed) in relation to environmental changes (Cao & Zhang, 2011). The offer of flexibility is also based on the ability of collaborating companies to quickly change the structures of the processes or adapt the information sharing process, in order to modify the characteristics of a product or service (Cao & Zhang, 2011).

Synergy, in turn, comes when supply chain partners combine complementary and related resources to achieve greater than normal benefits. Ansoff (1988) suggests that synergy can produce a combined return on resources that is greater than the sum of individual parts. This joint effect results from the process of greater use of resources in the supply chain, including physical assets, such as manufacturing facilities, and invisible assets, such as: customer knowledge, technological knowledge and organizational culture (Cao & Zhang, 2011).

Quality refers to the offer by a certain company - considering the supply chain partners - of quality products that create higher value for customers. Companies are expected to be able to respond quickly to customer needs with high quality products, innovative design and excellent after-sales service in order to build and maintain customer loyalty, increase market share and ultimately obtain high profits (Cao & Zhang, 2011).

Finally, innovation relates to those who work together with suppliers of products or services. Due to the shorter product life cycle, companies need to innovate frequently (Cao & Zhang, 2011).

At the same time, when examining the Business Analytics literature, a potential relationship with the three dimensions mentioned of transaction costs is perceived: (i) uncertainty; (ii) information asymmetry and; (iii) opportunistic behavior by agents. In this way, it is possible to apprehend that organizations that use BA are more likely to carry out a good management of the transaction costs resulting from their partnerships.

In the present research, the transaction cost itself was not measured in the proposed relationship, but how the agents involved manage these costs, so that they are minimized during the management of the contract, taking into account, therefore, the forms of management of ex-post transaction costs.

In addition, the justification for the delimitation of the study around the management of ex post transaction costs is based on the evidence found in the literature on the aspects in which BA can assist in the ability to manage transaction costs, believing that it will have greater relevance in the aspects which influence ex post transaction costs and, consequently, provide circumstances for the agents involved in the relationship to have relational gains, that is, a collaborative advantage.

Thus, based on the studies of Crook, Drnevich, Adams and Combs (2009), Dahlstrom and Nygaard (1999), Chandler, McKelvie and Davidsson (2009), Kabadayi (2011) and, Noordewier, John and Nevin (1990), we selected there are three theoretical dimensions (called 1st order latent variables) to measure the capacity to manage ex-post transaction costs, (i) information asymmetry, (ii) uncertainty and (iii) opportunism.

With regard to the theoretical design of the management of transaction costs, it means that the factors discriminated in the theory of transaction costs are controlled or reduced in the contract agreed between the organizations involved. Thus, organizational relationships in a context of low transaction costs are reflected in relationships that tend to be more collaborative, as elements such as uncertainty, opportunism and information asymmetry are reduced. Within this logic, the minimization of opportunism costs and the monitoring inherent to market transactions, increase the probability of partners to behave in order to reach the interest of the partnership (Treiblmaier, 2018), creating conditions for obtaining a collaborative advantage.

In this sense, a relationship between partners, in which the transaction costs are low, provides an environment and synergistic behaviors necessary for the development of exclusive resources of that partnership, generating, therefore, the so-called collaborative advantage. This result can be achieved either through the perceived impact on reducing transaction costs in the relationship, or through the creation of value for the good, as well as reducing the costs of its production.

Therefore, from the developed discussion, it is understood that the management of transaction costs is able to mediate the relationship between BA and collaborative advantage, since the application of analytical capabilities in the relationship - above all the creation of conditions to improve visibility and the information processing - provides an increase in the predictive capacity in reducing the opportunism of the agents involved in the relationship, in the information asymmetry and in the costs of monitoring the contract, benefiting the ability to manage the company's transaction costs, impacting, by once, positively in the collaborative advantage.

Therefore, based on the theoretical discussion undertaken here, the main theoretical proposition of the research is formulated: **H1: Transaction cost management mediates the relationship between business analytics and collaborative advantage.**

2.1. THEORETICAL MODEL AND OPERATIONALIZATION OF VARIABLES

The hypothetical research model includes constructs related to the conceptual domains of Business Analytics (BA), Transaction Cost Management (TCM) and Collaborative Advantage (CA). As shown in Figure 1, the theoretical model of this investigation presents BA and TCM as predictive variables of the dependent variable CA.

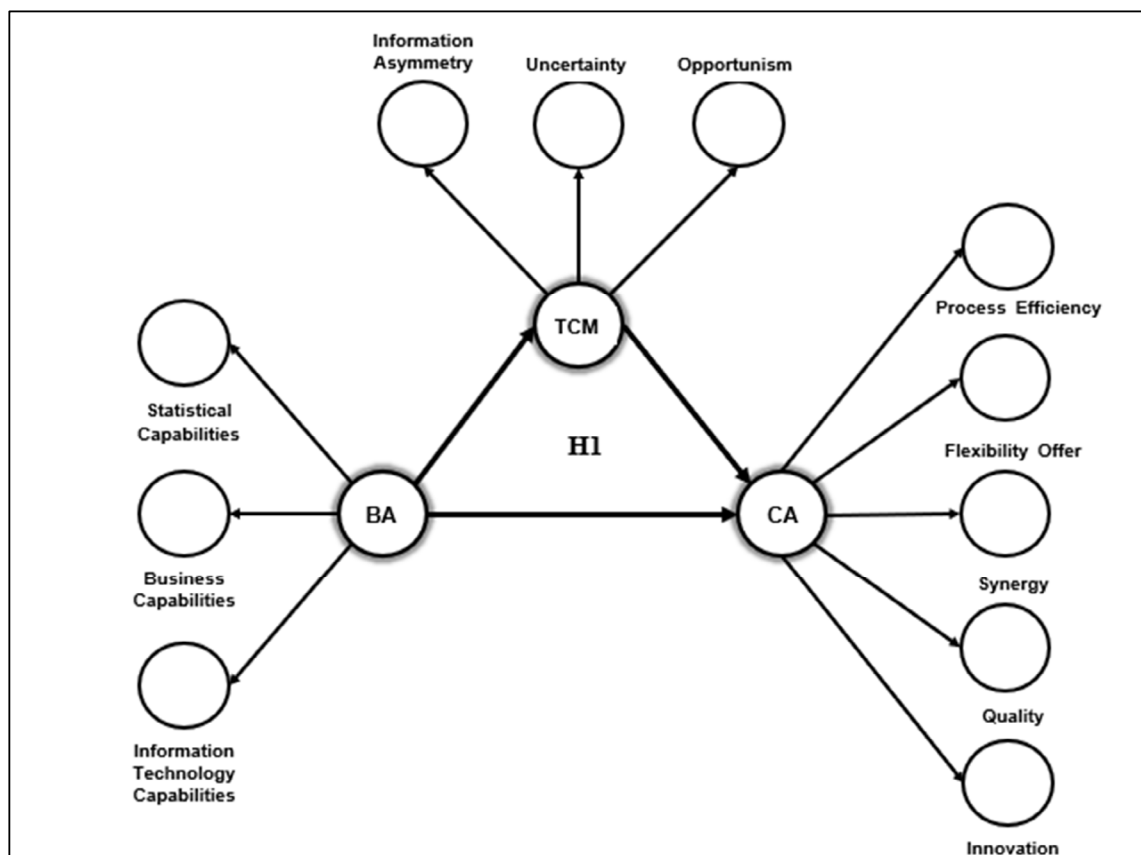


Figure 1. Research Model and Hypothesis.

Source: Prepared by the authors (2020).

Chart 1 presents a general systematic of operationalization of the research model, showing the items that made up the 1st order constructs.

Chart 1*Operationalization of the research model's constructs*

CONSTRUCTION OF 2nd ORDER	CONSTRUCTION OF 1st ORDER	SUMMARY OF ITEMS
BUSINESS ANALYTICS (BA)	Statistical Capabilities	inquisitive analysis; descriptive analysis; predictive analysis.
	Business Capabilities	problem communication; data translation; interpretation of analyzes; driving decisions.
	Information Technology Capabilities	data exploration, data sanitization; data integration; creation of big data environments.
TRANSACTION COST MANAGEMENT (TCM)	Information Asymmetry	information on production plans; long-term forecasts; notice of intended product changes.
	Uncertainty	use of many controls; quality training; inventory level monitoring.
	Opportunism	individual interests; difficulty to change factors in the partnership; distortion of information; exploration motivations.
COLLABORATIVE ADVANTAGE (CA)	Process Efficiency	unit costs; productivity standards; delivery time requirements; inventory requirements.
	Flexibility Offer	variety of products and services; personalized products and services; volume requirements; responsiveness to the customer.
	Synergy	IT infrastructure and resources; knowledge and know-how bases; marketing efforts; production systems.
	Quality	offering reliable products; offering durable products; offering high quality products; mutual cooperation.
	Innovation	introduction of new products and services; rapid development of new products; reduced time-to-market; frequency of innovation.

Source: Prepared by the authors (2020).

From the operationalization of the constructs, it became possible to measure the research model, thus enabling the empirical verification of the theoretical proposition that was articulated in the study.

3. METHOD

To investigate the mediating role of transaction cost management in the relationship between business analytics and collaborative advantage in organizational dyads, a survey was conducted with the application of an online questionnaire on the SurveyMonkey platform, aimed at professionals who held functions related to the management of contracts in organizations, such as directors, administrative, purchasing or production managers.

The study sample was composed by professionals working in companies listed in State registries, available on the internet for free or paid - depending on the State. The questionnaire was prepared based on specific references, which served as a theoretical basis for the formulation of 49 statements – 7 for the characterization of the respondent / company and 42 for the investigated constructs –, the questionnaire used a Likert scale of 1 (one) to 5 (five) categories. It is worth noting that the questions on the form were applied randomly.

The scale considered to assess BA was based on the work of Sincorá, Oliveira, Zanquetto-Filho and Ladeira (2018), validated with data from companies in the manufacture, commerce and service sector. Regarding the TCM construct, its measurement was defined based on the works of Crook, Drnevich, Adams and Combs (2009), Dahlstrom and Nygaard (1999), Chandler, McKelvie and Davidsson (2009), Kabadayi (2011) and Noordewier, John and Nevin (1990), who proposed measuring the ability to manage ex-post transaction costs. The measurement of the CA construct was inspired by the scale developed by Cao and Zang (2011).

After structuring the questionnaire, the 49 itens had their content evaluated by a group of specialists (professors- doctorate degree) experienced in conducting and applying survey research. The respective validation by these experts contributed to the objectivity, clarity and coherence of the instrument, eliminating redundancies, ambiguities and overlaps in content and, allowing the common variance bias of the research instrument to be reduced. After this verification, the elaboration of the questionnaire also included a validation by market professionals, in order to correct possible problems of understanding in the items of the scale, as recommended by Aaker, Wamba, Gunasekaran, Dubey and Childe (2001). The questionnaire link was sent to 20 companies that belonged to the research databases, asking them to inform about any doubts when answering the questionnaire. At the end of this validation process, the 49 questions originally formulated remained.

As for the data analysis procedures, first, normality tests of the distributions were applied to prepare the data. In a second step, the analysis involved descriptive statistics, which aimed to characterize the sample. The first two stages of data analysis were performed using the statistical software SPSS (Statistical Package for Social Sciences). Third, the scales were validated in order to identify whether the measures obeyed the quality and validity parameters recommended by the literature (composite reliability, convergent validity and discriminating validity) (Hair, Hult, Ringle & Sarstedt, 2017), being analyzed in the SmartPLS® 3.0 software (Ringle, Wende & Becker, 2014).

Based on Hayes, Montoya and Rockwood (2017) and Sarstedt, Hair, Nitzl, Ringle and Howard (2020), the reasons for choosing the use of PLS-SEM (partial least squares - structural equation modeling) are explained, for validation of the theoretical model built in the study: (i) sample size ($n = 132$); (ii) use of scores of latent variables in the subsequent analysis of predictive relevance, particularly in the implementation of the approach to model multidimensional constructions and; (iii) PLS-SEM is considered an adequate technique for statistical validation. In addition, its use for model validation in academic and scientific works is common, as can be seen in the works of Leal-Rodríguez, Ariza-Montes, Roldán and Leal-Millán (2014), Felipe, Roldán and Leal-Rodríguez (2016), Wu, Ma and Liu (2019) and, Ringle, Sarstedt, Mitchell and Gudergan (2020).

Finally, inferential statistics (correlation and mediation) were applied, in order to analyze the relationship between the variables studied. Such analyzes were performed based on the statistical software Macro PROCESS - an extension of SPSS (Hayes, 2013). Being the most suitable for testing mediation relations (Hayes, Montoya & Rockwood, 2017) and, using commonly as input, scores of latent variables extracted from the SmartPLS software. Furthermore, it is capable of producing estimates and confidence intervals - based on the bootstrap technique -, allowing for bias corrections for the indirect effect (Leal-Rodríguez et al., 2014).

3.1. SAMPLE FEATURES

As indicated by Hair et al. (2017), a minimum sample size of 40 respondents was identified. However, the initial sample consisted of 187 respondents - number of accesses to the questionnaire - but only 132 completed the survey, becoming the valid sample and representing 70,58% of the initial sample. To verify the non-response bias, the profile variables of respondents who completed all questions (132) were compared with non-respondents (55), that is, those who did not complete the questionnaire - as shown in Table 1.

Table 1

Comparison of profile between respondents

PROFILE VARIABLES		RESPONDENTS (132)	NON-RESPONDENTS (55)
Corporate Headquarters Location Region	Southeast	119 (90%)	53 (96%)
	South	5 (4%)	0 (0%)
	Midwest	4 (3%)	1 (2%)
	North	3 (2%)	1 (2%)
	North East	1 (1%)	0 (0%)
Economic Segment	Industrial	66 (50%)	27 (49%)
	Services	48 (36%)	20 (36%)
	Commercial	18 (14%)	8 (15%)
	Over 20 years	78 (59%)	28 (50 %)
Existence Time	Between 16 and 20 years	12 (9%)	7 (13%)
	Between 11 and 15 years	11 (8%)	8 (14%)
	Between 5 to 10 years	14 % (18)	10 (18%)
	Less than 5 years	10% (13)	3 (5%)
Size of Companies	Micro companies	29 (22%)	13 (24%)
	Small business	44 (33%)	22 (40%)
	Medium-sized companies	42 (32%)	14 (26%)
	Big companies	17 (13%)	6 (10%)
	President	27 (20%)	4 (7%)
Respondent's Position	Director	34 (26%)	16 (29 %)
	Manager	42 (32%)	21 (38%)
	Assistant	29 (22%)	14 (26%)

Source: Prepared by the authors (2020).

When comparing the two profiles, it is noted that there are similar characteristics between respondents and non-respondents. Additionally, a sample bias test was performed considering only the valid responses. For this purpose, the first respondents (responses received in the first two weeks) were compared with the subsequent respondents (responses received in the third week or later), using the Analysis of Variance (ANOVA). No statistically significant differences were identified.

Regarding the classification criteria selected to define the size of the companies participating in the research, the parameter of the National Bank for Economic and Social Development was adopted, based on their Gross Operating Revenue.

4. PRESENTATION AND DISCUSSION OF RESULTS

4.1. VALIDATION OF SCALES AND MEASUREMENT OF CONSTRUCTS

Then, the technique of analysis of structural equation modeling was used in order to validate the proposed conceptual model, in order to identify whether the model's quality indexes would be adequate.

When analyzing the internal consistency of the constructs, it was observed that the values obtained from Cronbach's Alpha and composite reliability were within the reference values. Regarding the convergent validity, the factorial loads and the AVE (extracted average variance), obtained values were above the recommended. The results for convergent validity and internal consistency of the constructs are shown in Table 2.

Table 2

Values of Tests for Validation of Reflective Models.

LATENT VARIABLE	ITEM	CONVERGING VALIDITY		INTERNAL CONSISTENCY	
		CHARGE	AVE	COMPOSITE RELIABILITY	CRONBACH'S ALPHA
		>0,70	>0,50	> 0,60 until 0,90	> 0,60 until 0,90
BUSINESS CAPABILITIES	BC1	0,790			
	BC2	0,783			
	BC3	0,830	0,646	0,880	0,818
	BC4	0,812			
STATISTICAL CAPABILITIES	SC1	0,925			
	SC2	0,858			
	SC3	0,829	0,761	0,927	0,895
	SC4	0,876			
INFORMATION TECHNOLOGY CAPABILITIES	ITC2	0,867			
	ITC3	0,841	0,718	0,884	0,804
	ITC4	0,834			
	IA 1	0,821			
INFORMATION ASYMMETRY	IA 2	0,883	0,688	0,869	0,772
	IA 3	0,782			
	UN1	0,791			
UNCERTAINTY	UN2	0,809	0,629	0,836	0,705
	UN3	0,779			
	OP1	0,696			
OPPORTUNISM	OP2	0,769			
	OP3	0,631	0,514	0,808	0,686
	OP4	0,764			
	PE1	0,709			
PROCESS EFFICIENCY	PE2	0,795			
	PE3	0,770	0,569	0,841	0,747
	PE4	0,741			

Table 2

Cont.

LATENT VARIABLE	ITEM	CONVERGING VALIDITY		INTERNAL CONSISTENCY	
		CHARGE	AVE	COMPOSITE RELIABILITY	CRONBACH'S ALPHA
		>0,70	>0,50	> 0,60 until 0,90	> 0,60 until 0,90
FLEXIBILITY OFFER	FO1	0,892			
	FO2	0,761	0,701	0,875	0,785
	FO3	0,854			
SYNERGY	SY1	0,817			
	SY2	0,816			
	SY3	0,803	0,673	0,892	0,838
	SY4	0,845			
QUALITY	QU1	0,792			
	QU2	0,772	0,602	0,858	0,779
	QU3	0,816			
	QU4	0,719			
INNOVATION	IN1	0,761			
	IN2	0,805	0,549	0,829	0,725
	IN3	0,702			
	IN4	0,690			

Source: Prepared by the authors (2020).

The discriminant validity, on the other hand, could be verified through the Fornell-Lacker analysis. It was observed that the constructs Capabilities in Business (indicator BC3), Capabilities in IT (indicator ITC1) and Flexibility Offer (indicator FO4) presented values outside the recommended parameters, impairing the adjustment of the model. Thus, after removing such indicators, since they showed a high correlation with other data sets, the new results showed that all the relationships between indicators and constructs were considered valid within the quality criteria explained by Hair et al. (2017) – Chart 2.

After the validation of the measurement models, the analysis of the structural model began. Therefore, the significance and relevance of the path coefficients was analyzed. The results showed that BA has a positive and statistically significant impact on Transaction Cost Management (0,587 and p-value = 0,000). On the other hand, the impact of BA in Collaborative Advantage was not statistically significant, although the path coefficient had a positive value (0,132 and p-value = 0,061). Still, the analysis of the coefficients allowed to affirm that the Transaction Cost Management has a positive and statistically significant impact on Collaborative Advantage (0,748 and p-value = 0,000). This statistical finding reinforces the suspicions of the veracity of the hypothesized relationship for this study, that there is a possible mediated relationship between the constructs that make up the research model.

Finally, in relation to the analysis of the structural model, the results indicated that 69,30% of the variation that occurs in the behavior of the Collaborative Advantage can be explained by the impact it receives from the independent variables Business Analytics and Transaction Cost Management.

Chart 2
Values for Discriminant Validity.

CONSTRUCTS	Business Capabilities	Statistical Capabilities	Information Technology Capabilities	Information Asymmetry	Uncertainty	Opportunism	Process Efficiency	Flexibility Offer	Synergy	Quality	Innovation
Business Capabilities	0,830										
Statistical Capabilities	0,526	0,848									
Information Technology Capabilities	0,508	0,776	0,873								
Information Asymmetry	0,525	0,774	0,801	0,804							
Uncertainty	0,604	0,452	0,357	0,380	0,754						
Opportunism	0,697	0,503	0,502	0,463	0,576	0,793					
Process Efficiency	0,663	0,504	0,440	0,497	0,566	0,666	0,741				
Flexibility Offer	0,679	0,448	0,361	0,405	0,729	0,699	0,635	0,837			
Synergy	0,630	0,452	0,385	0,403	0,653	0,632	0,597	0,515	0,717		
Quality	0,571	0,365	0,357	0,412	0,649	0,490	0,594	0,694	0,378	0,776	
Innovation	0,652	0,591	0,552	0,529	0,586	0,771	0,717	0,682	0,582	0,554	0,820

Source: Prepared by the authors (2020).

4.2. ANALYSIS OF THE MEDIATING EFFECT

In order to examine the relationship between a dependent variable (Collaborative Advantage) as a function of an independent variable (Business Analytics) using a mediating variable (Transaction Cost Management), the ordinary least squares technique (OLS) was used, contained in the simple mediation model executed within Macro PROCESS software.

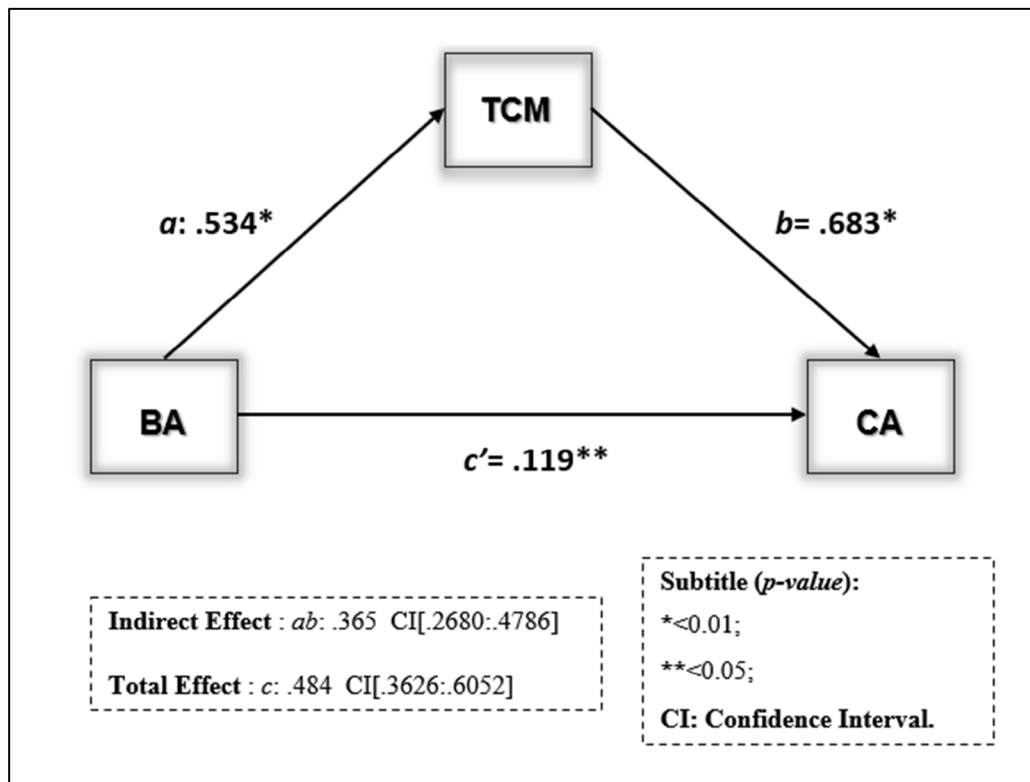
As noted in Table 3, all the relationships in the model proved to be statistically significant. It was evidenced that both the independent variable (BA) and the mediating variable (TCM) are positively associated with CA (dependent variable).

Based on the results of the PROCESS, the management of transaction costs partially mediates the relationship between the variables (Figure 2). When the TCM dimension is included as a mediator, the business analytics-collaborative advantage relationship practically does not change, remaining similar in magnitude (from 0.132 to 0.119), but it becomes significant (p-value = 0,021); however, the indirect effect of BA on CA through TCM is three times greater than the direct effect. In other words, a large part of the effect of business analytics on the collaborative advantage in an organizational dyad occurs through the management of transaction costs (specifically, the ex-post).

Table 3*Business Analytics-Collaborative Advantage mediation through the Interaction term*

	β	STANDARD ERROR	CONFIDENCE INTERVAL (CI)	
Total Effect $X \rightarrow Y$ (c)	0.4839	0.0613	0.3626	0.6052
$X \rightarrow M$ (a)	0.5340	0.0659	0.4035	0.6644
$M \rightarrow Y$ (b)	0.6830	0.0556	0.5730	0.7929
Direct Effect $X \rightarrow Y$ (c')	0.1192	0.0512	0.0178	0.2206
Indirect Effect $X \rightarrow M \rightarrow Y$	0.3647	0.0535	0.2680	0.4786

Source: Prepared by the authors (2020), using bootstrapping resampling technique (10,000 subsamples) and 95% confidence level.

**Figure 2.** PROCESS Macro Output - Simple Mediation (Model 4)

Source: Prepared by the authors (2020), based on Hayes (2013, p.7).

In this way, the mediating role played by the management of transaction costs is evident, denoting that the respective variable acts as an explanatory mechanism for obtaining a collaborative advantage between business partners, in an environment in which data and information are transformed into valuable resources from the analytical capabilities of organizational actors.

4.3. MANAGEMENT IMPLICATIONS

Regarding the testing of hypothesis H1, it was found that there is a partial mediation of the management of transaction costs in the relationship between BA and collaborative advantage, demonstrating that companies that practice an analytical approach are able to obtain collaborative advantages by better managing their transaction costs. This is because, an organizational structure

oriented analytically by means of facts and data, provides support to the practices of transaction costs management, making them controlled or reduced in the contract agreed between the organizations, making it possible to build and obtain process efficiency, offer flexibility, promote synergy, quality and innovation in products and services. Therefore, collaboration in the sharing of data, information and knowledge between different companies and the use of the analytical approach can result in the formation of an idiosyncratic resource that is difficult to imitate (Akter, Wamba, Gunasekaran, Dubey & Childe, 2016; Ghasemaghaei, Ebrahimi & Hassanein, 2018).

Such research implications can be used to direct managerial actions and intelligently reprogram the interorganizational relationship between business partners, especially with regard to the improvement of ex-post cost management, to generate performance advantages. These implications, in turn, can be sustained from collaborative examples distributed by corporations around the globe. Initially, Valekumar Krishnan, vice president of BEROE - a global company in purchasing intelligence solutions - made the statement, stating that data is at the 'heart' of a purchasing strategy. For Krishnan, "data, information and insights from suppliers form the basis of purchasing strategies ... whether during a steady or turbulent state, due to a market disruption". As Krishnam argues, overcoming data barriers and leveraging the analytics force along with the strategic purchasing process will continue to be vital in a post-COVID environment (Pymnts, 2020).

Another example is that of the Danish industrial group VELUX, which automated 64% of its 20,000 monthly purchases, after digitally transforming operations in the supply chain and developing extensive collaboration with suppliers. The Velux Group now conducts transactions seamlessly with more than 200 suppliers and enjoys improved processes, faster delivery dates, more time savings and, consequently, lower transaction costs (Thompson, 2020).

In this sense, by using joint capacities of creativity, innovation, mutual learning and knowledge sharing, companies can improve the absorptive capacity and, thus, introduce new products and services quickly and frequently (Duan, Cao & Edwards, 2018). Handfield and Bechtel (2002), for example, pointed out that companies such as Hewlett-Packard, IBM, Dell and Procter & Gamble have created long-term collaborative relationships with their suppliers in order to reduce transaction costs and achieve a strong competitive position.

Finally, Mohr and Nevin, even in the 1990s, already stated that although the researchers had addressed some important aspects of collaboration in the supply chain, they did not adequately emphasize the need for collaborative communication as a critical variable - remaining a current gap. What was evidenced in this work through the study of BA, given that it can constitute a distinctive ability to act as a facilitator of communication. For example, allowing the efficiency of data processing, reducing informational asymmetries, ensuring agility in sharing, increasing the flow of information, expanding the visibility of information, guaranteeing the quality of the content and, among other aspects, both from an organizational and supply chain perspectives (Dubey et al., 2019; Oliveira & Handfield, 2019).

5. CONCLUSIONS AND LIMITATIONS

The academic relevance of the results achieved in this study is focused on inviting researchers to review the Transaction Costs Theory (TCT), taking into account the current informational context of organizations, that is, the development of new information technologies and BA capabilities in companies, which would have a great contribution to make to the consolidation of neo-institutionalist theories. More specifically, it is argued that the asymmetry in information processing, discussed in the scope of business analytics, should be included in the TCT, given the empirically proven relationship in this research, between BA and Transaction Cost Management.

The research also shows that BA and TCM act as two critical and predictive elements to determine the variation in CA. Thus, the findings of this investigation allow us to conclude that the analytical approach (BA) can support the management of transaction costs by obtaining relevant information, processing, sharing and expanding its visibility in the partnership and, consequently, positively influence CA.

The empirical results of this study demonstrate that the TCM plays a mediating role in the relationship between BA and CA, in addition to informing that, specifically, both BA and TCM act as antecedents of CA. However, limitations in the work were pointed out, since it is a non-probabilistic research and for convenience, the article presents as a limitation the generalization of its results. Therefore, parsimony is recommended when extrapolating the findings of this investigation to other contexts, even though these have been supported by the literature.

Despite these restrictions, it should be noted that this study presents relevant findings for the research field in BA and TCT. In relation to BA, only a few years ago the effective discussion involving the topic within organizational studies took root as an opportunity to bring exclusive contributions to the maturation of the field of organizations, both from a teaching and scientific research perspective, since academic production - mainly in international journals - is expanding, favoring the evolution of the analytical movement in the scope of business and academia. Regarding TCT, the contribution comes from the review of the understanding and application of the concept nowadays, taking into account the informational context of 21st century organizations, characterized by the development of new information technologies and the promotion of the analytical approach (BA) as a critical competitiveness factor.

Thus, understanding the assumptions of the theory in this emerging scenario marked by the high production of data and information and, by the dissemination and use of analytical tools in corporations, offers subsidies to give density to neo-institutionalist theories, above all, in defense that information processing should be included in the current TCT discussion, given that in the context in which it was developed, historically, it was marked by the difficulty of accessing data in general, influencing the increase in the limits of the agents rationality, configuring at the time, by itself, in the essence of the asymmetry to be overcome, which today, in turn, can be further understood by the asymmetry in the treatment of information.

In this sense, for this situation, a study that shows that by using data and information by companies and their practices of managing transaction costs can be positively reflected in obtaining a collaborative advantage, seems to receive outlines and relevant current practical implications. Therefore, through the analysis of the collected data, it became possible to identify viable ways to generate sustained collaborative advantage through the management of transactional costs, the use of information resources and the application of an analytical approach in interorganizational relationships.

Finally, as a suggestion for future work on the topic addressed, the relevance of evaluating specific relationships identified, but not explored in the scope of this research, is verified. For example, deepen the conceptual and empirical understanding of the variables BA, TCM and CA, in order to identify other possible relationships between them and, of other constructs that can broaden the understanding of the investigated phenomenon, giving new directions to the research. Regarding BA specifically, since it is a discussion that emerged approximately a decade ago in the areas of business and management, it still seems to lack further investigation to understand its recent theoretical and empirical developments within the area of operations management.

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CONFLICT OF INTEREST

The authors of the manuscript declare that they have no conflict of interest. The first author is the creator of the research, who also contributed to the theoretical framework, data collection, development and conclusion of the research. The second, third and fourth authors contributed to data collection, data treatment and analysis, writing, adjustments, conclusion and finalization of the article.