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Exploration, Exploitation, and Organizational Coordination Mechanisms

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Resumo

Este artigo apresenta uma relação empírica entre exploração, explotação e mecanismos de coordenação organizacional, classificados como centralização de tomada de decisão, formalização e conectividade. Para analisar os resultados desta *survey*, nós utilizamos duas técnicas: *Principal Component Analysis* (PCA) e *Partial Least Squares Path Modeling* (PLS-PM). Nossa análise foi baseada nas respostas de 249 gestores de empresas localizadas no Brasil (amostragem por conveniência). Contrário às nossas expectativas, centralização e explotação se associaram com sinal negativo. Nossos dados revelaram que a formalização se associou positivamente com explotação. Embora a relação entre formalização e exploração tenha sido considerada significante, o resultado foi contrário à hipótese de pesquisa enunciada. Os relacionamentos entre conectividade e explotação e conectividade com exploração foram considerados positivos e significantes. Este relacionamento significa que quanto mais aumenta a conectividade, maior é a probabilidade de ocorrer exploração e explotação.

Palavras-chave: centralização; formalização; conectividade; exploração; explotação.

Abstract

This paper presents an empirical relationship among exploration, exploitation, and organizational coordination mechanisms, classified as the centralization of decision-making, formalization, and connectedness. In order to analyze the findings of this survey, we used two techniques: Principal Component Analysis (PCA) and Partial Least Squares Path Modeling (PLS-PM). Our analysis was supported by 249 answers from managers of companies located in Brazil (convenience sampling). Contrary to expectations, centralization and exploitation were negatively associated. Our data supports the research hypothesis that formalization is positively associated with exploitation. Although the relationship between formalization and exploration were significant, the result is contrary to the research hypothesis that we made. The relationships among connectedness and exploitation, and connectedness and exploration were both positive and significant. This relationship means that the more connectedness increases, the higher the likelihood of exploitation and exploration.

Key words: centralization; formalization; connectedness; exploration; exploitation.

Introduction

The concepts of exploration and exploitation, made clear in the seminal work by March (1991), consist of approaches related to organizational learning (Levinthal & March, 1993) and other theoretical lines that consistently require further studies seeking to understand how organizations deal with them. Gupta, Smith and Shalley (2006) opined that these concepts must be discussed from different standpoints: technological innovation (Benner & Tushman, 2002, 2003; Laursen, Leone, & Torrisi, 2010; Tushman & O´Really, 1996), organizational design (Tushman, Smith, Wood, Westerman, & O´Reilly, 2010), organizational adaptation, organizational learning process (Lyytinen, Rose, & Yoo, 2010), competitive advantage or organizational survival. They raised questions about these two concepts concerning conceptualizing and balance of exploration and exploitation.

Among those studies already carried out, Jansen, Van Den Bosch and Volberda (2005) aimed their questionings at the effects of coordination mechanisms and at environmentally moderated variables in organizational performance, associated with explorer and exploiter innovations. In this sense, taking a section of that article by these authors as a basis, this paper's objective is to present an empirical relationship between exploration, exploitation and organizational coordination mechanisms described by Jansen *et al.* (2005) as the centralization of decision-making, formalization, and connectedness.

Our study's main contribution involves the association of the concepts of exploration and exploitation of managerial coordination mechanisms (centralization, formalization, and connectedness).

This study has the following structure: first, it provides a discussion on the concepts of exploitation and exploration and the three organizational coordination mechanisms involving centralization, formalization, and connectedness. Then it goes into hypotheses regarding the association conducted in this study and an analytical approach based on structural equation modeling. Finally, results, the study's limitations and future directions are discussed.

Theoretical Background

Exploitation - For March (1991), exploitation implies fine-tuning, choice, production, efficiency, selection, implementation and execution. When an organization strives for exploitation, there is a trend towards greater certainties and greater speed, proximity and clarity of activities. This suggests that less effort is allocated to revolutionary innovations, and over the medium to long term this may be an element influencing trends for obsolescence of organizational knowledge. Explicit knowledge is more present in exploitation, and there is an idea of continuity, routine, standards and repetition. Adding competencies and skills increases the possibility of rewards both for the staff and for the organization as a whole.

Gilsing (2002) states that exploitation is defined by a strong appeal to pump up economic growth based on existing knowledge and learning routines. Together with a tight focus on cost cutting, this provides an incentive for subsequent exploitation concerning economies of scale.

Scaling effects are ensured by the fact that the essential knowledge transmission and retention mechanisms are highly institutionalized through technical standards, formal procedures for problem-solving and professional associations (Gilsing, 2002).

Hence, developing an internal or external network (Lazer & Friedman, 2007) may allow building up a competitive position while providing leverage for growth through deploying specific knowledge in different contexts (Lazer & Friedman, 2007).

This development leads to the differentiation phase: applying the knowledge base to new areas outside the network, connected by strong links where the knowledge base begins and requiring a certain

level of adaptation. As a result, the learning process' purpose shifts towards adapting knowledge to the new context (Gilsing, 2002).

Exploration - March (1991) associates exploration with new possibilities, which include research, variations, risk-taking, experimentation, games, flexibility, discoveries, and innovation. Organizations focused on exploration require higher outlays on experimentation, without significant gains in terms of short-term benefits.

The associated tangible and intangible returns are systematically less certain, further away in time and more remote from the action and adaptation context. Exploration may involve basic research, implying fewer certainties, longer time frames and facts that are less widely disseminated, as compared to product development.

Exploration also tends to be harder to internalize for organizations, encompassing a focus on innovation (Li, Vanhaverbeke, & Schoenmakers, 2008; Tushman *et al.*, 2010) and tacit knowledge. In marketing, exploration is defined by Slater and Narver (1995) as a generated learning process and as a double-loop system by Argyris and Schön (1978). The level of exploration in marketing is determined by the sum of the effects of these changes (Argyris & Schön, 1978; Greve, 2007; Slater & Narver, 1995).

Dimensions associated with the model's development - A review of published work showed that studying exploitation and exploration strategies could lead to the conclusion that there are two standpoints associated with these issues (Popadiuk, 2012).

The first is related to aspects inherent to the organization's internal environment, and the other refers to external aspects. At least six dimensions are associated with theoretical discussions between these two standpoints.

With regard to the internal environment, the focus lies on the organization's capabilities and thus on the efficient and effective use of resources. This is a function of the adjustment between organizational activities and its strategic planning.

Organizational effectiveness and efficiency are always related, to a greater or lesser extent, to organizational knowledge. They involve control mechanisms, rules, procedures and routines. Thus, four dimensions may be described as: (a) strategic orientation; (b) organizational knowledge practices; (c) organizational efficiency; and (d) innovative practices.

From the standpoint of the external environment, two dimensions are particularly noteworthy: one relates to competition and the other focuses on establishing partnerships with a variety of players in the environment. Both must also be blended with the four previous dimensions in order to seek out innovative stances.

From this discussion on exploitation and exploration, it may be deduced that the management of activities inherent in these two approaches requires a broad set of coordination mechanisms (Jansen, Van Den Bosch, & Volberda, 2005).

As these authors stress, there are few existing studies that seek to detect the implications among exploration and exploitation and coordination mechanisms. They add that part of these studies is focused on formal mechanisms and ignores informal coordination mechanisms (Cardinal, 2001). Hence, it may be assumed that different coordination mechanisms of organizational knowledge should give rise to different impacts in situations where guidelines are more focused on exploration or focused on exploitation, as we shall describe in the following sections.

Coordination mechanisms - Organizations use various coordination mechanisms to promote integration and connection of different divisions and activities in their business. In this study two generic types of coordination mechanisms are evaluated, as explained by Jansen *et al.* (2005): (a) formal, which entails the hierarchical structure of organizations involving two elements: centralization and

formalization (Cardinal, 2001; X. Lin & Germain, 2003) and; (b) informal, consisting of the set of social relationships, referred to as connectedness.

Centralization - Hage and Aiken (1967) define centralization as the way in which power is distributed among social positions. They assert that it is made up of two components: (a) the concentration of decisions regarding the distribution of resources or policy making, whose indicator is participation in the decision-making process; (b) the concentration of decisions relating to carrying out tasks whose indicator is the hierarchical authority. Cardinal (2001) states that centralizing decision-making decreases communication channels. As a consequence, it also reduces the quality and quantity of ideas and knowledge concerning troubleshooting (Sheremata, 2000). Cardinal (2001) adds that if information is transmitted through formal communication channels, the success probability of a project involving a radical technology may be greatly reduced, if the project does not fit the dominant status quo in the organization.

On one hand, Jansen *et al.* (2005) consider that centralization of decision-making is reflected in smaller chances for the emergence of innovations with explorer characteristics. On the other hand, centralization can help innovations with exploiter characteristics (March, 1991; Sheremata, 2000).

Because this type of innovation is limited in its scope and its novelty level, it generates less uncertainty. In this sense, centralization of decision-making authority increases the efficiency of information processing and facilitates innovation exploiters.

A meta-analysis prepared by Damanpour (1991) on the relationship between innovation and organizational characteristics shows that high levels of organizational centralization have a negative effect on radical innovation processes due to reduced autonomy by individuals.

However, it may have positive effects on situations of incremental innovation. In this case, a set of routines and procedures is already established, which requires more centralized control mechanisms (Ettlie, Bridges, & O´Keefe, 1984). Therefore, we state the following research hypotheses:

H_1: The higher the centralization of decision-making, the greater its level of exploitation.

H_2: The higher the centralization of decision-making, the lower its level of exploration.

Formalization - Aiken and Hage (1968) define formalization as the degree of work standardization and the amount of deviations from standards. A high degree of formalization implies that knowledge is relatively more explicit, rules and procedures are dominant and, additionally, people tend to submit themselves to these controls.

Hence, controls can influence innovation processes. High levels of formalization negatively impact the degree of organizational flexibility and the spontaneity of people when they need to troubleshoot. Controls do increase the efficiency of knowledge acquisition. On the other hand, they can hinder its transformation aimed at creating innovations that deviate from the standards set by organizational routines.

Jansen *et al.* (2005) emphasize that the formalization of rules, procedures, instructions and communications hampers experimentation and *ad-hoc* problem-solving, and also reduces the likelihood of an individual's deviation from structured behaviors. Hence, formalization blocks deviation of existing knowledge and that of a variety of behaviors. Thus, formalization restricts innovations with explorer characteristics.

Through formalization, best practices are encoded in such a way that make them more efficient for exploitation, as well as easier to apply and to accelerate their implementation (Zander & Kogut, 1995). Thus, formalization reinforces exploiters' innovative features that involve the enhancement of existing products, processes and services (Liao, 2007). Therefore, we state two new research hypotheses:

H_3: The higher the formalization, the greater its level of exploitation.

H_4: The higher the formalization, the lower its level of exploration.

Connectedness - Describes the informal collaboration between disciplines and functions at the organizational level (Jansen *et al.*, 2005). It consists of effective cross-functional teams, with enough force to overcome the different mental models and cultures that exist in the organization or consists of the necessary connectivity within the organization that ensures disagreements among members of cross-functional teams.

Connectedness leads to the formation of links involving more than two firms. It also leads to the perception of shared networks. Connectivity enhances the complementarity of sequences or other interdependent activities, leading to the formation of a chain by adopting activities in various relationships. Such adjustments result in a reorientation of network structures with a view to maximizing the benefits. Network density is reflected in increasing controls, influencing the partners' activities (Pillai, 2006).

Jansen *et al.* (2005) argue that connectedness increases opportunities for informal conversations and access to knowledge sources within the organization. It helps the combination of knowledge between individuals and the development of new knowledge underlying exploratory innovation. Also, they argue that social relations help in establishing legitimacy and empowers staff to adopt an exploratory innovation. However, from a certain point, the density of social networks may limit diverging perspectives and alternative ways of doing things.

Because highly dense networks spread strong standards and establish shared behaviors, they reduce the deflection of behaviors and also limit the search scope and selective perception of alternatives.

Connectedness is advantageous for the development of trust and cooperation among members. It allows individuals to develop a deep understanding of refinements and improvements in products, processes, and existing markets. In addition, dense social relations enable members of the organization to share experiences concerning implementation of certain enhancements. Therefore, we state two final research hypotheses:

H_5: The higher the connectedness, the greater its level of exploration.

H_6: The higher the connectedness, the lower its level of exploitation.

Figure 1 reflects the structural model concerning these research hypotheses.

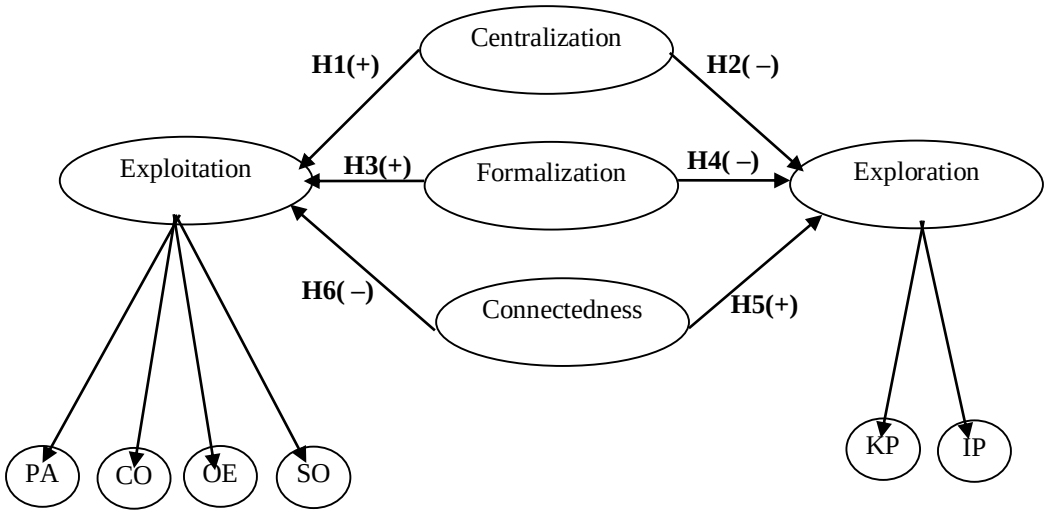

Figure 1. Structural Model
Exploitation is a reflective second-order latent variable (Jarvis, C. B., Mackenzie, S. B., & Podsakoff, P. M. (2003). A critical review of construct indicators and measurement model misspecification in marketing and consumer research (p. 205). *Journal of Consumer Research, 30*(2), 199-218. doi: 10.1086/376806). Its indicators were the first-order latent variables: (PA) partnerships, (CO) competition, (OE) operational efficiency and (SO) strategic orientation. As these relations are measurement model, we did not state them as hypotheses. Exploration is a reflective second-order latent variable. Its indicators were the first-order latent variables: (KP) knowledge practices and (IP) innovation practices. Formative latent variables, in general, are to generate indexes; reflexive latent variables are those in which the indicators express the latent variable (Bagozzi, R. P. (2007). On the meaning of formative measurement and how it differs from reflective measurement: comment on Howell, Breivik, and Wilcox (2007). *Psychological Methods*, *12*(2), 229-237. doi: 10.1037/1082-989X.12.2.229); Coltman, T., Devinney, T. M., Midgley, D. F., & Venaik, S. (2008). Formative versus reflective measurement models: two applications of formative measurement. *Journal of Business Research*, *61*(12), 1250-1262. doi: 10.1016/j.jbusres.2008.01.013; Mackenzie, S. B., Podsakoff, P. M., & Jarvis, C. B. (2005). The problem of measurement model misspecification in behavioral and organizational research and some recommended solutions. *The Journal of Applied Psychology*, *90*(4), 710-30. doi: 10.1037/0021-9010.90.4.710. We classified coordination mechanisms – centralization, formalization, and connectedness - as reflexive latent variables based on a discussion by Jansen, J. J. P., Van Den Bosch, F. A. J., & Volberda, H. W. (2005). Managing potential and realized absorptive capacity: how do organizational antecedents matter? *Academy of Management Journal*, *48*(6), 999-1015. doi:10.5465/AMJ.2005.19573106; Hage, J., & Aiken, M. (1967). Program change and organizational properties: a comparative analysis. *American Journal of Sociology*, *72*(5), 503-519; Cardinal, L. B. (2001). Technological innovation in the pharmaceutical industry: the use of organizational control in managing research and development. *Organization Science*, *12*(1), 19-36. doi: 10.1287/orsc.12.1.19.10119; and Lin, X., & Germain, R. (2003). Organizational structure, context, customer orientation, and performance: lessons from Chinese state-owned enterprises. *Strategic Management Journal*, *24*(11), 1131-1151. doi: 10.1002/smj.348.

Methodological Procedures

We developed the instrument for data collection based on a review of the published works on these topics: We measured centralization, formalization, and connectedness with items based on the authors referenced in the Analysis Model item, and the scale to measure exploration and exploitation is the outcome of studies carried out by the authors since 2007 and published by Popadiuk (2012).

We used several strategies to collect data: partly through personal contacts, partly through e-mail messages and partly through direct mail with prepaid replies, with the remainder collected through services rendered by a team hired for this purpose, which visited the companies where respondents worked.

The final non-probabilistic convenience sample was composed of 249 companies in all three business sectors: industry, trade and services, and the key-respondents were preferably managers, assuming that they had a broader overview of the company.

To reduce common method bias (CMB), we separated the predictor and criterion variable items over the length of the survey instrument and assured participants that their responses would be kept anonymous, and to assess the CMB, we used Harman's single-factor test (Podsakoff, Mackenzie, Lee, & Podsakoff, 2003).

The unrotated exploratory factor solution of all 58 items (principal components extraction) resulted in ten components (69.8% of total variance extracted) with eigenvalue greater than 1.0. The first component extracted just 30.7% of variance, which means that the results do not eliminate the possibility of any common method bias, but they suggest that it is unlikely to confuse their interpretation.

Although Harman's test did not detect the percentage of variance due to the method, and the one from the model itself (legitimate relations), it is a method widely used in current publications, for example: Bansal e Zahedi (2014); Liu, Yen, Lo e Chen (2014); Torres, Johnson e Imhonde (2014); Wang, Tseng e Yen (2014); Wei, Yi e Yuan (2011).

On 04/01/2015, we conducted a search in ProQuest (Full texts + Peer reviewed + basic search, keywords: **common method** AND Harman). We sorted the results by relevance and selected articles published from 01/2014, which resulted in 127 articles. Then we downloaded the first 30 items to assess the results of Harman's test on the 19 articles that reported the results in detail, the variance extracted by the first factor was: minimum = 11.0%; mean = 27.5%; median = 27.6%; maximum = 38.0%, which was considered acceptable in all cases. So we may consider that our result (30.7%) is consistent with the usual standards.

Data Treatment and Analysis

Organizational Profile – 41.8% of the companies were known as leaders in their fields of activity; 50.6% posted estimated revenues of up to US$ 50 million in 2007; and 29.0% had headcounts of over 2,000 employees, with 85.7% in São Paulo State, Brazil. Information on leadership was based on the perception of informants. Table 1 reflects the profile that relates revenue, positioning, and sector.

Table 1

Companies' Profile(1)

Revenue US$ Millions	Industry		Trade		Services		Total			
	Leader	Other	Leader	Other	Leader	Other	Leader	Other	TOTAL	NI(*)
Until 2	20.0	29.0	40.0	33.3	16.3	31.6	22.4	31.1	26.9	12
+2 - 4	8.6	3.2	0.0	13.3	4.7	0.0	5.1	2.9	4.0	2
+4 - 40	28.6	29.0	15.0	40.0	9.3	17.5	17.3	7.8	20.9	8
+40	42.9	38.7	45.0	13.3	69.8	50.9	55.1	41.7	48.3	9
(1)Total	35	31	20	15	43	57	98	103	201	31
	32.8		17.4		49.8		100.0			

Note. (*) Not informed – (1) 17 responses not matched (232+17 = 249).

We required informants to have at least five years of expertise related to the organization considered for this study. For this reason, we assumed informants had a broader overview of the organization under study. Contact with 70.0% of informants was personal. 32.8% of the sample consisted of respondents who worked in the economy's industrial sector; 17.4% worked in the trade sector and 49.8 % in the service sector. In the industrial sector, at least 34% of the respondents worked in the automotive industry. In the trade sector, 62.7% of the sample consisted of informants employed

at auto dealerships. In the service sector, 47.5% of the sample referred to informants working in the insurance and financial sectors. Among the respondents, 70.6% were men; 94.0% were university graduates; 81.8% were more than 30 years old, and 80.7% held managerial positions.

Analysis Model – In order to analyze the survey's findings, we used two analytical techniques: the first consisted of a Principal Component Analysis (PCA) intended to eliminate items with low commonality levels, undermining the findings on convergent validity as well as reliability (Pett, Lackey, & Sullivan, 2003). The second technique consisted of a Partial Least Squares Path Modeling (PLS-PM). The purpose of this technique was to examine the convergent and discriminant validity of the exploitation and exploration constructs (Anderson & Gerbing, 1998). Additionally, to evaluate the relationship between these constructs and coordination mechanisms.

PLS-PM is often considered more appropriate than LISREL by virtue of its capacity to estimate the model, even with non-normal data (demanding a lower sample size than LISREL), and to handle a complex model (*e.g.*, second-order latent variables) (Chin & Dibbern, 2010; Hair, Hult, Ringle, & Sarstedt, 2014; Henseler, Ringle, & Sinkovics, 2009).

As we can see in Figure 1, the model has two second-order reflective latent variables (Jarvis, Mackenzie, & Podsakoff, 2003; Wetzels, Odekerken-Schröder, & Oppen, 2009).

We measured exploiter as a second-order latent variable (Table 3), derived from the first-order latent variables (Table 2): organizational efficiency, competition, strategic orientation and partnerships, and explorer, in the same way, by two first-order latent variables: organizational knowledge practices and innovative practices.

Table 2

Factor Loading and t-Values (1st- Order Latent Variables)

Knowledge Practices – (Exploration)	Factor loading	t-value
Volume of new ideas generated	.719	12.3
Use of new sources of knowledge drawn from partners	.768	14.9
Existing knowledge in databases	.794	17.1
Use of knowledge already in place in the company	.793	14.9
Sharing in-house knowledge	.855	29.9
Individual learning processes	.801	18.4
Collective learning processes	.854	26.7
Team-building capacities	.854	33.0
Personnel development intensity	.883	37.3
Appreciation of individual knowledge	.823	22.9
Innovative Practices – (Exploration)		
Focus on completely new products or processes	.812	16.1
Prototype development	.764	11.5
Product innovation rate	.832	21.3
Marketing techniques innovation	.822	18.6
Opening up new distribution channels	.816	20.2
Focus on radical product innovations	.893	38.4

Continues

Table 2 (continued)

Innovative Practices – (Exploration)	Factor loading	t-value
Focus on radical technology innovations	.852	30.1
Ceaseless quest for new markets	.790	15.8
Development of new products and services	.879	30.4
Aggressive participation in technology-based alliances	.805	19.0
Competition – (Exploitation)		
Appearance of new competitors (new players)	.728	3.0
Existence of substitute products or processes	.645	3.1
Competition in the local (Brazilian) market	.821	2.9
Price-based competition in the local (Brazilian) market	.841	2.9
Fierce competition in company industry	.854	2,9
Existence of promotional (or price) wars in company industry	.821	2.9
Competition covers company offers easily	.701	2.6
Price-based competition is the high point of the company industry	.728	2.9
Strategic Orientation – (Exploitation)		
Strategic view focused on the present	.945	61.1
Strategies focused on the short term	.946	59.9
Organizational Efficiency – (Exploitation)		
Creation of detailed routines	.779	17.0
Importance of efficiency	.853	28.8
Focus on performing activities	.878	30.5
Concerns about gains of scale	.818	18.4
Organizational control mechanism	.847	24.0
Focus on costs	.844	24.2
Focus oriented towards production	.834	20.4
Partnerships – (Exploitation)		
Local relationships with outside partners	.820	19.5
Level of dependency on outside partners	.661	8.6
Use of contracts in relationships with outside partners	.740	11.5
Transparency in joint efforts with partners	.772	13.5
Duration of outside partnerships	.803	15.8
Sharing knowledge with partners	.842	24.9
Concern with establishing outside partnerships	.863	24.7
Number of outside partners for the company	.828	19.3

Continues

Table 2 (continued)

Centralization (Dewar, Whetten, & Boje, 1980; Hage & Aiken, 1967; Jansen *et al.*, 2005)	Factor loading	t-value
Most decisions people make here have to have their supervisor's approval	.650	3.1
There can be little action taken here until a supervisor approves a decision	.791	3.5
A person who wants to make his own decisions would be quickly discouraged	.915	3.1
Even small matters have to be referred to someone higher up for the final decision	.684	2.8
People need to ask their supervisor before they do almost anything	.557	2.1
Formalization (Deshpande & Zaltman, 1982; Jansen *et al.*, 2005)		
Whatever situation arises, written procedures are available for dealing with it	.748	8.5
Rules and procedures occupy a central place in the organizational unit	.813	11.0
Written records are kept of everyone's performance	.737	9.2
Written job descriptions are formulated for positions on all organizational levels	.756	9.9
Employees are hardly ever checked for rule violations	Excluded	
Connectedness (Jansen *et al.*, 2005; Jaworski & Kohli, 1993)		
There is ample opportunity for informal **hall talk** among employees	.624	6.0
Employees from different departments feel comfortable calling each other when the need arises	.724	10.1
Managers discourage employees from discussing work related matters with those who are not their immediate superior	Excluded	
People around here are quite accessible to each other	.880	28.0
It is easy to talk with virtually anyone you need to, regardless of rank or position	.830	16.3

Note. t-values estimated by bootstrap in SmartPLS 2.0.M3 (Ringle, C. M., Wende, S., & Will, A. (2005). SmartPLS (version 2.0 M3) [Software]. Germany: University of Hamburg. Retrieved from https://www.smartpls.com/smartpls2) with 249 cases and 1000 resamples. t > 1.96 is significant at 5% and t > 2.58 at 1%.

Table 3

Statistics on Convergent Validity and Reliability

Latent variable	AVE	Composite Reliability	Cronbach's Alpha	Mean	Standard Deviation
Explorer – 2nd-order	.844	.91	-	-	-
. Knowledge practices	.666	.95	0.94	4.99	1.12
. Innovation practices	.685	.95	0.94	4.53	1.41
Exploiter – 2nd-order	.462	.76	-	-	-
. Competition	.594	.92	0.90	4.73	1.32
. Strategic orientation	.895	.94	0.88	5.46	1.30
. Organizational efficiency	.700	,94	0.92	5.52	1.11
. Partnerships	.630	,93	0.91	5.03	1.18

Continues

Table 3 (continued)

Latent variable	AVE	Composite Reliability	Cronbach's Alpha	Mean	Standard Deviation
Centralization	.533	.84	0.83	3.85	1.13
Formalization	.585	.84	0.76	4.23	0.94
Connectedness	.595	.85	0.76	4.29	0.76
Recommendation	>.50	>.70	>.70	-	-
2nd order Latent variable	Factor loadings			t value	
Exploration > Knowledge Practices	.918			53.6	
Exploration > Innovation Practices	.919			56.0	
Exploitation > Competition	.435			2.7	
Exploitation > Strategic orientation	.606			7.4	
Exploitation > Organizational efficiency	.830			20.8	
Exploitation > Partnerships	.777			14.8	

Note. Significance probability: t > 1.96 is significant at 5% and t > 2.58 at 1%. From Table 2 and Table 3 we verify that all factor loadings are high and reveal potential to be significant. For a sample of 249 cases, any correlation superior to|.124| will be significant at the level of 5.0%. This result is obtained by the sensitivity test in G*Power3 (Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191. doi: 10.3758/BF03193146), or directly by the formula $t = r\sqrt{\frac{n-2}{1-r^2}}$ (Costa, P. L. O., Neto (1977). *Estatística.* São Paulo: Edgard Blücher).

For modeling second-order latent variables, we followed recommendations from Wetzels, Odekerken-Schröder and Oppen (2009), with repetition of the first-order latent variable's indicators on the second-order latent variable.

Measurement model assessment - The scale for exploitation and exploration used in this survey (Popadiuk, 2012) listed 45 indicators (7-points) whose final indicators with the respective factor loadings and t-value are included in Table 2. The scales for centralization, formalization, and connectedness (6-points) were based on prior studies also referenced in Table 2.

Convergent Validity - For the convergent validity analysis, we adopted three criteria as proposed by Hair, Babin, Money, and Samouel (2005): factor loadings higher than .7; AVE – Average Variance Extracted higher than .5 and t-values higher than 1.96 (or $p < .05$).

An examination of Table 2 shows us that all the factor loadings were significant ($p < .05$). Apart from six indicators, all others reflected a factor loading greater than .7, showing that for these criteria, the model was adequate in terms of its convergent validity, which was confirmed by the average variance extracted (AVE) values that exceeded .5 (Table 3), except for the exploiter latent variable at .46, but that was nevertheless very close to the minimum recommended value. Reliability measured by Cronbach's Alpha and composite reliability also proved adequate, with values exceeding .7.

Discriminant Validity - For the discriminant validity analysis, we used two criteria: the factor loadings (cross-loadings matrix is not shown here due to limitations of space) in the focal construct greater than the loading in the other constructs, in addition to ascertaining the correlations among the latent variables, whose values must be less than the square root of the AVE indexes for each construct (Fornell & Larcker, 1981; Hair *et al.*, 2014). It is apparent from Table 4 (Panel a) that they are lower than the AVE (main diagonal), thus disclosing discriminant validity through this criterion as well.

Table 4

Correlations and Crossloadings

Panel (a) – Correlations between first-order latent variables									
	1	2	3	5	6	8	9	10	11
1 Centralization	**.730**								
2 Formalization	.068	**.765**							
3 Connectedness	-.288	.353	**.771**						
5 Knowledge practices	-.261	.365	.502	**.816**					
6 Innovative Practices	-.187	.373	.440	.686	**.827**				
8 Competition	.023	.115	.031	.173	.197	**.771**			
9 Strategic orientation	-.189	.189	.211	.440	.496	.182	**.946**		
10 Organizational efficiency	-.159	.407	.389	.591	.558	.145	.512	**.837**	
11 Partnership	-.240	.122	.359	.447	.467	.205	.287	.403	**.793**
Panel (b) - Correlations between latent variables of the structural model									
	1	2	3	4	7				
1 Centralization	**.730**								
2 Formalization	.068	**.765**							
3 Connectedness	-.288	.353	**.771**						
4 Exploration	-.244	.403	.514	**.918**					
7 Exploitation	-.223	.330	.417	.694	**.679**				
Panel (c) – Crossloadings between exploration and exploitation									
	4	5	6	7	8	9	10	11	
4 Exploration	**.918**								
5 Knowledge practices	.918	**.816**							
6 Innovative Practices	.919	.686	**.827**						
7 Exploitation	.694	.633	.640	**.679**					
8 Competition	.215	.173	.197	.435	**.771**				
9 Strategic orientation	.510	.440	.496	.606	.182	**.946**			
10 Organizational efficiency	.626	.591	.558	.830	.145	.512	**.837**		
11 Partnership	.498	.447	.467	.777	.205	.287	.403	**.793**	

Note. The square root values for the AVE were inserted in the diagonal in order to assess the discriminant validity. All correlations greater than |.18| are significant at 5% (n = 249, power = .80, two-tail) and those greater than |.21| are significant at 1%, that was computed from G*Power 3 (Buchner, A., Erdfelder, E., Faul, F., & Lang, A. (2006). G*Power (3.0.3) [Software]. Germany: Universität Dusseldorf. Retrieved from http://www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3/). The gray cells are the factor loadings.

In panel (b) of Table 4, we can see that the correlation between exploration and exploitation surpasses the value of the square root of AVE for exploitation. Nevertheless, the disattenuated correlation (Nunnally & Bernstein, 1994) resulted in .83. This value (.83) indicates discriminant validity according to the criteria of Netemeyer, Bearden, and Sharma (2003). That is the correlation is less than 1.

Panel (c) explains what occurred: competition and strategic orientation had low factor loadings (less than .7) which resulted in a low value for AVE (.46, in Table 2). If we removed competition from the measurement model, AVE would be .55. In this way, the square root of AVE would surpass the correlation between exploration and exploitation. However, it would jeopardize the content validity of the latent variable exploitation. For this reason we may conclude that exploration and exploitation were measured correctly and that both are highly correlated.

The positive correlation between exploration and exploitation (.694, $p < .01$) is not reflected as a theoretical inconsistency. From those considerations developed by Gupta *et al*. (2006) and by other authors (March, 1991), we concluded that it is practically impossible to rate an organization as taking on an exclusively explorer or exploiter orientation.

The reason for this is that each department within an organization can carry out its work in accordance with its own need for knowledge, which is aimed more at what already exists in the company, or from new knowledge arising from the interaction with internal and external environments. Hence, while one area such as R&D requires research, creativity, experimentation and new knowledge, manufacturing may only use routines, procedures, and explicit regulations in accordance with the organization's documentation. In this sense, strictly speaking, any organization has, to a greater or lesser extent, a connectedness in its structure that may have both exploiter and explorer orientations. In other words, they have a certain degree of ambidexterity (Duncan, 1976).

A study carried out by Cao, Gedajlovic, and Zhang (2009) provides an approach that bolsters the argument contained in the previous paragraph. These authors based their position on an illustrative example when referring to the presence of explorer or exploiter orientation. This is reflected in Table 5.

Table 5

An Example of an Ambidexterity Profile for Two Generic Companies

Company	Degree of exploration	Degree of exploitation	Degree of ambidexterity based on the balance between exploration and exploitation	Degree of ambidexterity based on the combination between exploration and exploitation
A	10	5	Low	High
B	5	5	High	Low

Note. Source: Adapted from Cao, Q., Gedajlovic, E., & Zhang, H. (2009). Unpacking organizational ambidexterity: dimensions, contingencies, and synergistic effects. *Organization Science, 20*(4), 781-796. doi: 10.1287/orsc.1090.0426. From this Table we can see that company A has level 10 for exploration and level 5 for exploitation. Company B has level 5 for exploration and level 5 for exploitation. Cao *et al*. (2009) raise the question: As a response, they affirm that it depends on how the researcher envisages ambidexterity. If ambidexterity is seen as a balance between exploitation and exploration, then company B would be more ambidextrous than company A. However, should it involve a combination of exploration and exploitation, then company A would be rated as more ambidextrous than company B. They conclude that due to the way the researcher defines ambidexterity, it becomes difficult to make a comparison between studies carried out by different researchers into this subject. In part, it is because of this argument that some studies developed by other authors found that the correlation between exploration and exploitation was positive. As examples, we might mention: (.26) Kyriakopoulos, K., & Moorman, C. (2004). Tradeoffs in marketing exploitation and exploration strategies: the overlooked role of market orientation. *International Journal of Research in Marketing, 21*(3), 219-240. doi: 10.1016/j.ijresmar.2004.01.001, (.70 and .75) Yalcinkaya, G., Calantone, R. J., & Griffith, D. A. (2007). An examination of exploration and exploitation capabilities: Implications for product innovation and market performance. *Journal of International Marketing*, *15*(4), 63-93. doi: 10.1509/jimk.15.4.63, (.67) Im, G. (2006). *Exploratory and exploitative knowledge sharing in interorganizational relationships* (Doctoral dissertation). Georgia State University, Robinson College of Business, (.58) Greve, H. R. (2007). Exploration and exploitation in product innovation. *Industrial and Corporate Change, 16*(5), 945-975. doi: 10.1093/icc/dtm013, (.46) Isobe, T., & Montgomery, D. B. (2004). *Exploitation, exploration, and firm performance: the case of small manufacturing firms in Japan*. Research Collection Lee Kong Chian School of Business. Retrieved from http://ink.library.smu.edu.sg/cgi/viewcontent.cgi?article=3341&context=lkcsb_research, (.74) Bierly, P. E., III, Damanpour, F., & Santoro, M. D. (2009). The application of external knowledge: organizational conditions for exploration and exploitation. *Journal of Management Studies, 46*(3), 481-509. doi: 10.1111/j.1467-6486.2009.00829.x and (.52) Vorhies, D. W., Orr, L. M., & Bush, V. D. (2011). Improving customer-focused marketing capabilities and firm financial performance via marketing exploration and exploitation. *Journal of the Academic Marketing Science, 39*(5), 736-756. doi 10.1007/s11747-010-0228-z

Reliability - Reliability can be assessed by Cronbach's Alpha or composite reliability. In the context of structural equations modeling and PLS-PM, composite reliability is the most appropriate measurement and all results found in Table 3 meet the criteria proposed by Hair *et al.* (2005) and Hair, Hult, Ringle and Sarstedt (2014): composite reliability are greater than 0.7.

Structural Model Assessment – Hypothesis tests - In Table 6 we can verify that the three coordination mechanisms are correlated with exploration and exploitation. Model 1 is equal to Figure 1, and in model #2 we included control variables (sector, size, and leadership). Despite sector and leadership being significant at 5%, we noted that the changes in structural coefficients were lower than 0.03, increasing our reliance on the meaningfulness of these coefficients.

Table 6

Path Coefficients among Exploration, Exploitation, and Coordination Mechanisms

Path Coefficients (Hypothesis)	Model #1				Model # 2 (with controls)			
	β	**p**	**ΔR²**	**R² (R² adj.)**	**β**	**p**	**ΔR²**	**R² (R² adj.)**
Centralization → Exploitation (H1)	-.156	.016	3%	23.1% (22.2%)	-.183	.009	4%	27.0% (25.2%)
Formalization → Exploitation (H3)	.239	.000	8%		.235	.000	8%	
Connectedness → Exploitation (H5)	.285	.000	12%		.258	.000	11%	
Leader → Exploitation					.143	.007	2%	
Sector → Exploitation					-.025	.717	0%	
Size → Exploitation					.136	.019	2%	
Centralization → Exploration (H2)	-.157	.006	4%	34.2% (33.4%)	-.183	.003	4%	38.4% (36.9%)
Formalization → Exploration (H4)	.283	.000	11%		.281	.000	11%	
Connectedness → Exploration (H6)	.369	.000	19%		.343	.000	18%	
Leader → Exploration					.153	.004	2%	
Sector → Exploration					.016	.782	0%	
Size → Exploration					.153	.021	3%	

Note. Key: β = standardized path coefficients. p = p-value. ΔR^2 = contribution of each predictor to explain the variance of dependent variables. R^2 adj. = R^2 adjusted. Sector (n = 78 industry, 51 trade, 120 service) was dummy encoded, and these two indicators were used as formative in the measurement model (Falk, R. F., & Miller, N. B. (1992). *A primer for soft modeling*. Ohio: The University of Akron Press.).Revenue in 2007 was used as indicator of Size, and was grouped in classes: 1 = to 1M R$, 2 =]1 – 5] M, 3 =]5 – 10], 4 =]10 – 100], 5 = above 100 MR$, and Leadership (n = 104 leader, 145 = non-leader) was dummy encoded.

All structural coefficients were significant at 5%. However, it should be noted that exploitation and centralization has a negative path coefficient (-.156, $p < .05$). This negative value reveals that the centralization of decision-making and exploitation has opposing directions. When one is more prevalent, this tends to inhibit the other, and vice-versa. Therefore, H_1: The higher the centralization of decision-making, the greater its level of exploitation - is not supported by our study.

One of the reasons for the research hypothesis in this study not being supported, as expected, could be explained by the following argument: There is more exploitation, meaning that the processes, routines, procedures and control mechanisms are already institutionalized within the organization, mainly when innovation tends to be incremental. Therefore this becomes an organizational practice and the individuals in the organization probably no longer perceive that there is centralization.

As H_1 was not supported, this may reveal that centralization is necessary, but it is not enough to facilitate exploitation. This result is relatively consistent with the results obtained by Jansen *et al.* (2005).

In other words, centralization makes the exploration process more difficult, but this alone is not enough to prove the positive impact on the exploitation process.

Research hypothesis H_2 -The higher the centralization of decision-making, the lower its level of exploration – has been supported (-.157, $p < .05$). Therefore the predominance of centralization of decision-making implies a trend towards inhibiting the exploration process and vice-versa.

Research hypothesis H_3 - The higher the formalization, the greater its level of exploitation - was supported (.239, $p < .05$). However, H_4 - The higher the formalization, the lower its level of exploration – has not been supported (.283, $p < .05$). Though the coefficient is significant, its value was positive, revealing that formalization and exploration have the same direction.

While it is understandable that exploitation demands formalization, the fact that our data do not support H_4 suggests that the formalization process is an essential practice for any organization and therefore regardless of the fact that there is more or less of an explorer orientation. Accordingly, we concluded that even if there is an explorer orientation, formalization is necessary. Formalization is an organizational practice that should take place whatever the type of innovation – be it radical or incremental – carried out by the organization. It may be more intense or less intense in accordance with the type of innovation, but it is always present. Therefore individuals within the organization may find that even in creative situations with new ideas, products and services inherent to situations where there is an explorer orientation, a certain level of formalization is present due to the use of procedures, practices and necessary routines for documenting the activities developed.

Research hypothesis H_5 - The higher the connectedness, the greater its level of exploration – was supported (.369, $p < .05$). Therefore, the more connectedness in the organization, the more there is evidence of exploration and vice versa.

Research hypothesis H_6 - The higher the connectedness, the lower its level of exploitation - was not supported (.285, $p < .05$), though the coefficient is significant and associated positively. This result shows that even an exploiter orientation requires connectedness.

This result seems to be solid due to the high level of connectivity necessary between companies whose coalition could be in search of knowledge, with either explorer or exploiter features, provided by knowledge sharing. Moreover, by institutionalizing the exploitation process, routines, processes, procedures, control mechanisms, structures, and other features, which are inherent to the exploitation orientation, flow easily throughout the organization. This could make individuals believe that there is more connectivity inside the organization.

Conclusion

The relationship between exploration and centralization (H_2) was supported (-.157, $p < .05$), as expected. While one predominates in one direction, the other follows the opposite direction. Therefore, more centralization means less effort for exploration and vice versa. Contrary to expectations, centralization and exploitation (H_1) are associated in a negative way (-.156, $p < .05$). That is, if one is predominant the other follows an opposite direction. Our research hypothesis had supposed the same direction, that is, more centralization, more exploitation and vice versa.

Based on this result, we infer that centralization of the decision-making process is enough to inhibit exploration. However, as there is a negative relation between centralization and exploitation, a plausible explanation is that centralization is necessary but in itself not enough to facilitate the exploitation process. This result is consistent with that found by Jansen *et al.* (2005). Therefore, although centralization makes the exploration process more difficult, this is not strong enough to prove the positive impact on the exploitation process.

The research hypothesis that formalization was positively associated with exploitation was supported (H_3) (.239, p <.01). Inherent in this result, an organization oriented towards exploitation must have more explicit knowledge, more competition, a short-term strategic orientation, more controls aiming at organizational efficiency and an increasing number of partnerships. Although the relationship between formalization and exploration (H_4) was deemed significant, the result is contrary to the research hypothesis made (.283, p <.01). Our expectation was that more formalization would involve less exploration. However, it is possible that the opposite relationship between formalization and exploration is effectively present in situations where the organization's focus is on activities with exploiter features. Thus, a likely explanation for the contradictory result is that companies could be adopting ambidextrous postures in their innovation processes. In the study by Jansen *et al.* (2005), formalization and exploitation displayed a relationship similar to this. However, the relationship between formalization and exploration was not significant.

Consequently, it is understandable that exploitation requires formalization. As H_4 was not supported, it suggests that the formalization process is an essential practice for any organization and therefore regardless of the fact that there is more or less an explorer orientation. Accordingly, we concluded that even if there is an explorer orientation, formalization is necessary.

The relationship between connectedness and exploitation (H_5 - path = .285, p <.01) and connectedness and exploration (H_6 - path = .369, p <.01) were significant and positive. This means that the more connectedness increases, the higher the likelihood of exploitation and exploration. Although an opposite result has been found between connectedness and exploitation, this result may be explained by means of the same reason associated with formalization. That is, organizations in this study tend to adopt ambidextrous postures (Duncan, 1976; Güttel & Konlechner, 2009; Im & Rai, 2008; Litrico & Dean Lee, 2008; Z. Lin, Yang, & Demirkan, 2007). This posture is not surprising. Previous studies using this same database (Popadiuk, 2012) revealed that approximately 40% of the organizations were rated as ambidextrous, 9% as explorers, 14% as exploiters, and 37% were not in a well-defined position. Jansen *et al.* (2005) formulated the hypothesis that connectedness was related to exploration as an inverted U-shape. Therefore, this hypothesis was not supported in the study. On the other hand, the hypothesis that connectedness had a positive relationship with exploitation was supported, similar to that found in this study. Furthermore, the fact that connectedness is directly related to exploitation and exploration reveals the importance of social interactions within the organization, as envisaged in other studies of organizational knowledge management.

Final remarks

Based on our results and past studies, we concluded that the idea of exploration and exploitation is complex. One cannot simply elaborate a definition in merely a few words. It is evident from published works that many perspectives need to be taken into consideration to have a clear understanding of their meaning and significance within organizations. Essentially, these two concepts refer to organizational learning. In this sense, the learning curve is a relevant factor to be taken into account when discussing this issue. If an organization makes a constant effort to learn, because of the capacity and valuation of its internal knowledge, this will relate greatly to the exploitation process. However, if the organization is open to absorbing what happens outside of its domain, it will look for orientation that could be defined as exploration. Furthermore, this simultaneous search must be desired by the majority, because it allows joining these two lines of research, creation and use of knowledge in a synergistic manner able to generate a competitive advantage.

Although in the seminal article by March (1991) a trade-off between these two strategic orientations of organizational knowledge was discussed, the studies analyzed in published works and affirmations made in this study allow us to conclude that it is not possible for organizations to position themselves in only one of the extremes, be it that of exploration or exploitation.

This argument becomes clear in the discussion by Gupta *et al.* (2006) who reflected on the set of factors that should be taken into account when trying to find a possible definition of these two concepts.

Accordingly, when faced with such complexity it may be considered that the hypothesis formulated for this study reflects in part the association between exploitation and exploration and mechanisms of organizational coordination.

Besides possible theoretical gaps, some points viewed as critical must be taken into consideration in future studies of this topic such as common method biases (CMB). Although analyses regarding CMB were within the usual values of other studies, it is not possible to assess the extent to which this bias is present, so for future research we recommend using the procedure of Chin, Thatcher, Wright, and Steel (2013), or preferably to include variables obtained from other sources in the model, such as secondary data for example.

One of these critical points refers to the depth of analysis of this phenomenon. When referring to exploration and exploitation, March (1991) viewed the essence of their role as explaining innovation processes in organizations. In general terms, it is possible to pursue this discussion. However, as assessed by other researchers the discussion of these concepts is far more complex than imagined. Initially, this will depend on the viewpoint of the user of the knowledge or learning process.

For example, for somebody writing a text, the process consists of far more exploitation. The knowledge is held by the writer even when derived from knowledge obtained elsewhere (exploration); this is a pure exploitation process. Intellectual efforts are required to be able to express the ideas in the text. On the other hand, the reader of this text even when endowed with knowledge on the topic, will be engaged in an exploration process when reading it. Here we are referring to an individual ontological analysis level. This process may be extrapolated to the group and/or organizational context. Thus, demarcation is essential for the analysis.

The second point refers to the sampling process. Although the sample used here focused on three business activities representing industry, trade and services in an attempt to develop a more homogeneous data set, it is evident that factors intrinsic to the collection process may have influenced data quality. Part of the data was collected by telephone, part by e-mail and part personally. It was not always possible to obtain respondents with the desired profile in order to answer the questionnaire: more specifically, a manager with a broad-ranging overview of the organization.

Another point to be analyzed is the context of the information. Through a description of the companies encompassed by the sample, it seems clear that they are quite large. Even an entrepreneur who established the organization will not have a detailed view of everything happening throughout its structure. Therefore, he or she alone cannot be accountable for this organization. In an ideal survey, there should be many respondents within the company when possible, several from various areas within the company. However, this would require the researcher to spend quite some time in the company, which might perhaps be possible if engaged in a consulting project. One manner of making the model more accurate would be to apply the questionnaire in a very specific context – marketing, finance, production, administration, etc. – or even in an activity such as some project, for example.

Still on the topic of sampling, the ideal would be the use of a probabilistic sample that could represent the activity, the project or the organizational function being studied. In this study's particular case, the sample was gathered by convenience. Part of this sample was based on updating records used in another survey that was conducted some years before, in order to analyze the information environment of organizations.

Another limitation in this study is that the data collection was cross-sectional, which leads us to suggest that in future research, a longitudinal model should be tested to assess how exploitation and exploration are able to explain the variables considered as predictors here (which makes sense considering that this is an organizational learning cycle).

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