

Organizational Cooperation and Knowledge Management in research and development organizations

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Organizational Cooperation (OC) is a current concept that responds to the growing interdependence among individuals and teams. Likewise, Knowledge Management (KM) accompanies specialization in all sectors of human activity. Most KM processes are cooperation-intensive, and the way both constructs relate to each other is relevant in understanding organizations and promoting performance. The present paper focuses on that relationship. The Organizational Cooperation Questionnaire (ORCOQ) and the Short form of the Knowledge Management Questionnaire (KMQ-SF) were applied to 639 members of research and development (R&D) organizations (Universities and Research Institutes). Descriptive, correlational, linear multiple regression and multivariate multiple regression analyses were performed. Results showed significant positive relationships between the ORCOQ and all the KMQ-SF dimensions. The prediction of KMQ-SF showed a large effect size ($R^2 = 62\%$). These findings will impact on how KM and OC are seen, and will be a step forward in the development of this field.

Keywords: knowledge management, Knowledge Management Questionnaire, organizational cooperation, Organizational Cooperation Questionnaire

The present study aims to deepen understanding of the relationship between organizational cooperation (OC) and knowledge management (KM) in a sample of research team members. Research and development organizations undertake a knowledge-intensive activity where knowledge management is crucial. At the same time, the various KM sub-processes require people to cooperate.

Knowledge represents the prime resource for individuals, organizations and society (Ahmadi, Selsele, & Ahmadi, 2011) and in organizations is a

“critical ingredient”, which must be held and set “into routines, processes, and practices” (Desouza, 2004, p. 5). Knowledge is something humanly and socially constructed (Davenport & Prusak, 1998). It results from a number of cognitive, emotional and behavioral elements, and is viewed as an organizational asset (Bodrožić & Stepanović, 2012; Cardoso, 2007; Cardoso, Gomes, & Rebelo, 2005; Davenport & Prusak, 1998; Durst & Edvardsson, 2012).

Knowledge Management is currently a universal management concept (Takeuchi, 2001; Zhu, 2004) which is an important research focus in the organizational literature. KM is mainly a cooperation-intensive activity but the link between cooperation and knowledge management remains under-researched (see below). Desouza (2004) and Serenko (2013) pointed out the importance of researching the link between KM and several organizational constructs such as success, performance and productivity. The same can be said regarding cooperation. Considering both constructs (cooperation and knowledge management) are complex and multidimensional, it would be wise to deepen the understanding of the relationships between the dimensions of each construct. That is particularly relevant for organizations whose core business is knowledge, as research and development organizations are. Doing this will help these organizations to design strategies for developing knowledge and improving performance.

This research is based on a humanized perspective, which claims that interactions between people and teamwork are a key factor for KM (Ahmadi et al., 2011; Pais & dos Santos, 2015). This people-orientated approach considers that knowledge is closely linked to people and that face-to-face interactions are crucial for it to be effectively created, shared and used. Another perspective, more technology-orientated, emphasizes knowledge codification and storage, with knowledge being perceived as a separate entity from whoever created, shared and used it (e.g., Carter & Scarbrough, 2001; Davenport, 1996; Snowden, 2000).

Cooperation as the combination of acts involving social interaction, coordination in goal-setting and achievement, and communication (Argyle & Lu, 1991), is a widely recognized psychological organizational construct. Organizational Cooperation (OC) will impact on how the organization can effectively adapt to changes in the environment, be well positioned in inter-organizational networks and be flexible in production or services, to cope with environmental constraints (Schalk & Curseu, 2010). Cooperation must be stimulated, as it constitutes “much of the value-creation opportunities within an organization” (Gratton, 2005, p. 151).

Current organizational life demands effective cooperation processes in KM, to boost performance (Xu & Bernard, 2013). Further research is required on collaborative networks as determinants of the way knowledge flows (Singh, 2005). Interpersonal networks and social ties between workers impact the way knowledge is spread in the organization (Ahmadi et al., 2011). Employees in

organizations work in groups, teams and projects. Strategies must be built in order to improve socialization and trust among team members (Ribiere & Walter, 2013), crucial requirements for cooperation.

Knowledge Management

Griffiths, Koukpaki, and Martin (2010) and Griffiths and Koukpaki (2010) proposed this definition: “KM is about managing the environment to develop value-based solutions that enable the acquisition and storage, use, sharing and creation of knowledge assets for strategic and tactical use within the organization to meet the end of innovation, adaptive capacity and decision-making” (Griffiths & Evans, 2011, p. 780). Focusing on the human side of KM adopted by Cardoso (2003, 2007), Cardoso and Gomes (2011), and Cardoso, Meireles, and Peralta (2012), organizational knowledge has a social and interactive nature, requiring involvement and committed participation by people, making it a dynamic process. In this perspective, human variables such as organizational commitment, knowledge-centered-culture and training, are crucial to the development of informal and formal KM practices (Cardoso et al., 2012). Furthermore, people management practices developed from an organic and valued approach have a positive impact on KM processes (Figueiredo, Pais, Monteiro, & Mónico, 2016).

As Serenko (2013) states, KM is recognized as a practitioner-driven concept, and results from the pressure to improve efficiency and competitiveness felt by organizations in the second half of the last century. According to Ribiere and Walter (2013), KM relies strongly on the way stakeholders of the organizations are managed and motivated, making this a distinctive strategy for organizations to become innovative and competitive.

Pais (2014) conceptualizes KM as a set of day-to-day activities, related to the creation and development of internal organizational conditions, which catalyze every knowledge-related process. This author suggests KM requires an organizational culture serving the purposes of knowledge creation, sharing and use. That means a Knowledge-Centered-Culture, the adoption of strategies that affect all organizational actors, and the commitment of the whole organization to KM processes. In her model, Pais (2014) proposes four dimensions of KM: (a) *Knowledge-Centered-Culture* (reflecting a framework that guides the rules, norms, practices and procedures of the organization regarding knowledge); (b) *Competitive-Orientation* (expressing the orientation of the organization to the external environment, focused on knowledge use aiming to reach a sustainable competitive advantage); (c) *Formal-KM-Practices* (expressing the existing formal organizational actions aiming to develop knowledge); (d) *Informal-KM-Practices* (reflecting the informal interactions that take place within the organization and facilitate the social construction of knowledge). This perspective is adopted here.

Organizational Cooperation

Cooperation is defined by Argyle (1991) as “acting together, in a coordinated way at work, leisure, or in social relationships, in the pursuit of shared goals, the enjoyment of the joint activity, or simply furthering the relationship” (p. 4). In organizations Marcus and Le (2013) emphasized working with others for shared goals and pointed out situations such as sharing information and helping one another to complete certain tasks, where these cooperative behaviors are noticed. Smith, Carroll, and Ashford (1995) distinguish cooperation’s focus on the interaction within individuals, groups and organizations, and the subsequent psychological relationships either for common gain or benefit. These authors state that cooperative relationships can be formal or informal, depending on whether they involve contractual obligations and formal structures of control, or adaptable arrangements that define parties’ contributions.

Deutsch (2001), in his theory of Cooperation and Conflict Resolution, showed that cooperative groups will differentiate from competitive groups in some ways: more effective communication and acceptance among members; more friendly and helpful group discussions; more effort coordination, work division, orientation through task achievement, more order when discussing, and higher productivity; a greater feeling of agreement and confidence in each other’s ideas and value for the group, and a better sense of similarity in values and beliefs. Also, cooperation leads to the perspective of conflict as a problem to be solved mutually and collaboratively.

Gratton (2005), focusing on specific high-performing companies as practical examples of cooperative workplaces, showed that executive teams perceive cooperation as a key asset for their organizations’ success. An interesting contribution of this study is Human Resources’ implication in the establishment of cooperative networks that combine the promotion of proximity, time shared with colleagues, shared tasks, and a culture of trust and respect. To sum up, in this study cooperation is claimed to have a crucial function within organizations being positively related to effective communication, members’ satisfaction, productivity, sense of community and compromise.

The present paper refers back to Pais et al. (2014), in conceptualizing Organizational Cooperation. Those authors consider that cooperation is not a homogenous concept but a complex one, with several dimensions through which different forms of cooperation can be characterized. Three dimensions emerged in their research: (a) *Principles-of-Cooperative-Relationship* (corresponding to the relational framework underlying cooperative processes between individuals in organisations); (b) *Formal-Cooperation* (the degree to which cooperation is formally configured in laws, regulation or procedures); and (c) *Cooperation-Focused-on-the-Organizational-Mission* (the degree to which “individuals are driven and cooperate to accomplish the organizational mission, that mission being related to the role the organization has within society”; Pais et al., 2014, p. 79).

Differently from previous conceptualizations, cooperation in this perspective is not considered a unidimensional construct, but a multidimensional one, that can take different configurations more or less adapted to specific contexts. Accordingly, different cooperation dimensions are expected to relate differently to KM dimensions and those specificities should be taken into account whether we think in terms of intervention or research.

Relationship between KM and OC

Cooperation as defined above is crucial for KM processes. Previous research highlights that KM benefits from teamwork, cooperation and collaboration (Moss, Kubacki, Hersh, & Gunn, 2007). For instance, Nahapiet, Gratton, and Rocha (2005) suggested the future of organizations in the global and knowledge-based economy lies in establishing cooperation as the norm. Managers are starting to see workers' ability to create value through KM as a source of competitive advantage for the business (Nahapiet et al., 2005). These authors state that the quality of social interactions, with special emphasis on the role of cooperation, has been recognized empirically as an important factor in the knowledge economy.

Arthur and Kim (2005) hypothesized that the level of cooperation and trust among employees had an impact on the way people take risks at work, resulting in different patterns of information sharing. These authors showed that differences in labor management cooperation can lead to distinctive patterns of information sharing, which would probably occur similarly in other work practices.

Allarakhia, Walsh, and Wensley (2007) studied the role of cooperation in KM in the biomedical field. These authors asserted that academia, government and industry have a role and duty, through their policies, in controlling and impacting on cooperative knowledge production and expanding biological knowledge. Also in health organizations Radaelli, Lettieri, Mura, and Spiller (2014) found knowledge sharing behaviors are related to the involvement in other processes of knowledge management linked to innovative work behaviors.

Lin (2007) conducted research to see whether cross-functional cooperation and competition had any effect on new product performance and KM processes. Cross-functional cooperation was found to have a positive effect on KM processes, meaning that the characteristics of "collaborative working relationship", "high quality interactions (communication)" and "high level of involvement" had positive effects on KM processes. Furthermore, Ghobadi and D'Ambra (2011) concluded that factors related to the organization, the individual and knowledge predict both cooperation and competition, which in turn have an impact on the effectiveness of the knowledge sharing process, one of the processes within KM. Xu and Bernard (2013) also found that cooperation through teamwork has a crucial role in creating advantages for organizations facing everyday issues.

Knowledge sharing (KS) can be approached as a social dilemma where cooperation is a desirable resolution (Pais & dos Santos, 2015). These authors synthesize the literature published on the strategies aiming to promote cooperation, but found out that beyond these strategies, different types of cooperation are ignored. That is relevant for conceptualizing the relation between cooperation and KS as well as for designing strategies focused on improving KM processes. These processes are complex and ‘knowledge sharing’ is not enough to describe that complexity.

In general, previous studies support the proposition of a link between OC and KM. Nevertheless, a coherent and consistent overview of the different OC and KM dimensions is missing. The present research aims to provide new insights into this relationship in research team members.

Method

Study aim and hypotheses

The purpose of this study is to explore the relationship between the different dimensions of OC and KM. Specifically, we intend to verify the predictive effects of individuals’ perceptions of the several dimensions of OC (measured by the ORCOQ, described below) on their perception of the KM dimensions (measured by the KMQ-SF, described below). Accordingly, the following hypotheses will be tested: **Hypothesis 1 (H1):** *Knowledge Management is positively predicted by Organizational Cooperation.* **Hypothesis 2 (H2):** *Knowledge-Centered-Culture is positively predicted by Organizational Cooperation dimensions.* **Hypothesis 3 (H3):** *Competitive-Orientation is positively predicted by Organizational Cooperation dimensions.* **Hypothesis 4 (H4):** *Formal-KM-Practices are positively predicted by Organizational Cooperation dimensions.* **Hypothesis 5 (H5):** *Informal-KM-Practices are positively predicted by Organizational Cooperation dimensions.*

Participants

All research team members of Portuguese public research and development organizations (Higher education organizations and Research centers) were contacted via email (addresses available in the websites) and invited to participate in this research. Details of the sampling process are presented in the procedure section.

The sample size is $N = 639$ of both sexes, 58.3% being female. The age-range is as follows: 18–24 years, 7.5%; 25–34 years, 42.5%; 35–49 years, 38.4%; 50–64 years, 10.4%; and ≥ 65 years old, 1.3%. Considering job tenure in the organization, 9.4% have worked for less than one year, 38.7% for 1–5 years, 21.2% for 5–10 years, and 30.7% for more than 10 years. Considering function, 66.4% are researchers/professors, 26.5% are scholarship researchers/PhD or master students, 3.2% have leadership functions, 1.1% are trainees, 1.9% are Technicians, and 0.9% are administrative staff. Academic qualifications are distributed as follows: 52.1% PhDs, 33.4% master degree, 14.2% college degree, 0.2% were bachelors, and 0.2% had high school qualifications (see Table 1).

Table 1
 Demographic characteristics of the sample

Sample	<i>n</i>	Valid %
Gender		
Male	262	41.7
Female	367	58.3
Missing	10	
Age (years)		
18–24	48	7.5
25–34	270	42.5
35–49	244	38.4
50–64	66	10.4
>65	8	1.3
Missing	3	
Job tenure (years)		
<1	60	9.4
1–5	246	38.7
5–10	135	21.2
>10	195	30.7
Missing	3	
Function		
Researchers/Professors	374	66.4
Scholarship Researchers/PhD or master students	149	26.5
Leaders	18	3.2
Trainers	6	1.1
Technicians	11	1.9
Administrative staff	5	0.9
Missing	76	
Academic qualifications		
PhD	329	52.1
Master	211	33.4
College	90	14.2
Bachelor	1	0.2
High school	1	0.2
Missing	7	

Sociodemographic variables did not show relevant associations with criteria variables (KM global scale and KM dimensions), which means no need for their statistical control: $rpb_{\text{gender (dummy)}} = -.04, p = .33$ for KM global scale ($-.07 \leq rpb \leq .10$ for KM dimensions); $\rho_{\text{age group}} = -.11, p = .01$ ($-.19 \leq \rho \leq -.03$ for KM dimensions); $\rho_{\text{academic qualifications}} = -.08, p = .06$ for KM global scale ($-.09 \leq \rho \leq .03$ for KM dimensions); main functions: $rpb_{\text{researcher/ professor (dummy)}} = -.09, p = .03$ for KM global scale ($-.10 \leq rpb \leq -.04$ for KM dimensions); $rpb_{\text{scholarship_researcher / PhD or master student (dummy)}} = .12, p = .002$ for KM global scale ($.00 \leq rpb \leq .15$ for KM dimensions); $rpb_{\text{leader (dummy)}} = .07, p = .09$ for KM global scale ($.02 \leq rpb \leq .08$ for KM dimensions); $rpb_{\text{trainees (dummy)}} = .04, p = .33$ for KM global scale ($-.02 \leq rpb \leq .07$ for KM dimensions); $rpb_{\text{technicians (dummy)}} = .04, p = .31$ for KM global scale ($-.05 \leq rpb \leq .07$ for KM dimensions); $rpb_{\text{administratives (dummy)}} = -.10, p = .01$ for KM global scale ($-.10 \leq rpb \leq -.06$ for KM dimensions). Thus, sociodemographic variables were only used for sample characterization purposes.

Data analysis

Data was processed in IBM SPSS Statistics and AMOS 22.0. Missing values (< 2%) were all MCAR and replaced through the Expectation Maximization Method (Ibrahim, Chen, Lipsitz, & Herring, 2005). The existence of outliers was evaluated by the square distance of Mahalanobis (Tabachnick & Fidell, 2007) and normality of the variables was evaluated by the univariate and multivariate coefficients of asymmetry (Sk) and kurtosis (Ku). No significant outliers were registered and none of the variables presented indicated violations of normal distribution, considering $|Sk| < 3$ and $|Ku| < 10$ (Curran, West, & Finch, 1997; Finney & DiStefano, 2006; Kline, 2011). A probability of .05 for Type I error was considered for all the analyses.

Exploratory Factor Analysis (EFA) was performed by Principal Component Analysis (PCA) with SPSS and Confirmatory Factor Analysis (CFA) was executed with AMOS (Arbuckle, 2013). For CFA the quality of the global adjustment of the dimensional models was ascertained by the X^2 , CFI, NFI, TLI, and RMSEA indices, referring to the respective reference values (Bentler, 1990; Brown, 2006; Hu & Bentler, 1999; Kline, 2011; Schumacker & Lomax, 1996). Composite reliability (CR; Hair, Anderson, Tatham, & Black, 2008) and average variance extracted for each dimension were evaluated as described in Fornell and Larcker (1981). Reliability was calculated by Cronbach's alpha (1951). Discriminant validity was evaluated by average variance extracted (AVE).

The first step of the results was to conduct a descriptive and correlational analysis of each of the global scales (ORCOQ and KMQ-SF), and of the factors of each scale. In order to test our hypothesis that individuals' perception of OC can predict the perception of KM dimensions, a multiple regression analysis was performed. Normal distribution and homogeneity assumptions were checked graphically, whereas the independence assumption was checked by the Durbin-Watson Test (values between 1.9 and 2.2, which are not problematic; Maroco, 2010). The VIF (variance inflation factor) was used to check multicollinearity and all the variables appeared to be non-collinear ($VIF < 10$). The existence of outliers for regression analysis was assessed by the results of the standard residuals, all being less than 3|. Lastly, a Multivariate Multiple Linear Regression analysis was run to analyze the effect of the three ORCOQ factors on the four factors of KMQ-SF altogether. The significance of the regression coefficients was assessed after estimating the parameters through the maximum likelihood method calculated with AMOS (Arbuckle, 2013). The existence of outliers was assessed by the square distance of Mahalanobis (DM^2) and the variables' normality was evaluated by the univariate and multivariate Sk and Ku. No values of DM^2 were found to indicate the existence of outliers, nor sufficiently strong correlations between the exogenous variables to indicate possible multicollinearity problems.

Instruments

Knowledge Management Questionnaire – Short-Form (KMQ-SF). This research used KMQ-SF, formed of 22 items (Pais, 2014), which identifies and evaluates employees' perception of 4 KM dimensions. The items are presented on a five-point Likert scale, where 1 is "almost not applicable" and 5 is "almost always applicable". This short-form emerges from the need to have a more parsimonious version of the KM Questionnaire, originally with 56 items. The longer version was applied in several studies (e.g., Cardoso, 2007; Cardoso & Gomes, 2011; Cardoso et al., 2012), and in 2010 Cardoso and Peralta presented a first short version with 15 items. Further studies (Brito, Pais, & dos Santos, submitted; Pais, 2014) consolidated a 22 item version used in the present research. The KMQ-SF used in the present paper has four dimensions:

- *Knowledge-Centered-Culture* (7 items): a common interpretative framework that guides the rules, norms, practices and procedures of the organization, revealing the orientation followed by every member. It addresses a culture oriented by knowledge, where this concept acquires value in productivity, quality and organizational performance. Example of item: *We act according to how we are organized.*
- *Competitive-Orientation*: (4 items): focused on the way the organization looks at its external environment, including clients and competitors. This orientation requires strategic KM, controlling both internal knowledge and the demands of the different stakeholders, in order to respond and adapt effectively to the environment, creating a sustainable competitive advantage. Example of item: *What we know is a fundamental “weapon” to beat our competitors.*
- *Formal-KM-Practices* (6 items): include the established processes related mostly to explicit knowledge. This dimension reveals the notion that there is a need to engage in practices that enable the creation, acquisition, preservation, share and use of knowledge, based on products and services. Example of item: *We attend seminars/conferences, read what is published or hire experts.*
- *Informal-KM-Practices* (5 items): assess the interactions that contribute to the social construction of knowledge, brought about by the creation of a common, collective and symbolic language. The type of knowledge in question is tacit, which calls for face-to-face contact and sense attribution in constructing a collective understanding of organizational events. Example of item: *We ask our colleagues how they solved problems similar to ours.*

The dimensional validity of the questionnaire was evaluated by CFA (Maximum likelihood estimation), given that this questionnaire already showed an invariant factor structure (Brito et al., submitted; Pais, 2014). Model fit was carried out by modification indices (higher than 80; $p < 0.001$), which allowed us to correlate the residual variability between items 7 and 12, 15 and 16, and 19 and 20. The final Tetra-dimensional Model of KMQ-SF revealed an acceptable fit, NFI = .893; CFI = .929, TLI = .918, and RMSEA = .054.

The global scale presented high reliability (Nunnally, 1978) $\alpha = .911$, composite reliability (CR $\geq .70$; Hair et al., 2008) CR = .96, and average variance extracted (AVE $\geq .50$; Bagozzi & Yi, 1988) AVE = .74. *Knowledge-Centered-Culture* presented coefficients of $\alpha = .83$, CR = .92, and AVE = .62. *Competitive-Orientation* had coefficients $\alpha = .62$, CR = .64, and AVE = .33; considering the reliability coefficient, although less than .70 (value considered sufficient by Nunnally, 1978, p. 245), is composed of only 4 items, very different in their content (inter-correlations between .195 and .368), and Cronbach's alpha is sensitive to the number of items; furthermore, deleting any of them would lead to a significant reduction of internal consistency of this dimension (α from .499 to .619), which presents a mean for inter-item correlation of .297. Briggs and Cheek (1986) recommend that “the optimal level of homogeneity occurs when the mean inter-item correlation is in the .2 to .4 range” (p. 114), and Clark and Watson (1995) that “(...) the average inter-item correlation fall in the range of .15-.50” (p. 316). *Formal-KM-Practices* had $\alpha = .83$, CR = .90, and AVE = .60, and *Informal-KM-Practices* had $\alpha = .76$, CR = .86, and AVE = .55. Regarding discriminant validity, we can consider that we are in the presence of a good indicator, given that the average extracted variance of factors is greater than the values of the correlations between each pair of factors (Bollen, 1989; Schumaker & Lomax, 1996).

Organizational Cooperation Questionnaire (ORCOQ). The ORCOQ is a 24 item questionnaire. All items are presented on a five-point Likert scale (1 is “almost never apply” and 5 is “almost always apply”). This questionnaire has been developed and applied in recent research (Pais et al., 2014; Pais, dos Santos, Castro, & Mónico, 2014). EFA was carried

out with the aim of exploring its dimensionality in the present specific sample of research team members. With this purpose, PCA was performed with VARIMAX rotation (Kaiser's normalization), given that we expected independent factors. Previously, we checked the requirements for a reliable interpretation of PCA. According to Gorsuch (1983) a minimum of 5 subjects per item is needed; since the questionnaire has 31 items, the ratio found was $603/31$ items = 19.45 subjects/item, which enables, a priori, reliable use of PCA. Furthermore, the Kaiser-Meyer-Olkin test (KMO) was higher than .70 (KMO = .947), showing sampling adequacy. The Bartlett's Test of Sphericity presented a $X^2(465) = 10854.25, p < .001$, showing that the correlation matrix differs from the identity matrix (Gorsuch, 1983). According to eigenvalue > 1 and the Scree plot, three interpretable factors were extracted from PCA, responsible for 59.53% of the total variability:

- *Principles-of-Cooperative-Relationship* (13 items; 26.98% of explained variance; item loadings from .485 to .810): Corresponding to the relational framework underlying cooperative processes between individuals within organizations. Example of item: *We cooperate with each other in our work because everyone is different, and this improves cooperation.*
- *Formal-Cooperation* (7 items; 18.92% of explained variance; item loadings from .589 to .878): Measures the degree to which cooperation is formally configured in laws, regulation or procedures. Example of item: *We cooperate with each other in our work by putting into practice the guidelines provided by our superiors.*
- *Cooperation-Focused-on-the-Organizational-Mission* (4 items; 14.33% of explained variance; item loadings from .690 to .831): Measuring the degree to which individuals are driven and cooperate towards fulfilling the organizational mission, that mission being related to the role the organization has in society. Example of item: *We cooperate with each other in our work by acknowledging that what we do is important to citizens.*

Confirmatory Factor Analysis of the tri-factorial solution achieved with EFA was performed with AMOS software (Arbuckle, 2013). This solution revealed an acceptable fit, NFI = .880, CFI = .905, TLI = .893, and RMSEA = .074 (Lower boundary of a two-sided 90% confidence interval for the population of .069 and upper boundary = .079). The scale presented high reliability (Nunnally, 1978), composite reliability (CR \geq .70; Hair et al., 2008), and AVE \geq .50 (Bagozzi & Yi, 1988), $\alpha = .94$, CR = .99, AVE = .86 ($\alpha = .92$, CR = .99, AVE = .85 for Principles-of-Cooperative-Relationship; $\alpha = .89$, CR = .96, AVE = .79 for Formal-Cooperation; $\alpha = .88$, CR = .91, AVE = .72 for Cooperation-Focused-on-the-Organizational-Mission). Regarding discriminant validity, we are in the presence of a good indicator, given that the variance extracted of each factor is greater than the values of the correlations between each pair of factors (Bollen, 1989; Schumaker & Lomax, 1996).

Procedure

The data used in the present study were collected taking into account ethical issues such as participants' anonymity and confidentiality, and also to avoid bias. An online version of ORCOQ and KMQ-SF was used, enabling contact with organizations via email (including a link), through which a letter was sent explaining the purpose of the research and ensuring confidentiality. The average time of response was 15 minutes, to read the instructions and answer the self-reported questionnaires.

Results

Both questionnaires, ORCOQ and KMQ-SF, were analyzed concerning the descriptive statistics, and the correlations between them were assessed (see Table 2).

Table 2
 Descriptive statistics and correlation matrix between ORCOQ and KMQ-SF

	<i>Sk</i>	<i>Ku</i>	α	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>SD</i>	ORCOQ_G	ORCOQ_F1	ORCOQ_F2	ORCOQ_F3	KM_F1	KM_F2	KM_F3	KM_F4
ORCOQ_G	-.24	.20	.94	1.00	5.00	3.09	.65	1							
ORCOQ_F1	-.29	-.46	.92	1.00	5.00	3.13	.76	---	1						
ORCOQ_F2	-.07	-.31	.89	1.00	5.00	2.93	.79	---	.44	1					
ORCOQ_F3	-.44	.03	.88	1.00	5.00	3.23	.84	---	.59	.46	1				
KM_G	-.68	.70	.91	1.18	5.00	3.55	.57	.77	.77	.45	.57				
KM_F1	-.78	1.18	.83	1.00	5.00	3.71	.64	.74	.70	.49	.57	1			
KM_F2	-.62	.72	.62	1.25	5.00	3.59	.64	.43	.43	.20	.40	.57	1		
KM_F3	-.42	-.26	.83	1.00	5.00	3.45	.77	.73	.73	.37	.51	.73	.51	1	
KM_F4	-.38	.41	.76	1.00	5.00	3.41	.68	.55	.54	.37	.38	.55	.40	.64	1

All correlations are significant ($p < .001$)

Note. ORCOQ_G: Global scale of ORCOQ; ORCOQ_F1: Principles-of-Cooperative-Relationship; ORCOQ_F2: Formal-Cooperation; ORCOQ_F3: Cooperation-Focused-on-the-Organizational-Mission; KM_G: Global scale of KMQ-SF; KM_F1: Knowledge-Centered-Culture; KM_F2: Competitive-Orientation; KM_F3: Formal-KM-Practices; KM_F4: Informal-KM-Practices

All the correlation coefficients were significant at the $p < .001$ level, being generally positive and medium-high (Cohen, 1988). The correlation between the two global scales, ORCOQ and KMQ-SF, is strong and positive, with $r = .77$. Formal-KM-Practices (KM_F3) was the dimension most strongly correlated with Principles-of-Cooperative-Relationship (ORCOQ_F1, $r = .73$). Knowledge-Centered-Culture (KM_F1) was most correlated with Principles-of-Cooperative-Relationship (ORCOQ_F1, $r = .70$), and also with Cooperation-Focused-on-the-Organizational-Mission (ORCOQ_F3, $r = .57$).

In order to analyze the prediction of workers' perception of KM by OC, a multiple linear regression analysis was performed (see Table 3). The analysis considered the three factors of the ORCOQ as predictor variables, the KMQ-SF as criterion, and each of the four KMQ-SF dimensions as criteria variables, in accordance with the previously established hypotheses of study.

Results of the multiple regression analysis show that for all four dimensions of the KMQ-SF and the global scale, the ORCOQ dimension with the highest effect size for all the criteria is Principles-of-Cooperative-Relationship (ORCOQ_F1). This means that, concerning perception of OC, the notion of Principles-of-Cooperative-Relationship in the organization is the one that affects all the dimensions of KMQ-SF, and influences perception of KM most strongly. In contrast, Formal-Cooperation only has a significant effect on prediction of Knowledge-Centered-Culture and Informal-KM-Practices. Cooperation-Focused-on-the-Organizational-Mission does not predict Informal-KM-Practices (see Table 3).

Table 3
Multiple linear regression analysis of KM forecast from the three dimensions of ORCOQ

Organizational Cooperation (ORCOQ) Predictors:	Knowledge Management (KM)					
	Criterion: Global scale					
	<i>b</i>	<i>SE</i>	<i>B</i>	<i>t</i>	<i>F</i> (3, 599)	<i>R</i>
ORCOQ_F1	.47	.02	.63	19.67**		$r_{\text{multiple}} = .787$
ORCOQ_F2	.08	.02	.11	3.61**	324.80**	$R^2 = .619$
ORCOQ_F3	.11	.02	.15	4.72**		$\text{Adj } R^2 = .617$ $SE = .35$
Criterion: KM_F1 – Knowledge-Centered-Culture						
Predictors:	<i>b</i>	<i>SE</i>	<i>B</i>	<i>t</i>	<i>F</i> (3, 599)	<i>R</i>
ORCOQ_F1	.42	.03	.51	14.53**		$r_{\text{multiple}} = .742$
ORCOQ_F2	.15	.03	.18	5.71**	243.88**	$R^2 = .550,$
ORCOQ_F3	.14	.03	.19	5.35**		$\text{Adj } R^2 = .548,$ $SE = .43$
Criterion: KM_F2 – Competitive-Orientation						
Predictors:	<i>b</i>	<i>SE</i>	<i>B</i>	<i>t</i>	<i>F</i> (3, 599)	<i>R</i>
ORCOQ_F1	.26	.04	.31	6.64**		$r_{\text{multiple}} = .467$
ORCOQ_F2	-.03	.03	-.04	-.94	55.60**	$R^2 = .218$
ORCOQ_F3	.18	.04	.24	5.11**		$\text{Adj } R^2 = .214$ $SE = .57$
Criterion: KM_F3 – Formal-KM-Practices						
Predictors:	<i>b</i>	<i>SE</i>	<i>B</i>	<i>t</i>	<i>F</i> (3, 599)	<i>R</i>
ORCOQ_F1	.73	.03	.72	22.27**		$r_{\text{multiple}} = .781$
ORCOQ_F2	.02	.03	.02	.74	311.55**	$R^2 = .609$
ORCOQ_F3	.07	.03	.08	2.33**		$\text{Adj } R^2 = .607$ $SE = .48$
Criterion: KM_F4 – Informal-KM-Practices						
Predictors:	<i>b</i>	<i>SE</i>	<i>B</i>	<i>t</i>	<i>F</i> (3, 599)	<i>R</i>
ORCOQ_F1	.41	.039	.46	10.62**		$r_{\text{multiple}} = .564$
ORCOQ_F2	.13	.034	.15	3.90**	93.15**	$R^2 = .318$
ORCOQ_F3	.03	.035	.04	.86		$\text{Adj } R^2 = .315$ $SE = .57$

** $p < .001$

Note. ORCOQ_G: Global scale of ORCOQ; ORCOQ_F1: Principles-of-Cooperative-Relationship; ORCOQ_F2: Formal-Cooperation; ORCOQ_F3: Cooperation-Focused-on-the-Organizational-Mission; KM_G: Global scale of KMQ-SF; KM_F1: Knowledge-Centered-Culture; KM_F2: Competitive-Orientation; KM_F3: Formal-KM-Practices; KM_F4: Informal-KM-Practices.

A model of Multivariate Multiple Linear Regression was established between the four KMQ-SF dimensions (dependent variables) and the three ORCOQ dimensions. Figure 1 presents the model with standardized estimates of the regression coefficients and the R^2 of the dependent variables. We find the three ORCOQ dimensions explain 61% of Formal-KM-Practices, 55% of Knowledge-Centered-Culture, 55% of Knowledge-Centered-Culture, 32% of Informal-KM-Practices, and 22% of Competitive-Orientation. Principles-of-Cooperative-Relationship influences most strongly Formal-KM-Practices ($\beta = .72$), followed by Knowledge-Centered-Culture ($\beta = .51$), Informal-KM-Practices ($\beta = .46$), and Competitive-Orientation ($\beta = .31$). Formal-Cooperation and Cooperation-Focused-on-Organizational-Mission are less influential. The path of Formal-Cooperation with the greatest effect size is on Knowledge-Centered-Culture ($\beta = .18$), followed by Informal-KM-Practices ($\beta = .15$), although with a small effect size. In turn, the path of Cooperation-Focused-on-Organizational-Mission with a slight moderate effect size is on Competitive-Orientation ($\beta = .24$), followed by a small effect size on Knowledge-Centered-Culture ($\beta = .19$).

The different predictive ability of the three ORCOQ dimensions on the four KMQ-SF dimensions is then shown (see Figure 1). This predictive ability is especially high regarding Principles-of-Cooperative-Relationship among the ORCOQ dimensions. At the same time, Formal-KM-Practices and Knowledge-Centered-Culture are the more strongly predicted of the KMQ-SF dimensions.

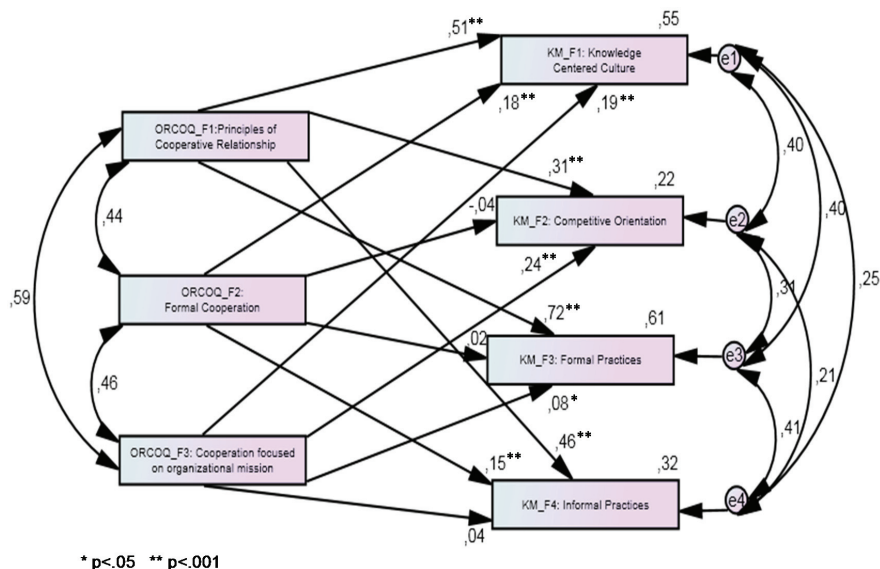


Figure 1. Model of Multivariate Multiple Linear Regression Analysis between the variables ORCOQ_F1, ORCOQ_F2 and ORCOQ_F3, and the dependent variables KM_F1, KM_F2, KM_F3, and KM_F4

Discussion

As mentioned previously, the objective of this study was to understand the relationship between OC and KM in R&D organizations. Specifically, we aimed to explain how the OC dimensions (Principles-of-Cooperative-Relationship, Formal-Cooperation and Cooperation-focused-on-the-Organizational-Mission) predict KM dimensions (Knowledge-Centered-Culture, Competitive-Orientation, Formal-KM-Practices, and Informal-KM-Practices).

Firstly, the results show a very significant positive correlation of .77 between ORCOQ and KMQ-SF. This result is in agreement with some of the aforementioned authors who claimed a connection between these two concepts. For instance, Arthur and Kim (2005) asserted that different forms of cooperation in the organization would result in different forms of information sharing. Likewise, Allarakhia et al. (2007) stated that the creation of biological knowledge would be done better cooperatively. Accordingly, Ghobadi and D'Ambra (2011) assumed that cooperation, as well as competition, could affect knowledge sharing. Finally, Xu and Bernard (2013) considered that cooperation could be an important part in the process of knowledge selection. Although these studies lack a comprehensive understanding of both constructs and their connection, they already pointed to a possible strong and positive relationship between them, something which was confirmed in the present research.

Note that some bivariate correlations between ORCOQ and KMQ-SF factors are higher than between ORCOQ factors or between KMQ-SF factors. This can be explained due to cooperation in knowledge-intensive organizations being intimately associated with knowledge management. All cooperation in knowledge workers is associated with knowledge management processes (e.g., creating, sharing and using knowledge). Additionally, ORCOQ factors and KMQ-SF factors are distinct inside their second-order latent construct (Cooperation and knowledge management), given that Varimax rotation (performed in ORCOQ and in previous EFA of KMQ-SF) intended to obtain as distinct factors as possible.

In knowledge-intensive organizations, cooperation and knowledge management share an emphasis on a knowledge culture, more than on a competitive orientation. Our results support this explanation, given that associations between ORCOQ dimensions and Knowledge-Centered-Culture are higher than with Competitive-Orientation.

After having demonstrated a strong positive relationship between OC and KM, we analyze how OC predicts KM positively, as stated in **H1**: This was supported, with 62% of variability explained by the ORCOQ in the KMQ-SF Global Scale, a value in line with the literature and supporting the aim of this study. Then, we provided deeper insights into the possible effect of each of the three ORCOQ dimensions separately on the four dimensions of KMQ-SF, testing our Hypotheses **H2**, **H3**, **H4**, and **H5**.

Regarding **H2**, all the relations were significantly positive, strong or moderate. *Formal-KM-Practices* was the dimension most strongly predicted by

Principles-of-Cooperative-Relationship, meaning for instance, that the cooperative relationship seems to facilitate the acceptance of formalities such as time scheduling and coordination of tasks and procedures (dos Santos, 1999) needed in *Formal-KM-Practices*. It was *Knowledge-Centered-Culture*, as a collective memory of shared values and norms (Pais, 2014), that benefits from a culture where cooperation is the norm, embedded in trust and respect (Gratton, 2005).

Informal-KM-Practices came next in the prediction effect of *Principles-of-Cooperative-Relationship*, and can be explained by the fact that they refer to interactions and social construction of knowledge (Pais, 2014), strictly linked with the face-to-face interactions that define cooperation (Ahmadi et al., 2011; Argyle, 1991; Smith et al., 1995). Finally, *Competitive-Orientation* was moderately predicted by *Principles-of-Cooperative-Relationship*. That means the focus on sustainable competitive advantage (Pais, 2014) benefits from the shared values perceived within the organization, concerning cooperative relationships, previously seen as a key resource for organizations' success (Gratton, 2005; Schalk & Curseu, 2010).

These results show the predictive capacity of *Principles-of-Cooperative-Relationship* in the four dimensions of KMQ-SF, making it the ORCOQ dimension with highest predictive impact on KM. We can then assume that *Principles-of-Cooperative-Relationship*, being the collective shared framework within which researchers cooperate, is the basis of OC involved in knowledge management processes.

H3 was only partly supported, with a minor significant positive effect on *Knowledge-Centered-Culture* and *Informal-KM-Practices*, and no significant effects on the other two KM dimensions. The effect of *Formal-Cooperation* on *Knowledge-Centered-Culture* may be interpreted as follows: cooperation according to rules, established processes, procedures and formal control structures (Smith et al., 1995) may include processes related to KM that are institutionalized and relate to a *Knowledge-Centered-Culture*. Furthermore, the significant effect on *Informal-KM-Practices* means that when participants (mainly researchers) have established cooperation practices to develop their work, the fact that they do not need to discuss procedures gives them space to debate the content of their work and develop *Informal-KM-Practices*.

In contrast, there is no significant effect of *Formal-Cooperation* on *Formal-KM-Practices*. As stated above, *Formal-KM-Practices* are strongly predicted by *Principles-of-Cooperative-Relationship*, which agrees with the last interpretation that established cooperation procedures facilitate *Informal-KM-Practices*. Additionally 2 of the 3 characteristics proposed by Lin (2007) regarding the cooperative relationship – “collaborative working relationship”, and “high quality interactions (communication)” seem to trigger the creation/acquisition, sharing, retrieval and use of knowledge, namely *Formal-KM-Practices*. Lastly, regarding *Formal-Cooperation*, there was no significant effect on *Competitive-Orientation*, which can be explained by the fact this is an orientation towards the organization's external environment, and so the internal processes that formally induce cooperation do not influence this orientation.

Concerning **H4**, it was partly supported in the effect on *Knowledge-Centered-Culture* and *Competitive-Orientation*. This ORCOQ dimension (*Cooperation-Focused-on-the-Organizational-Mission*) corresponds to the cooperative behaviors developed to accomplish the organizational mission. It has an effect on workers' commitment and how they manage their knowledge to deal with environmental challenges and constraints. *Cooperation-Focused-on-the-Organizational-Mission* also relates to *Knowledge-Centered-Culture*. This dimension is the "common referential" and "collective memory" (Pais, 2014) of the organization. This effect can be explained by the fact that when individuals are working as a team to advance the organizational mission, they are embedded in this collective memory, which builds Knowledge-Centered-Culture. The two missing effects are the prediction of *Formal-KM-Practices* and *Informal-KM-Practices* by *Cooperation-Focused-on-the-Organizational-Mission*, which were not found to be significant. This shows that the behaviors through employees' alignment with the organizational mission can sometimes be disconnected from *Formal Practices* and *Informal-KM-Practices*. A possible explanation may be that this cooperative dimension is more focused on the common path workers follow, whereas the practices of KM are concentrated in several KM processes, and also in its symbolic and social construction.

Conclusion

The results of the present research indicate that OC strongly predicts KM. Mainly, the *Principles-of-Cooperative-Relationship* factor predicts *Formal-KM-Practices*, *Knowledge-Centered-Culture*, *Informal-KM-Practices* and *Competitive-Orientation*. Several practical implications for organizations are, for instance, that they can build a culture oriented towards people and the value they can achieve working in cooperation. That can be done examining both the definition of the factor and the items which are part of it. The *Principles-of-Cooperative-Relationship* factor is focused on internal tacit rules that regulate the cooperative relationship. Since knowledge management is crucial to the participants and their organizations (knowledge-intensive organizations) good cooperative relationships make the difference. In addition, cooperative behaviors included in contextual performance need to be recognized and rewarded as an added value for the organization. This can have a very positive impact on the way knowledge is managed.

Some limitations should be mentioned. First of all, the questionnaires were sent by email, which made it difficult to obtain an answer to any doubt. Although nothing suggests this has affected the results, they would be even more reliable if the data had been collected in the researcher's presence. Second, the participants chose to accept our invitation to participate in the study. That means that the sample does not represent those who did not reply to our invitation. This limitation has a consequence in terms of understanding the results: the sample might be composed of more cooperatively oriented individuals (accepting

to cooperate with the researchers). Therefore, our results have this limitation regarding the possibility of generalization.

Furthermore, as this is a transversal study, the results are limited to a specific time of data collecting. To overcome this limitation we suggest longitudinal studies to help explain the relationship between these two constructs. Further research could analyze the relationship between OC and KM in different populations of knowledge-workers, usually seen as individual workers, but more and more working in cooperative environments. The present research aims to contribute to managers emphasizing teamwork and cooperation in organizations, and KM processes embedded in this cooperative framework.

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