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Information culture and its influences in knowledge creation: Evidence from university teams engaged in collaborative innovation projects

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ABSTRACT

This paper empirically analyzes the typology of information cultures (TICs) developed by Choo ((2013). *International Journal of Information Management*, *33*, 775). The primary objective is to identify information behaviors and values that could describe the information culture in the context of project team work while knowledge creation occurs, resulting in technological innovation. The secondary aim is to find resulting relationships between the TICs and the modes of knowledge conversion. Twelve university project teams were selected to participate in the study. The teams are part of the Partnership for Technological Innovation Research Program (PITE) from the São Paulo Research Foundation (FAPESP), Brazil. The qualitative technique of categorical content analysis was used. The data analysis is based on a set of five attributes: (i) the primary goal of information management; (ii) information values and norms; (iii) information behaviors in terms of information needs, (iv) information seeking, and (v) information use. The main results are twofold. First, we confirmed the existence of two dominant culture profiles, as hypothesized by Choo ((2013). *International Journal of Information Management*, *33*, 775). Second, results also showed plausible relationships between the risk-taking culture and externalization of knowledge; the rule-following culture and the combination of knowledge; result-oriented culture and internalization of knowledge; and the relationship-based culture and socialization of knowledge.

1. Introduction

Information processes represent a change both quantitatively and qualitatively in the cognitive structure that transforms the knowledge of people. From this premise, it is possible to admit that information is the input that makes, creates, and innovates the conceptual foundations of individuals and organizations in a social process of assigning meanings, which promotes and encourages individual and organizational knowledge.

The knowledge produced by individuals is a result of the interactions of individuals with the environment. It is necessary to point attention at the environment or the culture where this knowledge production and social interaction take place. It is, therefore, essential to consider information culture, which deals with specific issues related to organizational information.

This paper addresses the typology of information cultures (TICs) developed by Choo (2013) in order to investigate its influences in knowledge generation by university teams in cooperation with companies, and attempts to explore determinants for policy and practice. The basis of our empirical analysis is the development of innovation projects, which requires new ideas that are formed through a deep interaction among people in environments that have the conditions to enable knowledge creation (Popadiuk & Choo, 2006). It is important to highlight that, to the best of our knowledge, TICs are not considered empirically in the context of collaborative innovation projects in earlier research.

Aiming to explore how the TICs influence knowledge creation, this study also addresses the four modes of knowledge conversion conceived by Nonaka and Takeuchi (1995).

Two research objectives guide our work:

- to identify information behaviors and values that could describe the information culture in the context of innovative project teamwork, while knowledge creation occurs;

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Table 1
Summary of early research on information culture.

Analysis	Scope	Main contributions	Authors
The concept of information culture	Definition of information culture	Transformation of intellectual resources where the input are varying kinds of knowledge and information, and the output achieved is a processed intellectual product	Ginman (1988)
	Indicators of information culture	Values, utility of information in achieving operational and strategic success, attitudes towards it, norms, and practices that together define the information culture	Curry and Moore (2003), Choo, Bergeron, Detlor, and Heaton (2008) and Oliver (2011)
Components of information culture	Elements considered important for the evaluation of information culture	Information and communication flows that are horizontal and vertical; effective internal information sharing and environment; leadership; IT; information management; cross-organizational partnerships; processes and procedures	Curry and Moore (2003), Choo et al. (2008)
Types of information culture	Distinguishing the types of information culture	Open or closed; factually oriented or rumor and intuition-based; internally or externally focused; controlling or empowering; information channels or media	Davenport (1997)
		Functional culture; sharing culture; inquiring culture and discovery culture	Marchand, Kettinger, and Rollins (2001)
		Relationship-based; risk-taking; rule-following and result-oriented	Choo (2013)
Framework for information culture	Proposed stages to analyse and understand information culture	The information environment; information as a resource; work processes; innovation; and business performance.	Widén-Wulff (2000)

- to find resulting relationships between the TICs and the modes of knowledge conversion.

We use the case of university teams engaged in innovation projects, which are developed in collaboration with companies and supported by Brazilian government funds, as the empirical context to meet the aforementioned objectives and develop theoretical insights. Knowledge institutions in emerging economies such as Brazil reflect their enhanced capacities in innovation, and these changes are unfolding on a scale of global significance (Etzkowitz, Carvalho de Mello, & Almeida, 2005). Brazil has a strong public research sector, comprising most of the national system of innovation. Fostering university–industry (U–I) links has become the key areas of contemporary Brazilian innovation policy (Etzkowitz et al., 2005; Ponomariov & Toivanen, 2014).

2. Theoretical framing

Our study focuses on a central place of knowledge creation, namely academia. The University is a relevant case because it is a site of knowledge creation (Hautala & Jauhiainen, 2014). The current policy context makes it even more noteworthy, since universities are becoming more entrepreneurial (Etzkowitz & Viale, 2010), aiming at innovations and distinguished knowledge. Therefore, knowledge is created in U–I increasingly in teams with multiple views and skills that promote the novelty aspects of knowledge (Intemann, 2009).

As we mentioned above, one of this work's emphases resides in finding relationships between the TICs and the modes of knowledge conversion. One of the most important and widespread theories about organizational knowledge creation is defended by Nonaka and Takeuchi (1995). In their view, the organization creates knowledge through interaction and conversion between tacit and explicit dimensions. Knowledge conversion occurs in four modes: from tacit knowledge to tacit—mode of socialization; from tacit knowledge to explicit—mode of externalization; from explicit to explicit knowledge—mode of combination; and from explicit knowledge to tacit—mode of internalization. The SECI model is considered one of the rationales of this work.

The pillar of this discussion is information culture (IC). Table 1 summarizes the few studies that have attempted to explore the IC topic over the last two decades:

Based on a widely applied construct from Cameron and Quinn (2011) that has been used to differentiate organizational culture types and their relationships to organizational effectiveness, Choo (2013) neatly developed a typology of information cultures. He emphasizes elements from information behavior research. According to Choo, the information culture typologies are characterized by a set of five attributes: (1) the primary goal of information management; (2) information values and norms; (3) information behaviors in terms of information needs, (4) information seeking, and (5) information use. These five attributes serve as a guide to our empirical analysis. In addition, Choo (2013) classifies information culture into four categories: relationship-based culture, risk-taking culture, result-oriented culture, and rule-following culture:

Relationship-based culture: information management supports communication, participation, and a sense of identity. Information values and norms emphasize sharing and the proactive use of information. These values promote collaboration and cooperation. The focus is on internal information. Individuals seek information about social groups, as well as information for self and group-development. The main sources include well-connected individuals and human resource data.
Risk-taking culture: innovation, creativity, and the exploration of new ideas are encouraged while information is managed. Information values and norms emphasize sharing and the proactive use of information. These values promote innovation, development of new products or capabilities, and the boldness to take the initiative. The focus is on external information. The organization seeks ideas for new products, new markets, and information about trends and changes in its environment. The main sources include creative individuals, technology experts, and industry and government sources. Information is used to identify and evaluate opportunities, and promote entrepreneurial risk-taking.
Result-oriented culture: information management enables the organization to compete and succeed in its market or sector. Information values and norms call attention to control and integrity: accurate information is valued in order to assess performance and goal attainment. There is a focus on external information. The organization seeks information about customers, competitors, markets, as well as data to assess its performance. Information is used to understand clients and competitors, and to evaluate results.

Rule-following culture: information management reinforces the control of internal operations, rules and policies. Information values and norms emphasize control and standardized processes. The focus is on internal information. The organization seeks information about workflows, as well as information about regulatory or accountability requirements. The main sources include data generated by operations, policy documents, and specialists who advise on technical or legal matters. Information is used to control operations, improve efficiency, and provide accountability.

3. Research method

The choice of studying project teams of technological innovation is due to the magnitude of knowledge embedded in these groups since scientific and technological knowledge is the principal 'feedstock' for production. Twelve project teams, which were involved in technological innovation, were selected to take part in the study. The most important criterion for choosing the cases that they had ongoing projects in the period in which the interviews were conducted (2013–2014). This criterion was intended to ensure that the process of knowledge creation by the teams was active.

All of the scientists interviewed from the twelve teams were tenured faculty. Our qualitative analysis was based on more than 10 h of semi-structured interviews and on examining the whole body of empirical material—over 100 pages of transcript. The interviews lasted about fifty minutes and occurred on a typical day of work of the innovation teams. As a way to analyze the data obtained from the teams, we followed the recommendations of Bardin (1979) by using the categorical content analysis. The analysis of the material was conducted in three phases:

(1) Pre-analysis involved the first reading of the transcripts of the interviews; (2) Exploration of the material involved review of the transcripts to identify instances of the research variables (choices made according to the frequency, absence, order of appearance and co-occurrence); (3) treatment of the results involved the construction of the following analytical categorizations: (a) units of meaning; (b) condensed meaning units; (c) codes. This procedure ensured that the main characteristics of each team were classified according to the specific attributes of each information culture proposed by Choo (2013): (i) the primary goal of information management; (ii) information values and norms; (iii) information behaviors in terms of information needs, (iv) information seeking, and (v) information use.

The set of open interview questions were based on the following attributes (Table 2):

3.1. The PITE-FAPESP program

In Brazil, FAPESP (the São Paulo Research Foundation) funds research projects that are created and developed in partnerships between academic institutions and the private sector. The PITE Program (Partnership for Technological Innovation) was set up twenty years ago and has supported 197 projects.

In partnership with national and transnational technology-based companies, Brazilian scientists have developed original projects that result in innovations with the potential to compete with technologies produced in major world centers. Examples of these results include advanced equipment for fiber optic communication, technology for more accurate diagnosis of skin cancer, and improvements in control strategies and operational planning of petroleum refineries, resulting in benefits of tens of millions of dollars.

Table 2
Set of open questions.

Data collection	
Attributes	Open questions
The goal of information management Information values and norms	How do the team members give meaning and formalize the new ideas?
Information behaviors/information needs Information seeking	Talk about your personal and collective strategies of search and information retrieval
Information use	Talk about the development of mental maps, diagrams and notes. How often are they made? Regarding the information coming from all stages of the project, is it in a common language to all the team members? Have you created a system of organization of information, with relevant records for future retrieval and use?
Socialization Externalization Combination Internalization	What are the main areas of cooperation and exchange of information? Are all the team members always present? In what way the exchange of ideas and informal conversations are stimulated? Is the new knowledge gained in meetings often registered? In which formats? Talk about the project's impact on the individual and team learning.

4. Results

In this section, the twelve teams studied are characterized according to the TICs. Among the twelve teams analyzed, four showed a risk-taking culture. The rule-following culture is represented by five of the teams studied. This result indicates that the information culture of the teams is influenced by the information culture of the organization in which these teams are connected: academia.

We found the creation of academic subprojects (related to theses and dissertations) within the technological innovation project, which demonstrates the visible prioritization of some teams for the development of human resources. This aspect differs from what was expected by the researchers with regard to the team's orientation to the result (innovation). Thus, the information culture profiles of the innovation teams reflect some ongoing challenges in Brazil: the new instruments to support innovation bring to universities the need to adapt their modes of operation, definition of priorities, strategies, and expected results. Table 3 lists the specific characterization of each team in relation to the activity, information culture profile, and number of members involved.

Table 3
Specific characterization of the studied teams.

Team	Activity	Information culture	Members
1	Chemical engineering	Relationship-based	15
2	Biochemistry	Rule-following	5
3	Genetics	Risk-taking	5
4	Biochemistry	Rule-following	5
5	Computing	Relationship-based/result-oriented	8
6	Agricultural engineering	Risk-taking	8
7	Electrical engineering	Rule-following	12
8	Botany	Rule-following	6
9	Ecology	Relationship-based	10
10	Food technology	Rule-following	7
11	Microbiology	Relationship-based/risk-taking	10
12	Agricultural engineering	Relationship-based/risk-taking	8

Some particularities about the nature of the innovative activity are worth mentioning:

(1) Regarding the discipline: it is interesting to note that the teams with activities in the areas of biological sciences (genetics, ecology, botany, biochemistry, and microbiology) prioritize the records of information in laboratory notebooks (information values and norms); thus, ensuring the possible recovery of results for future use (e.g., replication).
(2) Regarding the product type: unlike the biological science teams, Team 5 with an activity in computing did not prioritize the formal records of the project phases. The team was the only one to present a resulted-oriented culture. For the innovation project, the team used an agile method (information behavior in terms of information needs), a characteristic that is due to the type of the expected product: software, which may quickly become obsolete.

4.1. Relationship-based culture

The Relationship-based culture was found in Team 1 (multidisciplinary) and Team 9, based on the synthesis of the following five attributes:

(1) The primary goal of information management:
T1: A virtual communication system (Moodle) was created, through which the exchange of internal information was encouraged on a daily basis.
T9: Weekly formal and daily informal meetings to encourage written brainstorming were promoted.
(2) Information values and norms:
T1: The multidisciplinary team encourages the presentation of information in a common language, to promote better understanding of the members from the different disciplines.
T9: *"We are looking to increase the frequency of written brainstorming, with a discussion and presentation of ideas, which is a less technical action and emphasizes interpersonal relations".*
(3) Information behaviors in terms of information needs:
T1: *"One concern we have in our project is that in the Moodle environment we try to document everything to facilitate our communication: weekly meetings, annual report of the team members, papers on the subject, all the studies that are attached to the project, etc".*
T9: *"We have our notes on personal notebooks, but we are not used to produce meeting records. What is important is the interaction between all the members. The team members make their notes as they prefer".*
(4) Information seeking:
T1: *"I always emphasize that every new information need be discussed at the group level; our members are working on issues that are interrelated, so sometimes it is not exactly what the person is workin ong, but he/she may need that information at some point".*
T9: The team created a sense of trust with members in relation to the frequency of meetings and the encouragement of co-creation. "*People feel safer with this frequent contact*".
(5) Information use:
T1: The team members take the initiative to contribute with new information by daily accessing patent databases, and these surveys are registered in the Moodle environment.
T9: The information use is guided by group discussions on surveys in scientific databases and electronic spreadsheets.

4.2. Risk-taking culture

The Risk-taking culture was found in Team 3 and Team 6, based on the synthesis of the following five attributes:

(1) The primary goal of information management:
T3: Team members are involved in managing information related to the intellectual property of the project, with the goal of generating a patent application.
T6: *"As we already have a lot of experience working with companies, the team members are trained to think about opportunities for innovation and development of new technologies. Our goal is to make the new information become a spin-off".*
(2) Information values and norms:
T3: The new information and new results of each stage of the project are repeated, discussed and re-examined in order to eliminate contradictions, all are stored in laboratory notebooks.
T6: The organization and registration of project information are made in the format of technical bulletins and the new ideas are presented in bimonthly workshops.
(3) Information behaviors in terms of information needs:
T3: *"There are other researchers outside of the team that can provide feedback and collaborate with our innovation project, whenever we have a question that we cannot solve in our group, we search for external information, such as technology experts".*
T6: *"We analyze and register meeting information that arises from discussions and suggestions of the partner company. These records are essential to avoid future misunderstandings".*
(4) Information seeking:
T3: Based on the analysis of documents from the partner company, the team seeks ideas for new projects by searching for research trends in the area.
T6: Members suggested the participation of technology experts from the partner company in the design phase of the project. They also collected information from the company for evaluation and proposal of new products.
Information use:
T3: The team identifies new opportunities for innovation through access to patent databases, scientific databases, and also by conducting written brainstorming sessions without formalisms.
T6: The information collected in the company is used at all stages of the innovation project and evaluated in comparison to information that is accessed in scientific databases.

4.3. Rule-following culture

The Rule-following culture was found in teams 2, 4, 7, 8 and 10, based on the synthesis of the following five attributes:

(1) The primary goal of information management:
T2: The team has a history of project development with a partner company. All project information is controlled by the norms and policies established by the company.
T4: *"We are developing the project with a contract that requires informational secrecy, if there is the possibility of a patent, we can not divulge any information, because all the project information belongs to the company".*
T7: Members spend much of their time trying to circumvent bureaucratic difficulties; the partner company imposes excessive formality in the informational control of the project.

T8: The team leader demands the annotation of all project activities in laboratory notebooks.
T10: The management of information is strictly based on the definition of project objectives by recording the results of project phases, analysis of the records, and decisions on the next steps.

(2) Information values and norms:
T2: *"We are developing the project by telling the 'story' of the product, based on the values of the partner company. All the specifications of our project follow the profile of the company".*
T4: The standards of informational confidentiality are reinforced by the team leader in weekly contact with members.
T7: Team members are individually responsible for documenting new inputs of the project and keep this information in a common archive for all the team members.
T8: The laboratory notebooks are controlled by the team leader; the team members need permission to make copies or use them outside the lab.
T10: *"Our control is related to the technical and internal information; we have flowcharts of what we consider the main project stages, which are the inputs, outputs, so we can have a general idea of the project".*

(3) Information behaviors in terms of information needs:
T2: Team members are encouraged to adapt the information content of the project to the company's expectations.
T4: *"All phases of the project require monthly reports which are under the control of the company".*
T7: *"I believe that the rigidity of the contract between the team and the company is an obstacle for any activity: when we need to modify any information, we need to ask permission, and we have to wait three months for reviews, during this time the activities are consequently hampered".*
T8: *"With respect to the standardization of the notebooks, I always try to give directions about how to write the experimental procedures in a way that the document can be understood by all of the team members and the partner company".*
T10: The partner company receives project information in the form of reports with the experimental data set attached.

(4) Information seeking:
T2: Based on the search of norms and documents from previous projects with the same partner company, the team makes scientific and informative reports.
T4: Team members seek internal information contained in laboratory notebooks to generate monthly reports for the partner company.
T7: *"The technology we are developing does not yet exist as a product in the market, so we need to seek information that is 100% internal to the project, especially with members who are technical experts".*
T8: The team is seeking a computer expert to assist in creating a database to store and standardize project information for future projects.
T10: Based on information generated through the experimental results of the project, the team creates manuals to be delivered to the partner company.

(5) Information use:
T2: The partner company evaluates reports of the monthly meeting and the next goals in order to control project progress.
T4: Marked by the registration of internal weekly meetings for retrieval and future use.
T7: The team uses a server to archive meeting reports in order to control and provide structured information for future phases of the project.
T8: Laboratory notebooks are used outside the workplace only with leader's permission and information contained in these records is transmitted in a report for the partner company.
T10: The team uses several tools of process and information management that have been adapted to the reality of the project.

4.4. Teams with two dominant information cultures

As predicted by Choo (2013), the typology does not imply that the IC of an organization would be characterized solely by one of the four types. Instead, it is suggested that most organizations would be displayed in different degrees, norms, and behaviors of all four types. The authors hypothesize that for many organizations two types of culture would dominate, as we observed in the following cases.

4.4.1. Two dominant ICs: Relationship-based and result-oriented

The two dominant ICs were found in Team 5, illustrated by the following aspects:

Relationship-based culture attributes: Team 5 encourages communication and emphasizes sharing and the proactive use of information: *"In the project we use all possible types of communication (videoconferencing, e-mail, telephone); the more we interact, the better the results. We use several types of visual and textual communication to minimize the doubts of the members and the response time with fewer problems. Besides oral communication, we use graphical and textual specifications and models that help to supplement what we speak".*

Result-oriented culture attributes: In team 5, accurate and reliable information is valued in order to assess performance and goal attainment: *"This project is based on an agile method and on 'sprints': we divide the project into stories, these stories are divided into tasks that are delegated and organized into sprints. At the end of each sprint, we have a product, and in the next sprint we have a new version of that product. We recorded all these processes in documents which are available on the website, as well as our publications".*

4.4.2. Two dominant ICs: Relationship-based and risk-taking

Another two dominant ICs were found in teams 11 and 12 as shown in the following aspects:

Relationship-based culture attributes: Both teams emphasized communication and encouraged sharing and the proactive use of information:

T11: Team 11 is multidisciplinary and involves members in the areas of agro-technology, pharmaceutical, organic chemistry, phytochemistry, pharmacology and toxicology. Due to this, communication and information exchange among members was constantly stimulated, and the different methodologies we are adapted to the reality of the project.
T12: *"We have divided the project into sub areas, and each member is responsible for making an informational survey, an extensive systematic search in each sub area, and all members present a weekly survey. Based on the weekly surveys we organized our discussions".*

Risk-taking culture attributes: Both teams manage information to encourage innovation, creativity, and the exploration of new ideas:

T11: *"We make frequent informational searches in patent databases such as Direct Innovation Index. Our team generated a patent with the partner company, and we are responsible for a new product on the market, which is very rewarding for us".*
T12: In team 12, there is a focus on external information: *"Our project involved the creation of courses via international teleconferences, training, preparation of manuals, national and international*

Table 4
Main characteristics of the information culture profiles.

Typology of information cultures				
Attributes	Relationship-based	Risk-taking	Rule-following	Result-oriented
Primary goal of information management	Informal meetings encouraging written brainstorming	Related to the intellectual property of the project	Information is controlled by the norms established by the partner company	The innovation project is based on an agile method for goal achievement
Information values and norms	Presentation of project information in a common language	New results are re-examined in order to eliminate contradictions	Laboratory notebooks are controlled by the team leader	Every accurate information is documented and presented on a website
Information behaviors/information needs	Project documentation available in a virtual communication system	Need of external information – participation of researches – non team members	Standardization of project information and monthly reports to the partner company	The project is divided into tasks that are delegated and organized into sprints
Information seeking	Group level discussions for every new information	Groups seek information about the partner company for evaluation and proposal of new products	Team members seek internal information via laboratory notebooks	Team seeks external information about market research in every sprint for a new product
Information use	Guided by group discussions about surveys in scientific databases	Patent databases are used in order to identify new opportunities for innovation	Registration of internal weekly meetings for retrieval and future use	The performance is evaluated in the end of every sprint, resulting in a new version of the product

collaboration, international simulation models, etc. International collaborators were here to meet our structure, and we had a great experience of exchanging information with them".

Table 4 summarizes the main characteristics found in the teams according to the TICs.

5. Discussion and final considerations

Our findings revealed that teams with a higher number of members (8–15), as well as multidisciplinary teams, were identified with a relationship-based culture. That leads to the idea that larger teams realize the need to promote collaboration and are likely to seek information for group and self-development. The focus is on internal (group) information and in the need to maintain well-connected individuals. We consider that this kind of information culture, therefore, foments knowledge socialization since the tacit knowledge, which is difficult to transfer, is fully dependent upon the relationships between well-connected and collaborative individuals.

Another observation is related to the risk-taking culture: among the 12 teams analyzed, only four showed a risk-taking culture: two of them have two dominant culture profiles (see Table 1). This result is contrary to what was expected by the researchers, given the premise that innovation teams, by their nature, must have a culture in which information is managed to encourage innovation, creativity, and the exploration of new ideas. Teams characterized by a risk-taking culture presented a focus on external information, arising from frequent contact with the partner company and resulting in patents. In these cases, information values promote individuals' boldness to take the initiative. We admit that this kind of information culture, therefore, promotes the externalization of knowledge, since individuals are encouraged to explore new ideas (i.e., the knowledge that has just been externalized, from tacit for the individual to explicit for the team).

Furthermore, the rule-following culture is represented by five of the teams studied. This result indicates that the information culture of the teams is influenced by the information culture of the organizations in which these teams are connected: academia and the partner company. Norms such as informational secrecy, the bureaucratization of processes, and regulation of information flow are often found in the cases studied. On the other hand, the rule-following culture can be seen in a positive way, even in innovation teams. The controlled record of (technical) information for retrieval and use in future projects is an example of information values and norms that emphasizes control and integrity. Based on this aspect, we suppose that this kind of information culture stimulates the combination of knowledge; in other words, the conversion of explicit knowledge generated by an individual is added to the explicit knowledge of the team and of the organization.

The result-oriented culture was found in only one of the 12 teams (Team 5), seeing that this team revealed two dominant information culture profiles. In this case, information was valued in order to assess performance and goal attainment. The method of teamwork is heavily based on results, and the information flow follows the same perspective. Every step of the method was characterized by sprints: from creating a new product, to evaluating informational performance and lessons learned. Bearing that in mind, it appears that this kind of culture favors the internalization of knowledge; i.e., the conversion of parts of the explicit knowledge of the team into tacit knowledge of the individual.

To sum up, the main results showed plausible relationships between the risk-taking culture and externalization of knowledge; the rule-following culture and the combination of knowledge; the result-oriented culture and internalization of knowledge; and the relationship-based culture and socialization of knowledge, as we represent in Fig. 1:

The relationships between the TICs and knowledge creation are part of an informational, interactive, dynamic, social process comprised of individuals (team members) and objects (information and knowledge) resulting in a product (innovation). The innovative process that exists in collaborative projects may be described by two conceptual axes: the involvement of individuals with information and their involvement with knowledge generation (Vick, Nagano, & Santos, 2013). By studying the typology proposed by Choo (2013), we suggest how the theory of knowledge creation and the process of team formation can be benefited by analysis and guidance related to the four information cultures.

Finally, it is worth mentioning the following possibilities to continue this research. The first, and most immediate, concerns the chance of extending the study by analyzing additional teams from companies, which are engaged in innovation projects; thus expanding the potential of interpreting the results and relationships that we found.

A further opportunity for future study would be to investigate how the profile of the team leader affects the goal of information management, information values and norms, and information behaviors in terms of information needs, information seeking, and

Fig. 1. Relationships between the TICs and knowledge creation.

information use. These new studies could use methods of triangulation and techniques of data collection, adopting measures based on perceptions (questionnaires and interviews) and indicators of intellectual production (document analysis) when comparing different areas. Another possibility for future research is to explore the influence of the nature of the team's activity (e.g., discipline, product type, and task) in the information culture profiles and knowledge creation.

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References

Bardin, L. (1979). *Content analysis*. Portugal: Edições 70.
Cameron, K. S., & Quinn, R. E. (2011). *Diagnosing and changing organizational culture: Based on the competing values framework*. Reading, MA: Jossey Bass.
Choo, C. W. (2013). Information culture and organizational effectiveness. *International Journal of Information Management*, *33*, 775–779.
Choo, C. W., Bergeron, P., Detlor, B., & Heaton, L. (2008). Information culture and information use: An exploratory study of three organizations. *Journal of the American Society for Information Science and Technology*, *59*(5), 792–804.
Curry, A., & Moore, C. (2003). Assessing information culture: An exploratory model. *International Journal of Information Management*, *23*(2), 91–110.
Davenport, T. H. (1997). *Information ecology: Mastering the information and knowledge environment*. New York, NY: Oxford University Press.
Etzkowitz, H., Carvalho de Mello, J. M., & Almeida, M. (2005). Towards meta-innovation in Brazil: The evolution of the incubator and the emergence of a triple helix. *Research Policy*, *34*, 411–424.
Etzkowitz, H., & Viale, R. (2010). Polyvalent knowledge and the entrepreneurial university: A third academic revolution? *Critical Sociology*, *36*, 595–609.
Ginman, M. (1988). Information culture and business performance. *IATUL Quarterly*, *2*(2), 93–106.
Hautala, J., & Jauhiainen, J. (2014). Spatio-temporal processes of knowledge creation. *Research Policy*, *43*, 655–668.
Intemann, K. (2009). Why diversity matters: Understanding and applying the diversity component of the national science foundation's broader impacts criterion. *Social Epistemology*, *23*, 249–266.
Marchand, D., Kettinger, W., & Rollins, J. (2001). *Information orientation: The link to business performance*. New York, NY: Oxford University Press.
Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company*. New York, NY: Oxford University Press.
Oliver, G. (2011). *Organizational culture for information managers*. Oxford: Chandos Publishing.
Popadiuk, S., & Choo, C. W. (2006). Innovation and knowledge creation: How are these concepts related? *International Journal of Information Management*, *26*, 301–311.
Ponomariov, B., & Toivanen, H. (2014). Knowledge flows and bases in emerging economy innovation systems: Brazilian research 2005–2009. *Research Policy*, *43*, 588–596.
Vick, T. E., Nagano, M. S., & Santos, F. A. (2013). Identifying the information management process and knowledge creation in technology-based companies: A Brazilian comparative case study. *Knowledge Management Research & Practice*, *11*, 278–287.
Widén-Wulff, G. (2000). Business information culture: A qualitative study of the information culture in the Finnish insurance business. *Information Research*, *5*(3). Available at:. http://informationr.net/ir/5-3/paper77.html

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