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INFLUENCE OF THE HIERARCHICAL LEVEL ON KNOWLEDGE MANAGEMENT TOOLS AND PRACTICES: A STUDY ON MANAGERS AND TECHNICIANS[1]

INFLUÊNCIA DO NÍVEL HIERÁRQUICO EM RELAÇÃO AO USO DE FERRAMENTAS E PRÁTICAS DE GESTÃO DO CONHECIMENTO: UM ESTUDO COM GESTORES E TÉCNICOS

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Abstract

Company employees have always joined efforts to create, capture, organize, share, disseminate and use knowledge for organizational excellence. The objective of this work is to verify the influence of the hierarchical level of employees in relation to the knowledge management applied in the organizations. This descriptive-quantitative study had as research method the gathering of information through a structured questionnaire that was responded by 319 managers and technicians of fifteen large and medium-sized companies operating in the software industry in Brazil. The results indicated significant differences on knowledge management practiced by managers and technicians. Specifically, in relation to knowledge management practices, it was verified that from every three practices, two presented a higher degree of utilization by the surveyed managers than by the surveyed technicians. Regarding information technology tools for knowledge management, the surveyed managers identified three out of four tools as the most intensely used. As conclusion, there is adherence to practices and tools aimed at knowledge management with strategic management logic, emphasizing different roles, but somehow integrated, between managers and technicians.

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Resumo

Os colaboradores da empresa sempre se uniram para criar, capturar, organizar, compartilhar, disseminar e usar o conhecimento para a excelência organizacional. O objetivo deste trabalho é verificar a influência do nível hierárquico do funcionário em relação à gestão do conhecimento (GC) praticada nas organizações. Este estudo descritivo-quantitativo teve como método de pesquisa o levantamento de informações com aplicação de questionário estruturado junto a 319 funcionários gestores e técnicos de quinze empresas de grande e médio porte atuantes na indústria de software no Brasil. Os resultados indicaram diferenças significativas sobre a GC por parte de gestores e técnicos. Especificamente em relação às práticas de GC, verificou-se que a cada três práticas, duas foram indicadas com maior grau de utilização por parte dos trabalhadores gestores do que dos técnicos pesquisados. Já acerca das ferramentas de tecnologia da informação voltadas à GC, verificou-se que três em cada quatro ferramentas foram apontadas com maior intensidade de uso pelos gestores pesquisados. Como conclusão, há aderência das práticas e ferramentas voltadas à gestão do conhecimento com a lógica da gestão estratégica, ao enfatizarem papéis distintos, mas de certa forma integrados, entre gestores e técnicos.

Palavras-chave: Gestão do conhecimento. Nível hierárquico. Ferramentas e práticas de GC. Indústria de software.

Introduction

The development of the information society or knowledge era, as raised by Castells (1999) and Stewart (1998), has contributed to the change of organizations within them. In this context, Saadoui and Mekkaoui (2015) suggests that the knowledge based economy arises, where knowledge is seen as an asset that is the main source of sustainable competitive advantage. Although some aspects such as infrastructure and access or use of Information Technology (IT) are still deficient in the Brazil, as well as the lack of synergy between educational politics, science and industrial technology, as indicated by Corrêa et al. (2014), companies assume a leading role in the current context, particularly in terms of research and development activities associated with the creativity of its employees. The software industry, through its managers and technicians, aims to become increasingly effective to satisfy its customers with differentiated products and services, disseminating knowledge management practices within such economic sector (BARI et al., 2016; ROSE, 2015).

The size and importance of the software industry in Brazil can be deduced by the fact that in 2015 it consolidated the 7th position worldwide, with revenues of approximately US$ 60 billion in Information Technology (IT), which includes hardware, software and services, equivalent to 3.3% of Brazilian GDP and 2.7% of global IT investments that year (ABES, 2016). The Brazilian national market comprises approximately 13,950 companies dedicated to the development, production, distribution of software and services in the domestic market (ABES, 2016).

Knowledge, as a resource, is a fundamental item so that companies in this industry may continuously offer differentiated products and services that add value to customers and their businesses. Knowledge as resource is presented in the knowledge based view (KBV) proposed by Eisenhardt and Santos (2002). Braganza et al. (2017) affirm that the generated knowledge is stored today in big data, that is, the large volumes of data of organizations that become essential for the development of capacities in the long term.

Nevertheless, companies are composed by numerous employees that are distributed in different hierarchical levels. The view that each of these employees has about the relevance of knowledge as a resource can vary significantly. These different views can be constructed from the

hierarchical level in which a given individual is inserted. In other words, it is possible to affirm in a simplistic way, that different angles of vision considering the same resource can result in diverse points of view about that same resource, specifically knowledge. However, regardless of the hierarchical level, there are always efforts carried out by the company employees to create, capture, organize, share, disseminate and use knowledge to achieve organizational excellence (SINGH, 2008).

Considering the importance of company employees in the creation and dissemination of knowledge and, even more, their relevance in the management of such knowledge in the company, this article aims to verify the influence of the hierarchical level of the employee in relation to the knowledge management applied in the organizations. In this sense, the study seeks to identify if there are significant differences in the vision of two groups of employees of different hierarchical levels: managers and technicians. The field research sought to answer the previous question by examining 15 medium or large companies in the software industry in Brazil.

Several studies related to knowledge management have been found, for example, leadership styles (SINGH, 2008); organizational performance and innovation (BARI et al., 2016); transformational leadership and organizational effectiveness (FOGANHOLO; KUNIYOSHI, 2016), and transactional leadership (GHANBARI; ABEDZADEH, 2016), but none that specifically addressed the approach of the present study.

To this end, the article presents a theoretical support about knowledge management, beyond the diverse meanings given to knowledge management in different hierarchical levels. Following, the methodology of the field research is explained, as well as the analysis of the obtained results. Finally, the main conclusions of the study are presented, as well as the limitations found and suggestions for future studies.

Related works

Knowledge Management in Companies

Knowledge is an inherent faculty of the human being. It can then be inferred that knowledge is intrinsic to the human being, occurring as a result of experiences or through thinking or reasoning (BRAUNER; BECKER, 2006). However, the perception of knowledge as something dynamic was profoundly transformed from the ideas presented by Polanyi (1964), who pointed out the tacit knowledge that exists in people. Nonaka and Takeuchi (1997) suggest that knowledge is considered as a pragmatic human phenomenon, always in continuous development. For De Sordi (2015), knowledge is the new learning resulting from the analysis and reflection of information according to the values and mental model of the one who develops it, giving it a better adaptive capacity to the circumstances of the real world.

According to Davenport and Prusak (1999), knowledge is composed of what is known and evaluated in the human mind, including its respective reflection, synthesis and contextualization. Fleck (1997) further states that another important characteristic should be associated to knowledge: the meaning it gives to things and to facts.

Therefore, it is clear that knowledge is an essential part of the development of the human being. Standing on the premise that man is essentially a social being while pursuing his quest for collective life, it can be understood that corporations, which are made of and by human beings, can be considered as auspicious places for the acquisition, creation, application, sharing and dissemination of knowledge. In this sense, Singh (2008) points out to master the art of knowledge management practices in a software organization, people must be provided with a kind of leadership style in which each individual employee is given sufficient power, authority, as well as the responsibility to manage their own life on the workplace.

Stewart (1998) and Castells (1999) have highlighted terms such as 'information society' or 'knowledge era', which express the exact measure of the importance of these assets for contemporary organizations, or as Corrêa et al. (2014) propose, as a new technological and productive standard, and of capitalist accumulation, given that information, knowledge and technological innovations are essential resources for the development of both organizations and nations.

Davenport and Prusak (1999) argue that the application of knowledge can generate increasing returns and new perspectives for organizations, especially as knowledge assets increase with their use, since ideas generate new ideas, and shared knowledge enriches all those who participate in it. Drucker (2001) corroborates this view by stating that the typical enterprise will be

knowledge-based, and that large firms in particular do not have much choice in becoming knowledge-based organizations.

Therefore, a better understanding of the treatment given by the companies to the manipulation of knowledge becomes necessary. Nonaka (1990) understands that the process of creation and dissemination of knowledge is first and foremost a process of social conversion, in which tacit knowledge and explicit knowledge expand within the organization in qualitative and quantitative terms. For Nonaka and Takeuchi (1997), tacit knowledge is associated with people's ability to act, their skills, expertise, experiences, competences, reasoning, mental models, conclusions, generation of ideas, opinions, emotions, values, intuition, creativity, and beliefs. Then, explicit knowledge results from tacit knowledge, and can be understood as the materialization or representation of someone's knowledge from some kind of record, written or mediated, and that can be transferred, transmitted, communicated, viewed, stored, preserved, understood and assimilated by others. In that way, explicit knowledge acts as a guide that leads people to the production of new knowledge whether it is tacit or explicit.

According to Eisenhardt and Santos (2002), knowledge management at companies gains importance to the extent that the codification of knowledge becomes real, that is, when tacit knowledge becomes more explicit in a way that can be more easily communicated and understood for people. The authors explore the importance of knowledge-based view, by considering knowledge as a strategic resource to the company (BARI et al., 2016).

The management of this resource, that is, knowledge management, is a specialty of the administration that consists of applying a set of techniques of this area of knowledge to manage knowledge as one of the resources used by employees of the company in their daily life, as identified by Santos et al. (2001). According to Pillania (2009), knowledge management is a systematic, organized, explicit, deliberate, and continuous process of creating, disseminating, applying, renewing, and updating knowledge to achieve organizational objectives. For Dalkir (2011), knowledge management is a deliberate and systematic coordination of people, technologies, processes and company structure in order to create values through the use of knowledge and innovation. This coordination is accomplished through the creation, sharing, and application of knowledge through the nurture of valuable lessons learned and best practices within corporate memory, continuously fostering organizational learning.

In the specific case of software industry companies, one of the basic premises of existence is the knowledge generation and dissemination itself, so the importance of knowledge management activities seems to be even more evident (BARI et al., 2016, ROSE, 2015). According to Carrillo and Anumba (2005), knowledge management should be seen as empowerment for the transformation of knowledge into assets meant to enable a continued and sustainable growth. However, the success of an effective knowledge management arises from the correct structuring of practices and technology tools that support its evolution (ZAIM et al., 2007). Song (2001) argues that, through the use of knowledge management practices and initiatives supported by information technology tools, the information technology companies surveyed during the field research of his very own study increased their effectiveness.

Knowledge Management Seen from Different Hierarchical Levels

In this subsection, we question the perception that knowledge management is or should be perceived in a homogeneous way by different hierarchical levels, especially by managers and technicians (operational). Some researches related to the subject will be presented to show that there are signs of differences in approaches and perceptions of knowledge management determined by hierarchical levels, especially in managers and technicians, present in contemporary organizations.

As a generator of competitive advantages, knowledge management assumes, from the organizational point of view, the configuration of a resource focused on a superior innovation and performance compared to that of the competition (BARI et al., 2016). In this context, it is observed that the ideal knowledge management practice is closely related to strategic management, by proposing greater interaction and integration between managers and technicians, and greater use of the skills of technicians (operational level) to participate in the formulation process of the strategy through suggestions that result in organizational innovations (MINTZBERG, 1990). The concept of strategic management by Mintzberg (1994) opposes to the clear separation between thinking

(strategy formulated only by managers) and action (execution by technicians), since this separation presupposes that the strategist (manager) can analyze and formulate without closely knowing the products, the factory floor, and company clients.

The classic view that strategic decisions are strictly related to the company's external problems tends to endure serious criticism from academics and practitioners of strategy, according to Mintzberg (1994). According to the author, this would result in the disconnected attitude of managers from the operational details (delegated to the technicians, responsible for the implementation of the formulated strategy) and they would focus only on the external thinking (formulation of future strategies seeking to align the company with trends external to their ambience). Based on the approach of this author, when considering knowledge management as an inherent practice of strategic management in an organization, it is assumed that managers will focus on information technology practices and tools that allow greater communication and interaction with technicians, besides stimulating greater involvement and participation of technicians in the process of formulating strategies and policies for the company. In relation to the technicians, it is expected from the strategic management point of view, a greater ease to formulate opinions and contribution to innovation and establishment of competitive advantages (SINGH, 2008).

Mintzberg (1994) and Hrebiniak (2006), suggest that the perception of knowledge management by different hierarchical levels would obey the strategic management logic, which defends a greater interaction level among managers and technicians in the process of formulating objectives and implementing the strategy through tools that help communicate, monitor achievement of objectives, and measure performance. Therefore, based on these authors, it would be up to the manager to emphasize knowledge management practices that aim at communication with the technicians level, in order to use their competencies to help formulate feasible strategies; and at the level of technicians, would involve greater involvement in innovation and overall improvements that may impact products, processes, customers, and markets.

In the article written by Singh (2008), the role of leadership in knowledge management was analyzed, based on the impact of the different leadership styles. The results of the research indicated a positive relationship with knowledge management practices when there are leadership styles that focus on greater delegation or that play an advisory role with their collaborators.

Foganholo and Kuniyoshi (2016) demonstrated through their study that managers could consider the type of transformational leadership as a factor to contribute to organizational performance within the processes of knowledge conversion. However, in the structural model of the present study, no significant difference was found between the two hierarchical groups (managers and technicians).

Considering the research of Bari et al. (2016), that analyzed the relationship between innovation and organizational performance, there was a high positive relation between the acquisition and dissemination of knowledge, the capacity to respond to knowledge, as well as to the innovation capacity. Nevertheless, a weak positive relationship was found between the acquisition of knowledge regarding innovation or organizational performance.

Meanwhile, in the article by Ghanbari and Abedzadeh (2016), a positive and significant relationship was found between transactional leadership and knowledge creation, as well as knowledge transfer, knowledge utilization, knowledge retention, and knowledge capture.

In his study, Rotimi (2016) analysed the factors that influence knowledge management at the operational level employees within companies in New Zealand. The author indicates that there is a relevant participation of operational employees in the management of knowledge in the company in order to promote its success.

To verify if knowledge management in different hierarchical levels in Brazilian organizations follows the logic of the authors, as discussed above, the methodology of this article is presented in order to determine the information technology tools and practices used by managers and technicians.

Research methods and materials

The present article performs a descriptive study of quantitative nature, which considers information gathering from companies operating in the software industry of Brazil as a research method, following the classification indicated by Hair Jr et al. (2005) and Yin (2015). To achieve this,

it uses primary data collection through the application of structured questionnaires to the professionals of companies operating in this specific industry.

The field research sample was selected from criteria of convenience and accessibility for data collection. Fifteen medium or large size companies, with outstanding relevance in their business sectors, were surveyed from the software industry of Brazil. The structured electronic questionnaire was applied to 319 employees of the surveyed companies, of which 67 had a management position and 252 had a technical position or function.

The existing records in the database, at the end of the collection phase, were transformed into a Microsoft Excel spreadsheet for later export to the SPSS (Statistical Package for the Social Sciences) application, aiming at a more refined treatment of the collected data in the field research.

For both groups (managers and technicians), 46 knowledge management practices were presented, generally referred as 'Pn' and distributed in five dimensions:

• Strategy dimension (PAn)

PA01 - Declared knowledge management strategy

PA02 - Declared knowledge management policies

PA03 - Innovation management

PA04 - Management by competences

PA05 - Corporate communication of knowledge management

PA06 - Knowledge benchmarking

• Structure dimension (PBn)

PB07 - Innovation centers

PB08 - Call center/help desk/online support

PB09 - CKO/CKM - (Chief of Knowledge Management or Certified Knowledge Manager) - knowledge management manager

PB10 - Competence center

PB11 - Internal area or specific department for knowledge management

PB12 - Specialists networks

PB13 - Spaces and situations dedicated to the socialization of knowledge

• People dimension/organizational culture (PCn)

PC14 - Competence mapping

PC15 - Knowledge mapping

PC16 - Career plans

PC17 - Recognition and reward system for knowledge management

PC18 - Coaching (tutoring for competences development) for training leaders in knowledge management

PC19 - Mentoring (tutoring for career development) for the formation of leaders towards knowledge management

PC20 - Repository of lessons learned

PC21-Repository of best practices

PC22 - Communities of practice

PC23 - Corporate education

PC24 - Face-to-face trainings with instructors

PC25 - Knowledge multipliers

PC26 - Story telling

• Process dimension (PDn)

PD27 - Process mapping

PD28 - Knowledge processes evaluation system

PD29 - Patents

PD30 - Intellectual property

• Technology dimension (PEn)

PE31 - Knowledge bank

PE32 - Content management

PE33 - Specific applications for knowledge search

PE34 - Competitive intelligence

PE35 - Business intelligence - BI

PE36 - Internal Wikis (virtual encyclopedias), internal blogs (virtual journals) or internal twitters (news publishing page)
PE37 - Internal yellow pages
PE38 - Corporate portal (or for specific departments)
PE39 - Corporate library/document repository (physical or electronic)
PE40 - Virtual meetings and conferences
PE41 - Virtual trainings with the presence of online instructors
PE42 - E-learning (self-learning without the presence of instructors)
PE43 - Corporate University
PE44 – Knowledge summarization
PE45 - Knowledge inventories
PE46 - Ontology (essence and nature of knowledge) or taxonomy (systematic classification of knowledge)

Similarly, both groups (managers and technicians) were presented with information technology tools for knowledge management, generally referred as 'Fn' and distributed in six dimensions:

• Content creation dimension (FAn)
FA01 - Authorship
FA02 - Models
FA03 - Annotations
FA04 - Data mining
FA05 - Experts' profile
FA06 - Blogs (electronic diary based on web technology)
• Content management dimension (FBn)
FB07 - Metadata definition
FB08 - Content classification
FB09 - Content archiving
FB10 - Personal knowledge management
• Communication and collaborative technologies dimension (FCn)
FC11 - Landline
FC12 - Mobile phone
FC13 - Phone via Internet (Skype, others)
FC14 - Videoconference
FC15 - Chat rooms
FC16 - Instant messaging
FC17 - Email
FC18 - Discussion forums
FC19 - Groupware (collaborative software)
FC20 - Wikis (open encyclopedia based on web technology)
FC21 - Workflow (workflow management)
• Network technologies dimension (FDn)
FD22 - Intranets
FD23 - Extranets
FD24 - Web servers and browsers
FD25 - Knowledge repository
FD26 - Corporate portal of the company or specific area
• E-learning dimension (FEn)
FE27 - CBT (computer-based training)
FE28 - WBT (web-based training)
FE29 - EPSS (electronic performance support system)
• Artificial intelligence dimension (FFn)
FF30 - Specialized systems
FF31 - DSS (decision support system)
FF32 - Customization/personalization

FF33 - Recommendation system (compares data collections and suggests a list of recommendations)
FF34 - Preview
FF35 - Knowledge maps
FF36 - Intelligence agents
FF37 - Automated taxonomy system
FF38 - Content analysis (summarization)

Presentation and discussion of results

The following results are presented by segmenting the view of managers and technicians, regarding knowledge management practices and tools in the surveyed companies. First, all the results of the scores attributed by the 319 respondents are presented. Afterwards, the main results found are summarized for each of the two analyzed groups: managers and technicians.

Results of Knowledge Management Practices

The main results of the field research regarding the identified knowledge management practices in the surveyed companies are consolidated in Table 1. Here, it is possible to observe in descending order, for each researched knowledge management practice, the most designated score by the respondents, their frequency, and the respective percentage, as well as the average score of the practice in question.

The average scores of the 46 knowledge management practices attributed by the 319 respondents ranged from 3.56 to 7.59 in a scale from 0 (zero) to 10 (10) points.

Table 1: Ranking of knowledge management practices

Knowledge management practices	Most designated score	Frequency of the most designated scores	Percentage of the most designated score	Average score
First segment				
PE40. Virtual meetings and conferences	8	107	33.60%	7.59
PE41. Virtual training	8	99	31.00%	7.37
PC24. Face-to-face training	8	87	27.30%	6.74
PE42. E-learning	6	87	27.30%	6.58
PB08. Call center/help desk/support	7 e 8	68 (each)	21.3 % (each)	6.57
PE38. Corporate portal	8	99	31.00%	6.57
PE39. Corporate library	6	113	35.40%	6.49
PD28. Evaluation system	6	86	27.00%	6.46
PB07. Innovation centers	6	106	33.20%	5.97
PD27. Process mapping	6	84	26.30%	5.91
PA03. Innovation management	6	82	25.80%	5.85
Second segment				
PB13. Spaces and situations	6	95	29.80%	5.80
PC16. Career plans	4	68	21.30%	5.78
PC15. Knowledge mapping	5	90	28.20%	5.77
PE31. Knowledge bank	6	88	27.60%	5.77
PE32. Content management	6	69	21.70%	5.76
PA05. Corporate communications	5	79	24.80%	5.75
PC25. Knowledge multipliers	6	88	27.60%	5.74
PD33. Knowledge search	5	80	25.10%	5.73
PC14. Competence mapping	6	90	28.20%	5.72
PD30. Intellectual property	6	95	29.80%	5.67
PA06. Benchmarking	5	80	25.10%	5.66
PE34. Competitive intelligence	5	89	27.90%	5.60
Third segment				
PD29. Patents	6	73	22.90%	5.54
PC17. Recognition system	5	88	27.60%	5.50
PC21. Repository of best practices	6	102	32.00%	5.35

PC22. Communities of practice	5	104	32.60%	5.32
PE35. Business intelligence	5	93	29.20%	5.32
PA02. Declared policies	5	82	25.80%	5.27
PA01. Declared strategy	6	71	22.30%	5.24
PA04. Management by competences	5	71	22.30%	5.22
PB12. Specialists networks	4	75	23.50%	5.16
PC23. Corporative education	4	79	24.80%	4.96
PB10. Competence center	4	88	27.60%	4.95
PE36. Wikis, blogs, twitters	5	77	24.10%	4.95
Forth segment				
PC20. Repository of lessons learned	5	105	32.90%	4.86
PC26. Story telling	4	72	22.60%	4.82
PB09. CKO/CKM	4	73	22.90%	4.75
PB11. Internal area/specific department	4	80	25.10%	4.66
PE37. Internal yellow pages	6	74	23.20%	4.49
PE43. Corporate University	4	96	30.10%	4.26
PE44. Summarization	4	86	27.00%	4.17
PE45. Inventory	4	81	25.40%	4.16
PC18. Coaching	5	90	28.20%	4.12
PC19. Mentoring	4	81	25.40%	3.80
PE46. Ontology/taxonomy	2	67	21.00%	3.56

Knowledge management practices were classified by respondents of the survey, being considered relevant (to a greater or lesser degree) for their activities, which agrees with Bari et al. (2016) about the importance of the implementation of these practices for the evolution of software companies.

Influence of the Hierarchical Level - Knowledge Management Practices

The main results of the field research regarding the identified knowledge management practices in the surveyed companies in relation to the hierarchical level of the respondents (managers or technicians) are consolidated in Table 2. There, it is possible to observe each researched knowledge management practice, the general average score, and the average scores indicated by the surveyed managers and technicians. In addition, the results of the applied statistical test for the validation of the significant differences are also evidenced.

Table 2? Comparative summary of the main results about knowledge management practices between managers and technicians

Knowledge management practices	General average score	Average score of managers	Average score of technicians	Significant differences
PA01. Declared strategy	5.24	5.78 (a)	5.10	0.00
PA02. Declared policies	5.27	5.79 (a)	5.13	0.01
PA03. Innovation management	5.85	6.24 (a)	5.74	0.02
PA04. Management by competences	5.22	5.60 (a)	5.12	0.06 (b)
PA05. Corporate communication	5.75	6.03 (a)	5.67	0.10 (b)
PA06. Benchmarking	5.66	5.88 (a)	5.61	0.26 (b)
PB07. Innovation centers	5.97	5.87	6.00 (a)	0.57
PB08. Call center/help desk support	6.57	6.58 (a)	6.57	0.73 (b)
PB09. CKO/CKM	4.75	5.04 (a)	4.67	0.30 (b)
PB10. Competence center	4.95	5.30 (a)	4.86	0.09 (b)
PB11. Internal area/specific department	4.66	5.04 (a)	4.56	0.14 (b)
PB12. Specialists networks	5.16	5.37 (a)	5.10	0.23 (b)
PB13. Spaces and situations	5.80	6.24 (a)	5.69	0.02
PC14. Competence mapping	5.72	6.31 (a)	5.56	0.00
PC15. Knowledge mapping	5.77	6.36 (a)	5.62	0.00
PC16. Career plans	5.78	6.25 (a)	5.66	0.01
PC17. Recognition system	5.50	5.79 (a)	5.42	0.13 (b)
PC18. Coaching	4.12	4.48 (a)	4.02	0.13 (b)
PC19. Mentoring	3.80	3.94 (a)	3.76	0.68 (b)

PC20. Repository of lessons learned	4.86	5.19 (a)	4.77	0.06 (b)
PC21. Repository of best practices	5.35	5.57 (a)	5.29	0.19 (b)
PC22. Communities of practice	5.32	5.66 (a)	5.23	0.03
PC23. Corporative education	4.96	5.31 (a)	4.86	0.07 (b)
PC24. Face-to-face training	6.74	7.10 (a)	6.65	0.12 (b)
PC25. Knowledge multipliers	5.74	6.18 (a)	5.62	0.02
PC26. Story telling	4.82	5.27 (a)	4.69	0.06 (b)
PD27. Process mapping	5.91	6.34 (a)	5.79	0.02
PD28. Evaluation system	6.46	6.81 (a)	6.37	0.06 (b)
PD29. Patents	5.54	5.64 (a)	5.51	0.51 (b)
PD30. Intellectual property	5.67	5.61	5.68 (a)	0.61
PE31. Knowledge bank	5.77	6.19 (a)	5.66	0.01
PE32. Content management	5.76	5.87 (a)	5.73	0.45 (b)
PE33. Search for knowledge	5.73	5.97 (a)	5.67	0.15 (b)
PE34. Competitive intelligence	5.60	5.93 (a)	5.51	0.02
PE35. Business intelligence	5.32	5.60 (a)	5.25	0.12 (b)
PE36. Wikis, blogs, twitters	4.95	5.00 (a)	4.94	0.94 (b)
PE37. Internal yellow pages	4.49	4.57 (a)	4.47	0.79 (b)
PE38. Corporate portal	6.57	7.01 (a)	6.45	0.06 (b)
PE39. Corporate library	6.49	7.06 (a)	6.34	0.00
PE40. Virtual meetings and conferences	7.59	7.91 (a)	7.50	0.07 (b)
PE41. Virtual training	7.37	7.73 (a)	7.27	0.07 (b)
PE42. E-learning	6.58	7.03 (a)	6.46	0.00
PE43. Corporate University	4.26	4.54 (a)	4.19	0.26 (b)
PE44. Summarization	4.17	4.58 (a)	4.06	0.08 (b)
PE45. Inventory	4.16	4.51 (a)	4.07	0.09 (b)
PE46. Ontology / taxonomy	3.56	3.60 (a)	3.55	0.98 (b)

Legend: (a) highest average of the two analyzed groups; (b) significant difference to managers.

To examine the differences found between the responses given to each variable by the managers and technicians, regarding knowledge management practices, it was used the non-parametric Mann-Whitney test. This test is used in non-normal distributions in order to verify the significant differences found in the results of each analyzed variable in the responses of two datasets (in this case, managers and technicians). Therefore, values greater than 0.05 are considered significant, indicating the existence of a significant difference between the compared results, according to Pestana and Gageiro (2005).

In 30 of the 46 analyzed knowledge management practices it was observed the existence of a significant difference to the answers provided by the managers. That is, from every three practices evaluated by the respondents, two show a significant difference of greater intensity on behalf of the managers. From the remaining 16 knowledge management practices, only two presented a significant difference in favor of practices indicated by technicians (centers of innovation and intellectual property).

Another 14 practices did not present significant difference between the two groups. Subsequently, it is possible to diagnose that the surveyed managers, in general, claim to perceive with greater intensity the use of knowledge management practices, compared to the surveyed technicians.

According to the results of the research, managers indicated greater importance of knowledge management practices in its activities to the company's results than technical responders. According to Rose (2015) research, the software industry professionals are charged to promote the satisfaction of customers, and managers, due to your hierarchical position, have greater responsibility for such result.

Results of Information Technology (ICT) Tools for Knowledge Management

The main results of the field research regarding to the information technology tools used for knowledge management in the surveyed companies are consolidated in Table 3. Here, it is possible to observe for each researched tool the most designated score by the respondents, its frequency, and its percentage, as well as the average score of the tool in question. The average scores of the 38 information technology tools ranged from 3.48 to 8.15, using a scale of 0 (zero) to ten (10) points.

Table 3: Ranking of ICT tools for knowledge management.

Information Technology Tools for Knowledge Management	Most designated score	Frequency of the most designated score	Percentage of the most designated score	Average score
First Quartile				
FC17. Email	8	112	35.10%	8.15
FC13. Phone via Internet	8	105	32.90%	7.75
FC12. Cell phone/radio	8	97	30.40%	7.70
FD22. Intranet	8	107	33.50%	7.67
FD24. Web servers and browsers	8	101	31.70%	7.60
FC11. Landline	8	96	30.10%	7.48
FC16. Instant messaging	8	111	34.80%	7.45
FD26. Corporate portal	7	94	29.50%	7.11
FE27. CBT	8	93	29.20%	7.00
Second Quartile				
FC14. Videoconference	8	95	29.80%	6.93
FE28. WBT	7	93	29.20%	6.82
FD23. Extranet	6	80	25.10%	6.76
FC15. Chat Rooms	8	88	27.60%	6.52
FD25. Knowledge repository	6	85	26.60%	6.47
FC18. Discussion forums	6	71	22.30%	5.94
FF32. Customization / personalization	6	81	25.40%	5.89
FC19. Groupware	5	84	26.30%	5.79
FC21. Workflow	6	86	26.60%	5.75
FA02. Models	5	85	26.60%	5.71
Third Quartile				
FA01. Authorship	6	98	30.70%	5.69
FE29. EPSS	6	98	30.70%	5.68
FF30. Specialized systems	6	87	27.30%	5.62
FF31. DSS	6	94	29.50%	5.50
FF35. Knowledge maps	6	87	27.30%	5.39
FB09. Archiving content	5	69	21.60%	5.31
FB07. Metadata	5	69	21.60%	5.19
FB08. Content classification	5	92	28.80%	5.02
FA03. Annotations	4	87	27.30%	5.01
FF34. Preview	4	91	28.50%	5.00
Quartile Room				
FC20. Wikis	6	67	21.00%	4.97
FF36. Intelligence agents	4	72	22.60%	4.90
FB10. Personal knowledge management	5	72	22.60%	4.74
FA05. Experts' profile	4	76	23.80%	4.56
FA04. Data mining	4	93	29.20%	4.37
FF33. Recommendation system	4	78	24.50%	4.23
FA06. Blogs	5	84	26.30%	4.15
FF38. Content analysis	4	95	29.80%	4.08
FF37. Automated taxonomy system	4	67	21.00%	3.48

The respondents of the field research carried out in this study, to a greater or lesser degree, attested to the use of Information Technology tools for the promotion of knowledge management in the company. This result is similar to the results of research promoted by Song (2001) about the support that the Information Technology tools can provide the knowledge management of enterprise for your effectiveness.

Influence of the Hierarchical Level - Information Technology Tools used for Knowledge Management

The main results of the field research regarding the information technology tools, used in knowledge management practices applied in the surveyed companies, in relation to the hierarchical

level of the respondents (managers or technicians) are consolidated in Table 4. It is possible to observe, for each surveyed information technology tool, the general average score and the average scores indicated by the surveyed managers and technicians. Furthermore, the results of the applied statistical test for the validation of the significant differences found in the two groups of respondents are also shown.

Table 4: Comparative summary of the main results about the use of ICT tools in knowledge management among managers and technicians

Information Technology Tools for Knowledge Management	General average score	Average score of managers	Average score of technicians	Significant differences
FA01. Authorship	5.69	5.90 (a)	5.63	0.53 (b)
FA02. Models	5.71	6.15 (a)	5.59	0.07 (b)
FA03. Annotations	5.01	5.51 (a)	4.88	0.02
FA04. Data mining	4.37	4.78 (a)	4.27	0.06 (b)
FA05. Experts' profile	4.56	4.90 (a)	4.47	0.09 (b)
FA06. Blogs	4.15	4.30 (a)	4.12	0.37 (b)
FB07. Metadata	5.19	5.63 (a)	5.08	0.12 (b)
FB08. Content classification	5.02	5.43 (a)	4.91	0.06 (b)
FB09. Archiving content	5.31	5.49 (a)	5.27	0.47 (b)
FB10. Personal knowledge management	4.74	4.81 (a)	4.72	0.68 (b)
FC11. Landline	7.48	7.73 (a)	7.41	0.12 (b)
FC12. Cell phone/radio	7.70	7.78 (a)	7.68	0.35 (b)
FC13. Phone via Internet	7.75	8.24 (a)	7.62	0.00
FC14. Videoconference	6.93	7.16 (a)	6.87	0.23 (b)
FC15. Chat rooms	6.52	6.85 (a)	6.44	0.19 (b)
FC16. Instant messaging	7.45	7.58 (a)	7.41	0.50 (b)
FC17. Email	8.15	8.43 (a)	8.07	0.03
FC18. Discussion forums	5.94	6.27 (a)	5.85	0.14 (b)
FC19. Groupware	5.79	6.24 (a)	5.67	0.06 (b)
FC20. Wikis	4.97	5.30 (a)	4.89	0.11 (b)
FC21. Workflow	5.75	6.36 (a)	5.58	0.00
FD22. Intranet	7.67	8.06 (a)	7.57	0.02
FD23. Extranet	6.76	7.40 (a)	6.58	0.00
FD24. Web servers and browsers	7.60	8.03 (a)	7.49	0.01
FD25. Knowledge repository	6.47	6.67 (a)	6.42	0.12 (b)
FD26. Corporate portal	7.11	7.39 (a)	7.04	0.18 (b)
FE27. CBT	7.00	7.16 (a)	6.96	0.27 (b)
FE28. WBT	6.82	7.06 (a)	6.76	0.26 (b)
FE29. EPSS	5.68	5.96 (a)	5.60	0.07 (b)
FF30. Specialized systems	5.62	6.06 (a)	5.50	0.06 (b)
FF31. DSS	5.50	6.04 (a)	5.36	0.01
FF32. Customization / personalization	5.89	5.99 (a)	5.87	0.91 (b)
FF33. Recommendation system	4.23	4.66 (a)	4.11	0.08 (b)
FF34. Preview	5.00	5.66 (a)	4.82	0.00
FF35. Knowledge maps	5.39	5.67 (a)	5.32	0.22 (b)
FF36. Intelligence agents	4.90	5.28 (a)	4.80	0.06 (b)
FF37. Automated taxonomy system	3.48	3.90 (a)	3.37	0.11 (b)
FF38. Content analysis	4.08	4.54 (a)	3.96	0.06 (b)

Legend: (a) highest mean of the two groups analyzed; (B) significant difference in favor of managers.

In order to analyse the differences between the responses given to each variable by the managers and technicians, regarding the information technology tools used in knowledge management, the non-parametric Mann-Whitney test was used. This test is used in non-normal distributions in order to verify the significant differences found in the results of each analyzed variable in the responses of two datasets (in this case, managers and technicians). Therefore, values greater than 0.05 are considered significant, indicating the existence of a significant difference between the compared results, according to Pestana and Gageiro (2005).

In 29 of the 38 analyzed information technology tools, there was a significant difference in favor of the answers provided by the managers. That is, from every four tools evaluated by the respondents, three show a significant difference of greater intensity on behalf of the surveyed managers. In the remaining nine tools, no significant difference was found between the analyzed groups. Therefore, it is possible to diagnose that the surveyed managers, in general, claim to perceive more intensely the use of information technology tools used for knowledge management, compared to the surveyed technicians.

The results of the field research show that managers indicated greater importance of information tecnology tools applied to knowledge management than the technical respondents. In fact, managers are important elements responsible for the implementation and use of information technology tools focused on knowledge management in the company, notably as regards your application to the organizational effectiveness. The results of this field research corroborated the study of Zaim *et al.* (2007) about the importance of proper use of practices and information technology tools to knowledge management, in order to acchieve best results for the company.

Conclusions

Contemporary society is highly grounded in information and knowledge, having in these pillars its main factors of evolution. Companies play a central role in this context, becoming inseparable elements of this new social structure based on knowledge. Considering that companies are intrinsically formed by people, the importance of the employees in the construction and delivery of value based on knowledge is consequently denoted. Especially in companies based on creativity and, therefore, that aim to innovate, whose premise is the offer of products and services that seek to satisfy their customers; knowledge management becomes even more necessary as a potential provider of long-lasting competitive differentials. This is the case of software industry companies, which pursue to become increasingly effective through the management of a fundamental resource for the evolution of the software business: knowledge.

Furthermore, knowledge management is based on structured practices and processes that aim to a better management of the resource of knowledge, as an important asset of the company. Associated with practices, there are also information technology tools that enable the processes of knowledge management in companies. Based on the challenges that companies face in this new corporative context, the present study sought to verify and indicate knowledge management practices and the information technology tools associated to such practices, which are frequently used in companies operating in the software industry in Brazil, according to the hierarchical level of its employees.

The knowledge management practices that were identified as the most used during the field research are, in order of priority: virtual meetings and conferences, virtual trainings, face-to-face training, e-learning, call center / help desk / online support, corporate portal, corporate library, evaluation system, innovation centers, mapping processes, and finally, innovation management. These practices were the most indicated by the respondents, constituting thus the most embedded practices in the surveyed companies. Likewise, the less identified knowledge management practices in the field research were: repository of lessons learned, story telling, CKO/CKM (knowledge management manager), internal area or specific department, internal yellow pages, Corporate University, summarization, inventories, coaching, mentoring and ontology/taxonomy. The results found in the field research are in line with the studies of Bari et al. (2016) and Rose (2015), for which knowledge management practices are important for the evolution of companies.

Regarding the information technology tools used for knowledge management in the surveyed companies, the most indicated by the respondents were: e-mail, phone via Internet, cell phone/radio, intranet; web servers and browsers, landline, instant messages; corporate portal and CBT (computer-based training). On the other hand, the information technology tools less indicated in the research were: wikis, intelligence agents, personal knowledge management, expert's profile, data mining, recommendation system, blogs¸ content analysis, and lastly, automated taxonomy system. These results corroborate the studies of Zaim *et al.* (2007) and Song (2001) that clarify the importance of the use of information technology tools to knowledge management, in order to improve the companies' results.

About to the influence of the hierarchical level of the respondents regarding knowledge management, it was observed that workers occupying management positions indicated greater use of information technology practices and tools linked to communication processes oriented to the formulation of strategies for their companies. This result is especially close to the results of the studies promoted by Rose (2015) and Ghanbari and Abedzadeh (2016), that consider the importance of leaders and managers during the knowledge management process.

On the other hand, workers occupying technical positions indicated an extensive use of practices focused on intellectual property and innovation centers. Specifically considering knowledge management practices, it was found that from every three practices, two were identified with higher degree of utilization by management workers, compared to those identified by technicians. About the information technology tools used for knowledge management, it was verified that three out of four tools reached greater utilization intensity on behalf of the managers. These findings provided by the research are in agreement with the study of Rotimi (2016), that states the potential influence of the operational employees in the knowledge management conducted by company.

The situation revealed by the results seems to indicate that managers are more conscious and have greater access, or even greater familiarity and responsibility concerning the surveyed practices and tools, compared to the technical workers, regarding policy formulation, strategies, and skills management. This result is closer to the findings of Bari et al. (2016) and Foganholo and Kuniyoshi (2016). Technicians, broadly speaking, emphasize in innovation practices in the operational areas; thus, they focus less on other applications of knowledge management, except for innovation and intellectual property centers. This result is closer to the findings of Rotimi (2016).

This research brings an interesting contradiction; even though the managers emphasize these innovation-oriented practices, technicians have not demonstrated an emphasis on other relevant knowledge management practices such as patents, repositories of best practice and lessons learned. It appears that knowledge management practices are used by technicians with the intention to innovate, but without the awareness of the multiple benefits or possibilities that other practices may also have to innovation. This may happen due to the lack of clarification, awareness, or even training of technician employees on the benefits of knowledge management practices. A situation is now faced where technicians value innovation centers, but do not emphasize the competence center or the repository of lessons learned. Such practices could, if better explored, provide greater synergy and potentially better results.

It is worth mentioning that the research results indicate an adherence of practices and IT tools aimed at knowledge management by literature with strategic management logic, emphasizing different roles, but somehow integrated, between managers and technicians: a) managers: emphasis on communication practices, by sharing corporate goals and policies with technicians; b) technicians: emphasis on the involvement and participation in the strategy formulation process through suggestions, improvements, and innovations, in processes and operations; however, without the apparent awareness of the wide range of applications and correlations of knowledge management practices.

Besides the previous considerations, the practices and tools with the best individual results can be considered as the most widely used by the employees of the surveyed companies in knowledge management processes; additionally, these indicators may also support new extensive or complementary studies. Derived from this fact, such results can be presented as parameters to guide other organizations interested in improving their internal knowledge management processes. Moreover, it is suggested to carry out this same study with more organizations to observe the differences of this relationship among other business sectors.

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