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The Software Artifacts as Knowledge Products: A Systematic Review

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Abstract
Software industry organizations use different knowledge that can be consolidated, as in the case of a software artifact. A software artifact represents all organizational knowledge, as well as a knowledge product, once it has the same purpose as a software artifact in those organizations. However, these organizations face difficulties to update both software artifact and knowledge products continuously. So, this article aims to identify and understand the state of the art of adaptable software artifacts as knowledge products within software industry organizations. Therefore, we carried out a systematic literature review using searches in scientific digital databases. Our results point out 51 articles grouped into six categories according to their respective goals: explicit knowledge, in the most diverse forms; overview of the software industry; knowledge products; adaptive software artifacts; explicit knowledge within organizations of the software industry; and knowledge products in organizations of the software industry. Thus, these categories sought to group related issues; however, none of them presented a clear relationship on adaptive software artifacts as knowledge products within software industry organizations. However, the main finding of this research concerns the support of adaptable software artifacts backing the registration, storage and updating of organizational knowledge. That occurs since such organizations are inserted in the context of several technological changes, in which such adaptable software artifacts would be a support to keep the knowledge available and updated.

Keywords: *Explicit knowledge. Organizational knowledge. Software Industry.*

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I. Introduction

Knowledge is highlighted in the most different sectors of an organization since it can be processed and maintained in the human mind through facts, procedures, concepts, perspectives, experiences, and therefore the interpretation of information obtained previously (WIIG, 1997). However, knowledge requires adherent processes, so that it can become useful and applicable to an organization. In this sense, Dalkir (2013) emphasizes further processes knowledge is vital to advance the registration of knowledge so that it can be retrieved. Knowledge registration is essential in organizations, in particular, those of the software industry.

In this context, the software industry organizations have a particular distinction once they develop activities intensive in knowledge and that generate products of high added value (BJØRNSON; DINGSØYR, 2008). Therefore, using conduits that allow incorporating knowledge into the organization makes it possible to achieve greater productivity and innovation, since the knowledge of the individuals is directly related to the final product, *i.e.,* software (FENTON; BIEMAN, 2014).

Takeuchi and Nonaka (2008) stress out that tacit and explicit knowledge concepts as the key pieces for an organization once they have complementary characteristics such as a common source knowledge. However, both of them have their attributes. For instance, tacit knowledge is hard to be represented or expressed, *e.g.*, translating knowledge into words, texts, or drawings. That happens because knowledge is difficult to articulate since it is present in people's minds (DALKIR, 2013). Inversely, explicit knowledge is characterized by being documentable, which means that it can be easily recorded in written, electronic or digitized form (TSOUKAS, 2003), *i.e.*, explicit knowledge can be registered as a knowledge product.

The knowledge product concept is not easily found in the literature, since they are a relatively new object of study, having few published works in the area (LOURENÇO et al., 2018). However, according to Lourenço et al. (2018), a knowledge product comprises the register of the supplier's expertise, experience, and skills of that knowledge, in which it becomes accessible to groups of people, *e.g.*, departments, sectors, communities of practice, or even the entire organization. One of the characteristics of a knowledge product

refers to the fact that it is explicitly shared and words or even numbers can present it, and it is possible to document and record, when required, to be shared and used (ONTE; MARCIAL, 2013).

Therefore, a knowledge product is a way of registering and making explicit the individual knowledge, internal or external to the organization. Thus, that knowledge can be used in diverse situations such as training new employees, solving questions and problems in workdays, improving the understanding of a specific subject and so on (WOITSCH; HRGOVCIC; BUCHMANN, 2012). In this scenario, software industry organizations use artifacts as knowledge products because those artifacts make knowledge explicit through their requirements, specifications, test cases, and diagrams. In this way, these software artifacts store the knowledge which, in most cases, is not adaptable to product and organizational changes (CORREIA, 2010). So, an adaptable software artifact is that one which evolves along with the system being developed, so that at the end of the development process such an artifact faithfully represents all the functionalities and specifications of that system (CORREIA, 2013), and it has to be captured and stored regularly. Therefore, it is relevant to understand software artifacts from the perspective of a knowledge product once both store organizational knowledge and enable the organization to increase its ability to solve problems keeping its processes and products updated.

Considering this scenario, this paper aims to identify and understand the state of art of adaptable software artifacts as knowledge products within organizations of the software industry. For this, it is organized into four sections. In addition to this Introduction, the second section deals with knowledge within organizations, with the first subsection discussing the knowledge products and the second dealing is about the software artifacts. In the third section, we present the methodological procedures used in this research, clarifying how the data were obtained and analyzed, and the following section presents the results and discussions. Finally, in the fifth section the conclusions of the research are presented, followed by the references used.

II. The Knowledge Within Organizations

Knowledge has been seen as one of the most important resources in organizations because it helps to create new skills and contributes to adding value to products or services in the organization (CHAUDHURI, 2011). Besides, Davenport and Prusak (1998) point out that knowledge is the result of a complex and subjective processing of information because when a person internalizes an information, he or she interacts logically and non-logically mental processes, previous experiences, insights, values, beliefs, commitments and various kind of elements which are part of the person's mind, because consciously or not he or she uses the psychic content to work the information and how to make a decision according to the context in which they are involved.

In organizations, there are two types of knowledge, tacit and explicit. Tacit knowledge is described as personal knowledge, which may come in the form of insights that lead to new results or process (BERNSTEINER; SCHLÖGL, 2016). It is a type of knowledge relatively hard to be placed in words, drawings, therefore, complex to be expressed as it tends to reside in individuals' heads (DALKIR, 2013). Moreover, tacit knowledge is very specialized and can only be extracted in parts by another individual (WANG et al., 2009). Thus, it is observed that tacit knowledge is extremely personal and difficult to transfer to other people. However, explicit knowledge is characterized as a documentary, which means that it is easily recorded in written, electronic or digitized form (TSOUKAS, 2003).

Nonaka (1994) highlights that explicit knowledge can be articulated in words and numbers, which can be shared through scientific data and formulas. Thus, it is understood that documentation and registration are the principles of explicit knowledge. However, both tacit and explicit knowledge is present in large volumes in organizations. In addition, it is important to emphasize that organizations are always looking for ways to maintain knowledge because employee turnover or lack of means to systematize organizational knowledge are facts that make this preservation difficult (NONAKA; TAKEUCHI, 1997). In this way, knowledge must be formalized, since only this allows the continuous improvement of processes to obtain the highest level of efficiency (OLIVA, 2014).

Therefore, knowledge, in its different forms, tacit and explicit, is one of the most important factors of an organization. In this perspective, it is essential that it be formalized and preserved in order to enable the organizations to obtain future benefits. One way of preserving and formalizing knowledge is by a knowledge product.

Knowledge products

Documenting, recording and storing the knowledge so as to make it accessible within an organization is an essential task today. In this sense, one of the behaviors used to preserve knowledge refers to a knowledge product. A knowledge product is the explicit organizational knowledge that becomes valuable and applicable within an organization (WOITSCH; HRGOVCIC; BUCHMANN, 2012). For Mentzas, Apostolou, Young and Abecker (2001) a knowledge product is given by the process of transferring knowledge to documents or files, that is, it consists of making explicit all knowledge and registering it in order to make it available to other

employees. Therefore, it is observed that a knowledge product is given by the register of skills of the supplier of this knowledge, making it accessible to groups of people or the whole organization.

Thomas and Hettige (2012) point out that a knowledge product is one of the keys to disseminating knowledge within the organization, which can occur through the continuous publication of results, experiences, conference reports, transfer of knowledge to other organizations, among other forms. In this way, those authors emphasize that knowledge dissemination brings preservation of organizational information so that there is no waste of this resource. So, knowledge products are generated through the knowledge of individuals within the organization. Such knowledge can be disseminated based on knowledge products such as documents, software artifacts, videos, podcasts, articles and so on (SCALABRINI et al., 2016). In this scenario, such knowledge products, when properly created and stored, allow the reuse of best practices and reduction of the rework of a project (NONAKA, 1994).

Thus, a knowledge product makes explicit the information contained therein. Nonetheless, knowledge is documented, recorded and made available so that it becomes organizational. However, individual knowledge within the software industry is made explicit through different knowledge products, *i.e.*, software artifacts.

Software Artifacts

Failure in software development projects has been a current concern in organizations within the software industry. This is because for a software development project a process of requirements elicitation is required (MUQEEM; BEG, 2014). To do so, the Requirements Engineering provides a solid basis for a project, through techniques that guarantee the understanding of the domain of the problem to be developed, which allows that such design and construction of the product (software) can meet the needs of the client.

Requirements Engineering provides different techniques to extract data and create so-called software artifacts (SOMMERVILLE, 2015). Pressman (2010) conceptualizes a software artifact as an artifice that assists in the understanding and development of the software. Therefore, a software artifact helps to describe the activities, structures and design of the software being developed, generating detailed system documentation that can be used later. Thus, software artifacts become the documentation of the software, such as the requirements document, which is conceptualized as an agreed statement of the needs the system must meet, which are defined unitedly with the user (SOMMERVILLE, 2015).

Software artifacts captured knowledge which is not easy to adapt to organizational changes. That adaptation must be carried out considering the software development process adopted by the project. So, as software changes occur, artifacts need to be updated so that they do not become obsolete (CORREIA, 2010). For instance, one type of software artifact is the 'Use Case Diagram', which represents a process of identifying the actors involved in an interaction, assigning a name to the type of action, allowing everyone involved a clear view of the software (SOMMERVILLE, 2015). In addition, software artifacts can be seen as a new way of establishing the organization's corporate memory. In this way, they make explicit knowledge available to the people of these organizations (LOURENÇO et al., 2018).

However, software artifacts are a way of documenting explicit knowledge throughout the development project, and thus, such artifacts can be understood as knowledge products once software artifacts and the knowledge products store some explicit knowledge. In this way, the registration of knowledge occurs so that it becomes available to the individuals belonging to the organization.

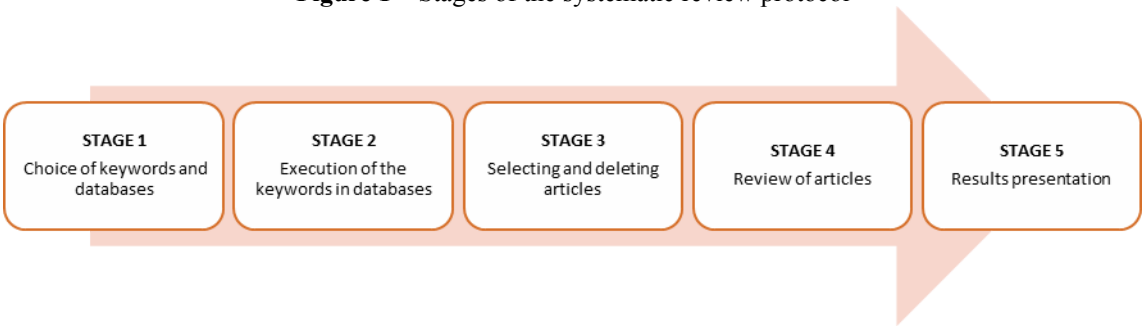
III. Method

A systematic review of the literature presents a rereading of evidence on a clearly formulated research question. To do so, systematic and explicit methods are used to identify, select and critically evaluate relevant primary research. In this way, it is possible to extract and analyze data from the studies that are included for a review (WRIGHT et al., 2007). In this context, Ali (2012) reinforces that a systematic review aims to find as much as possible of the relevant context of the research using explicit methods to identify what can be reliably said based on that study. Therefore, the purpose of this systematic review was to identify and understand the state of the art of adaptable software artifacts as a knowledge product within organizations of the software industry. For that, a protocol for the selection of articles was elaborated. This protocol was based on those used in the Prikladnick and Audy (2010) and Pinto et al. (2017). That's because the Prikladnick and Audy (2010) protocol demonstrate several perspectives of methods of data analysis, processes, besides the qualitative and quantitative analysis of the proposed theme. Anon, the Pinto et al. (2017) was used in complementation due to the clarity and cohesion of the research steps presented in his article. Thus, the protocol of this research is guided by the following question: 'There are adaptable software artifacts as knowledge products within organizations of the software industry?'

Given this issue, it is important to note that it is necessary to understand how these software artifacts, as knowledge products, are understood in the literature, as well as to obtain clues as to whether such products have continuous updating within the organizations of the software industry. The systematic review was carried

out from June to August 2018. The protocol of this systematic review follows the five Stages presented in Figure 1.

Figure 1 – Stages of the systematic review protocol



Source: The authors (2019).

In Stage 1, the keywords and databases to be used for the search are established. The applied keywords were established for the purpose of solving the proposed research question. To that end, the choice of databases becomes an indispensable task, because the research theme is related to the software industry, the databases chosen must correspond to technology themes and the like. In this way, the international databases used are Emerald Insight, ACM Digital Library, IEEE Xplore and ScienceDirect. The national database used corresponds to the Portal de Periódicos da CAPES. Since the topic of this research is relatively new, in Stage 2 the keywords were reported one by one. After the initial execution, these keywords were combined. However, even words in Portuguese have been executed in international databases. In addition, the words in English have also been implemented in the national databases, in particular in the Portal de Periódicos da CAPES, following the suggestion of Tenório et al. (2017) with regard to scientific literature, which is routinely published in English, which can be disadvantageous as members of the scientific community speak and work in a variety of languages. Thus, according to the authors, to analyze words in English as well as in the Portuguese Language helps to find and analyze a more varied set of works in the literature. In this context, the list of keywords used in this systematic review is presented in Chart 1.

Chart 1 – List of keywords used in the systematic review

English language	**Portuguese language**
Knowledge Products	*Produtos do Conhecimento*
Adaptive Software Artifact	*Artefatos de Software Adaptável*
Explicit Knowledge	*Conhecimento Explícito*
Software Industry	*Indústria de Software*
Knowledge Products *and* Adaptive Software Artifact	*Produtos de Conhecimento e Artefato de Software adaptável*
Knowledge Products *and* Explicit Knowledge	*Produtos de Conhecimento e Conhecimento Explícito*
Knowledge Products *and* Software Industry	*Produtos do Conhecimento e Indústria de Software*
Adaptive Software Artifact *and* Explicit Knowledge	*Artefato de Software adaptável e Conhecimento Explícito*
Adaptive Software Artifact *and* Software Industry	*Artefato de Software Adaptável e Indústria de Software*
Explicit Knowledge *and* Software Industry	*Conhecimento Explícito e Indústria de Software*

Source: The authors (2019).

The execution of the keywords of this research, described in Stage 2, resulted in 5.019 articles, of which 2.624, *i.e.*, 52% were present in ScienceDirect. Emerald Insight stood out as the second database in which more articles were found, totaling 1,288 and corresponding to 26% of the articles found. The IEEE Xplore database resulted in a total of 687 articles, accounting for 14% of the total of this research. Following, the database ACM Digital Library returned 252 articles, representing 5%. Lastly, the Portal de Periódicos Capes displayed a total of 168 articles, totalizing 3% of articles found in this review. Table 1 shows the relation of the number of articles found in each international database researched.

Table 1 – Number of articles found on international bases

Keywords	**Emerald Insight**		**ACM**		**IEEE Xplore**		**ScienceDirect**	
	n.	%	n.	%	n.	%	n.	%

Knowledge Products	66	5	34	14	4	1	329	13
Adaptive Software Artifact	0	0	1	0	0	0	0	0
Explicit Knowledge	954	74	48	19	207	30	775	30
Software Industry	240	19	169	67	476	69	1398	54
Knowledge Products and Explicit Knowledge	8	1	0	0	0	0	30	1
Knowledge Products and Software Industry	2	0	0	0	0	0	1	0
Explicit Knowledge and Software Industry	18	1	0	0	0	0	43	2
Total	**1.288**	**100**	**252**	**100**	**687**	**100**	**2.576**	**100**

Source: The authors (2019).

The keywords 'Knowledge Products and Adaptive Software Artifact', 'Adaptive Software Artifact and Explicit Knowledge', 'Adaptive Software Artifact and Software Industry', were searched in the databases of Emerald Insight, ACM Digital Library, IEEE Xplore and ScienceDirect. However, there were no results. In addition, we searched these keywords in the Portuguese Language, as presented in Chart 1, and also did not return results by their respective search engines. Table 2 shows the number of articles found in the national databases.

Table 2 – Number of articles found in the national databases

Keywords	**ScienceDirect**		**Portal de Periódicos CAPES**	
	n.	%	n.	%
Produtos do Conhecimento	5	10	3	2
Conhecimento Explícito	20	42	99	59
Indústria de Software	23	48	66	39
Total	**48**	**100**	**168**	**100**

Source: The authors (2019).

In Stage 3, the articles were selected, and the following criteria were considered: i) to be available in the databases searched; (ii) published between 2012 and 2017; iii) published in conferences or in renowned journals. However, articles that only touched on such keywords were excluded, that is, those in which keywords were not the main object of study, in addition to articles that did not meet the criteria for inclusion. Thus, the search fields used in this first Stage are presented in Chart 2. Also, in Stage 3, the entire articles were read in full.

Chart 2 – Base search fields used

Database	**Search field**
Emerald Insight	Document Title and keywords
ACM Digital Library	Title, keywords and abstract
IEEE Xplore Digital Library	Document title and abstract
ScienceDirect	Title and abstract
Portal de periódicos CAPES	Título e resumo

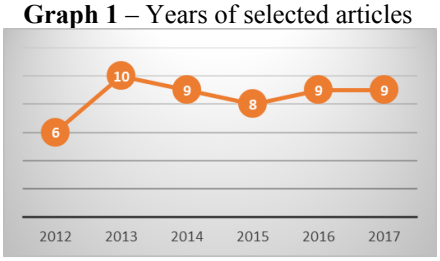
Source: The authors (2019).

Finally, in Stage 4, after a complete reading of the selected articles, a systematic analysis of each article was performed, and the following aspects were considered for each one: year of publication, journal/publication event, purpose, number of citations, data analysis, keywords, results, methodology and authors. At the same stage a bibliometric analysis was also carried out, which is widely used to summarize the most representative results of a set of bibliographic documents (BONILLA; MERIGÓ; TORRES-ABAD, 2015). Therefore, in order to analyze in detail, the results of this research, a graphic mapping of the bibliographic results was developed through the software *VOSviewer*. According to Van Eck and Waltman (2010), the *VOSviewer* collects bibliographical data, providing graphic maps in terms of bibliographic coupling, co-citation, co-authoring and co-occurrence of keywords and authors, however, the bibliographic coupling occurs when two documents cite the same third document. The authors also point out that the main advantage of this technique is the illustration of how the different variables of the journal are connected according to several criteria. It should be noted that the data used in the *VOSviewer* were collected in the *Dimensions* database, so the limitations of this database can also be applied to this study.

IV. Results And Discussion

The presentation of the results includes Stage 5, which presents 51 publications that make up the total sample of this systematic review, as presented in Chart 3. The publications related to the topic happened in all the years surveyed with some oscillations, however, an average of eight publications per year. Graph 1 shows that a peak occurred in 2013, with ten articles published, with the most published years being 2014, 2016 and 2017, with nine articles each year. In the year 2015 was presented eight articles and in the year 2012 only six publications.

Graph 1 – Years of selected articles



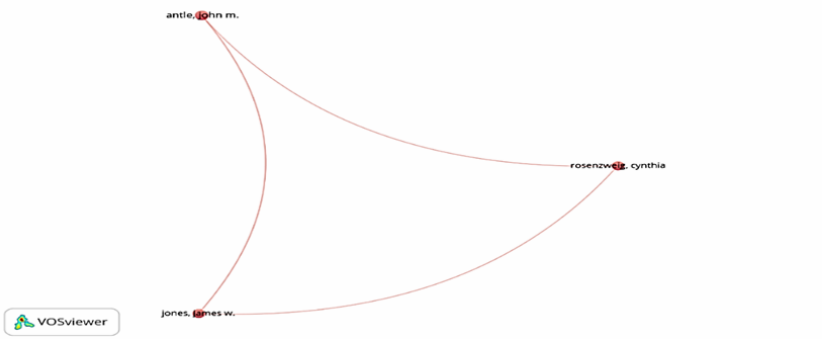
Source: The authors (2019).

Of the 51 publications, 36 were published in foreign magazines in English and 15 in conferences. The journals that were most present in this systematic review were Agricultural Systems, with four publications. Following, the most recurrent journals were the Perspectives in Knowledge Management and the Journal of Knowledge Management, both with two publications each. In this scenario, it was also observed that of the total of articles of this research it is understood that 82% is related to the data analysis in a qualitative way and 18% quantitative. Thus, it is noted that the qualitative data analysis is the most used by the authors of this systematic review. This is because, in qualitative data analysis, the conceptions, strategies and research methods that will be used for the interpretation of the research are discussed. In order to explore to understand the meaning of a given social or human problem, however, in quantitative analysis, it is possible to understand the research problem by means of numerical data that can be used in the qualitative analysis in order to explain and refine quantitative data (CRESWELL, 2013).

The selection of the articles in this systematic review is composed of 138 authors, of whom, some are notable for having a greater number of publications, such as Jhon Antle, with four. The following are other authors, such as Oscar Dieste, Natália Juristo, James Jones and Cynthia Rosenzweig, with two publications each. The other authors, 133, had only one article present in this systematic review. Figure 2 shows the main collaboration network among authors about the search string 'Knowledge Products', executed in the Dimensions database. The search string was chosen because it is one of the key factors of the research question proposed in this systematic review, making an investigation necessary on this topic. From this perspective, it is possible to visualize in Figure 2 that the author Jhon Antle is the most referenced in this theme.

However, authorship and citation relationships among researchers of this subject are concentrated between John Antle, James Jones, and Cynthia Rosenzweig, among whom there are co-operation and citations from these authors. In this way, it is possible to verify a gap in other researchers that collaborate with the research of knowledge products, reinforcing the importance of different researchers to evolve this theme.

Figure 2 - Main collaboration network among authors on the subject of Knowledge products



Source: The authors (2019).

Figure 3 – Keyword cloud

Source: The authors (2019).

Figure 3 presents the keywords that were most present in the 51 articles selected for this systematic review. It turns out that the word Knowledge is in the center, which means that it has been the most present, with uses in different articles. Soon after, the word software is highlighted, which appeared 18 times in different articles. Following, the string industry added 11 occurrences, followed by the word knowledge with eight, innovation with seven and development with four. The 51 articles in this research sample add up to 708 citations in Google Scholar. In this way, the most cited article was that of Mahr and Lievens (2012), with 197 citations. In the sequence, Nidhra et al. (2013) with 58 citations and Runesson and Gustafsson (2012) with 49 citations. However, the average for the work cited was 14. Thus, it is concluded that these articles are already used by other authors in their respective research, and are already recognized by the academic community. In order to organize the articles of the sample of this systematic review, Chart 3 was constructed, composed of six categories: (P1) Explicit knowledge, in the most diverse forms, (P2) Software industry overview, (P3) Knowledge products (P4) Adaptive software artifacts, (P5) Explicit knowledge within organizations of the software industry, (P6) Knowledge products within organizations of the software industry. These categories include specific subjects and are represented by their respective descriptions. In this way, the objectives of all the 51 articles present in the sample of this work were analyzed in order to group them by objectives and subjects in common.

Chart 3 – Category of articles

Category	Authors
Explicit knowledge, in the most diverse forms	Rodrigues and Graeml (2013), Bernsteiner and Schlögl (2016), Lai (2013), Rumanti, Ari Samadhi and Wiratmadja (2016), Kamimura (2014), Park, Vertinsky and Becerra (2015), Barcelo-Valenzuela et al. (2016), Adam et al. (2015).
Software industry overview	Nannetti, Mesquita and Teixeira (2015), Dal-sato et al. (2016), Oliveira et al. (2014), Galvis-Lista and Sánchez-Torres (2013), Diegues and Roselino, Garcia (2013), Rojas and Carrizo (2017), Cuffa, Rojo and Maccari (2015), Flores-rios et al. (2014), Gaspar et al. (2016), Vegas, Dieste and Juristo (2015), Norman and Venter (2016), Dieste, Juristo and Martinez (2013), Pérez, Cambra-Fierro (2015), Wendling, Oliveira and Maçada (2013), Mahanti and Evans (2012), de Souza Bermejo et al. (2016), Sahoo and Nauriyal (2014), Gupta, Dutta, and Chauhan (2016), Shahzad, Xiu and Shahbaz (2017), Giannopoulos (2014), Aryanto, Fontana e Afiff (2015), Chen et al. (2012), Amer et al. (2017), Anwar, Bibi and Ahsan (2013), Facin, Spinola and Gomes (2015), Bonakdar et al. (2013).
Knowledge products	Zhang, Wang, and Wang (2016), Runesson and Gustafsson (2012), Woitsch, Hrgovcic and Buchmann (2012), Antle, Jones and Rosenzweig (2017a), Antle, Jones, and Rosenzweig (2017b), Capalbo, Antle and Seavert (2017), Antle et al. (2017).
Adaptive software artifacts	Correia (2013).
Explicit knowledge within organizations of the software industry	Saenz and Pérez-Bouvier (2014), Mathrani and Parsons (2012), Vásquez-Bravo et al. (2014), Nidhra et al. (2013), Huang and Liu (2017), Mahr and Lievens (2012).
Knowledge products within organizations of the software industry	Ma et al. (2014), Morgan (2017), Leonardi (2017).

Source: The authors (2019).

The category 'Explicit knowledge in the most diverse forms' is composed of nine articles, in question discussed various aspects about explicit knowledge *e.g.*, dimensions, framework proposals, transfer, and extraction. The article by Rodrigues and Graeml (2013) seeks to understand the epistemological dimension of knowledge, in which he reflects on the relation of explicit and tacit knowledge, under the view of several Brazilian authors who discuss the perspective of Nonaka and Takeuchi, between the years 1997 and 2010. The papers by Bernsteiner and Schlögl (2016), Park, Vertinsky and Becerra (2015) and Adam et al. (2015), discuss the transfer of knowledge, which in this case has the focus on how to turn tacit knowledge into explicit for other individuals. Lai (2013) tries to understand the relation of implicit and explicit knowledge to the organizational sphere through the suggestion of a model for the accumulation of knowledge. In turn, Rumanti, Ari Samadhi and Wiratmadja (2016) discuss the impact of tacit and explicit knowledge on knowledge sharing within organizations, while Kamimura (2014) investigates the extraction of explicit knowledge for self-organizing maps. Finally, Valenzuela et al. (2016) present a structure of the acquisition, classification, and dissemination of explicit knowledge. Although the studies of these authors contributed significantly to the presentation of knowledge from different perspectives, they did not consider specific examples of explicit storage and codified knowledge, such as manuals, videos, and images. Thus, there is a clear gap in the literature about examples of the application of explicit coded and stored knowledge.

The category 'Vision about the software industry' consists of 26 articles that seek to present different aspects of the software industry in relation to their processes, employees, resources, and practices. Thus, the articles by Nannetti, Mesquita and Teixeira (2015), Dal-Sato et al. (2006), Oliveira et al. (2014), Vegas, Dieste and Juristo (2015), Wendling, Oliveira and Maçada (2016), Aryanto, Fontana and Afiff (2015), Flores-Rios et al. (2014), Chen et al. (2012) and Anwar, Bibi and Ahsan (2013), discuss the human aspects related to the creation and sharing of knowledge, as well as the perceptions about Information Management and Knowledge Management within organizations of the software industry. However, such authors consider the factors of behavioral analysis in these organizations, as well as the satisfaction of clients and employees. The study and understanding of human aspects are essential to a greater understanding of the software industry in relation to its processes and practices. Norman and Venter (2016), Gupta, Dutta, and Chauhan (2016), and Cuffa, Rojo and Maccari (2015) have the objectives of Pérez, Cambra-Fierro (2015), Dieste, Roselino, and Garcia focused on resources, strategies, initiatives, and plans that seek to leverage competitiveness in organizations in the software industry. On the other hand, the researches of Galvis-Lista and Sánchez-Torres (2013), Rojas and Carrizo (2017), Gaspar et al. (2016), Mahanti and Evans (2012), Sahoo and Nauriyal (2014), Amer et al. (2017) and Bonakdar et al. (2013) seek to provide insights about models and practices adhering to the software industry, in addition to pointing out critical factors that permeate that industry. However, the articles by Souza Bermejo et al. (2016), Shahzad, Xiu and Shahbaz (2017), Giannopoulos (2014), Diegues, Roselino and Garcia (2013) and Facin, Spinola and Gomes (2015) focus on innovation and its most diverse aspects for the software industry. Thus, it is important to emphasize that this category concentrates the largest number of articles on the subject of this systematic review. In addition, it is noted that these articles reflect the day-to-day reality of software industry organizations in different aspects, such as human, practical and strategic.

The category 'Knowledge Products' consists of seven articles: Antle, Jones, and Rosenzweig (2017a), Antle, Jones and Rosenzweig (2017b), Antle et al. (2017) and Capalbo, Antle, and Seavert (2017). Although this set of papers discusses the knowledge products in the agricultural field, the field of application in the software industry is very similar since these researches show that the products of knowledge help in the decision making and contribute to the sustainable competitiveness and innovation in the Marketplace. However, Zhang's paper Wang and Wang (2016) seeks to understand the creative process in the production of knowledge, a fundamental process for the creation of knowledge products in an organization. In turn, Woitsch, Hrgovcic and Buchmann (2012) report that knowledge products are a consumable, identifiable and accessible knowledge format. In addition, the authors emphasize that the quality of a knowledge product depends entirely on the specialist's domain, which creates objectives aligned with Knowledge Management in the organization. Finally, Runesson and Gustafsson (2012) seek to report how a product of knowledge can be used in the educational environments of different countries, is considered a facilitator for teaching in different nations. Therefore, this category of articles presents the products of knowledge under different contexts, such as educational, agricultural and productive processes.

The 'Adaptive Software Artifacts' category comprises articles dealing specifically with the topic 'adaptive software artifacts'. However, in this category only one article was present, Correia (2013). The author states that an adaptive software artifact is a method to facilitate the use and evolution of information within software development teams, especially in the context of medium to large-sized projects, where the amount of knowledge involved easily increases all these challenges. Thus, it is noted that the theme of 'adaptable software artifacts' is not so common, perhaps because the adaptability of the artifacts is more specific to a particular artifact, such as software requirements. Thus, it is concluded that for this category, there is not a significant amount of scientific research.

The category 'Explicit Knowledge within Software Industry Organizations' contains six articles discussing explicit knowledge in the software industry. Saenz and Pérez-Bouvier (2014) and Mahr and Lievens (2012) discuss innovation within organizations of the software industry. According to the authors, this innovation can occur through internal, external agents, or even communities of practice. However, Mathrani and Parsons (2012) and Nidhra et al. (2013) present aspects of organizational learning processes and challenges that permeate the transfer of knowledge in the software industry. In this way, the authors also discuss the learning difficulties in the software industry, which may be related to the employee's willingness to report their knowledge. Huang and Liu (2017) discuss the importance of preventing human defects in organizations in the software industry since they often produce mission-critical software in which a thorough human-defect prevention process is required. However, Vásquez-Bravo et al. (2014) discuss the enhancement of knowledge acquisition through software engineering techniques, such as cognitive maps, brainstorming, and structured interviews. However, while articles in this category present themes related to explicit knowledge in the software industry, none of them deals with an explicit coded and stored knowledge, e.g., manuals, videos, images, that could be used by members of development teams as a basis of learning for the execution of their daily tasks.

The category 'Knowledge products in organizations of the software industry' has three articles where knowledge products are discussed within organizations of the software industry. In the studies of Ma et al. (2014) and Leonardi (2017), there is a discussion about how knowledge sharing in the organizational environment is crucial for communication. For this, social media can be used to document knowledge, however, it does not replace communication between individuals. In this way, this documentation, together with the communication between the individuals in the organizational scope, promotes the sharing of knowledge in an effective way. However, Morgan (2017) provides a better understanding of the concept of best practices that promote knowledge sharing through communities of practice. Although articles in this category have contributed significantly to a better understanding of the subject matter proposed in this systematic review, none of them presented a clear relationship about knowledge products in software industry organizations, which would be important to deepen this study.

However, with regard to the category 'Explicit knowledge, in the most diverse forms' it was observed that even with the contribution of several authors to the presentation of such knowledge from different perspectives, none of the works presented concrete examples of explicit knowledge stored and codified, such as in manuals, videos, and images. These concrete examples become important as they are forms of knowledge products.

The category that deals with the 'Vision about the software industry' was the one that was most present in this systematic review of the literature by the number of articles presented. Thus, it is seen that the software industry is an object of study present in the literature under different aspects, such as processes, human, and practical. Concerning the category 'Knowledge products' it is noted that such products are already present in educational, agricultural and production processes. However, it has been observed that this subject is relatively new and is still uncommon in the literature. Regarding the category 'adaptable software artifacts' referring to adaptive software artifacts, the results obtained about the researches in the area were significant for a better understanding of the construction and continuous updating of software artifacts as knowledge products. However, it is noted that there is currently not much research related to adaptive software artifacts, perhaps because such research focuses on certain types of specific artifacts, such as software requirements, for example. Thus, it was possible to identify a theoretical gap in this topic. In what refers to the category 'Explicit Knowledge within the Software Industry Organizations', which discusses explicit knowledge in the software industry, there has been no clear listing of articles where explicit knowledge is viewed in a coded and stored manner. This explicit encoded and stored knowledge would be important since it could be made available to employees to perform various tasks, such as creating a new project, artifact, or software system. In this sense, the explicit knowledge stored and codified in the software industry still lacks related research. Finally, the category 'Knowledge products in organizations of the software industry' presented articles related to knowledge products within organizations of the software industry, and a better understanding of the category is possible with regard to the tasks of using a product of the knowledge in these organizations. However, none of the articles in this category presented a clear relationship between knowledge products such as codified and stored knowledge in order to be available to the individuals of these organizations in the software industry.

Therefore, it is observed that this subject - products of knowledge within organizations of the software industry - is a subject little explored in the literature. Thus, the analyzed publications did not present adaptable software artifacts as knowledge products within the software industry organizations. This identified gap reinforces the proposed research problem, highlighting the literature's need to explore adaptive software artifacts as knowledge products within organizations of the software industry. This is because along with the advancement of science, to study and present strategies to keep organizational knowledge up to date. Besides, the software industry is also favored, since the organizations that are part of this industry perform processes, tasks, and activities dynamically, in which it is often not possible to register, store or update organizational

knowledge. Thus, adaptable software artifacts within organizations of the software industry would support the registration, storage, and updating of organizational knowledge, in which the main purpose is the availability of knowledge to facilitate the realization of processes and practices in this industry.

V. Conclusion

This work aimed to identify and understand the state of the art of adaptable software artifacts as a knowledge product within organizations of the software industry. For this, a systematic review of the literature was carried out, which was divided into five stages. The first Stage consisted in choosing keywords and databases; in the second there were the execution of the keywords in the chosen databases; in the third one, the selection of the articles was made by reading titles, keywords and abstract, in addition, this selection obeyed the criteria of i) being available in the searched databases; (ii) published between 2012 and 2017; iii) published in conferences or renowned journals. However, to exclude the article was considered articles that only touched on such keywords, this means that, excluding articles in which keywords were not the main object of study, in addition to articles that were not in agreement with the Inclusion criteria. In Stage 4, a complete reading of the selected articles was carried out, as well as a systematic analysis of each article of the previous stage, which included: year of publication, journal/publication event, objective, number of citations, analysis of data, keywords, results, methodology and authors. In addition, in Stage 4, a bibliometric was also carried out about the string Knowledge Products. Stage 5 corresponds to the results of the research, which corresponds to a sample of 51 articles, which were grouped into six categories. Concerning the category that deals with explicit knowledge in the most diverse forms, it was observed that even with the contribution of several authors to the presentation of such knowledge from different perspectives, none of the works presented concrete examples of the explicit knowledge stored and codified, as in manuals, videos and images. The category that has a focus on the software industry was the one that was most present in this research. Thus, it is seen that the software industry is an object of study present in the literature under different aspects such as processes, human, and practical. With regard to the category that deals with the products of knowledge, it is visualized that such products are already present in the educational, agricultural and production processes; however, they are not very common in the literature. However, it has been observed that this subject is relatively new and still uncommon in the literature. In the category that explores adaptive software artifacts, it is noted that there is currently not much research related to adaptive software artifacts, perhaps because such research focuses on certain types of specific artifacts, such as software requirements, for example. The category that discusses explicit knowledge in the software industry has not clearly presented articles in which explicit knowledge is viewed in a coded and stored manner so that it is available to employees in performing various organizational tasks. With the category that discusses knowledge-related articles within organizations of the software industry, a better understanding of the tasks of using a knowledge product in those organizations has been possible, however, none of the articles categories presented a clear relationship of knowledge products from the perspective of a codified and stored knowledge to be available to the individuals of these software industry organizations. Thus, it has been observed that there is a gap in adaptable software artifacts as a product of knowledge within organizations of the software industry. Although the articles presented in this systematic review support the proposed objective, none of them were able to solve the research question. However, they show a possible path to be explored. This path concerns the contribution of these artifacts in the sense of registering, storing and updating organizational knowledge. Such processes of registering, storing and updating organizational knowledge are essential for organizations in the software industry that are embedded in an environment of constant technological change. In this way, it is possible to facilitate the availability of knowledge in order to facilitate the realization of processes and practices in organizations belonging to the software industry. Thus, as future work, it is suggested a greater investigation on adaptable software artifacts, as knowledge products within organizations of the software industry.

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