Recording Lessons Learned in Projects: an Ontological Perspective

Mauricio Augusto Cabral Ramos Junior

February 27, 2023

Recording lessons learned in projects: an ontological perspective

Mauricio Augusto Cabral Ramos Junior[1]
Universidade Federal Fluminense
ORCiD ID: https://orcid.org/0000-0002-3567-1678

Abstract. Although different organizations dedicated to the research and dissemination of Project Management recognize it as a relevant factor for improving this activity, the lessons learned recording don't commonly realize in projects. Although these lessons represent relevant knowledge obtained from living significant experiences, several studies show that establishing an effective and efficient format for recording them is complex. In this scenario, a conceptual modeling development can contribute to the efficiency and effectiveness of this record, valuing it as a means of organizational learning. Thus, research with a qualitative approach, applied nature, exploratory objectives, and bibliographic procedures was carried out, which analyzed a conceptual model for recording lessons learned in projects. The model is of the Entity-Relationship type, elaborated from a sample of fifty-four project lessons learned record forms obtained in public or private organizations of Australia, Brazil, Canada, Ghana, Holland, India, Italy, Lebanon, Norway, United Kingdom, and the United States. The objective of the research was to evaluate the accuracy and integrity of the conceptual model against the Basic Formal Ontology (BFO), a fundamental ontology widely used for building domain ontologies, and the Information Artifact Ontology (IAO), a domain ontology derived from the BFO and which addresses information entities and their bearers, processes, and relationships. By considering the recording of lessons learned in projects as a process and record (document), the research focused on the artifacts of these ontologies that are directly involved in the process of creating documents and their respective records. The research results demonstrated the accuracy and integrity of the conceptual model since its structure establishes correspondences between its entities and the BFO and IAO artifacts and contemplates the execution of the five fundamental processes to manage lessons learned (Explicitation, Categorization, Evaluation, Monitoring, and Dissemination).

Keywords. Conceptual modeling, knowledge, lessons learned, ontology, project.

1. Introduction

Project Management is based on improving knowledge through experimentation, tacit and explicit knowledge, and formal practices of knowledge sharing [1]. However, organizations face challenges in managing their knowledge assets related to project management and consider that Knowledge Management is complex and emphasizes social and technical aspects as factors of knowledge processes [2].

Knowledge Management depends on mechanisms for creating and converting knowledge and searching for and retrieving information, organizational culture, and the

[1] Corresponding Author: Mauricio Augusto Cabral Ramos Junior, macrjunior@id.uff.br.

ability to learn and preserve organizational memory [3]. In this way, information and communication technologies make it possible to organize, formalize and disseminate knowledge [4] through the cognitive and organizational practice of individuals supported by computer networks, technologies application to increase communication and data processing, and computational methods to organize and combine application data [5].

In this context, the lessons learned link Project Management to Knowledge Management as they represent an improvement in knowledge based on experiences in the life cycle of projects [6] [7] [8]. In general, lessons learned are refined through specific methods that seek efficiency and effectiveness in information handling and knowledge transfer [9]. A challenge that arises then is how to refine and share the lessons learned in projects to ensure their recognition as capable of improving organizational processes [10] [11] [12].

A knowledge organization/representation activity uses tools to explain the knowledge and respective structures (classifications, concepts, characteristics, and relationships) about a specific domain. In the context of information systems, one of these tools is conceptual modeling [13], a representation process of a situation from the perspective of individuals interested in it [14]. Conceptual modeling corresponds to an ontological exercise [13] that aims to guarantee accuracy (defined knowledge is true in a domain) and integrity (all relevant knowledge in a domain has been defined) [15].

A widespread conceptual model is the Entity-Relationship Model, which offers a helpful graphical language to identify informational structures relevant to a given domain [16]. A conceptual modeling language allows one to determine entities that can be named, labeled, restricted, instantiated, and related, constituting a fundamental ontology [17]. Ontologies are conceptual schemes used to represent a field of knowledge or the structure of systems [18], epistemological resources that formally represent the concepts (and the relationships between them) of a given domain [19].

According to a perspective that presents it as a document and process, recording lessons learned in projects was the chosen domain for conceptual modeling that elaborated an Entity-Relationship model [20]. This perspective, in turn, enabled an epistemological approximation between ontologies of archival documents and informational entities, and the Entity-Relationship model developed. Therefore, the objective of this article is to analyze the accuracy and completeness of this model against the Basic Formal Ontology (BFO), a fundamental ontology widely used for building domain ontologies, and the Information Artifact Ontology (IAO), a domain ontology derived from the BFO and which addresses information entities and their bearers, processes, and relationships.

2. Methodology

The research which sustains that article has a qualitative approach, basic nature, exploratory objectives, and bibliographic procedures. The methodological route adopted started from the analysis of an Entity-Relationship model that represents the record of lessons learned in projects [20], aiming to determine its accuracy and integrity before the Basic Formal Ontology (BFO) and Information Artefact Ontology (IAO). IAO is a domain ontology that describes artifacts related to communication and informational recording [21] and originated from BFO, a foundation ontology [22] based on reality, widely used to represent ontologies from different domains, as that of documentary production [23]. A joint representation of these ontologies was then used as a basis to demonstrate their relationships with this model, as shown in Figure 1:

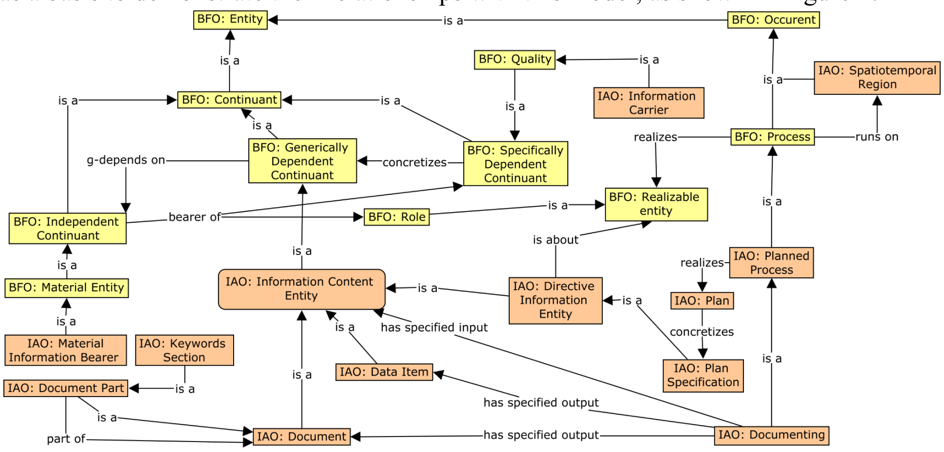

Figure 1. BFO-IAO model.

The Entity-Relationship model was developed based on the analysis of fifty-four project lessons learned registration forms, prepared by fifty-four public (thirty-seven) or private (seventeen) organizations from eleven countries (Australia, Brazil, Canada, Ghana, Holland, India, Italy, Lebanon, Norway, United Kingdom, United States). The result of this analysis originated a basic (and statistically representative) set of metadata to record lessons learned in projects. An analysis of this set then allowed the identification of eleven entities and twelve relationships between them, which then came to constitute the Entity-Relationship model [20]. Figure 2 shows this model and its respective metadata:

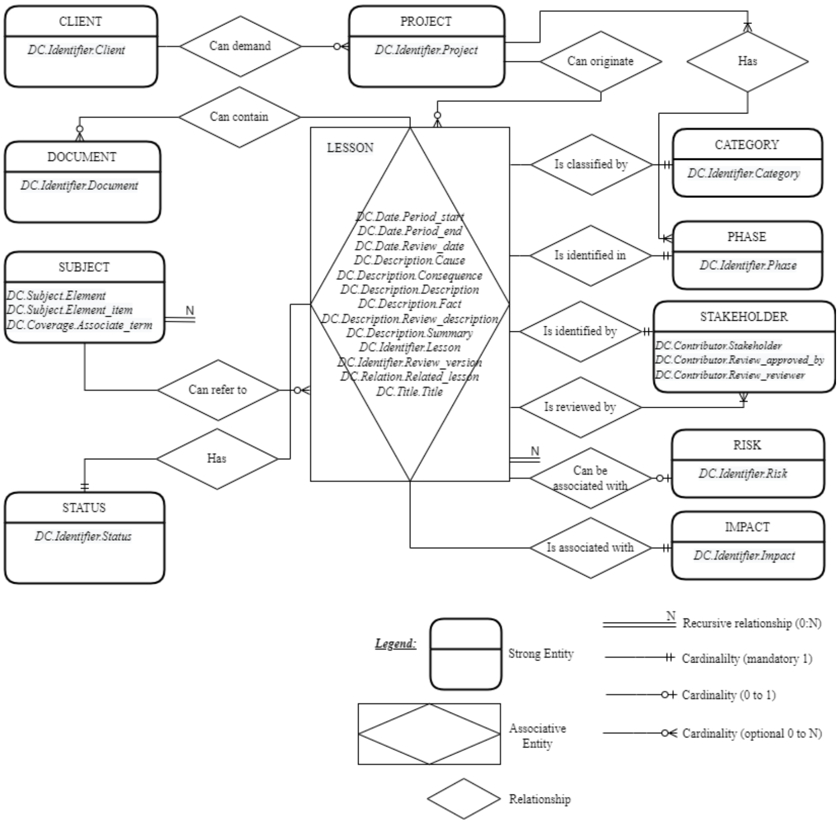

Figure 2. Entity-Relationship model.

When considering that the record of lessons learned in projects can be classified as a document or process [20], an analysis was made of the joint representation of the BFO and IAO from the entities that refer to the creation of a document and to the process itself to create it [23]. In this sense, to determine the model accuracy, correspondences between its entities and the ontologies artifacts were sought. And to determine the integrity of the model, correspondences were sought between its entities, the ontologies artifacts, and, according to [24], the five fundamental processes to manage lessons learned (Explicitation, Categorization, Evaluation, Monitoring, and Dissemination).

3. Theoretical Reference

The Entity-Relationship model in question was elaborated based on the following theoretical framework.

3.1 Information and Knowledge

Information is composed of data that represent a computational process result that gives it meaning [25]. Data and information are the knowledge management system's main inputs, whose elements arise in organizations in any situation where information is created or elaborated with the need for storage, classification, and sharing [12]. That stems from the fact that producing, locating, evaluating, and using information (in different formats and supports) are actions that invariably occur through the participation of individuals in a community [26].

If preserved and used, information will never disappear because it will be reconstructed over time, from other (parts of) information that make it a living concept and part of an ongoing process [27]. In this sense, information can serve to expand the user's knowledge, leading him to a new state of knowledge that differs from the previous state [28]. Information dissemination is the preservation guarantee of specific knowledge, considering that the greater its use, the greater the probability of guaranteeing the memory of this knowledge [29].

All knowledge is part of a domain whose extremities are occupied, on the one hand, by tacit knowledge (not codified) and, on the other, by explicit knowledge (codified) [30]. Knowledge then manifests itself in different ways, a continuum that starts from the uncodified to the clearly codified and that allows a knowledge form to transform into another according to a context and value that this transformation adds [31]. Thus, there is a force between tacit and explicit knowledge, called self-transcendent knowledge, a potential knowledge that divides tacit knowledge into incorporated tacit (knowledge in use) and not yet incorporated tacit (self-transcendent knowledge) [32].

Another form of knowledge is knowledge by familiarity, knowledge of things, where the relationship between subject and reality is direct through experience, knowledge that can only be transferred indirectly, through an externalization process. Finally, there is propositional knowledge, knowledge about things, in which the relationship between subject and reality is indirect through propositions materialized in artifacts and mentefacts. Due to its characteristics, propositional knowledge can be transferred because the proposition is the way knowledge is communicated [33] [34].

In the organizational context and to ensure the preservation of accumulated organizational knowledge, it is necessary to offer conditions for this knowledge to be disseminated among the organization's members. For this to occur, thus making this knowledge a collective property (and not individual) as its origin, registering it in a written, recorded, and/or documented form is fundamental [35]. Unregistered information has its socialization impaired because its access is limited to spatial and temporal variables [36]. In turn, the preservation of a document refers to its temporal character, which entails an approach to the classification, temporality, and destination of documents [37].

3.2 Lessons Learned in Projects

A project is a temporary integrated effort to create a unique product, service, or result, generally conceived from organizational strategies and needs [8], a unique, organized, and multidisciplinary undertaking to carry out previously agreed deliveries and according to requirements and restrictions [6]. Projects (and the programs and portfolios they comprise) provide for the production of data during the execution of their activities, which can be collected in different ways and must be converted into information through their interpretation, analysis, and presentation [38]. It is the nature of projects to consume and produce information high volume, the sharing of which is closely related to the context in which they originate [39].

In this context, information management aims to prospect, select, process, make available, disseminate, and store the information necessary for project management and organizational learning in projects [40]. In turn, knowledge management is a systematic information and learning management activity, which brings together information and individual experiences to form collective knowledge, which can be shared to improve organizational activities. The knowledge's main source is the experiences lived in the organization, usually documented in the form of lessons learned [38].

In general, the lessons learned to refer mainly to negative events and, therefore, the context that originated them must be duly investigated [41]. The identification of significant events, that is, those that serve as a basis for recording lessons learned, is done through three elements: facts (irrefutable occurrences that can be recorded), perspectives (points of view of project team members on the main occurrences in this) and deliverables (planned results for the project) [12]. A record of lessons learned can include the category, description, and impact of the situation that originated it, as well as the problems, risks, and opportunities or any other relevant content, in the form of text, audio, video, images, or any other for represent content [8].

There are several methods for assessing lessons learned, mainly applied by project teams (and, if applicable, other interested parties) during or after project execution [9]. An important perspective on recording lessons learned is offered by the PRINCE2 method: during the life cycle of the project, a lesson is only classified as identified, starting to be classified as learning only if it is proven that it caused a change (Axelos, 2017). Lessons learned should be made available for application in future projects, aiming to improve organizational performance [38] [7] [8].

Based on the classification of knowledge used here [32], we have the following concepts [20]:

- A lesson is self-transcendent knowledge identified during the life cycle of a project and which, legitimized, can be incorporated into the organizational knowledge base on project management for eventual use in future projects.
- A lesson learned is tacit knowledge incorporated through individual practice and legitimized by an individual's group credited with the technical competence to do so.
- A lesson learned record is the knowledge explanation contained in a lesson learned, the document that represents it.

3.3 Conceptual Modeling and Ontologies

Models are schematic descriptions of a phenomenon, system, or theory used to explain its known or inferred characteristics and properties [14]. In turn, a conceptual model is a social computational artifact, a partial representation of a domain that is capable of answering a question [42]. Thus, conceptual models improve models based on concepts shared by a community or stakeholders in the modeling process [14].

Any knowledge base is committed to some conceptualization and must be capable of representation so that it can be adapted to the requirements of computerized systems [43]. In this way, a conceptual model is an artifact elaborated through the use of a conceptual modeling language [17], applied in an abstract space composed of four perspectives (or Spaces) [14]:

- Origin Space, the domain that is intended to model conceptually, where the context acts as a delimiting element to define the scope, attention, orientation, origins, infrastructure sources, and restrictions..
- Representation Space, which establishes the language to be used to explain the means of representation (words, terms, statements, explanations, hypotheses, logical and mathematical symbols, diagrams, figures).
- Understanding Space, based on the intentions, attitudes, skills, knowledge, skills, and experiences (especially those related to problem-solving) of model users.
- Concept Space, where it is specified, through propositions consensually elaborated by the community interested in the domain, the knowledge that one has about certain things and their properties.

In information systems, ontologies are conceptual models that establish concepts, entities, properties, and relationships increasingly used to represent a field of knowledge or the system's structure using an unambiguous computational language [18]. In this context, ontologies describe how information systems should behave in the digital world [44] and, like metadata, they can offer solutions to knowledge reuse problems related to understanding contexts, documentation contents, and support offered by information technologies [45].

Ontologies represent a perspective on a given domain [18] and a common vocabulary to be used in communication between different agents [46]. Thus, an ontology is generically composed of a set of logical axioms designed to explain the intended meaning of a vocabulary [47]. As for typology, ontologies can be domain (representing a specific domain) or foundation (representing generic concepts and properties) [48].

4. Results Presentation and Analysis

The Entity-Relationship analysis model that represents the record of lessons learned in projects was carried out in two stages. Through the comparison between the entities of this model and the artifacts of the ontologies represented in Figure 1, the first step consisted in checking the accuracy, and the second step in checking the integrity of this model. The results of these steps are described below:

4.1 Step One: Determine the model accuracy

Table 1. Correspondences between model's entities and BFO-IAO's artifacts.

Model's Entity	BFO-IAO's Artifact	Definition
Category	BFO: Quality	Category = Def. BFO: Quality which classifies a lesson or lesson learned
Client	BFO: Continuant	Client = BFO: Continuant which represents an individual, a group or an organization who demands projects
Document	IAO: Information Content Entity	Document = Def. IAO: Information Content Entity which represents documents associated with lessons (identified or learned) in order to expand its informative content
Impact	BFO: Quality	Impact = Def. BFO: Quality which represents the degree's impact on an organization exposed to a consequence associated with an identified lesson
Lesson	BFO: Generically Dependent Continuant	Lesson = Def. BFO: Generically Dependent Continuant which represents identified or lessons learned
Phase	BFO: Occurent	Phase = Def. BFO: Occurent which represents projects phases
Project	BFO: Occurent	Project = Def. BFO: Occurent which represents executed or in execution projects
Risk	BFO: Quality	Risk = Def. BFO: Quality which represents risks probability (to the organization) arising from the events that gave rise to the lessons or their consequences
Stakeholder	BFO: Independent Continuant	Stakeholder = Def. BFO: Independent Continuant wich represents an individual, a group or an organization interested in a one or more projects
Status	BFO: Quality	Status = Def. BFO: Quality which represents lesson's condition in certain moment
Subject	BFO: Quality	Subject = Def. BFO: Quality which represents themes related to a lesson or lesson learned or a analyze object theme of a lesson or lesson learned

Table 1 shows that correspondences were found for all entities in the model, which were defined using the ontologies' artifacts. In this way, the model accuracy was confirmed.

4.2 Step Two: Determine the model integrity

The BFO: Process and IAO: Planned Process artifacts are some artifacts examples from the BFO and IAO ontologies that represent processes in general. In this way, the five fundamental processes to manage lessons learned has correspond with these artifacts. It is also worth mentioning that the execution of each process (and their respective activities) occurs within a specific space-time, which is represented by the IAO artifact: Spatiotemporal Region. Thus, as a process and by analogy, the Entity-Relationship model that represents the record of lessons learned in projects is also the representation of the entities of the respective process. Specifically, other correspondences are presented in Table 2:

Table 2. Correspondences between fundamental processes and BFO-IAO's artifacts.

Fundamental Process	BFO-IAO's Artifact	Comments
Explicitation and Categorization	IAO: Documenting, IAO: Document, IAO: Data Item, IAO: Keywords Section, IAO: Document Part	The very process of registering lessons learned in projects, whose initial activities comprise (with the use of model metadata) the explanation and classification of information pertinent to the identified lessons
Evaluation and Monitoring	BFO: Role, BFO: Quality	Evaluation and Monitoring processes depend on people to evaluate the collected information quality and qualify it. They also represent the cycle of the registration process, from the identification of the lessons to their classification (or not) as a lesson learned, the transformation of self-transcendent knowledge into incorporated tacit
Dissemination	IAO: Material Information Bearer, IAO: Information Content Entity	Dissemination of lessons learned in an organization, after their incorporation into the organizational knowledge base on project management

Table 2 shows that correspondences were found for all the five fundamental processes to manage lessons learned, which were defined using the ontologies' artifacts. In this way, the model integrity was verified.

5. Conclusion

The present article presented the analysis of an Entity-Relationship model that represents the record of lessons learned in projects, aiming to verify its accuracy and integrity before a foundation ontology, the BFO (Basic Formal Ontology), and a domain ontology derived from the BFO, the IAO (Information Artifact Ontology). In this sense, the results of the analysis demonstrated the accuracy and completeness of the model, which indicates its applicability in the elaboration of information systems to record lessons learned in projects. In this way, the analysis results also demonstrated that ontologies (especially those of foundation) can represent a reliable way to elaborate and analyze knowledge representation models. Thus, a suggestion for future research is the development of a domain ontology to represent the record of lessons learned in projects.

References

[1] Jugdev K, Wishart P. Mutual caring – resolving habituation through awareness: supporting meaningful learning from projects. Project Management Journal. 2014 45(2):66-82.

[2] Handzic, M., Durmic, N. Knowledge management, intellectual capital and project management: connecting the dots. The Electronic Journal of Knowledge Management, 2015 13(1):51-61.

[3] Molina, L. G., Valentim, M. L. P. Memória organizacional como forma de preservação do conhecimento. Perspectivas em Gestão & Conhecimento. 2015 5(2):147-169.

[4] Rautenberg, S. Modelo de conhecimento para mapeamento de instrumentos da gestão do conhecimento e de agentes computacionais da engenharia do conhecimento baseado em ontologias. 2009. Tese (Doutorado em Engenharia e Gestão do Conhecimento) - Universidade Federal de Santa Catarina, Florianópolis.

[5] Waltz, E. Knowledge management in the intelligence enterprise. ArtechHouse; 2003.

[6] International Project Management Association. Individual competence baseline for project, programme & portfolio management. Zurich: IPMA; 2015.

[7] Axelos Limited. Managing successful projects with PRINCE2®. Norfolk: Axelos Limited; 2017.

[8] Project Management Institute. Um guia do conhecimento em gerenciamento de projetos (Guia PMBOK®). Project Management Institute, Inc.; 2017.

[9] Veronese, G. Métodos para captura de lições aprendidas: em direção à melhoria contínua na gestão de projetos. Revista de Gestão e Projetos. 2014 5(1):71–83.

[10] Mmatseleng, M., Carl, M. Project reviews: the vehicle for learning in organisations.African Journal of Business Management. 2012 6(44):10853-10861.

[11] Asrar-Ul-Haq, M., Anwar, S. A systematic review of knowledge management and knowledge sharing: Trends, issues, and challenges. Cogent Business and Management. 2016 3:1–17.

[12] Bost, M. Project management lessons learned: a continuous process improvement framework. Boca Raton: CRC Press; 2018.

[13] Guizzardi, G. Ontological patterns, anti-patterns and pattern languages for next-generation conceptual modeling. Proceedings of the 32rd International Conference on Conceptual Modeling; 2014; Atlanta. Switzerland: Springer International Publishing; 2014. p. 13-27.

[14] Thalheim, B. The theory of conceptual models, the theory of conceptual modeling and foundations of conceptual modeling. In: Embley, D. W., Thalheim, B. 1st. editors. Handbook of Conceptual Modeling. Berlin Heidelberg: Springer-Verlag; 2011. p. 1-37.

[15] Tort, A., Olivé, A. An approach to testing conceptual schemas. Data & Knowledge Engineering. 2010 69(6):598-618.

[16] Chen, P. P. The Entity-Relationship model – toward a unified view of data. ACM Transactions on Database Systems. 1976 1(1):9-36.

[17] Delcambre L. M. L. et al. A reference framework for conceptual modeling. In: Trujillo J. et al. editors. Conceptual Modeling. Lecture Notes in Computer Science. 11157. Switzerland: Springer; 2018.

[18] Guarino, N., Oberle, D.; Staab, S. What is an Ontology? In: Staab, S., Studer, R. 2nd. editors. Handbook on Ontologies. Springer; 2009. p. 1-17.

[19] Ferneda, E. Ontologia como recurso de padronização terminológica de um sistema de recuperação de informação. 2013. Relatório de Pesquisa (Pós-Doutorado em Ciência da Informação) – Universidade Federal da Paraíba, João Pessoa.

[20] Ramos Junior, M. A. C.. Registro de lições aprendidas em projetos: uma proposta de modelagem. 2022. Tese (Doutorado em Ciência da Informação) – Universidade Federal Fluminense, Niterói.

[21] Almeida, M. B. Ontologia em Ciência da Informação: teoria e método. Curitiba: CRV; 2020.

[22] Smith, B. Basic formal ontology 2.0: specification and user's guide. 2015.

[23] Löw, M. M. Proveniência arquivística e semântica: uso de ontologias de BFO para representação da produção documental e contexto. 2021. Dissertação (Mestrado em Ciência da Informação) - Universidade Federal do Rio Grande do Sul.

[24] Góes, A. de S., Hisatomi, M. I., Barros, R. M de. A maturity model for lesson learned - GAIA L.A.: a case study aiming to increase the quality of knowledge management in software development. Proceedings of the XXXIX Latin American Computing Conference (CLEI). Naiguata; 2013, p. 1-11.
[25] Chen, M. et al. Data, information and knowledge in visualization. IEEE Computer Graphics and Applications. 2009 29(1):12-19.
[26] Harris, B. R. Communities as necessity in information literacy development: challenging the standards. The Journal of Academic Librarianship. 2008 34(3):248-255.
[27] Runardotter, M. et al. The information life cycle: issues in long-term digital preservation. Proceedings of the 28th Information Systems Research Seminars. Scandinavia; 2005.
[28] Nöth, W., Gurick, A. A teoria da informação de Charles S. Peirce. Revista Digital de Tecnologias Cognitivas. 2011.
[29] Dodebei, V. L. Tempos memoriais e patrimoniais: Notas de pesquisa sobre memória e informação. In: Netto, C. X. de A. editor. Informação, Patrimônio e Memória: Diálogos interdisciplinares. João Pessoa: Editora da UFPB; 2015. p. 44-64.
[30] Virtanen, I. In search for a theoretically firmer epistemological foundation for the relationship between tacit and explicit knowledge. The Electronic Journal of Knowledge Management, Sonning Common. 2013 11(2):118-126.
[31] International Organization For Standardization. ISO 30.401:2018 – Knowledge management systems: requirements. Geneva, Switzerland: ISO; 2018.
[32] Scharmer, C. O. Self-transcending knowledge: sensing and organization around emerging opportunities. Journal of Knowledge Management. 2001 5(2):137-150.
[33] Zagzebski, L. O que é conhecimento? In: Greco, J.; Sosa, E. editors. Compêndio de epistemologia. São Paulo: Edições Loyola; 1998. p. 153-189.
[34] Souza, E. D., Oliveira, M. L. V. de. Condições da informação e do conhecimento no contexto da gestão: aproximações epistêmicas. In: Feitoza, R. A. de B., Duarte, E. N. editors. Visões epistemológicas da gestão do conhecimento na ciência da informação. João Pessoa: Editora UFPB; 2020. p. 206-232.
[35] Souza, E. D., Oliveira, M. L. V. de. É preciso aprender para ser gestor: aprendizagem para desenvolver a competência de gestor da informação e do conhecimento. In: Feitoza, R. A. de B., Duarte, E. N. editors. Visões epistemológicas da gestão do conhecimento na ciência da informação. João Pessoa: Editora UFPB; 2020. p. 233-269.
[36] Correia, M. C. S. A informação como o conhecimento registrado. 2017. Tese (Doutorado em Ciência da Informação) - Universidade de Brasília, Brasília.
[37] Arquivo Nacional (Brasil). Conselho Nacional de Arquivos. 2019.
[38] Association of Project Management. APM body of knowledge. Association of Project Management; 2012.
[39] Sugahara, C. R. Flujo de información y conocimiento en el entorno organizacional. Revista Interamericana de Bibliotecología. 2019 42(1):45-55.
[40] Monteiro, N. A., Falsarella, O. M. Um modelo de gestão da informação para aprendizagem organizacional em projetos empresariais. Perspectivas em Ciência da Informação. 2007 12(2):81-97.
[41] Fosshage, E. Considerations for implementing and organizational lessons learned process. Sandia National Laboratories. United States: Albuquerque; 2013.
[42] Mayr, H. C., Thalheim, B. The triptych of conceptual modeling: a framework for a better understanding of conceptual modeling. Software and Systems Modeling. 2021 20:7-24.
[43] Campos, M. L. de A. O papel das definições na pesquisa em ontologia. Perspectivas em Ciência da Informação. 2010 15(1):220-238.
[44] Bax, M. P., Coelho, E. de M. P. Compromissos ontológicos e pragmáticos em ontologias informacionais: convergências e divergências. DataGramaZero. 2012 13(3).
[45] Montesa Rausell, P. M. Desarrollo de una base de datos para la reutilización del conocimiento en proyectos de diseño. Aplicación al rediseño del interior de un MINI. 2017. Tese (Mestrado em Engenharia Industrial) - Escuela Técnica Superior Ingenieros Industriales, Universitat Politècnica de València, València.
[46] Silva, R. J. da. et al. Um modelo semântico baseado em ontologia para o cris brasileiro. In: Silva, C. G. da; Revez, J., Corujo, L. editors. Organização do conhecimento no Horizonte 2030: Desenvolvimento sustentável e saúde. Proceedings of the V Congresso ISKO Espanha Portugal, Universidade de Lisboa, Faculdade de Letras. Lisboa: Centro de Estudos Clássicos, Colibri; 2021. p. 273-284.
[47] Guarino, N. Formal ontology in information systems. In: Proceedings of FOIS'98, Trento, Italy, jun. 1998. Amsterdam: IOS Press; 1998. p. 3-15.
[48] Biagetti, M. T. Ontologies (as knowledge organization systems). In: Hjørland, B., Gnoli, C. editors. ISKO Encyclopedia of Knowledge Organization; 2021.