

# “Systematic review about methods and techniques to build ontologies”

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A literature review is a basic step in a process to research development. Usually, a literature review occurs on initial phases. A systematic review (SR) is a literature review method. A systematic review is a documented method of research that aims to identify the data source to the literature on a particular subject of interest. SR also evaluate and interpret all available research pertaining to a research question. The results of SR is a mapping of the previous knowledge existing and relevant initiatives about the research topic. On the SR's planning phase research protocol is defined to conduct all following steps of the review (Biolchini, Mian, Natali, & Travassos, 2005; Brereton, Kitchenham, Budgen, Turner, & Khalil, 2007; Kitchenham, 2004; Mian, Conte, Natali, Biolchini, & Travassos, 2005). This documents is a protocol from a systematic review aiming to verify the state of the art regarding the development of ontologies.

## 1 FORMULARIZATION OF THE SYSTEMATIC REVIEW:

This section describe the research objectives, issues and purpose of this SR. It is also presented general keywords about research scope. The researcher obtained the keywords on papers previously known.

### 1.1 Objectives of the systematic review of literature:

Identify primary studies that propose methodologies for development of ontologies.

### 1.2 Reach of Research:

Determine a set of consolidated methodologies for building domain ontologies (MBDO).

#### 1.2.1 Research issues:

Analyze this set of methodologies identifying: workflow, activities with description, activities sequence, inputs, outputs, development life cycle, application area, ontologies built, and tools used.

**Intervention:** Methodologies for development of ontologies.

**Control:** Previous studies about general concepts of ontologies and methodologies for develop ontologies. These studies were indicated by researcher's supervisor or found by an informal research on google scholar. These control material are:

1. Corcho, O., Fernández-López, M., & Gómez-Pérez, A. (2003). *Methodologies, tools and languages for building ontologies*. Where is their meeting point? Data & Knowledge Engineering, 46(1), 41-64
2. da Silva, D. L., Souza, R. R., & Almeida, M. B. (2008). *Ontologias e vocabulários controlados*: comparação de metodologias para construção. Ci. Inf, 37(3), 60-75.
3. da Silva, D. L., Souza, R. R., & Almeida, M. B. (2013). Uma comparação de metodologias para construção de ontologias e vocabulários controlados.
4. de Almeida Falbo, R., de Menezes, C. S., & da Rocha, A. R. C. (1998). *A systematic*

- approach for building ontologies.** Progress in Artificial Intelligence—IBERAMIA 98 (pp. 349-360): Springer.
5. Fernández-López, M. (1999, 1999). **Overview of methodologies for building ontologies.** Paper presented at the IJCAI-99 workshop on Ontologies and Problem-Solving Methods, Stockholm, Sweden.
  6. Fernández-López, M., Gómez-Pérez, A., & Oacute. (2002). **Overview and analysis of methodologies for building ontologies.** The Knowledge Engineering Review, 17(02), 129-156.
  7. Gómez-Pérez, A., Fernández-López, M., & Corcho, O. (2004). **Methodologies and methods for building ontologies.** Ontological Engineering: with examples from the areas of Knowledge Management, e-Commerce and the Semantic Web, 107-197.
  8. Guarino, N. (1997). **Understanding, building and using ontologies.** International journal of human-computer studies, 46(2-3), 293-310.
  9. Hafner, N. F. N., & Carole, D. (1997). **The State of the Art in Ontology Design: A Survey and Comparative Review.** 18, 3, 53-74.
  10. Jones, D., Bench-Capon, T., & Visser, P. (1998). Methodologies for ontology development.
  11. Lim, S. C. J., Liu, Y., & Lee, W. B. (2011). A methodology for building a semantically annotated multi-faceted ontology for product family modelling. Advanced Engineering Informatics, 25(2), 147-161.
  12. Mendonça, F. M., & Almeida, M. B. (2014). **Princípios metodológicos para desenvolvimento de ontologias: análise das práticas correntes e proposição de melhorias.** Paper presented at the XV Encontro Nacional de Pesquisa em Pós-Graduação em Ciência da Informação, Belo Horizonte, Brasil.
  13. Smith, B., & Ceusters, W. (2010). **Ontological realism: A methodology for coordinated evolution of scientific ontologies.** Applied Ontology, 5(3-4), 139.
  14. Suárez-Figueroa, M. C. (2010). **NeOn Methodology for building ontology networks: specification, scheduling and reuse.** (PhD thesis), Universidad Politécnica de Madrid, Madrid.
  15. Uschold, M., & Gruninger, M. (1996). **Ontologies: Principles, methods and applications.** The Knowledge Engineering Review, 11(02), 93-136.

**Population:** publications regarding the follow subjects: basic concepts about ontology; activities, process, methodologies, methods and techniques for developing ontologies.

**Results:** deep and comprehensive overview of methodologies, methods and techniques for building ontologies, features; analyze the advantages and disadvantages of each; make a comparison among them.

**Application:** To help researchers that desire to understand how to build a domain ontology, and researchers that need to define a methodology to build their own domain ontology.

### **1.2.2 Keywords or main words related on control papers:**

Methodologies for/to building ontologies, methodologies for/to developing ontologies, ontology building, ontology engineering, ontology development process, ontology life cycle.

## **2 SOURCES SELECTION**

This section presents the criteria used to choose databases that primary studies will be extracted, what kind of resources will be considered, which languages the primary studies must be written, and search strings to be used. We also presents a list with databases or studies sources selected.

### **2.1 Sources Selection Criteria:**

#### **2.1.1 Sources Selection Criteria Definition:**

We will execute the search for primary studies using electronic databases indexed. Databases that don't provide full text of studies will be excluded. All databases selected must be open or provided for academic research by University at Buffalo (UB) and/or CAPES<sup>1</sup>. The sources should cover the following areas of expertise: Information science, computer science, philosophy, health sciences and medicine.

#### **2.1.2 Sources List:**

From criteria defined, and according frame available on annex 3, the follow databases were selected:

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<sup>1</sup> Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

In English: Coordination for the Improvement of Higher Education Personnel.

CAPES is a Foundation within the Ministry of Education in Brazil whose central purpose is to coordinate efforts to improve the quality of Brazil's faculty and staff in higher education through grant programs. CAPES is particularly concerned with the training of Doctoral candidates, Pre-doctoral short-term researchers, and Post-doctoral Scholars.

- IEEE Xplore
- ACM Digital Library
- INSPEC (Information Services for Physics, Electronics, and Computing)
- Web of Science
- PubMed
- EBSCOhost Research Databases
- CAPES Journals Portal

### 2.1.3 Studies Languages:

Preferably English, being the language most internationally accepted for writing scientific papers. Portuguese, first due to be the native language of the researcher, and secondly because some previous studies that are known by the researcher were written in this language. Spanish and French also can be used, due to familiarity of the researcher with these languages. However, language criteria will not be applied until preliminary selection, unless the studies returned on search do not have title, keyword and abstract in these languages. English is the language used to compose the search strings.

### 2.1.4 Kind of Material and Studies Selection:

This systematic review analyzes studies available in format of theses and papers published in journals, conferences, proceedings of conference, and books with collection of papers.

## 2.2 Sources Search Methods:

In this systematic review is performed two types of search in databases (Figure 1), an initial search identifies consolidated existing methodologies to building ontologies, and a second search recovers studies about each methodology identified on first search. Each search is explained on next subsections.

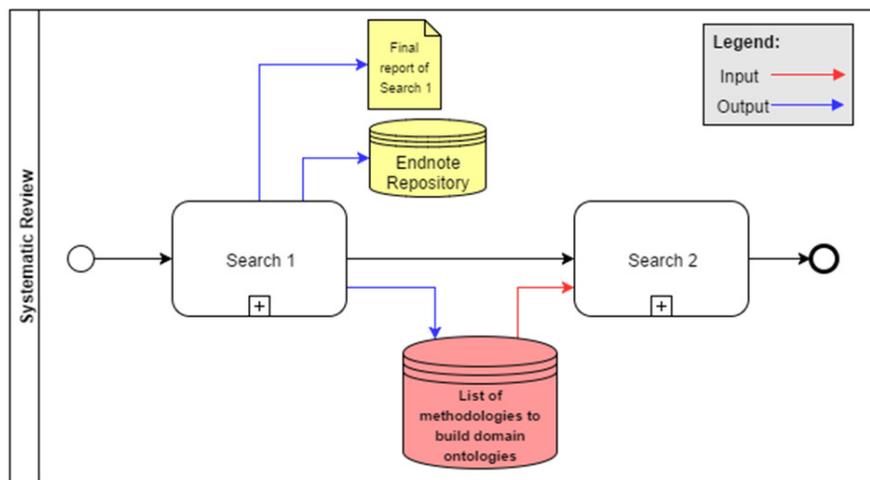


Figure 1: General systematic review search method

### 2.2.1 Search 1: Identifying methodologies to build ontologies.

A preliminary search will be conducted so as to identify a set of methodologies to build domain ontologies. At this moment the full text language selection criteria is not relevant.

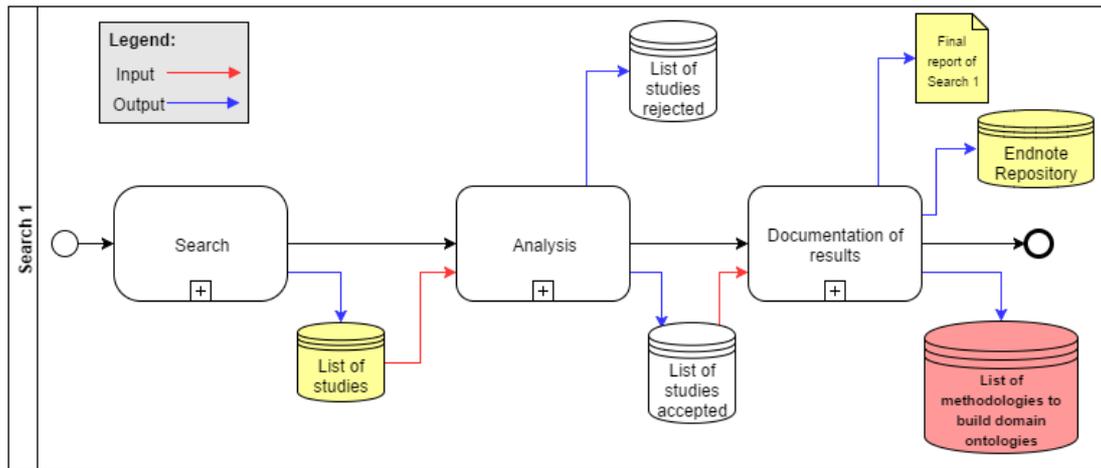


Figure 2: Search 1 process.

The process activities of Search 1 are: search of studies, analysis of results and documentation (Figure 2). This process will be performed for each database identified on subsection 2.1.2.

### 2.2.1.1 Search:

Carrying out searches in each source defined using their search engines available. Figure 3 presents a diagram with Search steps in details.

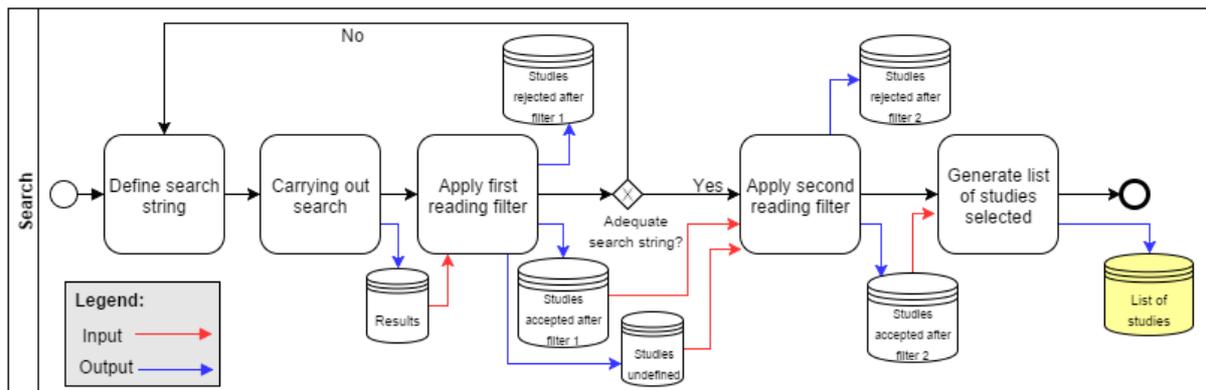


Figure 3: Details of Search step from Search 1.

First, we must to define a search string to be submitted. Note that each source has its own search mechanism, becoming necessary to adapt the search string to each source. Then, we carried out searches looking for both primary and secondary studies which satisfied our research. Before proceeding, should be checked the keywords defined on each studies and compare with search string submitted, in order to verify the adherence of this string. May, could be necessary adjust search string and start again.

Next step, both primary and secondary studies will be submitted to the filter 1, where, just by reading the title, abstract and keywords, studies will be classified. Articles aligned with objective of search 1 and complies the inclusion criteria will be accepted and those in disagreement rejected. Often, just application of filter 1 is not enough to know whether the study complies the objectives and inclusion criteria in this case, they will be classified as undefined.

- Objective of search 1: identify methodologies to build domain ontology
- Studies inclusion criteria: We will be accepted primary and secondary studies that cite one or more methodologies for building domain ontologies.

After, studies classified as accepted or undefined are subjected to the filter 2 that consists in reading the introduction and conclusion and repeats reading the title, abstract and keywords. Studies aligned with objective of search 1 and meet the inclusion criteria will be accepted and those in disagreement are eliminated from the review.

### 2.2.1.2 Analysis:

The analysis stage is the final selection of articles that serve the purpose of the research, and will be used for the extraction of data relevant research (Figure 4). At that moment it is important to focus on the objectives and inclusion criteria.

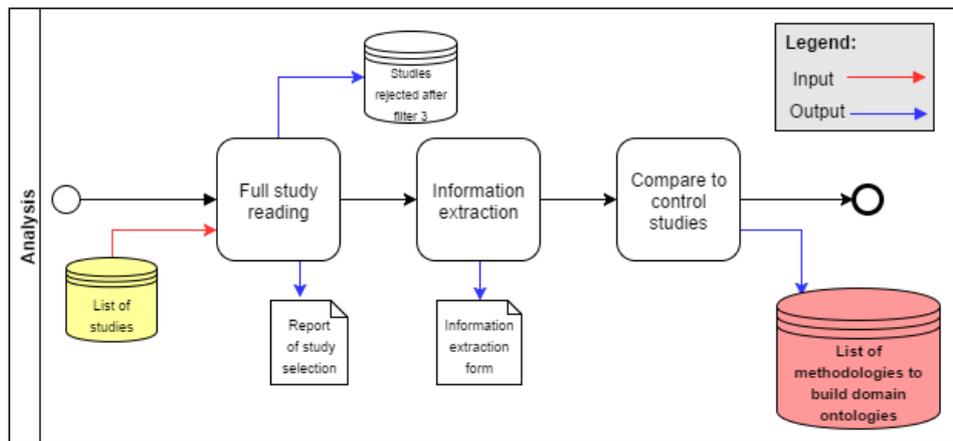


Figure 4: Details of Analysis step from Search 1.

First, studies selected in the Filter 2, are undergo thorough reading (Filter 3). At this point, can still be eliminated from review items that do not meet the search goals and the inclusion criteria, and that only after complete reading was possible to identify non-compliance with the objectives. Articles approved through this filter will be used to extract the information needed to systematic review. In both steps it is important to document the data for future evaluation. Each study submitted in the filter 3, will be documented at “*Report of study selection*”, according the model on appendix 1. Information extraction step will be documented at form of information extraction, according the model on annex 4.

Finally, the form of information extraction generated will be compared with the frame of methodologies extracted from control studies (subsection **Erro! Fonte de referência não encontrada.**). At this point, the form of information extraction could be improved with methodologies from control studies. Final result of “*Analysis*” is a list containing methodologies used to build domain ontologies.

### 2.2.1.3 Documentation of results:

Articles that were selected in the third filter and were analyzed should be stored in a repository of research articles.

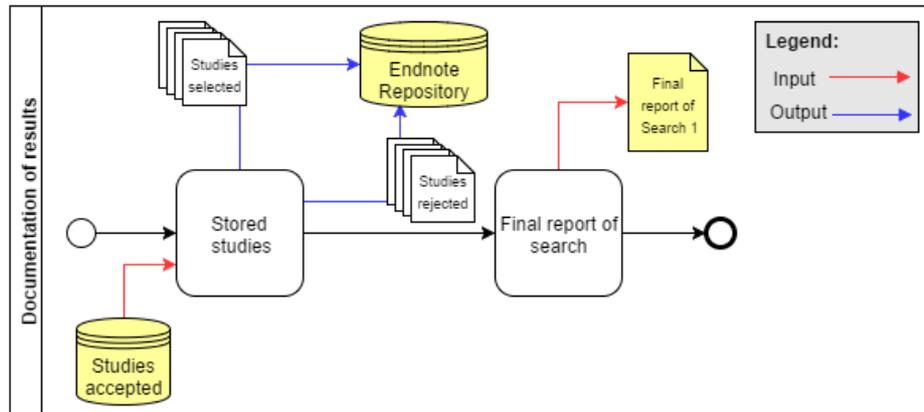


Figure 5: Details of Documentation step from Search 1.

We will be stored using EndNote X7, a software for managing references. Unselected studies should be saved on EndNote for possible reanalysis. We also are going to create a report with a summary results of this first search, where issues about agreement and disagreement between reviews are described, total of papers found on search and amount selected, decisions made, and others relevant informations.

### **2.2.2 Search 2: Analyzing methodologies to build ontologies.**

A main search will be conducted to recovers primary studies that describing each methodology from the list defined on search before. Secondary studies could be accepted since that they compare and/or synthesizes the outcomes of many primary studies about methodologies to build domain ontologies. At this moment the full text language selection criteria will be applied.

The process of Search 2 is quite similar to process of Search 1, but here, we are going to reuse some studies selected to Search 1. The process activities are: preliminary selection of studies, search of studies, analysis of results and documentation (Figure 6).

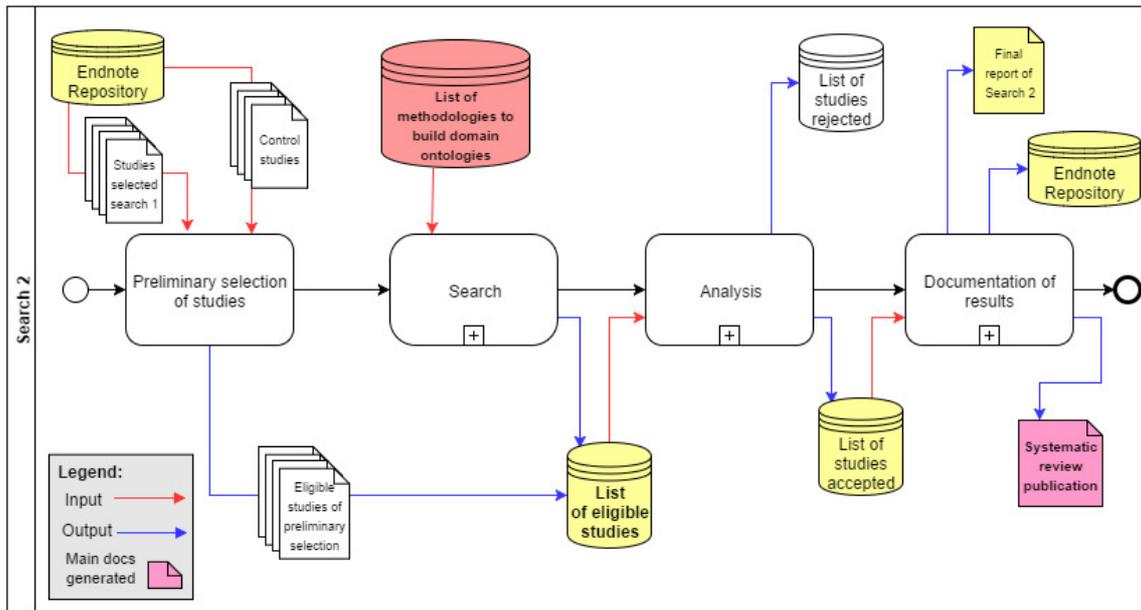


Figure 6: Search 2 process.

Our first task is perform a preliminary selection of studies on research repository to identify among control studies and studies that were selected in the Search 1 those who are eligible for the Search 2. We will create a preliminary list of eligible studies.

#### 2.2.2.1 Search:

Submit a main search in each database defined at section 2.1.2 based on list of methodologies resultant of Search 1 process. The steps in details to be performed are represented on Figure 7. The first five tasks will be carried out until all bases are searched.

First task is select a database, among a source list on subsection 2.1.2, to be searched. Then, we will define a search string according search mechanism of the database selected. Next, we will submit search looking for studies, preferably primary studies, which describe one or more MBDO. As in Search 1, we will checked the keywords defined on each studies and compare with search string submitted, in order to verify the adherence of this string. If necessary we will adjust search string and start again.

Afterward, on "Apply first reading filter" task, we will start a study selection based on reading of the title, abstract and keywords (filter 1). All studies will be classified in "accepted", "rejected", and "undefined", according aligning with search objective and the inclusion criteria, defined, respectively, in subsection 1.2 and 3.1.

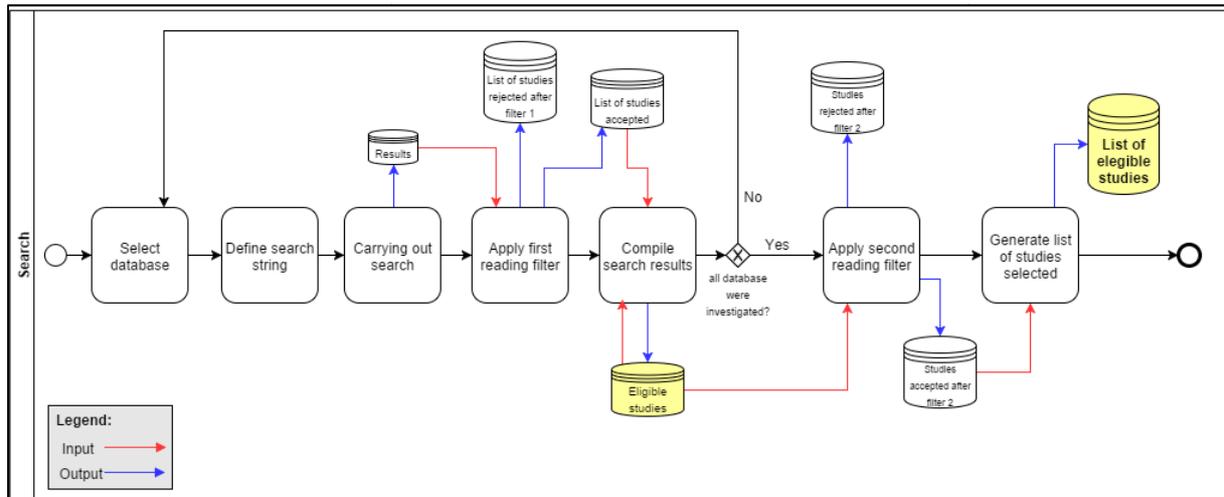


Figure 7: Details of Search step from Search 2.

After filter 1, at task “Compile search results”, we will put together the studies accepted from current database and previous studies eligible. When all databases from our list (subsection 2.1.2) were investigated, we will apply the second reading filter that consists in reading the introduction and conclusion of eligible studies and undefined studies. We also will repeat reading the title, abstract and keywords. Studies aligned with objective and the inclusion criteria will be accepted for next step, and those in disagreement are eliminated from the review. Finally, we will generate a list of studies selected to start our analysis.

#### 2.2.2.2 *Analysis:*

The analysis stage refers to full reading and information extraction on studies selected. This stage is detail on Figure 8.

First, eligible studies selected will be undergo thorough full reading (Filter 3). At this point, can still be eliminated from review items that do not meet the search goals and the inclusion criteria, and that only after complete reading was possible to identify non-compliance with the objectives. Selected studies will be documented as founded paper on “Studies selection report” (template model in Appendix 1).

Then, we will start our information extraction. Information extraction forms should contain a summary of work with the main points to this systematic review and basic information about the study (bibliographic data, date of publication, abstract, etc) (template model in Appendix 2). First informations to be extracted are: Methodology, Ontologies built, Life cycle, Area or field, Principles defined, Patterns defined, Tools (annex X, Form 1). Second information extraction aims to extract for each methodology found: Activities, Activities description, Activities sequence, Workflow model, Activities required or not, Activities’ inputs and outputs (annex X, Form 2).

To support the comparison between the methodologies and each of the selected studies, can be created a checklist summarizing the items that must be observed in each methodology (Annex 3).

After that, we will compile the results of information extraction generating synoptic frames

according annex X. We intend to identify from this study amount of ontologies built, advantages, and disadvantages of each MBDO.

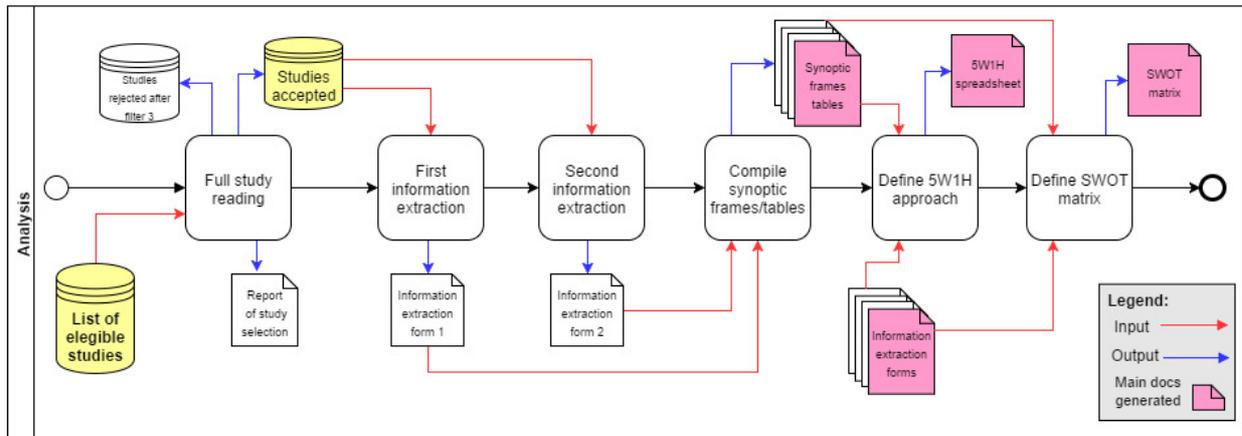


Figure 8: Details of Analysis step from Search 2.

As part of our analysis, we also intend to apply the 5W1H approach that is a technique to help visualize process activities with better clarity. 5W1H approach aims a mapping of these activities identifying: What (activities or steps) will be done; Who (responsible) will do that; When (what time) it will be done; Where (place) it will be done; Why (reasons) this activity should be done; and How (procedure or manner) this activity should be done.

Finally, we finish our analysis using a SWOT analysis or SWOT matrix that is a method used to evaluate the strengths, weaknesses, opportunities and threats involved in a project, or in our case in a MBDO. Where: Strengths, are the characteristics of the MBDO that represent an advantage over others; Weaknesses, are the characteristics of the MBDO that represent a disadvantage over others; Opportunities, are features or elements of the MBDO that could employ advantage compared to others; and Threats, are: are features or elements of the MBDO that could cause trouble if compared to others.

Both researcher and reviewer should still make notes of each job highlighting the relevant points. These notes will compose the data extraction forms that for each text considered valid and read in its entirety the reviewer will create.

### 2.2.2.3 Documentation of results:

As well as "Documentation of results" stage of the Search 1, we will store all studies at EndNote repository for possible reanalysis. A final report will be create with a summary results of this systematic review. It's going to be part of the report data such total of papers found on search and amount selected, decisions made, and others relevant informations. Finally, we going to write a document to publish our results with this systematic review.

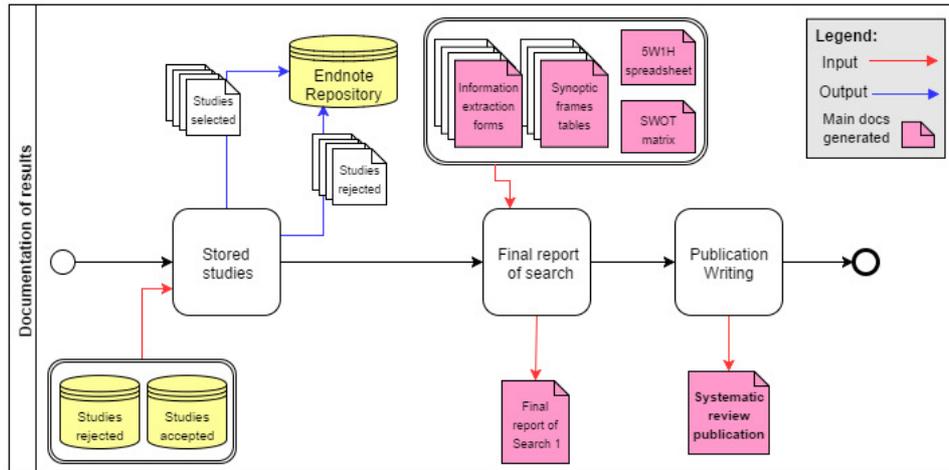


Figure 9: Details of Documentation step from Search 2.

### 2.2.3 Search Strings Base:

In English:

#### 2.2.3.1 Search string base to search 1:

To search studies about general methodologies:

(methodology OR methodologies OR method OR methods OR techniques OR technique OR process OR processes OR procedure OR procedures OR proceeding OR proceedings) AND (building OR build OR engineering OR engineer OR developing OR develop OR designing OR design OR compound OR conception OR make OR making OR fabricating OR fabrication OR creation OR create) AND (ontology OR ontologies OR ontological) AND (knowledge AND (organization OR representation))

Database	Search String	Results
IEEE		
ACM		
INSPEC		
Web of Science		
PubMed		
EBSCOhost		
CAPES Portal		

### 2.2.3.2 Search string base to search 2:

To search studies about specific methodologies:

("Uschold Methodology" OR "Grüniger and Fox's methodology" OR "Cyc method" OR "TOVE Project" OR "Enterprise Ontology" OR "Kactus method" OR "SENSUS method" OR "On-To-Knowledge" OR "Ontological Realism Methodology" OR "Ontology Development 101" OR "Methontology" OR "Neon methodology" OR "DILIGENT methodology" OR "EXPLODE methodology" OR "UP for ONtology").

("ontology building" OR "ontology engineering" OR "ontology developing")

Database	Search String	Results
IEEE		
ACM		
INSPEC		
Web of Science		
PubMed		
EBSCOhost		
CAPEs Portal		

### 2.2.4 Search database 1:

### 2.2.5 Search database 2:

## 3 CRITERIA AND PROCEDURES FOR SELECTION OF STUDIES

### 3.1 Studies Selection Criteria

For the selection of the studies were defined types of studies, besides inclusion and exclusion criteria as described below. The scale used for each inclusion and exclusion criteria is nominal involving two options: *yes* or *no*.

**Studies Types:** All kinds of studies related to the research topic will be selected if they are papers, thesis, dissertation, **books**. Conclusion projects/researches of undergraduate courses will not be used.

**Studies Priority Criteria:** This research will prioritize studies wrote by the authors that proposed the methodology.

**Studies Inclusion Criteria:** This research will select studies that...

- a. must be published and available work fully in scientific databases or printed versions.
- b. must be written in English or Portuguese.
- c. must be recent work (published since 2005) or a consolidated oldest work.
- d. must already have approval by the scientific community.
- e. must present methods and techniques to build ontologies that has already been used at least once.
- f. present methodologies and methods most discussed in the literature. This will be defined by an occurrence frequency table that will be built.
- g. present a comparison between methods and techniques to build ontologies if properly present the researched references.
- h. must present methods and techniques to build formal ontology.
- i. must present methods and techniques to build domain ontology.

**Studies Exclusion Criteria:** This research will not select studies that ...

- a. describing methodologies to build top level ontologies.
- b. published as short papers or posters.
- c. present ontology construction methodology without showing their practical application.
- d. not present domain ontology construction.
- e. present methodologies and methods weakly discussed in the literature. This will be defined by an occurrence frequency table that will be built.
- f. their titles, keyword and abstract are not available in English, Portuguese, Spanish or French.

### 3.2 Quality criteria in studies:

In case of papers or articles, the study must have been published in a journal or conference proceedings with peer review.

In case of dissertation or thesis, they must have been approved by the examining board.

To evaluate the articles the following criteria will be used: population considered in the evaluation and statistical methods.

- a) the number of citations received.
- b) the number of citations received by the authors.

- c) the ranking of source or journal where the study was found according SJR<sup>2</sup>.

## **4 INFORMATION EXTRACTION**

### **4.1 Summary of the results:**

For each methodology to build ontology founded on studies, the information that will be extracted are:

- a. Activities and activities sequence.
- b. Draw a workflow model.
- c. Activities description.
- d. Inputs and outputs activities.
- e. Identify if the activity is required or not.
- f. Development life cycle.
- g. Area or field of the ontology created using this methodology (main area).
- h. Ontologies built.
- i. Principles and patterns defined.
- j. Tools used and recommended.

A quantitative analysis of the methodology will be drawn up in order to determine how much the methodology is used from the amount of ontologies built with it. It will also elaborate a qualitative analysis in order to determine the advantages and disadvantages of each methodology.

### **4.2 Final report**

## 5 REFERENCES

Biolchini, J., Mian, P. G., Natali, A. C. C., & Travassos, G. H. (2005). Systematic review in software engineering. *System Engineering and Computer Science Department COPPE/UFRJ, Technical Report ES, 679(05)*, 45.

Brereton, P., Kitchenham, B. A., Budgen, D., Turner, M., & Khalil, M. (2007). Lessons from applying the systematic literature review process within the software engineering domain. *Journal of Systems and Software, 80(4)*, 571-583. doi:<http://dx.doi.org/10.1016/j.jss.2006.07.009>

Kitchenham, B. (2004). Procedures for performing systematic reviews. *Keele, UK, Keele University, 33(2004)*, 1-26.

Mian, P., Conte, T., Natali, A., Biolchini, J., & Travassos, G. (2005, 2005). *A systematic review process for software engineering*. Paper presented at the 2nd Experimental Software Engineering Latin American Workshop, Brazil.

Uschold, M., & Gruninger, M. (1996). Ontologies: Principles, methods and applications. *The Knowledge Engineering Review, 11(02)*, 93-136.

## Annex 1: GLOSSARY

<b>Term</b>	<b>Definition adopted</b>	<b>Synonyms</b>
<b>Activity</b>	Smallest unit of work performed for a particular purpose.	Task, Step
<b>Ontology</b>		
<b>Domain ontology</b>		
<b>Procedure</b>	A description to define how to do an activity.	
<b>Process</b>	A set of activities used to define what needs to be done to develop something, when the step should be performed and who are involved on this.	Methodology, method, workflow

**Annex 2: METHODOLOGIES RELATED ON CONTROL PAPERS**

Methodology	Author(s)	Ontologies built	Studies related
1. Methodology of Ontological Realism		Gene Ontology	
2. Methontology	Gómez-Perez, FernandezLopes and Vicente (1996)		
3. Neon methodology	SuarézFigueroa (2008)		
4. Up for ONtology (UPON)	De Nicola, Missikoff and Navigli (2009)		
5. TOVE Project (Toronto Virtual Enterprise)	Gruninger and Fox (1995)		
6. On-To-Knowledge Methodology (OTKM)	Sure, Staab and Stuber (2003)		
7. Enterprise Ontology	Uschold and King (1995)		
8. DILIGENT methodology			
9. EXPLODE methodology			
10. Kactus method			
11. SENSUS method			
12. Cyc method	Reed and Lenat (2002)		
13. Ontology Development 101	Noy and McGuinness (2001)		
14. OntoForInfoScience			

## Annex 3: COMPARATIVE TO SELECTION OF DATABASES:

Database	Subject <sup>3</sup>					Partial or Full text available		Provider		URL	Comments
	IS	CS	PH	HS	ME	YES	NO	UB	CAPEs		
1. Philosopher's Index			X			X		X		<a href="http://philindex.org/">http://philindex.org/</a>	Full Text via EBSCOhost Research Databases: <a href="https://www.ebscohost.com/">https://www.ebscohost.com/</a>
2. JSTOR (Journal STORAge)			X	X		X		X		<a href="http://www.jstor.org/">http://www.jstor.org/</a>	JSTOR provides the full-text of articles from hundreds of the most influential academic journals.
3. Project MUSE	X	X	X	X	X	X		X	X	<a href="https://muse.jhu.edu/">https://muse.jhu.edu/</a>	MUSE content can be accessed through partners such as EBSCO, ProQuest, SCOPUS (Elsevier).
4. MEDLINE				X	X	X		X	X	<a href="https://www.nlm.nih.gov/pubs/factsheets/medline.html">https://www.nlm.nih.gov/pubs/factsheets/medline.html</a>	MEDLINE is the largest subset of PubMed.
5. Web of Science Core Collection	X			X	X	X		X		<a href="http://wokinfo.com/products_tools/multidisciplinary/webofscience/">http://wokinfo.com/products_tools/multidisciplinary/webofscience/</a>	Collection of multidisciplinary databases which includes: <ul style="list-style-type: none"> <li>•Arts and Humanities Citation Index</li> <li>•Science Citation Index</li> <li>•Social Sciences Citation Index</li> <li>•Book Citation Index</li> <li>•Conference Proceedings Citation Index</li> <li>•Current Chemical Reactions</li> <li>•Index Chemicus</li> </ul>
6. Library Literature & Information Science Full Text	X					X		X			Full Text by EBSCOhost Research Databases: <a href="https://www.ebscohost.com/">https://www.ebscohost.com/</a>
7. Library, Information Science & Technology Abstracts with Full Text	X					X		X			Full Text by EBSCOhost Research Databases: <a href="https://www.ebscohost.com/">https://www.ebscohost.com/</a>
8. Education Resources Information Center (ERIC)	X					X		X		<a href="http://eric.ed.gov/">http://eric.ed.gov/</a>	Full Text by EBSCOhost Research Databases: <a href="https://www.ebscohost.com/">https://www.ebscohost.com/</a>
9. Library and Information Science Abstracts (LISA)	X						X				Excluded by absence of full text
10. IEEE Xplore		X				X		X		<a href="http://ieeexplore.ieee.org/Xplore/home.jsp">http://ieeexplore.ieee.org/Xplore/home.jsp</a>	
11. ACM Digital Library		X				X		X		<a href="http://dl.acm.org/">http://dl.acm.org/</a>	
12. INSPEC (Information Services for Physics, Electronics, and Computing)		X				X		X		<a href="http://www.engineeringvillage.com/">http://www.engineeringvillage.com/</a>	
13. Computer Source		X				X		X			Full Text by EBSCOhost Research Databases: <a href="https://www.ebscohost.com/">https://www.ebscohost.com/</a>

<sup>3</sup> IS=Information science or Library Science; CS=Computer science; PH=Philosophy; HS=Health sciences; ME=Medicine



Database	Subject					Partial or Full text available		Provider		URL	Comments
	IS	CS	PH	HS	ME	YES	NO	UB	CAPEs		
14. Applied Science & Technology Source		X				X		X			Full Text by EBSCOhost Research Databases: <a href="https://www.ebscohost.com/">https://www.ebscohost.com/</a>
15. AccessMedicine					X	X		X		<a href="http://accessmedicine.mhmedical.com">accessmedicine.mhmedical.com</a>	AccessMedicine provides access to the full text of the current editions of nearly 70 medical textbook and reference titles with updated content and thousands of images and illustrations.
16. Academic Search Complete	X	X	X	X	X	X		X			Full Text by EBSCOhost Research Databases: <a href="https://www.ebscohost.com/">https://www.ebscohost.com/</a> The world's most valuable and comprehensive scholarly database, with multi-disciplinary documents to full-text access.
17. Web of Science (formerly Web of Knowledge)	X	X	X	X	X	X		X	X	wokinfo.com/ OR <a href="https://www.webofknowledge.com">https://www.webofknowledge.com</a>	Collection of multidisciplinary databases which includes: Web of Science Core Collection BIOSIS Previews (Biological Abstracts) & BIOSIS Citation Index Current Contents Connect Data Citation Index Derwent Innovations KCI-Korean Journal Database MEDLINE SciELO Citation Index - Latin America, Spain, Portugal, the Caribbean & South Africa Zoological Record
18. PubMed				X	X	X				<a href="http://www.ncbi.nlm.nih.gov/pubmed">http://www.ncbi.nlm.nih.gov/pubmed</a>	PubMed cover MEDLINE database.
19. Proquest Dissertations & Theses Global	X	X	X	X	X	X		X	X		
20. SciELO - Scientific Electronic Library Online	X	X	X	X	X	X		X	X	<a href="http://www.scielo.org/php/index.php">http://www.scielo.org/php/index.php</a>	
21. ScienceDirect (Elsevier)				X	X	X		X	X	<a href="http://www.sciencedirect.com/">http://www.sciencedirect.com/</a>	Access by <a href="http://www-periodicos-capes.gov.br">www-periodicos-capes.gov.br</a>
22. Scopus (Elsevier)	X	X	X	X	X	X		X		<a href="http://www.scopus.com/home.url">http://www.scopus.com/home.url</a>	Access by <a href="http://www-periodicos-capes.gov.br">www-periodicos-capes.gov.br</a>
23. Fiocruz Journals Portal (Portal de Periódicos Fiocruz)	X			X	X	X			X	<a href="http://periodicos.fiocruz.br/pt-br">http://periodicos.fiocruz.br/pt-br</a>	Access by <a href="http://www-periodicos-capes.gov.br">www-periodicos-capes.gov.br</a>
24. Springer/LNCS and SpringerLink	X	X		X	X	X			X	<a href="http://link.springer.com/">http://link.springer.com/</a>	Access by <a href="http://www-periodicos-capes.gov.br">www-periodicos-capes.gov.br</a>
25. CiteSeerX	X	X				X			X	<a href="http://citeseer.ist.psu.edu/index">http://citeseer.ist.psu.edu/index</a>	Access by <a href="http://www-periodicos-capes.gov.br">www-periodicos-capes.gov.br</a>

Database	Subject					Partial or Full text available		Provider		URL	Comments
	IS	CS	PH	HS	ME	YES	NO	UB	CAPES		
26. CAPES Journals Portal (Portal de Periódicos CAPES)	X	X	X	X	X	X			X	www-periodicos-capes-gov-br	
27. CAPES Theses database (Banco de Teses da CAPES)	X	X	X	X	X	X			X	http://bancodeteses.capes.gov.br/	
28. EBSCOhost Research Databases	X	X	X	X	X	X		X		Access by UB login. https://www.ebscohost.com/	Collection of multidisciplinary databases which includes with UB Access: Academic Search Complete, AHFS Consumer Medication Information, Alt HealthWatch, Associates Programs Source, Business Source Alumni Edition, Business Source Complete, Canadian Reference Centre, CINAHL Plus with Full Text, Computer Source, eBook Collection (EBSCOhost), EconLit, Environment Complete, ERIC, GreenFILE, Health Source - Consumer Edition, Health Source – Nursing Academic Edition, Library Literature & Information Science Full Text (H.W. Wilson), Library, Information Science & Technology Abstracts, Library, Information Science & Technology Abstracts with Full Text, MasterFILE Premier, MEDLINE with Full Text, Military & Government Collection, Philosopher's Index, Religion and Philosophy Collection, Social Sciences Full Text (H.W. Wilson), Applied Science & Technology Source,
29. EBSCOhost Research Databases	X	X	X	X	X	X			X	Access by CAPES (UFMG) login. https://www.ebscohost.com/	Collection of multidisciplinary databases which includes with CAPES Access: Academic Search Premier; CINAHL with Full Text; Dentistry & Oral Sciences Source; Information Science & Technology Abstracts (ISTA); Library, Information Science & Technology Abstracts with Full Text; SocINDEX with Full Text; Academic Search Elite; Computers & Applied Sciences Complete; MEDLINE Complete
30. CiteSeerX	X	X				X			X	http://citeseer.ist.psu.edu/index	Access by www-periodicos-capes-gov-br

## ANNEX 4: SEARCH 1 - INFORMATION EXTRACTION FORM

Methodology	Author(s)	Ontologies built	Studies related
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			
9)			
10)			
11)			



ANNEX 5: CHECKLIST OF INFORMATION EXTRATION

Methodology <sup>4</sup>	Activities*	Activities sequence*	Workflow model*	Activities description*	Activities required or not*	Life cycle*	Activities' inputs and outputs*	Area or field of use*	Ontology built*	Principles defined*	Patterns defined*	Tools recommended*	Amount of ontologies built*	Advantages*	Disadvantages*
1.															
2.															
3.															
4.															
5.															
6.															
7.															
8.															
9.															
10.															
11.															
12.															
13.															
14.															
15.															

<sup>4</sup> Each methodology is going to receive a number to be identified.

\* Inform: X (checked), NA (Not applicable).

Annex 6

Annex 6: COMPARATIVE METHODOLOGIES SYNOPTIC TABLE

Methodology	Advantages	Disadvantages
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		

ANNEX 7: SEARCH 2 - INFORMATION EXTRACTION FORM 1

Methodology	Ontologies built	Life cycle	Area or field	Principles defined	Patterns defined	Tools
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						

ANNEX 8

Methodology	Activities name and sequence	Activities and description	Required? (Yes or No)	Activities' inputs	Activities' outputs
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

ANNEX 9

Methodology	What?	Why?	Where?	When?	Who?	How?
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						

## APPENDIX 1: TEMPLATE OF STUDIES SELECTION REPORT<sup>5</sup>

Source <sup>6</sup> :	
Search date:	
Search strings <sup>7</sup> :	
Period considered:	
Filters used:	

### Found Papers List<sup>8</sup>:

1. Authors, Paper name, Publication date Publication vehicle.
2. Authors, Paper name, Publication date Publication vehicle.
3. Authors, Paper name, Publication date Publication vehicle.
4. ....

### List of studies with inclusion or exclusion status:

Study	Inclusion criteria attended <sup>9</sup>	Exclusion criteria attended <sup>10</sup>	Status <sup>11</sup>
1.			
2.			
3.			
4.			
5.			
6.			
7.			

Comments<sup>12</sup>:

<sup>5</sup> A Studies Selection Report Form must be one for each search conducted in each source.

<sup>6</sup> Where the search was conducted.

<sup>7</sup> Research string compound based on item 2.4 that used in the search.

<sup>8</sup> Relation of all documents found in the search.

<sup>9</sup> Consider the letters used to designate each inclusion criterion according section 3.1.

<sup>10</sup> Consider the letters used to designate each exclusion criterion according section 3.2.

<sup>11</sup> Excluded or included: If at least one exclusion criteria was found in the study, or if no inclusion criteria was found in the study, the study will be excluded.

<sup>12</sup> Reviewer's comments or justification about each/some choice, if necessary



## APPENDIX 2: TEMPLATE OF DATA EXTRACTION REPORT

Paper Name:	
Authors:	
Publication date:	
Publication vehicle:	
Source:	
Keywords:	
Abstract:	

Reviewer Summary

### Information Extraction 1:

Methodology:	
Ontologies built:	
Life cycle:	
Area or field:	
Principles defined:	
Patterns defined:	
Tools Used:	