IJWR

Developing an Ontology for Business Process Management Techniques and Tools

Zahra Ghasemi Nik[a], Ameneh Khadivar*[b], Chitra Dadkhah[c], Samaneh Rahimian[d]

[a] *Masters of Information Technology Management, Faculty of Social Sciences and Economics, Alzahra University, Tehran; Iran, ghasemi.kntu@gmail.com*

[b] *Department of Management, Faculty of Social Sciences and Economics, Alzahra University, Tehran, Iran; a.khadivar@alzahra.ac.ir*

[c] *Assistant Professor, Department of Computer Engineering and IT, Faculty of Computer Engineering, K.N.Toosi University of Technology, Tehran, Iran; dadkhah@kntu.ac.ir*

[d] *Phd, Management dept., Tehran University, Tehran; samaneh.rahimian@ut.ac.ir*

ABSTRACT

In line with increasing attention to the scope of Business Process Management (BPM) over the past two decades, many techniques and tools have been introduced. Finding the proper technique and tool in each phase of the business process management life cycle takes time and effort. This study aims to design and develop an ontology to facilitate the selection of suitable techniques and tools at each step of the BPM life cycle. This ontology provides a common understanding of concepts of this domain for computers. The study results showed that two taxonomies for techniques and software tools for business process management were created based on BPM life cycle steps. Then, an ontology was developed for them. Noy & McGuinness methodology was applied to implement this ontology, and Protégé 5.2 and owl language were used. Also, the quality criteria-based approach was used for the evaluation of ontology. All the main concepts in the domain of BPM techniques and tools were extracted from previous studies. There are 298 terms. 58 of them are domain concepts or classes, 2 are about taxonomic relations, 2 are related to data property, and 224 are instances. This research used these terms, and the deployed ontology with the quality criteria-based approach was evaluated.

Keywords*— *Domain Ontology, Business Process Management Techniques, Business Process Management Software Tools, The Taxonomy Of Business Process Management Techniques.

1. Introduction

Business process management (BPM) is a set of technologies that support process-based management. It is a paradigm of organizational engineering that involves designing, implementing, controlling, and improving business processes to increase the organization's ability to achieve a high level of global performance. BPM has proven over the past decade to be a valuable approach to bringing maturity and agility to organizations that use it [20]. Over the past 20 years, attention to the scope of Business Process Management (BPM) has been increasing among the community of managers, analysts, consultants, end users, vendors, and academics. This growing interest is evident in a fundamental body of knowledge, an expanding scope, and a plethora of methodologies, tools, and techniques. While the demand for BPM increases, the challenge to provide concise and broad taxonomies and overall frameworks for BPM has grown [2]. Many resources can be found in the literature that have introduced numerous process management techniques and tools. Hence, it is difficult to select the appropriate technique in each step of the business process management life cycle from these resources. On the other hand, the recognition of special tools or software systems that are used in different phases of the process management life cycle is another challenge for organizations.

Therefore, designing and applying a knowledge management system which uses a knowledge base and an inference engine to store, categorize, and introduce tools and techniques for each BPM phase, is essential. The purpose of this study is to design and develop an ontology to facilitate the selection of suitable techniques and tools at each step of the BPM life cycle. In addition, the concepts of domain knowledge are expressed in formal language, so it is also understandable for computers. This makes it possible to reach a comprehensible description of the domain concepts and to share the knowledge among specialists in this domain around the world. The ontology as one of the semantic web technologies facilitates the construction of a domain model and provides a vocabulary of terms and relations with shared understanding between them [3]. The type of ontology used in this work is "domain ontology".

Therefore, designing and applying a knowledge management system which uses a knowledge base and an

http://dx.doi.org/10.22133/ijwr.2023.406557.1168

Citation Z. Ghasemi Nik, A. Khadivar, C. Dadkhah, S. Rahimian, " Developing an Ontology for Business Process Management Techniques and Tools," *International Journal of Web Research*, vol.6, no.1,pp.77-86, 2023, doi: http://dx.doi.org/10.22133/ijwr.2023.406557.1168.

*Coressponding Author

Article History: Received: 11 May 2023; Revised: 5 June 2023; Accepted: 10 July 2023.

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This study tried to collect and classify the BPM techniques and software tools according to phases of the BPM life cycle and known types of techniques and tools. Using ontology for a solution in modeling managerial and organizational knowledge is innovative. Until now, there exists no formal ontology for this domain, and ontology has not been used in the life cycle of business process management. As a result, this topic can be new and innovative. The main value of this study is to develop a formal ontology for business process management techniques and tools. In this research, by following the findings of previous studies, a more complete taxonomy for techniques and tools according to phases of the BPM life cycle was created. Also, to better identification of techniques and tools, other attributes such as age for techniques and license for tools were added to taxonomy. After creating the taxonomies, to formalize the concepts of domain knowledge, an ontology for these taxonomies was developed in the ontology engineering tool.

The structure of this article is as follows: The BPM life cycle, BPM technique and tools, and ontology are defined in section 2. The research methodology is explained in section 3. Our ontology development and evaluation are described in section 4 and section 5 respectively. Finally, the conclusion is explained in section 6.

2. Literature Review

2.1. Business process management life cycle

We can define BPM as a body of concepts, methods, techniques, and tools to discover, analyze, redesign, execute, and monitor business processes. This definition reflects the fact that business processes are the focal points of BPM, as well as the fact that BPM involves various steps and activities in the business life cycle [4]. The BPM life cycles that have been represented by the authors are shown in Table 1.

To map the business process life cycle steps to techniques or tools, the life cycle presented by Dumas et al. (2018) was selected. This methodology includes the following steps: Process identification, Process discovery, Process analysis, Process redesign or improvement, Process implementation, Process monitoring and controlling. Figure 1 shows this methodology.

Table 1. BPM life cycle models (Macedo et al., 2014)

Authors	***Phases of BPM Life cycle***					
Van der Aalast (2004)	design	configuration	execution	diagnosis		
Netjes et al (2006)	design	configuration	execution	control	diagnosis	
Zur Muehlen and Ho (2006)	Specification of Objectives and analysis of environment	Design	Implement ation	Monitoring	Evaluation	
Wesk (2007)	Administration and stakeholders	Design and analysis	Configurat on	Operation	Performance Evaluation	
Hallerbach et al (2008)	modeling	Frequency and selection	Executing and monitoring	optimization		
ABPMP (2009)	planning and strategy	Analysis	Design and modeling	implementation	Monitoring and control	refining
Vema (2009)	Define objectives	Identify process	Classify process	Choose process	Define tool and implement Process	Monitoring
Houy et al. (2010)	development of strategy	Definition and modeling	implement ation	execution	Monitoring and control	Optimization and improvement
van der Aalst (2011)	problem definition	modeling	realization	verifying and validating	experimenting	interpreting
Dumas et al. (2018)	identification	discovery	analysis	redesign	implementation	controlling

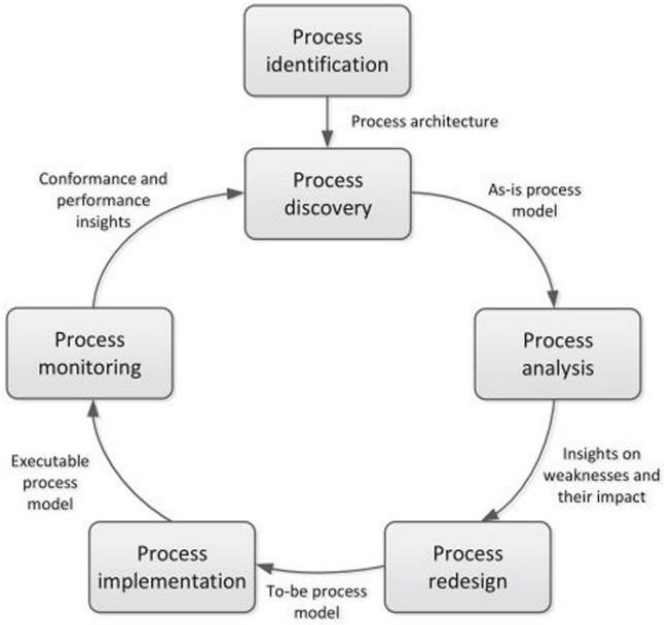

Figure 1. BPM life cycle (Dumas et al., 2018)

2.2. Business process management techniques and tools

Kettinger and colleagues (1997) defined three abstract levels to support the Business process change life cycle: methodology, technique, and tool. The term Methodology is described as "the highest level of abstraction for conceptualizing problem-solving methods". Also, Checkland (1981) defined methodology as "a collection of problem-solving methods governed by a set of principles and a common philosophy for solving targeted problems". The term technique at the second level of abstraction is defined by Hackathorn and Karimi (1988) as "a set of precisely described procedures that help in achieving a standard task". At the lowest abstract level, which typically refers to instruments or certain tangible aids in performing a task, is a tool [5]. Palvia and Nosek (1993) defined a tool "as a computer software package to support one or more techniques". Some of the software tools focus on one function and others on more. For example, process modeling tools contain specific notations and business process utilities, so business managers can develop process diagrams that can then be converted to other notations for software development [6].

In today's era, business process management is one of the biggest challenges facing business organizations. Businesses and the surrounding environment are constantly changing, which inevitably leads to changes in processes and how they are managed. Technology development also plays an important role in this as one of the factors that has a great impact on business process management (BPM). The purpose of Bozev and Ivanov's article was to examine exactly this issue. What are the trends and innovations in the use of BPM, as well as the role of new technologies in the evolution of business processes [7]?

Software tools are one of the important technology-oriented factors in BPM. Zuhaira and Ahmed's paper aimed to create a set of generic features provided by software tools for process modeling their analysis implementation and management. This article provides an objective analysis of identifying the strengths and weaknesses of these tools, primarily for BPM [8].

Business process management (BPM) is an approach that eliminates isolated functions. It also creates a view of end-to-end processes through cycle improvement and the use of management techniques. De Pádua and colleagues' paper aims to find out how the techniques used to promote BPM contribute to KM [9].

The use of BPM is seen in various sectors such as the industrial, service, and commercial sectors. Fernandez and colleagues (2020) evaluated the results of the application of the business process management method on clinical processes using a systematic review. This article also examined whether business process management can be turned into a useful tool for improving the effectiveness and quality of processes or not. The findings of this research indicate that the use of business process management is an effective method for optimizing clinical processes. Business process management is a practical and useful method for designing and optimizing clinical processes as well as for automating tasks. More comprehensive follow-up of this method, better technical support, and greater involvement of all clinical staff are key factors in developing its true potential [10].

2.3. Ontology

In the literature, there are many different definitions of ontology. These definitions are given briefly as follows: For the first time, Aristotle applied ontology as a philosophical discipline and the science of being qua being. In 1991, Neches and colleagues defined Ontology as "the basic terms and relations comprising the vocabulary of a topic area as well as the rules for combining terms and relations to define extensions to the vocabulary ". In 1993 Gruber defined ontology as "an explicit specification of a conceptualization". In 1995 Guarino and Giaretta defined Ontology as "a logical theory which gives an explicit, partial account of a conceptualization". Borst (1997) defined ontology as "a formal specification of a shared conceptualization". Studer and colleagues (1998) merged Gruber and Borst's definitions, stating that: "an ontology is a formal, explicit specification of a shared conceptualization".

In the field of ontology, there are key terms that are used during the development process of ontology, including class, subclass, property, and instance.

A class or a concept refers to a set of things, objects, and instances with common features. One concept can be about anything that is defined, so it can be a description of a task, function, action, strategy, reasoning process, and technique [11]. A Subclass is defined as part of a class whose members are distinguished from other members of that superclass by a shared property. In other words, the subclasses represent concepts that are more specific than the concepts of superclass. So, a hierarchical class is established from superclasses to specific ones. The Property is used to describe the common features of all instances of a class. The properties represent the relationships in ontology. When we join a property to a class, it becomes that property's domain. An instance, or individual is a unit of the world or knowledge domain that can be a member of one or more classes [12].

Semantic Web technologies, especially ontologies, are promising tools for BPM advancement. In this scope, Annaneh and colleagues (2019) developed the BBO ontology (BPMN 2.0 Based Ontology) to represent business processes, reusing existing ontologies and meta-models such as BPMN 2.0, an advanced meta-model for business process representation. They evaluated BBO using schema metrics, which showed that it is a deep and rich ontology with a variety of relationships [13].

Song and colleagues (2019) proposed that the context-aware BPM ecosystem consists of four components: context-aware process models, context models, decision-making models, and context-aware process implementation. A framework was proposed to connect the infrastructure of IoT to a context-aware BPM ecosystem using integrated IoT ontologies and IoT-enhanced decision models, enabling IoT capabilities to make business processes and the decision-making involved aware of the dynamic context [14].

Thuan et al. (2020) explained that although several classifications of process flexibility have been proposed, the field still lacks an ontological structure that clarifies and organizes the field. They filled this gap by creating an ontology to improve process flexibility. Their results identify the main business contexts, cases, dynamic modeling techniques, process flexibility management mechanisms, and their hierarchical relationships structured in an ontology [15].

Romero et al. (2022) introduced a hybrid approach to perform assessments in enterprises using text data as assessment evidence. Their study merged the Long Short-Term Memory Network (LSTM) approach and the use of an Ontology named Process Capability Assessment Ontology (PCAO), which also contains a set of rules to calculate process attribute ratings, and capability levels, among other aspects. The approach was grounded on the Smart Assessment Framework, a conceptual model devised to guide the development of intelligent assessments in enterprises. Also, they established a demonstration of the assessment of a process based on the management of chemical samples from a research institute [16].

In Bartolini and his colleagues' paper, they presented a solution for enhancing the modeling of business processes with facilities to help evaluate compliance with the GDPR. The proposal was based on a model describing the constituents of the data protection domain: a structured form of the legal text, an ontology of data protection concepts, and a machine-readable translation of the GDPR provisions [17].

Adams et al. (2021) proposed the definition and use of a common process model ontology, from which an extensible range of process views may be derived. The approach was represented through the realization of a plug-in component for the YAWL BPMS, although it is by no means limited to that environment. The component demonstrated that the process views frequently mentioned in the literature as desirable can be effectively implemented and extended using an ontology-based approach [18].

2.4. Research Methodology

Since the early 1990s, many methodologies have been presented to build and engineer the ontology. These methodologies describe lifecycle and ontology engineering processes that contain different phases. Some instances of Methodologies are given as the following: Kactus (1995), Enterprise ontology (1995), Tove (1995), Uschold and Gruninger (1996), Methontology (1997), Sensus (1997), Ontology Development 101 (2001), On-To-Knowledge (2003) and Horridge (2009) methodology.

These methodologies are used for a particular goal and are supported by specific engineering tool suites and languages. The Cyc [19], Kactus [20]and Enterprise Ontology [21] methodologies have been designed on experience.

The methontology framework enables the construction of ontologies at the knowledge level and consists of a life-cycle based on evolving prototypes [22]. Ontology Development 101 and On-To-Knowledge methodology are iterative methodologies that consist of several steps. On-To-Knowledge methodology is a process oriented methodology for introducing and maintaining ontology-based knowledge management systems and consists of five main steps: Feasibility study, kickoff, evaluation, refinement, application and evolution [23]. The Horridge and colleagues' (2009) methodology presented a practical guide to build OWL ontologies that focuses on restrictions. The restriction is applied to describe a class of individuals based on the relations that individuals of classes participate in [24]. Therefore, it should be noted that there is no standard methodology or a single correct way for developing ontopology. Regarding the aspects and goals of this study, Ontology Development 101 methodology [25] was applied. This methodology offers an iterative process for the ontology implementation and is easy and suitable for this study. For this purpose, PROTÉGÉ5.2 was utilized for the implementation of ontology, because this engineering tool can support Ontology Development 101 methodology and provide knowledge acquisition, Conceptual modeling and also export into different Semantic Web languages including XML, RDF and OWL.

2.5. Ontology development

The applied methodology includes the following steps (Figure 2).

Step1: Defining the domain and scope of the ontology

First, the knowledge of ontology's domain is defined by the competency questions. By giving the answers to these questions, the domain knowledge and capability of ontology in representing detailed information in the intended domain will be determined [25]. In the domain of techniques and tools of BPM, the following questions are the possible competency questions: what are the phases of the BPM life cycle? Which techniques will support the discovery phase? What are the transformational techniques? Which tools will support the process of mining? Which tool could be the alternative to the Bizagi tool?

The answers to these questions can be at any level of the ontology, including superclass, subclass, and instances. These answers show that this ontology can display this information:

The phases of the BPM Life cycle, the techniques and tools and categories of them in each of the BPM phases, software tools and techniques alternatives in each of the BPM phases.

Step2: considering reusing existing ontologies

A literature review indicates that there has not been developed a formal ontology for BPM techniques and tools yet, so this ontology is novel. However, the classifications of BPM techniques and tools in previous studies were used to complete taxonomy.

Step3: Enumerating important terms in the ontology

The nouns of business process management phases, instances of techniques and tools, and types of techniques and tools are key terms in this taxonomy. 6 terms are BPM Phase classes, 12 terms are subclasses of technique, 12 terms are subclasses of the tool, 91 terms are technique instances and 133 terms are tool individuals.

Step4: Defining the classes and the class hierarchy

Uschold and Gruninger (1996) defined three approaches to the development of hierarchical classes: top-down, bottom-up, and combination. In this study, the top-down approach was applied to hierarchical class development. So each of the techniques or tools is defined as individuals at the top level of ontology. According to this approach, general concepts or superclasses are at higher levels and more detailed concepts are at lower levels. At first, the class BPM Facilitator was defined at the most general level, and then at the second level, classes of techniques and tools of BPM were defined separately. In the Third level, the classes of BPM lifecycle steps are defined. These classes are subclasses of BPMPhases_techniques and BPMPhase_tools. The three higher levels of class hierarchy are shown in Figure 2. The classes of types of techniques or tools are defined after level three. Appendices 1 and 2 show a part of the class hierarchy of techniques and tools categories with instances. Each level of class hierarchy introduces the type of techniques or tools. In each row, the instances are the members of the last level of class which is defined in that row.

Step5: Defining the properties of classes

Property is a type of term that introduces the relation between domain concepts in the taxonomy. Object properties describe relationships between two individuals [24]. To design this ontology, taxonomic relations were applied. Taxonomic relations describe hierarchical relations and can be labeled as is-subclass- of/has-subclass, is-part-of/has-part, is-a/has-a, is-superclass-of/has-superclass, is-instance-of/has-instance. For example, the classes Technique for Analysis and Quantitative_tech have a taxonomic relationship. In this ontology, there are relations of has subclass/is-a and has individual. Figure 3 and Figure 4 show the is-a relations between classes.

Figure 5 displays part of the classes using the OntoGraf plugin in the Protégé ontology editor. The blue lines with arrows indicate the taxonomic relations.

Step6: Defining the instance characteristics

To describe instances' characteristics, age property for instances of techniques with values (old, middle, new) and license property for instances of tools with values (closed source, open source) were allocated. To define the age of techniques, three-time slots for the age were allocated. Before the year 2000, the age value was old, between 2000-2010

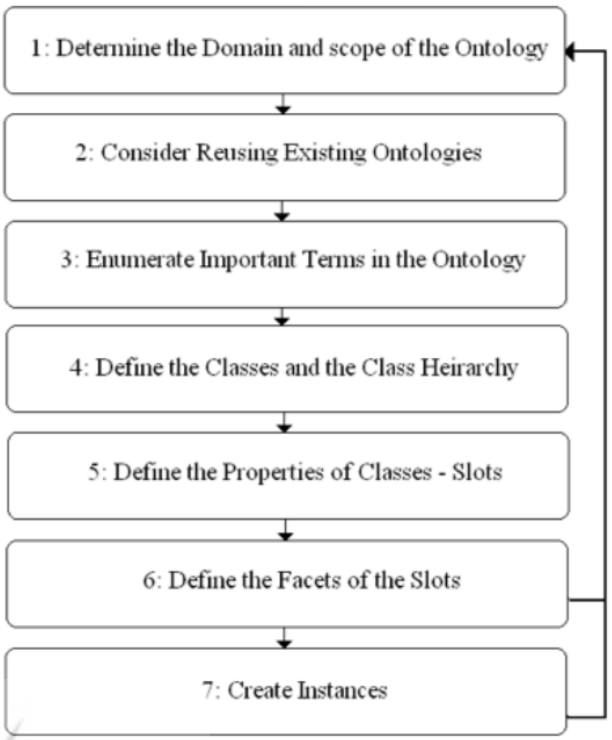

Figure 2 .Steps in Ontology Development Process based on (Noy and McGuinness)

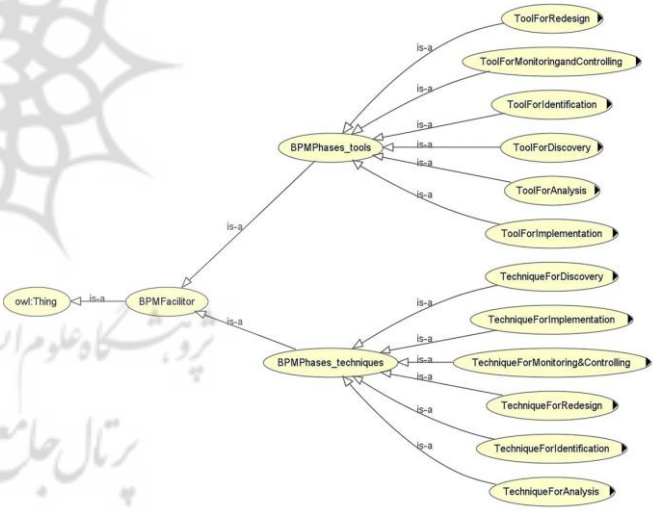

Figure 3. Three higher levels of ontology in the OWLViz plugin of Protégé

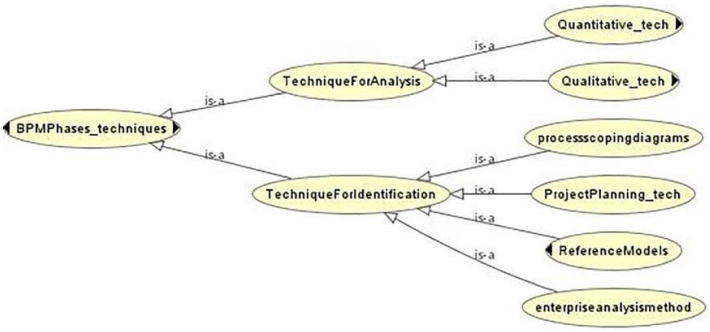

Figure 4. Taxonomic relations in owlviz plugin of Protégé

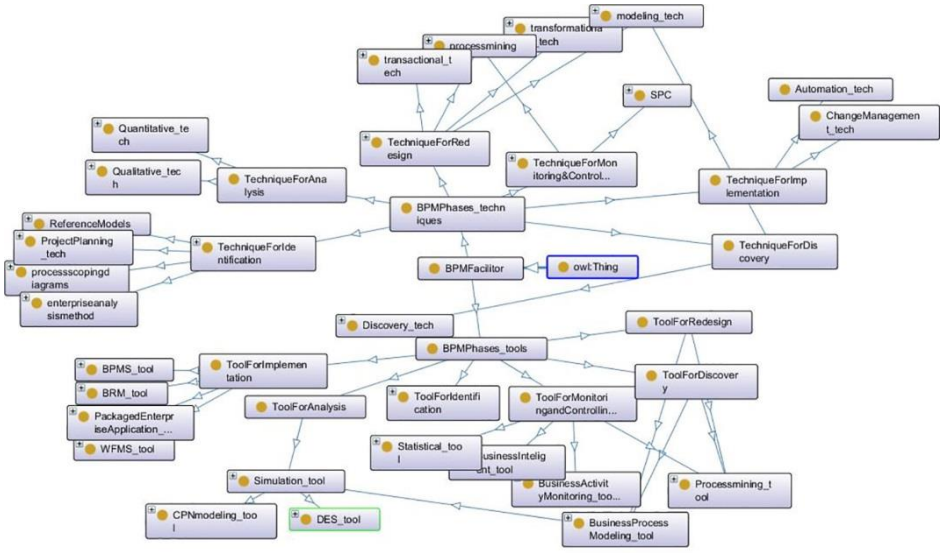

Figure 5. OntoGraf depiction of class (circles) hierarchy in using Protégé

age's value was middle, and after 2018 age's value was new. Here, the term age means the time domain the technique was introduced. The value type of these properties is a string.

Step7: Creating Instances

Reviewing literature in the domain of BPM, the techniques and tools were collected, and also, given the importance of license type in the choice of software tools and also the age of techniques, license property, and age property as the instance attributes were allocated. Table 2 shows parts of the instances with some details including instance name, instance attribute, value type, and attribute value.

Table 2. Details of instances attributes

Instance name	*Concept name*	*Instance attribute name*	*Value type*	*Attribute value*
ADONIS	Business process modeling tool	License	string	Close source
BizAgi	BPMS tool	License	String	Close source
jBPM	Workflow management system tool	License	String	Open source
Process Maker	BPMS tool	License	String	Open source
7FE	Exploitative Redesign (transactional)methods	Age	String	New
Design-led innovation	explorative redesign (transformational) methods	Age	String	Middle
ABC (activity based cost estimation)	Project Planning Techniques	Age	String	Old

2.6. Ontology Evaluation

Given the complexity of evaluating ontologies, various evaluation approaches have been proposed depending on the goal and kind of ontologies in the past years, including the task-based approach, corpus-based approach, criteria-based approach, data-driven approach, Golden standard approach, assessment by humans and evaluation by application [26]. In the present study, the criteria-based approach was applied to evaluate the ontology. A good ontology does not necessarily cover all the criteria, even some of the criteria conflict with each other. So the first task of the evaluator is selecting the suitable criteria for evaluation [27]. The goal of this ontology is to provide a vocabulary for the domain of BPM techniques and tools and to help search for the appropriate techniques and tools at different steps of the BPM lifecycle for managers. Given that, consistency, competency, computational efficiency, and correction were chosen for evaluating ontology.

Ontology is consistent if there is not any contradiction in the definition of concepts and class relations. If a class or an instance is a part of two classes and those classes are defined as disjoint with each other, that ontology is inconsistent. To avoid inconsistency, the classes that overlap are defined as disjoint classes. Also, if the two classes overlap completely, a description of the equivalent to or necessary and sufficient condition is used to define those classes. In addition to avoiding consistency, this ability is used to avoid redundancy. Avoiding redundancy supports the conciseness criteria. Finally, to check the consistency of ontology, a reasoning service in the Protégé was used. This provides checking consistency and finding errors with an explanation of them. Uschold (2016) says this way alone is not enough to find errors, and one important way to find more errors is to manually examine the inferred hierarchy. Given that, their concepts and relations between them were checked and verified manually.

We should make sure that the ontology can answer the defined competency questions. To evaluate this criterion, six experts in the BPM field were asked to evaluate this criterion by answering the competency questions based on the Likert spectrum (very poor, poor, medium, high, and very high). For instance, the following questions have been asked: which

open-source tools can be used for the implementation phase of the process? Which are the new (after the year 2010) BPM transformational techniques? And for which stage of the BPM life cycle is being used? The query using DL-query is shown in Figure 6 and Figure 7. Five of the six experts answered very high and one of six answered high.

This criterion refers to the successful reasoning process of ontology. Also, how fast and satisfactory the usual reasoning services can be in the deployed ontology? This criterion was evaluated by 6 BPM experts. The answers given by four of the experts stated very high and the other two stated high

The correctness of ontology refers to the validation of codified knowledge in ontology by domain experts, manually [27]. The domain knowledge of this ontology includes phases of the BPM life cycle, the techniques and tools of business process management, and the types of them. The knowledge of deployed ontology was validated by six business process management experts. The answers given by five of the experts stated very high and the other stated high.

As explained earlier, different criteria have been taken into consideration for the validation of the ontology, and in fact, a combined method has been used for evaluation. About the competency criteria, Experts have been interviewed and relevant questions have been asked. previous researchers have pointed out, that the number of experts depends on the type of domain ontology developed, and domain experts may vary from two to more [28,29]

3. Conclusion

In many studies, a lot of techniques and tools for business process management scope have been introduced [4, 5, 30, 31] that have categorized techniques and tools for one stage or more of the BPM life cycle. However, these taxonomies haven't been expressed in formal language to understand machines. In this paper, the techniques and tools of business process management were gathered, then two separate taxonomies were built for them. For this purpose, by investigating various types of BPM techniques and tools in previous studies, such as Fundamentals of Business Process Management by Dumas et al.(2018), the taxonomy of BPR Techniques and Tools by Kettinger et al. (1997), and Taxonomy of BPM/ISM modeling Techniques by Giaglis (2001), two hierarchical taxonomies for different types of techniques and tools were created manually. In addition, the age attribute for instances of technique and also license attribute for instances of tools were defined as instance property. To formalize the concepts of taxonomy and to create ontology, as in Hashemi and her colleagues' (2018) studies and Amiri et. al.'s (2017) study, the Ontology Development 101 methodology was used [32,33,34]. According to Ontology Development 101 methodology, the founded terms of techniques and tools were defined as classes, and instances and attributes of the instance were defined as individual property in protégé5. Finally, to evaluate ontology, the consistency criterion was evaluated and verified by the Protégé reasoning service plug-in. Then competency, computational efficiency, and correctness in finding techniques and tools of the BPM phases were evaluated and verified by domain experts and ontology engineers.

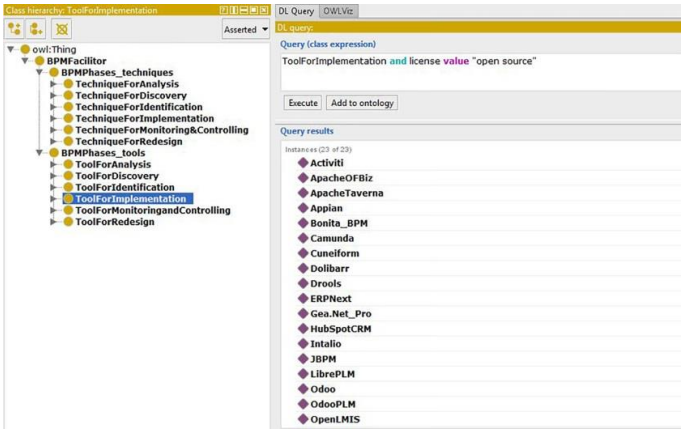

Figure 6. A sample DL-query to inference tools of process implementation phase in protégé

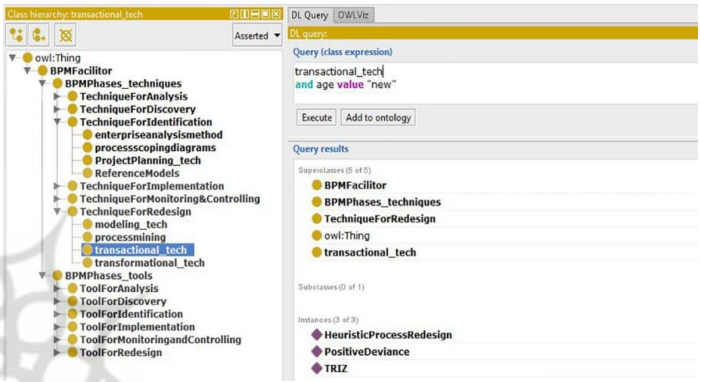

Figure 7. A sample DL-query to inference transformational techniques in protégé

According to assessors' expertise, using this ontology during the business process management life cycle will make choosing the appropriate techniques and tools for managers easier and will provide a common understanding of defined concepts for computers in a web context. In addition, the identification of tools and techniques in each BPM life cycle phase provides the opportunity to select alternative techniques and tools. Also, the identification of open-source software tools leads organizations to cost savings. Of course, organizations in choosing software should consider other factors such as organization size, ease of use, and the needs of the organization. The deployed ontology can be used as a knowledge-sharing tool for those interested in the management field, including managers, vendors, and consultants.

In the future, there will be added to current ontology, new techniques and tools. In addition, more features for techniques and tools can be considered to help the selection process.

Declarations

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions

ZGN: Acquisition of data, interpretation of the results, statistical analysis, drafting the manuscript

AK: Study design, acquisition of data, interpretation of the results, statistical analysis, drafting the manuscript, revision of the manuscript
CD: Interpretation of the results, statistical analysis, drafting the manuscript
SR:Interpretation of the results, drafting the manuscript, revision of the manuscript.

Conflict of interest

The authors declare that no conflicts of interest exist.

Appendix

Table appendix1. A part of BPM techniques' taxonomy

Third level class	*Fourth level class*	*Fifth level class*	*Sixth level class*	*Instances or individuals*	*'Age' property values*
Techniques of Analysis Phase	Qualitative analysis	Root Cause Analysis	-	Cause–Effect Diagram	old
				Why–Why Diagram	old
				5 whys	old
		Stakhoder analysis and Issue Documentaton	-	Issue Register	old
				Pareto Analysis /PICK Charts	old
				Stakhoder analysis	old
		-	-	TOC	old
				Task Analysis/Activity Analysis framework	old
				Value-Added Analysis	old
				Waste analysis/Lean	old
	Quantitative analysis	process performance measures	-	key performance indicators or KPIs	old
			Reference Models and Industry Benchmarks	Balanced Scorecard	old
				SCOR	old
				PCF	old
				ITIL	old
				DCOR	middle
				eTOM	middle
				VRM	middle
				Performance Framework of Rummler–Brache	old
		-	-	Flow Analysis	old
				Queueing theory	old
				Simulation	old

Table appendix 2. A part of BPM tools' taxonomy within the part of individuals

Third level class	*Fourth level class*	*Fifth level class*	*Instances or individuals*	*'License' property values*
Tools For Implementation	BPMS tools	-	BizAgi	Close source
			Bonita	Open Source
			Intalio	Open source
			Process maker	Open source
	BRMS tools	-	Red Hat's JBoss BRMS	Open source
			Agiloft Custom workflow	Close source
			FICO Blaze Advisor	Close source
			Drools	Open source
	Workflow management system tools	-	Activiti	Open source
			CEITON	Close source
			Apache Taverna	Open source
	Packaged Enterprise Application tools	CRM tools	HubSpot CRM	Open source
			Pipedrive	Close source
			Freshsales	Close source
		ERP tools	SAP Business One	Close source
			Dolibarr	Open source
			Oracle E-Business Suite	Close source
		SCM tools	Odoo	Close source
			QuickBase	Close source
			Appache of Biz	Close source
		PLM tools	OpenPLM	Open source
			Gea.Net Pro	Open source

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Zahra Ghasemi nik received B.Sc. degree in Information Technology Engineering from the K.N.Toosi University of Technology, Tehran, Iran and received M.Sc. degree in information technology management from Alzahra Universityin Tehran, Iran. Her fields of interest include Business process management, Expert systems, Artificial Intelligent, system analytic.

Ameneh Khadivar is an Associate Professor at the Faculty of Social Sciences and Economics, University of Alzahra, Tehran, Iran. She has got a B.A in Industrial Management from Iran University of Science and Technology in Iran. She obtained her M.A in Information Technology Management from Tarbiat Modares University in Iran. She also received her Ph.D. in Systems Management from Tarbiat Modares University. Her research interests include Expert System, Business Intelligence, Knowledge Management, and System Dynamics.

Chitra Dadkhah received the B.Sc. degree in software engineering from Shahid Beheshti University, Tehran, Iran, in 1990, the M.Sc. degree in computer engineering (artificial intelligence) from the IASI Department, University of Paris 11, Orsay, France, in 1993, and the Ph.D. degree in computer engineering from the Department of Computer Engineering and IT, Amir Kabir University (Polytechnique), Tehran, in 2005. She is currently an Assistant Professor with the Faculty of Computer Engineering, K. N. Toosi University of Technology, Tehran. Her research interests include evolutionary and swarm algorithms, natural language processing, recommender systems, and robotic (simulation).(Based on document published on 10 February 2019).

Samaneh Rahimian has got her B.A and M.A in Industrial Management from Tehran University. She also received her Ph.D. in Information Technology Management from Tehran University. Her research interests include Digital transformation, digital technologies, Business Intelligence and customer experience.