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Knowledge Repository Design to Improve Knowledge Management Process Capabilities: A Systematic Literature Review

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Abstract

The role of technology in supporting knowledge management is very vital. The knowledge repository system is the foundation of knowledge management and its implementation. Knowledge sharing, discovery, and other knowledge processes will be more accessible through proper knowledge repository system as an organizational knowledge base. This research explored various approaches employed by practitioners and researchers in designing a knowledge repository that allowed people to study and implement the knowledge repository as needed. A Systematic Literature Review (SLR) method proposed by Kitchenham was used to answer three research questions; (1) how is model knowledge storage in an organizational repository developed? (2) what tools can help create a knowledge repository? (3) what are features that should be present in a knowledge repository? It was confirmed that the repository storage model was mainly represented in the ontology model. Furthermore, the technologies for creating knowledge were Protégé and Neo4j graph-based databases. In addition, features that were mostly applied in the knowledge repository system included data catalogs, search, API, knowledge management, visualization, rule-based and case-based reasoning.

Keywords: knowledge repository system, knowledge management system, ontology

1. Introduction

One of the most critical aspects of knowledge management is acquiring one's knowledge and expertise to be accessed and learned more broadly [1]. According to [2], there are two types of knowledge; explicit knowledge and tacit knowledge. Explicit knowledge is generally represented in the forms of narratives or numbers. Meanwhile, tacit knowledge is knowledge in the form of insight, intuition, or hunch in one's mind [3]. Organizations can adopt two types of knowledge sharing which included personalization and codification [4]. Personalization is a way of sharing knowledge with individual within social contacts. On the contrary, codification is done by codifying knowledge and storing it in a repository for easier access.

Information technology plays different roles in these two knowledge management strategies. In codification, technology stores the knowledge, while in personalization, it rather supports social interaction [5]. In codification, a knowledge repository system manages the knowledge of an organization. The implementation of knowledge processes such as knowledge capture, knowledge sharing, and knowledge discovery will be more straightforward through a knowledge repository system that servers as an organizational knowledge base.

Knowledge repository also acts as an organization's memory where habits, history, business processes, human knowledge, and other information are stored integrated into a system [6]. Valid and actual data obtained from previous knowledge helps in generating innovations. In addition, the existing knowledge can increase the efficiency of solutions applied to address the existing problems. The utilization of current knowledge offers various advantages including: reducing product development time and costs, avoiding duplication of development, reducing routine tasks, expanding and deepening recent experience, shortening training time, and systematically accelerating work [7].

In the practice, building a knowledge repository has many challenges that include unclear definition of goals, inaccurate data, weak knowledge sharing culture, and forgetting to update the knowledge that has been stored [8]. Defining the goals influences the design of the knowledge repository implementation. In this

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research, approaches that have been employed by practitioners and researchers in designing a knowledge repository were identified to allow authors study and implement it as needed.

Knowledge repository is the most critical asset in implementing knowledge management. However, knowledge management varies widely according to organizational goals. Some authors summarize challenges in modeling knowledge stored in a knowledge repository system. The rapid development of technology also makes it difficult for an organization to choose the proper hardware and software to build a knowledge repository system with good mapping of the knowledge management functionality to fit organization's needs of specific functions and features in the knowledge repository system.

In regards to the research problems, the research questions were formulated as follows (1) What is the model for storing knowledge within the organization in a repository (2) What technologies can help create a knowledge repository system and (3) What features should be in a knowledge repository system?

This research is the initial stage of a series of research that the author will conduct. This research is expected to be the basis for preparing the models, designs, and architectures for implementing knowledge repositories in IT support units in government institutions in Indonesia. The results of this research are expected to contribute to further studies and provide more comprehensive benefits. Research has not been limited to a particular domain context that it opens up the opportunity to become an insight for other researchers in understanding developments and trends in the implementation of the knowledge repository system.

2. Research Methods

This research employed the Systematic Literature Review (SLR) method by Kitchenham consisting of three stages in filtering the literature as shown in Table 1.

Table 1. SLR Stage by Kitchenham

Stage	Procedure
Planning	Identify needs
	Formulate the review's research question
Conducting	Identify relevant literature
	Perform a selection of primary studies
	Perform data extraction
	Assess studies quality
	Conduct synthesis of evidence
Reporting	They are writing research output in an article.

At the planning stage, the authors identify phenomena related to the research topic. The topic of knowledge repositories has a broad scope, and there has been a lot of research done in this field. Approaches proposed by other researchers are very diverse. The author wanted to collect only relevant studies to form a basis for further research using the SLR method. After that, the writer formulated the research questions to be answered in this research. To define the scope of the literature, the structure of the research questions is presented in Table 2.

Table 2. Literature Search Structure

Population	knowledge repository system
Intervention	architecture, design, implementation, construction, framework, prototype
Comparison	-
Outcome	architecture and implementation knowledge repository system in the organization
Context	government, academic, industry, organization

Literature search from journal databases was performed to obtain journal articles and papers related to technology and computer science. The databases included (1) Scopus, (2) Science Direct, (3) ACM Digital Library, (4) Emerald Insight, and (5) IEEE Xplore. The keywords were: "knowledge repository" AND (system OR application) AND (construct* OR framework OR model OR prototype OR architecture). The inclusion and exclusion criteria of the screening process are listed in Table 3.

Table 3. Inclusion Criteria and Exclusion Criteria

Stage	Inclusion Criteria	Exclusion Criteria
- Initiation Stage	- According to the search keyword - Written in English - Published 2015-2021 - Proceeding or journal	- Not written in English - Published outside 2015 – 2021
- Stage 1 (Selection of title and abstract)	- Implementation of the knowledge repository system - Propose design, model, framework, or architecture	- Not proposed knowledge repository system - Only determine influence factors - Only use knowledge repositories such as text mining and others
- Stage 2 (Selection Full-Text)	- Model and architecture of knowledge repository system for improving the knowledge management process	- Repository other than for knowledge management needs

The author then ensured that the selected literatures had met the predetermined criteria as listed in Table 4.

Furthermore, the authors extracted the data from the literatures obtained to be classified and categorized based on certain specific criteria for further analysis. The classification criteria included the research objectives, research domain or context, artifact output, knowledge repository features, and the technology employed.

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Table 4. Literature Assessment Criteria

No	Question
1	Does the article explain the purpose of the research?
2	Does the article include a literature review and background related to the research?
3	Does the article include related research and point out the differences?
4	Does the research explain the model, framework, design, or architecture of the knowledge repository used?
5	Does the article write about the advantages of using a knowledge repository?
6	Does the article explain the research output?
7	Does the article produce conclusions that answer the research problem?
8	Does the article recommend further research?

3. Results and Discussions

Literatures were retrieved from five research databases, namely Scopus, Science Direct, ACM Digital Library, IEEE Xplore, and Emerald Insight, with the search results, as shown below.

Table 5. Literature Results

Database	Initiation Stage	Stage 1	Stage 2	Quality
Scopus	199	37	20	18
Science Direct	12	-	-	-
ACM	47	-	-	-
IEEE Xplore	35	4	2	2
Emerald Insight	21	-	-	-
Total	**314***	**41**	**22**	**20**

* there is duplication

Table 5 shows that at the initiation stage, 314 pieces of literature were retrieved. They were then sorted based on the relevancy of the titles and abstracts, leaving 41 literatures that met the predetermined criteria. The 41 literature were then thoroughly studied and analyzed, where only 20 literatures were included as the data of this reseach for further analysis. Table 6 presents the literature review summary that is divided into four categories; research domain, features, technology, and the artifact output. The categorization made it easier to find the gaps among those research.

The author then reviewed and analyzed the selected literature from several points of view. Before answering the research questions, the proportion of the research domain about the knowledge repository system was determined in advance as follows.

The domain of knowledge repository system research is mainly applied in the manufacturing and academic industries as shown in Figure 1. The manufacturing industry is an industry that produces various kinds of component products, such as engineering equipment, electricity, or others. The knowledge repository is the biggest asset for managing the product knowledge to assist in manufacturing other products. The education sector has also implemented the knowledge repository system to connect the information from practitioners to learning activities.

Table 6. Research Gaps

No	Literature	Feature	Technology
1	[9]	API Endpoint recommender system	RDF, SPARQL, Apache Jena, Ontology
2	[10]	searching, similarity checking, machine learning to automate extraction	MySQL, Django
3	[11]	searching, metadata	PHP
4	[12]	semantic indexing	MySQL
5	[13]	data catalog	WordPress
6	[14]	rule-based, case-based, model-based	ontology
7	[15]	API Endpoint	Ontology
8	[16]	semantic search	Ontology
9	[17]	search, task list, forum, profile, virtual folder, chat, framework development, library	FTP, DBMS
10	[18]	form input, ontology representation, searching	Protégé, RDF, SPARQL, SWRL
11	[19]	crawling, parsing, visualization	MySQL, Neo4J, Protégé, OWL, API
12	[20]	graph	ontology, sensor
13	[21]	CRUD, query, sharing	RDBMS
14	[22]	interactive map, knowledge representation, text mining, network analysis	Minerva
15	[23]	knowledge representation, knowledge navigation	RDBMS
16	[24]	searching, knowledge presentation, knowledge service module, ontology management module	Protégé, Apache Jena, RDF, SPARQL
17	[25]	data catalog, searching	web application
18	[26]	decision support system	UML
19	[27]	streaming data loading, rule-based engine, query	neo4j DB, jess engine
20	[28]	knowledge map, knowledge classification	visualization

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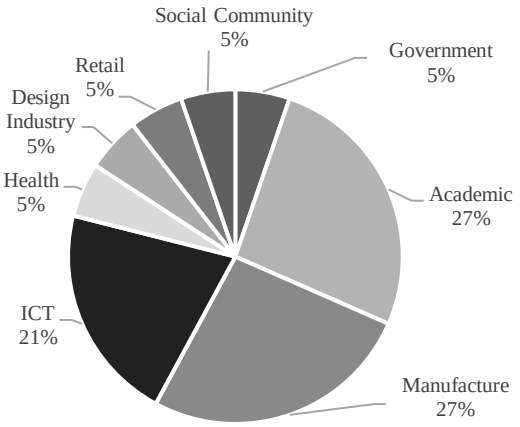

Figure 1. The proportion of Research Domains Related to Knowledge Repository

After that, the literatures were reviewed to find answers to the research questions.

RQ1: What is the model for storing knowledge within the organization in a repository?

The answer to this question was proposed based on the examination of the models used by prior researchers to store knowledge in the knowledge repository. The results of the analysis can be seen in Figure 2.

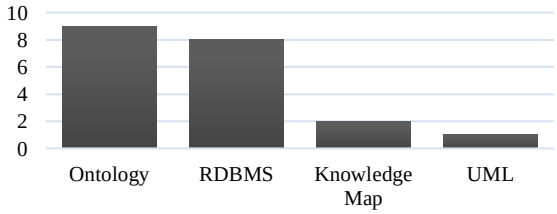

Figure 2. Knowledge Repository Storage Model

One of the most widely used method for modeling knowledge is the ontology model. The ontology model is able to compose entities based on the desired specific classification, attributes, functions, and relationships. As a repository of diverse knowledge, a knowledge repository requires complex modeling that fits the organizational context. The ontology model supports these needs and can be implemented on various platforms. In addition to the ontology model, some researchers still used the Relational Database Management System (RDBMS) to manage knowledge. Several other researchers still used Knowledge Map and UML.

RQ2: What technologies can help create a knowledge repository system?

Supporting technology used in developing a knowledge repository system varies according to the organization's needs. From the literature review, the author summarizes the tools and software used to build a knowledge repository system as shown in the following figure:

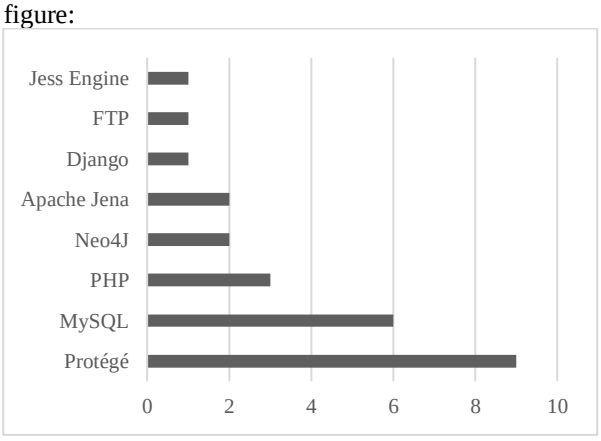

Figure 3. Knowledge Repository Development Tools Based on Number of Research

The most widely used tool for building a knowledge repository is Protégé. Protégé is open-source software that is used to build ontology models. This software can also export models in RDF or SWRL format. The data storage database with the ontology model is Neo4J, a graph-based database that is quite popular in repository development. In addition, there are still some researchers who used standard technologies such as PHP, MySQL, and Django. Researchers also used Apache Jena combined with an ontology model for knowledge repositories and an inference engine for rule-based reasoning needs.

RQ3: What features should be in a knowledge repository system?

Knowledge Repository System is a system created for specific purposes of certain organization or company. In this section, the author summarizes the features used in the selected literature.

Table 7. Features of Knowledge Repository System

No	Feature	Literature
1	API Endpoint	[9], [15]
2	Searching	[10], [11], [14], [16]–[18], [21], [24], [25], [29]
3	Data Catalog	[9], [11], [28], [29], [13], [14], [17], [18], [21], [22], [24], [25]
4	Semantic Indexing	[12]
5	CRUD (Create, Read, Update, Delete)	[13], [17], [18], [21], [25], [29]
6	Rule-Based	[14], [27]
7	Case-Based	[14]
8	Crawling	[10], [19]
9	Visualization / Knowledge Map	[18], [19], [22], [24], [28]–[30]
10	Data Streaming	[27]

The features in a knowledge repository are very diverse (See Table 7). The essential elements commonly applied to a knowledge repository are data cataloging, knowledge retrieval, visualization, and knowledge

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management. In addition, there are other features such as API endpoints, semantic indexing, rule-based and case-based reasoning, crawling, and data streaming.

Based on the results of the literature review, research on the knowledge repository system in government agencies was still limited, even though government institutions possess unique characteristics compared to other institutions. Government institutions mainly function to provide excellent service to the community. Thus, the perceived benefits are not only offered for the internal organization but also for the community. From 20 selected literature, only one literature was related to government, namely the construction of a knowledge repository system at tax institutions in Thailand. The knowledge repository system in government institutions needs to be studied more deeply for more open government and more manageable knowledge to formulate policies in order to make more effective and efficient decisions.

4. Conclusions

Developing a knowledge repository system is the first step to the implementation of knowledge management in an organization or company. Planning in designing a knowledge repository significantly affects the achievement of the expected goals in a knowledge management system. The results of the literature review done in this research showed that the mostly-used repository storage model is ontology model, types of tools for knowledge creation are Protégé and Neo4j graph-based database and many practitioners also used RDBMS to store knowledge. Third, the most widely applied features in the knowledge repository system are data catalogs, search, API, knowledge management, and visualization. Meanwhile, if the knowledge repository requirement is used as a decision support system, then the ontology model development, rule-based implementation, and case-based reasoning must be prepared. The preparation of the knowledge structure should be an essential concern among knowledge repository developers. Literature also showed that it is necessary to define the most general to the most detailed features to understand complex knowledge. This kind of knowledge structure makes it easier for users to learn knowledge from a Knowledge Repository System.

References

[1] R. Mack, Y. Ravin, and R. J. Byrd, "Knowledge portals and the emerging digital knowledge workplace," *IBM Syst. J.*, vol. 40, no. 4, pp. 925–955, 2001, doi: 10.1147/sj.404.0925.

[2] H. T. Ikujiro Nonaka, *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. New York: Oxford University Press, 1995.

[3] I. Becerra-Fernandez and R. Sabherwal, *Knowledge Management: Systems and Processes*. M.E.Sharpe, 2010.

[4] M. T. Hansen, N. Nohria, and T. Tierney, "What's your strategy for managing knowledge?," *Harv. Bus. Rev.*, vol. 77, no. 2, pp. 106-116,187, 1999.

[5] G.-W. Bock, R. Sabherwal, and Z. J. Qian, "The effect of social context on the success of knowledge repository systems," *IEEE Trans. Eng. Manag.*, vol. 55, no. 4, pp. 536–551, 2008, doi: 10.1109/TEM.2008.927824.

[6] G. Hackbarth and V. Grover, "The knowledge repository: Organizational memory information systems," *Inf. Syst. Manag.*, vol. 16, no. 3, pp. 21–30, 1999, doi: 10.1201/1078/43197.16.3.19990601/31312.4.

[7] P. C. Gembarski, "Agent collaboration in a multi-agent-system for analysis and optimization of mechanical engineering parts," in *Procedia Computer Science*, 2020, vol. 176, pp. 592–601, doi: 10.1016/j.procs.2020.08.061.

[8] Chris Rall, "4 Challenges of Implementing a Knowledge Base," 2021. https://blog.usu.com/en-us/4-challenges-of-implementing-knowledge-base.

[9] M. Buranarach, C. Anutariya, N. Kalayanapan, T. Ruangrajitpakorn, V. Wuwongse, and T. Supnithi, "An ontology-based approach to supporting knowledge management in government agencies: A case study of the Thai excise department," *IEICE Trans. Inf. Syst.*, vol. E101D, no. 4, pp. 884–891, 2018, doi: 10.1587/transinf.2016IIP0001.

[10] D. Dann, A. Maedche, T. Teubner, B. Mueller, C. Meske, and B. Funk, "DiskNet - A platform for the systematic accumulation of knowledge in IS research," 2019, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85108162910&partnerID=40&md5=541b8030d984a6eb03634ffbdcf50f08.

[11] M. Firdaus, H. Wang, H. Qin, and Y. Liu, "Digital repository for design knowledge reuse," in *Proceedings of the International Conference on Engineering Design, ICED*, 2015, vol. 10, no. DS 80-10, pp. 315–324, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84979715865&partnerID=40&md5=08bda412c7804c295c8fab92d373a2be.

[12] N. S. Fitriasari *et al.*, "IoT-based Knowledge Repository Design for Supporting Knowledge Integration within the Marine Information System Study Program," *J. Phys. Conf. Ser.*, vol. 1811, no. 1, Mar. 2021, doi: http://dx.doi.org/10.1088/1742-6596/1811/1/012101.

[13] C. Garcia-Lopez, S. Tesconi, and E. Mor, "Designing Design Resources: From Contents to Tools," *Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics)*, vol. 11566 LNCS, pp. 87–100, 2019, doi: 10.1007/978-3-030-22646-6_7.

[14] P. C. Gembarski, M. Bibani, and R. Lachmayer, "Design catalogues: Knowledge repositories for knowledge-based-engineering applications," in *Proceedings of International Design Conference, DESIGN*, 2016, vol. DS 84, pp. 2007–2016, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84980043181&partnerID=40&md5=0ceaa7ef80e76f465bd3543c4092f6ac.

[15] A.-M. Ghiran and R. A. Buchmann, "Semantic integration of security knowledge sources," in *Proceedings - International Conference on Research Challenges in Information Science*, 2018, vol. 2018-May, pp. 1–9, doi: 10.1109/RCIS.2018.8406673.

[16] Y. Huang, Z. Jiang, C. He, B. Song, and L. Liu, "An inner-enterprise wiki system integrated with semantic search for reuse of lesson-learned knowledge in product design," *Proc. Inst. Mech. Eng. Part B J. Eng. Manuf.*, vol. 230, no. 3, pp. 548–561, 2016, doi: 10.1177/0954405414555739.

[17] Imelda and G. R. Tanzil, "Knowledge repository design for a startup company (Case Study : Cv. Metric Design)," *Int. J. Appl. Bus. Econ. Res.*, vol. 14, no. 6, pp. 4681–4692, 2016, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84989316749&partnerID=40&md5=b0dec7df1faff801fa0ff0a4a5444b42.

[18] J. S. Liang, "A knowledge with ontology representation for product life cycle to support eco-design activities," *J. Eng. Des. Technol.*, 2021, doi: 10.1108/JEDT-05-2021-0265.

DOI: https://doi.org/10.29207/resti.v6i2.3929

[19] I. Liem, T. Semiawan, A. Chandra, and Suprihanto, "A software system family: Learning from simple data processing to knowledge management system of research," in *Proceedings - 2015 7th International Conference on Information Technology and Electrical Engineering: Envisioning the Trend of Computer, Information and Engineering, ICITEE 2015*, 2015, pp. 24–28, doi: 10.1109/ICITEED.2015.7408906.

[20] E. Maleki, F. Belkadi, B. J. van der Zwaag, and A. Bernard, "A sensor ontology enabling service implementation in Industrial Product-Service Systems," *IFAC-PapersOnLine*, vol. 50, no. 1, pp. 13059–13064, 2017, doi: https://doi.org/10.1016/j.ifacol.2017.08.2005.

[21] R. Mokhtar, A. A. Rahman, and S. H. Othman, "Academic quality assurance metamodel knowledge repository as a quality monitoring mediator," in *2016 IEEE Conference on e-Learning, e-Management and e-Services (IC3e)*, 2016, pp. 176–181, doi: 10.1109/IC3e.2016.8009062.

[22] M. Ostaszewski *et al.*, "COVID19 Disease Map, a computational knowledge repository of virus–host interaction mechanisms," *Mol. Syst. Biol.*, vol. 17, no. 10, 2021, doi: 10.15252/msb.202110387.

[23] S. H. Othman and G. Beydoun, "A metamodel-based knowledge sharing system for disaster management," *Expert Syst. Appl.*, vol. 63, pp. 49–65, 2016, doi: 10.1016/j.eswa.2016.06.018.

[24] S.-F. Wen and B. Katt, "An Ontology-Based Context Model for Managing Security Knowledge in Software Development," in *Conference of Open Innovation Association, FRUCT*, 2018, vol. 2018-Novem, pp. 416–424, doi: 10.23919/FRUCT.2018.8588107.

[25] S.-F. Chien, H.-P. Su, and Y.-W. Huang, "Parade: A pattern-based knowledge repository for parametric designs," in *CAADRIA 2015 - 20th International Conference on Computer-Aided Architectural Design Research in Asia: Emerging Experiences in the Past, Present and Future of Digital Architecture*, 2015, pp. 375–384, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84936110817&partnerID=40&md5=67c94033bdf9783d35f782d98482d56b.

[26] A. Cicchetti, M. Borg, S. Sentilles, K. Wnuk, J. Carlson, and E. Papatheocharous, "Towards Software Assets Origin Selection Supported by a Knowledge Repository," in *2016 1st International Workshop on Decision Making in Software ARCHitecture (MARCH)*, Apr. 2016, pp. 22–29, doi: 10.1109/MARCH.2016.11.

[27] J. Li, A. Sato, R. Huang, and D. Chen, "A Rule-Based Knowledge Discovery Engine Embedded Semantic Graph Knowledge Repository for Retail Business," in *2016 International Conference on Advanced Cloud and Big Data (CBD)*, Aug. 2016, pp. 81–86, doi: 10.1109/CBD.2016.024.

[28] H. Noprisson, E. Hidayat, and N. Zulkarnaim, "A preliminary study of modelling interconnected systems initiatives for preserving indigenous knowledge in Indonesia," in *2015 International Conference on Information Technology Systems and Innovation (ICITSI)*, 2015, pp. 1–6, doi: 10.1109/ICITSI.2015.7437730.

[29] S. H. Othman and G. Beydoun, "A metamodel-based knowledge sharing system for disaster management," *Expert Syst. Appl.*, vol. 63, pp. 49–65, 2016, doi: https://doi.org/10.1016/j.eswa.2016.06.018.

[30] E. Maleki, F. Belkadi, B. J. V. D. Zwaag, and A. Bernard, "A sensor ontology enabling service implementation in Industrial Product-Service Systems," 2017, vol. 50, no. 1, pp. 13059–13064, doi: 10.1016/j.ifacol.2017.08.2005.

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