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Review Paper

Knowledge organization and knowledge graph, including related technologies, applications

Md. Khairul Islam and Md. Nurul Islam*
School of Information Management, Nanjing University, Xianlin, Qixa District, Nanjing, Jiangsu, 210023, China
dg1914501@smail.nju.edu.cn

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Abstract

Knowledge organizations an intellectual discipline concerned with activities such as document description, indexing, and classification that serve to provide systems of representation and order for knowledge and information objects. These activities are done by librarians, archivists, subject specialists as well as by computer algorithms. A Knowledge Graph is a flexible, reusable data layer used for answering complex queries across data silos. They create supreme connectedness with contextualized data, represented and organized in the form of graphs. Built to capture the ever-changing nature of knowledge, they easily accept new data, definitions, and requirements. An Enterprise Knowledge Graph is simply a Knowledge Graph of enterprise data.

Keywords: Organizations; Knowledge; Computer; Representation; Graph.

Introduction

Knowledge organization and knowledge graph have become increasingly important concepts in the field of information science and technology[1]. The primary goal of knowledge organization is to develop and maintain systematic ways of representing information, knowledge and data to support their effective retrieval, management and use. Knowledge graph, on the other hand, is a computational representation of information, knowledge and data as a graph structure that enables the machine to understand and reason about the relationships between entities and the information that describes them[2].

The development of knowledge organization and knowledge graph has been driven by the growth of information and data and the need for more efficient and effective methods of accessing and using them[3]. The advent of the Internet and the World Wide Web (WWW) has led to an explosion in the amount of information and data available, making it increasingly difficult for individuals and organizations to find and use the information they need[4]. This has created a demand for better methods of knowledge organization and representation, which can help users to more easily find, access and understand the information they need.

Related Technologies: The development of knowledge organization and knowledge graph has been influenced by a number of related technologies, including artificial intelligence, semantic web, and natural language processing[5].

Artificial Intelligence (AI): AI refers to the development of computer systems that can perform tasks that typically require human intelligence, such as understanding natural language, recognizing images, and making decisions[6]. AI has been applied to knowledge organization and representation in the form of knowledge-based systems, which use knowledge representation and reasoning to support decision-making and problem-solving.

The Semantic Web: The semantic web is a vision of the WWW in which information is presented in a format that can be understood and processed by computers[7]. The Semantic Web is based on the use of standardized data formats, such as RDF (Resource Description Framework), that enable computers to understand the relationships between data elements and the meaning of the data. This has provided the foundation for the development of knowledge graphs, which use RDF to represent information, knowledge and data as a graph structure[8].

Natural Language Processing (NLP): NLP is a field of AI that deals with the interaction between computers and human language. NLP has been applied to knowledge representation and organization by allowing computers to understand and process human language text, and to extract meaningful information from it[9]. This has enabled the development of text-based knowledge representation and organization, which has been integrated into knowledge graphs to provide a more comprehensive representation of information and knowledge.

Applications of Knowledge Organization and Knowledge Graph: The application of knowledge organization and knowledge graph is widespread, with applications in a wide range of fields, including information management, natural language processing, and artificial intelligence[10].

In information management, knowledge organization and knowledge graph are used to support the retrieval, management and use of information, knowledge and data. Knowledge graphs are used to provide a comprehensive representation of information, knowledge and data, and to support the discovery and use of information, by providing a clear and intuitive understanding of the relationships between entities and the information that describes them[11].

In natural language processing, knowledge organization and knowledge graph are used to support the understanding and processing of human language text. Knowledge graphs are used to provide a structured representation of information and knowledge that can be used to support the processing of natural language text. This includes applications such as named entity recognition, coreference resolution, and information extraction[12].

In artificial intelligence, knowledge organization and knowledge graph are used to support decision-making and problem-solving. Knowledge graphs are used to represent information, knowledge and data in a structured form that can be used by AI algorithms to perform tasks such as reasoning and problem-solving. This includes applications such as expert systems, decision support systems, and recommendation systems[13].

Knowledge management: The act of organizing and classifying information so that users may find it more easily and usefully is known as knowledge organization. In order to make information simpler to discover, use, and comprehend, it entails developing and using systems, structures, and procedures for information organization, management, and retrieval[14].

As the quantity of information accessible has expanded significantly over the last several years, there is a greater demand for efficient knowledge organization. There is an enormous quantity of data and information accessible today thanks to the growth of the internet, social media, and other digital technologies, most of it unstructured and difficult to explore[15]. This problem is addressed by knowledge organization, which develops more meaningful and organized representations of information to make it simpler to manage and utilize.

Depending on the context and function of the information being organized, the objectives of knowledge organization might change. Typical objectives include: Enhancing information retrieval: Improving information retrieval is one of the main objectives of knowledge organization. Users may find the information they need more quickly by developing logical and consistent organizational systems[16].

Accessibility: Knowledge organization also attempts to increase information accessibility for a broader variety of users, including those with various degrees of knowledge or skill as well as those with various physical or mental capacities.

Enhancing comprehension: By making it simpler to find the essential ideas and connections between various bits of information, effective knowledge organization may also contribute to users' increased understanding of the material. Reuse is made possible by knowledge organization, which arranges data in a manner that is simple to comprehend and apply[17]. Information may be reused for a number of tasks, such as research, instruction, and problem-solving.

Depending on the nature of the information being organized and the objectives of the organization, a variety of alternative methodologies and approaches might be utilized. Typical techniques and strategies include.

Classification: Classification is the process of putting similar things into groups or classes based on the traits or qualities they have in common. This may be done by considering a range of factors, including audience, format, and topic matter[18].

Taxonomy: A taxonomy is a hierarchical organization of information that places more general categories at the top and more specific subcategories at lower levels, like a tree. Information may be arranged using taxonomies in a fashion that represents its logical or hierarchical links.

Thesaurus: A thesaurus is a standardized vocabulary that offers a collection of phrases and connections that are used to describe and classify information. The usage of thesauri may help guarantee correctness and consistency in the description of data[19].

A formal representation of knowledge, or ontology, represents the links and interactions between ideas and things. Ontologies may be helpful for describing intricate knowledge domains and for facilitating more advanced information searching and analysis.

A folksonomy is a classification and tag system created by individuals based on their own knowledge and comprehension of the content. Information may be arranged using folksonomies in a manner that takes into account the preferences and requirements of the users[20].

Several difficulties may arise in the creation and use of knowledge organization systems, including the following: Complexity: When dealing with big or diverse collections of information, knowledge organization may become highly complicated. Effective knowledge organization systems may be difficult to create and can cost a lot of money.

Subjectivity: Choosing how to classify and characterize information requires making subjective judgements, which may result in divergent interpretations and arguments among users[21]. Information and knowledge are always changing; therefore, knowledge organization systems need to be updated and maintained often to be current and useful.

Cost: For big businesses or those with vast volumes of data, developing and maintaining efficient knowledge organization systems may be expensive.

User adoption: Ensuring user adoption is the last difficulty of knowledge organization. If the intended users do not embrace and utilize the systems, even the best knowledge organization systems will be unsuccessful[22]. In addition to providing training and assistance to help users understand and utilize the system, this necessitates taking into account the requirements and preferences of users.

Despite these obstacles, efficient knowledge organization may provide a number of advantages, such as better information retrieval, increased comprehension, and more effective resource usage[23]. By offering a standard structure for collecting and sharing information, it may also aid in fostering user cooperation and communication.

In conclusion, managing and making sense of the enormous volumes of information that are now accessible requires knowledge organization. It entails a variety of techniques and strategies for classifying and organizing data with the intention of enhancing access, comprehension, and reuse[24]. Although creating and implementing efficient knowledge organization systems may be difficult, the rewards can be great, and firms that invest in knowledge organization are likely to be more successful in the long term.

Graph of knowledge: Using a structured and semantically rich format, a knowledge graph is a sort of database that stores and expresses information. It is intended to capture the links and interconnections between various things and ideas and to make information analysis and querying more complex and intelligent[25]. Nodes, which stand in for things like people, places, or objects, and edges, which stand in for the connections between these things, make up a knowledge graph. The edges may be either directed or bidirectional, and they can have a variety of kinds and qualities that provide more details about the nature and traits of the connection.

A knowledge graph's ability to provide more advanced and intelligent information processing and querying is one of its main advantages. A knowledge graph may provide more natural and intuitive information search and navigation by recording the connections between things and ideas, enabling advanced reasoning and inference[26].

A knowledge graph may also make it easier to combine data from many sources and disciplines, as well as to provide a coherent, consistent, and semantically enhanced picture of the data. This may facilitate more sophisticated applications like natural language processing and machine learning and make it simpler to aggregate and evaluate data from many sources. Many different applications, such as search engines, recommendation systems, and information management systems, are increasingly using knowledge graphs[27]. They are especially helpful in situations when a lot of complicated and diverse data has to be arranged and evaluated, such in the fields of science, economics, and healthcare.

A knowledge graph's major characteristics include: Structure: A knowledge graph is a comprehensive, flexible architecture for describing information that is designed to describe the links between things and ideas.

Semantics: Semantic metadata that adds to a knowledge graph's understanding of the meaning and context of the data.

Connectivity: A knowledge graph records the links and interconnections between items and ideas, enabling more complex and insightful information processing and querying.

Integration: A knowledge graph may make it easier to combine data from many sources and domains, giving users a uniform and consistent picture of the available data.

Flexibility: A knowledge graph is very adaptable, and it is simple to add new kinds of links and data to it.

Scalability: A knowledge graph can provide high-performance searching and processing while scaling to address extremely big and complicated datasets.

Knowledge graphs may be created and managed using a variety of techniques and technologies. These include graph databases that are designed for storing and accessing graph data, such Neo4j and Amazon Neptune. RDF and OWL ontologies, the Google Knowledge Graph API, and the Apache Jena framework are just a few of the tools available for creating and displaying knowledge graphs[28]. An effective and adaptable technique for expressing and evaluating complex and diverse information is a knowledge graph, in conclusion. It supports a broad variety of applications in industries including healthcare, banking, and scientific research by recording the links and connections between things and ideas and enabling more complex and intelligent querying and analysis of data[29]. Knowledge graphs are anticipated to become a more vital tool for organizing and interpreting data in a meaningful and efficient manner as data complexity and size continue to rise.

Knowledge organization and knowledge graph relationships: In the realm of information management and knowledge representation, knowledge organization and knowledge graphs are two related ideas. There are significant disparities between the two strategies despite the fact that they have certain shared objectives and strategies[30]. Knowledge organization is the act of organizing and classifying information in a manner that increases its usefulness and users' access to it. To do this, it may be necessary to develop taxonomies, thesauri, and other types of structured vocabularies that provide uniform terminology and ideas for describing and classifying data.

Libraries, archives, and other information repositories are just a few of the places where knowledge organization may be employed[31]. It can also be used to the design of digital user interfaces and search engines.

On the other hand, a knowledge graph is a particular kind of knowledge representation that makes use of graph theory to describe the connections and interactions between various things and ideas. Each node in a knowledge graph represents an entity, while edges or connections between nodes reflect relationships between things[1]. From scientific ideas to actual things and occurrences, knowledge graphs may be used to represent a broad variety of knowledge areas.

Although knowledge organization and knowledge graphs first seem to be completely distinct from one another, they really have a lot in common. For instance: facilitating the retrieval of information Users may discover and retrieve information more easily with the help of knowledge organization and knowledge graphs. While in knowledge organization, the development of organized vocabularies and taxonomies may aid users in more efficiently navigating and searching for information, in a knowledge graph, the connections between entities can be leveraged to direct users to related or pertinent information[2].

Increasing comprehension by making it simpler to recognize crucial ideas and links, effective knowledge organization and knowledge graphs may both contribute to users' better comprehension of complicated material. While in knowledge organization, the development of a logical and consistent framework may serve to emphasize the links between various pieces of information, in a knowledge graph, the depiction of relationships between entities can allow users to understand how various ideas fit together. Facilitating reuse Research, teaching, and problem-solving may all benefit from the reuse of information, which can be facilitated by knowledge organization and knowledge graphs, respectively. While in knowledge organization, the development of a consistent vocabulary may serve to assure consistency and correctness in the use of information, in a knowledge graph, the links between things can be leveraged to produce new insights or hypotheses.

Despite these similarities, knowledge organization and knowledge graphs have several significant distinctions. The degree of abstraction involved is a significant distinction[32]. Creating organized vocabularies that provide uniform terminology and ideas for classifying and describing information is a common step in knowledge organization. These vocabularies are merely lists of words and ideas, despite the fact that they may be highly complicated and include links between terms.

Knowledge graphs, on the other hand, portray knowledge in a more flexible and abstract manner. A broad variety of connections and links between items, including complex and dynamic interconnections that may change over time, are possible when graph theory is used. Knowledge graphs may be more powerful and versatile than conventional knowledge organization systems, but they may also be more complicated and challenging to build and manage.

The degree of automation used in knowledge organization vs knowledge graphs is another significant distinction. Systems for organizing knowledge may be somewhat automated, but they normally need a lot of human labor to create and maintain. Contrarily, the production and upkeep of knowledge representations may be sped up by employing machine learning and natural language processing methods to automatically build knowledge graphs[33].

Overall, there is a complicated and developing link between knowledge organization and knowledge graphs. Even while the two strategies have some similar objectives and working principles, they also have substantial differences. Traditional knowledge organization methods may be adequate for many knowledge management and information retrieval tasks; however, knowledge graphs may be more suited for complex and dynamic knowledge domains. In the end, the decision

Technology connected to knowledge organization and knowledge graph: Both knowledge organization and knowledge graphs, which fall under the umbrella of knowledge management, are concerned with making it easier to handle and comprehend huge volumes of data[34]. A variety of technologies that make it possible to create, organize, and analyze data have helped these industries grow.

Ontology is one technology that has been crucial in the structuring of knowledge. An ontology is a formal statement of the ideas and connections that comprise a body of knowledge. Ontologies may serve a broad variety of applications, from semantic search to intelligent decision-making systems, by representing information in an organized and standardized manner.

Thesauruses are another tool that have been extensively used in knowledge organizing. A thesaurus is a regulated vocabulary that has words arranged in a hierarchy to help people explore a knowledge base[35]. The organizing and retrieval of information may be facilitated by the use of thesauri, which have been utilized in a variety of settings, including library science and information retrieval.

Along with these tools, improvements in machine learning and natural language processing have given rise to increasingly complex knowledge organizing strategies. Machine learning algorithms, for instance, may be used to automatically extract important ideas and connections from vast volumes of data as well as to group concepts that are related. Based on the context in which they are used, natural language processing methods may be used to determine connections between phrases.

A number of technologies, including as graph databases, graph visualization tools, and machine learning algorithms, have aided in the construction of knowledge graphs. Large volumes of data may be stored and managed in a graph form using graph databases, enabling effective querying and connection analysis between entities[36]. While machine learning techniques may be used to automatically create and update knowledge graphs based on massive quantities of data, graph visualization tools can be used to explore and comprehend the connections between items in a graph.

The Resource Description Framework is one of the most crucial technologies for knowledge graph creation (RDF). RDF is a framework for describing and transferring information on the web, and it offers a mechanism to standardize and organize the manner in which connections between entities are described. Linked data, which enables the integration and exchange of data across many systems and domains, may be produced using RDF.

The Semantic Web is a crucial technology that aids in the creation of knowledge graphs. An addition to the World Wide Online called the Semantic Web seeks to give computers the ability to comprehend and decipher the meaning of web information. It comprises a variety of tools for creating semantic descriptions of online material, such as RDF and the Web Ontology Language (OWL). Applications ranging from information management systems to intelligent agents may be supported by the Semantic Web.

The use of artificial intelligence (AI) and machine learning (ML) to assist information organization and knowledge graphs has gained popularity in recent years. It is possible to automatically analyze and understand enormous volumes of data using AI and ML approaches, as well as to find links and patterns that may be difficult for people to notice. As a result, knowledge graphs may evolve more quickly and advanced analyses and predictions based on vast volumes of data may be made.

Using deep learning algorithms to produce embeddings, which are representations of words or ideas in a high-dimensional vector space, is one example of an AI-powered method for knowledge organizing. These embeddings serve a broad variety of applications, from sentiment analysis to recommendation systems, and may be used to find connections and similarities between items.

In conclusion, a variety of technologies, such as ontologies, thesauri, machine learning, natural language processing, graph databases, RDF, and the Semantic Web, have aided in the development of knowledge organization and knowledge graphs. Large-scale data production, organizing, and analysis are now possible because to these technologies, which have also aided in the design of increasingly complex knowledge management systems. These technologies will remain essential in helping firms to efficiently manage and analyses their data as data volume and complexity increase.

The capacity of knowledge graphs to integrate and communicate data across several areas and systems is one of its fundamental advantages. This is accomplished by using linked data, which enables the connection and access of data from many sources using a common language and structure. Numerous applications, ranging from customized suggestions to semantic search, may be supported by linked data.

Knowledge graphs can facilitate intricate analyses and predictions based on enormous volumes of data, which is another advantage. For instance, knowledge graphs may be used to spot patterns and trends in data, make predictions about the future based on the past, and assist in complicated decision-making.

Although information organization and knowledge graphs have numerous advantages, they also have certain drawbacks. The difficulty of constructing and maintaining accurate and current knowledge graphs is one of the major issues[37]. This calls for a lot of work and knowledge, and it may be especially difficult in fields that change quickly or need for specific understanding.

Making sure that the data in a knowledge graph is reliable and consistent is another hurdle. This may be especially difficult when combining data from several sources since different sources could describe the same ideas using various vocabularies or structures. For knowledge graphs to be accurate and reliable, it is essential to ensure the consistency and quality of the data.

Additionally, a balance must be struck between the advantages of knowledge organization and knowledge graphs and the security and privacy of sensitive data. It is crucial to take the necessary precautions to preserve the security and privacy of sensitive data when knowledge graphs are utilized more often.

In conclusion, companies' ability to successfully manage and comprehend their data is greatly aided by the areas of knowledge organization and knowledge graphs. A variety of technologies, such as ontologies, thesauri, machine learning, natural language processing, graph databases, RDF, and the Semantic Web, have helped these domains evolve. Large-scale data production, organizing, and analysis are now possible because to these technologies, which have also aided in the design of increasingly complex knowledge management systems.

Although knowledge organization and knowledge graphs have many advantages, they also have a number of drawbacks, such as the difficulty of building and maintaining accurate and current knowledge graphs, ensuring the quality and consistency of data, and safeguarding the privacy and security of sensitive data.

Applications for knowledge graphs and knowledge organization: Applications for knowledge organization and knowledge graphs are many, ranging from e-commerce and healthcare to finance and healthcare. We will look at some of the main uses for these technologies in this section.

Healthcare: In the healthcare industry, patient data from many sources, including electronic health records, medical imaging data, and genetic data, may be integrated and analyzed using knowledge organization and knowledge graphs. This may aid in the development of novel medications and cures as well as more precise illness diagnosis and treatment. A knowledge graph, for instance, may be used to link patient data with knowledge about illness symptoms, medical procedures, and clinical trials, enabling doctors to make better choices about patient care.

Finance: To combine and evaluate financial data from many sources, such as stock prices, market data, and economic indicators, the finance domain makes use of knowledge organization and knowledge graphs. As a result, market trends may be predicted more precisely, supporting better-informed investing choices. A knowledge graph, for instance, may be used to link information about a company's financial performance with information about its rivals, market trends, and economic indicators, enabling investors to make better choices about how to deploy their funds.

Education: Knowledge organization and knowledge graphs may be utilized to assist individualized learning and adaptive instruction in the educational field. A knowledge graph may assist in the creation of customized learning plans and adaptive teaching techniques by assessing student performance data and linking it to knowledge about learning goals, curricular standards, and instructional tactics. A knowledge graph, for instance, might be used to spot a student's knowledge gaps and recommend specific learning activities to fill them.

E-commerce: Knowledge organization and knowledge graphs may be used to assist individualized product suggestions and search in the e-commerce industry. A knowledge graph may assist in the creation of tailored product suggestions and more efficient product search by evaluating consumer behavior data and linking it to knowledge about product attributes, customer preferences, and other relevant aspects. A knowledge graph may be used, for instance, to recommend items that are comparable to those that a consumer has already bought or that are well-liked by customers with similar tastes.

Information administration Knowledge organization and knowledge graphs may be used to assist more general information management activities like data integration, data curation, and data discovery in addition to these domain-specific applications. A knowledge graph may facilitate more efficient data curation and discovery by combining data from many sources and linking it to pertinent information. For instance, a knowledge graph may be used to link data on a specific item (such a person, place, or idea) with details about its attributes, connections, and context, making it simple for users to find and examine pertinent information.

Overall, there are several uses for knowledge organization and knowledge graphs across numerous industries. More better decision-making, more individualized services, and more effective information management may all be supported by these technologies. Organizations looking to get insights from their data and make better choices are likely to find that using knowledge organization and knowledge graphs will become more and more crucial as data continues to increase in volume and complexity.

Application of knowledge graphs and knowledge organization in information management: Since it includes gathering, organizing, and disseminating information, information management is a vital part of many companies. An efficient use of information may lead to more effective operations, better judgment, and better customer service. We will investigate how knowledge organization and knowledge graphs may be used to assist more efficient information management in this part.

Integration of data Managing information involves several issues, one of which is integrating data from many sources. Large enterprises with complicated data structures may find this especially difficult. This problem may be solved with the use of knowledge graphs, which provide a unified perspective of data from several sources. A knowledge graph may provide a more thorough and integrated picture of an organization's data by linking data from various sources based on shared qualities or connections.

The act of choosing, organizing, and keeping data in order to guarantee its quality, completeness, and relevance is known as data curation. By tying data to pertinent metadata and contextual information, knowledge organization and knowledge graphs may facilitate more efficient data curation. A knowledge graph, for instance, may be used to link a given data point to details about its origin, importance to certain business operations, and connections to other data points.

Data discovery: For companies looking to glean insights from their data, efficient data discovery is essential. By offering a more organized and accessible perspective of an organization's data, knowledge graphs may be utilized to assist more efficient data discovery. A knowledge graph may facilitate more effective and precise searches for relevant data by linking data to pertinent metadata and contextual information.

Information retrieval: Accessing and obtaining pertinent data from a vast amount of data is the process of information retrieval. By offering a more organized and thorough perspective of an organization's data, knowledge graphs may be utilized to promote more efficient information retrieval.

A knowledge graph may facilitate more effective and precise searches for pertinent information by linking data to pertinent metadata and contextual information.

Data analysis with the purpose of supporting decision-making is referred to as business intelligence. By linking data to pertinent metadata and contextual information, knowledge graphs may be utilized to promote more effective business intelligence. A knowledge graph may allow more accurate and perceptive analysis of business operations, consumer behavior, and market trends by offering a more complete and integrated perspective of an organization's data.

The process of organizing and preserving digital material, such as papers, photographs, and videos, is known as content management. By tying digital material to pertinent metadata and contextual data, knowledge organization and knowledge graphs may facilitate more efficient content management. A knowledge graph, for instance, may be used to link a single document to details about its creator, its applicability to certain business processes, and its connections to other documents.

Conclusion

Knowledge management is the process of gathering, compiling, and disseminating knowledge within of an organization. By linking knowledge resources, including as articles, reports, and best practices, to pertinent metadata and contextual data, knowledge graphs may assist more effective knowledge management. A knowledge graph may facilitate more effective and precise information sharing by offering a more organized and thorough picture of an organization's knowledge resources. Information management may use knowledge organization and knowledge graphs for a variety of purposes. These tools may help business intelligence, content management, knowledge management, data integration, curation, discovery, and information retrieval become more efficient. Knowledge graphs may help organizations make better decisions, provide better customer service, and support more efficient operations by giving a more thorough and integrated picture of their data and knowledge resources.

References

1. Chen, J., Liu, Y., Dai, J., & Wang, C. (2023). Development and status of moral education research: Visual analysis based on knowledge graph. *Frontiers in Psychology*, 13. https://doi.org/10.3389/fpsyg.2022.1079 955
2. Qin, J., Wang, S., Ni, H., Wu, Y., Chen, L., Guo, S., Zhang, F., Zhou, Z., & Tian, L. (2023). Graph analysis of diffusion tensor imaging-based connectome in young men with internet gaming disorder. *Frontiers in Neuroscience*, 16. https://doi.org/10.3389/fnins.2022.1090224
3. Yang, B., & Liao, Y.M. (2022). Research on enterprise risk knowledge graph based on multi-source data fusion. *Neural Computing and Applications*, 34(4), 2569–2582. https://doi.org/10.1007/s00521-021-05985-w
4. Waszak, M., Lam, A. N., Hoffmann, V., Elvesater, B., Mogos, M. F., & Roman, D. (2022). Let the Asset Decide: Digital Twins with Knowledge Graphs. 35–39. https://doi.org/10.1109/ICSA-C54293.2022.0001
5. Tzitzikas, Y. (2022). FS2KG: From File Systems to Knowledge Graphs (Demo). 3254. Scopus.
6. Mansfield, M., Tamma, V., Goddard, P., & Coenen, F. (2021). Capturing Expert Knowledge for Building Enterprise SME Knowledge Graphs. 129–136. https://doi.org/10.1145/3460210.3493569
7. Han, X., Dell'Aglio, D., Grubenmann, T., Cheng, R., & Bernstein, A. (2022). A framework for differentially-private knowledge graph embeddings. *Journal of Web Semantics*, 72. https://doi.org/10.1016/j.websem.2021.1006 96
8. Wang, Z., & Wan, F. (2022). Research on Knowledge Extraction Technology for Knowledge Graph Construction. 51–56. https://doi.org/10.1109/APCT55107. 2022.00020
9. Nunes, M., Bagnjuk, J., Abreu, A., Cardoso, E., Smith, J., & Saraiva, C. (2022). Creating Actionable and Insightful Knowledge Applying Graph-Centrality Metrics to Measure Project Collaborative Performance. *Sustainability (Switzerland)*, 14(8). https://doi.org/ 10.3390/su14084592
10. Hao, X., Ji, Z., Li, X., Yin, L., Liu, L., Sun, M., Liu, Q., & Yang, R. (2021). Construction and application of a knowledge graph. *Remote Sensing*, 13(13).
11. Gallofré Ocaña, M., & Opdahl, A. L. (2022). Supporting Newsrooms with Journalistic Knowledge Graph Platforms: Current State and Future Directions. *Technologies*, 10(3).
12. Jiang, L., Shi, J., Pan, Z., Wang, C., & Mulatibieke, N. (2022). A Multiscale Modelling Approach to Support Knowledge Representation of Building Codes. *Buildings*, 12(10). https://doi.org/10.3390/buildings12101638
13. Liu, K., Wang, F., Ding, Z., Liang, S., Yu, Z., & Zhou, Y. (2022). Recent Progress of Using Knowledge Graph for Cybersecurity. *Electronics (Switzerland)*, 11(15). https://doi.org/10.3390/electronics11152287
14. Tang, W., Zhang, X., Feng, D., Wang, Y., Ye, P., & Qu, H. (2022). Knowledge graph of alpine skiing events: A focus on meteorological conditions. *PLoS ONE*, 17(9 September).
15. Zamini, M., Reza, H., & Rabiei, M. (2022). A Review of Knowledge Graph Completion. *Information (Switzerland)*, 13(8). https://doi.org/10.3390/ info 13080396
16. Gao, J., Lu, F., Peng, P., & Xu, Y. (2022). Construction of Tourism Attraction Knowledge Graph Based on Web Text and Transfer Learning. *Wuhan Daxue Xuebao (Xinxi Kexue Ban)/Geomatics and Information Science of Wuhan University*, 47(8), 1191–1200 and 1219.

17. Jiomekong, A. A. J., & Asong, F. M. D. (2022). Designing, implementing and deploying an Enterprise Knowledge Graph from A to Z. 87–88. https://doi.org/10. 1145/3531056.3542761

18. Konstantinidis, I., Maragoudakis, M., Magnisalis, I., Berberidis, C., & Peristeras, V. (2022). Knowledge-driven Unsupervised Skills Extraction for Graph-based Talent Matching. *ACM International Conference Proceeding Series*. https://doi.org/10.1145/3549737.3549769

19. Wang, M., Wang, H., Li, B., Zhao, X., & Wang, X. (2022). Survey on Key Technologies of New Generation Knowledge Graph. *Jisuanji Yanjiu yu Fazhan/Computer Research and Development*, 59(9), 1947–1965. https://doi.org/10.7544/issn1000-1239.20210829

20. Xu, R., Geng, B., & Liu, S. (2022). Research on structural knowledge extraction and organization for multi-modal governmental documents. *Xi Tong Gong Cheng Yu Dian Zi Ji Shu/Systems Engineering and Electronics*, 44(7), 2241–2250. https://doi.org/10.12305/ j.issn.1001-506X.2022.07.20

21. Guangjian, L., & Liqun, L. (2020). Towards Knowledge Fusion: The Development Trend of Information Science in Big Data Environment. *Journal of Library Science in China*, 46(6), 26–40. https://doi.org/10.13530/j.cnki.jlis. 2020046

22. Nnaji, C., Gambatese, J., Karakhan, A., & Osei-Kyei, R. (2020). Development and Application of Safety Technology Adoption Decision-Making Tool. *Journal of Construction Engineering and Management*, 146(4). https://doi.org/10.1061/(ASCE)CO.1943-7862.0001808

23. Xia, H., Wang, Y., Gauthier, J., & Zhang, J. Z. (2022). Knowledge graph of mobile payment platforms based on deep learning: Risk analysis and policy implications. *Expert Systems with Applications*, 208. https://doi.org/10. 1016/j.eswa.2022.118143

24. Sellami, S., & Zarour, N. E. (2022). Keyword-based faceted search interface for knowledge graph construction and exploration. *International Journal of Web Information Systems*, 18(5–6), 453–486. https://doi.org/10.1108/IJWIS-02-2022-0037

25. Seddigh, E. M., Abazari, Z., & Hariri, N. (2022). Development of Iranian Pistachio Knowledge Management Model Based on Knowledge Management for Development (KM4D) Model. *Journal of Nuts*, 13(4), 259–271. https://doi.org/10.22034/jon.2022.1950091.1149

26. Liu, Z., Gu, Z., Thelen, T., Estrecha, S. G., Zhu, R., Fisher, C. K., D'Onofrio, A., Shimizu, C., Janowicz, K., Schildhauer, M., Stephen, S., Rehberger, D., Li, W., & Hitzler, P. (2022). Knowledge explorer: Exploring the 12-billion-statement KnowWhereGraph using faceted search (demo paper). GIS: Proceedings of the ACM International Symposium on Advances in Geographic Information

27. Khobragade, A. R., & Ghumbre, S. U. (2022). Study and analysis of various link predictions in knowledge graph: A challenging overview. *Intelligent Decision Technologies*, 16(4), 653–663. https://doi.org/10.3233/IDT-210103

28. Vasilevich, A., & Wetzel, M. (2023). Multilingual Knowledge Systems as Linguistic Linked Open Data. *Cognitive Technologies*, 319–324. https://doi.org/10.1007/ 978-3-031-17258-8_23

29. Sekkal, H., Amrous, N., & Bennani, S. (2022). Knowledge graph-based method for solutions detection and evaluation in an online problem-solving community. *International Journal of Electrical and Computer Engineering*, 12(6), 6350–6362. https://doi.org/10.11591/ijece.v12i6.pp6350-6362

30. Chen, Y., Li, H., Li, H., Liu, W., Wu, Y., Huang, Q., & Wan, S. (2022). An Overview of Knowledge Graph Reasoning: Key Technologies and Applications. *Journal of Sensor and Actuator Networks*, 11(4). https://doi.org/10. 3390/jsan11040078

31. Chaves-Fraga, D., Corcho, O., Yedro, F., Moreno, R., Olías, J., & De La Azuela, A. (2022). Systematic Construction of Knowledge Graphs for Research-Performing Organizations. *Information (Switzerland)*, 13(12). https://doi.org/10.3390/info13120562

32. Takko, T., Bhattacharya, K., Lehto, M., Jalasvirta, P., Cederberg, A., & Kaski, K. (2023). Knowledge mining of unstructured information: Application to cyber domain. *Scientific Reports*, 13(1). https://doi.org/10.1038/s41598-023-28796-6

33. Ren, H., Zhang, L., Whetsell, T. A., & Ganapati, N. E. (2023). Analyzing Multisector Stakeholder Collaboration and Engagement in Housing Resilience Planning in Greater Miami and the Beaches through Social Network Analysis. *Natural Hazards Review*, 24(1). https://doi.org/10.1061/ (ASCE)NH.1527-6996.0000594

34. Zhu, Z., Huang, T., Zhen, Z., Wang, B., Wu, X., & Li, S. (2023). From sMRI to task-fMRI: A unified geometric deep learning framework for cross-modal brain anatomo-functional mapping. *Medical Image Analysis*, 83. Scopus.

35. Goyal, N., Mamidi, R., Sachdeva, N., & Kumaraguru, P. (2023). Warning: It's a scam!! Towards understanding the Employment Scams using Knowledge Graphs. 303–304.

36. Huang, Z., Guo, X., Liu, Y., Zhao, W., & Zhang, K. (2023). A smart conflict resolution model using multi-layer knowledge graph for conceptual design. *Advanced Engineering Informatics*, *55*. https://doi.org/10.1016/j.aei. 2023.101887

37. Kaiser, F. K., Dardik, U., Elitzur, A., Zilberman, P., Daniel, N., Wiens, M., Schultmann, F., Elovici, Y., & Puzis, R. (2023). Attack Hypotheses Generation Based on Threat Intelligence Knowledge Graph. *IEEE Transactions on*

Dependable and Secure Computing, 1–17. https://doi.org/ 10.1109/TDSC.2022.3233703