IndustryPortal: a Common Repository for FAIR Ontologies in Industry 4.0

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Abstract

This demo paper describes the technical architecture and features of IndustryPortal (http://industryportal.enit.fr), a dedicated open-source platform designed to develop, publish, and maintain FAIR (Findable, Accessible, Interoperable, Reusable) ontologies –and more largely semantic artefacts– in the industrial domain. The primary objective of this semantic catalogue is to enhance the interoperability of ontologies, increase their reusability, and ensure that they meet the high-quality standards demanded by the industrial community. IndustryPortal has been developed in the context of the H2020 OntoCommons project, released in March, 2022 with a robust plan for long-term support. The portal is based on the open source and shared OntoPortal technology.

Keywords

Ontologies, Semantic artefacts, FAIR principles, Ontology repository, Semantic artefact catalogue,

1. Context and motivations

The increasing use of ontologies in various industrial domains highlights the need for a common repository to store and maintain these semantic artefacts for long-term reusability. Although several domain-related ontology repositories have been created since 2006, such as BioPortal, AgroPortal, EcoPortal, MatPortal, and OntoHub, no dedicated repository for ontologies exist in the industrial domain. Generally, existing portals serve as a common infrastructure for the identification, reuse, alignment, and maintenance of semantic artefacts in their respective domains. Considering these benefits, the need for a repository to ensure the sustainability and reusability of ontologies in the industrial domain was recommended in the first version of the roadmap [1] published by the H2020 OntoCommons CSA project (https://ontocommons.eu) as feedback of the subject-matter experts, industrial stakeholders, and end-users from materials and manufacturing (M&M) domain [1]. More specifically, two major hurdles in the wider use of

[1]"One of the main services that the OntoCommons project can offer is to create a public resource where all the major ontologies, their uses, and their users, are listed. This outcome can provide a practical benefit to the engineering

ontologies in M&M were mentioned in the roadmap: 1) many good quality ontologies were lost due to the lack of maintenance and not reused due to the difficulty in finding them. Moreover, some of these ontologies were crowded out by ontologies from other domains when stored in some of the existing repositories (e.g., BioPortal), 2) users are not confident in reusing ontologies that are not categorised by their target domain or topic and their coverages. Furthermore, one of the recommendations regarding domain ontologies in the OntoCommons roadmap is to make domain ontologies FAIR (Findable, Accessible, Interoperable, Reusable) by storing the ontology in a permanent ontology repository specific to the industry, adopting FAIR metadata for annotation and documentation. Addressing these gaps, IndustryPortal aims to provide a sustainable, FAIR, and Open repository for the persistence and reusability of ontology exclusively in the Industrial domain.

2. IndustryPortal: technical architecture and features

IndustryPortal (http://industryportal.enit.fr) is designed to be an open portal, providing permanent access to FAIR ontology-based services. It is based on the OntoPortal technology (previously known as BioPortal virtual appliance). The OntoPortal architecture consists of several key components[2]: (a) Ontology repository stores the ontologies or other types of semantic artefacts and their metadata in an RDF triplestore that supports SPARQL queries. (b) Ontology services provide a suite of RESTful web services for managing and accessing ontologies and their associated data. These services include ontology search, ontology mapping, and ontology visualisation services. (c) An application programming interface to access the ontologies and related services automatically and in different formats, e.g., RDF, OWL, and OBO, etc. (d) User Interfaces provide a user-friendly front-end for the ontology services, multiple content visualisation and user community features (notes, comments, notifications, slices, etc.). Currently, IndustryPortal hosts over 100 semantic artefacts, most of which (95%) are unavailable in other OntoPortal-based portals. The initial set of ontologies was derived from the landscape survey [3] conducted by the OntoCommons project. The hosted ontology versions and metadata are curated by administrators and original ontology developers. The portal counts over 30 registered users at the time of writing this article.

The primary functions of IndustryPortal span across typical ontology engineering phases. In Fig. 1, these functions are mapped to the different steps of Linked Open Terms (LOT) [4] methodology, a popular methodology for ontology engineering. Most importantly, IndustryPortal provides several ways to find an existing ontology for reuse, e.g., using an upper-level ontology for some domain application, or to model application data, e.g., search ontology by name, category, topic, group, and other metadata, by class or certain term, or by using a Recommender service. Fig. 2 shows an illustration of the IndustryPortal features for an ontology. While using more than one ontology for implementation, users can also ensure mapping among the ontologies by using or editing the mappings stored in IndustryPortal (computed by LOOM matcher by default but new mapping may be added manually or via API). Most importantly, newly developed ontologies can be submitted to IndustryPortal or an existing ontology may be automatically updated with a new version.
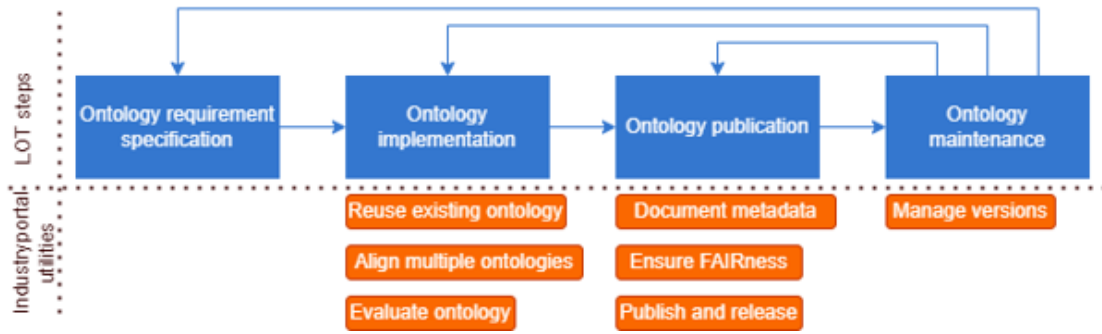
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and industrial communities." - Barry Smith, author ISO/IEC 21838-2:2021

Figure 1: Use of IndustryPortal in different ontology engineering phases.
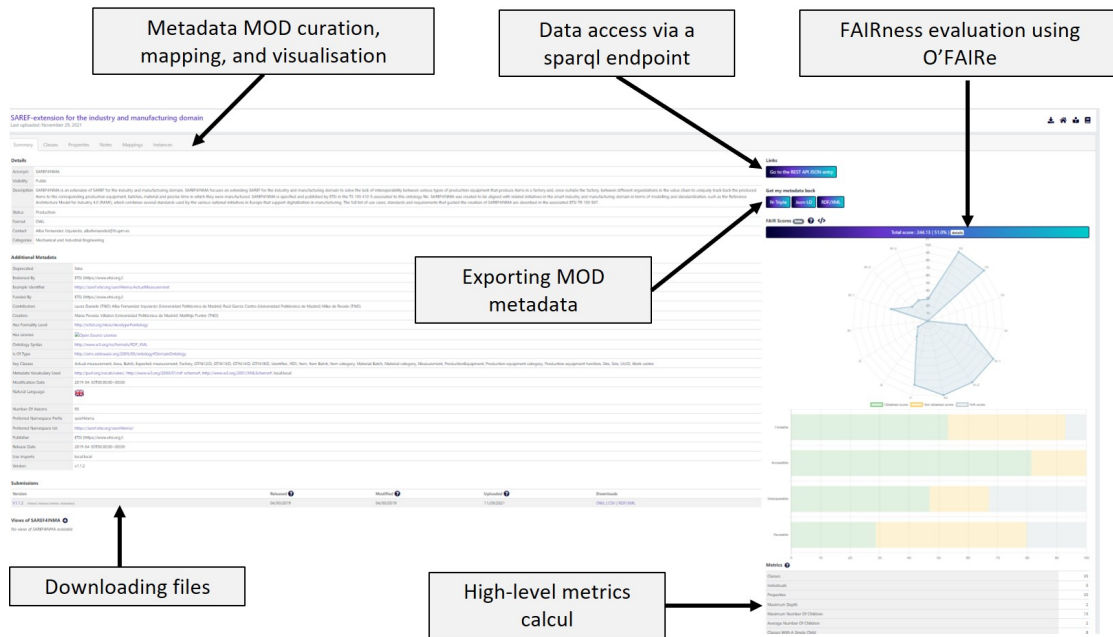

Figure 2: An overview of the SAREF4INMA ontology in the summary page from the IndustryPortal. The portal provides a user-friendly interface (via open APIs) that allows users to curate, evaluate, align, and visualise industrial ontologies, as well as upload and share their own ontologies.

Equipped with MOD version 2.0 (Metadata for Ontology Description and Publication Ontology) [5], IndustryPortal allows annotation of an ontology by a myriad of metadata to increase its FAIRness and evaluate it against O'FAIRe (Ontology FAIRness evaluator). O'FAIRe is a methodology designed to evaluate the FAIRness of ontologies implemented in some OntoPortal repositories [6, 7] that support the required metadata model. It was originally developed for AgroPortal [8] to provide scoring and guidance to improve FAIRness of an ontology.

Last, a robust ontology mapping management utility is being developed to enable users to store complex (description logic compliant) mappings among classes along with detailed metadata and exchange them in Simple Standard for Sharing Ontological Mappings (SSSOM)

format [2]. Later, we will curate and improve the rudimentary mappings between the archived ontologies with rich metadata.

3. Conclusion and future plans

IndustryPortal represents a significant achievement stemming from the OntoCommons project. It serves as a valuable platform for showcasing the extensive ontology harmonization endeavours undertaken within the project. These efforts encompass the creation of new ontologies, the establishment of mappings between existing ontologies, and the promotion of FAIR principles to ensure the long-term sustainability of ontologies. Building upon the robust foundation of OntoPortal, IndustryPortal leverages its proven stability and resilience, cultivated through a decade of development and continuous enhancements. Furthermore, IndustryPortal benefits from collaborative knowledge sharing and support from various communities employing the same technology, such as BioPortal, AgroPortal, and MatPortal. In addition to these technological foundations, a dedicated team of developers and ENIT leadership commit to maintaining and ensuring the availability of IndustryPortal for industrial domain users in the long run.

As elaborated in the preceding section, IndustryPortal is already equipped with an array of features and tools designed to uphold the FAIRness of hosted ontologies. This underscores IndustryPortal's commitment to staying current with the latest trends in FAIR research. For instance, it follows some propositions discussed in the EOSC FAIR-IMPACT project and the OntoPortal Alliance with respect to ontology metadata (reusing MOD) and FAIRness assessment (reusing O'FAIRe).

However, IndustryPortal aspires to transcend its role as a mere ontology repository. As outlined earlier, IndustryPortal already encompasses several features that support activities across various phases of the ontology life cycle. Looking ahead, IndustryPortal aims to facilitate interoperability with a wide range of ontology engineering tools. For example, it is presently being integrated into SousLeSens (deployed at https://souslesens.enit.fr/login), which is a suite of open-source tools for visual ontology editing, mapping, and data transformation. Additionally, IndustryPortal will also provide a range of ontology metrics for the hosted ontologies to report the quality of the ontologies.

On completion of the ongoing work on the management of ontology mappings in SSSOM format, IndustryPortal will allow users to curate context-specific mappings, enrich their annotations, and seamlessly share these mappings in the SSSOM format. This advanced functionality, which enables the creation of contextual alignments among ontologies, positions IndustryPortal as a powerful tool for automating the assembly of ontology networks based on predefined vocabulary sets within specific contexts. This transformative capability will significantly expedite the development of new ontologies by fostering more efficient reuse of existing ones.

Acknowledgments

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[2]https://mapping-commons.github.io/sssom/home/

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4. Online Resources

Access the sources and supplementary materials for the portal through the provided links below:

- IndustryPortal GitHub,
- IndustryPortal demo video
- MOD GitHub,
- OntoPortal technical documentation