Preface for the 1st International Workshop on Semantic Industrial Information Modelling (SemIIM)

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Abstract

SemIIM2022 was a full-day workshop that took place on 30th May 2022 in Hersonissos, Greece, co-located with the 19th edition of the Extended Semantic Web Conference (ESWC2022). This workshop invited industrial as well as academic keynotes, industrial panellists and papers covering the challenges and solutions for addressing industrial information modelling, including methods and practices of representing concepts, relationships, constraints, rules and operations to specify data semantics for a chosen domain of interest. The workshop gathered the interested community and discussed the latest approaches for challenges both from the perspectives of academia and industry.

1. Introduction

Information Modelling (IM) has been under the spotlight of both academia and industry for decades [1, 2]. Important aspects of IM include methods and practices of representing concepts, relationships, constraints, rules and operations to specify data semantics for a chosen domain of interest. As a response to the IM challenge a number of modelling paradigms and languages arose and they range from ERM [3], UML [4], ORM [5] to OWL [6] and Knowledge Graphs [7] and come with a wide range of systems to support the life cycle of information models [8, 9].

Despite the past success, existing approaches and systems for IM fail to cope with new challenges of overwhelming global industrial digitalization that requires advanced information models and aims at fully computerized, software-driven, automation of production processes and enterprise-wide integration of software components [10, 11, 12, 13, 14]. Such trend and the technological and industrial developments that come with it are an important part of Industry 4.0 and industrial Internet of Things [15]. It requires IM that, for example, allows to capture the functionality of and information flow between different assets in a plant, such as equipment and production processes. Moreover, it requires IM and models that are based on ISA and IEC standards and have a number of desirable properties, e.g., reusable, explainable, scalable, simulatable etc [16, 17]. Such IM should allow for seamless data sharing and integration e.g., via data market places and across value chains [18, 19].

SemIIM'22: 1st International Workshop on Semantic Industrial Information Modelling, 30th May 2022, Hersonissos, Greece, co-located with 19th Extended Semantic Web Conference (ESWC 2022)
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These new challenges require new theory, methodology, best practice, systems and this should be developed, shared, and discussed by a wire range of stakeholders. Therefore, we initiated the 1st International Workshop on Semantic Industrial Information Modelling (SemIIM) to provide a venue for the community of industrial information modelling.

2. The SemIIM2022 Workshop

The 1st International Workshop on Semantic Industrial Information Modelling (SemIIM) aims at gathering researchers and practitioners who work on addressing these challenges with the help of semantic technologies. We in particular invited IM experts who are excited and committed to push the frontiers of IM further and support modern industry in its current technological transformation. In our workshop we welcomed novel methods, systems, solutions, experience, and practice for semantic industrial information modelling.

The workshop included the following sessions:

2.1. Industrial Keynote

The Industrial Keynote was given by Jean-Charles Leclerc at TotalEnergies on the topic: "Bridging Industrial Ecosystems Around Standardized Semantic Information Models"

As emphasized in the European Green Deal and in the New Industrial Strategy for Europe, developing new standards, coupled with increased efforts of international standardization bodies, will be essential to boost industry's competitiveness and build a sustainable and more inclusive future. Recent European H2020 projects and clusters, Joint Industrial Projects in industry and advanced standards of Standardization Development Organizations converge towards new ways of using standards to enable integration of data and applications, thus enabling new ways of working all along the products' and plants' life cycle and ecosystem. In this talk, the speaker elaborated in the context of developing an industrial ecosystem and real interoperability conditions:

- A necessary common framework for information management and its genericity, based on ISO15926-14 ontology for an efficient formal and concretes disambiguation of concepts then ISO15926-4 PCA (more than 60000 concrete classes) for our Multi-Energies Company business objects references URI mappings, then we addd additional standards such ISO/IEC81346 for systems, ILAP and ISO15926-13, for dynamic aspects of quality configuration management against roles and activities all along Life-Cycle Information.
- An agreed methodology required for the alignment of internal reference data, models and technical repositories with external ontologies-based standards, such as ISO 15926-14/-4, and other future SMARTs (Standards Machine Applicable Readable and Transferable), digitalized according to common principles and rules for the provision of consistent digital specifications, and configurations management.
- A concrete illustration thanks to a set of tools enabling industry standards visualization, manipulation, and mapping/linking to enterprise data. All these operations based on capabilities offered by the W3C semantic web standards are necessary for a real and manageable interoperability and for delivering the real value of incoming digital twins.

- We illustrated our point with the ongoing TotalEnergies initiative of Reference Data Domain business objects alignment exercise to feedback our experience outcomes and provide some way forward and lessons learned perspectives.

2.2. Academic Keynote

The Academic Keynote was given by Hedi Karray at National Engineering Scholar of Tarbes on the topic: "Semantic Industrial Models - State of the Art From an Academic Perspective"

Ontology has been touted as a solution to interoperability and a formal knowledge representation in an evolving collaborative industrial domain [20, 21, 22, 23]. However, even where ontologies are used in industry, they are often embedded as components in larger proprietary systems. Moreover, such ontologies were in almost all cases developed without any heed to reuse existing ontology or apply lessons learned from past initiatives. Most of the common concerns for reusing existing ontology are regarding lack of consensus among models, limited coverage of domains, and ambiguity in the semantic definitions of the concepts of those ontologies. Furthermore, such disagreement among ontologies arises because most of them do not adhere to a suitable top-level ontology and often built without following a standard ontology development methodology. Consequently, adopting these ontologies rather increases the risk and uncertainty of the project in place of saving time and effort. The presentation addresses different layers of ontologies interoperability and will introduce some examples of ambiguity for each of the layers. The speaker introduced how these interoperability issues may be mitigated by stratification of ontologies.

2.3. Industrial Panel

The industrial panel was on the topic: "Semantic Industrial Information Modelling - Dream vs Reality (Mitigating the Gap for Industry)" given by the following panellists:

- Marcel Fröhlich, Director Services at Eccenca
- Daniel Herzig, Chief Operating Officer at Metaphacts
- Vladimir Alexiev, Chief Data Architect at Ontotext
- Irlan Grangel Gonzalez, Activity Manager at Bosch Corporate Research
- Maja Miličić Brandt, Senior Key Expert at Siemens
- Claude Fauconnet & Jean-Charles Leclerc, Innovation & Standards Lead at TotalEnergies

Panel goal: The panel brought together researchers and two kinds of industry representatives:

1. technology providers (of semantic solutions) and
2. semantic technology consumers such as Siemens, Bosch and Total that rely on ontologies and KGs to model equipment, processes, etc and put such models in production [24]. There is still a gap between what research and technology providers offer to industry today and the actual industrial needs. During the panel it was discussed whether such gap indeed exists and how to mitigate it.

Panel format:

- Each panelist had 10 min to give a short presentation of her/his organisation (3-5 min), thoughts / pitch on the topic of the panel (5-7 min).
- Then, we had 1h for question answering and discussions (questions from panellists to each other, questions from the audience, questions from the moderators).
- We had short presentations grouped in 2 sessions - first 3 talks of technology adopters and then 3 talks of technology providers.

2.4. Workshop Papers

Seven papers were submitted. The reviews were hosted at EasyChair. Each paper received at least three reviews from reviewers with different background and status. Six papers were accepted. Two of the accepted papers were regular papers and four were short papers. The following papers were accepted for publication and presented at the workshop

- Regular papers:
  - Towards Models of Conceptual and Procedural Operator Knowledge [25]
  - Ontoflow: A User-Friendly Ontology Development Workflow [26]
- Short papers:
  - Towards Addressing Requirements to Identification Posed by the Digital Transformation [27]
  - SparTDD - A SPARQL Based Thing Description Directory [28]
  - Towards a Visualisation Ontology for Data Analysis in Industrial Applications [29]
  - Industrial Geological Information Capture with GeoStructure Ontology [30]

3. Organizing Committee

- Arild Waaler, University of Oslo, Norway
- Evgeny Kharlamov, Bosch Center for AI / University of Oslo, Germany
- Baifan Zhou, University of Oslo, Norway
- Dongzhuoran Zhou (Web Chair), Bosch Center for AI / University of Oslo, Germany

4. Program Committee

- Ahmet Soylu, Oslo Metropolitan University, Norway
- Arild Waaler, University of Oslo, Norway
- Baifan Zhou, University of Oslo, Norway
- Dongzhuoran Zhou, Bosch Center for AI / University of Oslo, Germany
- Dumitru Roman, SINTEF AS / University of Oslo, Norway
- Ernesto Jiménez-Ruiz, University of London, United Kingdom
- Evgeny Kharlamov, Bosch Center for AI / University of Oslo, Germany

- Gong Cheng, Nanjing University, China
- Irlan Grangel Gonzalez, Bosch Corporate Research, Germany
- Jiaoyan Chen, University of Oxford, United Kingdom
- Kavitha Srinivas, IBM Research, United States
- Maryna Waszak, SINTEF AS, Norway
- Muhammad Yahya, National University of Ireland, Ireland
- Vincenzo Cutrona, University of Applied Sciences and Arts of Southern Switzerland, Switzerland
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- Yulia Svetashova, Causaly, United Kingdom
- Zhuo Chen, Zhejiang University, China
- Zhuoxun Zheng, Bosch Center for AI / Oslo Metropolitan University, Germany

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