

Legend: **MFG:** Manufacturing, **PROD:** Products, **PROC:** Processes, **RES:** Resources, **P.COMP:** Plant Components, **ACTV:** Activities, **SHED:** Scheduling, **MAINT:** Maintenance, **SENS:** Sensors, **ROBT:** robotics, **ENG:** Engineering, **BATCH:** Batch Processing, **MSMT:** Measurements, **STD:** Standards, **SIM:** Simulation

	MFG	PROD	PROC	RES	P.COMP	ACTV	SHED	MAINT	SENS	ROBT	ENG	BATCH	MSMT	STD	SIM	CLASSIF	REF
SOIL	✓	✓	✓	✓								✓				SM	[1]
SemAnz4.0	✓	✓	✓													SM	[2]
iFAB	✓															SM	[2]
ADACOR	✓		✓		✓		✓									SM	[2]
MASON	✓	✓	✓	✓												O	[3, 4]
MaSDeM	✓	✓	✓	✓							✓					O	[2]
SIMPM	✓		✓													O	[5]
PSL	✓		✓			✓	✓								✓	O	[3]
OntoCAPE			✓								✓					O, SM	[2]
BaPrOn			✓				✓					✓				O	[6]
FABMAS	✓	✓		✓		✓	✓									O	[7]
PrOnto	✓	✓	✓		✓											O	[2, 8]
ARUM	✓	✓	✓	✓			✓									O	[9]
RGOM	✓	✓	✓	✓			✓	✓							✓	SM	[8]
ONTO-PDM	✓	✓	✓	✓			✓								✓	O	[10]
MPMO	✓		✓	✓						✓						O	[11]
MCCO	✓	✓														O	[2]
SCRO	✓		✓	✓	✓	✓										O	[12]
MSDL	✓	✓	✓	✓												O	[2]
AMU	✓	✓	✓	✓	✓											O	[13]
MTM	✓			✓												O	[14]
MPO	✓		✓	✓							✓					O	[15]
IMAMO	✓			✓	✓			✓	✓							O	[13]
IEO	✓	✓	✓	✓	✓							✓				O	[2]
COMPOSITION	✓	✓	✓	✓												O	[16]
MaRCO	✓			✓												O	[17]
ExtruOnt	✓		✓	✓					✓							O	[17]
OntoProg	✓			✓				✓								O	[18]
Onto-ICMS	✓		✓	✓	✓	✓		✓								O	[19]
AMLO	✓	✓	✓	✓	✓				✓		✓				✓	O	[20]
WSSN								✓								O	[21]
M3									✓	✓			✓	✓		O	[22]
CSIRO-SO			✓						✓				✓			O	[23]
OPW	✓	✓	✓	✓		✓										O	[24]
CDM-Core	✓		✓				✓			✓			✓	✓		O	[25, 13]
ROMAIN			✓	✓				✓								O	[26, 13]
STO	✓														✓	O	[27]
SSN				✓					✓							O	[28]
newSSN				✓					✓							O	[28]
AWARE				✓					✓	✓						O	[28]

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	MFG	PROD	PROC	RES	P.COMP	ACTV	SHED	MAINT	SENS	ROBT	ENG	BATCH	MSMT	STD	SIM	CLASSIF	REF
OntologySim	✓	✓	✓	✓		✓									✓	O	[29]
CMSD	✓	✓	✓	✓											✓	O	[30]

References

- [1] Amon Göppert, Lea Grahn, Jonas Rachner, Dennis Grunert, Simon Hort, and Robert H Schmitt. 2021. Pipeline for ontology-based modeling and automated deployment of digital twins for planning and control of manufacturing systems. *Journal of Intelligent Manufacturing*, 1–20.
- [2] Felix Ocker, Birgit Vogel-Heuser, and Christiaan J. J. Paredis. 2019. Applying Semantic Web Technologies to Provide Feasibility Feedback in Early Design Phases. *Journal of Computing and Information Science in Engineering*, 19, 4, (July 2019). 041016. ISSN: 1530-9827. DOI: [10.1115/1.4043795](https://doi.org/10.1115/1.4043795). eprint: https://asmedigitalcollection.asme.org/computingengineering/article-pdf/19/4/041016/6415224/jcise_19_4_041016.pdf. <https://doi.org/10.1115/1.4043795>.
- [3] Sadeer Beden, Qiushi Cao, and Arnold Beckmann. 2021. Semantic Asset Administration Shells in Industry 4.0: A Survey. In *2021 4th IEEE International Conference on Industrial Cyber-Physical Systems (ICPS)*, 31–38. DOI: [10.1109/ICPS49255.2021.9468266](https://doi.org/10.1109/ICPS49255.2021.9468266).
- [4] S. Lemaignan, A. Siadat, J.-Y. Dantan, and A. Semenenko. 2006. MASON: A Proposal For An Ontology Of Manufacturing Domain. In *IEEE Workshop on Distributed Intelligent Systems: Collective Intelligence and Its Applications (DIS'06)*, 195–200. DOI: [10.1109/DIS.2006.48](https://doi.org/10.1109/DIS.2006.48).
- [5] Dušan Šormaz and Arkopaul Sarkar. 2019. Simpm – upper-level ontology for manufacturing process plan network generation. *Robotics and Computer-Integrated Manufacturing*, 55, 183–198. Extended Papers Selected from FAIM2016. ISSN: 0736-5845. DOI: <https://doi.org/10.1016/j.rcim.2018.04.002>. <https://www.sciencedirect.com/science/article/pii/S0736584517302119>.
- [6] E. Muñoz, G.M. Kopanos, A. Espuña, and L. Puigjaner. 2009. Towards an Ontological Infrastructure for Chemical Batch Process Management. In *19th European Symposium on Computer Aided Process Engineering*. Computer Aided Chemical Engineering, Volume 26. Jacek Jezowski and Jan Thullie, editors. Elsevier, 883–888. DOI: [https://doi.org/10.1016/S1570-7946\(09\)70147-6](https://doi.org/10.1016/S1570-7946(09)70147-6). <https://www.sciencedirect.com/science/article/pii/S1570794609701476>.
- [7] Lars Mönch and Marcel Stehli. 2003. An ontology for production control of semiconductor manufacturing processes. In *German Conference on Multiagent System Technologies*. Springer, 156–167.
- [8] Muhammad Yahya, John G. Breslin, and Muhammad Intizar Ali. 2021. Semantic Web and Knowledge Graphs for Industry 4.0. *Applied Sciences*, 11, 11. ISSN: 2076-3417. DOI: [10.3390/app1115110](https://doi.org/10.3390/app1115110). <https://www.mdpi.com/2076-3417/11/11/5110>.
- [9] Ondřej Hrcuba and Pavel Vrba. 2015. Ontologies for flexible production systems. In *2015 IEEE 20th Conference on Emerging Technologies & Factory Automation (ETFA)*. IEEE, 1–8.
- [10] Hervé Panetto, Michele Dassisti, and Angela Tursi. 2012. Onto-pdm: product-driven ontology for product data management interoperability within manufacturing process environment. *Advanced Engineering Informatics*, 26, 2, 334–348.
- [11] Qiushi Cao, Ahmed Samet, Cecilia Zanni-Merk, François de Bertrand de Beuvron, and Christoph Reich. 2020. Combining Chronicle Mining and Semantics for Predictive Maintenance in Manufacturing Processes. *Semantic Web*, 11, 6, 927–948.
- [12] Sadeer Beden, Qiushi Cao, and Arnold Beckmann. 2021. SCRO: A Domain Ontology for Describing Steel Cold Rolling Processes towards Industry 4.0. *Information*, 12, 8. ISSN: 2078-2489. DOI: [10.3390/info12080304](https://doi.org/10.3390/info12080304). <https://www.mdpi.com/2078-2489/12/8/304>.
- [13] Marco Kainzner, Christoph Klösch, Dominik Filipiak, Tek Raj Chhetri, and Anna Fensel. 2021. Poster: Towards Reusable Ontology Alignment for Manufacturing Maintenance. In *CEUR workshop proceedings series (Vol-2941)*. SEMANTICS 2021 EU, Amsterdam, the Netherlands. <http://ceur-ws.org/Vol-2941/paper9.pdf>.
- [14] T. Kjellberg, A. von Euler-Chelpin, M. Hedlind, M. Lundgren, G. Sivard, and D. Chen. 2009. The Machine Tool Model — A Core Part of the Digital Factory. *CIRP Annals*, 58, 1, 425–428. ISSN: 0007-8506. DOI: <https://doi.org/10.1016/j.cirp.2009.03.035>. <https://www.sciencedirect.com/science/article/pii/S0007850609001073>.
- [15] Luis Ramos, Richard Gil, Dimitra Anastasiou, and Maria J. Martin-Bautista. 2014. Towards a Machine of a Process (MOP) Ontology to Facilitate e-Commerce of Industrial Machinery. *Comput. Ind.*, 65, 1, 108–115. ISSN: 0166-3615. DOI: [10.1016/j.compind.2013.07.012](https://doi.org/10.1016/j.compind.2013.07.012). <https://doi.org/10.1016/j.compind.2013.07.012>.
- [16] COMPOSITION Consortium. 2021. D6.8 Collaborative Manufacturing Services Ontology and Language II. https://www.composition-project.eu/wp-content/uploads/2019/03/D6.8_Collaborative_Manufacturing_Services_Ontology_and_Language_II.pdf, Last accessed on 2022-02-15. (2021).

- [17] Víctor Julio Ramírez-Durán, Idoia Berges, and Arantza Illarramendi. 2020. ExtruOnt: An Ontology for Describing a Type of Manufacturing Machine for Industry 4.0 Systems. *Semantic Web*, 11, 887–909.
- [18] Qiushi Cao, Cecilia Zanni-Merk, Ahmed Samet, Christoph Reich, de Bertrand de Beuvron. François, Arnold Beckmann, and Giannetti. Cinzia. 2022. KSPMI: A Knowledge-based System for Predictive Maintenance in Industry 4.0. *Robotics and Computer-Integrated Manufacturing*, 74, 102281. ISSN: 0736-5845. DOI: <https://doi.org/10.1016/j.rcim.2021.102281>. <https://www.sciencedirect.com/science/article/pii/S0736584521001617>.
- [19] Qiushi Cao, Franco Giustozzi, Cecilia Zanni-Merk, François de Bertrand de Beuvron, and Christoph Reich. 2019. Smart condition monitoring for industry 4.0 manufacturing processes: an ontology-based approach. *Cybernetics and Systems*, 50, 2, 82–96. DOI: [10.1080/01969722.2019.1565118](https://doi.org/10.1080/01969722.2019.1565118). eprint: <https://doi.org/10.1080/01969722.2019.1565118>. <https://doi.org/10.1080/01969722.2019.1565118>.
- [20] Olga Kovalenko, Irlán Grangel-González, Marta Sabou, Arndt Lüder, Stefan Biffi, Sören Auer, and Maria-Esther Vidal. 2018. Automationml ontology: modeling cyber-physical systems for industry 4.0. *IOS Press Journal*, 1.
- [21] Rimel Bendadouche, Catherine Roussey, Gil De Sousa, Jean-Pierre Chanet, and Kun Mean Hou. 2012. Extension of the semantic sensor network ontology for wireless sensor networks: the stimulus-wsnode-communication pattern. In *5th International Workshop on Semantic Sensor Networks in conjunction with the 11th International Semantic Web Conference (ISWC)*, 16–p.
- [22] Amelie Gyrard, Soumya Kanti Datta, Christian Bonnet, and Karima Boudaoud. 2015. Integrating machine-to-machine measurement framework into onem2m architecture. In *2015 17th Asia-Pacific Network Operations and Management Symposium (AP-NOMS)*. IEEE, 364–367.
- [23] Holger Neuhaus and Michael Compton. 2009. The semantic sensor network ontology. In *AGILE workshop on challenges in geospatial data harmonisation, Hannover, Germany*, 1–33.
- [24] Kudirat Ayinla, Edlira Vakaj, Franco Cheung, and Abdel-Rahman H. Tawil. 2021. A Semantic Offsite Construction Digital Twin-Offsite Manufacturing Production Workflow (OPW) Ontology. In.
- [25] Luca Mazzola, Patrick Kapahnke, Marko Vujic, and Matthias Klusch. 2016. CDM-Core: A Manufacturing Domain Ontology in OWL2 for Production and Maintenance. In *KEOD*.
- [26] Mohamed Hedi Karray, Farhad Ameri, Melinda Hodkiewicz, and Thierry Louge. 2019. ROMAIN: Towards a BFO Compliant Reference Ontology for Industrial Maintenance. *Applied Ontology*, 14, 2, 155–177.
- [27] Irlán Grangel-González, Paul Baptista, Lavdim Halilaj, Steffen Lohmann, Maria-Esther Vidal, Christian Mader, and Sören Auer. 2017. The industry 4.0 standards landscape from a semantic integration perspective. In *2017 22nd IEEE International Conference on Emerging Technologies and Factory Automation (ETFA)*, 1–8. DOI: [10.1109/ETFA.2017.8247584](https://doi.org/10.1109/ETFA.2017.8247584).
- [28] Boulos El Asmar, Syrine Chelly, and Michael Färber. 2020. AWARE: An Ontology for Situational Awareness of Autonomous Vehicles in Manufacturing. (2020).
- [29] M. C. May, L. Kiefer, A. Kuhnle, and G. Lanza. 2022. Ontology-based production simulation with ontologysim. *Applied Sciences (Switzerland)*, 12, 3, Art.–Nr.: 1608. ISSN: 2076-3417. DOI: [10.3390/app12031608](https://doi.org/10.3390/app12031608).
- [30] Christian Block, Dominik Lins, and Bernd Kuhlenkötter. 2018. Approach for a simulation-based and event-driven production planning and control in decentralized manufacturing execution systems. *Procedia CIRP*, 72, 1351–1356. 51st CIRP Conference on Manufacturing Systems. ISSN: 2212-8271. DOI: <https://doi.org/10.1016/j.procir.2018.03.204>. <https://www.sciencedirect.com/science/article/pii/S2212827118303639>.