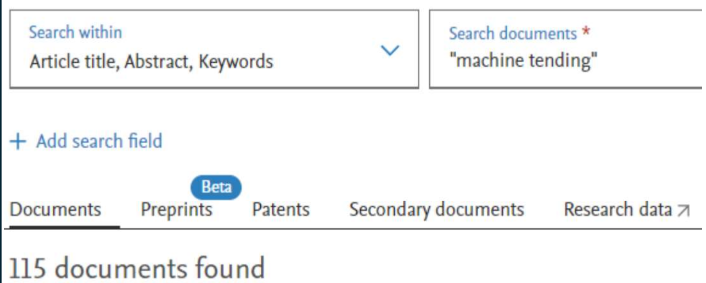
# Machine Tending: Systematic Literature Review




Machine tending is not a standarised term in literature. Therefore, there is a lack of findings to perform a SLR

Fig. 1. Lack of literature about machine tending in the literature

- The large amount of publications makes complex to be up to date with the State of Art.
- Systematic methods for Literature Review offer increased clarity, greater validity, and enhanced audibility.
- Lack of literature explicit about Machine Tending

## State of the art

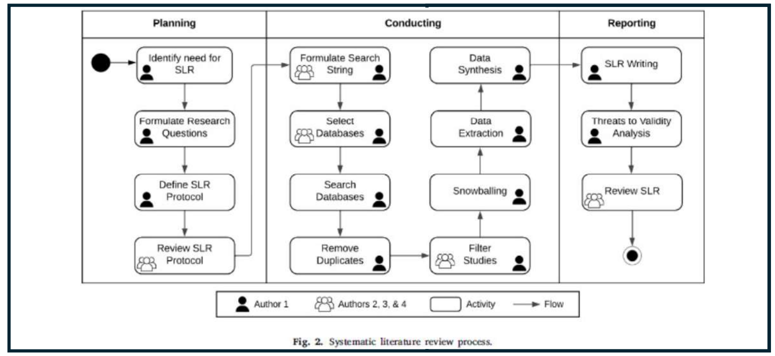



Fig. 2. Naveed, H., Arora, C., Khalajzadeh, H., Grundy, J., & Haggag, O. (2024). Model driven engineering for machine learning components: A systematic literature review. *Information and Software Technology*, *169*(February), 107423. https://doi.org/10.1016/j.infsof.2024.107423

Table 1: Research question formulation using the PICOC framework

| | |
|---|---|
| P<br>**Population and their problem** | **Population:**<br>• **lighting product manufacturers**<br>• **building lighting engineers**<br>**Problems:**<br>• **Information exchange** |
| I<br>**Intervention and issue** | Intervention<br>• The Semantic Web and Linked Data technology<br>Issue:<br>• Limitations of these technologies |
| C<br>**Comparative Intervention** | • The conventional approach of information exchanges using the openBIM standards |
| O<br>**Outcomes or themes** | • An improvement in information exchanges (improved interoperability) |
| C<br>**Context** | • Building and lighting product manufacturing industries |

Fig. 3. 'Amico, R. D., Erkoyuncu, J. A., Addepalli, S., & Penver, S. (2022). Cognitive digital twin: An approach to improve the maintenance management. *CIRP Journal of Manufacturing Science and Technology*, *38*, 613–630. https://doi.org/10.1016/j.cirpj.2022.06.004

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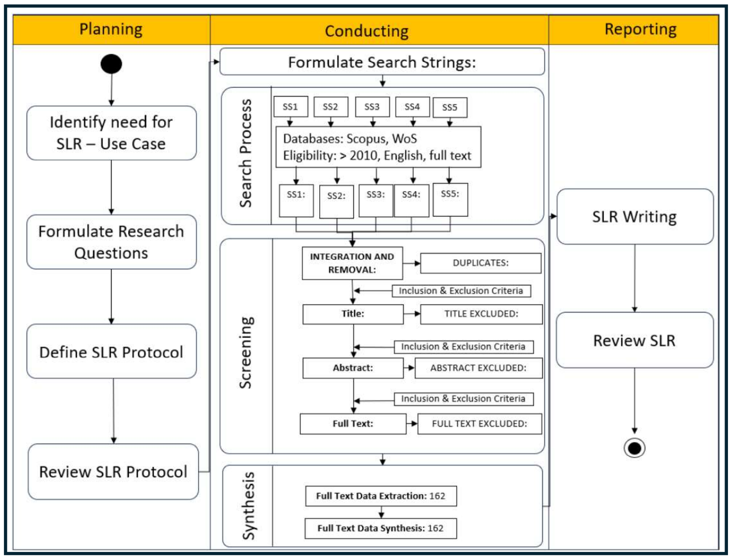


Fig. 4. Methodology followed, adapted to our topic from (Naveed, H. et al.).

- Databases: Scopus and WoS
- Eligibility: > 2010; English; Full Text
- Definition of Inclusion and Exclusion Criteria
- Following the defined protocol

## Materials and Methods

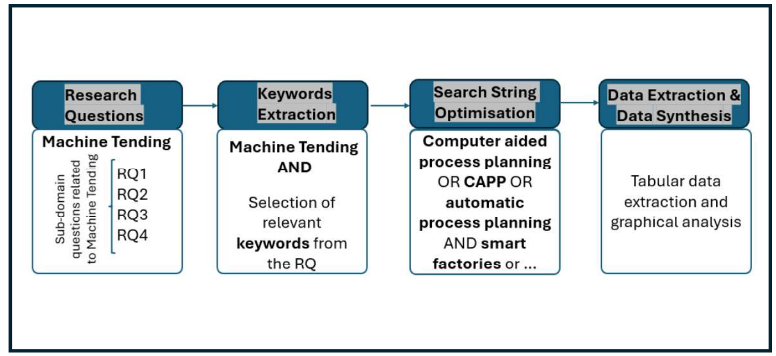


Fig. 5. Keyword selection is critical for a good SLR and it has been optimised during the formulation of the Search Strings .

## Expected results

- Answer to our RQ to fill the gap in the literature about machine tending
- Performe a systematic and replicable literature review, to gather all the approaches implemented from Indutry 4.0
- Find out the best approaches for knowledge representation in machining to apply them

# Knowledge Representation in Machining

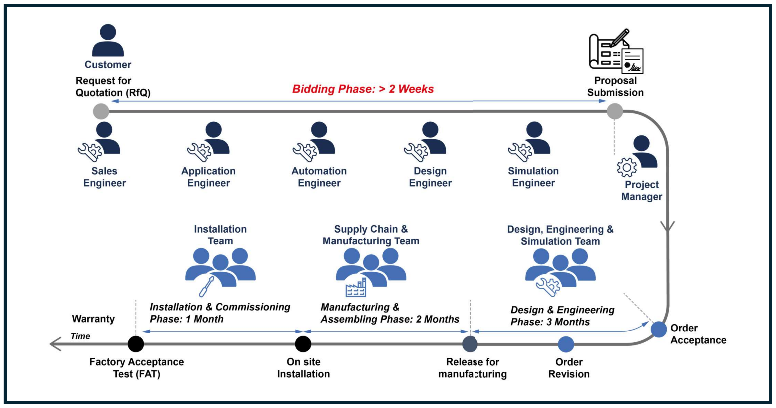


Fig. 6. Stakeholders and expertise involved in a complex Engineer-to-Order product/system

- Many stakeholders involved in the delivery of a project with different Expert Knowledge → Long latency of proposal submission
- Engineer-to-Order product, made to fit specific customer requirements, Machine Tending is a perfect example of it
- No longer possible to become specialized in all the domains of knowledge in complex products
- Lack of skilled personnel and frequent turn over of them
- Industry needs **DIGITALISE the KNOWLEDGE to avoid loosing. Knowledge is an asset!**

## State of the art

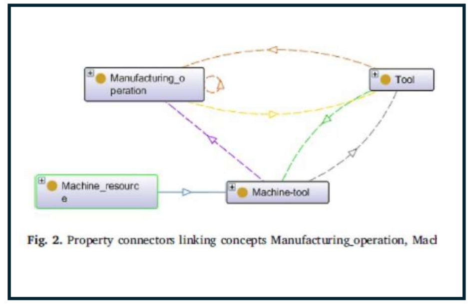


Fig. 7. Šormaz, D., & Sarkar, A. (2019). SIMPM – Upper-level ontology for manufacturing process plan network generation. *Robotics and Computer-Integrated Manufacturing*, *55*(April 2018), 183–198. https://doi.org/10.1016/j.rcim.2018.04.002

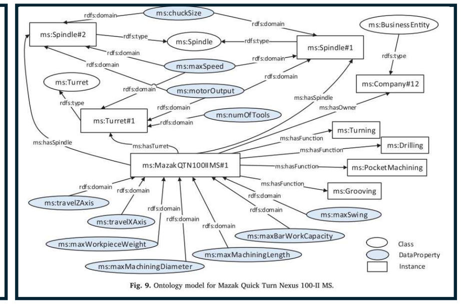


Fig. 8. Lu, Y., & Xu, X. (2018). Resource virtualization: A core technology for developing cyber-physical production systems. *Journal of Manufacturing Systems*, *47*(October 2019), 128–140. https://doi.org/10.1016/j.jmsy.2018.05.003

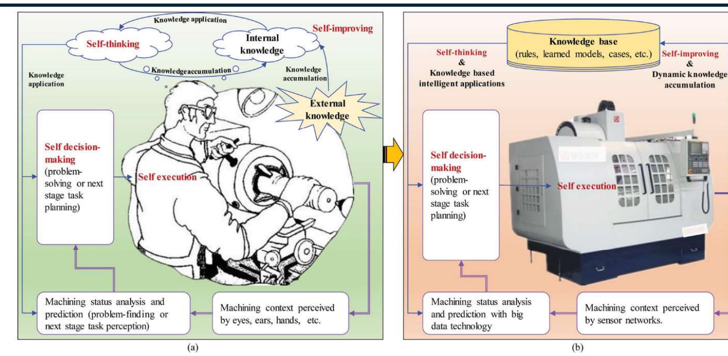


Figure 2. Illustration of the characteristics of manufacturing cell by analogy analysis with HMS. Characteristics of (a) HMS and (b) manufacturing cell in intelligent manufacturing.

Fig. 9. Zhou, G., Zhang, C., Li, Z., Ding, K., & Wang, C. (2020). Knowledge-driven digital twin manufacturing cell towards intelligent manufacturing. *International Journal of Production Research*, *58*(4), 1034–1051. https://doi.org/10.1080/00207543.2019.1607978

# Knowledge Representation in Machining

**Materials and Methods**

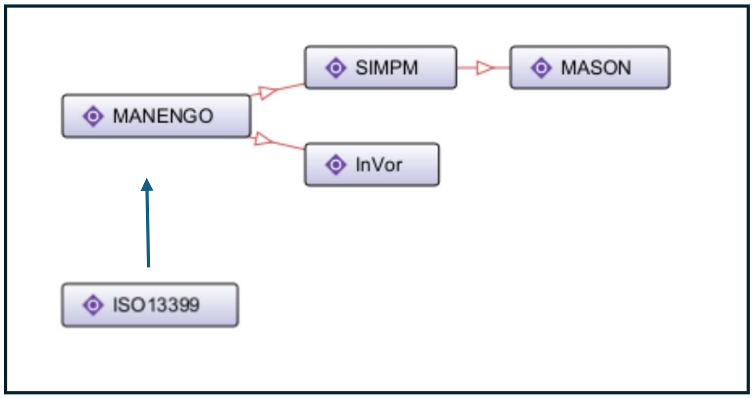


Fig. 10.

- Process of knowledge extraction from use cases and expert knowledge
- Knowledge acquisition using TMDA Framework (Motta et al., 1997)
- Usage of Semantic Technologies for knowledge representation (RDF, RDFs, OWL)
- Protégé and Vscode for Ontology development
- Following FAIR (Findable, Accessible, Interoperable, Reusable) Principles (https://www.go-fair.org)

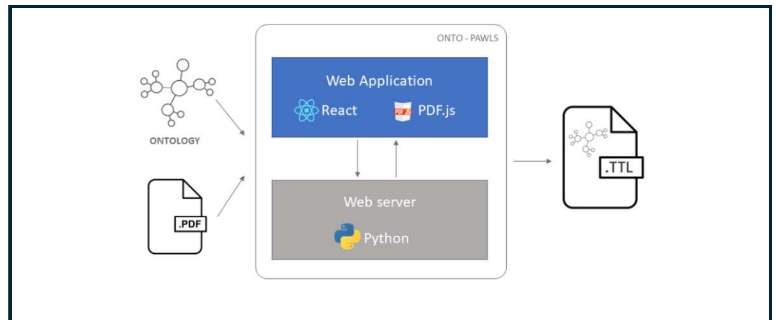


**Figure 5: The architecture of the tool.**

Fig. 11. Rula, A., Calegari, G. R., Azzini, A., Baroni, I., Celino, I., Annotation and Extraction of Industrial Procedural Knowledge from Textual Documents, 2023, K-CAP 2023 - Proceedings of the 12th Knowledge Capture Conference 2023

## Expected results

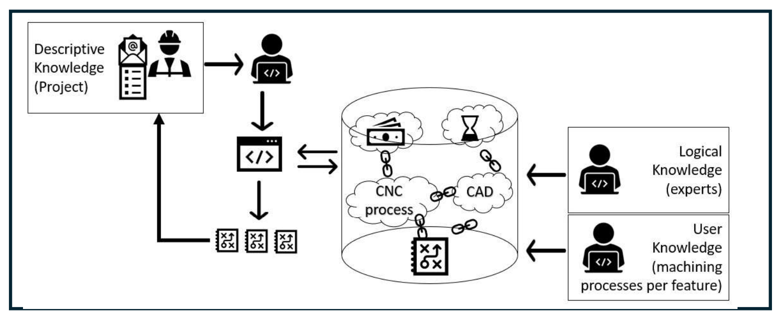


Fig. 12. Suggested architecture of the Knowledge Base System for machining