

# Towards FAIR ICT Data Sharing in the Circular Economy with Knowledge Graphs

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## The Need for Circular ICT

- The ICT sector is responsible for 3-6% of global CO<sub>2</sub> emissions (comparable to the cement industry). Predicted increase of up to 14% in 2040, without sustainable interventions [2].
- ICT such as laptops and data servers are being used on average for 3 and 4-5 years [2] respectively, while research shows that they should last 7 years before replacement [1].
- Digitization has a growing demand for critical materials as well. 15 of the 30 critical materials identified by the European Union are used in the production of ICT hardware.

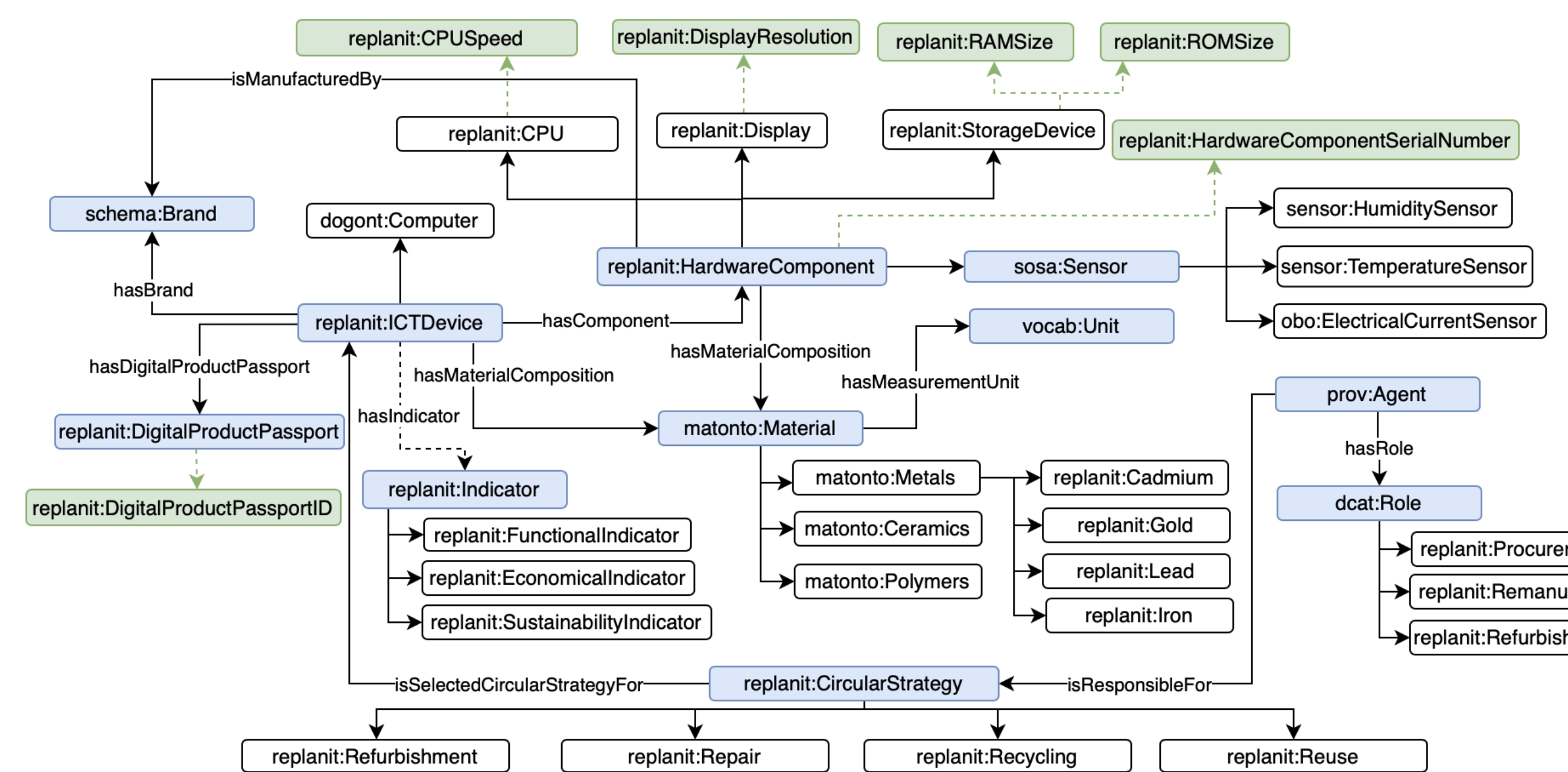


Figure 2: RePlanIT DPP Ontology Overview

## Barriers

- Limited **availability**, **accessibility** and **interoperability** of ICT, materials and Circular Economy (CE) data across organisations.
- Lack of digital infrastructures and tools that support **knowledge exchange** and interpretation between sustainability, ICT and technology experts in a **standardised** human and machine-readable formats.
- Lack of process transparency and data traceability along supply chains.

## Knowledge Graphs (KGs) - RePlanIT's FAIR Data Solution

To support findable, accessible, interoperable, reusable (FAIR) [6] ICT data sharing, based on review of existing ontologies [4] and analysis of KGs's applications [5], we present:

- RePlanIT's ontology\* for semantically representing and inter-linking the ICT, materials and CE domains.
- Machine-readable ICT Digital Product Passports (DPPs) as KGs [3], which can capture dynamic ICT life-cycles in the CE.

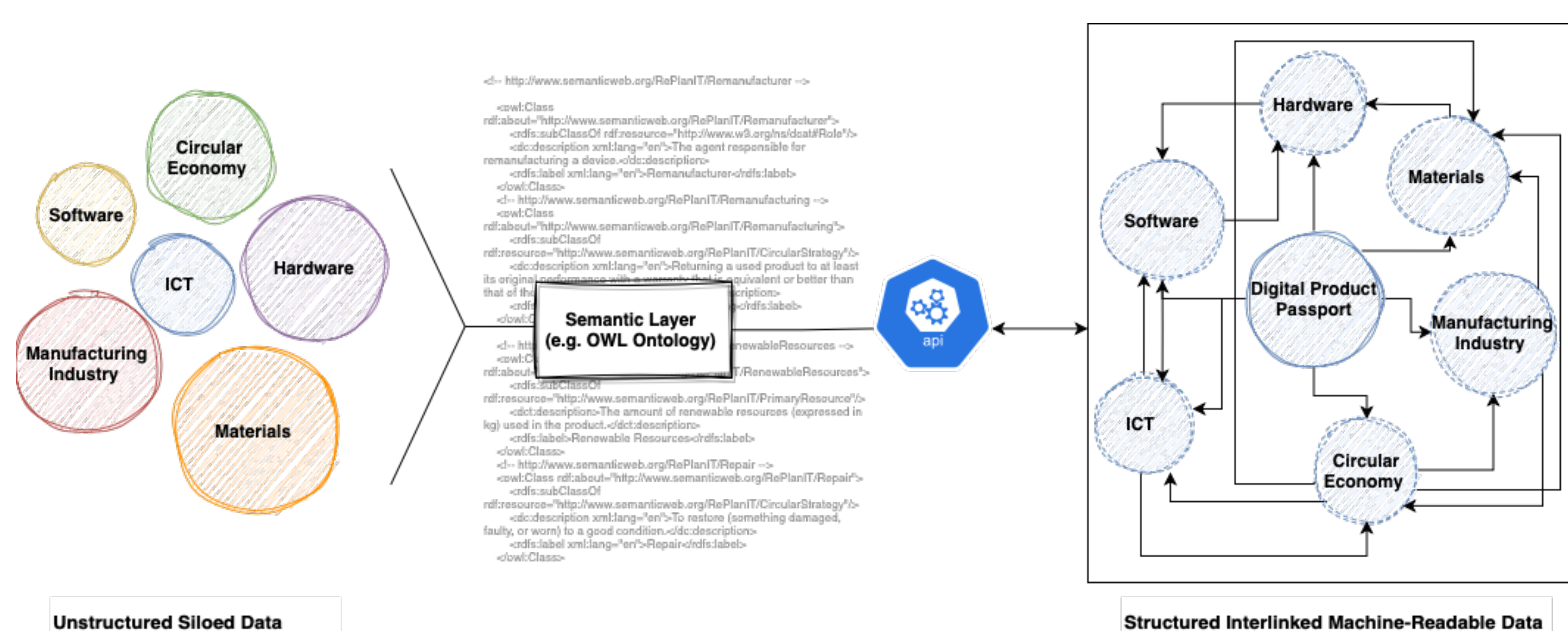


Figure 1: Transforming Data into Information with Semantics

## Applications

- The RePlaniT DPP ontology\* can be used as a stand-alone data model that guides the standardisation of ICT DPPs.
- The KG can be used to support human-decision making such as sustainable procurement of ICT hardware in organisations.
- KG-based semantic DPPs such as our can contribute to automated CE recommendations and context-aware predictive maintenance at scale.



Figure 3: Representing ICT DPPs with RePlanIT’s KG.

## References

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- [3] Dieter Fensel et al. "Introduction: What is a Knowledge Graph?" In: *Knowledge Graphs: Methodology, Tools and Selected Use Cases* (2020), pp. 1–10.
- [4] Anelia Kurteva et al. "Semantic Web and its Role in Facilitating ICT Data Sharing for the Circular Economy: State of the Art Survey". In: *Semantic Web* (2023). (In Review), Available at <https://www.semantic-web-journal.net/system/files/swj3381.pdf>.
- [5] Natasha Noy et al. "Industry-scale Knowledge Graphs: Lessons and Challenges: Five Diverse Technology Companies how how It's done". In: *Queue* 17.2 (2019), pp. 48–75.
- [6] Mark D Wilkinson et al. "The FAIR Guiding Principles for Scientific Data Management and Stewardship". In: *Scientific Data* 3.1 (2016), pp. 1–9.

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\* RePlanIT Ontology. Available at <https://kind.io.tudelft.nl/replanit/docs/>