Life cycle approach for electronics eco-design: case study on paper-based water quality sensors

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Life cycle-based methodologies facilitate an integrated assessment of the benefits and the burdens in terms of environmental, social and economic issues of specific products by adopting a holistic approach, from raw material extraction to product end-of-life. Such approach provides valuable support in integrating sustainability into design of products, the priorities being identified more transparently by the stakeholders. Circular economy acts on several steps of a product life cycle. Indicators measuring circular economy (e.g. product lifetime, repairability, remanufacturing, reuse, recycling rate, …) can therefore be included into life-cycle approaches.

Emerging devices for the Internet of Things (IoT) include complex non-standardized components made of key critical materials (Indium, Platinum, …) with low recycling rates. Also, lack of standardization of components and the fast pace of technological change are two factors that hinder reuse.

Therefore, there is a need for indicators guiding the stakeholders towards the design of IoT products and components allowing for the identification and separation of materials and a better understanding of the current limits to the reuse of components. As the current circular economy frameworks for IoT are at their early stage of development, there is a lack of relevant indicators in eco-design of IoT solutions.

Through this article, we aim to provide new insights in the identification of circular economy indicators relevant for the design of IoT solutions. The evaluation of circular design strategies (including lifetime, durability, modularity, disassembly, repair) of different connected water quality sensors by a life cycle approach will help to select the set of indicators necessary to assess circular economy of IoT, and guide us for the development of new ones that would better account for the IoT specificities.

The selection of such indicators will support the development of eco-design methodologies of IoT products focusing on preserving values in the material cycles, ultimately building more sustainable technologies.