Sustainability analysis in new circular value chains of new remanufacture industrial processes. R3-Mydas case-studies

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Introduction

The R3-Mydas project includes a Safe and Sustainable by Design (SSbD) approach to the new remanufacturing industrial process, to identify opportunities for adopting new circular value chains based on environmental, economic and social pillars from the early stages of project development. This approach supports the main European initiatives in the field of industrial ecology, such as the Zero Industry Act, the Product Environmental Footprint (PEFT) and the Circular Economy Directive, as well as others included in the Green Deal.

As a result of an initial analysis of the three demo-cases considered in the R3-Mydas project, in terms of sustainability, new circular scenarios in the value chains considered are more sustainable than current linear ones.

The main benefits of the adoption of SSbD in projects such as R3-Mydas are to ensure sustainability of new approaches to the circular economy from early stages and to open opportunities for new value chains based on repair, repurpose, remanufacturing and/or recycling.

Background

The SSbD Framework [1] is a general approach to steer innovation towards safe and sustainable chemicals and materials throughout the entire life cycle. The framework can be applied to the development of new chemicals and materials or to the assessment of existing ones. It combines established hazard and risk assessment approaches for chemicals and materials with sustainability assessment techniques, such as Life Cycle Assessment (LCA) methods.

The SSbD Framework has been developed by the Joint Research Centre to promote the design, development, production and use of completely new, safer and more sustainable chemicals and materials, considering their entire life cycle, steering the substitution of hazardous and less sustainable chemicals and materials. The overall goal is to help prevent pollution whilst also reducing society's environmental footprint.

Sustainable by Design revolves around integrating sustainability principles directly into the design process of products, services, and systems, ensuring that sustainability is considered at every stage of development. This proactive approach aims to minimise negative environmental, social, and economic impacts while maximising value and resource efficiency. Unlike traditional methods that may only address sustainability as a secondary concern, Sustainable by Design embeds it into the very foundation of the project, from ideation through to production and disposal.

Other European initiatives, such as the Zero Industry Act, Critical Raw Materials Act or Product Environmental Footprint, encourage stakeholders to consider sustainability as a pillar in the development of new value chains.

Along these lines, the R3-Mydas project incorporates SSbD as a key methodology for developing new remanufacturing processes. This allows them to identify opportunities in the design phase for a more sustainable approach and facilitate the adoption of circular economy models.

Supporting Arguments

Despite the multiple advantages of product remanufacturing, being widely recognised as an effective means for transitioning to a more circular economy, there is still a need for further research to enhance the sustainability of final products, as well as improved impact monitoring. Therefore, at the heart of SSbD is the commitment to creating products and services that contribute positively to the environment and society, while also meeting economic goals. It calls for a paradigm shift where sustainability is not an afterthought, but a core value embedded within the design process itself.

Sustainability requires integrated approaches, able to model complex systems. Life cycle-based approaches allow comparison of options and solutions in terms of sustainability. Life cycle thinking can be applied to assess the environmental, social, and economic pillars using LCA, Life Cycle Costing (LCC) and the Social Life Cycle Assessment (s-LCA).

During the R3-Mydas project, SSbD assessment is carried out. This assessment includes:

- Safety dimension: The three-step methodology defined by JRC will be followed. (Only for the electric vehicle value chain).
- Environmental dimension: It will consist of LCA of the proposed remanufacturing process for both demo cases, including the carbon footprint as one of the environmental impacts. The ISO 14040 series of standards for LCA will be followed.
- Socio-economic dimension: This consists of LCC assessment to ensure that new remanufacturing processes are economically viable, as well as s-LCA to identify potential social issues of the new circular value chains.

By considering sustainability from the outset, the SSbD methodology encourages designers and engineers to identify and address potential impacts early on, resulting in more efficient resource use, reduced waste, and better alignment with societal needs. It involves a holistic view, considering not only the technical aspects of a product or system, but also its social implications, life cycle impacts, and potential for long-term value creation.

- Therefore, the practices included in the SSbD methodology will guide the creation of solutions that are environmentally responsible, socially beneficial, and economically viable. This is particularly important for new circular value chains, such as R3-Mydas, where it is essential to ensure that the solutions that end-of-life solutions are also sustainable.

Counterarguments & Rebuttals

As a result of an initial analysis of the three demo-cases considered in the R3-Mydas project, in terms of sustainability, new circular scenarios in the value chains considered are more sustainable than current linear ones.

In this preliminary analysis, with limited data available, options such as reuse, repair, and remanufacturing considered in each demo-case seem to be more advantageous both environmentally and economically.

Nevertheless, some technical gaps need to be addressed to expand the repair and remanufacturing market, and R3-Mydas will work to close them. By the end of the project, an improvement in the sustainability of the three new circular value chains is expected.

Conclusion

The main benefits of the adoption of SSbD in projects such as R3-Mydas are to ensure the sustainability of new approaches to the circular economy from the early stages and to create opportunities for new value chains based on repair, repurposing, remanufacturing and/or recycling.

Furthermore, these methodologies enable opportunities to improve performance and develop new, more advantageous circular scenarios than current linear value chains to be identified. They also enable possible bottlenecks to be identified from early stages, allowing strategies to be designed for the straightforward adoption of these new business models.

References

[1] Caldeira, C., Garmendia Aguirre, I., Tosches, D., Mancini, L., Abbate, E., Farcal, R., Lipsa, D., Rasmussen, K., Rauscher, H., Riego Sintes, J. and Sala, S., Safe and Sustainable by Design chemicals and materials - Application of the SSbD framework to case studies, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/329423, JRC131878.