SUNSHINE Safe and Sustainable by Design (SSbD) approach and e-infrastructure

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1. Introduction

The European Chemicals Strategy for Sustainability and the Zero Pollution Action Plan have called for a transition towards Safe and Sustainable by Design (SSbD) approach for chemicals and materials (EC 2019) (EC 2020). To support this policy ambition, the European Commission (EC) has recommended the establishment of a SSbD framework based on a holistic approach developed by the Joint Research Centre (JRC) (EC, 2022; C. Caldeira et al., 2022). Due to their inherently complex nature and interactions the advanced materials (AdMa) pose safety and sustainability concerns. Therefore, it is important to equip the European industries with the knowledge and tools needed implement the JRC SSbD framework for these materials. The EU H2020 SUNSHINE project has addressed this challenge by delivering a digital e-infrastructure designed operationalise the RC SSbD framework for AdMa.

2. Methods

The SUNSHINE digital e-infrastrucure has been aligned to all 5 steps of the JRC SSbD framework (Caldeira et al. 2022), enabling tiered assessment at each step of the innovation process represented by the *Agile Stage-Gate* model (Cooper, 2014; Cooper and Sommer, 2018; Hristozov et al., 2022). It has been designed as a digital platform to foster dialogue, collaboration and information exchange between industry actors along entire supply chains. It is also a place where innovators can communicate with regulators in a trusted environment already in the early stages of innovation. The e-infrastrucure is *Inclusive* as it has been developed by engaging key stakeholders (e.g. SMEs, large industry, academia, regulators) to ensure that it addresses their needs and requirements. It is *State-of-the-art* as it has been based on the latest knowledge and data and includes (1) guidance for cost-effective generation of new data; (2) approaches for grouping to enable read-across of existing information for SSbD purposes; and (3) a tiered approach for assessing the safety-sustainability-functionality balance of the materials/products at each stage of the innovation process to inform 'Go to development' and 'Go to market' business decisions.

The SSbD approach underpinning the e-infrastrucure has been developed to help industries to modify and assess advanced materials/products to increase their safety and sustainability, while keeping their intended functionality in commercially viable ranges. This approach is composed of two Tiers. Tier 1 uses a scoring system to calculate indices

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for health, environmental, social and economic impacts and plot those on a chart that clearly visualizes safety and sustainability-related 'hotspots of concern' along the lifecycles of the materials/products. These hotspots can be further assessed in Tier 2 which involves quantitative LCA (Life Cycle Assessment), LCC (Life Cycle Costing), and S-LCA (Social Life Cycle Assessment) (Pizzol et al., 2023). The SSbD approach is comparative, so innovative materials can be compared to a benchmark. Such a benchmark could be an alternative design option or a conventional material/product that has the same or a similar function.

The e-infrastrucure is *Open & FAIR* as it is connected to the SUNSHINE Open & FAIR database, which enables access to high-quality safety and sustainability data. The system is also *Secure* as it ensures controlled exchange of information between supply chain actors by means of a highly innovative blockchain technology. The e-infrastructure will be able to generate a SSbD digital pass for each product assessed by it.

3. Conclusion

The SUNSHINE e-infrastructure operationalises the EC SSbD framework, enabling the assessment of safety and sustainability impacts at different stages of the innovation process and from a lifecycle perspective. This user-friendly digital system has been designed to be relatively simple for industries to implement, acknowledging their limited time and resources for safety and sustainability assessment. Its two tiers (qualitative and quantitative) cater to different analysis needs and generate comparison matrices for informed SSbD decision making for products enabled by AdMa.

4. References

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