Decision Support System for SSbD in the early innovation stages

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1. Introduction

Industrial designers have a vast number of tools and methods to choose from when they want to take safety and sustainability aspects into account when making decisions throughout the design process of advanced nanomaterials. Guidance is needed to assist industrial developers which tools and methods for safety and sustainability assessment can support decision making in each stage of the innovation process. Especially during early phases of the innovation process, the tools and methods need to be much simpler to apply with fewer questions and less information required to answer these questions. In addition, most of the existing methods and tools applicable in the lab phase are not sensitive enough to compare the safety and sustainability of different Safe and Sustainable by Design (SSbD) versions of a new material or product. The differences between the SSbD versions are too small to arrive at a different risk assessment outcome with these existing tools.

2. HARMLESS Decision Support System

Within the HARMLESS project we develop an online decision support system (DSS) to support industry in the development of innovative materials in a Safe and Sustainable by Design (SSbD) manner. Based on our experiences from applying existing methods and tools for SSbD to our case study materials, we have made the SSbD-DSS simpler and more sensitive to increase its practical applicability. The SSbD-DSS guides users through a workflow from the ideation phase up to the pilot phase of the innovation process starting with three tools, i.e. AMEA, WASP and ASDI (see Figure 1). First, we have implemented the Advanced Material Earliest Assessment (AMEA) tool for early categorization and advice as an integrated tool and starting point of the DSS. AMEA consists of only 3 questions and is used to check if the developed material or product falls within the applicability domain of the DSS and to provide initial innovation-dependent SSbD advice and early design principles for “exposure during the life cycle”, “hazard” and “sustainability”. If the DSS is applicable, the designer is advised to apply the second tool, named Warning flags, design Advice, Screening Priorities (WASP). WASP is based on the AMEA advice, LICARA innovation scan, Nano Exposure Quantifier and other existing tools, and developed for the ideation and business case phase of the innovation

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process as a simplified approach that requires less information. This approach consists of 14 questions to identify early warning flags on safety and sustainability and to provide design and assessment advice. To help industrial innovators to make an informed decision for the most optimal SSbD version in the lab phase, another approach, named Alternative SSbD Design Inspector (ASDI) was developed. Based on the early warning flags from WASP, ASDI provides a) guidance on which descriptors to measure and b) insight into the differences between the SSbD versions within the various dimensions (safety, sustainability and performance). More deeper analysis tools, including in vivo hazard prediction methods based on physicochemical and in vitro data using, for example, a Bayesian approach, are suggested and directly available in the DSS for pilot phase.

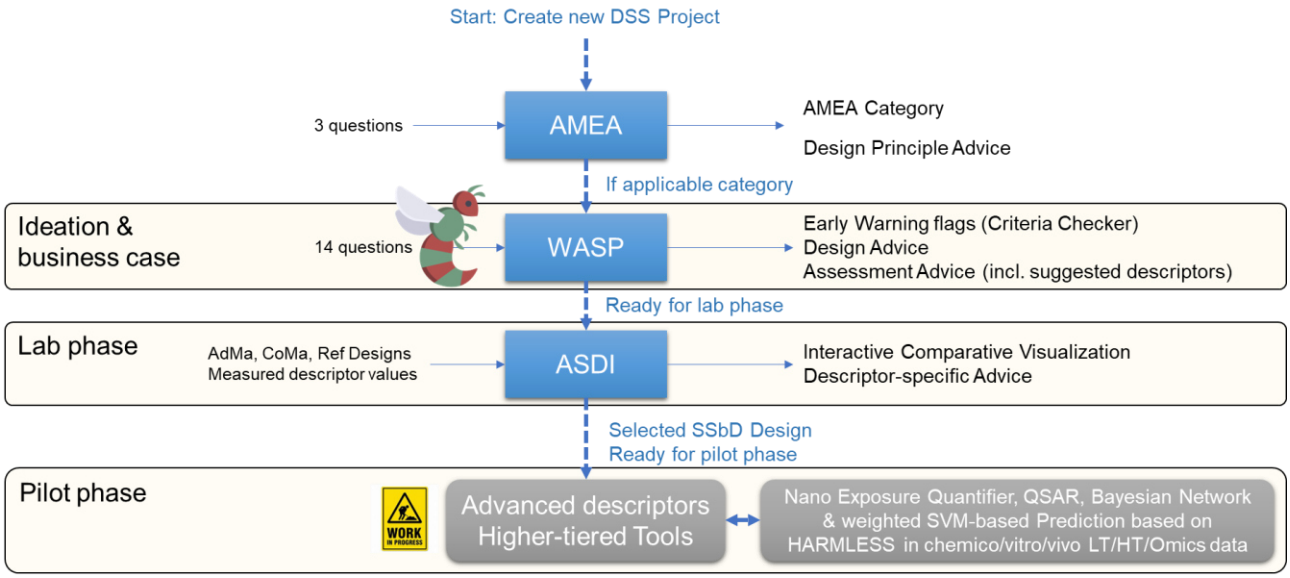

Figure 1: Improved workflow of the DSS: AMEA = Advanced Material Earliest Assessment, WASP = Warning flags, design Advice, Screening Priorities, ASDI = Alternative SSbD Design Inspector.

3. Conclusions

This presentation will describe the development of the new tools and the methods used for data and model integration in the HARMLESS Decision Support System (DSS). The availability of tools, data, and models is a dynamic development process that is changing and developing over time, particularly in a research project like HARMLESS where models and data are becoming available during the whole extent and lifetime of the project. To deal with the broadness of the data and models becoming available as well as to allow for in-depth and more detailed (but also more time-consuming) data and model fusion, we have developed two complementary integration approaches. These two integration approaches are complementary and work seamlessly together, allowing for the necessary broadness of covering important SSbD aspects in combination with more in-depth modelling where needed and possible given available data and models. Future steps will aim for both the AI recommendation engine (which proposes which action to do given the current situation) as well as the AI advice engine (which provides textual advice on the design choices given the current situation) to be able to incorporate decision rules more transparently by adding a functionality that allows experts to see the currently underlying rules.