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A NORMATIVE DIRECTION: SOCIAL, MORAL, AND DESIGN PERSPECTIVES OF SAFE-AND-SUSTAINABLE-BY-DESIGN

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Safe-and-Sustainable-by-Design (SSbD) aspires to be a transformative concept, one that would create a new social contract between science, technology, and society and align sustainable (material) innovation with societal needs (Brennan & Valsami-Jones, 2021). By incorporating regenerative principles, SSbD will deliver a “net positive impact across all stakeholder levels (nature, societies, customers, suppliers and partners, shareholders and investors, and employees)” (Soeteman-Hernandez et al., 2024, p.364). Currently, the social aspect still lags behind safety and environmental aspects in predominant SSbD approaches (Apel et al., 2024). For instance, social assessment remains at a low level of implementation and methodological maturity in various SSbD frameworks. Moreover, these frameworks tend to focus on the *measurement* of predefined categories of social / societal impacts (e.g. through tools such as S-LCA), but they tend to overlook, for instance, how to accommodate issues outside those predefined lists, or how to deal with tradeoffs (Apel et al., 2024). Typically, they also focus on the chemical level and molecular substitution, thus missing out on perspectives at the product, process, and system level. In this poster, we describe complementary—sometimes critical—perspectives from social science, ethics, and (product) design that can help to advance SSbD.



Product Design

With around 80% of a product's environmental impact determined during the design phase (European Commission, 2018), the product designer's perspective plays an important role in creating safer and more sustainable products. This perspective enables context-sensitive considerations related to the specific application of an SoC & the life cycle of the product containing it.

- Designers can intervene not only on the product level but can also design for system change. Through a **systems-thinking approach**, product design can anticipate product-specific conditions and potential behaviors of SoCs, enabling interventions at the material, component, product, and system levels (Bolaños Arriola et al., 2024).
- **Essentiality** of SoCs such as PFAS may be more meaningfully assessed at the product level (Cousins et al., 2019).
- **Trade-offs** associated with chemical substitution are often only discernible when assessing the **product life cycle**. E.g. PFAS in waterproof textiles, for example, could be replaced by a weaving technique to achieve the same water repellency, creating stiffer fabrics unsuitable for some uses (Bolaños Arriola et al., 2024).

By acting across these levels, designers can bridge product innovation with broader system transformation toward safety and sustainability.



Ethical Reflection

SSbD is not a feature of a product. It is a complex framework that requires **collaboration, commitment, and care** from all stakeholders in the value chain. An ethical framework for SSbD:

- Doesn't reduce SSbD decisions to technical optimisation, but is instead grounded in **explicit ethical deliberation** and collaborative moral judgment. Trade-offs are understood as **value conflicts** or **moral dilemmas** that require reflection and dialogue.

- Goes **beyond compliance** with checklist-based assessments. Conventional tools such as risk and life cycle analyses address known and foreseeable impacts, but ethical attention must be directed beyond that, to the evolving and unanticipated moral and social dimensions of design. In addition, it is necessary to reflect on what (and whom) we choose to measure, ignore, or prioritise, and what the **normative assumptions** are that underpin those choices.
- Navigates **uncertainty** by fostering sustained, reflective collaboration. This helps with both epistemic uncertainty (what is unknown) and moral uncertainty (what is ethically unclear).

A **care-oriented approach** (Fisher & Tronto, 1990) can help reframe SSbD as an **ongoing, relational responsibility** rather than a static product feature.



Societal Transformation

Chemical design has long aimed to address safety and environmental challenges, yet persistent issues like chemical pollution remain. Traditional approaches focus on chemical designers as primary agents of change, often overlooking social and political contexts. **Integrating**

participation into chemical design shifts the focus from purely technical solutions to socially and politically grounded practices, linking **material innovation** with **public values** and decision-making.

Key Points:

- Traditional chemical design emphasizes safety and environmental risk but often fails to **prevent pollution**.
- **Designers** are frequently positioned as **moral agents**, limiting broader **societal engagement**.
- **Participation embeds design in local**, socially and politically situated contexts.
- **Participation reduces asymmetry** between decision-making power and chemical-related risks.
- Value emerges through both production and circulation, where **chemicals carry social meaning**.
- Frameworks like Safe and Sustainable by Design (SSbD) should critically address **societal values** guiding chemical development.
- **Participatory design** can redirect chemical innovation toward **need-based solutions** for societal challenges.



Normative Direction

The normative direction refers to the **implicit ideals and influences that direct how SSbD will develop**. Through innovation and technology, the prevailing version of SSbD promises a healthy, toxic-free, and prosperous society. These are noble aspirations, but will everyone actually experience wellbeing and growth? The current normative direction shows that certain groups might pay a greater price.

- **Product Design:** Solutions in one part of the value chain can lead to burdens in another
- **Ethical Reflection:** Benefits for one part of the world can be damaging in another
- **Societal Transformation:** SSbD is influenced by the loudest voices at the agenda-setting table—whose are these and what are their motives?
- **Future Scenarios:** SSbD is not set in stone; there are multiple paths for how it can be implemented

These perspectives can help **make the normative direction explicit**, let it be discussed, and change it for the better.

Future Scenarios

Moving towards a safer and more sustainable future is complex and cannot rely only on small, incremental steps. Existing structures, such as laws, may unintentionally support less sustainable solutions. Futures studies help by considering long-term possibilities and combining bottom-up and top-down initiatives. **Futuring is not about predicting the future, but about shaping present perceptions to make certain futures more achievable**. Methods include roadmapping, visioning, scenarios, and backcasting, and should involve diverse actors to democratise the process.

These methods reveal different interpretations of safe and sustainable futures, which is crucial since sustainability priorities can conflict. Futuring can also **incorporate other elements** like social justice and enables consideration of radical long-term alternatives. Integrating futuring techniques with SSbD practices can support actors in progressing toward their preferred safer and more sustainable future.

Which perspective would you add?



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