

D4S_{M.D.} (Design for Sustainable Medical Devices)

A novel design methodology for Environmental, Social, and Clinical Sustainable Medical Devices

Goals of the research

Our aim is to develop a quantification methodology and tool to holistically incorporate sustainability (i.e., environmental, social, clinical, and economic sustainability) in the design process of medical devices (MDs).

With this research, we want to **address the following research questions:**

1. How to identify and arbitrate the trade-offs between the different dimensions of sustainability specific to the development of MDs? (**Impact Categories specific for MDs**)
2. How to model, quantify, and make sustainability-related decisions throughout the design process of MDs? (**Design Process specific for MDs**)
3. How to ensure that this novel Design Approach leads to preferable outcomes in terms of sustainability as well as usability for the designers? (**Outcomes**)

Context

Medical Devices have a big environmental and social impact (through embodied GHG emissions, or incorporated discriminatory biases), negatively impacting human health [1] and creating a self-reinforcing feedback loop. Biomedical designers have a significant influence and responsibility on this given that 80% of a MD's footprint is locked in during the design phase [2]. However, integrating sustainability into MD design is not yet standard practice [3]. In this, there are two major obstacles to consider:

1. Incorporating sustainability into product design can be intricate, especially during the initial stages of the design process where the uncertainty surrounding design decisions is the highest [4]. Yet, most sustainable design tools do not focus on this alignment of knowledge and complexity [5].
2. Striking a balance between sustainability (e.g. reusability) and clinical requirements (e.g. infection transmission risk) is essential [6], and illustrates the multi-dimensionality of trade-offs in the MD design process.

Our research aims to bridge the gap between design for sustainability (D4S), medical device design, and their associated methodologies and tools. We aspire to enhance multi-criteria decision-making for holistic sustainability in MD development, by acknowledging the complexity and uncertainty of the early design stages. The proposed quantification methodology and tool will facilitate:

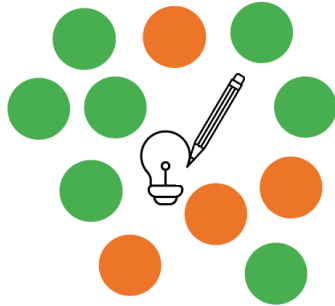
- The identification and balancing of trade-offs between the different dimensions of sustainability (environmental, social, clinical, economic) related to MD design.
- The quantification of these impact categories throughout the design process dealing with the uncertainty in the early design phases.

Through this approach, we seek to advance sustainable practices in medical device design, ultimately leading to more responsible and effective healthcare solutions.

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Proposed Approach

1. Create overview of Multi-Criteria aspects of design for sustainability (D4S) in general product development



2. Create overview of D4S towards MD design



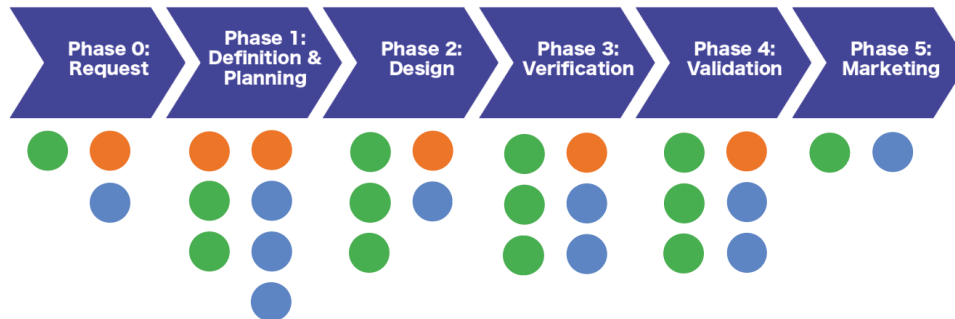
What is already applied/what is gap?
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3. Mapping of the MD design process



4. Creation of the methodology and tool quantifying Environmental, Social, and Clinical Sustainability throughout the MD design process



References

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