04. An Interdisciplinary Approach to Circularity

The circular building product canvas

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Our attitude towards building products has been based on our perception of their value for as long as the component they make up remains functionally current; we do not usually value these products or the materials they are comprised of intrinsically. Creating a circular building product or improving the circular performance of an existing product challenges that exact notion because it requires us to consider the product's life cycles from raw material sourcing all the way to its end-of-life strategy. *In a CBE, materials and components are not just what architects employ to consolidate form but instead form can now be perceived as a temporary configuration of materials and products that will eventually outlive it.* The component scale thus becomes crucial in the transition to a CBE.

This value shift requires *knowledge* by the building industry on how to source materials and how these are geared into the architectural decision-making process. Architects and engineers -who are usually not the ones designing building products and often have very little knowledge about them- are now challenged to not only make informed decisions as to their choices of building products, but to also design them themselves. Think for example of the Reuse strategy and how that challenges them to think about how secondary materials and products can be designed to be integrated in new constructions. Therefore, *knowing how products are designed, made and supported is essential for making the transition to the circular paradigm.*

Circular building products can be described by their relation to the four domains of *materials, design, manufacturing, and management*. In order to make this graphically explicit, we developed the Circular Building Product Canvas. The Canvas is a visual tool that can facilitate decision making by drawing attention to issues related to the development of circular building products. At the heart of the canvas lie the R strategies: what is the R strategy that a given circular building product is aiming to achieve? What are the implications of this choice on the four domains? In the canvas, every domain is represented through several questions that consolidate key arguments. Answering these questions can help someone identify the challenges behind each domain separately but also, uncover the complex interdependencies that exist amongst the four domains. Let's take closer look.

The first domain includes material choices. There are several questions related to this domain mainly, to the nature and origin of materials in a component: *how far did these materials travel from the production facility of the component to the actual construction site? Where were the raw material resources originally sourced?* Identifying the exact nature of all materials in a product is also key: *are they technical or biological? Does the product contain critical raw materials (CRM)?*

Sometimes it is difficult to trace all materials in a product. However, it is important to identify them accurately: only then can one properly understand the product's properties, consider its overall expected performance and reflect on what it is they can improve to make the product more circular.

Besides making the distinction between biological, technical or critical materials, it is important to consider how these materials are used in a product. Material processing here is key: for example, machining, coating, gluing, and how we process the products made out of these materials in the years to come.

Identifying all the materials in a product, allows one to compare the life cycles of a product's different parts: *how does the material choice match the projected lifetime of product components?* And by doing that one can come up with strategies of balancing possible inconsistences: *can a material with a short life span be replaced by another one that can reach the same lifespan as the rest of the materials of a product thus making the product more durable? Can technical materials in this product be replaced by more environmentally friendly materials? Or can secondary waste streams be used to replace these more vulnerable parts?* It is exactly these material questions that gradually lead us to consider a product's architecture.

Material choice has an impact on the architectural design of the product and vice versa.

Therefore, the second domain of the canvas looks into design choices and the main architectural features of the product: *is the product design aiming for modularity? Or is it aiming at demountability, adaptability or longevity?* These questions shift the focus to a product's internal interfaces by looking in on how the parts of a product, component or assembly are connected. They also relate to a product's external interfaces, and by that, how the product is integrated into the building.

So, *does the product's internal architecture allow for it to be easily disassembled so that parts with shorter lifecycles that others can be easily replaced? Are the connections of the product to the building reversible? Does its external architecture allow for it to be extracted from a building to be replaced or remanufactured without causing any damages to the neighbouring shearing layers?*

Material and design choices are related to the way a product is manufactured. But in turn, new manufacturing technologies can significantly contribute to a product's circular performance.

This is why the third domain revolves around (re) manufacturing choices. The questions for this domain are mostly related to whether a product can be (re)manufactured using low technology or if it requires elaborate equipment and/or skilled labour. *Is the (re)manufacturing energy intensive? Can it be done locally? Does the chosen technology of manufacturing reduce waste and/or maximize materials' use?* In any case, *how does the (re) manufacturing process facilitate the use of bio-based materials and the different design strategies so as to allow the implementation of higher-level R strategies?* And ultimately, *can technologies like CNC milling, laser cutting and 3d printing that challenge the mechanisms of a consumer-based market by turning consumers also producers be used for making circular building products?*

The fourth domain is about management. It shifts

attention from the product itself to the stakeholders and the operational processes behind its making. *Who are the current stakeholders and how are they affected by a more circular version of a product? Should any new stakeholders be added? What are the new resources needed and what are the new tasks that emerge?* But also, this domain asks us to identify the new skills and the knowledge needed to facilitate the transition. The value proposition of a product and/or service largely depends on systemizing the relations of all the stakeholders involved and reconsidering all economic aspects affected by the plan of circular transition. All these elements should be analysed and included in the product's business plan as either key resources or key activities; and of course, their economic implications should also be considered. Last but not least, circular building products heavily rely on the current policy framework and the top-down governance schemes that can include economic, administrative and informative measures to enhance Circular Economy initiatives. Knowing the current status quo in regulations or the existing financial incentives can lead to major innovations in the field.

There is no one way of using the Canvas. You can start from any domain and work your way through the rest. However, please remember that circularity calls for systemic change, and what this canvas consolidates, is the fact that you cannot change anything in one domain without considering the implications of that change to the rest.