# Towards Regenerative Product And Service Design

## Framing Mindsets And Opportunities For Designers

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## Abstract

It is no longer enough for businesses to strive to reduce their environmental impact. Recent literature argues that business models, and the product and service offerings that are part of them, must aim to improve planetary and societal wellbeing through regeneration. However, how to approach business model experimentation, and in particular the creation of product and service offerings, with a regenerative mindset is still underexplored. This paper therefore explores how designers can move towards creating regenerative products and services. It is based on an analysis of available scientific literature, but also grey literature, product and service examples and other initiatives. The analysis resulted in an initial framework for designers of regenerative products and services. First, seven foundations for regenerative products and services are presented. For each foundation, key shifts for designers are discussed to highlight what it takes to move from a degenerative mindset to a regenerative mindset. In addition, three opportunities for product and service designers are outlined; designing products, services and product-based systems that restore nature, harmonise with nature, and enable humans to co-evolve with nature. Design strategies are devised for each opportunity, drawing inspiration from existing examples. The initial framework presented in this paper can be a starting point for exploring regenerative product and service design as part of regenerative business model experimentation.

# Keywords

Regenerative design, Regenerative Business Models, Design strategies, Product design, Service design


# 1. Introduction

Recent research argues for the need for business models (BMs) that aim to regenerate natural and social systems in order to improve planetary and societal wellbeing (Hahn & Tampe, 2021; Konietzko et al., 2023). Such BMs can contribute to thriving economies while meeting human and planetary needs in a way that results in net positive impacts from a systemic perspective. Following a literature and practice review, Konietzko et al. (2023) propose that regenerative BMs can be described as BMs that create, deliver and capture value at multiple stakeholder levels through activities that promote regenerative leadership, co-creative partnerships with nature, justice and fairness, and multi-capital accounting.

Compared to the concept of sustainability, regeneration differs in its main worldview, theoretical underpinnings, and main ambition. A regenerative approach can be described as going beyond limiting environmental degradation and exploring how to offset past negative impacts by contributing to restoring and improving the health of ecological and social systems (Mang & Reed, 2020; Reed, 2007; Wahl, 2016). Wahl (2017, para. 10) urges us to question 'business as usual' and ask ourselves: "*How do we create design, technology, planning and policy decisions that positively support human, community and environmental health?*".

Because the concept of regeneration is based on new ways of understanding what is needed to meet human and planetary needs, a shift in mindset is needed to facilitate the adoption of regenerative practices (Konietzko et al., 2023; Mang & Reed, 2012, 2020; Toner et al., 2023; Wahl, 2016). Organisations wishing to experiment with regenerative BMs will need to explore entirely new ways of doing business and creating value (Hahn & Tampe, 2021; Konietzko et al., 2023).

However, how companies can approach BM experimentation, and in particular how they can design value propositions and product and service offerings with a regenerative mindset, is still underexplored. As Nowaki and Foissac (2022, p. 4) put it, "*regenerative and systemic design frameworks, guiding principles and call for actions are macro views that are quite different from the day-to-day reality of designers*".

As there is limited research and case studies on how to work with regenerative product and service design, Konietzko et al. (2023) call for research that studies how organisations can

operationalise regenerative thinking and explore design approaches based on a regenerative mindset.

The aim of this short paper is to contribute to the growing discussion on regenerative design by exploring what regenerative thinking means for product and service design. By exploring opportunities and strategies for regenerative product and service design, we also hope to provide useful input for researchers and practitioners who wish to explore opportunities for regenerative value propositions as part of BM experimentation.

# 2. Method

The research method involved a range of data collection activities to learn about regenerative product and service design, and activities to analyse and synthesise the findings.

## 2.1 Data collection

As noted previously (Nowaki & Foissac, 2022), the scientific literature on regenerative design in the context of product and service design is very scarce. Therefore, this paper draws on a number of sources to collect data about the topic.

To gain an initial understanding of the general topic of regenerative thinking and regenerative design, both researchers participated in the ETH Zurich Massive Open Online Course (MOOC) series *Designing Resilient Regenerative Systems* (ETH, 2022). Careful notes were taken to document insights from lectures, open seminars, and readings, and the course material was saved for future analysis.

Literature searches were conducted to identify scientific and grey literature that discusses regenerative thinking in terms of definitions, principles, methods, tools, and examples of regenerative product and service design. A literature search was conducted in the Scopus database in November 2023 using the search term “regenerative design” but excluding “farming”, “building” and “architecture”[1]. These terms were excluded to limit the search, as most publications on regenerative design relate to building design, with limited applicability to product and service design. The search returned 39 papers. None of the publications focused specifically on the application of regenerative thinking to product and service design. However, after reviewing the titles and abstracts, one journal article, one conference paper and one book chapter were considered relevant. These were read in full

[1] The complete search string used in Scopus was “TITLE-ABS-KEY ( "regenerative design" ) AND NOT farming AND NOT building* AND NOT architecture AND ( LIMIT-TO ( DOCTYPE , "ch" ) OR LIMIT-TO ( DOCTYPE , "cp" ) OR LIMIT-TO ( DOCTYPE , "ar" ) )”

and provided relevant insight into the broader topic of regenerative design. In parallel, an online search was conducted for grey literature. A search for “regenerative design” on the social publishing platform Medium returned 125 popular science articles. After title screening, 18 articles were read in full to extract insights and recommendations for key scientific references. A complementary search for “regenerative design” on the search engine Google also identified websites of organisations working with regenerative design, including the websites of the Regenesis Group, the Ellen MacArthur Foundation, and the Royal Society for Arts, Manufacturers and Commerce.

In addition, both researchers have also collected data by monitoring the topic as it was discussed on social media and by professional networks between 2020 and 2023. Posts from key organisations, design studios, experts, and top green voices on the social media platforms LinkedIn and Instagram were reviewed. Newsletters from key organisations including the Centre for Sustainable Design, the World Circular Economy Forum, and the Falay Transition Design collective were also reviewed. News, links, and material discussing the topic were documented and, where possible, relevant talks and webinars were attended. For example, a presentation on Circular and Regenerative Design organised by The Centre for Sustainable Design (2023) at the University for the Creative Arts, UK, highlighted key positions in the field.

## 2.2 Data analysis and synthesis

The collected material was compiled on a digital whiteboard to facilitate a joint analysis by both authors. The analysis was carried out in three main steps. First, key perspectives on regenerative design with relevance for product and service design collected from different sources were inductively analysed and clustered into themes. Based on the identified themes and interpretations of how the themes can be concretised at the product and service level, seven foundations of regenerative product and service design were synthesised.

Secondly, potential mindset shifts required for the application of regenerative product and service design were explored. Recommendations for important mindsets and shifts identified during data collection were listed and compared with current design practices as commonly reported in design literature and taught in product and service design programmes. Two mindset shifts were synthesised for each of the seven foundations through inductive clustering and interpretation of how required mindset shifts for product and service design can be concretised.

Finally, examples of products, services and other types of initiatives incorporating regenerative thinking were analysed to identify *seeds of regeneration* – meaning tendencies, characteristics or features of products or services that could be improved or refined to create products or services that contribute to regeneration. The identified seeds

of regeneration were inductively clustered into three categories, outlining three key opportunities for regenerative product and service design. These were found to be consistent with existing frameworks describing regenerative design in other fields, such as regenerative built environment (Mang & Reed, 2020), regenerative cultures (Wahl, 2016), and regenerative business (Hahn & Tampe, 2021). The identified seeds of regeneration were also used to develop a set of design strategies for each of the three opportunities. The design strategies highlight more concrete ways for product and service designers to incorporate regenerative thinking into their work.

# 3. Results

This section synthesises common perspectives on regenerative design into a description of key foundations and mindset shifts that are important for product and service designers. Opportunities for developing products and services in line with a regenerative mindset are also suggested, along with product and service design strategies for each opportunity.

## 3.1 Shifting to a regenerative mindset

The analysis of how regenerative design is discussed in the scientific literature, grey literature and educational material resulted in a large number of previously proposed definitions, perspectives, guiding principles, entry points, and shifts. These were synthesised and distilled into a description of seven key foundations that can be considered particularly relevant for product and service designers, see Figure 1.

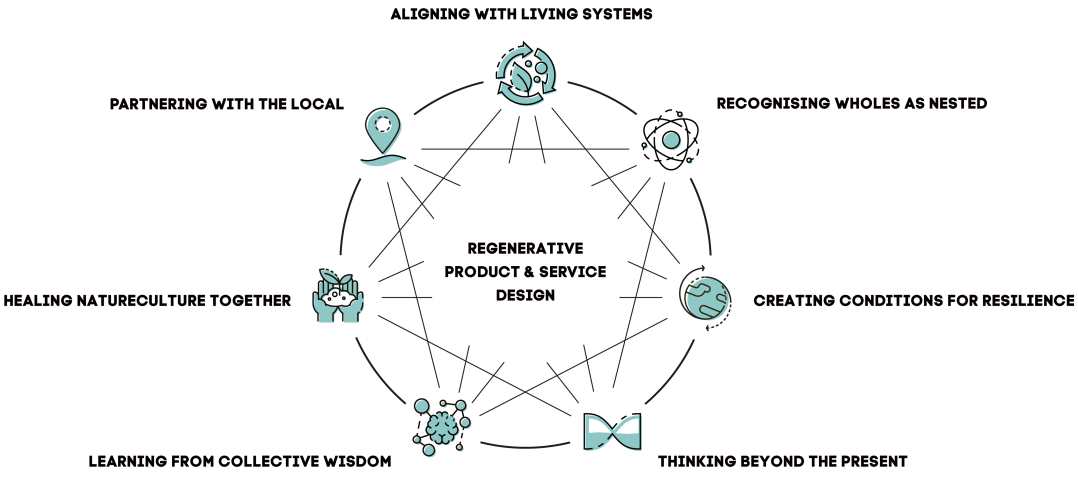


*Figure 1. Seven foundations of regenerative product and service design.*

The foundations build on and combine previous descriptions from various sources and are framed to be useful and inspiring for product and service designers. Each foundation also

points to mindset shifts that are essential for product and service designers who wish to embrace regenerative design. A summary is provided for each foundation and the mindset shifts are also summarised in Figure 2.

**Partnering with the local:** It is often argued in the literature that a regenerative approach requires designers to take on new roles, moving from being builders, engineers and creators to being stewards, gardeners and partners with a place (Mang & Reed, 2020). If designers are to become partners rather than creators, they will need to shift from designing *for* people to co-designing *with* local ecosystems. Solutions that are locally embedded can better support the ongoing co-evolution of the built, cultural, social and natural environments (Mang & Reed, 2020, Panneels, I., 2023). Rather than relying on a set of generic best practices, designers should work with the place to identify solutions that have the potential to support regeneration based on the uniqueness of a place (Mang & Reed, 2020). Since solutions that can support regeneration locally may not be transferable to other contexts (Ellen MacArthur Foundation, 2022), Wahl (2017, para. 8) suggests limiting "*the scale of implementation of any innovation to local and regional levels until proof of its positive impact is unequivocally demonstrated*". Businesses and designers may therefore also need to shift from developing, scaling and disseminating solutions globally to developing and inspiring local solutions that can be shared as unique examples of how to enhance the regenerative capacity of a place.

**Healing natureculture together:** A regenerative approach means moving away from the anthropocentric way of designing that dominates Western design (Tassinari & Manzini, 2024). Instead of prioritising human needs, we need to balance the needs of all species. As Toner and colleagues (2023, p. 2) describe it, "*the ethos of regenerative design and development is to foster new relationships between humans and natural systems so that all life might co-evolve and thrive*". Sustainable design is often about satisfying human needs with less negative impact on the environment, separating culture (humans) from nature. The term 'natureculture', used for example by Haraway (2003), is useful for designers to point instead to the inseparability of nature and culture (Puig de la Bellacasa, 2010; Tassinari & Manzini, 2024; Waldren, 2021). Regenerative design should move beyond the anthropocentric divide and "*acknowledge the interdependence of social and environmental issues*" (Tassinari & Manzini, 2024, p. 35). Building on the idea that regenerative design should enable human culture and nature "*to interact in radical interdependence*", or "*to actively care for that from which one interdepends*" (Tassinari & Manzini, 2024, p. 29), it can be argued that addressing nature's needs is a way of satisfying human needs.

**Learning from collective wisdom:** Design practice does not rely on a single epistemology (Jones et al., 2016), but borrows both understandings of the world and methods from different fields. With this experience, designers can be said to be prepared to move from one kind of knowledge or one way of learning to embracing the many ways of knowing required for regenerative design processes (e.g., Camrass, 2023; Ellen MacArthur

Foundation, 2022; Marshall, 2020; Paul et al., 2023). Based on a rapid review of practice in the building sector, Toner and colleagues (2023) point to the importance of reconciling scientific ecological knowledge and socially constructed knowledge. In line with this conclusion, Mang and Reed (2020, p. 18) state that regenerative solutions should be based "*on the richest possible understanding of the evolutionary dynamics of a place*". Here, co-design methods from product and service design can be extended to better engage all stakeholder in such a process. As Waldren (2021, p. 25) explains, "*regenerative thinking recognises that complex problems look different from different perspectives and that a diversity of views are needed to address them.*" This means that design processes need to move from enforcing uniformity to valuing diversity and niches. Hahn and Tampe (2021) argue that regenerative practices should be collective and participatory, focusing on co-learning and co-development.

**Aligning with living systems:** Regeneration requires "*an enduring and mutually beneficial relationship between the human and natural systems in a particular place*" (Mang & Reed, 2020, p. 22). Camrass (2023) describes the co-evolution of human and natural systems as the cornerstone of regenerative thinking and practice, and Mang and Reed (2020) argue for the alignment of human communities with living systems in a place so that both people and place co-evolve. To do this, a first shift is to move away from trying to control and protect nature, which may be the basic instinct of contemporary designers. But unlike the mechanical systems that designers are used to, like a car engine, where all the parts stay the same, nature is constantly moving and evolving (Waldren, 2021). To align with living systems, designers need to shift their mindset to act in symbiosis with nature. To do this, technology cannot be designed in isolation from living systems. Instead, designers should consider the relationships between technology and living systems. A key question to consider is how to create designs that are conducive to all life on Earth (ETH, 2022; Wahl, 2016). For example, designers can emulate ecosystems and the way nutrients and energy flow through systems, connecting organisms in cooperative networks of functionality so that the whole system is regenerative (ETH, 2022).

**Recognising wholes as nested:** Essential to regenerative thinking is general systems theory and the recognition that complex systems, such as nature, cannot be understood through simple analysis with a reductionist mindset (Mang & Reed, 2020). Designers must therefore move away from simplifying complex challenges and instead learn to dance with complexity (ETH, 2022; Wahl, 2016). Capra and Luisi (2014) argue for a holistic worldview, one where the world is seen as an integrated whole rather than as separable parts. Many scholars point to the importance of viewing living systems as composed of nested and interacting parts (Mang & Reed, 2012; Wahl, 2016; Waldren, 2021). To better understand the complexity of nested systems, designers can use different frames that help them approximate, reframe, and make sense of complexity without reducing it (ETH, 2022). They can zoom out to see patterns and change perspectives, and zoom in to see details. But putting this mindset into practice requires designers to be able to adapt to place, to look

for what contributes to a thriving whole, and to work with what emerges as the nested parts interact (Paul et al., 2023; Waldren, 2021). In practice, this means that designers cannot work at one level of the system, but must consider multiple system levels. When zooming in to address details, designers need to keep the whole system in mind and actively recognise and engage with the adjacent nested levels (Waldren, 2021).

**Creating conditions for resilience:** Ecological resilience, the property that mediates the transition of an ecosystem to a stable state after disturbance (Gunderson, 2000), can help an ecosystem cope with threats caused by human activities, such as resource depletion and biodiversity loss. When a system reaches its limits, it becomes brittle and may be forced into a new trajectory before returning to a stable state again. Gunderson (2000) states that if a capacity for renewal is maintained within the system, it can provide an ecological buffer that protects the system from failure. Building on this knowledge, it can be argued that regenerative products and services should be designed so that they do not contribute to extensive ecosystem disturbances, but instead support ecosystem self-renewal. This includes moving away from design practices perpetuate depletive linear resource flows towards exploring ways to enable cyclical and reciprocal flows. Waldren (2021, p. 27) argues that it is essential to ensure that physical resources and elements, as well as information, value and power, "*can flow and circulate across and between layers of the system in a way that helps the system regenerate*". This requires designers to consider and learn from the nature's adaptive cycles to synchronize design and human activity with ecosystem conditions (Ellen MacArthur Foundation, 2022; Hahn & Tampe, 2021). Designing flexible solutions that can adapt to emerging conditions is key. Waldren (2021) emphasises the need to build shared capabilities and foster relationships, mutuality and reciprocity, so that others can contribute to ecosystem self-renewal in the future.

**Thinking beyond the present:** Traditionally, design practice has been focused on developing specific solutions such as products, services and technical systems to meet current needs. In contrast, regenerative design in process-focused and aims to catalyse processes to progressively increase harmony between human and natural systems (Camrass, 2023; Mang & Reed, 2020). Thus, rather than seeking to deliver solutions that meet current needs, designers who wish to contribute to regeneration should also explore how they can support emerging processes of regeneration. Mang and Reed (2020, p. 20) stress the importance of "*embedding into the system the capacity to continue to improve performance through time and through varying environmental conditions*". Designers may therefore need to move away from a focus on achieving immediate effects and instead strive to increase regenerative capacity over time. This means that regenerative design projects do not end with the delivery of final drawings, production of products, or market launch. As Mang and Reed (2012, p. 34) point out in relation to projects in the built environment: "*The responsibility of a regenerative designer includes putting in place, during the design and development process, what is required to ensure that the ongoing regenerative capacity of the project, and the people who inhabit and manage it, is sustained*

*through time*". Designers must therefore learn to design for long-term effects, which are often delayed and non-linear (Hahn & Tampe, 2021). Therefore, when working to increase regenerative capacity over time, designers must test and iterate ideas and activities to learn about impacts and opportunities (Waldren, 2021) and make use of "*indicators and metrics that can track dynamic, holistic and evolving processes*" (Mang & Reed, 2020, p. 18).

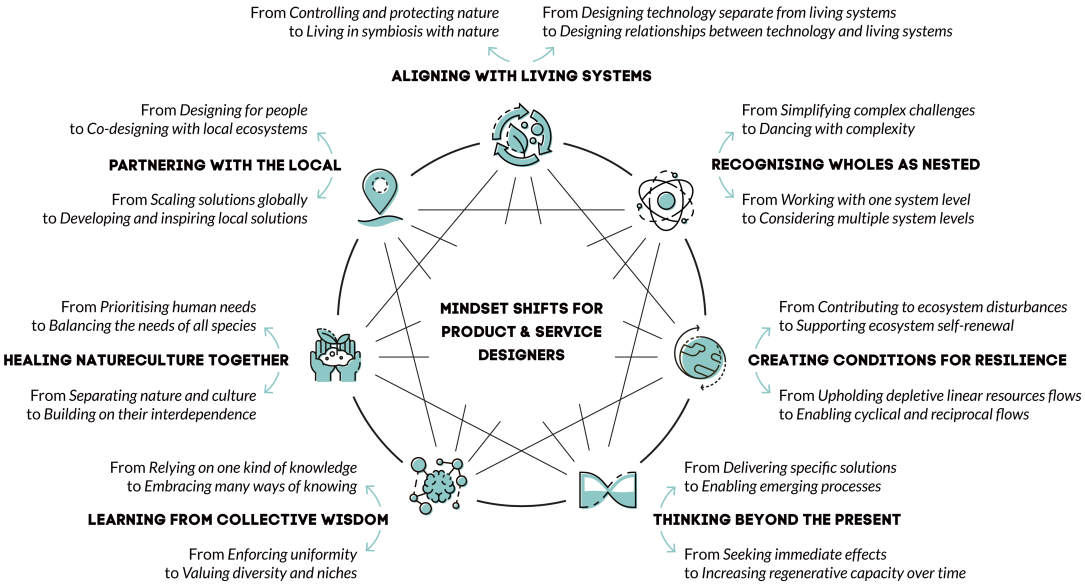


*Figure 2. Key mindset shifts that facilitate the adoption of a regenerative approach to product and service design.*

## 3.2 Design opportunities for regenerative products and services

In addition to the seven foundations and mindset shifts, the analysis conducted also led to the description of three key opportunities for how product and service design can contribute to regeneration. The opportunities were synthesised based on seeds of regeneration found in existing products and services and previously highlighted opportunities in the fields of regenerative built environment (Mang & Reed, 2020), regenerative cultures (Wahl, 2016) and regenerative business (Hahn & Tampe, 2021).

As illustrated in Figure 3, product and service designers can pursue three main opportunities: they can design products, services, and product-based systems that restore nature, harmonise with nature, and support humans to co-evolve with nature. The strategies are described on a continuum to highlight that they differ in terms of the way they contribute to regeneration. This is similar to the way Hahn and Tampe (2021, p.8) suggest that strategies for regenerative business should be structured: "*Conceiving of regenerative strategies as a range acknowledges that in practice, businesses may not be able or willing to fully live up to regenerative principles and criteria but only do so to*

*different degrees*". Similarly, designers may not always be able or willing to fully integrate regenerative principles into the design of specific products and services but may incorporate elements related to one or more opportunities. In this paper we refer to such elements as seeds of regeneration.

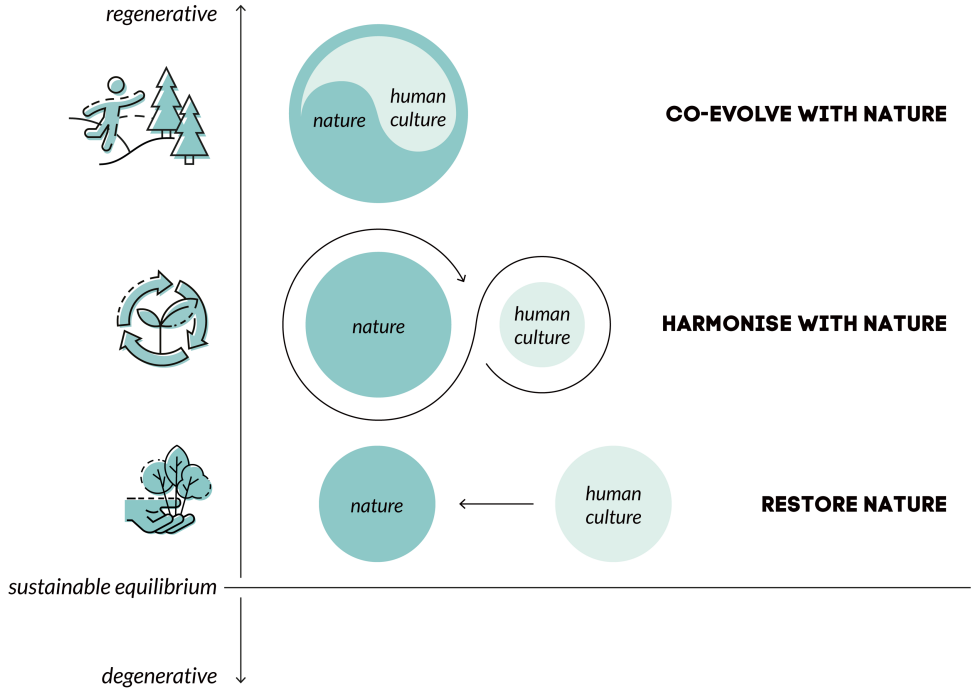


*Figure 3. Three opportunities for regenerative product and service design.*

## 3.3 Design strategies

As the foundations, mindset shifts, and the high-level design opportunities may be difficult for designers to relate to and put into practice, design strategies for the three opportunities for regenerative product and service design were also conceptualised. Based on the seeds of regeneration found in examples of products, services, and other types of initiatives, design strategies were derived for each of the three opportunities for regenerative product and service design.

Design strategies to ***Restore nature***, include designing products and services that:

- create conditions that support species or ecosystems to renew themselves,
- provide space for species or ecosystems with diminishing or limited habitat,
- harness and neutralise threats to ecosystems,
- remove or neutralise pollutants and harmful substances, and/or
- assess and communicate the status of ecosystems.

An example of creating conditions that support ecosystem renewal is providing underwater structures that facilitate and accelerate coral reef regeneration, such as biomaterial reef structures (Oceanus, 2024) and 3D-printed artificial coral reefs (Pacific Standard, 2018). Species with diminishing habitats can be supported by products that help them reclaim habitats and find suitable habitats, such as wildlife corridors (e.g. bridges that help crabs to move safely between habitats (Christmas Island, 2024)) and products that create new habitats (e.g. bee bricks that allow solitary bees and other cavity-nesting species to nest safely (Green&Blue, 2024)). Other examples we found take threats to ecosystems and neutralise them by using them as a resource, such as the Jani Pads sanitary pads made from invasive water hyacinth (e-Education, 2013), the Sargablock building material made from invasive sargassum seaweed (For Tomorrow, 2024), and the various Origin by Ocean products made from invasive algae (Origin by Ocean, 2024). There are also many examples of products and services designed to help remove or neutralise pollutants in the environment, such as solutions provided by the The Ocean Cleanup that can be used to rid the oceans of plastic waste (The Ocean Cleanup, 2024). Products can also help to assess and communicate the state of ecosystems; examples we found include a bio-cement that uses colour to communicate environmental factors such as pollutants in the environment (Gonzalez, 2022), and the Restoration Barometer provided by IUCN to help governments track and report on global restoration activities (IUCN, 2024).

Design strategies to ***Harmonise with nature,*** include designing products and services that:

- replace current destructive solutions with solutions that do not disrupt ecosystems,
- re-connect nature and humans, and/or
- enable circular resource cycles that benefit both nature and people.

Examples of solutions designed to replace current destructive solutions include hydroelectric turbines that allow fish and sediment to move safely through rivers while generating electricity (Natel Energy, 2024), and agricultural mulch films that are soil-biodegradable, provide higher yields and leave no persistent microplastic (BASF, 2024). When it comes to reconnecting people with nature, products and initiatives can help people learn, reflect, and share their experiences of nature, creating a stronger relationship. Examples include the iNaturalist app and online community (iNaturalist, 2024), which connects people to nature while advancing biodiversity science and conservation, and the classic nature journaling guide ”Keeping a Nature Journal” (Journaling With Nature Podcast, 2023). We also found several examples of solutions that enable circular and reciprocal resource cycles, such as waterless toilets that capture carbon and nutrients in human waste for used as soil fertiliser (Harvest Moon, 2024), and systems that convert biosolids into organic nutrients (Lystek Inc., 2014). Other examples use biodegradable materials that benefit nature as they decompose, such as alternative types of coffins for natural burials (Loop Biotech, 2024) and products grown from mushroom mycelium (Ecovative, 2024).

Design strategies to enable humans to ***Co-evolve with nature,*** include designing products and services that:

- support people to live in balance with ecosystems,
- use resources at a rate that allows ecosystems to reproduce and provide them,
- use resources when they are abundant and store them for times of scarcity, and/or
- are living systems integrated into ecosystems.

Examples of products and services that enable people to truly co-evolve with nature are rare, but we could find seeds of regeneration in some existing examples. For example, people can be helped to learn to live in balance with local ecosystems through courses designed to teach wilderness skills in and from nature (Teaching Drum Outdoor School, 2024). If humans are to evolve in balance with nature, it is also necessary for humans to shift to using less resources and to using resources in ways that allow nature to reproduce them. Here, Konietzko et al. (2020) give some examples, such as products that are made with and powered by renewable energy, and self-charging products that can harness solar energy and store it until needed. Other examples include replacing fossil-based products with products made from renewable resources, such as packaging foams made from wood cellulose (RISE, 2024). Finally, products and services can be designed with living elements that co-exist with humans, such as the SolarLeaf bio-reactive façade, which generates renewable energy from algae biomass and solar thermal heat (ARUP, 2024); Colorifix's colour pigments, which are grown by micro-organisms, reducing water, energy and land use and eliminating the need for toxic chemicals (Colorifix, 2024); and living bio-cement, which is grown with bacteria to transform static buildings into living systems (Gonzalez, 2022).

# 4. Discussion and conclusion

As recognised in the field of business model innovation, experimentation with BMs is essential to increase business competitiveness and create desirable and viable BMs (Bocken et al., 2021). Previously proposed frameworks for regenerative BMs and regenerative design highlight important perspectives to consider when experimenting with regenerative BMs. However, these discuss opportunities at a high strategic level and provide limited support for product and service designers seeking to develop value propositions based on regenerative thinking. To adopt a regenerative mindset and develop regenerative products and services, product and service designers also need support to be able to experiment with ways to contribute to regeneration. We believe that the initial framework presented in this paper can be a starting point for such experimentation, as it points to important mindset shifts, opportunities, and design strategies for developing products and services for regeneration.

By presenting ways of approaching regenerative product and service design, this paper contributes to the ongoing conversations and research around regenerative design. With this paper we also want to invite the community interested in regenerative BMs to join forces to explore ways of working with regenerative product and service design alongside experimentation with regenerative business models. Avenues for future research include exploring what regenerative design processes might look like and what support in terms of methods and tools that is needed. It will also be essential to learn more about the implications and long-term consequences of a regenerative approach for business development and design practice.

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