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Deep products via undisciplined stewardship: Towards an environmentally-led design pedagogy for the 21st century

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Abstract: Designers are envisioning new typologies of products aiming for instance to extract CO2 from the environment or creating products from landfill waste, in this context a fundamental question arises; what could be a philosophical framework for a subtractive practise in design? In this paper the notion of Deep Products is introduced by building from notions of Deep ecology, Deep Design, and stewardship. This theoretical proposition addresses the design of products from a life-cycle perspective through contemporary notions of subtraction-by-design. The model presented transitions design to a model demanding extended projects considering every aspect of the life-cycle of products, from inception to deployment, while addressing issues of impact and reuse with the characteristic of subtraction-by-design. In this context, undisciplined stewardship is introduced as an ethical responsibility principle to enable the creation of such products by building from notions of personal responsibility, alter-plinarity, and stewardship.

Keywords: *deep products; undisciplined stewardship; circularity; design education*

1. Introduction

Design Education for Sustainability has a significant role to play in progressively moving towards a sustainable future. This paper will critically and systematically investigate emergent design frameworks for Sustainable Development to rethink a new design pedagogy for the 21st Century. The possibility of overcoming planetary boundaries has become a major concern for the security of our Earth Systems, which provide a critical space for the survival of humanity (Leach et al., 2013: Steffen et al., 2015: Lade et al., 2020). In recent years, the importance of these planetary boundaries emerges a quintessential space for policies such as the 'EU Green Deal' — which aims to make Europe carbon neutral by 2050 — and provides society with a clear framework for operationalise a more sustainable planet (EU, 2019). Or the UNESCO's #ESDfor2030 agenda, which provides a roadmap seeking to strengthen the role of education in securing a sustainable future (UNESCO, 2020). The Sustainable Development Goals (SDGs) proposed in the SDG's framework places education as capital to their achievement. In this context, Petrina has critically analysed our current design practices. In

his view current models are not sustainable and when we teach design and technological problem solving, we "invariably neglect the interconnectedness of products" with our cultural and natural ecologies (Petrina, 2020, pp. 208). And states that "capitalist design" and our over consumption and production are no longer justifiable (Petrina, 2020, pp. 212). As suggested by Conway (2021) meaningful education for Sustainability could provide a critical lens through philosophies such as economic de-growth, cradle to cradle, and the circular economy. However, we are envisioning new typologies of products aiming for instance to extract CO2 from the environment or avoiding extractivistic practises by landfill waste activation, in this context a fundamental question arises; what could be a philosophical framework for a subtractive practise in design?

1.1 Deep ecology

How we act, think and live is determined by our way of understanding what surrounds us. Our constructed ontologies represent a fundamental element to explain our existence. As Sacher explains, we live in a historical, political and social context where scientific knowledge is constantly growing driven by technical and economic progress (Sacher, 2019), however, this idea of development and progress as a norm has been challenged and questioned by postulates such as de-growth, post-extractivism, nature rights, Buen Vivir, or post-growth. As Timothy Morton suggest with his concept of 'Dark Ecology', we continue to face a fundamental challenge: our coexistence with nature (Morton, 2016). This relational bond has been weakening, step by step, since the beginning of the modern era. In a short time, we have gone from conceiving the Earth as a sacred being, to be conceived as an integrated and living being, to the current configuration where it is understood as an inert and material entity ready to be exploited beyond its possibilities. This later process has been transforming our interaction with the Earth into a harmful process leading to a point of no return. This is easily demonstrated by the high Levels of pollution and the effects of climate change. All these processes are asking us to rethink our relationship with the planet. In this context, Arne Naess (1912-2002), a Norwegian environmental thinker, coined the concept of Deep Ecology last century. He defined it as a philosophy of ecology aiming for harmony and balance. His main intention was to end "modern arrogance", in order to recognize the Earth as a living entity, exposing the need to listen as a subject, while recovering other ontologies that have referred to nature as "Mother Earth", "Pachamama" or "Unci maka" (Escobar, 2015). In this context, Naess main recommendation is based on abandoning "technological adolescence". Instead, we should rediscover that we are part of the great prodigy that is nature; to recover and develop a harmonious and participatory relationship with the web of life.

At present, we are faced with what Panikkar calls "capitalist technocracy", a vision of the world that has anthropomorphised the Earth from a consumerist and extractivist perspective. This perspective makes the system incompatible with ecological balance and survival of other forms of life. Faced with this reality, Panikkar aims for a "cosmotheandric conception" of the Earth. That is an ontology where the cosmos, human being and relationships are being understood as agents that form, together, a single living entity. In a sense, Panikkar brings

back the concept of Deep Ecology from Naess, and formulates an ecological ontology to develop epistemologies operating with knowledge about the planet and his own wisdom in which we have to listen and share to enable this paradigm shift. In a sense, we should be considering the Earth as a collaborative being. Otherwise, in this ridiculous fight against the Earth, we will be the one's losing. We need to remember that nature will be able to continue its course without humanity, whereas humanity will not be able to live without it. In this context, the philosopher explains that there will never be a true sustainability without a transformation of our consciousness, and in the case of design, of our practises. This ecological philosophy urges a fundamental requirement to (re)initiate a new relationship between human beings and nature. Panikkar (1999) exposes three pillars of our societies that can act as a springboard;

- **Politics**: business as usual has ended up generating unsustainable progress where technological civilization has annihilated entire cultures in favour of a single system and a single economy. He recommends promoting political measures to generate a new healthy coexistence.

- **Sciences**: Pannikar defends that technocracy has generated a conception of the Earth and nature as an inert and lifeless reality and recommends recovering the ability to listen, understanding nature as a living and connected organism.

- **Philosophy**: Philosophy opens up the possibility of constructing new ontologies that recover these relations. In this context, the cosmotheandric reality is related to the whole, breaking the vicious circle in which, we find ourselves. An eminently emancipatory task in this model demands that we have to understand the Earth as our home, and not as our attic. (Panikkar, 1999)

What Panikkar is forgetting in his account is the role of design in this process. In Panikkar analysis we can find attitudes towards extractivist activities, but we could not find references towards subtraction. More importantly, design, as the main instrument of change and destruction, demands a rethinking for a new design pedagogy. As Deniz explains "Design is an environmental focal point since design decisions have huge impact in the environment" (Deniz, 2016, pp. 70). Inspired by Panikkar, we can build an Earth-building perspective for product design around three core elements and a specificity; non-extractivist policies, listening practices, and holistic and participatory models, with a specificity on subtraction-by-design.

However, as design is a broad field with a plethora of design roles, professions and practises under the umbrella-term 'design' (products, services, buildings, transportation, communication, graphic, industrial, facilitation, etc.), in this paper we will focus specifically on products.

2. Methodology

In order to build a meta-framework for design education, we will use comparative and case studies. According to Bukhari (2011) a Comparative Study analyses and compares two or more objects or ideas to examine, compare and contrast them to show how two or more subjects are similar or different. This process will be complemented by case studies. A case study enables the exploration and investigation of a real issue within a defined context by using a variety of data sources (Baxter et al., 2008). This methodology allows design researchers to develop and to enhance "the capacity of comprehension and analysis of real problems, the capacity to propose and evaluate alternatives for the improvement of the problem considered, to work collaboratively, [and facilitates] their capacity of information management and synthesis of problems" (Herrera et al, 2016). In this context, we will be addressing the issue of Deepness through a critical analysis on David Wann's concept of Deep Design. Then, we will conduct a comparative study among a range of emerging frameworks addressing circularity in the UK; the IDEO/EMF Circular Design Guide, RSA's Great Recovery reports and the RSA's design for regeneration, the Design Council's Beyond Net Zero report, and the Textiles Circularity Centre (TCC) at the RCA, to underpin gaps and opportunities.

3. Discussion

In this section, as described, we will critically review Deep Design as presented by Wann in 1996, to understand whether this framework aligns with the criteria outlined earlier by the authors building on Panikkar's account; non-extractivist policies, listening practices, and holistic and participatory models with the specificity on subtraction-by-design. This analysis will be followed by a comparative study among the frameworks above mentioned addressing circularity in the UK to underpin gaps and opportunities. Then, a critical analysis on uncompromised innovation will be implemented to underpin an alternative model for design, as this model of innovation has been dominating the discourse and practice in design schools. Finally, we will critically review cases on Facebook and Burberry to understand the lasting consequences of this modality, and will propose an alternative model to this configuration building from notions of alterplinarity and stewardship.

3.1 Deep design

The term Deep Design was coined by David Wann in 1996 in a book called *Deep Design: Pathways to a livable future.* According to the author;

> deep designs are aligned with nature—water, the sun, our genetic heritage. Their strategies often incorporate living systems, such as alternative wastewater treatment in a greenhouse environment that's designed to take advantage of lilies, snails, and fish. These living machines, as John Todd calls them, are self-adjusting and capable of improving their own performance. Rather than being "one-size-fits-all" systems, living machines can be customised to meet a particular need. They don't simply minimise wastes, they optimise resource flow, performing the intended function with the least amount of energy, material, and maintenance. Living machines are not about going back to unsophisticated technology. On the contrary, their development was possible

> only because of new, high-tech materials that are lightweight, light-transmitting, flexible, and waterproof. Thus, they are a synthesis of nature and technology. (Wann, 1996, pp. xiv)

The design pathways he describes range from low-impact chemical pathways, pollution prevention and recycling in the computer industry, renewable energy systems, and sustainable agriculture systems. They illustrate the concept thought processes that aim to optimise goals, while minimising effort and impact. Such "deep designs" meet the key criteria of renewability, recyclability, and non-toxicity. The life-cycle framework operates in this model as a system for assessing the full environmental, economic, and social consequences of design. However, Wann's model do not address contemporary notions of subtraction-by-design.

Recent models in this emerging category are for instance a paint called Celour by RCA's graduate Kukbong Kim. She has developed a paint made from demolished concrete that is capable of absorbing 20 per cent of its weight in carbon. The paint can sequester 27 grams of CO_2 for every 135 grams of paint used. As reported by Dezeen "That is the same amount of carbon dioxide that a normal tree absorbs per day," Kim said. (Hahn, 2021). Dezeen has profiled a number of carbon capture and utilisation companies that are working on turning captured CO_2 into useful products from bioplastic cladding to protein powder and concrete masonry units. (Dezeen, 2021). However, these products focus on specific subtractions and don't fully consider the life-cycle framework. From these insights we will conceptualise a mixed-model integrating these two notions. In this area some initiatives have emerged recently in the UK. For instance, the IDEO/EMF Circular Design Guide, RSA's Great Recovery reports and the RSA's design for regeneration, the Design Council's Beyond Net Zero report, or the Textiles Circularity Centre (TCC) at the RCA. From this point we will conduct a critical and systematic analysis on these frameworks based on the criteria outlined earlier; non-extractivist policies, listening practices, and holistic and participatory models with the specificity on subtraction-by-design.

The IDEO/EMF Circular Design Guide

This initiative is structured around workshops. They structure them around four areas; Circular Strategies, Circular Ventures, Safe & Circular Product Redesign, and Circular design brief for students. In order to enable them, they have generated a range of templates. Each of them covers a specific area of the process e.g., materials, services, chemical, etc. (Figure 1)

In the area of pedagogy, they use a Circular design brief for students. They structure their initiative with participants choosing an everyday object and rethinking the system surrounding it - from creation to use and beyond. Once they have mapped the system, they identify intervention points to make their objects more circular – and finally frame their own design challenge. According to the website, this programme is great for a group of at least 10 students. They undertake this activity in some hours (8 hours (MA students) to 12 hours (BA students)).

Worksheets

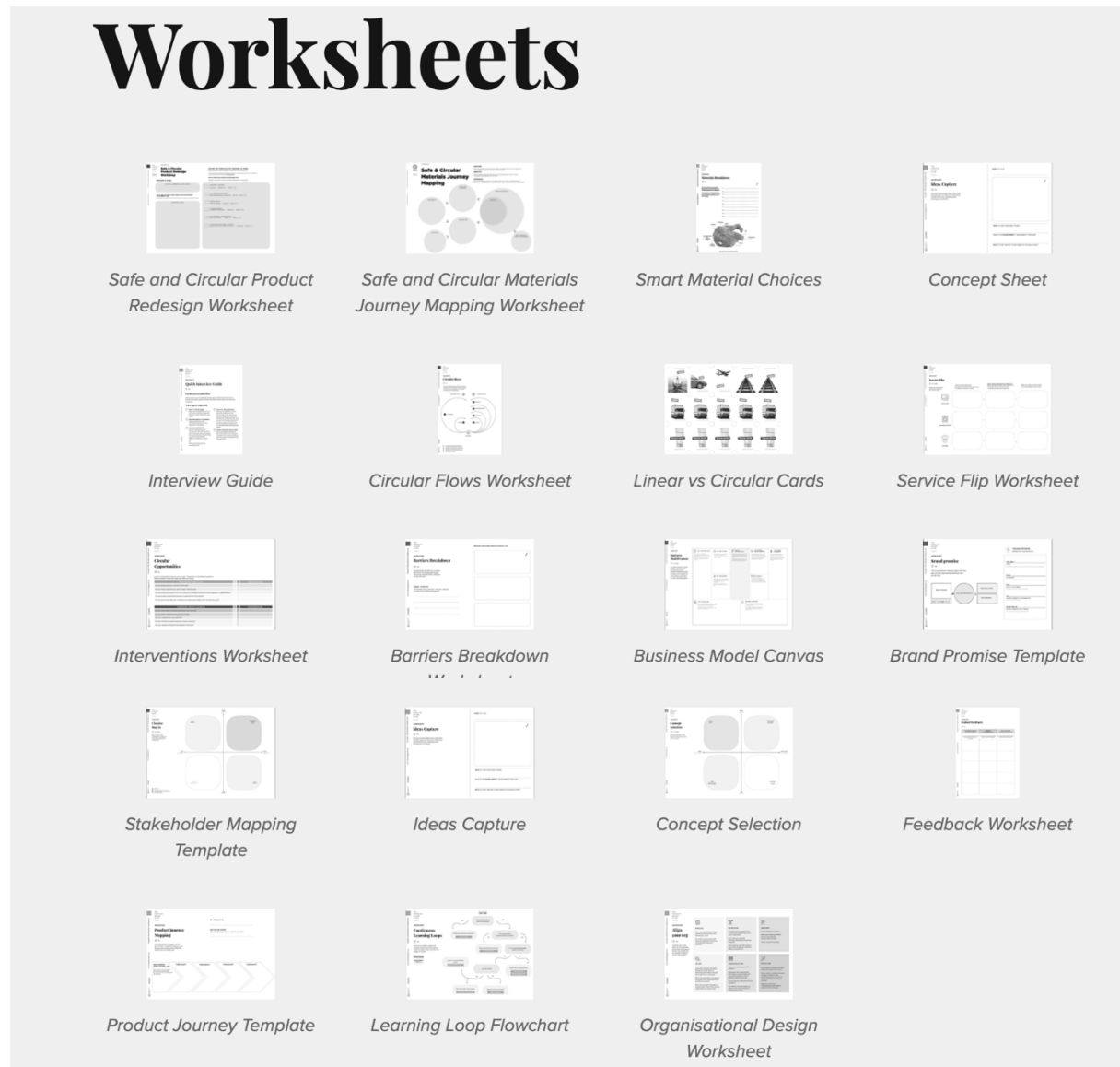|			
Safe and Circular Product Redesign Worksheet	Safe and Circular Materials Journey Mapping Worksheet	Smart Material Choices	Concept Sheet
Interview Guide	Circular Flows Worksheet	Linear vs Circular Cards	Service Flip Worksheet
Interventions Worksheet	Barriers Breakdown Worksheet	Business Model Canvas	Brand Promise Template
Stakeholder Mapping Template	Ideas Capture	Concept Selection	Feedback Worksheet
Product Journey Template	Learning Loop Flowchart	Organisational Design Worksheet	

Figure 1. The IDEO/EMF Circular Design Guide. This space incorporates a range of worksheets to address emerging notions of planetary-centre design. Ideo, 2022.

Ideo's model proposes an executable pedagogy. However, it does not mention subtraction-by-design. It considers landfill activation, but from a posteriori perspective; their main focus is on chemicals and afterlife product considerations. It operates as a fragmented meta-framework. A collection of methods building from HCD. There is not a holistic view integrating all the elements. The model they use is from the Ellen McArthur Foundation (Figure 2), to organize all the elements into an operational framework.
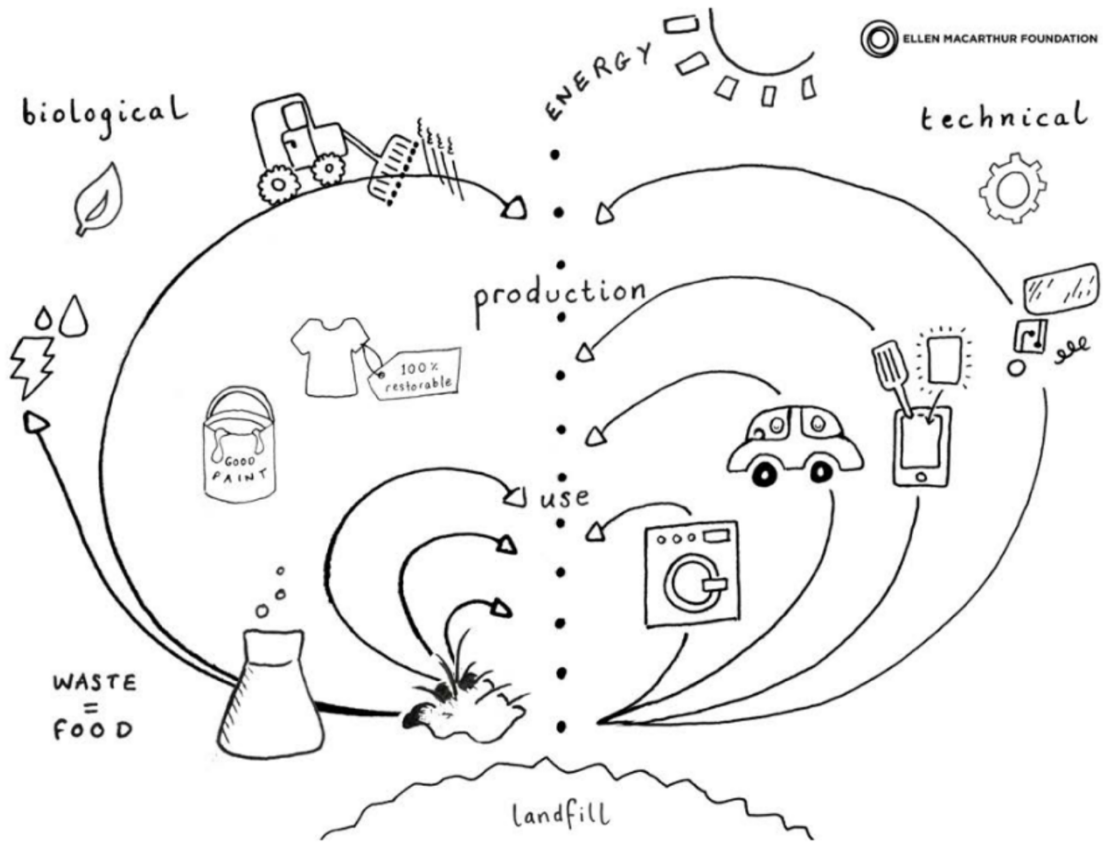
Figure 2. The IDEO/EMF Circular Design Guide. This space incorporates The Ellen McArthur foundation framework as a baseline to articulate their methods. Ideo, 2022.

Table 1. The IDEO/EMF Circular Design Guide.

IDEO		
Pedagogy	Yes (Professionals and Students)	Workshops
Approach	Templates	Singular theme
Non-extractivist policies	No	Circular & after-life
Listening practices	Yes	Interviews
Holistic model	No	(Use Ellen McArthur)
Subtraction-by-design	No	
Landfill waste activation	Yes and no	after-life circularity

RSA's design for regeneration

This initiative is structured around 5 principles; product lifecycles, leadership, individual lifestyles, financial systems, and grassroot movements. Their main objective is regeneration (Figure 3). They describe regenerative as both;

- A mindset, a way of seeing the world, which is long rooted in many cultures, religions and wisdom traditions around the globe, but which is less present in dominant economic and social systems today.

- And as an emerging paradigm, which looks to deepen notions of sustainability to take a holistic approach to addressing the challenges of our time.
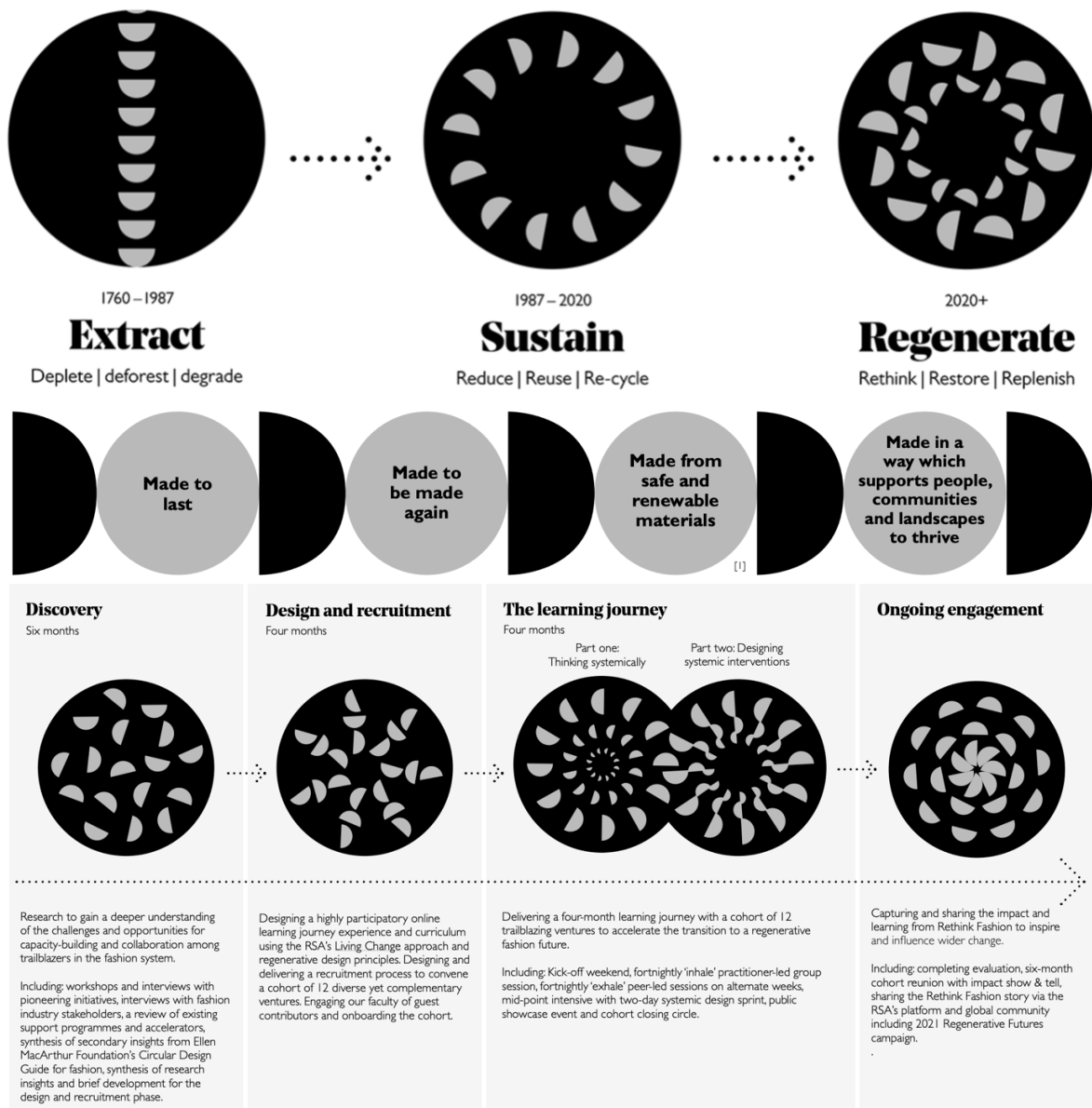

Figure 3. The RSA's design for regeneration. This space incorporates 5 principles as a baseline to articulate their framework. It focuses on Professionals and companies. RSA, 2022.

The model they present is very interesting, however, they do not present an executable pedagogy for students, but a framework for professionals and existing companies. It does not mention subtraction-by-design, nor existing landfill waste activation. It operates as a general set of principles or mindset. They main intention is to change industry rather than education. Their emphasis is on attitudes rather than products.

Table 2.   RSA – Design for regeneration.

RSA – Design for regeneration		
Pedagogy	Yes (Professionals)	Workshops
Approach	Attitudes	Holistic
Non-extractivist policies	No	Circular
Listening practices	Yes	Grassroot movements
Holistic model	yes	5 Principles
Subtraction-by-design	No	
Landfill waste activation	No	

The Design Council's Beyond Net Zero report

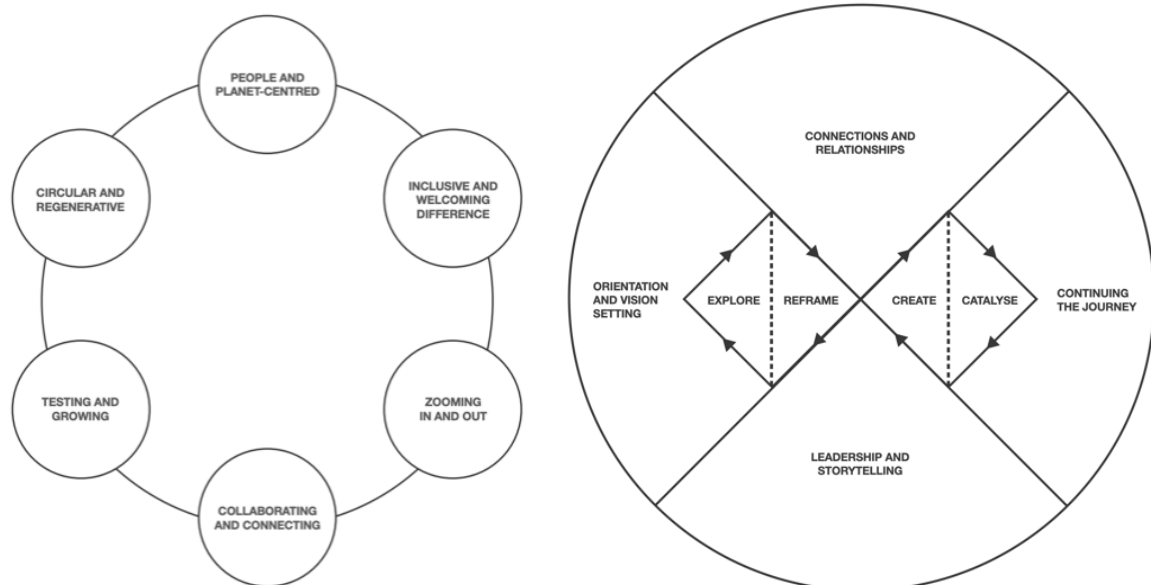This report is structured around 6 guiding principles (Figure 4).

Figure 4. The Design Council's Beyond Net Zero report. This space incorporates 6 principles as a baseline to articulate their framework. It focuses on Professionals and companies. Design Council, 2022.

The report introduces recommendations in the context of circularity. For instance;

- Design products, places and services that make it easy and desirable to live sustainably - that are circular, regenerative and learn from nature

- Designing policies, clear frameworks and parameters for decisions, and that provide a more equal playing field for different voices

- Producing in depth knowledge about what works technically and from nature

This model is also very interesting, however, like the RSA, it does not present an executable pedagogy. Neither it does mention subtraction-by-design or existing landfill waste activation. It operates as a general meta-framework to expand the Double Diamond.

Table 3.   The Design Council's Beyond Net Zero report.

The Design Council's Beyond Net Zero report		
Pedagogy	Yes (Professionals)	Workshops
Method	Attitudes	Holistic
Non-extractivist policies	Yes	Frameworks for decision
Listening practices	Yes	Participatory and learning from nature (inspired)
Holistic model	yes	6 Principles
Subtraction-by-design	No	
Landfill waste activation	No	

The Textiles Circularity Centre (TCC).

This centre was created to enable the transition to a more 'circular' economy. As described by the Centre;

> The TCC will provide underpinning research to enable the transition to a more circular economy that supports the brand 'designed and made in the UK'. The Centre will catalyse growth in the fashion and textiles manufacturing sector and the creative technologies sector by supporting the SME fashion-apparel community with innovations in materials and product manufacturing, supply chain design, and consumer experience design. These new UK-based supply chains encompass waste management and farming through to textile production, design and consumer experience.

> The Centre will take an integrated systems approach to reduce reliance on imported, environmentally and ethically impactful materials, and to diversify supply chains. This approach will drive the green jobs agenda, and eliminate textile waste going to landfill and incineration, and increase resource productivity, reduce carbon emissions and

environmental harm, provide alternatives to energy-from-waste, as well as grow the UK bioeconomy. (RCA, 2020)

This model is different from previous models as it focuses on research, however, it does not present an executable pedagogy either. On the other hand, it does mention subtraction-by-design and landfill waste activation. From this definition we can extract a range of quintessential elements; landfill materials, processes of re-materialisation, product manufacturing, supply chains design, and consumer experience.

Table 4. RCA - The Textiles Circularity Centre (TCC).

RCA - The Textiles Circularity Centre (TCC).		
Pedagogy	No	
Method	Research	Applied Research
Non-extractivist policies	No	
Listening practices	Yes	Participatory and learning from nature (inspired)
Holistic model	yes	5 Areas
Subtraction-by-design	Yes	reduce carbon emissions
Landfill waste activation	Yes	Existing waste

3.4 Deep products

Based on these insights, we have constructed an operational meta-framework. It divides circularity into six main components; territory, (re)generation, development, production, consumer experience, and a final future space to be developed dedicated to evaluation and metrics (Figure 5 and 6).

In developing the framework to address the specificity of subtraction, we focused the first component (territory) around landfill research. This would place the initiation of Deep Products in the context of subtraction by identifying existing waste. The second component is focused on (re)materialisation. This component aims to experiment with the materialisation of waste to re-value them, and the potential creation of new properties by altering, composing or engineering them. The third component would focus on product development. This phase would integrate practices around notions of prospectivity and consequentialism (See Galdon & Hall, 2019: Galdon, Hall & Wang, 2019). This component would be focused on transforming and embodying the materials into products aiming to improve environmental impact by integrating subtracting capabilities.
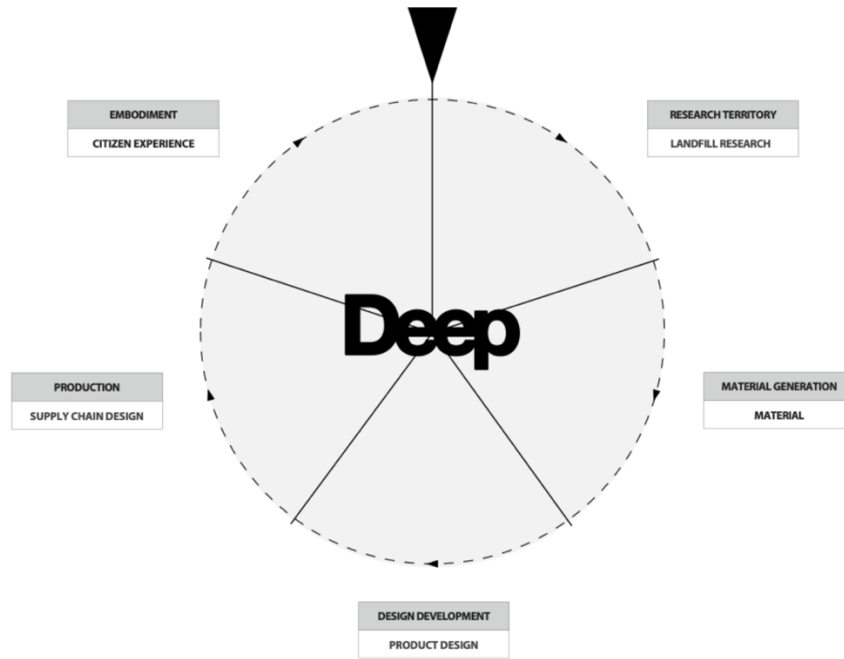
Figure 5. The five main components of circularity; five main components; territory, (re)generation, development, production, and consumer experience. Galdon & Hall, 2022.
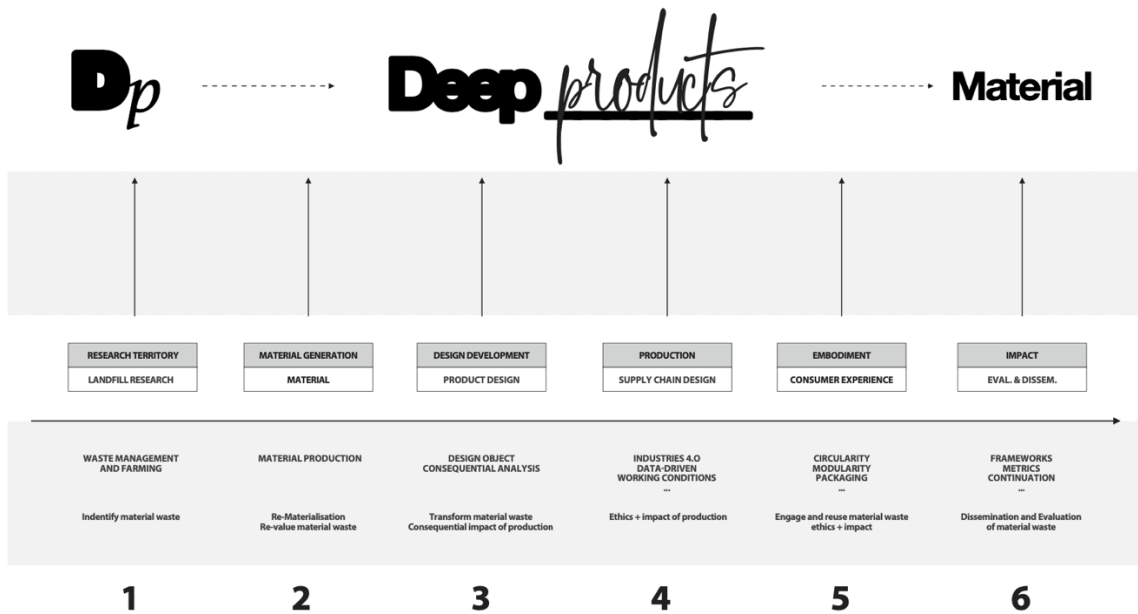

Figure 6. Guiding operational meta-framework to address notions of subtraction and deepness. Galdon & Hall, 2022.

In these processes we intersect design with the sciences (formal, social, and natural). The intersection of design with the social sciences aims to develop a new human condition by subtracting non-environmental behaviour of current configurations. In addition, social perspectives addressing labour conditions such as, dignity, outsourcing and de-localisation would complement this area. This area would take a historical and social perspective integrating

research areas on decolonisation, psychology, behaviour, and sociology. By intervening at the intersection of natural and material science and design, new properties may be created by altering, composing or engineering them. The intersection within the formal sciences would focus on the digital domain to develop a new relational condition by subtracting non-environmental energy consumption, logistic pollution and inefficiencies, or inappropriate land usage of current configurations. It would take an infrastructural perspective integrating research areas on databases, algorithms, and infrastructures with a focus on distributed manufacturing, or energy management and consumption.

This model transitions design practise from a model developing projects with an output in mind, to a model demanding projects considering every aspect of the life-cycle of objects/systems/actions in depth, from inception to deployment. Addressing issues of impact and reuse in the process, with considerations of non-extractive landfill practises and proactive subtractive approaches. In essence, designing deep is designing with care.

Once established a meta-framework of design practise for the 21st Century, the question at this point is; what kind of design principle should we articulate to enable this model to be fully operational? What kind of attitudes should we integrate? Why? In the next section, we will introduce the principle of undisciplined stewardship building from notions of Alterplinarity and stewardship.

3.2 Method: Undisciplined stewardship

If we look at computing, we come from an era of open and uncompromised experimentation, which can be embodied with Mark Zuckerberg's motto 'move fast and break things.' This era brought unprecedented innovations in the aforementioned area, but it has also created a mental health crisis, and nearly collapsed democracy. In this context, conflated debates have emerged in relation to whether this innovation model is suitable or not. By 2021, it seems that the answer is no. Stanford introduced the first ethical module in computing in 2018. And in 2019, Stephen A. Schwarzman, Chairman, CEO and Co-Founder of Blackstone donated 350 million dollars to be matched with another 400 million dollars to MIT in order to create a computer science cross-department with AI and ethics at its heart, aiming to "address the opportunities and challenges presented by the rise of artificial intelligence" (Iyengar, 2019), including its ethical and policy implications. Furthermore, he also donated another 188 million dollars to the Oxford Institute of the Internet to build The Stephen A. Schwarzman Centre for the Humanities. "It will bring together all of Oxford's humanities programs under one roof — including English, history, linguistics, philosophy and theology and religion. It will also house a new Institute for Ethics in AI, which will focus on studying the ethical implications of artificial intelligence and other new technology. The institute is expected to open by 2024" (Lyengar, 2019).

It seems that this idea of open and uncompromised experimentation, which places unrestricted innovation at its heart is not a suitable model for society. In this context product design is facing the same dilemma; should we keep the aesthetically-driven uncompromised

experimentation industrial model who was so successful in the 90s and 00s decades? The answer seems to be no. In the same manner that the computing field created a mental health crisis, and nearly collapsed democracy, it could be argued that this model is partially responsible for the environmental crisis. This can be represented by the unnecessary furniture made in the 00s by a marriage made in heaven between manufacturers and the specialist press, in a frenzy extravaganza of the latest model, style, or 'the best designer in the world' cover highlight. Or more recently with the development of ultra-fast fashion models generating overproduction by another marriage made in heaven this time by fashion conglomerates and social network platforms, which led to situations such a Burberry burning their excess of stock, or H&M, a Fashion Giant, holding $4.3 Billion in Unsold Clothes, as the New York Times reported back in 2018 (Paton, 2018). The question at this point is whether experimentation and prototyping as the core of design practise (Hall, 2011) should be open or guided (stewarded)? And if so, to which extend?

In response to the notion of exhaustion Rogers and Bremner (2013) proposed altermodern as an alternative model to the limits of capitalistic models of design. As defined by the corresponding authors;

> "the creative practitioner is viewed as a prototype of a contemporary traveller whose passage through signs and formats refers to a contemporary experience of mobility, travel and transpassing where the aim is on materialising trajectories rather than destinations, and where the form of the work expresses a course, a wandering, rather than a fixed space-time" (Rodgers & Bremner, 2011a)

And conclude

> "undisciplined" creative practice and states of "unknowing" in an age of alterplinarity therefore requires an epistemological shift. However, this will in turn offer us new ways of fixing the problems the old disciplinary and extra-disciplinary practices created in the first place" (Rodgers & Bremner, 2011b).

As Rogers and Bremner, other authors such as Tony Fry or Ettore Sottsass also warned long ago that design has deep and durable ethical and political dimensions. In these processes we can see a consequential turn in design (Galdon, 2021) demanding a new type of model placing stewardship at the centre of designing.

Stewardship is defined as "the act of taking care of or managing something, for example property, an organization, money or valuable objects" (Oxford, 2021). Good stewardship according to the Merrion-Webster dictionary first appeared in England during the Middle Ages. It functioned as a job description, denoting the office of a steward, or manager of a large household. Over the centuries, its range of reference spread to the oversight of law courts, employee unions, or college dining halls. In recent years, the long-established "management" sense of stewardship has evolved a positive meaning, "careful and responsible management." This sense is commonly found nowadays in contexts such as "stewardship of the environment, or the family business, ..." (Merriam-Webster, 2021)

In this context, we propose **undisciplined stewardship** as a new design principle to address notions of responsible innovation. This model marks a transition from an object-subject relationship (Latour, 2005), to the impact of this relationship into the system/environment (Ingold, 2008), with a specificity of care (Rogers & Bremner, 2019).

4. Conclusions

Design, as the main instrument of change and destruction, demands a rethinking for a new design pedagogy positioning environmentalism at the centre. In this paper we have introduced the concept of *Deep Products* by building from notions of Deep ecology, Deep Design, subtraction, and stewardship. This model refutes extractivist-production-consumption-waste linear models to approach the design of products from a life-cycle perspective — a system for assessing the full environmental, economic, cultural, and social consequences of design — addressing issues of impact and reuse in the process, with considerations of non-extractive landfill practises and proactive subtractive approaches.

This model would present an alternative education model for Sustainability to philosophies such as economic de-growth, cradle to cradle (C2C), and the circular economy (CE). Here, we are envisioning new typologies of products aiming for subtraction at every stage of the product's life-cycle. For instance, by starting with existing waste, framing its functionality to extract CO_2 from the environment, and re-using all its components at the end of its life. This model is applied, which differentiates it from attitudinal frameworks such as RSA, or the Design Council. And, it is holistic, which differentiates it form IDEO's approach.

Building from a systematic review, we extracted a range of quintessential elements to enable this framework; landfill materials, processes of re-materialisation, product manufacturing, supply chains design, and consumer experience. Based on these insights, the constructed operational model divides circularity into five main components; territory, (re)generation, development, production, and a final step focusing on consumer experience.

This model intersects design with the natural, the social, and the formal sciences through the notion of subtraction-by-design and transforms them into agents of environmentalism. We live in a historical, political, cultural, and social context where scientific knowledge is constantly growing driven by technical and economic progress (Sacher, 2019), however, this idea of development and progress as a norm has been challenged, and questioned by postulates such as de-growth, post-extractivism, nature rights, Buen Vivir, or post-growth to address a fundamental challenge: our coexistence with nature.

The intersection within the natural sciences would focus on subtracting existing material waste to re-materialise it. The intersection within the social sciences would focus on Identity creation to develop a new human condition by subtracting non-environmental and extractivist behaviour of current configurations. Finally, the intersection within the formal sciences would take an infrastructural perspective. It would focus on the digital domain to develop a new relational condition in logistics and manufacturing processes by subtracting non-

environmental energy consumption, pollution, land usage, and inefficiencies of current configurations. It aims to consider Earth as a collaborative being.

In this context we introduced ***undisciplined stewardship*** as an ethical pedagogic responsibility principle in design to enable the creation of Deep products. By building from notions of personal responsibility, alterplinarity, and stewardship, this principle aims to address the harmful social and environmental issues emerging from open and uncompromised experimentation. This model marks a transition from an object-subject relationship (Latour), to the impact of this relationship to the system/environment (Ingold) with a specificity of care (Rogers & Bremner). This model aims for systemic consequential experimentation at its heart.

In the paper presented we do not aim for conclusiveness, but to provide a new axiom in an open-ended process called design education. We provide a guiding meta-framework to address notions of subtraction and deepness in the context of product design practices and sustainability. A proposed future where Design is a changed practice. Here, we aim for 'ur-learning' (Macy & Johnstone, 2012) what we have learnt in design schools to create a new ecologically-led design literacy.

In this context further research needs to be implemented to frame concrete methods and techniques to enable this framework to be fully operational in the context of design education. The next step will focus on conducting a survey to underpin existing methods and identify gaps in practice. This survey will be structured around the 5 areas aforementioned with an earth-building perspective as described earlier; non-extractivist policies, listening practices, and holistic and participatory. Finally, a set of processes/protocols must be conceptualized and developed to monitor the life of the product and its components. As well as, a set of metrics and indicators to evaluate the reliability of the emerging products.

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