40. COMISIÓN EUROPEA, *Una estrategia europea de datos*, Oficina de Publicaciones Oficiales de las Comunidades Europeas, Bruselas, 2020.

41. El término minería urbana se utiliza en este contexto para referirse al proceso de recuperación de materiales de productos, edificios y/o residuos para que puedan ser utilizados, reutilizados y reciclados. Como ejemplo, en Europa el proyecto ProSUM ha desarrollado una plataforma regional de "minas urbanas". Y en Amsterdam, el consorcio formado por la Universidad de Leiden, TU Delft, Waag Society y Metabolic ha establecido un mapa "geológico" que muestra las concentraciones de metales valiosos en edificios para informar y planes futuros para extraer materiales de segunda mano.

42. A modo de ejemplo, Excess Materials Exchange es un mercado digital lanzado en los Países Bajos en 2017 para encontrar opciones de reutilización de alto valor para materiales usados.

Imágenes

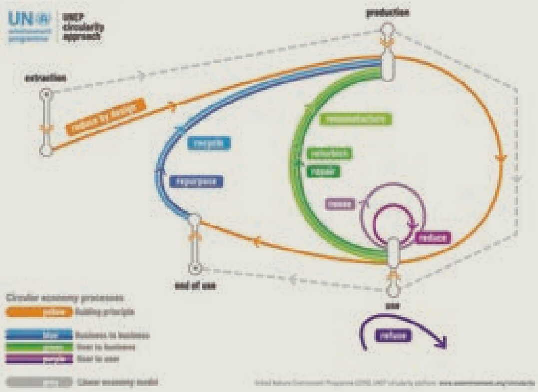
New Lenses, New Cartographies. Lucas Muñoz&Cristina Freire, 2020.

05

The circular nature of materials: emulating nature

Manuel Quirós

The transition from a linear economy to a circular one brings with it a series of practical challenges for the entire process chain: from the extraction of raw materials, processing, product or services design, manufacturing, usage and end of usage. We may ask ourselves: What are the strategies to comprehend and apply this new paradigm towards a circular economy? This article deals with some aspects within a framework of ideas in this complex circular system to help and guide designers and entrepreneurs to make progress with regard to materials in this paradigm change. It also describes some of Nature's strategies from a systemic perspective and their potential use.



The current economic and productive model that affects the entire global system, irrespective of the activity or sector, continues to be mostly linear. The process begins with the extraction (destruction) of pristine natural resources that are converted into raw materials which subsequently must be transformed in order to become products or services that shall be packaged, distributed, sold and used, to finally end up in a landfill after the end of their cycle of use. This model was globally accepted for decades and is currently being questioned due to many of its aspects that have a chronic and colossal environmental and social impact; to the realistic acknowledgement of the finite nature of the resources which must then be replaced by others, thus re-questioning the entire process itself. Government, scientific, business and financial organisations have spent more than a decade warning us of a growing pressure on global resources and the climate, owing to human activity (IPCC, 2014; WBCSD, 2014; *European Commission*, 2018). The circular economy seeks to lead to global sustainability and is a promising means to reduce the pressure exerted by humanity. This model constitutes a breakthrough (*European Commission*, 2014), whether by means of design or an economy that does away with the concept of waste, incorporating cascades where both biological and industrial materials are reincorporated without losing their value and utility. This model was launched in the 80's by Börlin and Stahel (Börlin, 1987), further developed by McDonough and Braungart (2002), and finally globalised by the Ellen McArthur Foundation (2000), **(fig. 02)** and the UN **(fig. 03).** It achieves a greater degree and depth of sustainability and regeneration, which is very interesting and hopeful. Additionally, the model reconnects us to nature, of which we are a part, emulating natural operations that have functioned in a sustainable and regenerative fashion for 3.8 billion years, for example, in water and carbon cycles, or in the flow of materials where the concept of waste does not exist and is replaced by that of resources (Quirós, 2016, 2019). The link between nature and design is vital and it must be consciously applied to improve innovation and lead towards sustainability and regeneration (Bar-Cohen, 2006). This process may be achieved by considering the functioning principles of living systems, comprehending survival strategies in nature, evolution and growth, as well as by a more in-depth and holistic understanding of the survival techniques and processes used in eco-systems on a daily basis. The circular model that it refers to is presented as a logical opportunity for valuable strategies that promote aspects such as recycling, systematic re-use, preventing the loss of valuable materials, ecological design as good design, and industrial symbiosis. Additionally it can generate new employment opportunities, sustained economic growth and development, demonstrating new associated business models that may direct Europe, currently the leader and promoter, towards a radical waste reduction that will concurrently decrease elevated levels of CO_2 and NH_4 emissions, and the consequences for the climate as well as other environmental impacts. This "new" model is a definitive optimisation of the system that goes beyond materials to include a careful management of its flow, whether within the technical cycle where they are maintained as much as possible, reused, refined and finally recycled, or within the biological cycle which promotes a cascade of non-toxic materials that can undoubtedly serve as fertiliser for natural soil productivity as the concept of natural capital. This afore-mentioned biological cycle refers to the use of organic materials in industrial processes which have the innate ability to return to the natural regenerative cycle. On the other hand, the technical cycle requires the capacity for disassembly and repair in the conceptualisation and design of products that may possess a high level of quality and durability that may be recovered within the flow of materials.

In the diagram displayed in Figure 02, the smallest circles constitute those that retain the greatest value and must be understood in 3 dimensions as if it were a top-down view of a cone. The expanding success of the model, involves the progress in and understanding of sectors such as industrial design, textile design or architecture, inverse logistics and undoubtedly, the emergence of new associated business models. It is estimated that it may have an impact on cost savings to the tune of more than 600-700 billion euros in Europe, regardless of the type of consumer goods and services (*The Ellen MacArthur Foundation*, 2012-2013), and also mitigate the risks linked to price uncertainty given the potential volatility in materials supply due to climate change (Goddin et al., 2014; Report of the European Commission (2014). Since 2000, sectors such as electronics, automobiles, home appliances or textiles, to name just a few, have been aware of the increase in the number of users and the volatility associated with supply security (*The Mckinsey Commodity price index* 1999-2001).

On the other hand, circular design for the technological cycle is also operational in services products, where technical materials or nutrients may be constantly and safely recycled into new materials and products. To establish the continued flow of resources in the so-called *wastes or rejects*, they must be recycled into materials that possess properties similar to those of the original material. This requires a primary or tertiary recycling of materials (McDonough, 2013), understood to be a mechanical re-processing into another product with equivalent properties. McDonough and Braungart stress that the quality of the material must be maintained, and distinguish between supra-recycling and infra-recycling where the latter does not permit a cyclical flow of resources but only delays the linear flow from production until the aforementioned waste. Therefore, infra-recycling means that a material is re-processed as a product of lesser value or of potentially lesser value. Supra-recycling, on the other hand, refers to retaining or improving the properties of the material, the latter being a relatively new and little-explored concept, although there are a few interesting cases in the textile sector, such as Elvis and Kresse or Freitag, to name a few. In line with this distinction, the processes that may be deemed quaternary recycling or external recycling do not fit within a circular approach to product design, according to certain authors (Kumar et al., 2011).

The circular model not only emulates natural strategies but also build a model based on waste disposal and pollution associated with the negative impacts of business "as usual" or *b.a.u*. To this classification we must add the resulting impact of greenhouse gas emissions as well as those that affect life on earth, in water and in air.

A second concept of this circular model is based on the favourable maintenance of the quality of products and their materials in order to preserve their value within the system (Steinmann, Z.J.N. et al. 2019). Finally, the circular model focuses on the regeneration of the natural systems that we depend upon, on which the welfare of the planet's inhabitants and the basis for a global economy rests. This was already stated by Ivon Chuinard, the creator and owner of the multinational textile company, Patagonia: "you can't do business on a dead planet" (Chuinard, 2016).

3 potential strategies that we should not underestimate rest on the aforementioned basis initiated by Stahel, McDonough and Braungart:

Slowing resource loops by designing long-lasting goods whose shelf life may be extended (for example, by repairing or remaking/refabricating), where the period of use of the products is extended and/or intensified, which would be progress in the deceleration of required resource loops.

Promoting *closed resource loops* that feed back, thus avoiding massive extractions of pristine materials.

Increased *resource efficiency*, understood as a backup to the previous point on reduced material usage in the initial stages of the product life cycle, the current basis of the production machinery.

Inaction and the resulting slowdown of this aspect towards circularity have a series of associated risks that businesses are already accounting for in their strategies and balances, as they affect the implicit value chain. Thus, for example, the historical prices of materials and/or future price projections are normally used to identify the risk of price variations and thus, their perspective and volatility (*The McKinsey Global Institute*; Duclos *et al.,* 2010). On the other hand, the risks to the continued supply of a specific material for a given product subject to the availability of this material for purchase by the product manufacturer, are well documented (IlbStudio, 2012, various references). But in reality, there is a complex interaction between various elements such as the availability of a material, the competing markets that use this material, supply and demand in each of these markets, the regulatory limits of legal extraction, the political stability of the supplying countries and the capacity of their buyers to absorb cost increases due to these factors. These are enormously complex multilevel projects. Thus, the supply chain risks may be associated to a series of external factors such as supply monopoly, the existence of legal imperatives, weak governments, deficient environmental standards or sources of certain materials such as conflict minerals (European Union, 2014; Yale University, 2018).

Another significant risk that must increasingly be taken into account is the scarcity of future and accessible supply in the earth's crust (EU 2010, Annex V). There is a debate on the concepts of "absolute scarcity" and "economic scarcity" that implies that the cost of extracting the materials increases as the available resources are consumed and the typical output reduces as a consequence of climate change and severe and unexpected environmental phenomena (hurricanes, floods, fires, pandemics,...) Finally, we must mention the growing risk associated with the toxicity of the material, increasingly subject to current legislation and prone to future restrictions which may lead to interruptions in the prolonged use of certain materials, thus limiting their potential use as well as their future economic value. Within the European Union (hereinafter, EU) the current REACH regulation REACH, 2006, from its initials for Registration, Evaluation, Authorisation and Restriction of Chemicals) also promotes alternative methods to assess the risks of substances that are potentially dangerous and harmful. To this we must add the RoHS Directive (RoHS, EU 2011), also of the EU which prohibits the marketing of new electrical and electronic goods that contain more than the agreed upon limits of lead, cadmium, mercury, hexavalent chromium, polybromides, flame retardants that contain biphenyls (PBB) and polybrominated diphenyl ether (PBDE). Another reference framework is the *Substitute It Now* programme (SIN List, 2014) of the International Chemical Secretariat, based on the criteria established by the EU regulation of chemical products that have identified very high concentrations of certain substances. Finally, the *Cradle to Cradle Certified* ™ list of prohibited chemical products (C2C, 2013) refers to substances that contain more than 1000 ppm owing to their tendency to accumulate in the biosphere, and lead to irreversible negative effects to the health of living beings, including human beings.

I would like to include a brief reference to an aspect that is little known to industry and design professionals: biomimicry. It is a disruptive discipline of strategic design and management for companies regardless of their sector, where the functions of living beings are emulated at different scales (organism-species-ecosystem) and levels (micro-macro-meso) to identify and expand the field of solutions to multiple challenges that we face in this century. Owing to space limitations, I shall only mention what is known to professionals and followers of biomimicry as Life's Principles (hereafter, LP: Figure 04; Baumeister *et al*., 2012) that other European schools have denominated Nature-Inspired Design Processes (Tempelman *et al*., 2015). LPs represent a pattern found in multiple living species that provide us with innovative, inspiring and creative strategies for survival, creating a model that is different from the current one. Adapting ourselves to these laws is an obligatory and non-negotiable challenge, not only for us but also for the ways in which we can contribute to the health of the planet on which we depend (Quirós, 2013). In this way, we see the inter-connections, the links between the species and their habitats. Nature thus shows us the limits that we should not have crossed, as for the first time in history, we have become climate "makers", capable of changing it at a global and systemic scale (Rockstrom et al., 2009)., At the centre of the diagram **(fig. 04)** we read, *"life creates conditions that lead to life*" which represents a fundamental message, a mantra that may be applied to any action developed by our discipline. We shall thus be able to ask ourselves: Does my business/design/proposal *create conditions favourable for life?* LPs can inspire us to find answers within the natural model. Through 6 principles sub-divided into a series of sub-principles that strategically guide us to understand and act with the goal of creating sustainable and regenerative solutions, just as life on Earth has been doing for many millions of years. On the outer layer we read a series of laws that operate inexorably on the terrestrial system and which cannot be ignored. Only if we consider Nature's lessons within a systemic context can we ensure that our designs shall be appropriate for the goal that we seek with sustainable development. This is a key step in biomimicry and what distinguishes it from a more general category of bio-inspired design. The application of these principles require time but once we begin to understand these patterns, we must begin to apply them at the start of any design process, at the stage of establishing the scope, and continue to take them into account and use them throughout the remaining stages of conceptualisation and development. The goal is to translate these natural lessons into design specifications, parameters for quality control, materials selection and other manufacturing or processing options. Although it frequently involves a certain degree of complexity and the full application of the 6 LPs presents certain ongoing limitations, however reproducing all of these patterns is an excellent goal to aspire to, in order to change the way we operate currently. It is interesting to comprehend the multi-disciplinary character of the application of this discipline to those that must be present at the decision-making table of biologists along with designers, engineers, economists, etc.

Ecovative. Biological cycle. The incessant increase in the demand for materials and products is going to create a bottleneck as the middle class develops greater economic access (Kharas and Hamel, 2018). Most of this material is made from finite resources that are used only once and then discarded. A clear example of this type of material/product is that which is used extensively in packaging using polystyrene for protecting shipments and for delivering breakable and not so breakable items. Polystyrene is made of petroleum and is usually used only once. It is voluminous and takes hundreds of years to break down by the action of light, water and wind, meanwhile creating enormous short-term, medium-term and long-term problems. Technically, it can be recycled, but the high economic and environmental costs make its recycling unfeasible. Parallel to this reality and applying the environmental emergency towards circularity, we have access to a large number of agricultural sub-products that are discarded or under-utilised, and that may serve as a potential source of applicability from the circularity described in this article. Bayer and McIntyre (ecovativedesign.com) , the founders of *Ecovative Design*, were inspired when they observed the mushrooms that grew on wooden splinters and how mycelium worked. Mycelium is the plant part of the mushrooms, formed by hundreds of interlinking microfibres produced by spores, which makes it an incredibly strong material when dried, being similar to a natural glue and self-assembly in its functioning. This allowed the team to formulate a new method to produce materials that can replace different products such as petroleum-based expanded plastics, particleboards with formaldehyde, which are known to cause cancer. Since 2007, *Ecovative*, a New York based firm has been seeding agricultural waste with mycelium, placing this material in different moulds according to the product desired **(fig. 05)**. By combining mycelium with agricultural waste, objects such as bricks, protective material for transporting delicate objects, furniture, decorative objects and even fireproof material for multiple uses can be crafted. As the plant material - fungi is completely organic, at the end of its cycle of use, the material can easily be retransformed or discarded, when it returns to the carbon cycle. Fungal mycelium, fed by nutrients from this agricultural waste, extends its network through the available organic material, holding it firmly and after several days of growth, a thermal shock stops it from growing further, thus producing the desired forms without any adverse effect for the users' health (Karana et al., 2018; Ikea; Ecovative).

Thus, materials that are toxic and hard to recycle such as expanded polystyrene (EPS), expanded polypropylene (EPP) or expanded polyethylene (EPE) which are widely used today can already be replaced. It is worth mentioning that mycelium grows in 5/7 days without the need for light or water, making the agricultural sub-product pass through a simple process of dehydration and thermal treatment to stop growth and ensure the absence of spores and allergens.

Within this category of processes we may already include a large variety of natural resources that have not been used until now in the manufacturing industry, such as living micro-organisms, in the aforementioned case. This would include other fungi and bacteria, agricultural waste, algae and compounds derived from plants, animals and micro-organisms, to name just a few. Companies such as Dell, Steelcase, H&M and Ikea are already expanding their scope with the guarantee provided by the *Cradle to Cradle* certification. Meanwhile Ecovative is already moving into the insulation sector with regard to construction, textiles (Mycoflex™), packaging and food-based products.

What began as a laboratory of ideas is today a business reality of great potential and development. Its expansion is guaranteed and the creativity to link business and nature awaits us.

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Images

01. UNEP circularity approach model (2019). Translated by the author.

02. Model of the circular economy according to the Ellen McArthur Foundation.

03. UNEP circularity approach model (2019). Translated by the author.

04. Life's Principles or Nature's survival strategies. Biomimicry Institute ©.

05. Diagram comparing the manufacturing process of a conventional material and a circular one. Modified from Ecovative®.

06

Consuming Signifiers

Joel Blanco

Products speak; they speak of their history, their producers, their ingredients and materials, and undoubtedly, they speak of their owners. In this text, I set out to explore the link between responsible consumption, its labelling, and the creation of consumer identity; and how the industry takes advantage of this phenomenon when positioning products.

Often, certain slogans or labels can be problematic: "Vegan"; "Cruelty Free"; "Green Planet", "Green Product"; "Biological"; "Sustainable"; "Conscious Consumption"; "Recyclable"; "Organic"; "Ethical"; "Palm Oil Free". There's a good chance that any of these labels may awaken in you a certain sense of guilt as a consumer. Guilt for not fulfilling their demands, for not adjusting to their definition of what it means to "consume responsibly", guilt for not fitting within their framework. Often, companies and providers appeal to the moral compass of consumers when advertising their products through slogans, prefixes and brands, endowing their products or services with these seals of confidence. Seals that guarantee the ethical nature of the product and give the client the most responsible or more ethical alternative when buying a cream, dinner, or in general, when investing their money. A logic that says consumption is not incompatible with making the world a better place.

Looking back at recent history, one of the most infamous cases in Spain was that of the "Bio" prefix. From 1993 onwards, the law dictated that the only products in the Spanish market that could include this denomination in their names were those that had been sourced organically - free from chemicals in their manufacturing process[1]. This prefix did not only designate the class of product, it also made the implicit statement that products without this prefix were of lower quality. As may be expected, this did not go down well with large food corporations; they wanted a share of this trade but could not label their products as such. Additionally, as we have said,