Tech enablers series

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More than just a big idea – how extended reality tech can enable a circular economy

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Imagination is the original innovation accelerator. It is essential if we are to solve big problems like climate change, waste, and pollution. The vision for a circular economy is more than just a big idea. It is a systems solution framework that sets out a new way to design our global economy so that it flows and functions within planetary boundaries. Implementing it at scale will require not only huge ambition but concerted action at every level of business and society. All of that starts by bringing to life the vision of a better future and making it tangible.

Over the past decade, immersive technologies which bring together imagination and industry have experienced rapid growth. Though they have not yet reached ubiquity, the extended reality (XR) market – virtual reality (VR), augmented reality (AR), and mixed reality (MR) – is expected to reach more than USD 250 billion by 2028. Each technology allows users to explore and interact with simulated environments in different ways.

What are extended reality (XR) technologies?

Virtual reality (VR)
Enables people to fully immerse themselves in a purely speculative virtual world

Augmented reality (AR)
Layers digital artefacts and virtual objects onto our everyday experiences in the physical world

Mixed reality (MR)
A blended experience in which real-world interactions have a virtual reality impact

Taking inspiration from the role of gamification in driving environmental engagement, XR technologies have been harnessed to highlight the problems with, and symptoms of, our current extractive economy with the aim of inspiring action. Time Magazine's 'Inside the Amazon: The Dying Forest' brings to life the environmentally and socially destructive realities of deforestation in an immersive journey. Meanwhile, the New York Times' AR-powered storytelling tool enables users to visualise microscopic air pollution as floating digital fragments and, using location based sensors, compare their local levels with those of the world's most polluted cities. The cumulative impacts of our linear economy could be similarly highlighted by XR to allow people to observe the gradual onset of 'shifting baseline syndrome' by simulating landscapes and ecosystems as they appeared twenty, thirty, or one hundred years ago.

But neither nostalgia for a past less polluted – nor knowledge of the planet's current trajectory – can alone transform awareness into action. XR technologies can be used to help to realise and scale the circular economy, in which waste and pollution are eliminated, products and materials are circulated, and nature is regenerated.

simple cardboard headset, with some of the country's most forward-thinking solutions. Viewers can explore Dutch companies already incorporating circular economy principles, including Brightlands, a campus community pursuing innovation projects such as the use of bio-based materials like agro waste and lignocellulose (plant dry matter) as raw material inputs for new products.

Communicating the backstory and benefits of initiatives already underway helps to raise the profile of the circular economy in action and encourage similar actions. But pushing forward at the speed and scale required necessitates showcasing the power of possibility. At their core, VR and AR are world-building technologies. As such, they can play a useful role in both scoping and shaping a circular future.

Transitioning from a linear business model to a circular one involves change at all levels, so gaining cross-functional consensus and building operational buy-in is essential. But for some leaders, taking the 'big idea' from point of concept to point of proof can be a challenge. In the transition process, virtual or augmented experiences can help businesses bridge the gap between theory and reality.

For example, an electronics company looking to incorporate remanufacturing might invest in a VR simulation which walks key stakeholders through a digital factory floor. In this way, resistance to change can be mitigated by highlighting the cost, material, and energy savings in a visually engaging and role-specific experiential way. Taking a slightly wider lens, both VR and AR could enable environmental designers, urban planners, and other infrastructure development roles within the built environment to help key decision-makers invest in a circular economy for their city or community. Already, cities such as Shanghai and Singapore use data-led digital twin technology to iterate innovations on intelligent virtual replicas. By adding XR elements, the decision making, design visualisation and optimisation, and operation management use cases for digital twins can be further elevated, helping to bring the vision to life in real-time. Using digital layering and geo-location based features, for example, AR could show how and where circular functions like street-level 'on the go' refill and return stations, multi-use buildings, and transport-sharing schemes might be implemented in an ambitious yet achievable circular future.

The regeneration of nature – a core component of the circular economy – can be similarly accelerated through XR. Moving to regenerative production is essential to mitigate climate change, halt and reverse biodiversity loss, and improve the resilience of our global food systems. Achieving broad spectrum support is therefore crucial. VR, AR, and – if future sensory-enabling developments in haptic, olfactory, and gustatory cues permit – experiential technology can be used to show, not tell, regenerative's transformative potential in touch, smell, and taste.

Requiring specialist hardware, VR can allow FMCG executives, fashion brands, and retail partners to remotely yet powerfully visualise the benefits of transitioning their global producers away from conventional, degradative, agricultural methods. AR technology meanwhile, because it is largely enabled by smartphones without the need for external equipment, makes it easier to reach farmers in remote rural areas. The EU-funded project 'FIT' intends to help farmers improve agricultural productivity by providing real-time analytics in an augmented reality display. While 'FIT' is aimed at streamlining operations and output within a conventional agricultural system, the same technology could support regenerative systems by helping farmers to manage complex intercropping systems and oversee the subsequent increase in crop diversity in the long-term. Further, multi-sensory virtual layering could provide immersive insight into regenerative outcomes: by superimposing the visible biodiversity benefits of rotational grazing patterns onto land currently continuously grazed, audibly demonstrating the return of pollinating insects into silent landscapes, revealing rich texture return to barren soil, and allowing users to taste the difference in the resulting final crops.

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From ambition to action: how XR can help achieve a circular economy

Combined, these technologies can offer us a powerful vision for the future. But they are being used to support circular business models in the here and now too.

Theoretically, any innovation which helps to eliminate waste and pollution from the production of a physical product contributes to a circular economy. Replacing an object with an experience – as fast-food outlet Burger King did when they stopped giving away plastic kids toys and instead offered young customers an immersive, nature-based 'animal planet' AR game – is one way to dematerialise the parts of the economy that are surplus to basic need.

In the fashion industry, various methods of XR-enabled dematerialisation are being trialled to address the sector's significant relationship with waste and pollution. A number of retailers, including Gucci, Nike, and more, are addressing industry-wide high return rates by developing apps that allow users to virtually try items on at home. Using 3D tracking software to scan body shapes and AI-informed movement predictors to mirror the physical experience, they can dramatically reduce the number of unworn clothes sent to landfill or incineration as well as the embedded and actual energy in the transportation and processing of unwanted items. But, though such apps reduce the risk of returns, simulated fitting room solutions still assume an eventual physical purchase. Making sure that each item of clothing bought is used for as long as possible is an essential part of a circular economy for fashion. Digital innovation that prioritises strategies such as resell, rental, repair, and remanufacturing should therefore always be considered before those which risk perpetuating the extractive, linear model.

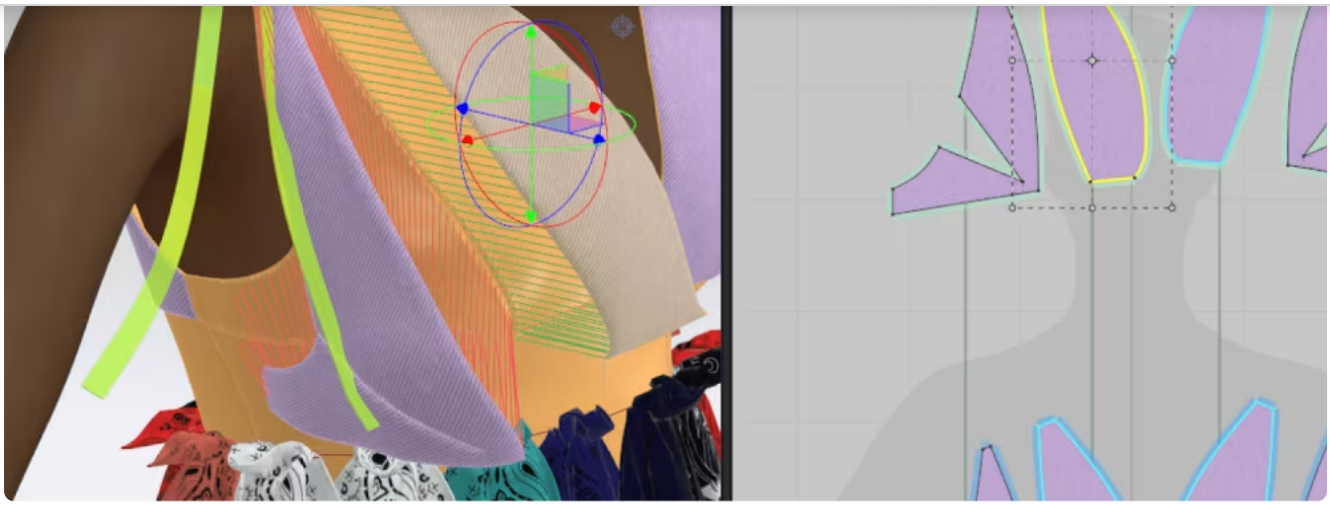

Image from DressX

Elsewhere in fashion, other XR offerings are picking up attention at pace. In the metaverse, digital-only fashion companies are attracting millions in funding, providing an add-on revenue stream which doesn't rely on mass manufacturing and therefore material extraction. A circular economy decouples economic activity from the consumption of finite resources. On the surface, by uncoupling physicality and self-expression, digital only fashion offers a complementary vision. Organisations including DressX are developing 'meta closet' collections, comprising virtual items and outfits. By addressing the volume of fast fashion which exists solely for content creation on social media platforms such as Instagram and TikTok, such applications help to eliminate material wastage. Instead of wearing the items – often just once – in the physical world, users layer their chosen 'meta garment' over an uploaded photo, ready to be digitally worn and shared immediately. While not available for individual purchase, the items in H&M Foundation's virtual 'Billion Dollar Collection' use this same technology to raise awareness and funding to help scale circular innovations. Meanwhile, The Fabricant works with global brands including adidas, Tommy Hilfiger, and Puma to create digital-only marketing campaigns which gauge real-world demand, reducing over-production of the collection's eventual physical launch. Certainly, the creation of a digital garment emits significantly less CO_2, uses much less water, and places far fewer overall pressures on the environment by virtue of its virtuality. Nevertheless, we must be careful to fully account for the entire lifecycle of a digital item, and not lose sight of the significant data burden associated with these – and all – emerging technologies. Dematerialisation doesn't always equal decarbonisation.

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Not all industries are suited to dematerialisation. Though moving from ownership to service and experience models is an important part of the circular economy, we cannot have virtual transport, augmented food, or simulated furniture. Some things will always need to be things. In these cases, solutions are needed to ensure things are kept in use at their highest value for as long as possible rather than designing them out of existence.

The starting point for creating products with multiple use cycles is design. Constructing ways of working that eliminate material wastage is an essential first step, and XR based tools can play a big part in enabling this. By introducing digital prototyping and virtual replicas, the design, manufacture, and – crucially – repair of everything from trains, planes, and automobiles to electronics and exercise equipment can be rendered relatively wasteless. In the built environment, 3D digital twin models are already being widely used, by multi-disciplinary design firm Arup and others, to expedite circular innovation. By allowing globally diffused teams to experiment with circular design in a material and risk free environment, multiple inputs can be trialled and integrated at once. Not only does such digital fabrication allow for a more precise use of construction materials – eliminating waste – but it liberates designers to consider how buildings can be created and repurposed around the principles of a circular economy.

While no technology represents a fix-all solution, as assistive tools VR, AR, and other technologies, used by both designers with the capability to dream and decision-makers with the authorisation to act, can play an enabling role in the transition to a circular economy.

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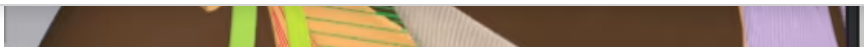

A digital-only, multi-brand fashion platform: DRESSX

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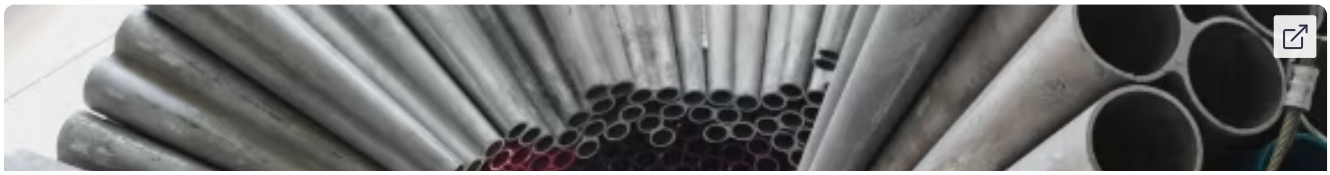

The power of digital technologies to enable the circular economy

Business