



PRODUCTS THAT LAST^{2.0}

PRODUCT DESIGN FOR CIRCULAR
BUSINESS MODELS

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BISPUBLISHERS



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PREFACE

The urgency to develop industry, trade and consumption towards a sustainable dynamic has become all too familiar. These days we discuss Circular Economy as the solution to our troubles and recycling is considered by many as the knight in shining armour who will make that happen. However, against the background of making products last, Circular Economy is an important tool, but the technical question if a material can be shredded and regenerated is only a rather trivial part of it.

This book is certainly not about recycling. That issue is indeed addressed in the book complementary to Products that Last, entitled 'Products that Flow' (also BIS Publishers). It concerns the manageability of flows of fast moving goods, such as disposables and packaging and relevant business and design potential.

The questions we get asked about lasting goods concern equally profound systemic shifts. We have to move from creating things that are produced, sold and mostly neglected to become waste, towards making products with value that we can cultivate during longer periods of time. That is what is implied by changing from a linear to a circular economic model. The difficulty here is not the environmental preferability of a circular over a linear economy, for there is no way on earth in which we can continue selling things and ignoring the consequences over the next 50 years or so. The difficulty does lie in finding ways to get there. How should we shape the circular economy? What kinds of products, services and schemes should we be developing?

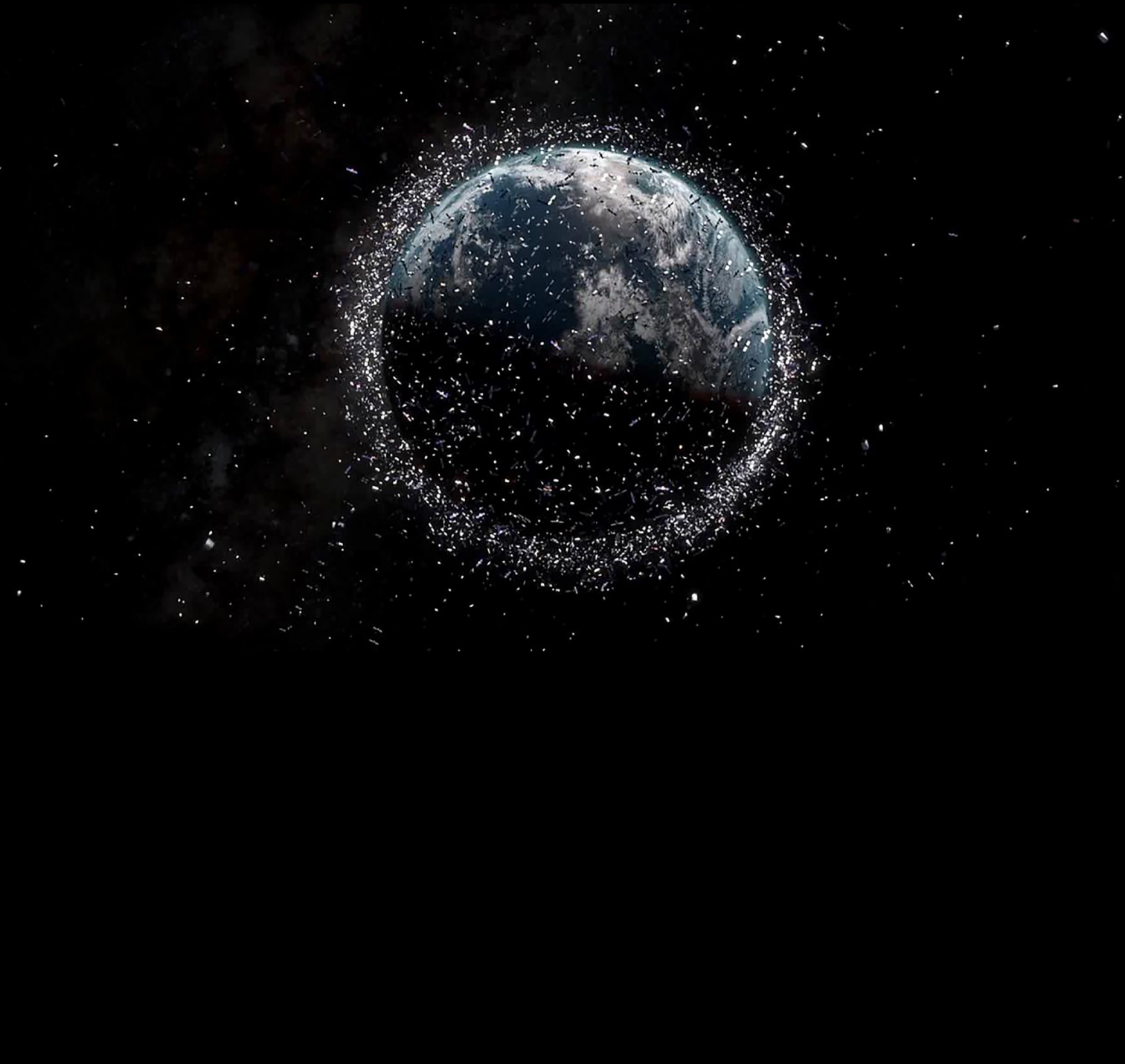
This book is the result of a three-year research effort into business scenarios that prolonged product lifespans may present. It helps slow down the speed of the flow of materials and goods through society, addresses consumption practices, reduces waste and 'buys us time' for more careful development.

Systemic change is not easy, but certainly tempting. The challenge is to find different perspectives, which at first may be unusual, for business development and fresh design concepts to match. The key is to analyse what your current tacit assumptions are and use those to envision long term opportunities. Making products last requires exploration of what may happen long after they were put to use. Think 30 years. Designers are able to explore new directions and express ideas that are in line with new business models. Entrepreneurs can focus on redefining their responsibility and on developing new partnerships that can contribute to sustaining long term product value. At the end of the day circularity first and foremost depends on cooperation.

We therefore dedicate this book to all active change agents and open-minded people: join us. Let us begin by challenging the 'sell more, sell faster' habit and explore the opportunities offered by a much longer product life.

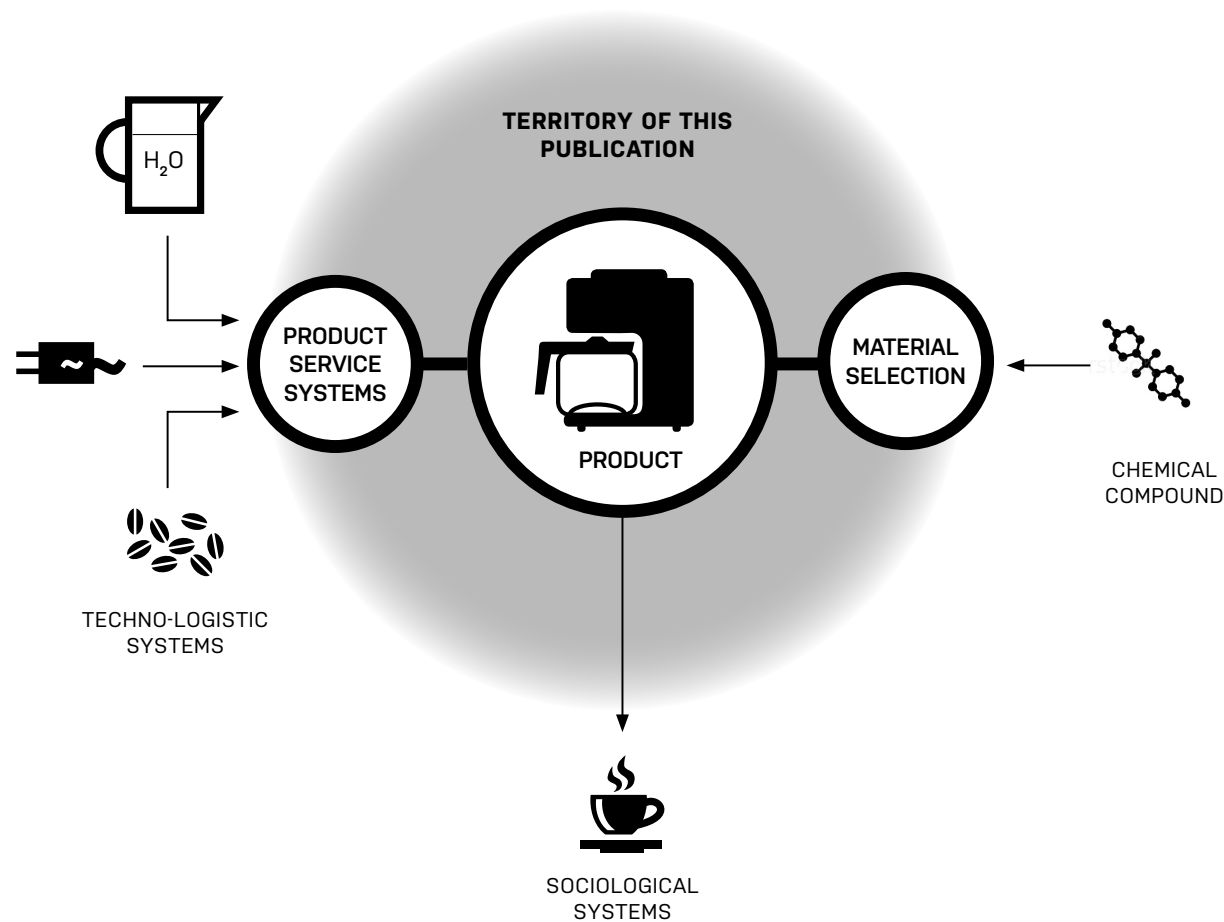
Conny Bakker, Marcel den Hollander, Ed van Hinte, Yvo Zijlstra

Image left: We have produced 8,000 tonnes of space debris, which basically means some 29.000 objects which are bigger than 10 centimeters and, maybe, around one million smaller ones. Most of them will live forever. Collisions with new objects will multiply their number and increase the danger of more accidents.



Some people own two functioning coffeemakers and a bunch of broken down ones stashed away somewhere. Sooner or later they will discard the wrecks, possibly when clearing up storage space. Or a functioning machine decides to start leaking and the owners decide to replace it with a brand-new and improved coffeemaker.

LONG TERM FRAMING



The product domain is wedged between product service systems and available material choices. This book is about interventions within the circle of influence of designers and businesses.

This ongoing family ritual represents a minute part of a stream of mass production, consumption and destruction of zillions of goods. So, what's new? Now imagine a different setting, one in which people lead a comfortable life without the constant noise of making and breaking products in the background. Companies focus on long-term convenience by offering products with lasting value and making a profit through exploiting and sustaining those products. This requires a drastic change towards entirely different ways of doing business and, consequently, a shift in what designers should focus on. The easy part is that the basics for alternatives have been around for ages. It is just that never before were they regarded as ways to engage in trade with a view to the extension of product life and saving materials and energy. *Products that Last*, provides a range of business models and design strategies with examples and backgrounds. It intends to serve as an inspiration to make the change happen. It is essential, therefore, that the subject matter of *Products that Last* is kept simple and that the overview provided is a clear one.

It concerns a shift of emphasis in the way entrepreneurs and designers develop and exploit goods towards reduction of material and energy consumption over time. Nothing more, much less.

The effort to develop new ways of doing business is part of a sizeable and varied attempt to turn our currently fragile life style into one of which we can be fairly certain that we can sustain it well into the remote future.

Products that Last proposes useful methods and strategies. There are no generic rules. Each case requires its own specific recipe. It offers a different perspective on commonly used notions in the sustainability discourse. 'Life cycle' is probably the most important concept in the book. There are various categories of life cycles. The kind aimed for in Life Cycle Assessment, for example, represents environmental impact. In the book product life cycle mainly concerns value changes. The emphasis is on maintaining value.

Energy consumption is only partly relevant to product lifespan extension. It is not a significant element when it concerns the design of a specific electric dishwasher, because value is the main issue. But it is certainly

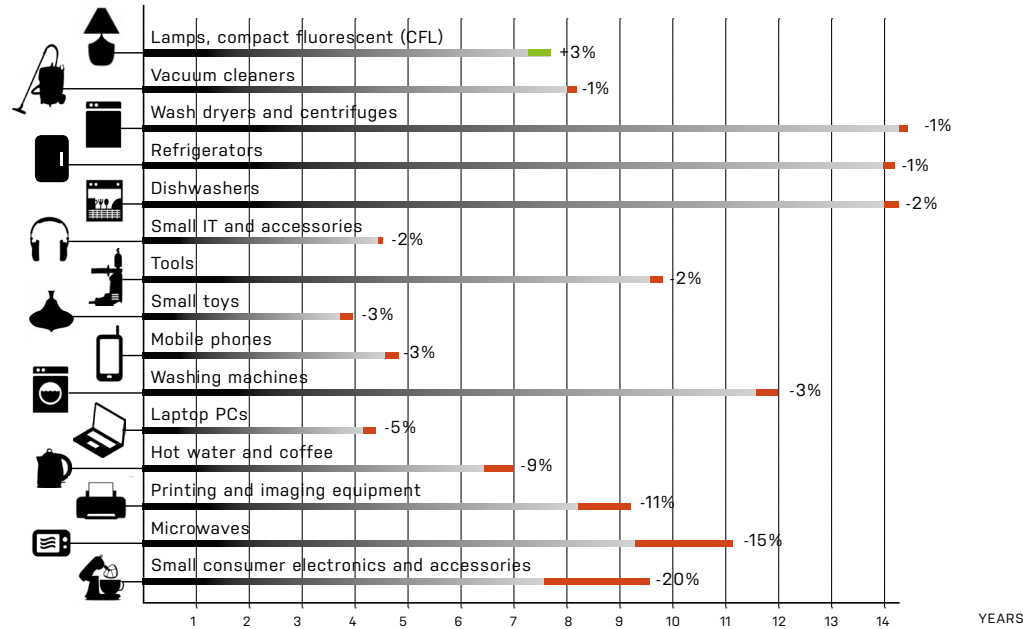
meaningful when the evolution of dish washing enters the picture. As technology develops over time, energy consumption per product is likely to decrease. The optimal product lifespan then is defined by the point in time where the environmental impact that arises from using a product equals the embedded impact of a - more energy efficient - replacement product. So, in some cases, early replacement can be an eco-effective strategy.

A similar evolution occurs in devices that produce and store energy, such as windmills, solar panels and batteries. For those it is important to note that they have a lifecycle too, in the 25 years range. This implies that their value is subject to cultivation as well. Free energy is so attractive that this fact is sometimes overlooked.

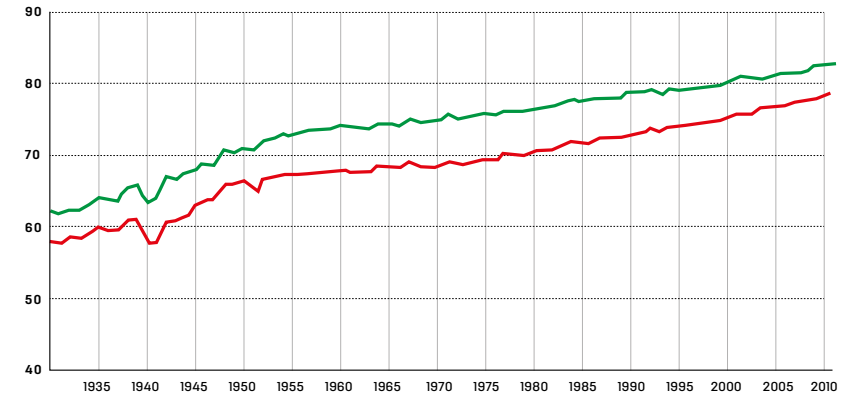
Using minimal amounts of material through thinking in lightweight structures has an aim similar to product lifespan extension. The former implies a direct reduction, the latter a reduction through intensified use. Both are in line with the adage of visionary designer Richard Buckminster Fuller: 'Do more and more with less and less until eventually you can do everything with nothing'. The many dome structures he designed are a close approximation. The future of technological development has a lot in store when we combine value cultivation with a diminished use of materials.

Perceived product value over time only partly depends on functional properties and the scenario of material interventions needed to keep the product going. Perceived meaning, the immaterial, STORYTELLING element is equally important for maintaining its reputation. In practice this may concern branding, advertising and organising what could be called 'image enhancing activities'. Up till now these efforts have been carried out exclusively within the linear model of design for sales, with the exception of the odd 'lifelong guarantee' advertisement. There are opportunities here that may affect the development of business models.

The last domain to be mentioned is HISTORY of design and commerce. Very little evidence is available regarding the relationship between assumptions about design and product longevity. The problem with the design of lasting products is that it must start out from speculation, and that it will by definition take a long time to be proven right. Historic longitudinal research could be of great value here. There is no future without learning from the past.



Median lifespan of a selection of household products, and change over time (2000 – 2005), based on Dutch data. Source: Bakker, C.A., Feng Wang, Jaco Huisman, Marcel den Hollander (2014) Products that go round: exploring product life extension through design. Journal of Cleaner Production, 69, 10-16.



Life expectancy at birth in the UK, 1930-2011, female (green) and male (red) Source: Office for National Statistics, UK.

A strong rationale underlies the extension of the lifespan of a product. There are three domains where we can find arguments in favour of long-life products. These stem from human characteristics and the observation that the reduction of the ongoing product lifespan collides with the increasing scarcity of raw materials.

LOADS OF REASONS

The first domain regards the ambiguous affinity of humans with their 'stuff'. It depends on age and individual mentality, and even on situation and mood. Generally people crave for the new. They follow the latest fashions and acquire things for practical or symbolic reasons, or just for the fun of it. At the same time, however, they cherish the familiarity of objects and rituals, are interested in the past and may indulge in nostalgia. Irish comedian Dylan Moran said it simply, 'there is too much of everything, and not enough.'

The second domain concerns business people and designers who seek to learn how to make a positive contribution by taking up new challenges. This is not so much a preference for developing and producing objects, but rather an inclination to observe, evolve and apply their skills, and to make a point.

The third and most important set of reasons emerges from awareness of the unintended side effects of what we have accomplished, as a rapidly expanding species that not so much adapts itself to living conditions, but rather continuously adapts its environment to what it figures it may need. Up until recently, little attention has been paid to the depletion of materials and the fact that so much is wasted as a result of the way production and consumption have developed.

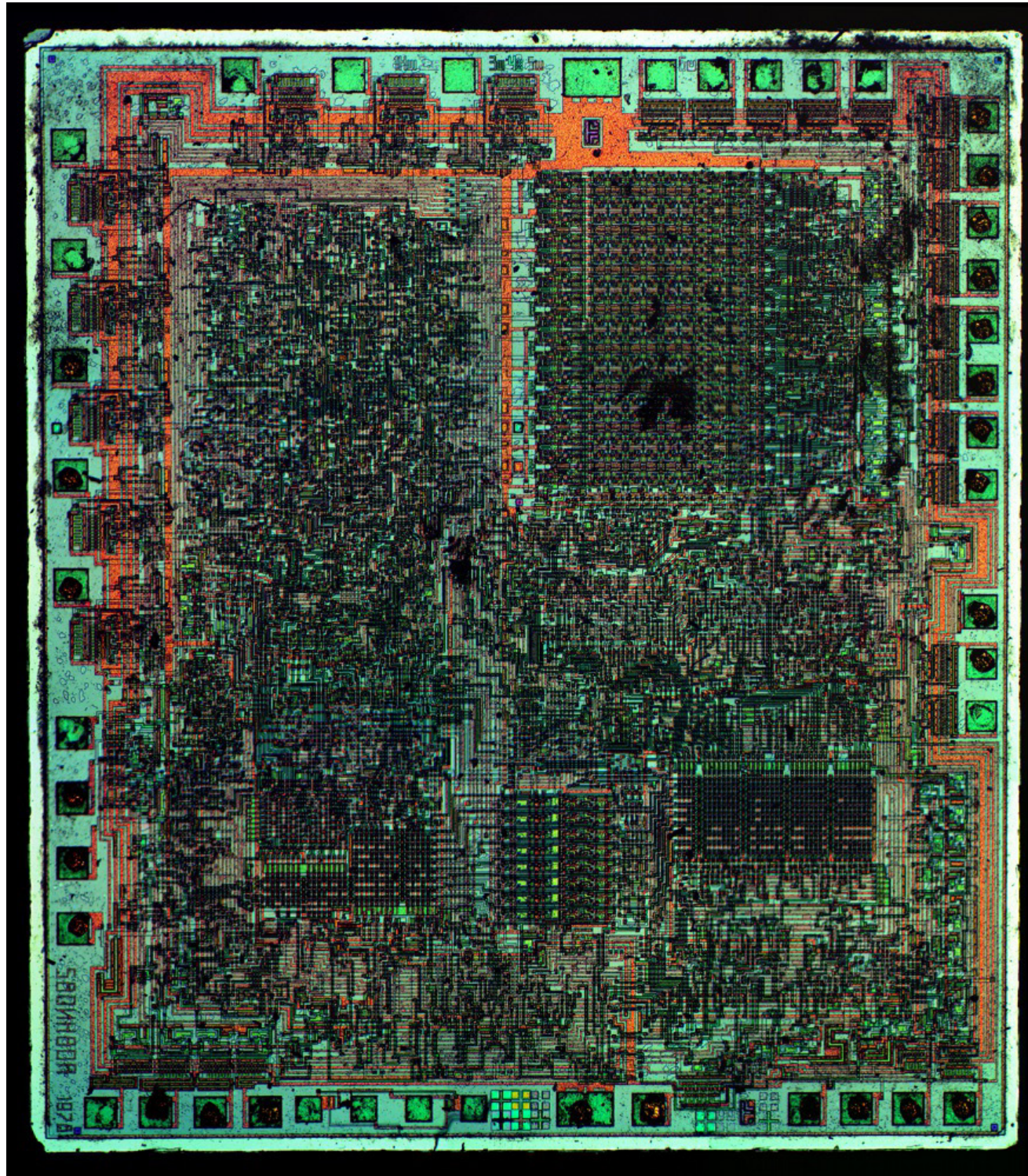
Let us start, rather philosophically, with the domain of human idiosyncrasies. Life is not easy. After birth we need maintenance and care to survive for a considerable amount of time before we become old age pensioners and, finally, die. Without this care and maintenance we wouldn't be able to survive for the number of decades we almost seem to take for granted nowadays. Maximising our lifespan in a state of reasonably good health requires a great deal of dedication and loads of stuff. Excluding basics like food, family and clothing, here, in random order, is a list of a number of human resources and implements that a certain female X requires to help maximise her lifespan: Spectacles, nurses, scissors, buggies, band aids, painkillers, teachers, tweezers, blankets, oxygen, toothbrushes, ointments, internet access, sunglasses, crutches, counsellors, hearing aids, glasses of water, mouthguards, doctors, books, antibiotics, beds, therapists, splints, mobile phones, sneakers, dentures, pads, soap, dentists, walking sticks, serum, handkerchiefs, plaster, stairlifts and towels. This list illustrates that we consider it appropriate and go out of our way to single-mindedly protect, maintain and repair our bodies and minds.

Our attitude towards products is far more ambiguous. Care is not obvious. On the one hand, we may feel it is

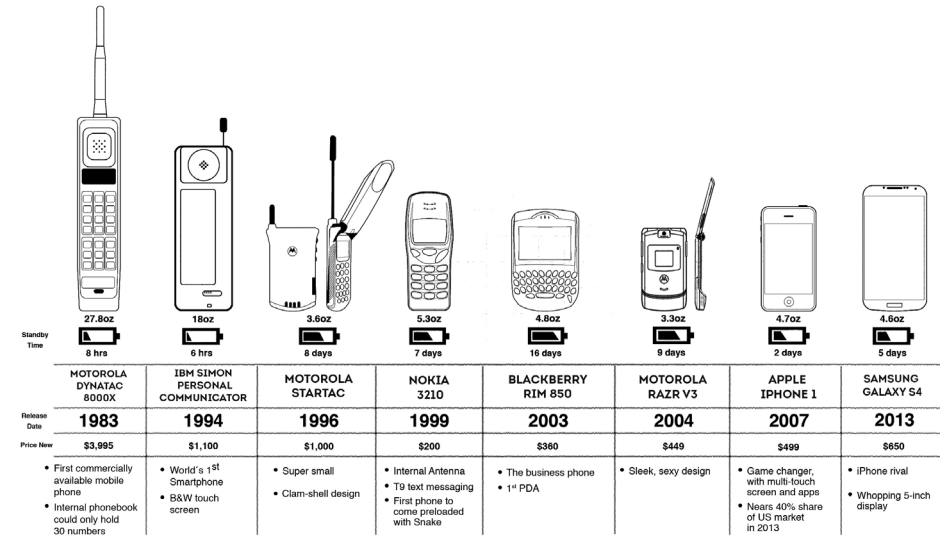


**ETERNAL CYCLES**

The 'Hoodoos' rock formation at Bryce Canyon began life some 144 million years ago. For 60 million years a great shallow sea built this area, depositing sediments as it repeatedly invaded, retreated, and then re-invaded the region. It left sediments thousands of feet thick. In the Tertiary Period, between 66 and 40 million years ago, the highlands eroded into shallow lakes. They deposited iron-rich, limy sediments that grew to become the red rocks from which the Hoodoos were (and still are) carved. Frost wedging and gravity are the forces that create these fantastic shapes. Different rock types erode at different rates, causing the undulating landscape expression. In millions of years these great monoliths will crumble down to sand, to rise again like a Phoenix made of stone.



An opened KR5801K80A Microchip - one of the most widespread Soviet processors. Contrary to popular belief, it appeared to be not an Intel 8080A (or 8080) clone, but a code-compatible redesign (while several parts are quite similar, routing is different as well as pad placement). Thinnest lines are 6µm.



Sustainability could do perfectly well without software. A conservative estimation of the amount of CO2 produced by data processing machinery for 30 'soft' Google queries is about the same as we emit into the atmosphere by boiling one 'hard' kettle of water. Mining crypto-money is already notorious for the disproportionate amount of energy it takes to produce monetary resonance on screens.

DATA THAT LAST

On the other hand, hardware has desperately needed software since Jacquard presented his punch card-controlled loom in 1801. Data storage and electronic computing devices are dead without programs. An unconscious smartphone is the epitome of powerlessness. Hard circuits without bytes moving around in them, are pointless.

This intimate relationship has mutual repercussions for soft- and hardware's respective life spans as well. The fast evolution of processors and memory, in size and data processing speed, increases programming code potential. The effect: growing size and complexity of software. As a consequence, it becomes too extensive for available memory. In user perception it also slows down devices that can be just a couple of years old.

Keeping software in line with expectations, maintaining it, getting rid of bugs, takes an awful amount of time, which consequently cannot be used for developing new software.

There is a rule of thumb that says that for any number of software developers involved in writing a given program, over half of them will be involved in maintenance within two years after introduction. Soon after that, only a fraction of the employed software engineers will be available for development of new programs. They can't keep up with improving technological potential anymore. The capacity to support existing software determines its longevity. Many digital products have an official (but not necessarily public) End of Life Date.

The cost of code maintenance is therefore, unfortunately, hampering 'backward compatibility', the capacity for up-to-date hardware to run elderly software. Simultaneously, new applications stimulate demand for higher processing speeds and more reliable, smaller and smarter hardware and connectors, the total disappearance of which seems to be the computing world's highest calling. In short: evolution of software and hardware are strongly interdependent, but not synchronous. They are like two dogs, each attached to one end of a leash.



*What is most essential, beneficial and profitable within the context of the tools we use, the skills we develop, the games we play, the chances we explore and the goals we aim for? It don't mean a thing if it ain't got that swing.
(Photo Harlod Eugene Edgerton, courtesey of MIT museum)*



Making products last requires a revolution in ways of doing business. Making a profit from the fortunes of a product in the outside world does happen, but it needs an entirely different focus. The difference between current after-sales trade and the new concept of *products that last* is that in the latter case there is no deadline for a product to be definitely finished.

CIRCULAR BUSINESS

Money is made not so much through the sales transaction, causing the producer benefiting from products to lose interest, but through new business models designed to keep the wheel turning and where producers benefit from every turn taken.

Throughout its life a product can be modified, updated, repaired, sold, rented, borrowed, used for a range of purposes, taken apart, divided up, discarded, stored, re-discovered, filled and so on. Every change represents an opportunity to contribute to the closure of its economic circle, to create and maintain value over time, and to keep the revenue coming in.

The rationale of the processes driving a company is termed a 'business model', which includes everything that should be taken into account and dealt with for the company to create a value proposition that customers will accept and pay for. Theoretically, any business model can serve to make products last, provided it contributes to sustaining value and reducing material flows. In theory this even holds true for the conventional 'sell more / sell faster' business model. It is not inconceivable that high-speed sales of some ephemeral product, leaving no trace of value destruction, have the potential to reduce or even eliminate environmentally damaging turnover. Since the 'sell more / sell faster' model is not specifically meant for doing business involving products in use, let alone be applied as such, and because it is so familiar, it will not

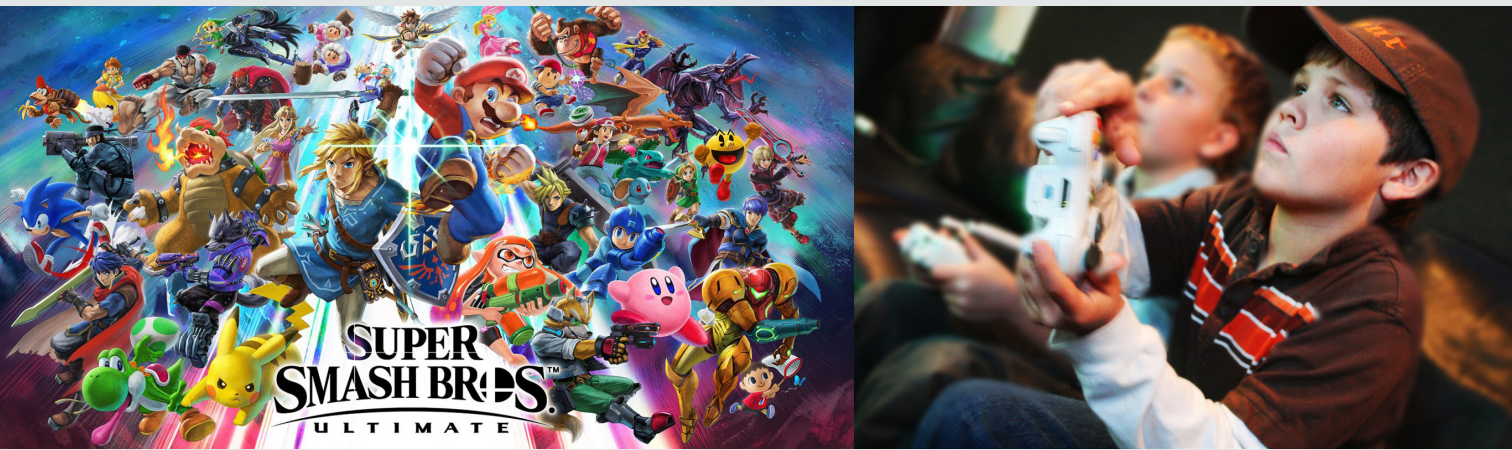
be given further explicit treatment within the framework of circular business models.

There are several principles to try and apply when considering the development of a circular business model. The first principle, of course, is to aim for just that: thinking in circles. Next, it is vital to think in systems around products rather than just the product itself.

Consider combinations of products and services in alternative business models. There are always more: logistics, transactions, narratives, identity, you name it. These may well require cooperation with different partners, all responsible for different life cycle segments.

Leave products intact as completely and for as long as possible in all your scenarios, although it can be fun to play with different lifecycles and lifespans. Think about ways in which your customer or user can have new relationships and experiences with products, and ways in which they can use them.

Five archetypal business models benefit from a longer than average product life. The order in which they are presented is determined by the amount of service the product requires and by product type.



2018 Nintendo Switch game - Super Smash Bros. Ultimate sold 5 million units within its first week, making it the fastest-selling Nintendo game of all times. It also has an all-time high record for launch-month dollars sales for a console exclusive: 12 million units sold in 3 weeks.

GAMEBOY Today's computer game consoles are extremely powerful 3D workstations disguised in diminutive plastic enclosures that belie their raw number crunching powers. The gaming hardware is sold at or slightly below true manufacturing cost level because the real money is to be made with the gaming software.

And make no mistake about the business potential of this Hybrid model, although it may be declining somewhat. So far the all time record is held by the fourteenth instalment of Grand Theft Auto for Xbox 360 and PlayStation 3 which did 12 million units, bringing in 800 million dollars in worldwide sales in its first 24 hours. That made 17 September 2013 the biggest launch day ever, for any piece of entertainment, any movie, any record, anything at all. In the next gaming episode the total number of players are likely to set different records. In 2018 EPIC's 'Fortnite' had a weekend with 3.4 million gamers playing online simultaneously.

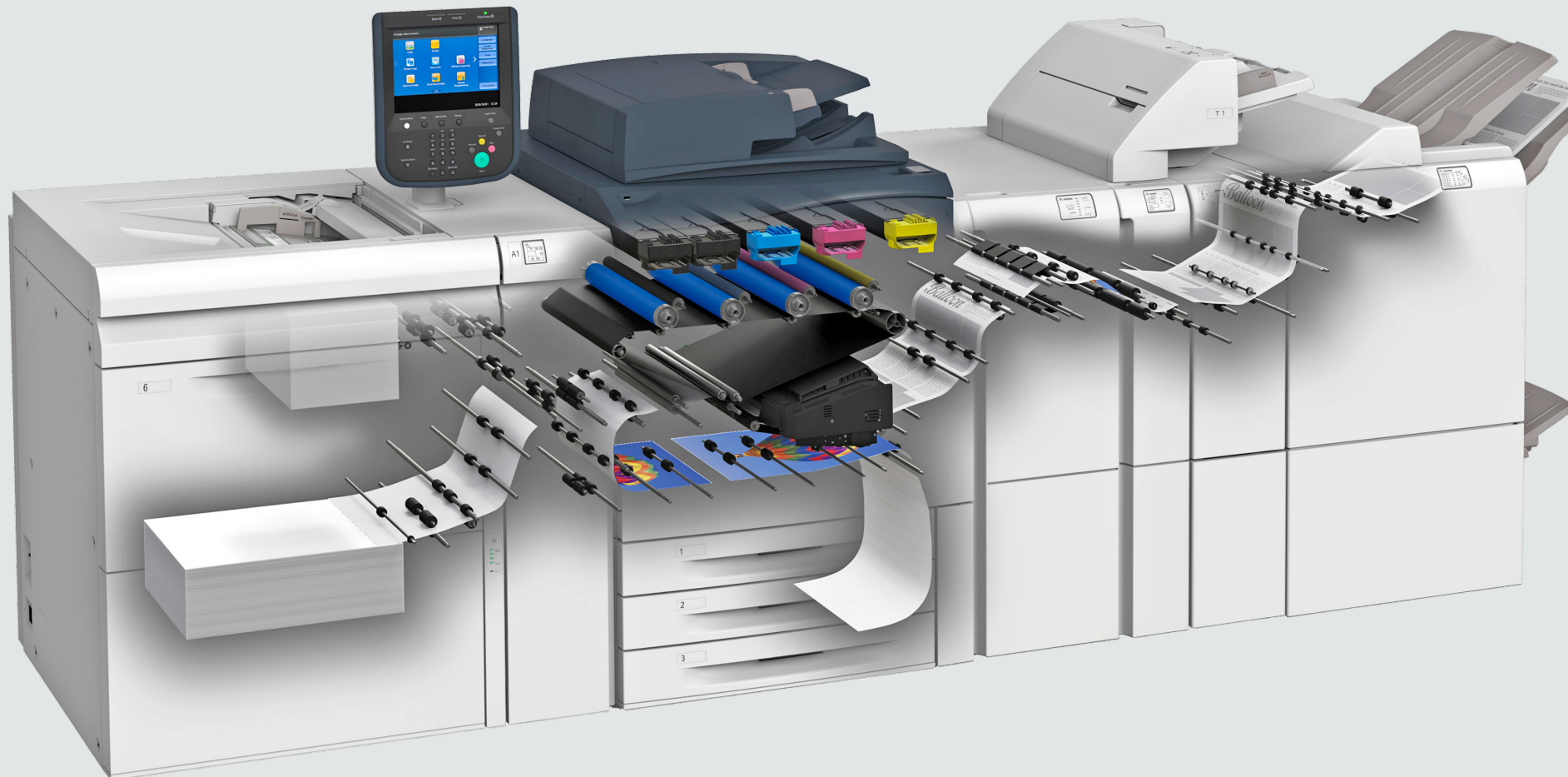


BUSINESS MODELS EVOLVE Herman Miller's Design for Environment (DFE) policy thoroughly evaluates products. In the design process four questions are used: Are the materials homogenous? Are common tools used to separate them? Did it take longer than 30 seconds to reverse a connection? And have the components been marked with their material type? Each and every component is scrutinised based on these factors and assigned ratings on a spreadsheet score card, allowing the design team to accurately evaluate the results.

The focus is on maintaining high standards while incorporating increasingly more environmentally sustainable materials, features, and manufacturing processes into new products. The Design for the Environment team has initiated a protocol to guide this effort. One of the main design tenets is durability. They design for repeated use, repair, maintenance, and reassembly, using standard parts as often as possible. During the new product design process, the team meets with the designers and engineers to review the whole product as well as incoming packaging, and potential waste generation.

CARTRIDGES AND SERVICE Toner can only make its lasting impression on paper with the help of a printer. Companies are cost conscious and well aware that in a hybrid business model the supplies and not the actual printers are the primary source of revenue. Xerox Versant 80 Press has a toner cartridge system and a modular design concept as well, to facilitate flexibility.

In some printer or copier instances a business gap emerges because affordable remanufacturing is becoming a new part of the trade. LMI in Phoenix Arizona does that, and not just cartridges, but everything. They offer refurbished, but also remanufactured printing machines.



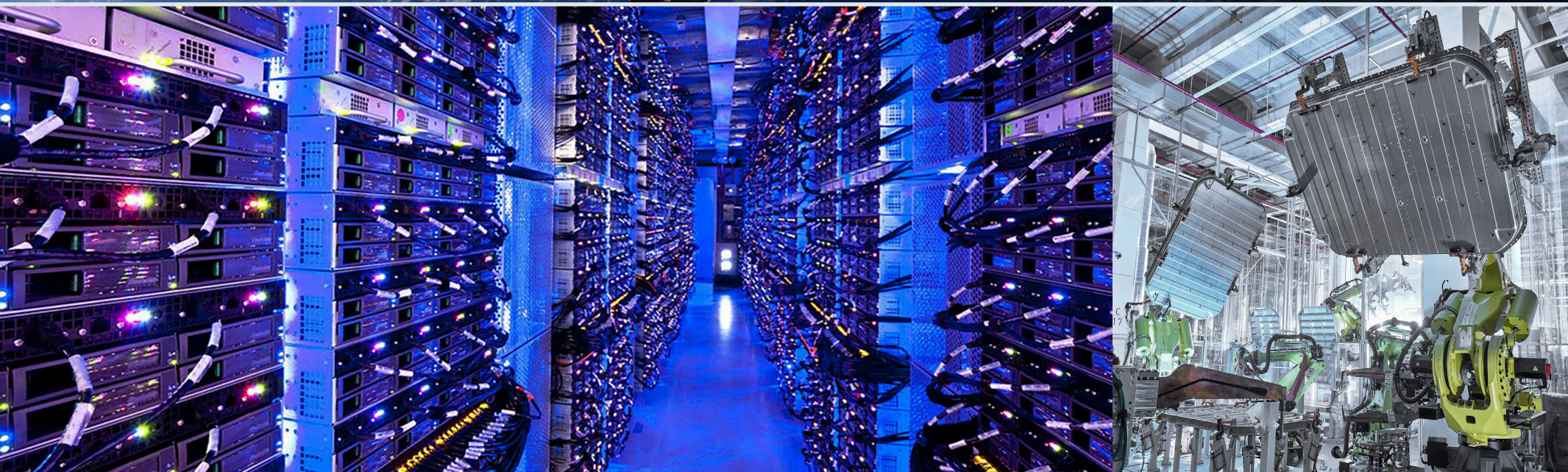


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ENDANGERED ELEMENTS Satellite data communication and navigation services and devices are taken for granted. These space invaders can also locate the very materials they need to function.

Computational clouds exist in power hungry climate controlled spaces on data storage devices containing endangered elements, in facilities like this Microsoft specimen. The orange elements in the periodic table above are dissipating into products.

Electric car manufacturer Audi and Umicore together developed an efficient battery recycling system. Up to 95 percent of materials is recovered, including metals such as cobalt, nickel and copper. Reusing battery materials reduces CO₂ emission from manufacturing, but it may also reduce cost. Currently, difficulty is in retrieving used batteries.





REPAIR OR REPLACEMENT A piano is not only a part of the art of music, it is also a work of art itself. The machine is extremely complex and has thousands of moving parts. It has a framework and a sound board supporting tremendous string tension, all concealed by a beautiful finished cabinetry. The piano is not as fragile as some other instruments, but it is still subject to deterioration over time. The felt wears, strings break, wooden structures weaken and crack, and the beautiful exterior cabinet loses its finish and elegance. The question always is if the cost of repairs exceeds the price of replacement. Renovating high-quality, large pianos may only cost half of the price to replace the instrument.



DO IT YOURSELF The first Haynes Manual (author John Haynes) was published in 1965. It provided detailed instructions on maintenance and repair for the Austin-Healy Sprite. Today Haynes Owners' Workshop Manuals appear in 15 languages. They are widely used both by DIY enthusiasts and professional garage mechanics. Manufacturers generally cooperate with Haynes by providing detailed technical information to evoke customer loyalty.



Cleaning, brushing and polishing are relatively simple acts of maintenance. Yet even these may put the relationship between supplier and customer under severe stress. Not everything is allowed, and faulty treatment will result in scratches and loss of gloss. Entering the bowels of products is more of a hassle. Stickers warn users not to touch anything and command them to return their (yes, their very own) product to the manufacturer, or, at the very least, take it to a qualified repair person. Product maintenance in a low-income country is quite a different matter, offering unlimited possibilities.

EASE OF MAINTENANCE AND REPAIR

Maintenance and repair are interventions in products within an economic force field, the limits of which largely depend on product design. Even something as straightforward as changing accumulators is cumbersome. A smartphone is really nothing but a battery with a lot of features. Maintenance and repair are labour intensive. In low-income regions anything is repairable, but in high-wage regions maintenance is expensive, and the majority of consumers have sufficient income to replace rather than repair moderately priced products. Blenders are less likely to be opened up to see what is wrong than washing machines. Cars suffer from the severity of their function, but luckily they are also expensive enough to be repaired and to give them their rightfully deserved portions of fresh oil and other messy fluids. Car history shows that technological development has an effect on design for maintenance as well: diagnosis is turned into a simple plug-in system and units that need regular replacement are easy to reach.

This provides an example for the principle according to which other, less expensive products could also be designed. There is a potential for considerable lifespan extension here, by designing maintenance which is worthwhile for all the parties involved. This means that maintenance turnover should generously compensate for a decrease in sales. It should generate money, but also increase reputational value. In addition, a change like this requires a redefinition of the areas that can be opened up and understood, in some cases by users with no professional competence. There could be a role for 3D printing here as well: open up your device, see what's wrong, download a template for a modest fee, print it and swap it for the broken part. Right now, the internet is already a gigantic source of manuals, repair information and instruction videos.

This new viewpoint requires redesign of product interiors, which implies that designers should have access to areas that traditionally belong exclusively to the realm of engineers. Together they can develop new concepts for certain components to be easily exchangeable. These different designs need not be costly; they follow from a different perspective with different requirements, but they do not necessarily involve more effort.

Design for maintenance is the most obvious strategy when the supplier benefits from it himself, which is the case in business models where the value proposition includes supplier ownership.

TU Delft IDE student Maarten van den Berg's graduation project at Philips Research suggests interesting ideas about a lighting system that the company will be leasing to Schiphol Amsterdam Airport, whereby spaces at the airport are properly lit, with the light provider taking care of every aspect, including payment of the electricity bill. This is a typical example of the Performance Business Model.

Van den Berg analysed five existing luminaires, of which only one seemed to be truly accessible for service and maintenance. Important observations were that a modular design helps, but that modules, or screwable attachment of parts, were in themselves not sufficient to accommodate easy replacement. An LED module is lovely, but pointless if you cannot reach it. Consequently he designed a concept for a new 'future-proof' luminaire, allowing for easy replacement of LEDs by more efficient ones. In a broader sense, the designer recommends 'an ecosystem of modules that is likely to be used and produced for a longer period of time'. This is in fact an introduction to the next strategy.



PART LIFETIME CATEGORIZATION Some samples from the bugaboo program: The frame has three use cycles / Seat fabrics and sun canopy to be replaced every use cycle / Wear and tear parts like wheels and straps can be replaced within one use cycle.



ANT FOR LIFE Life is rough for a stroller. Not only does it have to suffer from the, often undisciplined, behaviour displayed by the babies, or toddlers, or children it has to carry, but also, it is taken for granted by parents who always care for more for their offspring than for their equipment. Strollers just have to live up to expectations. Strollers are the main product of bugaboo, an enterprise that wants to facilitate free and responsible movement for all. It is a very good example of a company that tries to design by circular strategies as best they can. Their latest, the bugaboo Ant, is truly part of a material flow and created to last in almost all respects. It is of course modular, without any riveted or glued attachments. Therefore, it can be easily taken apart and put together again. Parts can be replaced and upgrading to more convenient levels of functionality is optional. Some of the materials, such as the fabrics of the seat and sun canopy, contain a considerable amount of recycled components and most of the stroller materials can be recycled too.

Particularly compelling is the categorization of parts according to the number of potential (re)use cycles in a circular economy. The first category are the lasting ones, engineered to function the full lifespan, but with the potential to go through more use cycles. They consist of durable metals, composites and high-grade plastics. Category two contains parts that can wear and tear and last five years minimum. Wheels and small plastic clamps belong here. Next there are parts for refurbishment and fresh looks, such as the textile ones. The final category is packaging, which is entirely made out of cardboard, with the exception of one plastic bag for cushions, because they have to be kept dry.

The company is in touch with its second-hand market and monitors use by parents, and their friends and their family and so on. A rather unique initiative are partnerships with companies like Atelier Little Boomerang, that repurposes leftover materials from strollers into carrier bags. Looking for this kind of cooperation is crucial for circular management and prepares the company for an even more responsible future.

EGG HELMETS The egg is a highly customizable multi-sport helmet for kids that was designed from the onset with the goal of matching a high level of fun with a high level of safety and comfort. Colourful skins can easily be combined with a choice of add-ons allowing users to match the look of the helmet with their moods. A safety 'must' thus becomes a fashion 'want'.



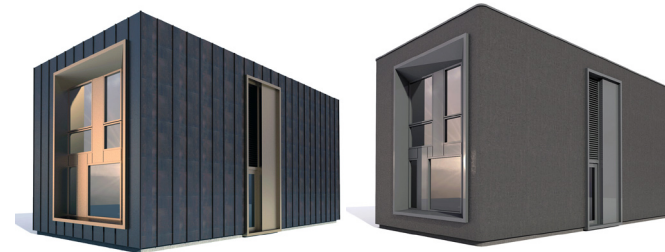
OPEN SOURCE CINEMA CAMERA Build your dream camera, one module after the other. AXIOM is an open hardware plus free software family digital of cinema camera devices. AXIOM camera systems are not only fully open but also built to be entirely modular, ready to evolve into things not even imaginable today. The Open Module Concept renders changing camera parts as easy as exchanging PCIe cards in a PC. It therefore renders AXIOM cameras to be fully extendible and keeps them from being outdated any time soon. This ensures sustainability of the entire assembly, since any module - such as the image sensor - can be replaced while keeping the rest of the camera intact.



MANHATTAN RESEARCH Raymond Scott was an American composer, band leader, pianist, engineer, recording studio maverick, and electronic instrument inventor. In 1946, Scott established Manhattan Research, which he announced would 'design and manufacture electronic music devices and systems.' With his company Scott designed audio devices for his own personal use and provided customers with sales & service for a variety of devices, for the creation of electronic music and 'musique concrete' including components such as ring modulators, wave, tone and envelope shapers, modulators and filters. And instruments such as 'Chromatic electronic drum generators' and 'Circle generators'. He called himself the inventor of the polyphonic sequencer. Scott often described Manhattan Research Inc. as 'More than a think factory - a dream center where the excitement of tomorrow is made available today.'

Scott developed some of the first devices capable of producing a range of electronic tones automatically in sequence. He began working on a machine that according to him made compositions with artificial intelligence. Scott called it the Electronium. With its vast array of switches, buttons and patch panels it is considered to be the first self-composing synthesizer.

Some of Raymond Scott's projects were less complex, but still ambitious. During the 1950s and 1960s he produced electronic telephone ringers, alarms, chimes, and sirens, vending machines and ashtrays with accompanying electronic music scores, and an adult toy that produced sounds that varied depending on how two people touched one another.



ARCHITECTURE AND (DIS)ASSEMBLY Architecture is sometimes a silly profession. It takes a very long time and a lot of money to design every house as a one-off prototype, and that makes no sense if you have a really good replicable design. Flat boxed houses are produced in series, shipped in boxes and can be assembled, disassembled and replaced. Be it permanent housing or temporary shelters.

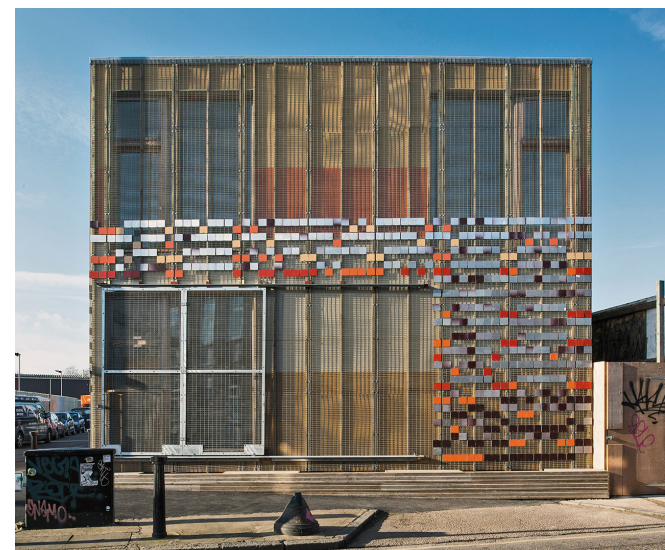


FLAT PACK HOUSES Kiss House comes in two, three and four bedroom versions. Configurable elements enable clients to make kiss house their own. The house is built according to passive energy principles, out of cross-laminated timber (CLT) panels. All Kiss houses are triple glazed. They can be customized using various external finishes and colour schemes. The house is flat packed so that it can be shipped efficiently and assembled very quickly.

REFUGEE SHELTER Better Shelter is a collaboration between the IKEA Foundation and United Nations High Commissioner for Refugees (UNCHR). The Better Shelter comes in flat packed cardboard boxes and people can start building it immediately by following an instruction manual. It is constructed in three subsequent steps: the foundations first, then the roof that includes ventilation and the solar panel, finally the walls with windows and a door. It takes four people four to eight hours to complete the construction. No additional tools are required and most components are assembled by hand.

At a cost of \$1,150 each, the shelters are three times more expensive than a standard UNHCR tent. Yet while the latter are designed to last for just six months, these new shelters last for a minimum of three years in harsh conditions, and up to twenty years in more temperate climates.

BUILDINGS BECOME MATERIAL BANKS In the next 40 years, we will be building just as much as we have built so far in human history. This requires a radically different mindset. Tomorrow's buildings must be designed for disassembly to ensure component and material contin-use. London-based design studio LYN Atelier designed a temporary community center in Hackney Wick, constructed using recycled materials from the London 2012 Olympic and Paralympic Games. The community center, named Hub 67, has a lifespan of up to five years, after which it will be disassembled and its parts reused elsewhere.





PRODUCTS THAT LAST starts where most books on product development end. From the perspective of designers and entrepreneurs, once a product has been designed, produced and sold, it disappears beyond the newness horizon. They are little aware of the opportunities that exist in the next product universe, where money is made from products in use, as well as from a product's afterlife. These opportunities clearly exist, otherwise they would not be providing an income for so many people. However, to be recognized as segments of a circle of continuous value creation, they need reframing.

DESIGN PROFESSIONALS can use it to develop products that enable circular businesses to extend their value propositions well beyond the newness horizon.

BUSINESS PROFESSIONALS can use it to manage product life beyond the point of sales, and to develop new business models that generate value over longer product lifetimes.

DESIGN STUDENTS AND RESEARCHERS can use it as a source of inspiration and guidance, and as a springboard for the study of all the product-life questions that still need to be answered.

PRODUCTS THAT LAST offers readers an innovative and practical methodology to unravel a product's lifeline and systematically scrutinize it for new opportunities. It introduces us to business models that benefit from the opportunities offered by a much longer product life.

PRODUCTS THAT LAST will change the way entrepreneurs and designers develop and exploit goods, helping to reduce material and energy consumption over time. Nothing more, nothing less.



B/SPUBLISHERS