Designing For The Next (Circular) Economy. 
An appeal to renew the Curricula of Design Schools

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Abstract: “We don’t have a waste problem, we have a design problem”, say Michael Braungart and William McDonough, the principle architects of the cradle-to-cradle concept (Braungart & McDonough, 2010). Our current economic paradigm is based on goods being produced, which are used briefly and finally gotten rid of by the consumers. Such a system is so conventional, that we actually stop noticing it (Kortmann & Piller, 2016) and continue teaching it in the business schools and design schools the world over. In November 2015 the department of Design and Product Management (DPM) at the Salzburg University of Applied Sciences hosted an international conference on “Circular Design”. Indeed, at DPM much design research is dedicated to circular product design and due to the very nature of the department- teaching skill sets for the entire breadth of the design process- we feel that we have much to offer in the form of advice.

Keywords: Circular Economy, Co-creation, Cradle-to-cradle, Design Education

1. Introduction
In times of industrial crises business sciences can offer explanations by either looking at what is known, borrowing wisdom from other disciplines or disruptive innovations from the own discipline. One of the greatest social scientists of the 20th century, J. A. Schumpeter, after decades of virtual obscurity is once again widely quoted. It is his famous expression of the creatively destructive entrepreneur and his theories of “long waves” in business cycles that are used to explain the current financial crisis (Acemoglu, 2009). According to the original writings, the faster existing frameworks are done away with the faster a paradigmatic change can take place (Schumpeter, 1942). Perhaps a similar revolution is needed in the design disciplines, and for the lack of a better alternative it is here suggested to make that shift towards the circular economy (CE).
The United Nations Conference on Sustainable Development (Rio+20) in June 2012 demonstrated a renewed focus on pursuing meaningful action for reducing resource and environmental pressures. This is due to the fact that the overriding global patterns of production, consumption and trade remain dangerously unsustainable. In December 2015 the European Commission adopted an ambitious Circular Economy Package, with detailed legislative proposals on production, consumption and waste management (EU Commission, 2015). The objective of this package is the reorganization of a current linear system of production and consumption into a circular economy, in order to minimize pollution of the environment and consumption of resources as well as repositioning the economic system towards increased competitiveness (Preston, 2012). As the system is being questioned on the political level, organizations have to re-invent their production and sales strategies.

The Ellen MacArthur Foundation in co-operation with the global management consulting company McKinsey & Company have done much to advance knowledge of the CE by always being open to partnerships with global business leaders (MacArthur, 2013). Key information is made available on their webpage and various publications and although the material is vast, it focuses mostly on steps taken by businesses in the production and sale of their products. While the CE seems to make headway on a societal level, it is still rarely found in the curricula of design schools.

2. Sustainability in Design

There exist a myriad of ways to design- and produce- sustainably and the authors observe a strong desire amongst Bachelor and Master students to do so. Thus, students create things to last for as long as possible materially (product attachment), produce things that can easily be recycled in order to prolong product lifetime cycle or produce things out of material previously employed in different products (up-cycling). Emotional durability is also very popular as an approach amongst students. This design direction addressed by Jonathan Chapman seeks to create stronger emotionality and enduring interaction with things, which in turn can lead to a more sustainable use of resources (Chapman, 2015). Our everyday things might also be longer lasting by purposefully injecting animacy into design (Norman, 2004) so that human animist tendencies can be triggered (Leube, 2016). Frugality in the use of resources as well as recycling can also help to reduce the need for extraction of raw materials, but the current economic system remains fundamentally open and linear, only delaying its unsustainable demands on the environment. For students, know-how is often limited since there still exists no clear design process for products of the CE.

2.1 Sustainable Design as Behavior Change

A kind of bottom-up approach is suggested here, where the products swamping the market have an ecologically sound design and the status quo than follows with ecological behavior. The places were new products and services are invented and conceived-design schools-are extremely important stakeholders in a much needed change towards sustainability and that change needs to be reflected in the schools’ curricula. If production, use and disposal of products need to change than consequently so does the design process, from an initial idea all the way to market entry and beyond.
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Human Behavior has to be first understood to see what can and what cannot be changed. In Jared Diamond’s 1987 article, “Worst Mistake in the History of the Human Race” he claims radically that the Neolithic agricultural revolution was the advent of a destructive path of dependency (Diamond, 1987). Perhaps the most satisfactory explanation for why we have become so careless with our commodities comes from Thorsten Veblen, who explained why we conspicuously consume (Veblen, 1899). Modern runaway consumerism seems to follow some archaic patterns and when combined with planned obsolescence obviously has detrimental environmental consequences (Slade, 2007). Design (as a discipline) is intrinsically path dependent since options are reduced with advances in the design process. However, the creative process is not teleological and, as Karl Popper remarked, “the future is open” (Popper, 1967).

Evolution as an innovative process is very wasteful, and experimentation tends to trump conservatism. Similarly, humans could enjoy a life of abundance as long as the design of our everyday things considers several lives instead of just one. Recent research in various behavioral sciences (prevention science, cognitive psychology, neurology, and experimental economics) shows that certain interventions can prevent many of the behavioral problems that trouble society. It is now possible to positively influence the further evolution of cultural practices (Wilson et al., 2014) and such knowledge might be crucial for designers. For example, at the British Behavioral Design Lab, a collaboration between Warwick Business School and the Design Council, scientific understanding of people is used to design better products, services and places. Perhaps the most relevant for designers is the so-called nudge theory. The basic argument here is that non-forced compliance can be achieved at least as effective by positive reinforcement as by negative sanctions (Thaler & Sunstein, 2008). Especially designers of services and social innovation – but also those of commodities- can thus become choice architects by shaping the situations in which people make choices. Of course marketers, advertisers and shop designers have been excellent choice architects for decades but their motivation has been on behalf of the seller. Designers could just as easily study human behavior and use choice architecture on behalf of the chooser. The argument made here does not have to be exclusively moral but can also be made using cold economic logic. Designs that reduce morbidity –rates in society will reduce the burden the strain on tax-payers in a welfare state (Miller, 2009).

2.2 Linear Economy vs. Circular Economy for Designers

We feel that the only way to reconcile design and ecology is thinking in terms of the CE, which at a system level goes back to the 1950s. The Austrian biologist Ludwig Von Bertalanffy, generally credited as the founder of the general systems theory noted that a system is characterized by the interactions of its components and the nonlinearity of those interactions. (Von Bertalanffy, L., 1950). A circular economy is based on a closed resource loops so that large volumes of finite resources (used by organizations), are captured and reused (Huber, J. 2000) as well as open approach to innovation and information. ‘Closed loops’ and ‘cradle to cradle’ in a business context were ideas already voiced as early as 1976 by Walter Stahel, a key industrial ecology thinker (Stahel, 1981) At its simplest level, the extraction of virgin materials would be kept to a minimum since these materials would be owned (and reused) by companies. The famous “double- butterfly” diagram (pictured below) illustrates nicely the different (closed) loops that can- and should be- employed in a circular
economy. It is interesting that the technical loops on the right side of the diagram stand in a hierarchical order, with recycling actually being the least effective and desirable.

![A system diagram illustrating a circular economy. (Source: Ellen Macarthur Foundation)](image)

Laying the groundwork for a wider acceptance of the concept and developing a common understanding of CE and its key components would be a first fundamental step in changing the industry the way it stands today. For this reason, DPM organized an international conference on the circular economy in November 2015 called “Circular Design”. The panel of speakers ranged from designers, philosophers and industry-leaders and a full program can be seen on the webpage www.circular-design.eu/Circular-Design.

On the level of design, change towards a circular economy must begin with business-models for creating and holding value over a longer period of time and for a larger group of stakeholders. The business model dictates business activities and consequently the design of products and services themselves. In short, the business model needs to change if resources are to be kept in closed technical and biological cycles (Braungart & McDonough, 2010). As for the business plan, sale of products is no longer a top priority in what has been called a performance economy (Stahel, 2010). For a viable circular design process, material selection is paramount and dependent on use. The choice of materials was less important in the past since production and sale was based on short product-lifespans and responsibilities for use and disposal were given exclusively to the user. Marketing is far from rendered obsolete, since much public relations and sensitization are needed for any systemic change (Birkeland, 2002).
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In a CE, a business is forced „to take responsibility for the entire lives of their products“ (Kleindorfer et al. 2005, S. 487). We believe that the relevance of the CE needs to be taught at every step of the product life cycle and thus we have implemented various courses relating to production (development, manufacturing and distribution), use (sale, utilization, disposal) and circulation (technosphere and biosphere). Following is a description of the circular design process as taught in the department of DPM. Roughly half of our curriculum focuses on product management, which in the context of CE implies a rethinking of all steps along the product-lifecycle from production to use and circulation of resources. The authors believe that co-creation, implying the active participation of all stakeholders is at the heart of a viable CE (Walcher & Leube, 2017).

3 Circular Economy at DPM
3.1 Cradle-to-Cradle

The most effective and rigorous approach for sustainable design is the concept of “cradle to cradle” as formulated by Braungart and McDonough (Braungart & McDonough, 2010). It stands at the center of the CE and the literature to this topic is required reading at DPM for both Bachelor and Master students. Braungart and McDonough’s work is based on the conviction that non-renewable fossil fuels are inherently unsustainable and a turn towards renewable energy sources such as the sun is imperative. But beyond that, it sees ‘materials of consumption’ as either the biological nutrient cycle, meaning that materials should either be biodegradable to be taken up in a natural cycle at the end of a product’s life or the technological nutrient cycle, where they are ‘upcyclable’, and be reused indefinitely in a technological closed loop system. Instead of doing “less bad”, designers should be encouraged to do “more good”, to upcycle rather than recycle (Braungart & McDonough, 2010,
Thus, the approach is inherently positive for designers since it is based on clever use of material rather than renunciation of abundance.

3.2 Material Choice, Co-Creation and Product-Management

The cradle-to-cradle approach is taught in an effort to sensitize students to toxicity (of materials) and closing material loops. The selection of materials for products and buildings has to guarantee that there will not be any off-gasing of toxic substances during their use, and that the material loop can either be closed biologically or technically. In short, the design student is required to deal with issues of biodegradability, disassembly, recyclability, ability to upcycle, reverse logistics and material toxicity. There are other variables to be considered, such as origin (of resources) and mono-materialism (Bakker et al, 2014). Students are required to attend technical courses on materials.

Our students are encouraged to consider the materials used for their designs as early as possible; such choices are fundamental for every step of production and the relationship between tools, materials and manufacturing. Thus, materials have to be chosen for their functionality rather than aesthetics and any time one material can fulfill a given functionality better, their exchange for another should be considered (Papanek, 1972). An example is our mandatory semester project called “Experimental Design”, where students are required to design products with at least two separate lives. With an eye on the entire design process, we encourage our students to mark or designate each and every part of materials used in a poly-materialistic product so that a return into the given technological cycles can be guaranteed.

As with conception, construction of products needs to be different in a circular economy. Products modeled for semester projects as well as Bachelor and Master theses should be modular in design, so that after use the product can easily be disassembled to ensure future use of the separate materials. Easy disassembly also allows for repair of each part, further prolonging the use of the product. The mantra of sustainable product design must be that the ease of repair must be raised to an ideal and should never be just an afterthought. Certainly, the use of epoxies and glues which ensure that products remain closed are strongly discouraged at our department. Encouraged are the study of industrial cases such as Fairphone and the Project Ara phone from Google.

Prior to the sale of a particular product and/or service an open stream of information and ideas must be established. Such topics are subject to rigorous research in the business sciences (Reichwald & Piller 2009). Already in the year 2003, Chesbrough wrote that society is in the middle of a paradigm shift in its treatment of innovation (Chesbrough, 2003). The shift in innovation paradigms is one moving from closed business models to more open and globally-linked ones. The heavy term “paradigm shift”, borrowed from the historian of science Thomas Kuhn is used in order to emphasize the fundamental change in how companies commercialize industrial information and knowledge. Closed innovation is the nature of most current business models, but it is not the only one. Closed innovation is simply a point of view saying that successful innovation necessarily requires control (Chesbrough, 2003). Such a view needs to be challenged in order for the CE to be successful.

Contrary to a closed innovation process, the boundaries- or “membranes” to borrow from biology- are permeable, making the exchange of information with other organizations possible (Walcher, 2012). The reason for this is that at the core of the circular economy lies the share economy and business models based on use rather than property. Currently, concepts such as co-creation, participatory design or inclusive design are being discussed (Manzini, 2015). Manzini (2015) reflects on the very definition of the “designer”, arguing that in a world of endless technical possibilities it is
possible for everyone to be a designer. The exchange of ideas is inclusive; it takes place between customers, workers and business partners in workshops and is designed to address the needs of a given target group.

Designers play a major, but not the only role in the creative process (Ramaswamy, 1996). Expert workshops, for example with lead users can also be part of such a participatory problem-solving process. The transfer of methods from the creative sector onto industry partners has been described as *design thinking* (Brown, 2009) and it is this approach we teach to all students in our department. Most importantly are the repeated iteration cycles where potential users are always asked about the merits of mock-ups and prototypes in order to further improve them.

It has been argued that a collaborative approach might be the only approach to solve the “wicked” problems of this world (Buchanan, 1992). In the words of Boldrin et.al, referring to the invention of the steam engine: “The collaborative innovation occurring after the expiration of the Watt patents resembles nothing so much as modern open-source software development” (Boldrin et.al, 2008). Using a clever play on words, open-source technology has even been called “copyleft” (Mustonen, 2003). Some designers echo such sentiments, most notably those pursuing the field of *design for social innovation* (Manzini, 2015).

![Fig. 3: Design-related aspects to be considered in a circular economy. (Source: Authors)](image)

### 3.3 Marketing and Usage

Contrary to the appeal of Victor Papanek for more responsibility (1972), new products rarely arise from necessity and instead are mostly fueled by marketing ambitions. Indeed, what is currently billed as “innovation” in industrial design is marketing-driven, which means that new desires must be created amongst customers in order for new products to be designed, produced and consumed. Such a model consequently produces considerable waste at every stage of production.

Although environment and corporate social responsibility are again at the forefront of management thinking and research (Chan and Lau, 2003) they are rarely more than *green washing*. The anticipated rise in green consumer behavior predicted for as early as the 1980s was a gross disappointment (Prakash, 2002) and the mass consumer market for green products still needs to be developed. Although this is disappointing on many levels as it shows that mass consumerism is slow to move in a sustainable direction, it is also reason for optimism. Marketing can to a large degree be blamed for overconsumption and the resulting waste in resources, but there is a great need for marketing in an emerging CE as the consumer needs to be educated on such a new system. Basically, the benefits of products made in a new fashion need to be advertised.
Our students are strongly discouraged to design pure service solutions since we consider that a type of escapism. Indeed, Product Service Systems (PSS) are probably the most effective instruments for moving society towards a resource-efficient, circular economy. However, these systems are still not widely implemented probably due to the fact that consumers want to have control over things and artifacts, territoriality being an archaic, human drive. Even in the business-to-business context, where ownership of commodities is far more abstract, PSS are not widely implemented (Goedkoop et al, 1999). It does however make a lot of sense to think in terms of services since it guarantees brand loyalty.

4. Conclusion and Outlook

Mankind seems to be undergoing a paradigmatic change and we find ourselves as the first generation that has the ability and responsibility to shape the future of all of mankind (Jakob v. Uexküll, 1982). Perhaps the historians of tomorrow will look back at this point in time and realize that the means were there to change most current problems. It is up to the designers to use those means. By implementing the above changes to our curriculum, students seem to experience less anxiety and more sense of purpose. Undoubtedly, moving towards a circular economy requires new thinking, skills and competence in design and all of it has to be systemic in nature. But, are designers familiar with CE principles or are they only aware of the buzzword? How well can the design community address CE challenges and turn them into realities with their products and services? It is the curricula of the design schools that have to change radically and quickly because designing for a circular economy would have to be truly disruptive and innovative and requires an open and creative process. It would have to be bold enough to lift the limitations imposed by current thinking and contexts.

References

Acemoglu, Daron, et al. "Reevaluating the modernization hypothesis." Journal of Monetary Economics 56.8 (2009): 1043--1058.
Acemoglu, Daron. "The Crisis of 2008: Lessons for and from Economics." Critical Review 21.2-3 (2009): 185--194.
Bakker, Conny, et al. "Products that go round: exploring product life extension through design." Journal of Cleaner Production 69 (2014): 10-16.
Birkeland, Janis. Design for sustainability: a sourcebook of integrated, eco-logical solutions. Earthscan, 2002.
Boldrin, Michele, and David K. Levine. "Against intellectual monopoly." (2008).
Brown, Tim. "Change by design." (2009).
Buchanan, Richard. "Wicked problems in design thinking." Design issues 8.2 (1992): 5-21.
Chan, Felix TS, et al. "A conceptual model of performance measurement for supply chains." Management decision 41.7 (2003): 635-642.
Chapman, Jonathan. Emotionally durable design: objects, experiences and empathy. Routledge, 2015.
Chesbrough, Henry, Wim Vanhaverbeke, and Joel West. Open innovation: Researching a new paradigm. Oxford University Press on Demand, 2006.
Diamond, Jared. "The worst mistake in the history of the human race." Discover 8.5 (1987): 64-66.
Goedkoop, Mark, et al. "Product service systems, ecological and economic basics." Report for Dutch Ministries of environment (VROM) and economic affairs (EZ) 36.1 (1999): 1-122.

Huber, J. (2000), 'Towards Industrial Ecology: Sustainable Development as a Concept of Ecological Modernization', Journal of Environmental Policy and Planning, October–December 2000, Vol. 2, No. 4, pp. 269–85

Kleindorfer, Paul R., Kalyan Singhal, and Luk N. Wassenhove. "Sustainable operations management." Production and operations management 14.4 (2005): 482-492.

Kortmann, Sebastian, and Frank Piller. "Open Business Models and Closed---Loop Value Chains." California Management Review 58.3 (2016): 88-108.

Leube, M., It's Alive: An Empirical Study on Animism and Animacy in Product Design, Paper presented at the Design and Emotion Conference Proceedings, Amsterdam, 27-30/10/2016.

Leonard, Thomas C. "Richard H. Thaler, Cass R. Sunstein, Nudge: Improving decisions about health, wealth, and happiness." Constitutional Political Economy 19.4 (2008): 356---360. MacArthur, Ellen. "Towards the circular economy." Journal of Industrial Ecology (2013).

Manzini, Ezio, and Rachel Coad. Design, when everybody designs: An introduction to design for social innovation. MIT Press, 2015.

McDonough, William, and Michael Braungart. Cradle to cradle: Remaking the way we make things. MacMillan, 2010.

McDonough, William, Michael Braungart, and Bill Clinton. The upcycle: Beyond sustainability-designing for abundance. Macmillan, 2013.

Miller, Geoffrey. Spent: Sex, evolution, and consumer behavior. Penguin, 2009. Mustonen, Mikko. "Copyleft—the economics of Linux and other open source software." Information Economics and Policy 15.1 (2003): 99-121.

Norman, Donald A. "Emotional design." (2004).

Papanek, Victor, and R. Buckminster Fuller. Design for the real world. London: Thames and Hudson, 1972.

Piller, Frank T., and Ralf Reichwald. "Wertschöpfungsprinzipien von Open Innovation." Kommunikation als Erfolgsfaktor im Innovationsmanagement. Gabler, 2009. 105-120.

Popper, Karl Raimund, and Konrad Lorenz. "Die Zukunft Ist Offen Das Altenberger Gespräch, Mit den Texten des Wiener Popper---Symposiums." (1985). Prakash, Aseem. "Green marketing, public policy and managerial strategies." Business strategy and the environment 11.5 (2002): 285-297.

Preston, Felix. "A global redesign? shaping the circular economy." Energy, Environment and Resource Governance 2 (2012): 1---20.

Ramaswamy, Rohit. Design and management of service processes: keeping customers for life. Addison-Wesley, 1996.

Schumpeter, Joseph. "Creative destruction." Capitalism, socialism and democracy (1942): 82---5.

Slade, Giles. Made to break: Technology and obsolescence in America. Harvard University Press, 2009.

Stahel, Walter R., and Genevieve Reday-Mulvey. Jobs for tomorrow: the potential for substituting manpower for energy. Vantage Press, 1981. Von Bertalanffy, Ludwig. "An outline of general system theory." British Journal for the Philosophy of science (1950), pp. 139-164

Von Uexküll, Jakob. "The theory of meaning." Semiotica 42.1 (1982): 25-79.
Walcher, Dominik, and Frank Thomas Piller. *The customization 500: an international benchmark study on mass customization and personalization in consumer e-commerce.* ICON Group International, 2012.

Walcher, D. & Leube, M. *Kreislaufwirtschaft durch Co-Creation: Wandel von Kunden- und Anbieterrolle mit Neudeinition von Geschäftsmodellen; PraxisWissen Marketing* (German Journal of Marketing), Arbeitsgemeinschaft für Marketing, 2017.

Wilson, David Sloan, et al. "Collaborating on evolving the future." *Behavioral and Brain Sciences* 37.04 (2014): 438-460.

**Internet Sources**

http://www.philips.com/innovationmatters/blog/circular-economy-by-design.html
https://www.macfound.org/ http://www.circular-design.eu/Circular-Design-Deutsch/CD-Konferenz-2015/Programm/ http://www.behaviouraldesignlab.org https://www.dezeen.com/tag/mobile-phones/ https://makermedia.com/
https://www.ellenmacarthurfoundation.org/
https://makermedia.com/ (accessed 26/12/2016)
http://www.circular-design.eu/
https://www.dezeen.com/tag/mobile-phones/, (accessed 26/12/2016)
http://www.behaviouraldesignlab.org, accessed on 9/2/2015