



Why we need a digital highway to the circular economy

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ABSTRACT

The need for advancing the Circular Economy is beyond doubt in the context of sustainable development and the fight against climate change. However while everybody agrees on the objective, the ways and means to achieve this remain less clear. Current barriers are first and foremost related to the inherent difficulties of the concept of the circular economy and have to do with structural issues of the businesses involved but also with behavioural aspects of individuals and organisations involved in the process. This short commentary addresses first the nature of the barriers to circularity and then the possible enabling role of information and communication technologies. To the extent that companies can achieve the transition towards a servitization of their products (products as a service) they may possibly succeed in translating the different components to digital occurrences through the appropriate ICT applications and components. However this will need a consistent business approach to digital transformation which presents its own hurdles.

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1. Introduction

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2. The imperative for a Circular Economy

Defining the Circular Economy could be a daunting task, since, despite the apparently clear concept, a lot of underlying difficulties remain. Hence a recent trend is to go for a meta-definition (definition based on a synthesis of other definitions). One of them identifies the Circular Economy in the following terms: "...an economic system that is based on business models which replace the 'end-of-life' concept with reducing,

alternatively reusing, [and] recycling [...] materials in production/distribution and consumption processes, [...], with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations" (Kirchherr et al., 2017, pp.224–225).

While there is an ongoing interest in the academic circles (but also in the mainstream media) on the circular economy the concept is not entirely new. Its origins can be traced back in the '60s with the discussion continuing until the end of the century and beyond. The recent strong diffusion of the basic idea by the Ellen MacArthur Foundation (Ellen MacArthur Foundation, 2013) gave it a strong impetus and drew considerable support by policy makers and prominent industries worldwide, in the light of the adoption of the UN Sustainable Development Goals. Supporters of the Circular Economy appreciated its concrete objectives and analysis and have seen that, probably for the first time, tangible results could be within reach. The benefits promised by the concept were huge: not only on making Sustainable Development a reality but also touching on concrete economic benefits: for instance the Circular Economy could help reduce CO₂ emissions by a whopping 48%, while creating some two million additional jobs in the European Union until 2030 and producing a net economic benefit of EUR 1.8 trillion.

Reminding the reader that the Circular Economy is an imperative for humanity may seem today quite trivial. During the last 20 years, a strong academic literature has demonstrated the

key benefits for adopting new consumption models privileging resource efficiency. We need to learn how to move away from the dominant model of “take, make and dispose” towards a different approach that evaluates and critically reappraises the role and the value of everything that is materially produced and consumed. More importantly we need to apply serious design-thinking like approaches in all production processes that ultimately should minimise waste, ensure to the maximum extent possible the re-usability of the whole or the parts of marketable products and create ‘authentic’ consumer responses that would prevent wasting precious resources, while privileging re-use. And this is not unimportant: McKinsey calculates that about 80 percent of the \$3.2 trillion worth of materials used by industry is never recovered.

However recycling is very different from a genuine circular economy process. In a circular economy, the production process becomes a systemic component for circularity as it has to be identifiable at all levels of the products life cycle. The potential of using non-toxic and pure components that at the end of their cycle could safely return to the biosphere, is crucial. Maximising the safe use of such cycles is critical and will ultimately define the context of circularity we want to achieve.

Such an approach calls for a radical departure of conventional roles. In the circular economy consumer profiles are replaced by user ones but such a consideration redefines the whole scenario for company behaviour and pushes for a whole new model that abandons ‘ownership’ with ‘temporary and controlled usage’ for circular economy products. This trend changes fundamentally the economic interplay for companies that wish to engage in the circular economy and creates new classes of problems that have to do with material management, quality control and integrated information management of the different design, production, lease, collection and re-use of the thus manufactured products.

3. The stumbling blocks: overcoming barriers on the road to circularity

Devising and managing a specialised information system on the circular economy is theoretically possible. It could be conceptualised like a central database that would store all kinds of parameters on the material state of products of the physical world that would need to address the issues of circularity. However before designing any information system, there is a need to identify well the underlying components of the entity or organization this is about to serve. Moreover it is necessary to identify the barriers that are inherent in the Circular Economy concept as a whole and prevent it to happen in the first place.

Before however identifying the barriers, it is useful to stress the potential and the strengths of the Circular Economy. A seminal report by the Ellen McArthur Foundation has identified four principles that characterise the circular economy in terms of value creation: these refer to: (a) the ‘power of the inner circle’ minimises the life-cycle of the product’s use and allows it to return to active use faster and less modified (b) the ‘power of circling longer’ refers to optimising the number of successive cycles as well as the timing of each cycle (c) the ‘power of cascaded use’ refers to reuse diversification across the value chain (multiple diversified instances of the same material, coming up as different product and (d) the ‘power of pure circles’ denotes that materials may come forward into several ‘uncontaminated streams’ that have an impact on their lifetime and productivity.

These four principles may guide the firms wishing to engage towards the circular economy to new organisational and business

models that are able to deliver results that are viable and economically sound. At the same time these business models have to be highly innovative and this presents firms with significant conceptual and organisational challenges. Such systems have emerged recently as Product-Service-Systems (PSS) (Beuren, F.H., Ferreira, M.G.G. & Miguel, P.A.C. (2013)) putting the emphasis from product to service orientation. These systems require exceptional innovativeness and are highly demanding. But they tend also to be most appropriate for pushing forward sustainable development.

Firms that are able to advance in this path are beneficial for the Circular Economy but they still have to struggle with at least three challenges: resources scarcity, reduced environmental impact and tangible economic gains. In order to be able to cope with these challenges, firms have to be able to manage and apply the so-called four R strategies, namely: repair, reuse, recondition and recycle. These can be better addressed if the concept of developing a product as a service is widely applied (Tukker, A. & Tischner, U., 2006).

Moving on to these strategies though, can face a lot of barriers, most often linked with structural, economic or behavioural factors. Such barriers are linked to behaviour and knowledge, value chain integration, as well as technology used. A better information and data exchange between suppliers and producers and between producer and customers could provide solutions. Some of these barriers can be addressed with new innovative attitudes but others require metrics and metrics management. These last ones can be better handled through information technologies.

To overcome such problems the help of information and communication technologies is crucial. Managing information of such complexity is close to impossible without the use of a sophisticated information system that would allow data storage, referencing and retrieval. But here is where the real problem starts.

4. Enabling the Digital Transition to a Circular Future: Tools and Pathways

The last part of the 20th century and the beginnings of the new one have seen unprecedented advances in ICT (Information and Communication Technologies). The advent and the generalised use of the Internet has paved the way for major breakthroughs that are gradually becoming mainstream like the Internet of Things (IoT), big data, analytics, artificial intelligence (AI) and robotics. Such advances suggest they can potentially be used to advance the Circular Economy in novel ways, helping material tracing across supply chains, identify products and track their status, signalling stages in their use. Thus technology can support the conception and implementation of business models like products as services, radically powering the ‘servitization’ of product delivery.

Several possibilities emerge, but a specific number of functionalities seems to be at the core of this trend: in particular the literature refers to: improving product design, focusing on particular customer base, monitoring product activity, providing technical assistance, delivering preventive and predictive maintenance, optimizing product use, delivering possible upgrades, reinforcing renovation and catering for product end-of-life activities. Among the developing technologies that can deliver on such functionalities, IoT could be classified as the more promising as it can be used for most of the monitoring and acting remotely functions identified above. Big data and analytics can be used to track and evaluate the state of products, improve

predictive maintenance and reduce waste, as they are able to identify the exact status of constituent parts and deliver literally only what's needed. Blockchain can also be used to better document and track data and procedures, adding to overall trust at the system.

To advance on this path, we need to raise awareness about available technologies, document existing technological possibilities and raise awareness and skills among professionals and the general public. Pilot-projects can be used to test model implementations corresponding to different real world cases and provide some practical blueprints, especially to the Small and Medium Size enterprises (SME) that are not generally ready to adopt new innovative business models. Documentation and systematic training should become available to the vast majority of businesses, together with appropriate mechanisms for assessment, monitoring and control of model implementations. Legislation must enable such efforts that have to be on a significant scale in order to be efficient and bring a real impact for the Circular Economy.

The widespread transformation of business models towards servitized ones will take time, with a lot of uncertainties about the ways to follow. History has repeatedly proven that it is very difficult to foresee which kind of innovative technologies can survive the test of time and remain competitive in the market. It is also true that there are many barriers to the development and wider use of such technologies, such as lock-in to existing ones, price signals that tend to favour less eco-efficient solutions, and complicated access to finance. Consumer awareness will be also critical as behavioural responses will largely determine the success or failure of new initiatives. One major challenge is therefore to improve the overall performance of the new servitized products throughout their life-cycle, in order to improve demand. Improved services to customers through advanced ICT for the Circular Economy could have a huge positive impact towards its adoption and success.

However such a perspective assumes a widespread adoption of advanced ICT by businesses across the board, which is not yet the case. Despite the fact that everybody acknowledges the need for digital transformation a lot of companies hesitate to take the plunge. Multiple causes have been identified by researchers and these range from lack of vision, no real sense of urgency regarding relevant needs, cultural objections but also institutional barriers. Starting from the top, leadership adherence is one of the most important impediments to transforming digitally the enterprise. Essentially a matter of vision about the nature and the evolving structure of business, lack of leadership motivation on pushing ahead with the digital transformation is crucial (and this has enormous implications also for the drive to servitization of products). Other factors include inertia to move forward from legacy (but still working) technologies, resistance from older staff and some kind of 'change fatigue' that may delay or stop new initiatives from happening.

For businesses wishing to move to Circular Economy solutions, adoption of a positive attitude to embracing new technologies is key. To this end, an integrated strategy is essential, combining the steps towards transforming the way end products are produced, delivered and serviced, together with ways to embrace and adapt digital solutions. To move forward, managerial solutions are necessary, together with technological ones. Providing for example incentives to staff to advance on the digital transformation may positively accelerate things. Introducing moral incentives is not costly and can make a difference: digital champions could be used to motivate and inspire transformative change across departments and provide

role models to follow. The need for entire organisations to move to a digital circular economy is greater than ever.

5. References

- Beuren, F.H., Ferreira, M.G.G. & Miguel, P.A.C. (2013) Product service systems: a literature review on integrated products and services, *Journal of Cleaner Production*, No 47, pp 222–231.
- Bocken, N., Short, S.W., Rana, P. & Evans, S. (2013) A literature and practice review to develop sustainable business model archetypes, *Journal of Cleaner Production* 65, pp. 42–56.
- Boons, F. & Lüdeke-Freund, F. (2013) Business models for sustainable innovation: state-of-the-are and steps towards a research agenda, *Journal of Cleaner Production*, No. 45, pp 9.19.
- Ellen MacArthur Foundation, 2013. Towards the circular economy: Economic and business rationale for an accelerated transition. *Journal of Industrial Ecology*
- Fitzgerald M.,Kruschwitz N., Bonnet D., Welch M. (2013) Embracing Digital Technology, A New Strategic Imperative, MIT Sloan Management Review, Research Report (in collaboration with Capgemini Consulting)
- Julian Kirchherr, Laura Piscicelli, Ruben Bour, Erica Kostense-Smit, Jennifer Muller, Anne Huibrechtse-Truijens, Marko Hekkert (2018) Barriers to the Circular Economy: Evidence From the European Union (EU) *Ecological Economics* 150 (2018) 264–272
- Moritz, Kugler (2016) Barriers and drivers towards Circular Economy within industrial manufacturers. *Technische Universität München*.
- Stahel, R. W., 1982. The Product-Life Factor. In: NARC, Hrsg. An Inquiry into the Nature of Sustainable Societies: The Role of the Private Sector. s.l.:1982 Mitchell Prize Papers, pp. 72–96
- Tukker, A. & Tischner, U., 2006. Product-services as a research field: past, present and future. Reflections from a decade of research. *Journal of Cleaner Production*, pp. 1552–1556.