Resumen Economía Circular Capítulo 1*

Mariano Andrés Garcia Fabián[1 [0009−0002−5359−3519]], Candelaria Ortiz[1 [0009−0005−3282−9926]], Genaro Scacciante Casaseca[1 [0009−0005−9350−7955]], and Agustín Hernán Jara Gentile[1 [0009−0007−2955−2940]]

Universidad Nacional de Cuyo, Mendoza, ARG
marianogarciafabian98@gmail.com; agustinjaragentile@gmail.com; ortiz.candelaria2002@gmail.com; pity-scacciante@outlook.com

Abstract. This edited book focuses on the circular economy perspective, which involves designing everything to be reused as long as possible and repurposed when reuse is no longer possible. The book adopts a biomimetic lens and discusses the need for cross-industry flows and different actors beyond producers and consumers in circular value cycles. The book covers the spectrum of recovery possibilities to return products back to the consumption supply chain, and the essential role of information management. It aims to move beyond a dyadic view and embrace a holistic network or ecosystem view, considering a cross-industry system perspective where there is a diversity of actors needed for a working ecosystem.

Keywords: Circular economy, circular systems, biomimicry, value systems, circular flows, and ecosystem view

1 Chapter 1

1.1 Introducción

The transition to a circular economy, which is based on principles of designing out waste and pollution, is challenging for US companies due to products that are difficult to disassemble. However, it is a sustainable and flexible way to grow without exhausting primary materials. Waste is reduced by closed-loop recycling and reuse, going beyond traditional recycling methods. The EU has created a finance support platform for circular economy projects, directing billions of euros towards these projects. The circular economy also involves a shift in product ownership to purchasing a service and a financial model of leasing rather than ownership. Collaboration within the circular framework is important, and networks of industries can be designed analogous to food webs to reach a sustainable and efficient state.

The book covers the biomimetic roles of producers, consumers, scavengers, and decomposers, and provides insights to transition linear supply chains to circular systems. Current economic systems have an abundance of producers

* Lydia Bals; Wendy L. Tate; Lisa M. Ellram

and consumers, resulting in a linear material usage pattern. In contrast, natural ecosystems have a balance between producers, consumers, scavengers, and decomposers. A systemic perspective that embraces cross-industry flows and an expansive spectrum of actors is needed to establish circular value cycles and move beyond limited-scope recycling solutions that result in value degradation and waste.

The current research lacks a systemic perspective that is needed to achieve an integrated management of material and information flows to realize a circular economy with circular value cycles. The biomimetic lens highlights the need for cross-industry flows and additional actors beyond producers and consumers. This book focuses on bridging the current linear material usage patterns towards circular systems, with a particular emphasis on biomimicry in natural ecosystems.

1.2 Structure Of Overall Book – The Biomimetic Lens

The book aims to provide a comprehensive overview and coverage of actors and preconditions for a circular economy using the biomimetic lens. Chapters are organized according to the respective actor group or needed information infrastructure. The book includes broad early chapters with a system perspective, specific roles of actors, information and financial flows, contextual ramifications, and cases from various industries. Many of the chapters highlight the importance of the roles of scavengers and decomposers in moving towards a circular business ecosystem. Ver imágenes adjuntas de la Tabla 1.2 en el anexo.

1.3 Conclusions

The authors of the book aimed to fill a gap in publications related to circular economy and value systems, using a biomimicry-inspired lens. They were grateful to the authors who contributed to the book. The book is divided into two parts: Chapters 2-13 focus on specific topics related to circular economy systems, while Chapters 14-19 provide practical examples and applications. The book is intended for both research-oriented and practical audiences, with numerous suggestions for future research provided throughout the individual chapters. The case studies may be particularly useful for companies or educational discussions. Overall, the book provides a system perspective on contemporary circular economy thinking and practice.

Table 1.2. Main Findings and Practical Implications.

#	Main Findings	Practical Implications
2	• Industrial symbiosis (IS) manifests in three different supply network contexts: localized, regionalized, or globalized, each with representative single or mixed industry sectors and different types of materials, products, and reuse potential. • The major challenge in local contexts lies in engaging diverse organizations, finding potential matches, and developing contracts between them as they may have little in common, except that they are located in the same region	• There is a high potential for symbiosis in networks where secondary materials are available locally and where social capital and shared values around material conservation exist. In such circumstances, facilitators, led by public, private, or hybrid ventures, could focus on bringing together diverse industry actors who could find partners for reusing or sourcing secondary materials or providing shared services for processing more commonly generated waste materials into materials that could be used by a wide variety of firms as inputs. • In a network that is more global with technologically complex products, there may be fewer opportunities for localized symbiosis, but instead, coordination across members of the global network can identify opportunities for material reuse at particular geographic nodes in the network. • The diversity of supply networks presents an opportunity to compare the varied circumstances under which IS offers realistic opportunities for supply chain reconfiguration to utilize local secondary materials
3	• Information on local supply networks, extended supply systems, and biosphere impacts is particularly important for circular production	• From local supply networks, actors playing the roles of scavenger and decomposer need to know what waste materials are available and what can be done with them. • In extended supply systems, information is needed from governments on their initiatives and regulations, as well as from analysts on potential critical material shortages. • Information needs to flow to consumers on circular product quality and how to participate in post-consumer waste collection. • Biosphere information should ideally be collected and translated into a form useful for individual actors

Fig. 1. Anexo Tabla 1.2

4	• A conceptualization of the transition from linear to CSCs using the adaptive cycle for the purpose of illuminating how the supply chain is embedded in a dynamic multilevel structure. By taking this nested view, a panarchical perspective allows us to reimagine supply chain models	• The co-occurrence of *remember*, *revolt*, and *release* influences creates opportunity. For manufacturers, seizing this window of opportunity enables the renewal of supply chain models and the potential to play a transformative role in shaping sustainable systems change for the future. • A panarchical perspective can help managers to understand when and how to act, to evaluate the effectiveness of possible circular strategies, and to understand the phases of creative opportunity, to develop circular business models that are transformative. • By building collaborative partnerships that reflect cross-level interactions between the supply chain, political-economic, and planetary levels, manufacturers can not only adapt more rapidly to changes in their contextual environment but also play a transformative role in systems change. • Through novel recombinations, a new supply chain model can be developed that will shape how usage and product transformation come together to create a fully circular mobility system
5	• Business models for a circular economy can guide value creation that promotes circular value chains. • For developing opportunities for value creation and capture within CBM, opening up the business model can contribute to joint value creation in a circular economy	• When moving toward circularity, producing companies are advised to expand their dyadic perspective of suppliers and customers to a network perspective and open their business models. • Joint value creation in the circular economy can be achieved by shifting the business model perspective more toward joint value creation and sustainability-oriented value chains that cannot be closed within a single company logic
6	• Locating recycling and sorting facilities in proximity to each other, as well as locating fabric and garment manufacturing in the same area, helps achieve the lowest cost and CO_{2e} CLSCs for each market	• Employ network perspectives by considering all distance- and location-dependent factors of every CLSC stage when selecting facility locations and suppliers in CLSCs to achieve the highest CLSC performance to support circular economy transition

(*Continued*)

Fig. 2. Tabla 1.2

Table 1.2. (*Continued*)

#	Main Findings	Practical Implications
7	• Moving forward, companies, regulators, and consumers need to reconsider the balancing of their interests, by forming reciprocal relationships. This stakeholder-theoretic concept is similar to the first principle of using natural ecosystem thinking in the circular economy. According to that principle, producers, consumers, scavengers, and decomposers must operate in a closed-loop format, and with harmony to create integrated value	• Firms pursuing a circular economy approach should try to serve multiple stakeholders as a managerial framework to attain long-term sustainability. • Stakeholder theory could advance circular economy implementation in industries at a global level. • There are insufficient numbers of "scavengers" and "decomposers." • It is important that at the initial stage of product design, the item's eventual fit in the circular economy is planned for and its modules or subassemblies, after being refurbished, may possibly be employed in a remanufactured unit to enhance the number of scavengers and decomposers
8	• Rather than focusing strictly on consumption, these organizations seek to design value creation systems that support a more holistic view of people's lives. Rather than treating humans as passive consumers of goods, these organizations seek to create symbiotic relationships with human end-users throughout their supply chains, from procurement and production to marketing and logistics (forward and reverse)	• Consumer-centric circular economy models offer a practical framework for redesigning core supply chain processes to better align with five underlying circular economy principles: closing, slowing, narrowing, dematerializing, and intensifying resource loops
9	• Secondary markets offer financial, social, and environmental benefits and are likely to become an increasingly important part of the retail systems going forward	• Sustainability and the circular economy can truly be better than free. • Secondary markets are clearly outpacing traditional brick and mortar retail and making a huge difference in the amount of excess inventory that used to be destroyed and placed in landfills

Fig. 3. Anexo Tabla 1.2

10	• Both blockchain and circular economy performance measurements – especially reverse logistics processes – are still evolving in both theory and practical developments	• Transactions on blockchain can highlight organizational-level activities, supply chain processes, and broader macro levels. This can set the stage for effective circular economy performance measurement concerning economic, social, and environmental issues. • Blockchain can enable the performance measurement and management process by involving stakeholders of various levels and providing transparent and secure information systems. • With the current underrepresented usage of environmental performance measurements, innovative technologies such as blockchain can help increase the efficiency and applicability of such measurements in the supply chain context
11	• Operationalizing CSC calls for much sophisticated, interdisciplinary, and very large-scale optimization models within which multiple criteria and mostly conflicting interests of decision-making units (consumers, businesses, supply chains, etc.) surface. • A holistic focus on the quadruple bottom-line aspects of circular economy seems to be lacking, especially from an overarching sustainable development perspective, including social enterprises (Bals & Tate, 2018)	• CSC modeling can benefit from the emerging field of sustainable supply chain analytics (SCCA). • The appropriate use of big data can provide insights into how CSC can slow down consumption by learning from consumer behaviors and leveraging sustainable consumption

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Fig. 4. Anexo Tabla 1.2

Table 1.2. (*Continued*)

#	Main Findings	Practical Implications
12	• The results from the efficiency evaluation are used as a dependent variable in determining which economic, social, institutional, and other factors have the greatest influence on circular economy and sustainable development achievements. • The resource production and corruption perception index has the greatest effect on the efficiency scores, followed by education attainment. The research and development variable is not significant in the observed sample	• Policymakers can rely on the efficiency scores as single numbers which enable them to make easier decisions, as those scores are a result of many different relevant variables that are taken into consideration at once. • The period and countries included in the study are the biggest possible based on the data (un)availability, so that better insights can be obtained in the results and possible causes
13	• As the results show, current legislation is organized along an axis of silos. This is typical for the governance structure of the linear economy	• To build up a circular bioeconomy, of which frass is a part of, this silo structure needs to be broken down. A collaboration between our case company, a soil improvement producer, and relevant competent authorities is seen as a useful first step bridging these silos
14	• The cases on circular innovations suggest a shift from firm-centric to "sustain-centric" dynamic capabilities which should not prioritize the firm's objectives over social, environmental, or stakeholder concerns at the ecosystem level	• Our multilevel perspective presented in the circular economy maturity model offers a potential pathway with a clear entry point for managers, connecting firm-level action with supply chain and then societal and environmental engagement

Fig. 5. Anexo Tabla 1.2

Table 1.2. (*Continued*)

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Fig. 6. Anexo Tabla 1.2

15	• This hybrid identity between an agricultural and an industrial enterprise led BDG to be stuck in gray legal and regulatory areas, which undermined its access to permits and insurance designed for either agricultural or industrial ventures. • The track record of mushroom farms in Canada, which includes several bankruptcies and the risk of contamination, compounded with a lack of data on the financial feasibility of such a project, led the bankers to assess their project as high risk. • This combination of alternative methods brought many challenges to the entrepreneurial duo because they are rarely used in this industry. They had to learn through research and development. Gaining such expertise helped them establish their credibility in the new niche market they were creating	• Creating a symbiosis is a social process through which actors exchange values (sustainability and circularity) and intentions (a business plan, a project, and intentions), which translate into material fluxes of living matter (such as beer draff and coffee grounds) and exchanges (financial and nonfinancial). • The higher costs relate to accessing geographically dispersed and qualitatively diverse materials are compensated for by the fact that they are free of charge. BDG provides a disposal service that is free for suppliers building social capital in their network. • BDG creates a close-knit network of suppliers and clients; this proximity makes the circulation of information, relates to both the quality of the product and the environmental benefits, about the process available. • Rules-based issues are not related to the absence of support but rather the need to systematically translate the circular business model features into noncircular, generic, and preexisting fiscal or regulatory categories

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Fig. 7. Anexo Tabla 1.2

Table 1.2. (*Continued*)

#	Main Findings	Practical Implications
16	• The future of tourism is dependent on the protection of cultural and natural heritage. Without this heritage, it is hard to achieve a sustainable touristic supply. • In circular tourism, it is important to address the roles of "unknown" actors and facilitate that they get an important role in waste prevention, waste management, and resource (re)distribution. In the destination, one of the more ambitious initiatives is to develop a circular destination certification, but the infrastructure available for, e.g., sorting waste constitutes a barrier for this	• New actors are involved in the network such as contact to waste management (both private actors and the municipality), local food suppliers, and sustainable transportation associations. • Through the network, the natural and cultural heritages are addressed as something that is "reused" and preserved, rather than something that is "used." This is also an important element in circular tourism: that the cultural and natural assets of an area are not degraded
17	• This case study demonstrates that while the guide may have been well received by public procurement officers, actually implementing its recommendations in tenders presents both a challenge and a learning opportunity	• Market engagement is imperative, as it can function as an innovation space wherein suppliers can demonstrate sustainable and circular solutions and discuss with public procurement officers how user needs can be met, or how needs and functionality could be redefined. • User groups should be included in the market engagement process in order to improve the communication between suppliers and user groups

Fig. 8. Anexo Tabla 1.2

18	• Circular economy native companies aim at durability of materials, materials that can be recycled repeatedly while keeping the quality, and reducing the environmental impact (less emissions, less water use, less chemicals, less energy, and green energy options). These kinds of decomposers on their part desire to change the world to be a better place to live in. • To accomplish the system change to circular economy, efficient system collection, and sorting of materials is needed as well as open-minded and innovative collaboration between network members. Regulatory bodies can also boost the change and set the level for circular economy. However, in a transition to circular economy, innovative thinking and innovations have a particular role. Finally, yet very importantly, socio-institutional and behavioral change toward circular economy-minded thinking of all network members is needed to reach systemic change to circular economy	• As the reused materials require relatively little processing, reusers of waste materials, together with their partners (e.g., garment factories, NGOs), act as a link between material streams and users of items created from the reused materials; supply chains in this group remain relatively short and the level of material processing is low. • Users of recycled materials contribute to decomposers circular ecosystem in dual roles; they sell and/or rent their products through their own brands as well as they aim to find ways to mechanical process development for the waste or use recycled fiber developed by others. • The technology developers have a high potential to contribute to a circular ecosystem by recycling several kinds of waste materials, and radically reducing the environmental impacts and closing material loops. • Facilitators could provide a steppingstone for companies of all sizes to gain visibility to their materials and to deliver the materials to ecosystem members. Facilitators are an emerging circular business model, but they could potentially have a significant impact in connecting companies into a circular ecosystem

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Fig. 9. Anexo Tabla 1.2

Table 1.2. (*Continued*)

#	Main Findings	Practical Implications
19	• At the final consumer front, it is important to emphasize that the design of fashion products must effectively be adapted to allow the use of recycled cotton. • There are no incentives for final consumers to correctly dispose and for scavengers to be financially rewarded. Finally, there are misguiding projects by larger brands. • Balance and transparency would allow scavengers to flourish as well as final consumers to gain awareness of the social benefits of transitioning to sustainable and circular fashion in Brazil. • Given the level of informality and lack of financial incentives, regulation might be key to foster the development of scavengers	• When a brand such as Osklen adopts a sustainable innovation, but fails to communicate it with clear criteria and impact measurement, and also targeting the right audiences, the value is not properly appropriated, and thus the innovation does not pay its costs. • There is no financial incentive for final consumers to bring clothes to the recycling bin, and moreover, this initiative ties the recycling effort to a visit to the store, alienating final consumers that do not want to visit such stores. Most importantly, there is a lack of transparency of what happens to these returned garments

Fig. 10. Anexo Tabla 1.2