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Circular Economy: Enabling the Transition towards Sustainable Consumption and Production

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Synonyms

Blue economy; Closed-loop economy; Cradle to cradle

Definition

The circular economy concept describes an industrial economy with a zero-waste approach. Circular economy is a model for sustainable economic growth, where generation of waste and pollution is minimized by maintaining the value of products and furthermore materials longer and keeping them in circulation. It has a foundation in multiple sustainability-oriented practices, including the reduce, reuse, and recycle principles of waste management hierarchy, the one industry's waste is another's resource approach, the regenerative principles of cradle-to-cradle design, and the sustainable business model approach of product-service systems. Circular economy includes both biological materials and technical materials.

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Biological materials are beneficial for a circular economy as their natural circulations can be harnessed for value creation; and technical materials can be reused multiple times without producing waste and harm to the environment (Scott 2015). In addition to combining earlier sustainability approaches, circular economy discusses the need for a fundamental shift of practices throughout macro-level (national and global), meso-level (regional and business networks), and microlevels (products, firms, and consumers) and the implementations on each level.

Introduction

From mid-2000s forward, the concept of circular economy has been gaining ground as a path toward sustainable consumption of natural resources while maintaining economic growth. It is often introduced as a replacement to a "linear economy" where natural resources are turned into products, which in turn become waste at the end of their life cycle. The linear model creates a dependency between economic activities and consumption of natural resources, a dependency that has already led to global over-consumption of natural resources. If continuing as is, the situation will only worsen, as global population and consumption per capita continue to grow simultaneously. By introducing a model where materials and products are diverted from becoming waste and maintain their value and stay in circulation for longer, circular economy seeks to decouple economic growth from consumption of natural resources.

Circular economy is tightly connected to sustainable development, linking closely to UN's sustainable development goal (SDG) 9: industry, innovation and infrastructure, SDG 11: sustainable cities and communities, and especially the SDG 12: responsible consumption and production. However, due to its focus on solving natural resource consumption and waste issues, circular economy has lacked a holistic perspective of the environmental, economic, and social aspects of sustainable development, primarily emphasizing the economic and environmental aspects (Murray et al. 2015). Recently scholars in the circular economy field have started focusing more on the social aspects of circular economy implementations by adopting a triple-bottom-line approach to analysis and making circular economy relevant for further sustainable development goals, such as SDG 8: decent work and economic growth and SDG 10: reduced inequalities. Acknowledging the holistic framework is crucial for circular economy to fulfill its promise of sustainable development, as the change from linear to circular models has drastic effects on, for example, existing waste management systems in countries where many rely on informally collecting and selling recyclable materials (Fei et al. 2016).

Partly the emphasis on economic and environmental sustainability is a result of the circular economy concept's focus on extending the hierarchy of reduce, reuse, and recycle, also called as the 3R principles, from waste management to national and regional development and industrial systems all the way to the consumer. Through this extension, the circular economy approach has a novel capability to suggest concrete implementations that simultaneously fulfill the 3R principles and are economically viable while also acknowledging the need for a fundamental systemic change of activities around production and consumption. As a result, circular economy is often discussed as a way to implement sustainable development (Ghisellini et al. 2016; Kirchherr et al. 2017). Especially CE focuses on ways to reach SDG 12: responsible consumption and production. This approach has also led to criticism due to a lack of clear theoretical foundation for the concept of circular economy and also for the way of adopting multiple earlier concepts under its umbrella, as implementations of circular economy can be drastically different based on the level of analysis and approach (Blomsma and Brennan 2017; Homrich et al. 2018).

To capture the essence of circular economy as a simultaneously systemic and concrete approach to sustainable production and consumption, this entry is structured around displaying how circular economy has been implemented on macro-, meso-, and microlevels of activity, an established categorization in the circular economy literature (Ghisellini et al. 2016). The dominant methods of implementing circular economy are also shortly presented, and links to SDGs are highlighted. However, since circular economy is still a young and developing concept, the core principles of 3R principles in hierarchy, the triple-bottom-line approach, and multilevel systems perspective provide the current frame, while the discussion on implementations is continuously evolving.

Circular Economy at the Macro-level: Policy and Regional Development

The highest level of the systems, the macro-level, is the furthest away from the actions of a single manager or a consumer. On this level, the transformation toward circular economy is primarily identified as policies and regulations and as regional development programs that implement pilot projects and otherwise support initiatives, which support the 3R principles of circular economy (Ghisellini et al. 2016). Activities on the macro-level influence the actions of firms and consumers by further legitimizing the concept (Ranta et al. 2017), and conveying trust and continuity in a way that economic actors on meso- and micro levels can initiate the transformation from linear to circular activities (Niesten et al. 2017). To give an overview of circular economy on the macro-level, this section showcases examples of policies and regional development initiatives toward circular economy from the China and the EU, the currently most active macro-level influencers of the circular economy.

High Level Policies and Regulations: Examples from China and the EU

While both China and the EU have highlighted circular economy as an important objective, the concept is perceived differently in the two areas. In China, circular economy has been brought to the center of the country's economic development strategy due to the pollution and waste issues created by rapid growth and urbanization. Thus, in China, the focus of circular economy is especially on SDG 12: responsible production and consumption, while acknowledging the potential for economic growth in the spirit of SDG 8: decent work and economic growth. Accordingly, the focus of Chinese macro-level influence is on making production cleaner, reducing waste and pollution generated in manufacturing, and improving the management of waste in both municipal and industrial contexts. Thus, the Chinese perspective to circular economy includes both materials and products but also the pollution aspects while focusing on manufacturing and waste management as the foremost domains where circular economy has influence. This perspective can be seen in the way circular economy is furthered in China: the national programs include measuring of pollution and resource efficiency in large cities and in manufacturing, linking China's CE approach to SDG 11: sustainable cities and communities and SDG 9: industry, innovation, and infrastructure. Chinese macro-level activities also include pilot programs where circular economy initiatives to increase resource efficiency and reduce pollution are first tested in selected cities and industrial parks and from which learnings are then transferred to larger-scale implementations. (McDowall et al. 2017).

In the EU, the perspective toward circular economy is different, as the concept is first and foremost seen as a potential path toward increased economic growth. The economic growth is expected to come through commercialization of new innovations and circular business models based on, for example, product-service systems (Tukker 2015) where a single product creates increased economic activity through added services or itself being sold as a service. Thus the focus of circular economy in Europe is to achieve the SDG 8: decent work and economic growth through industrial renewal in the spirit of SDG 9: industry, innovation, and infrastructure. In alignment to this perspective, EU policies emphasize designing products for reusability, maintainability, and recyclability so that the service business models can be realized. Indicators used for tracking the progress of circular economy in the EU include end-of-life recycling input rates measuring the proportion of inputs derived from recycled goods into an industry. As a result of this perspective, circular economy policy in the EU is much less concerned of pollution and environmental impact of the concept than its Chinese counterpart. The scale of public investments to supporting transformation to a circular economy is also much smaller in the EU, and initiations of the transformation are expected to come from firms pursuing the economic opportunities of the concept. However, it must be noted that the scope of circular economy in the EU is much narrower than in China. While circular economy policy does not extensively focus on pollution, EU has other policy initiatives that fulfill this gap (McDowall et al. 2017).

Urban and Regional Circular Economy

Not all macro-level activity that supports the transformation to a circular economy happens on the national level, as for example in the EU, or even the state level, as in China. Regional development activities, especially in cities, are also very relevant to moving the circular economy forward and furthering the SDG 11: sustainable cities and communities. One such development trajectory is the smart city concept, which has many linkages to the circular economy through the approach of improving the efficiency and livability of cities through smart technologies and use of data. When combined with the urban development strategy of urban metabolism focused on the flows of materials in a city, smart city initiatives are increasingly enabling the circulation of materials and the transition toward a more circular economy (Liu and Peng 2014).

The smart city concept approaches moving the circular economy forward from two distinct perspectives. Firstly, the digital infrastructure of a smart city acts as an enabler of activities that increase the circulation of products already in use by, for example, providing ways for citizens to use shared resources such as city bikes and further enabling citizens to share resources between each other through collaborative consumption platforms (Lyons et al. 2018). In a circular economy focused smart city, an area of interest is also enabling the production of resources such as food in a close vicinity to where the resources are consumed. When production and consumption take place near each other, the reusing and recycling of components and materials in the case of technical products or nutrients in the case of food becomes more feasible as the often critical barrier of logistics is reduced (Li et al. 2017). Secondly, smart cities often focus on optimizing waste management to be as efficient as possible by using smart sensors placed into the waste management infrastructure. This optimization of waste management infrastructure allows monitoring of the amount of waste produced and minimizes the costs and pollution occurring from the logistics of waste management. It also creates up-to-date information about source-separated recyclables and movement of waste streams, creating potential for tightening the loop of using waste as a resource (Liu and Peng 2014).

Meso-level Implementations: Business Networks

While the development of circular economy on a macro-level consists primarily of top-down policy or infrastructure-related initiatives, circular economy development on a meso-level is more market-driven and inherent to the business system. While meso-level initiatives are firm-driven, their implementation takes place at a level of a business network or a business ecosystem and thus requires the collaboration of multiple firms with aligned interests in circular economy (Ghisellini et al. 2016). The most prolific circular economy implementations on the meso-level are industrial symbioses, where multiple industrial firms collaborate to use resources efficiently (Saavedra et al. 2018), and green supply chains, where firms collaborate in a supply chain to close the loop for products and materials that traverse through it (Witjes and Lozano 2016).

Industrial Symbiosis

Industrial symbiosis is one of the central ways in which circular economy advances the SDG 9: industry, innovation, and infrastructure. Industrial symbiosis emerges when industrial firms begin collaborating with each other to make better use of the resources that they require. By combining their efforts, firms in an industrial symbiosis strive to turn their synergies regarding materials, energy, water, and by-products into competitive advantage over firms that do not have access to an industrial symbiosis (Chertow and Ehrenfeld 2012). Industrial symbiosis is one of the key concepts underlying circular economy and fundamentally shares the one's waste is another's resource – mindset.

The most common scenario for the birth of an industrial symbiosis is the existence of industrial plants that generate excess resources that they themselves cannot use effectively. This resource can be, for example, energy generated in a chemical process or by-products that are valuable to firms in other industries. For a single plant not operating in an industrial symbiosis, the options are to either search for a buyer for the resource from the market or dispose the resource entirely. Industrial symbioses as industrial parks form when other firms locate their plants to close proximity of the industrial plant and start a collaboration to use its excess resources. Furthermore, multiple industrial firms can collocate and form an eco-industrial park, where one key focus is on identifying and taking advantage of synergistic connections between the firms (Boons et al. 2011). For example, in the case of Kalundborg, Denmark, an often-cited case for industrial symbiosis, over ten stakeholders including industrial firms from multiple industries, the municipality, and local farmers are involved in the exchange of water, energy, and multiple by-products such as biomass, gypsum, fly ash, and liquid fertilizer. The key for successful exchanges to emerge was that all firms taking part see economic benefits, for example, by gaining resources more efficiently, reducing treatment costs, or being able to turn underutilized resources to revenue (Jacobsen 2006). Thus, the motivations for moving toward an industrial symbiosis from the perspective of a firm are similar to those of moving toward circular economy: being more efficient with the use of resource throughout the system and turning it into a competitive advantage.

In many industrial symbioses, a key characteristic is close proximity, which enables the firms to effectively collaborate and exchange resources. Key issues that collocation in an industrial park solves are the question of logistics and most importantly of knowledge transfer. The logistics problem in industrial symbioses is a question of economics and cost-effectiveness. Long transportation distances create a barrier for transporting resources with low value density due to increasing transportation costs. Making internal logistics more efficient is also a motivating factor for the development of specific infrastructure for firms to exchange resources. The knowledge issue however creates a barrier that can prevent exchanging even very valuable resources due to insufficient knowledge about where the producers and potential users of excess resources reside or whether they exist at all. The fact that by-product exchange in industrial symbiosis usually crosses industry boundaries highlights the issue, as experts of one industry can be incapable of identifying the potential of by-products they produce or potential alternative sources for the materials they use themselves from other industries (Boons et al. 2011). As the potential for scaling the logic of industrial symbiosis from industrial parks to larger systems is one central aspect of moving toward a circular economy, solving the issue of knowledge transfer of industrial symbiosis potential is an increasingly important topic.

One approach to solving the issue has been to take a top-down approach to facilitating industrial symbiosis, positioning the development of eco-industrial parks as an objective of policymaking and regional development. For example, in China, a key part of the strategy of circular economy has been the identification of industrial symbioses and their exploitation in eco-industrial parks in order to reduce the environmental effects of manufacturing (Mathews and Tan 2011). Thus, regional and governmental actors play a key role in solving the knowledge transfer issue through identification and communication of potential use of resources in collaboration with industrial actors. The emerging industry 4.0, where Internet-connected digital technologies are brought to an industrial environment to optimize operations with data-driven methods, is another potential answer to solving the knowledge transfer issue. In industry 4.0, data can be analyzed in real time, and information about industrial symbiosis potential can be communicated to other stakeholders quickly. However, the success of digital technologies requires industrial firms to openly share information about their resources, what they are not always prepared to do. While the regional development approach is able to facilitate trust and create connections between actors in a potential industrial symbiosis exchange, it is still unclear how digital technologies will overcome the issue (Tseng et al. 2018).

Circular Supply Chains

When a manufacturer adopts sustainability practices in its supply chain, it can be implemented and analyzed through slightly different angles that are all promoting sustainability and to some extent furthering the principles of a circular economy; these include green supply chain management, reverse logistics/closed-loop supply chain, and social sustainability (Ansari and Kant 2017). Adopting circular supply chains is especially important to advance SDG 12: responsible consumption and production, as the availability of sustainable products for end customers is dependent on the sustainability of the upstream supply chain.

The closed-loop supply chain is designed so that the recycling and recovery of products in their end-of-life stage can be better managed. This often requires that manufacturers take into use a so-called reverse logistics process. A reverse logistics process means that the goods are returned and recovered by the manufacturer or by some other actor operating for the manufacturer. Reverse logistics is used for handling returned products, recycling, remanufacturing, and resale. In closed-loop supply chains, the materials flow in reverse order due to recycling purposes, which complicate the whole supply chain management process, e.g., inventories, replenishment (Cannella et al. 2016). The American Reverse Logistics Executive Council has defined reverse logistics in the following manner: it is the "process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal" (Govindan et al. 2015). Usually the starting point for reverse logistics is at the end-user side who are the first customers of the products. The used products are collected from the customers as returned products, and the end-of-life management of the products starts. This can be recycling, where the original product is broken down to create raw materials or additional parts. Or it can be remanufacturing that results then in the resale of the products on the markets. It can also mean repairing the products so that they can be resold on the markets. There can also be the need to dispose of some of the used material or parts of the products (Govindan et al. 2015).

Reverse supply chains (RSC) have received more attention lately as the number of environmentally conscious or green consumers has increased, and in surveys they are reporting their willingness to pay premium prices for sustainably produced products. The RSC processes include special steps for handling the used products: the acquisition, the reverse logistics, sorting, recovery, and remarketing (Larsen et al. 2018). The reverse supply chain can be divided into three elements: the actual repair or remanufacturing process; the product itself which can be the final product, a product part, or a product material; and a financial driver for RSC which is either revenue increase or a decrease in the costs of operation (Larsen et al. 2018). Examples of reverse supply chains include repair, i.e., refurbishment, of products for resale in the primary markets in the form of a reduced priced version of the original product, refurbishment of product parts and components for reuse in the products that have been repaired as well as for resale as spare parts, and resale of used materials in the supply chain to suppliers of original materials.

Implementation on the Firm Level

Circular Design

Product design for the circular economy can also be called circular design, and it can be influenced by eco-design principles and the so-called Inertia Principle which ties to the concept of product integrity. In circular product design, the basic assumption is that, in theory, a product cannot become waste (Hollander et al. 2017). Through advocating reduction of waste, circular design advances the SDG 12: responsible consumption and production. The product lifetime is a critical factor in a circular economy. This is because in a closed-loop system following circular principles, from the perspective of material flow, the resources in the system need to be considered from all time perspectives, including the time when the products were not ready yet and in their end-of-life phase when they are no longer useful products.

According to eco-design principles, the waste hierarchy based on the European Waste Framework Directive should be taken into account (Hollander et al. 2017). The waste hierarchy includes a list how the handling of waste should be prioritized. In eco-design, the prevention of waste is the most preferred option, followed by reuse, recycling, and possible other recovery options, while disposal has been presented as the least preferred option. Waste is considered in the Waste Framework Directive to be all substances or objects that the owners discard or have an intention or a necessity to discard. Currently, the concepts of prevention, reuse, and recycling are connected to the notion that products eventually end up being waste. However, in the circular economy, the concept of waste should not exist, and therefore the concepts of reuse and recycling need to be redefined in this context with other terms.

For circular design, Stahel (2010) presented the Inertia Principle, which states that something that is not broken should not be repaired, something that can be repaired should not be remanufactured, and something that can be remanufactured should not be recycled. This way the economic value that is at that point inherent in the product should be maintained by replacing and repairing only what is essential for keeping the product functional. When designing products with the Inertia Principle, the focus is on product integrity, i.e., that the product stays the same after it has been manufactured during its product life (Hollander et al. 2017). When designing products with the Inertia Principle, the least preferred choice is to recycle the product, because it destroys the integrity of the product by disintegrating its materials and reprocessing them.

Circular product design strategies need to also take into account design of the technological cycles, design for biological cycles, and design for disassembly and reassembly. Products should be designed for remanufacturing already in the early product design phase. In the product design stage, over 70% of the product life costs are agreed, and for this reason, the potential handling of the product at the end of its life cycle, including remanufacturing, should be taken into account economically and from the material perspective already from the very beginning (Matsumoto et al. 2016). With eco-effectiveness and cradle-to-cradle design principles (see, e.g., Mendoza et al. 2017), the aim is to stretch beyond zero-emission approaches in order to develop products and industrial systems that improve or maintain the quality and productivity of the used materials in all life cycle stages (Braungart et al. 2007). As an important element of the eco-effectiveness concept, the cradle-to-cradle design principles target at creating products and industrial systems that have a positive relationship with the ecological health as well as long-term economic benefits (Braungart et al. 2007).

Already in the product design phase, it is important to consider the design of the entire sustainable circular systems covering the full product life cycle especially with regard to critical materials (Lieder and Rashid 2016). The circular design principles include guidelines on the material choices that should be considered already in the product design phase with regard to critical materials. Critical materials include such materials that are available only in one or few countries, the use of which is restricted due to large corporate interests, or such materials that are economically important for a certain country or their national security. Critical materials may involve supply risks, environmental impacts, or supply restrictions which could result in a global scarcity of the specific material (Lieder and Rashid 2016).

The product life lengths of many contemporary manufactured products have shortened which has led to the increase of material flows and generation of waste in society. Circular product design principles aim at improving the efficiency of material usage, production, and processing of materials, which would ultimately lead to more durable products with longer product lives (Lieder and Rashid 2016). To slow down the material flow loops, circular product design strategies stress the importance of design for the extension of product lives. Long-life products should be reliable and durable so that consumers can trust and be attached to them (Mendoza et al. 2017). Product-life extension is achieved by ensuring that products are easy to maintain and repair, upgrade, and adapt to different usages. In addition, standardization and compatibility with other products as well as disassembly and reassembly should be made simple and straightforward (Mendoza et al. 2017). Especially the focus on easy disassembly in the product design phase enables better reuse due to easy maintenance and repairs, as well as easy reuse of parts and materials. The design for recyclability and reuse is critical for increasing the recycling and reuse shares of products in their end-of-life phase. In the case of plastic packaging, the reuse and recycling of the material can require substantial redesign. However, it is worth the effort, as the design for recyclability and reuse can decrease the costs of recycling plastic package waste up to 50% (Ellen MacArthur Foundation 2017).

Remanufacturing

Remanufacturing is an important process assisting in the transition toward a circular economy in the manufacturing industry and advancing the SDG 9: industry, innovation, and infrastructure. Circular economy is considered to be the solution to multiple global challenges, as, for example, waste generation and resource scarcity, as well as being sustainable economically; however, the concept of circularity has already been introduced earlier in association with enhancing the reuse, remanufacturing, or recycling of products in their end-of-life phase (Lieder and Rashid 2016). Remanufacturing is a process used in the industry utilized for restoring used products, i.e., cores, into a new product life. In the process, the used product is treated in different phases, and finally it is tested to verify that it meets the required standards set for the products (Wei et al. 2015). Remanufacturing is in an important role when recovering products near their end of life and extending their product lives. After WW2 in the 1940s, the automobile industry resorted to remanufacturing as there were limited resources and a need to reuse car parts. In the 1990s remanufacturing was researched as the field where recycling is conducted by manufacturing, thus restoring and renewing products by inspection, disassembly, cleaning, reconditioning, and reassembly (Lieder and Rashid 2016).

Research has shown that with remanufacturing, companies can save even 90% in the use of materials in comparison with new product manufacturing processes, and also the energy needed in the remanufacturing is significantly lower than for original production (Matsumoto et al. 2016). Thus remanufacturing has environmental benefits as well as economic impacts. In used products there is often embedded value from the first original manufacturing phase, but these products tend to be disposed of taking advantage of the remaining value. In remanufacturing the remaining value is used as an advantage to create high margins economically. The ultimate goal of remanufacturing is to recover the remaining value of used products by reusing the product components that are still in good condition and function well (Larsen et al. 2018).

Remanufacturing is considered to be one of the vital elements in the implementation of resource-efficient manufacturing in a circular economy (Matsumoto et al. 2016). Remanufacturing transforms used products into products with similar quality and functionality as new products. Remanufacturing can also mean the addition of additional and better functionality to used products, e.g., by having more durable surface materials. Remanufacturing can be implemented, for example, on automobile components, different kinds of machinery, cameras, furniture, etc. In remanufacturing the form and shape of product usually remains the same, and it is a more beneficial process than material recycling from the perspective of energy and material savings.

Remanufacturing can be seen as a positive element in the economies of some countries; as it is labor intensive, it helps to create new jobs, advancing the SDG 8: decent work and economic growth. In addition, remanufactured products can be sold at a lower price than new products, and thus they can help advancing the SDG 10: reduced inequalities. Remanufacturing has important links with sustainable production and is an enabler for a sustainable society which is why it is globally considered to be important (Matsumoto et al. 2016). The potential and size for remanufactured product markets is still hard to estimate in many countries. However, in order to develop and promote remanufacturing and supporting policies, it would be important to do more detailed market impact analysis for remanufactured products.

Business Models for a Circular Economy

To move to circular economy, firms need to innovate their business models to enable circular strategies, in the spirit of SDG 9: industry, innovation, and infrastructure (Bocken et al. 2016; Ranta et al. 2018). Presently, most business models are optimized for linear economic system that does not take into account the negative environmental impacts of waste in the business model and product prices. Linear business models around products gain growth from selling more, leading to lack of incentives for product-life extension. In a so-called circular business model, the value creation is based on exploiting the residual economic value retained in used products to produce new product offerings (Linder and Williander 2017). Sustainable circular business models help to transform to a circular economy with innovative product design solutions and manufacturing processes, including remanufacturing, so that sourcing, resource consumption, and waste generation will change over time. Sustainable circular business models need to take into account the entire supply chain, stakeholders, including consumers, so that all the required environmental, social, and economic sustainability factors are identified and addressed (Mendoza et al. 2017).

When creating a circular business model, the value proposition, value creation and delivery, and value capture need to be designed with circular principles. When following a circular strategy, the required changes in material flows are included in the value creation logic to aid its implementation (Nußholz 2017). Circular business models can be defined in terms of resource efficiency taking into account material substitution, the extension of product lives, and closed material loops: “A circular business model is how a company creates, captures, and delivers value with the value creation logic designed to improve resource efficiency through contributing to extending useful life of products and parts (e.g., through long-life design, repair and remanufacturing) and closing material loops” (Nußholz 2017).

In the innovation and development of sustainable circular business models, such multi-disciplinary methods as backcasting and circular design can be used to apply the circular economy principles. With backcasting a company can vision how it transforms its current business practices toward a future vision and how this vision can be reached at a systems level. The target of circular design is to minimize the resource requirements of products and the environmental impacts of the whole product life cycle in the first phases of product design. Backcasting and circular design are an effective set of tools with which companies can set long-term targets based on visions and implement practical product design practices to achieve them. With a framework that includes both of these angles, companies can incorporate their stakeholders also in the process for innovating circular business models with circular design principles (Mendoza et al. 2017).

There are different versions of the circular business model in the literature. The main circular economy principles are presented in the ReSOLVE framework. ReSOLVE stands for regenerate, share, optimize, loop, virtualize, exchange (Lewandowski 2016). Another approach to circular business models is presented in the product-service system (PSS) business models that concentrate on producing products and services that have been designed to fulfill customer requirements and in addition to be environmentally, socially, and economically sustainable (Annarelli et al. 2016). In product-service systems (PSS) (Tukker 2015) and related service business models, firms have an incentive to design for maintainability and recoverability of materials, and also for extending product life, as the additional services are what drives growth. According to the PSS approach, sustainability goals can be attained in different ways, for example, by reusing and recycling at the end of the product life cycle, maintenance services to lengthen products lives, and leasing and sharing to allow a single product to fulfill needs of many (Annarelli et al. 2016). In a sharing economy approach to business models, collaborative consumption forms the basis for an economic model with a cultural dimension, where products are available for use, but they are not exclusively owned by the users. The sharing economy reflects the use orientation in the PSS business model approach. For example, car-sharing and bike-sharing systems are an implementation of the PSS model.

Key Issues

Consumer Behavior

One of the foundational issues in the implementation of the circular economy is the adoption rate of new kinds of products by consumers and the advancement of SDG 12: responsible consumption and production. If firms develop circular business models or products and consumers do not adopt them, circular economy will not move forward. Ever since the industrial revolution, products that have been designed to be disposed of after use have been prevailing, and in the fashion trends and style, a throwaway culture has been popular among consumers. Most global brands have business models that have been built on this kind of consumption culture, even though they are being challenged to change their business models (Dauvergne and Lister 2012; Saari et al. 2017). Most global brands have the required CSR activities implemented; however, sustainability is still not considered to be a priority in their strategies (Dauvergne and Lister 2012).

Sustainable consumption can be driven by brands; for example, Fairtrade brands in the food and textile industry reflect a positive brand reputation, and it is significant selection criteria for consumers (Czinkota et al. 2014). Green branding and green marketing are important means for selling green products to consumers, as brands are one of the most important purchase selection criteria among consumers (Keller and Lehmann 2006; Aaker 2011). When designing consumer marketing for products created with sustainable circular principles, the communication needs to focus first on the concrete product characteristics that fulfill consumers' needs and only then should it address the environmental information on the product, including details on the sustainability and supply chain management (Saari et al. 2018). The sustainability of a product needs to be introduced in the consumer marketing so that the sustainability aspects improve the competitiveness of these products when compared to conventional products. Providing visibility on the entire supply chain, including remanufacturing processes, can provide a competitive advantage for manufacturers when they are managing risks in their operations and integrating sustainable practices in their overall business processes (Cannela et al. 2016).

Future Directions

The main factors influencing the majority of consumers in a purchasing situation are still the actual product characteristics, quality, brand, and price of the products. To ensure that circular economy is also supported among consumers, products and services developed with closed-loop principles from waste resources should offer the same functionality as conventional products created from virgin materials. The calculation of the product prices needs to be included in the business models so that the full product life cycle including maintenance and repair of the products are covered as well, and the consumers can also benefit from this.

Producers still need common incentives that would favor launching products manufactured with circular design principles and circular business models. The criteria for circular product design needs to be harmonized globally and regionally, for example, within EU, so that material design and origin of material is clearly defined, especially for packaging and that limits for additives and chemical substances are set for especially plastic products. With Extended Producer Responsibility (EPR), the EU is trying to influence producers to be more responsible for the type of products they produce for the markets (Watkins et al. 2017).

When the guidelines for reporting data on waste streams have been standardized, companies will have better visibility to the availability of, for example, recycled materials that they can use in their business (Eunomia 2017). This will reduce the uncertainty associated currently to recycled material availability, and allow companies to build more circular business models. In addition, the prices of recycled materials should become more competitive in comparison with virgin raw materials, so that companies can benefit economically from producing or remanufacturing products according to the circular economy principles.

Cross-References

- ▶ Cleaner Production and Technologies
- ▶ Cradle to Cradle
- ▶ Eco-Industrial Parks
- ▶ Industrial Ecology
- ▶ Industrial Symbiosis
- ▶ Recycling of Materials
- ▶ Reuse, Reduce Recycle
- ▶ Urban Metabolism

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