Special Issue on the Circular Economy

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Introducing a Circular Economy:

New Thinking with New Managerial and Policy Implications

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SUMMARY

Since the industrial revolution, we have been living in a linear economy. Our consumer and "single use" lifestyles have made the planet a "take, make, dispose" world. This refers to a unidirectional model of production: natural resources provide our factory inputs, which are then used to create mass-produced goods to be purchased and, typically, disposed after a single use. This linear economy model of mass production and mass consumption is testing the physical limits of the globe. It is, therefore, unsustainable and a shift toward a circular economy is becoming inevitable.

KEYWORDS: circular economy, business models, sustainability, competitive strategy

Since the industrial revolution, we have been living in a linear economy. Our consumer and "single use" lifestyles have made the planet a "take, make, dispose" world. This refers to a unidirectional model of production: natural resources provide our factory inputs, which are then used to create mass-produced goods to be purchased and, typically, disposed after a single use. This linear economy model of mass production and mass consumption is testing the physical limits of the globe and threatening the stability of our future—it is, therefore, unsustainable. Currently, we may be consuming resources at a 50% faster rate than can be replaced, while, by 2030, our demand will require more than two planets worth of natural resources if they are to be met and, by 2050, three planets' worth.[1] In the same timeline, the global middle class will have doubled by 2030,[2] which will drive demand for resource-intensive

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goods such as vehicles and other contemporary conveniences that many of us in advanced industrialized countries enjoy today.

It is against this backdrop that organizations such as the Ellen MacArthur Foundation and the McKinsey Global Institute have turned to the circular economy as a viable model for industrial organization in which economic growth is decoupled from virgin resource consumption. While many sustainability paradigms revolve around doing more with less, the circular economy is also recuperative. In terms of sustainability, it would be incomplete to say that the circular economy is environmentally friendly. While that may be one of its characteristics, the circular economy is not just about attaining effective business terminologies and emphasizing idealistic words like "recycling." The circular economy can be defined by its focus on maximizing what is already in use along all points of a product's lifecycle, from sourcing to supply chain to consumption to the remaining unusable parts for one function and their conversion back into a new source for another purpose. If carried out extensively, the circular economy could potentially reduce consumption of new materials by 32% within 15 years, and by 53% by 2050.[3] Instead, primary materials used in construction, car manufacturing, synthetic fertilizers and pesticides, fuel production, and nonrenewable energy, among others, can be replaced with recovered and repurposed materials. The circular economy is of academic interest for its potential as a disruptive, innovative economic model that relates to government policy, businesses, and consumers. It is restorative and regenerative by design, structure, and objective: products, components, and materials are designed to continuously add, recreate, and preserve value at all times. The circular economy is disruptive as it changes the incumbent model and forces a rethinking of the many various aspects of production and consumption across the entire production and consumption chain.

In addition to materials, the circular economy is also a model for the efficient utilization of already produced assets. In Europe, cars are parked 92% of the time, while in the workplace, offices are used only 35% to 40% of the time—and that's only during working hours.[4] Moreover, the opportunity for new efficiencies is greater than ever across all industries and aspects of the supply chain. For instance, in farming, only 40% of irrigation water actually reaches the plants it was intended for.[5] Moving toward a circular economy could potentially eliminate 100 million tons of waste globally in the next five years alone.[6] Resource efficiency is a key source of new wealth in the twenty-first century and beyond. Lacy and Rutqvist estimate that by correctly utilizing natural resources, products, and assets, a $4.5 trillion reward can be obtained by turning current waste into wealth by 2030.[7] The authors explain that, by 2030, the linear growth model's inability to deal with growing demand for resources will result in a gap of eight billion tons between supply of and demand for constrained natural resources. This figure nearly equals the total resource use in North America in 2014. In the most likely scenario they have modeled, this translates into $4.5 trillion of lost growth by 2030, ballooning to $25 trillion by 2050.

This article summarizes the circular economy as an emerging paradigm of industrial organization and argues that the problems of today are not restricted to consumption and economic activity. From a circular economy model standpoint, the root issue at hand is bad design and restrictive mind-sets. The question then becomes: How can the circular economy be framed[8] to encourage economic actors to review their current models and change their conceptual relationship and thinking about markets, customers, and resources toward the context of the circular economy? To answer this question, we focus on the circular economy as an emerging system for sustainability, and emphasis is given to the inherent value proposition to firms. There is, however, an important gap in the circular economy literature. While it is rich in concepts and approaches, examination of pragmatic steps toward implementation often falls short.

Major schools of thought established the foundational thinking for the operation and functioning of a circular economy, with some that emerged in the 1980s but gained prominence and attention both politically and academically in the 1990s and early 2000s. Examples include the functional service economy of Walter Stahel,[9] the biomimicry of Janine Benyus,[10] the natural capitalism of Paul Hawken and Amory and Hunter Lovins,[11] the industrial ecology of Reid Lifset and Thomas Graedel,[12] and the design philosophy of William McDonough and Michael Braungart,[13] dubbed "cradle to cradle."

Circular Economy Activities

There are multiple approaches and activities that use the principles of a circular economy, and they vary according to the definitions and countries being considered. Circular economic activity includes reuse, repair, recycling, ecodesign, sustainable supply, and responsible consumption. This profusion of concepts demonstrates that the definition of a circular economy is not set in stone.[14] Nonetheless, a baseline level of understanding can be reached through the available literature. The Ellen MacArthur Foundation—which has made significant contributions in recent years to the concept of a circular economy, especially on the characteristics of the workings, process, operations, and objectives of a circular economy model—provides structure to the circular economy with five fundamental traits[15]:

- design out waste,
- build resilience through diversity,
- work toward energy from renewable sources,
- think in systems, and
- think in cascades.

Design Out Waste

Designing out waste pertains to the fact that waste should not exist when the product is designed to appropriate the biological or technical materials cycle. In this scenario, the remaining biological materials must be nontoxic so that they may be composted, technical materials are designed to be used several times if possible with lower energy consumption embedded in the design and process, and they should achieve higher quality retention. An example of this characteristic can be seen in the construction industry. For instance, according to an analysis by Law[16] (for Sustainable Construction Solutions Ltd.) relating specifically to the construction industry, construction waste arises as a result of inefficiencies caused by building contractors; however, it can be assumed that the waste can be attributed back to the early stages of the design of a structure. With a considerable amount of waste estimated to have been produced by the construction industry, it is important to apply an appropriate structural design from the outset by paying attention to the circularity and reusability of the individual materials and components within it. In addition to this, it is also important to focus on the packaging that these components are wrapped in; this approach of circularity by design is essential to achieving a circular economy approach in both production and consumption with zero waste. If the construction sector is used as an example to achieve important steps of circularity by design, then it would be important to design for reuse and recovery. This applies to an assessment of whether there exists an already established structure that could be fully or partially used and incorporated as part of the new design. The design would include different elements such as materials, components, packaging, and others that can be reused, remanufactured, returned, or repurposed. It has also been argued by Sustainable Construction Solutions that, in the construction industry, it would be useful to design for off-site construction, where "prefabrication" is an effective approach to reducing construction waste on site. This applies to different elements such as steel and other materials and components. Another aspect that is closely considered is to design for materials optimization. This includes identifying more accurately and efficiently the location and transportation of the materials, as well as the packaging, delivery, uses, and optimum service life for the material used. A further recommendation is designing for waste-efficient procurement. In this area, it would be important for designers from the outset to analyze the potential waste that would arise (e.g., in the construction industry it is argued that 20% of construction site waste is timber, which mainly comes from formwork). Another important aspect mentioned is design for flexibility and deconstruction, the idea being to create a process and a structured system that reduces the life of waste and also to design a model for reuse and repurpose. The creation of the flexibility option is a powerful tool that enhances the adoption of a circular economic system in different industries and sectors.

Build Resilience through Diversity

Diversity is often considered an important contributor to building resilience on a country level in general and on a sector and industry level in particular. Resilience is the ability of an economy, sector, or industry to withstand and adjust to unanticipated or unexpected shocks. Diversity refers to having multiple pathways in a system and the ability to produce on different scales. In this model, diversity is as important as efficiency. It implies that thinking in systems and processes alongside creating connections and interdependencies with several parts, components, technology, and materials is fundamental when establishing a circular economy model. One of the main approaches that decision makers depend on is the use of different services provided by the system. They also depend on this to interact with the economic and business environment. These services include, for example, the supply chain, the availability of resources, materials, rules, and regulations. A resilience-thinking approach in a circular economy model explores how these interacting systems of resources and technologies can best be managed to ensure a sustainable and resilient supply of the essential materials, resources, and technologies.

Work toward Energy from Renewable Sources

The circular economy model should function and develop by adopting a system that is based on renewable energy, as the fundamental principle is to preserve resources that include energy and fuel. However, the use of renewable energy is problematic for existing infrastructure if it has not been included in the design, and it is also disputable since material loops could be closed with any form of energy. The objective of the circular economy is to close the loops in as many areas of production and consumption as possible, and renewable energy adds to that goal.

Think in Systems

Understanding the influences, interdependencies, and the different forms of correlations and co-movements that exist in a system is pivotal to the effective and efficient working of a comprehensive circular economy model. Components are considered in connection to their economic, operational, environmental, and social impacts and contexts. While a machine is considered as a system where the different parts interact to produce an action, it is obviously limited and thought to be deterministic. However, a circular economy involves both deterministic and behavioral systems that possess spillover and feedback effects and characteristics.

Think in Cascades

Changes that occur in the economy and the environment in which we operate can either be established through a “top-down” transformation approach or be formed by structuring a “bottom-up” approach that helps in the establishment of a novel production system. From observing the way nature uses a cascading approach to grow organisms and systematically structure cell-by-cell, a structured cascading approach through the bottom-up addition of molecular and atomic building blocks is optimal. This process allows the materials from one organism (product) to be reused in a circular manner to produce another organism. A circular economy model based on nature will include a cascading approach. Such an application to materials is essential in a circular economy model, as it would continuously attempt to extract additional value from materials, resources, and products by cascading them through different applications and uses.

Waste

Research by the Ellen MacArthur Foundation focuses on designing with circular economy principles from the beginning, in the ideation phase. While their work offers much in the way of creating a circular economy, it could do more on pathways for firms to transition a linear economy production line to a circular economy model. Other circular economy scholars focus on waste as a useful commodity. Lacy and Rutqvist define and classify waste in four distinct categories[17]:

- *Wasted resources*—materials and energy that cannot be continually regenerated but, instead, are consumed and forever gone when used (e.g., fuel).
- *Products with wasted lifecycles*—products that have artificially short working lives or are disposed of even if there is still demand for them from other users (e.g., smartphones).
- *Products with wasted capability*—products that sit idle unnecessarily, for instance, cars typically sit unused for 90% of their lives.
- *Wasted embedded values*—these are components, materials, and energy that are not recovered from disposed products and put back into use (e.g., textiles that are not reused).

Business Models

Based on these sources of waste/value, Lacy and Rutqvist state that by putting more of the currently underutilized resources to use, a $10 billion property renting business could be created without the use of additional energy, metal, or other resources used to build houses. They also state that, by constructing a business model based on circular economy principles, a company could increase its gross profit by 50% while reducing material use by 90%, all by recovering and remanufacturing used components. Finally, they estimate that appropriate waste utilization could turn around a country's underutilized biomass resources to tap into an $80 billion market for advanced chemicals and energy.

To enable firms and institutions to develop a model that allows for leveraging the use of underutilized resources, Lacy and Rutqvist propose a three-phase model development guideline that uses three key drivers—resource constraints, technological development, and socioeconomic opportunity—to create regenerative business models by design that involve the creation of a new breed of services that leverage long-term use and maintenance. They conclude that by following such an approach, business models will be based on reincarnation and efficiencies in product design, systems design, and the use of new materials. They propose five new models for circular growth:

- circular supply chain,
- recovery and recycling,
- building products to last,

- sharing platform, and
- Product-as-a-Service (PaaS) business model.

Circular Supply Chain

This business model pushes forth the use of fully renewable, recyclable, or biodegradable inputs as substitutes for linear ones. For example, tires last longer today, but the products that make them last longer can be toxic and create health problems for people who are coming into contact with them. Companies can use the circular supply-chain model in two ways: to produce for others' or for their own operations.

They cite various examples of such a model. CRAiLAR Technologies produces renewable and environmentally responsible biomass resources using flax, hemp, and other bast fibers for apparel brands (Nike and Adidas) and for industrial, energy, medical, and composite material industries as well. While it usually takes anywhere from 2,000 to 29,000 liters of water to produce a single kilogram of finished cotton, CRAiLAR uses just 17 liters of water to produce one kilogram of its material—a saving of as much as 99%. AkzoNobel, a paints, coatings, and special chemicals company, uses bio-based materials to provide customers with more recyclable and reusable materials. Novozyme turns corn, soya, sugarcane, wheat, and waste into products as diverse as cooking oil, fish feed, electricity, plastics, and detergents.

Recovery and Recycling

In such a model, every by-product and waste stream is optimized to maximize its revenue potential. Waste is revived for other uses; this results in waste no longer being seen as a problem to be dealt with but as a resource that is fully integrated into the business model.

Resource return chains transform waste into value through recycling and reincarnation. Using new technologies such as the Internet of Things (IoT) and smart materials and by operating a two-way supply chain (i.e., moving products to customers and then retrieving end-of-life goods), companies can recover almost any resource output to a level that's at least equivalent to their initial investment.

Two companies that have adopted the recover and recycle model and that are making their way to zero waste are Procter & Gamble (P&G) and General Motors (GM). At least 45 P&G facilities now operate on a zero-waste basis, with all manufacturing waste being recycled, repurposed, or converted into energy. GM, which launched a zero-waste program in 2011, now recycles 90% of its worldwide manufacturing waste and has 102 landfill-free facilities with hopes of reaching 125 facilities globally by 2020. GM reports that it generates $1 billion in revenue annually from by-product recycling and reuse.

Building Products to Last

Known as the Product Life-Extension Business Model, this model is in direct opposition to most current business models that are predicated on consumers continually replacing their products (e.g., white goods and electronics). Some of the key tenets are:

- *Build to last*—very durable products for customers who are willing to purchase such products.
- *Refurbish*—restore used products to their original state aimed at price-sensitive clients.
- *Take-back/trade-in/buy-back to remarket*—collect pre-owned goods to trade or resell (also called "ReCommerce").
- *Upgrade*—add new features, functionality, or fashion. Instead of replacing the core product, target customers who are more interested in consuming content, functions, and style rather than the products themselves.
- *Refill*—replace a function that's depleted more quickly than the product itself, such as refillable packaging.
- *Repair*—fix a product that's broken and target customers who have limited interest in replacing an item.

One company that is practicing this model at scale is Electrolux. They use modularity to simplify products and take back, refurbish, and resell products to new consumers.

Sharing Platform

Also referred to as "sweating idle assets," this model lets multiple customers use the same resources, reducing demand for new manufacturing. Customers can also access thousands of products at various price points and locations, instead of being limited to a narrow range of products served from a central site.

The sharing economy model has always been seen as more of a consumer-to-consumer model rather than a business-to-business one. This is, however, in a state of flux. For example, the company Storefront provides short-term retail space rentals, while Deliv lets retailers use "crowdshipping" by partnering with mall operators and retailers to provide a low-cost, high-quality, same-day delivery service via its quality-controlled fleet of crowdsourced drivers (the Uber for retail delivery). Other firms, such as FLOOW2, exclusively target general contractors and those who rent out their construction equipment, thus putting idle earth diggers, tractors, and excavators to use while enabling its users to share equipment, services, and the knowledge and skills of personnel. Although compatible, the sharing economy is focused more on human relations and can be distinguished from circular economy, which is more focused on production and consumption relations and underutilization.

Product-as-a-Service (PaaS) Model

The main feature of this model is that performance takes on a more important role than ownership. The PaaS model can take several forms:

- *Pay for use*—customers buy output rather than a product and pay based on use (e.g., miles driven, hours used, pages printed, or data transferred).
- *Leasing*—customers buy contractual rights to exclusively use a product over a longer period of time.
- *Rental*—customers buy the rights to use a product for a short period of time, typically less than 30 days.
- *Performance agreement*—customers buy a predefined service and quality level, and companies commit to guaranteeing a specific result.

The tire manufacturing firm Michelin Solutions, for instance, allows fleet customers to lease instead of purchase tires. In doing so, they have effectively created a model where tires are a service and customers pay for miles driven. Customers do not own the tires, and they do not have to deal with the hassles of punctures or maintenance of any kind. By adopting a PaaS model, Michelin Solutions is incentivized to develop longer lasting tires. And, by reclaiming worn-out tires, the company is motivated to make sure that, through design and material selection, returned tires can be reprocessed into a valuable input for new tires or a completely different product. These models represent alternatives for businesses in specific sectors.

Materials

The circular economy also addresses materials. The topic of new materials is essential to the conversation owing to the current pace of technological innovation and the ubiquity of technology in every business dimension. With regard to biological or renewable materials, the concept of regeneration, reuse, and reincarnation is of pivotal importance when we consider the trends being seen with respect to resources. Materials can be classified into two substrates: those that are biological (renewable), which are designed for reuse and can return to the biosphere, and those that are technical (nonrenewable), which are designed to move back and forth between production and consumption with minimal quality or value reduction. Each group of materials needs to be reviewed in order to determine the future of business model construction and also to gauge the role of technology for current and future evolution. The McKinsey Global Institute found that the availability of resources such as oil, natural gas, thermal coal, iron ore, and copper is changing, and they forecast a decline in demand over the next two decades.[18]

This forecast raises two scenarios: first, resource-exporting regions whose public finances rely on resource endowments will need to find alternative sources of revenue. Second, importers could stock up strategic reserves of commodities while prices are low; this would safeguard against future supply or price disruptions, and they could use the savings from avoided resource spending to invest in other areas. Moreover, these scenarios are not just relevant to developed economies. In fact, the real disruptions will be seen in emerging markets and developing economies. The McKinsey Global Institute report predicts that in spite of China's massive industrialization and India's economic growth, emerging markets will be unlikely to focus on infrastructure investment in the same way that we think about it today. Current supply could be sufficient to meet global needs over the next 20 years, followed by oversupply in the foreseeable future that will be sufficient to meet declining demand.

Copper, however, is the outlier in the group owing to its versatility, according to the study. Copper is an essential element in production and consumption, which has a wide range of uses with far more consumer applications than iron ore and is used in the electronics industry (almost half of all the copper we extract is used for electronics), building and construction (almost a quarter), machinery, vehicles, and consumer products. Considering that one ton of electronic waste, specifically circuit boards, has as much as 30 to 40 times more copper than a ton of copper ore, the potential for a circular economy model is opportune and likely necessary for future sustainability.

Based on these findings, the options offered by a circular economy approach become laden with opportunities. If companies are to accelerate change and achieve growth, they will need to significantly increase recycling copper, especially since primary copper demand could potentially grow to 31 million tons by 2035, a 2% annual increase. At the same time, the supply outlook is challenging as declining ore grades and increasingly difficult mining environments could result in supply constraints and more expensive investment.

The McKinsey Global Institute's report shows that it is not just the availability of resources such as oil, natural gas, thermal coal, iron ore, and copper that are reasons for an impetus to change. The evolution of technology also has consequential impacts on the deployment and use of technical or nonrenewable materials. Technologies such as artificial intelligence, robotics, advanced analytics, 3D printing/additive manufacturing, and the IoT are beginning to transform the way these resources are produced and consumed. The McKinsey Global Institute report further states that, over the next two decades, technology-led changes could lead to savings of between $900 billion to $1.6 trillion from a combination of demand reduction, substitution, and increased productivity. This will have major first- and second-order effects on both this sector and on the global economy.

The first-level effects are in regard to evolving technology that is allowing for more possibilities with lower labor demands. The second-level effects relate to the way consumers live and their declining consumption of resources. The report identifies seven transitions with regard to renewable energy and the use of renewables for energy production, advanced telematics and analytics, greater use of sensors in an increasing number of objects, increased automation in manufacturing, a rise in use of electric vehicles, greater use of autonomous vehicles, and the spread of the sharing economy.

Along with these transitions, the report also mentions the interoperability and change in the way industrial systems are being constructed today. For example, renewables are not only substitutes for fossil fuels but also reduce overall demand for energy, as they do not incur the heat losses associated with power generation from fossil fuels. Renewable energies could also enable accelerated "sector coupling" (the combination of power, heat, and mobility) as the energy used to supply homes and offices is also used to power cars and other transportation.

Irrespective of which strategy is adopted—biological-centric or technological-centric—the conclusion of the McKinsey Global Institute report is salient: As shifts occur in the way resources are consumed as well as produced, companies and countries will have to harness digital and other technologies if they intend to drive down capital costs, organize their investments, and adapt to the new landscape. Moreover, these systemic adaptations are not just reserved to a single country. In Australia, Rio Tinto's mines are using automated haul trucks and automated drills. The increases for both uses are 40%, and 10% to 15%, respectively, along with improved safety, better maintenance, lower energy use, and greater operational precision.

Developing a strategy that is based on the principles of biological resource optimization and technology-enabled productivity, then, could derive advantages from doing more with less, moving faster, thinking differently, and incorporating the best practices from other industries such as manufacturing, services, venture capital, and consumer products. The report concludes that harnessing these technologies requires us to change the way we think about resource sourcing and designing strategies. It suggests the following:

- Resource extraction companies need to develop a more active approach to strategy and growth, and they need to search for resource-related business opportunities outside the core business.
- Resource producers can become productivity leaders by increasing throughput and reducing capital costs, spending, and labor costs.
- Manufactures should adopt a digital mind-set; barriers to technology adoption are not only physical, financial, and legal, but they are also cultural. Companies should embrace digitization and automation in a holistic manner, restructuring their organization and providing incentives to maximize adoption of these technologies.

These changes in technology and the future state of resource allocation signify that a complete rethinking of how products and services are constructed and offered is required. Shifting to a circular model means changing our linear economy's supply logic. Products need to be designed to use recovered secondary material and for low-cost, end-of-life recycling, effectively closing the manufacturing loop. To increase resource efficiency, the circular economy requires components to be designed for reuse in products that can be upgraded and refurbished rather than discarded and replaced. The challenge also lies in how a company engages its customers and their role during and after a product's use.

Research conducted by the Ellen MacArthur Foundation[19] argues that intelligent assets, or IoT, constitute a powerful disruptive technological model that can effectively link to a circular economy so that there is an increase in value creation. The study identifies the circular economy value drivers as extending the usage and the lifecycle of an asset, increasing the utilization of an asset or a resource, looping and cascading an asset through additional use cycles, and also regenerating natural capital. These value drivers are cross-checked against the intelligent asset value driver such as knowledge of the location of the asset, knowledge of the condition of the assets, and knowledge of the availability of the assets. The main points relating to the report pertain to the recognition that the advancement of the digital transformation can define the foundations of our "material reliant industrial economy."

Businesses are continuously facing unprecedented challenges and new levels of complexity. Technology has reshaped business models and decision making, contributed to society and social trends, and has also influenced consumer demand, tastes, and preferences. Smart, digitally connected products will "generate real-time readings that are unprecedented in their variety and volume. Data now stand on par with people, technology, and capital as a core asset of the corporation and in many businesses is perhaps becoming the decisive asset."[20] The report draws the connection between technological advancements and enabling the circular economy, and highlights the early signs of this transformation.

If we accept the estimates of future consumption patterns, the transition of businesses to a new circular economic model is a need, not a wish, as we are rapidly approaching a point where the linear growth model is no longer viable. Governments and businesses need to analyze and evaluate the model's economic and financial viability as well as its efficiency and productivity. Economic viability relates to the ability of the firm to achieve profit, while financial viability relates to creating value. Efficiency pertains to reducing costs, and productivity relates to increasing the volume of output while maintaining or even reducing input.

Researchers have investigated the economic viability of the circular economy. Tuladhar, Yuan, and Montgomery built a computer model to simulate and evaluate the effects of circular economy scenarios.[21] The model assumed the objective was to minimize the use of new resources and the generation of residuals not reused in production. Two scenarios were built for Denmark and the EU. The results showed that Denmark's GDP would increase by 0.8 to 1.4% relative to the baseline by 2035, while the EU GDP could increase by 1.4 to 2.7% by 2035. Different sectors were included in the simulation, such as manufacturing, mining, oil, food, and chemicals. An important economic takeaway from the research is not only that output increases but also that there is an impact on price reduction. Bohringer and Rutherford also introduced a model to assess and analyze the economic implications of technological shift and regulatory policies in the context of a circular economy perspective, with a focus on how to increase the allocative efficiency of scarce resources.[22] The results showed that technological shocks can create resource savings (through productivity gains) even though it may not affect resource demand, thereby providing insight into the magnitude and composition of an economy-wide effect. Although their work is outside the scope of this introduction, Mitchell and James offer an analysis of how a circular economy model can reduce structural unemployment.[23] Their analysis shows where jobs may be created in different areas related to the specialization and the development of a circular economy model in high unemployment regions.

Conclusion

Despite impending resource scarcity predictions and the existing literature on the benefits of the circular economy, the private sector and many governments have yet to recognize the full potential and benefits associated with the circular economy. Resource scarcity problems can not only be mitigated but also corrected by taking a long-term view of sustainability and by redesigning production processes according to a circular economy model. This provides an optimistic scenario where current standards of living and expectations can be maintained under rising demand and dwindling natural resources.

Adopting the circular economy model requires that firms initiate and develop disruptive technology and business models that are based on longevity, renewability, reuse, repair, upgrade, refurbishment, servitization, capacity sharing, and dematerialization. This means that they have to take cost management and control into consideration and also start focusing on rethinking products and services as well as end-user propositions that increase efficiency, effectiveness, and performance. Although there are estimated economic benefits to be found in transitioning to a circular economy, the challenges to both businesses and policymakers are diverse; they must consider how to deal with the stakeholders who lose out in the circular economy and must create organizational designs that facilitate adoption of the circular model.

This article has highlighted a number of concepts that are linked to the circular economy paradigm. The definition of the circular economy according to the available literature ranges from restorative waste control that enables the development of innovative business models to issues relating to design thinking and an efficiency approach toward consumption and production. This wide range represents an array of areas of opportunity. Looking forward, value creation continues to be critical in moving the circular economy from concept to practice, where tight loops can be established both in the technical/manufacturing cycles and in the biosphere.

While there has been substantive work on the subject of the circular economy, there are more opportunities for interdisciplinary conversations between scholars and practitioners. Therefore, the purpose of this special issue of the *California Management Review* is to examine further the value creation inherent in a circular economy model and to provide rich insights and detailed analysis. Connecting our understanding is an important milestone on the journey to unlocking the great potential of a fully operational circular economy.

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