Closing the Loop for Resource Efficiency, Sustainable Consumption and Production: A Critical Review of the Circular Economy

Mark Anthony Camilleri, University of Malta, Malta and University of Edinburgh, Scotland.

a) Department of Corporate Communication, Faculty of Media and Knowledge Sciences, University of Malta, Msida, MSD2080, MALTA. Email: mark.a.camilleri@um.edu.mt

b) The Business School, University of Edinburgh, Bucchleuch Place, Edinburgh, EH8 9JS, SCOTLAND.

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Dr Mark Anthony CAMILLERI is a resident academic in the Department of Corporate Communication at the University of Malta. He holds a PhD (Management) from the University of Edinburgh, in Scotland.

Dr Camilleri is a member in the Global Reporting Initiative (GRI)'s Stakeholder Council, where he is representing Europe and Asia's CIS region. He is a member in the editorial boards of a number of management journals. Mark is also a member of the academic advisory committee in the Global Corporate Governance Institute (USA). He has published his research in reputable peer-reviewed journals and is a frequent speaker and reviewer at the British Academy of Management and in the American Marketing Association's (AMA) annual gatherings.

Mark's first book, is entitled; "Creating Shared Value through Strategic CSR in Tourism" (2013). In 2017, he published two Springer textbooks; "Corporate Sustainability, Social Responsibility and Environmental Management: An Introduction to Theory and Practice with Case Studies" (2017), and 'Travel Marketing, Tourism Economics and the Airline Product'. Moreover, he edited "CSR 2.0 and the New Era of Corporate Citizenship" (that was indexed in Scopus).

Abstract

The circular economy proposition is not a novel concept. However, it has recently stimulated sustainable consumption and production ideas on remanufacturing, refurbishing and recycling of materials. A thorough literature review suggests that the circular economy's regenerative systems are intended to minimise industrial waste, emissions, and energy leakages through the creation of long-lasting designs that improve resource efficiencies. In this light, this research critically analyses the circular economy's closed loop systems. The findings suggest that this sustainable development model could unleash a new wave of operational improvements and enhanced productivity levels through waste management and the responsible use and reuse of materials in business and industry. In conclusion, this research implies that closed loop and product service systems could result in significant efficiencies in sustainable consumption and production of resources.

Keywords: Circular Economy, Resource Efficiency, Corporate Sustainability, Creating Shared Value, Corporate Social Responsibility, Strategic CSR, Stakeholder Engagement, Social Responsibility, Recycling Resources, Reusing Resources, Restoring Resources, Reducing Resources.

1. Introduction

Prior to the industrial revolution, business and industry would hardly throw away their by-products. The waste or unusable material that was generated from craftmanship or from other manual processes was usually re-utilised or recycled (Barnes, 1982). However, the industrial revolution may have changed the mentalities on the use of resources; as this period has introduced disposable products, with the explicit purpose of being discarded after use (Lieder and Rashid, 2016). This development has probably stimulated a throwaway-mindset which has become widely pervasive in the consumption behaviours of many societies. Today, the economic models of many countries are mostly built on the premise of 'take-make-consume and dispose" patterns of growth (EU, 2015). Business and industry have customarily followed such a linear model that assumes that resources are abundant, available and cheap to dispose of; as every product is usually bound to reach its 'end of life' at some stage. When products are no longer useable or required, they are often discarded as waste. Their improper disposal in landfills may cause

inconvenience and can pose serious health risks to nearby communities. In addition, the incineration of waste products could create the need to dispose of residual toxic metals which may in turn bring problems of groundwater contamination. Moreover, the plastic waste that is dumped into the ocean is responsible for the deaths of millions of fish, seabirds and sea mammals. At the same time, land degradation is constantly impacting on the natural environment, as arable land continues to disappear. Furthermore, the warming of the earth's climate, that is one of the outcomes of carbon emissions from fossil fuels, is yet another serious problem facing today's society.

Industrial and mining activities are also causing pollution problems as well as exhausting the world's resources. The world's growing populations and their increased wealth is inevitably leading to greater demands for limited and scarce resources. Notwithstanding, it is envisaged that the reserves of some of the globe's key elements and minerals shall be depleted within the next 50 years or so (Shrivastava, 1995). Boulding's famous paper from 1966, "The economics of the coming spaceship Earth" had anticipated that man will need to find his place in a cyclical ecological system which is capable of continuous reproduction of material. He described the econosphere as a material process involving the discovery and mining of fossil fuels. Boulding (1966) went on to suggest that the ecological environments are not appropriated and do not enter into the exchange system, as the effluents of the system are passed out into non-economic reservoirs, including the atmosphere and the oceans.

Extant economic models seem to rely too much on resource extraction and depletion. If solutions are to be found, the public must be encouraged to alter a number of its irresponsible behaviours (Williams and Zinkin, 2008). Therefore, this paper argues that there is scope in using resources more efficiently; as better eco-designs, waste prevention as well as the reuse and recycling of materials can possibly bring net savings to businesses, whilst also reducing their emissions (Stahel, 2016; Stubbs and Cocklin, 2008; Porter and Van der Linde, 1995). This way, organizations would benefit from operational efficiencies in the use and reuse of resources, and could become sustainable and competitive (Yuan, Bi and Moriguichi, 2006). The circular economy's closed loop systems could minimise the cost of dealing with pollution, emissions and environmental degradation (Geissdoerfer, Savaget, Bocken and Hultink, 2017; Peeters, Vanegas, Tange, Van Houwelingen and Duflou, 2014; Geng, Sarkis, Ulgiati and Zhang, 2013; Geng and Doberstein, 2008; Stubbs and Cocklin, 2008; Jayaraman, Guide and Srivastava, 1999). Therefore, the purpose of this paper is twofold. Firstly, this research traces the conceptualization

and origins of the circular economy, as it critically reviews the theories and empirical studies that are drawn from different academic disciplines, including; environmental economics, ecological economics, and industrial ecology, among others. Secondly, it includes a critique on the circular economy as it evaluates the potential tensions and limitations that are inherent in the appropriation and application of the circular economy systems.

The paper is structured as follows: The following section explains the origins of the circular Economy as it examines its relationship with previous research. Afterwards, the researcher clarifies how the circular economy proposition and its closed loop systems are being planned, implemented and measured by sustainable businesses and policy makers in different contexts. This contribution sheds light on the circular economy concept. It offers a critique on its inherent limitations and identifies future research avenues that might be undertaken.

2. The Origins of the Circular Economy Construct

The Brundtland Report (WCED, 1987) called for a holistic approach to be taken by societies (including businesses) towards 'development which meets the needs of the present without compromising the ability of future generations to meet their own needs' (p. 43). Its underpinning assumption is that the physical resources are not finite, therefore, they have to be managed to sustain future generations. This reasoning is also echoed within the definition of the Circular Economy. A circular economy is a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling (Geissdoerfer et al., 2017; Camilleri, 2016).

The term circular economy gained its popularity when its proponents have framed its antonym (i.e. the linear economy). The linear economy uses the natural capital from the environment (through mining / unsustainable harvesting, et cetera) in the manufacturing of products. At times, the production of goods is leading to unwanted externalities, including the pollution from waste and to the deterioration of the environment (Bird, 1987). The model of a linear economy assumes that there is an unlimited supply of natural resources and that the environment has an unlimited capacity to absorb waste and pollution. Cooper (1999) argued that the circular economy reduces the throughput of energy and raw materials. Therefore, the circular economy is intended to restore any damage in resource acquisition, by ensuring that little waste is generated throughout the

production process and during the products' life. Evidently, this notion builds on previous conceptualizations revolving on sustainable development, including; sustainable consumption and production (Cooper, 2012, 1999; Yuan et al., 2006; Porter and Van der Linde, 1995). It its most basic form, it balances the economic development with environmental and resource protection; it leads to higher operational efficiencies through reduced energy consumption and lower emission of pollutants (UNEP, 2006). However, this construct is related to industrial ecology, environmental responsibility (Camilleri, 2017a; Lewis, Cassells and Roxas, 2015; Kovács, 2008), environmental citizenship (Dobson, 2007; Rondinelli and Berry, 2000), environmental economics (Cropper and Oates, 1992) and ecological economics (Daly and Farley, 2011) among other sustainability constructs.

3. Policy Formulation on the Circular Economy

This promising concept is a response to the aspiration for sustainable growth in the context of increased regulatory pressures toward controlled operations management and environmentally responsible practices. Therefore, the circular economy was championed by a number of environmental non-government organizations (NGOs) including the Ellen MacArthur Foundation and the World Economic Forum, as this proposition represents one of the most recent attempts for the integration of economic activity with environmental wellbeing. Therefore, the setting of coherent policy frameworks and appropriate legislation at a national level could help to raise the bar for more responsible behaviours amongst public and private organizations (Camilleri, 2017b; Prothero, Dobscha, Freund, Kilbourne, Luchs, Ozanne and Thøgersen, 2011).

The United Nations General Assembly Resolution of 25 September 2015 on "Transforming our world: the 2030 Agenda for Sustainable Development" and the Paris Climate Agreement (COP 21) and Resolutions 1/5 and 2/7 on chemicals and waste, and 2/8 on sustainable production and consumption, as adopted by the 1st and 2nd sessions of the United Nations Environment Assembly (UNEA) in Nairobi on 27 June 2014 and 27 May 2016 are considered as important policy instruments that could facilitate the transition toward the circular economy. Moreover, there were several EU Communications on this subject: "Innovation for a sustainable future - The Eco-innovation Action Plan"; "Building the Single Market for Green Products: Facilitating better information on the environmental performance of products and organisations"; "Green Action Plan for SMEs: enabling SMEs to turn environmental challenges into business opportunities"; "Closing the loop –An EU action plan for the Circular Economy" and the report

on its implementation, and "Investing in a smart, innovative and sustainable Industry - A renewed EU Industrial Policy Strategy", among others (EU, 2017).

In 2014, the Commission anticipated that, "new business models, eco-designs and industrial symbiosis can move the community towards zero-waste; reduce greenhouse emissions and environmental impacts" (EU, 2014:4). Actually, Europe has already started to prepare the ground work toward this transition. The 'Resource Efficient Europe' initiative involved the coordination of cross-national action plans and policies on the formulation of sustainable growth. The circular economy proposition was intended to bring positive environmental impacts, real cost savings, and greater profits. EU (2014) indicated that its envisaged improvements in waste prevention and eco-designs, the use and reuse of resources, and similar measures could translate to the net savings of € 600 billion, or 8 % of annual turnover (for European businesses); while reducing total annual greenhouse gas emissions by 2-4%. This EU (2014) communication anticipated that the markets for eco-industries will double between 2010 and 2020. It also posited that internationally, resource-efficiency improvements are in demand across a wide range of industrial sectors.

Moreover, in 2015, the European Fund for Strategic Investments (EFSI) has also announced a new financing avenue for future investments in infrastructure and innovation, that could be relevant for circular economy projects and closed loop systems. In December of the same year, the EU launched its Circular Economy Package, which included revised legislative proposals to "close the loop" of product lifecycles through greater recycling and re-use. Its action plan specified that the inefficient use of resources in production processes can lead to lost business opportunities and significant waste generation throughout a product's life. It suggested that product designs could make products more durable or easier to repair, upgrade or remanufacture. Operational improvements would enable recyclers to disassemble products in order to recover valuable materials and components. Therefore, the EU legislative proposals on waste management included long-term targets for the sustainable consumption and production of resources. They also encouraged the reuse and recycling of materials, including; plastics, food waste; critical raw materials from electronic devices; construction and demolition resources; as well as from biomass and bio-based products, among other items. Moreover, the EU's action plan recommended further innovative investments in fields such as waste prevention and management, food waste, remanufacturing, sustainable process industry, industrial symbiosis, and in the bioeconomy to support the circular economy and global supply chains (EU, 2015).

Eventually, in March 2017, the EU Commission and the European Economic and Social Committee organised a Circular Economy Stakeholder Conference, where it reported on the delivery and progress of some of its Action Plan. It also established a Finance Support Platform with the European Investment Bank (EIB) and issued important guidance documents to Member States on the conversion of waste to energy.

The circular economy has also been featured in the Chinese government's 'Five Year Plans', escalating the concept of the western policymakers and NGOs (Murray, Skene and Haynes, 2017). China actively collaborated with Asia Pro Eco Programme, the United Nations Environment Programme (UNEP) and the European Commission in formulating a 'Policy Reinforcement for Environmentally-Sound and Socially-Responsible Economic Development' (PRODEV). These stakeholders have supported the relatively, underdeveloped city of Guiyang. This city was chosen by the Chinese government as a pilot city to implement the circular economic approaches. In 2005, PRODEV supported Guiyang's policy frameworks and financial systems that were intended to bolster development of the private sector. PROVDEV facilitated technology transfers and sustained infrastructural developments. It also specified the best environmentally-sound practices that led to cleaner production processes (UNEP, 2005). Guiyang's businesses have learned how to increase their operational efficiencies through the better use of resources. These developments also brought significant cost savings, and improvements in the firms' bottom lines. At the time, China needed a new sustainable development model which had the ability to 'achieve improvements in resource productivity and eco-efficiency' (Yuan et al., 2006:7). There are similar examples of other Asian jurisdictions that have adopted a circular economy approach. For example, Japan enacted a recycling law entitled, "The Basic Act for Establishing a Sound Material-Cycle Society" (Japanese Act 110/2000, 2002).

Across the Atlantic, the US Chamber of Commerce Foundation described the circular economy as a model that focuses on the careful management of material flows through efficient product designs, reverse logistics, business model innovation and cross-sector collaboration (UCCF, 2015). The US Foundation recognised that this regenerative model offers viable business opportunities that tackle environmental issues whilst stimulating economic growth and development. In 2017, the Foundation in partnership with The Ellen MacArthur Foundation, the World Business Council for Sustainable Development, and with support from the World Economic Forum Platform for Accelerating the Circular Economy, has convened a Sustainability

and Circular Economy Summit to raise awareness on the business case for the circular economy's practical actions and solutions among practitioners.

In the past four years, the circular economy has also been endorsed during the World Economic Fora in Davos. WEF's (2014) first report, entitled; 'Towards the Circular Economy' has also communicated the business case for circular economic practices. This report highlighted 'Project Mainstream', an initiative that was aimed to accelerate cross-sector engagement towards the closed loop practices. Business leaders have acknowledged that the circular economy led to a competitive advantage, and helped them build better relationships with customers and suppliers.

4. Methodology

This research analyses the context and the processes which illuminate the conceptualization of the circular economy construct. The researcher made use of qualitative content analysis to identify the current state of academic insight with regards to this promising concept. Past studies relied on content analysis to examine textual data (Hsieh & Shannon, 2005). Therefore, this research method involved an analysis of the relevant content or on the contextual meaning of the appertaining to the circular economy and / or on its related closed loop systems. The textual data was in electronic form and was obtained from academic articles. The researcher inserted the "circular economy" keyword through the Web of Science and Scopus online libraries, for the period from 2000 to 2018. There were almost 3,400 contributions in total in both repositories. The top five categorisations in Web of Science included: environmental sciences (479), engineering environmental (333), green sustainable science technology (288), environmental studies (84) and economics (67). Whilst in Whilst Scopus reported the top subjects, including; Engineering (901), Environmental Science (897), Energy (411) Social Sciences (407) and Business, Management and Accounting (377). This review was limited to journal publications in the English language. As a next step, the researcher has made reference to the most cited articles, after scrutinizing the content of their abstracts.

The researcher has used a directed content analysis approach to validate or to conceptually extend a theoretical framework or theory that reflects the latest developments in academic research (Hsieh and Shannon, 2005). Previous theoretical insights and empirical findings have shed light on the variables of interest or about the relationships among them. Relevant articles on the circular economy have been reviewed and compared, as the researcher checked for similarities and differences amongst them. A critical analysis involved an iterative process in order to achieve

consistency in the review of the literature. The findings from the directed content analyses has extended supporting evidence of the conceptual development of the circular economy. Like any multi-disciplinary field circular economy also contains elements from various disciplines and paths of research that are the predecessors of current knowledge **(**Lieder and Rashid, 2016). The researcher has identified different perspectives in the academic literature on the circular economy approach, including; its contribution to resource scarcity, sustainable consumption and production. The thorough review reported that the closed loop systems improve waste management, reduce the environmental impact, and bring significant operational and strategic benefits, including cost saving and operational efficiencies to the practitioners.

5. An Appraisal of the Circular Economy

Firms are encouraged to continuously re-examine their extant operations, management systems and production processes as they need to identify value-added practices (Porter and Van der Linde 1995). Their industrial operations can be improved through redesigned processes, the elimination of some of them, the modification of certain technologies and / or inducting new technology. Prakash (2002) suggested that the businesses could adopt management systems that create the right conditions to reduce their negative impact on the natural environment. He posited that this could take place in the following ways: (i) repair – extend the life of a product by repairing its parts; (ii) recondition – extend the life of a product by significantly overhauling it; (iii) remanufacture – the new product is based on old ones; (iv) reuse – design a product so that it can be used multiple times; (v) recycle – products can be reprocessed and converted into raw material to be used in another or the same product, and (vi) reduce – even though the product uses less raw material or generates less disposable waste, it could still deliver benefits that are comparable to its former version. These preventative and restorative practices are related to the circular economy. Hence, the word 'circular' has an inferred, descriptive meaning which relates to two types of cycles: the (i) biogeochemical cycles and (ii) product recycling (EMF, 2013).

5.1 Closed Loop Systems

The biological and / or technical nutrients that are used for the production of goods and resources, are either designed to re-enter the biosphere 'safely', or to re-circulate at high-quality, without entering the biosphere (UNEP, 2006). Therefore, the circular economy proposition comprises a 'closed-loop economy' that involves a 're-design' thinking (UNEP, 2006). Murray et al. (2017) suggested that sustainable production is optimized via biomimetics, wherein the structure and

function of natural systems would inform industrial processes. This approach is related to UNEP's (2006) proposition to 'design out' waste, return nutrients via product recycling. Such closed loop systems emit lower emissions of pollutants and will result in high efficiencies for an industrial economy which is, by design or intention, restorative in nature. In industrial symbiosis firms use each other's waste as resources (EMF, 2013). In a similar vein, the circular economy models would involve the slowing down of cycles to delay waste output within the service economy. By increasing the longevity of products through better manufacturing and maintenance, the rate of replacement decreases, and so the use of resources is considerably reduced.

Therefore, companies of all sizes could engage in new sustainable approaches such as extending the producers' liability, life-cycle analyses, material-use and resource flows, and eco-efficiencies (EMF, 2013). Cooper (2012) held that individual consumers would prefer to use longer-lasting products. Such products would appear to provide added value for money to customers. Yet, the longevity in product design could not always be efficient, in ecological terms. However, the durable products consume more useful energy than those that are designed towards more environmentally-friendly outcomes (UNEP, 2006). For example, paper and cardboard items are more sustainable than plastics in landfills. On the other hand, the products that are made out of natural nutrients are more easily re-assimilated back into the environment. Notwithstanding, long-lasting materials may eventually prove harder to break down into key components for further recycling. Very often the unwanted outputs of one industrial process could be used as raw materials in other industrial processes. In a sense, the circular economy is a mode of economic development that is based on the ecological circulation of natural materials; often requiring compliance with ecological laws coupled with the sound re-utilization of natural resources (Feng, Mao, Chen and Chen, 2007).

There is more to the circular economy's model than improving resource utilization. Hu, Xiao, Zhou, Deng, Wang, and Ma (2011) stressed that the focus of the circular economy is on resource productivity and eco-efficient improvement, through reducing, reusing, recycling and recovering. The circular economy approach encourages the re-organization of economic activities with feedback processes that could mimic restorative ecosystems. This happens through a process where natural resources are transformed into manufactured products and by-products that could be re-used as resources in other contexts. Hence, the throughput of energy and raw material is considerably reduced (Cooper, 1999:10). The circular economy also aims to repair

previous damage by re-designing better operational systems. It draws on concepts such as resource efficiency where industries reduce their environmental impact by being waste-free (Anastas and Zimmerman, 2003). For example, Rolls Royce has improved its manufacturing processes and technologies to reduce waste and keep resources in circulation. The British car and aerospace engine maker has boosted its efficiency and productivity levels by reducing the number of processes and items that are required to make turbine discs. This translated to significant savings in terms of costs, time and operational efficiencies for the facility (Eco-Business, 2015). The circular economy optimizes manufacturing and supply systems as it informs industrial processes and industrial ecology by focusing on the positive restoration of the environment within the industry (Martens, Gutscher and Bauer, 2011; Cooper, 1999; Sharma and Vredenburg, 1998).

The circular economy approach involves developing closed loop systems that avoid waste and resource depletion as small improvements in eco-design, waste prevention and waste reuse can bring net savings to business and industry. Hence, this concept focuses on the redesign of manufacturing and service systems. Closed loop systems increase resource throughput in industrial production and consumption (Ghisellini, Cialani and Ulgiati, 2016). The recycling of resources has been a significant part of sustainability practices for many years. For instance, the formation of inter-firm clusters at supply chain level that were represented by eco-industrial parks (EIPs) involved industrial symbiosis; where firms use each other's waste as resources (Dong, Zhang, Fujita, Ohnishi, Li, Fujii and Dong, 2013; Geng, Zhang, Côté and Fujita, 2009; Chertow, 1998). The unwanted outputs of one industrial process may be used as raw materials in another industrial process. Notwithstanding, responsible businesses could increase the longevity of products through better manufacturing and maintenance (Camilleri, 2017a). They could decrease resource utilization and their rate of replacement. Furthermore, it encourages the positive restoration of the environment by redesigning manufacturing systems within the industry that improve resource utilization as opposed to natural resource depletion and environmental degradation (Liu, Li, Zuo, Zhang and Wang, 2009). As a result, the circular economy and its closed loop systems may lead to the sustainable development of the economy, environment and society (Murray et al., 2017). The Ellen Macarthur Foundation (2013) has described the circular economy as an industrial economy that is restorative or regenerative by intention and design. This latter perspective suggests that the circulation of resources could regenerate the organizations' operational performance, whilst ensuring the environmental protection. Lieder and Rashid (2016) also reiterated that the concept of circular economy was considered as a

solution to the series of challenges such as waste generation and resource scarcity. The adoption of closed loop production patterns would increase the operational efficiency of resource use (Zhang, Ren, Liu and Si, 2017; Bocken, Short, Rana and Evans, 2014; Mont, 2002; Shrivastava, 1995).

5.2 Product Service Systems

Many academic commentators claim that product service systems (PSS) are moving society towards a resource-efficient, circular economy (Tukker, 2015; Piscicelli, Cooper and Fisher, 2015; Tucker and Tischner, 2006). PSS is based on the final users' needs and wants, rather than on the individual products. Therefore, businesses could design need-fulfilment systems with lower impacts to the environment. Tukker (2015) suggested that firms will have an incentive to prolong the service life of their products, and to make them as cost- and material-efficient as possible. Therefore, the proponents of PSS contended that it could lead to the minimization of material flows in the economy whilst maximizing the businesses' service output and their users' satisfaction. For example, Koninklijke Philips N.V. (Royal Philips, commonly known as Philips), a diversified technology company that is based in the Netherlands, claims that it is moving toward closed loop initiatives as it innovates its circular economy model; in terms of material, component and product reuse. Specifically, Philips sells lighting as a service to customers, and is responsible for its investments' technology risk. The Dutch company installs its lighting equipment (including street lighting), maintains it, and ensures that it runs for a very long time. Eventually, it reclaims back its equipment when it's the right moment to recycle materials. This model is conspicuous with the product-service system, where the property rights remain distributed among clients and their providers, over the life time of the product (Tukker, 2015). Philips have recognised an untapped opportunity to retain ownership of its products, as the Dutch multinational has committed itself to dispose of the infrastructure and its constituent parts at their end of life. At the same time, customers (including the government) don't have to pay high upfront costs for their lighting equipment. Moreover, Philips is also using closed loop systems within healthcare environments where it has established leasing relationships with clients for its medical infrastructure. Again, the company will eventually reclaim back its equipment and upgrades it when necessary. Most of Philips products are recyclable, upgradable and maintainable (McKinsey, 2014). When the medical equipment is refurbished with state-of-the art technology, the multinational firm will re-use it for another customer; it provides a warrantee cover and guarantees its products as new.

Very often, businesses are resorting to new PSS models where the ownership of the product remains with the provider, during their lifetime. Many firms are also offering integrated solutions, or even experiences, which allow them to achieve a competitive edge by creating customer utility and generating value (Tukker, 2015). For instance, when manufacturers provide integrated service products (ISP) they are meeting their discerning clients' needs with service packs comprising the physical product as well as the provision of a comprehensive service (Berkovich, Leimeister and Krcmar, 2011). Tukker (2015) posited that PSS's result-oriented services is facilitating a shift to a circular and resource-efficient economy. However, he also admitted that practitioners will probably incur ongoing research and development costs; as well as operational costs to repair, upgrade and modify used resources. They may also have to dispose the unwanted materials at some stage, in their end of life.

6. A Critique of the Circular Economy

There are potential challenges and opportunities for the implementation of the circular economy and its closed loop systems. Very often, the circular economy approach may be criticized for its over-simplistic goals as well as its unintended consequences. Moreover, there are macro-environmental factors, including political, economic, social and technological issues that could also impact on the businesses' responsible and sustainable behaviours (Camilleri, 2017a).

At times, the responsible initiatives may possibly cause negative outcomes. For instance, the alternative fuel that is produced from palm oil or soybeans has inevitably led to the loss of large forested areas around the world. Equally, green energy production necessitates large stretches of arable land, and puts huge pressures on food supply chains (Kovács, 2008), particularly in the poorest countries. Notwithstanding, the production of Ethanol is yet another example that requires more fossil fuel than it produces (Farigone, Hill, Tilman, Polasky and Hawthorne, 2008). Furthermore, the idea that we can design much longer- lasting products appears useful. However, the product longevity is not always feasible, and may not be efficient in ecological terms. Many long-lasting products which do not break down quickly consume more useful energy and release more entropy than those that are designed towards a more natural outcome. For example, a bamboo chopstick would be better than a highly specialized plastic fork, as it could easily be recycled and would be shortly be removed from the Biosphere. The bamboo chopstick uses only natural nutrients, unlike technical nutrients, and therefore is more easily re-assimilated back into the environment. By building long-lasting materials, it will be harder to break them down in the end of their life time. The environmentally-friendly technologies, including the wind farms and

solar panels rely on certain minerals that are difficult to recycle. Their green structures will invariably require servicing and replacement. Hence, the prices of such green technologies may not necessarily reflect the real costs of their materials and components. These structures contain technological nutrients that will invariably need significant, energy-expensive servicing and replacement, as nothing lasts forever in an entropic universe (Murray et al., 2017). Therefore, delaying the lifecycle of products through prolonged servicing may not be a sustainable strategy.

The transition toward a zero-waste model could prove to be a very difficult endeavor for the business and industry. Although financial investments in new technologies could possibly improve operational yields and efficiencies (Porter and Kramer, 2011), there could still be a low demand for them, particularly if these new systems require behavioural changes by their users (Porter and Van Der Linde, 1995). Notwithstanding, business and industry practitioners would probably resent any mandatory changes that may be imposed on them by institutions and policy makers. It is very likely that they would opt to remain in their status quo, where they are 'locked-in' to their traditional linear models (Bocken, de Pauw, Bakker and van der Grinten, 2016). Several challenges could slow down or may prevent their implementation of the circular economy. For example, certain developing countries may not follow the international regulatory guidelines and principles for sustainable development. There may also be characterized by the poor enforcement of their respective legislation. Contingent issues may include; the shortage of advanced technology, weak economic incentives, poor leadership and management of corporations, and the lack of performance assessments of sustainability models, among other matters. Technology is a key factor in the development of a circular economy model. However, businesses may not always be in a position to invest in economic and efficient infrastructures. Moreover, they may not be incentivized to conduct "green activities" in terms of their waste management, since changing or updating equipment is usually both time- and money-consuming, while the potential economic benefit is limited. Many governments may not provide economic instruments, such as tax incentives to support businesses and clusters in their closed loop systems (Wang, Wang and Zhao, 2008). Similarly, financial services institutions, including banks may not finance environmental-friendly technologies.

The business practitioners may see little economic incentives to save energy, material and water. The producers can easily transfer the manufacturing costs to their customers in the form of higher sale prices. The active engagement of the marketplace stakeholders, including suppliers and distributors is indispensable to the development of the circular economy. At times, local

governments may lack the human and institutional capabilities to encourage corporate sustainable behaviours (Camilleri, 2017a).

Eventually, many governments may have to introduce intelligent, substantive and reflexive regulations for performance assessment (Camilleri, 2015), covering areas such as; standardizing the process of data collection, calculation and submission, adding prevention-oriented and absolute energy / material consumption reduction indicators, to setting specific and quantitative goals (Su, Heshmati, Geng and Yu, 2013). These issues may discourage the eagerness of governments to introduce hard legislation on the circular economy as they do not know to what extent their regulation would impact on the businesses' prospects. Hence, national government may consider setting up region-specific indicators, rather than using the same national standards, so that even the poorer regions would have incentives to pursue circular economy targets (Su et al., 2013).

For the time being, the circular economy perspective is focused on the environmental and economic issues. It is virtually silent on the social dimension, as there is no explicit recognition of the social aspects that are inherent in other sustainable development conceptualizations. It may appear that the circular economy is focused on the redesign of manufacturing and service systems that will benefit the biosphere; through an ecological renewal and survival, and by reducing the use of finite resources (Murray et al., 2017). Yet, there is no explicit recognition of the social aspects that are inherent in other sustainability and business ethics concepts. It is still unclear how the concept of the circular economy could unleash social responsibility, unlike other terms, including creating shared value, corporate citizenship, corporate sustainability and responsibility, sustainable development, sustainable entrepreneurship, social entrepreneurship, social cohesion, social inclusion, social equity, among others (Camilleri, 2017). The societal needs are not included in the circular economy's basic formulation.

7. Discussion and Conclusions

The transition towards circular economy comes from the involvement of all stakeholders and on their capacity to collaborate and forge relationships. National governments, inter-governmental organizations and NGOs have formulated a number of policy levers on the circular economy. At the same time, exemplary companies out of their own volition, are increasingly developing common approaches and generalized guidelines for environmental sustainability (EMF, 2018). Perhaps, lessons could be learned from good practice as well as on failures. Success stories also

point out the need for an economic return on investment, in order to provide suitable motivation to companies and investors. This research posits that there is more to the circular economy than process improvements and product benefits. A through literature review suggests that businesses are resorting to closed loop and product service systems to increase their operational efficiencies and cost savings (Ghisellini et al., 2016; Tukker, 2015; Piscicelli et al., 2015; Tucker and Tischner, 2006; Dong et al., 2013; Geng et al., 2009; Chertow, 1998). There is a possibility that the circular economy would result in lower product costs, lower packaging costs and lower net costs of product disposal to customers (Bocken et al., 2016; Stahel, 2016; Tukker, 2015). Several businesses are already converting their by-products or unwanted materials and products into valuable resources for new products (EMF, 2018). The case studies of the responsible businesses who are resorted to closed loop systems are being promoted by environmental NGOs, including the Ellen Mac Arthur Foundation are indicating that there is market for used materials and resources. Moreover, many countries are providing the appropriate conditions for the development of clusters at supply chain level, as they enable businesses to exchange waste resources (Dong et al., 2013; Geng et al., 2009). Any reductions in waste could translate to lower costs for the businesses themselves, as they do not need to handle, transport and store waste prior to its disposal. As a result, businesses will consume lower energy in their production processes.

The main challenge is creating the right environment where businesses collaborate in supply chains. The development of clusters and eco-industrial parks would help them to turn their unwanted externalities into useable materials for others. Local institutions and governments may provide their support to those responsible firms to benefit from the sustainable consumption and production of resources. This contribution contended that there is scope for businesses to build fruitful relationships with suppliers, customers and other industry players, including competitors in order to create closed loop systems (Stubbs and Cocklin, 2008; Jayaraman et al., 1999). Some industries lend themselves to circular initiatives more than others as the recirculation of their resources may be straightforward. For example, primary industries such as iron, steel and aluminium may need to be incentivised to minimise their waste in closed loop systems. Secondary industries, including solar and wind energy technologies, battery production and biotech materials will inevitably have to be re-assessed on the basis of their recirculation potential and performance over their whole life cycles.

The circular economy concept has the potential to maximise the functioning of global eco-systems. Everyone has a responsibility to bear for the products' disposal at their end of the life.

The businesses are encouraged to measure their direct and indirect environmental impacts. Circular-economy metrics may have need to be developed. At present, there is no way of measuring how companies are effectively circulating resources. These metrics should assess the ecological sustainability as well as economic benefits that could accrue from the adoption of closed loop systems. Academic researchers and practitioners themselves should support institutions in the development of such metrics. The intergovernmental organizations, including; the Organization for Economic Co-operation and Development and the European Union have already put forward their policies and regulatory principles that promote the circular economy. However, they could formulate implementation and disclosure guidelines that are targeted at large undertakings.

Evidently, there are opportunities as well as serious challenges facing our organizations and the environment in the foreseeable future. Over-simplified goals that are based on weak foundations could pose significant risks to the usefulness of the circular economy in the sustainability agenda. This research has indicated that policy developments and adequate financial support toward research and development could foster a climate for more engagement in the circular economy agenda (Prothero et al., 2011). Within this proposed model, the production of goods operates like a natural system where waste becomes the source of growth for something new.

Research Implications, Limitations and Future Research Avenues

In conclusion, the closed loop systems are restorative by design as they optimize processes and outputs through continuous improvements in planning, resourcing, procurement, production and reprocessing (Peeters et al., 2014). In a way, the circular economy model resonates with Boulding's (1966) argumentation; where he predicted that in future, man must find his place in a cyclical ecological system which is capable of continuous reproduction of material. Today, a global population of more than 7.2 billion requires food, clothing, housing, and everything else that is essential for a good life. Most of the world's economies are thriving as they are more intertwined than ever. At the same time, several corporations have bargaining power over national institutions that are supposed to control them. We are living in an era where humanity has become a geologically significant player through its impact on the biosphere. Hence, the economic and environmental challenges appertaining to the circular economy's closed loop systems will inevitably demand pre-emptive corporate responsibility.

Given that the circular economy notion addresses the economic and environmental pillars of the triple bottom line. Future research could incorporate the latest ecological knowledge into our knowledge and understanding of naturalistic economical models and systems, without silencing the social and human dimension. The implications of re-aligning economic and management practice with the ecological and social models can contribute to the development of sustainable business practice.

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