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The Trend of Circular Economy Studies in Asian Countries: A Bibliometric Analysis

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Abstract

The present study utilises bibliometric methods to compile a body of knowledge on the circular economy, with a specific emphasis on Asian countries, from 2005 to 2023. This study contains 184 publications and is conducted as a descriptive analysis. The conceptual analysis shows that recycling, waste management, and sustainable production are closely related to the circular economy. According to the analysis, recycling, sustainable development, waste management, and sustainability are the five main themes of circular economy research. Current research trends prioritise governmental interventions and the implementation of rules and regulations to facilitate the transition towards a circular economy. This involves promoting recycling and reuse practices while discouraging the prevailing culture of excessive consumerism. The findings underscore the obstacles and complexities involved in implementing comprehensive policies for the circular economy.

Keywords: Circular Economy, Recycling, Sustainable Development, Waste Management, Sustainability

Introduction

It is common for the term “circular economy” (CE) to be used in the context of academia, politics, and actual industrial activities. The concept of the circular economy encompasses the increasing limitations imposed on Earth’s natural resources, necessitating the development of a new approach to production and consumption that is environmentally sustainable. The CE encourages a mindset that emphasises cyclical thinking rather than seeking “closed loops,” having an open-ended understanding of the value-added chain, or reducing the use of virgin materials and energy. However, beyond being solely an environmental strategy, CE is increasingly seen as an economic strategy that requires a comprehensive overhaul of the entire system of human activity, encompassing both production processes and consumption activities. To find a solution, the industrial structure and reforms in industrial policies need to be modified to encourage the development of new technologies by shifting the emphasis to waste recycling (Homrich et al., 2018).

The production and consumption patterns of today seriously jeopardise the Earth's biocapacity (Wackernagel & Beyers, 2019). Due to population growth, urbanisation, and industrialization, energy consumption is at an all-time high, increasing greenhouse gas emissions and influencing the climate globally (Lipson et al., 2019). The enormous volumes of garbage being produced and the geological scarcity of vital raw resources are further pressing concerns (Henckens et al., 2016; Massari & Ruberti, 2013). The buildup of improperly managed plastic waste is especially concerning (Lebreton & Andrady, 2019). Interest in bringing global industrial systems into alignment with natural equilibria has been sparked by these and numerous other environmental problems associated with contemporary economic practices (Borrello et al., 2020).

According to Barreiro-Gen and Lozano (2020), one of the newest and most essential approaches to promoting environmental sustainability is through CE. By focusing on closing material loops through various types and levels of recovery, or the 4Rs (reduce, repair, remanufacture, and recycle), waste is employed as a resource in other sections of the value chain in CE. The macro and meso levels have dominated CE activities. Microlevel research and practice have been few, primarily concentrating on one sort of organisation, namely companies, or with a concentration on certain nations. To effectively accomplish the global sustainable development goals set by the United Nations, it is crucial to immediately adopt and implement CE practices (2015) and to guarantee more sustainable patterns of production and consumption (Dominko et al., 2023). To ensure long-term sustainability through increases in GDP, employment, and resource productivity, circularity has been proposed as a critical component (Trica, Banacu & Busu, 2019). All social actors, however, must collaborate and be dedicated to bringing about crucial changes in the provision of social justice, equity, and inclusion, along with consumer lifestyles (Jaeger-Erben et al., 2021). The Ellen McArthur Foundation is spearheading the spread of the CE and has created several useful initiatives that governments across the globe have adopted. The Ellen MacArthur Foundation (2015) outlines the three guiding principles of CE, as follows: (1) to maximise resource yields by circulating materials, products, and components at the highest utility in both technical and biological cycles; (2) to optimise natural capital by managing finite stocks and balancing renewable resource flows; and (3) to promote system effectiveness by identifying and eliminating negative externalities.

International organisations like the United Nations and others, as well as policymakers in developed countries, have also begun to pay more attention to the CE. However, many low- and middle-income countries have paid relatively little attention to the useful contributions of the circular economy strategy. Many of these nations must implement a circular economy if they are to meet the Sustainable Development Goals (SDGs). The circular economy idea is already included in the current sustainable development goals. When SDG 12 (responsible consumption and production) is advanced through the application of the concept, other social, economic, and environmental development goals will also advance and be achieved [8], as is also discussed in the UNEP Circularity Platform, 2019 UNEP Resource Efficiency 2020+.

According to Moraga et al. (2019), CE aims to reduce the number of materials used and the amount of waste produced. The relevance of this idea demonstrates how it immediately influences the decrease in the use of natural resources and leads to the recycling of waste materials as secondary raw materials. Furthermore, CE aims to raise the likelihood of product valuation and prolong the usable life of goods (Negrete-Cardoso et al., 2022). One of the issues that arises in this situation is whether it is feasible to imagine sustainable production

when considering CE. Moreover, there is an issue over the extent to which Asian nations implement and adhere to circular economy ideas. Using bibliometric methodologies, a descriptive analysis of the literature was conducted to identify the body of knowledge in this field, with a focus on CE in Asian countries from 2005 to 2023. The descriptive analysis was done to better understand this concept, its evolution, and its contribution.

The growing importance of the circular economy (CE) in addressing global environmental challenges and fostering sustainable development has spurred significant academic and policy interest. As the term becomes increasingly pervasive in academic, political, and industrial discourse, there is a pressing need to delve deeper into its practical implications, particularly in regions that are pivotal to the global economic landscape, such as Asia-Pacific countries.

This study is motivated by the recognition that CE is not merely an environmental strategy but a comprehensive economic approach requiring significant systemic changes. The traditional linear model of production and consumption has led to severe environmental consequences, and the circular economy offers a transformative pathway towards sustainability. By emphasizing cyclical thinking, waste recycling, and the 4Rs (reduce, repair, remanufacture, and recycle), CE presents a holistic framework for addressing the depletion of natural resources, rising energy consumption, and escalating waste generation.

The urgency of adopting CE practices is underscored by the contemporary challenges posed by population growth, urbanization, and industrialization. The study acknowledges the current threats to the Earth's biocapacity, the surge in energy consumption contributing to global climate change, and the critical issues of improperly managed plastic waste. These challenges necessitate immediate attention and the implementation of circular economy principles for the long-term well-being of the planet.

In focusing on Asia-Pacific countries, this study makes a significant contribution by addressing the existing gap in bibliometric research on CE in this region. While there is growing attention from international organizations and policymakers in developed countries, the perspectives, and contributions of low- and middle-income countries, particularly in Asia, have been relatively underexplored. Understanding the adoption and adherence to circular economy principles in these nations is crucial not only for their sustainable development but also for the achievement of global Sustainable Development Goals (SDGs).

The study employs bibliometric methodologies to conduct a comprehensive analysis of the literature on CE, with a specific emphasis on Asian countries, from 2005 to 2023. This approach allows for a nuanced exploration of the evolution of CE concepts, the body of knowledge in this field, and the contributions made by Asian countries. By doing so, the study aims to provide valuable insights that can inform future research directions, policy initiatives, and industrial practices, ultimately contributing to the broader discourse on sustainable development and circular economy implementation on a global scale.

Therefore, this effort aims to address the lack of bibliometric research on CE, with a particular focus on Asia-Pacific countries. The organisation of this article is as follows: The study consists of four main sections: (a) a comprehensive examination of CE and its development based on a literature review (the “theoretical framework and literature review” section); (b) a detailed explanation of the methodology employed (the “methodology” section); (c) a thorough analysis of the data, including the conceptual and intellectual framework (the “descriptive analysis” section); and (d) final remarks and suggestions for future research.

Theoretical Framework and Literature Review

Prior studies suggest that academics lack consensus over the existence of numerous definitions pertaining to the circular economy (Yuan & Moriguichi, 2006; MacArthur, 2013; Birat, 2015; Tukker, 2015). The fundamental objective of a CE is to maximise the longevity of resources, materials, and products in the economy (Merli, Preziosi & Acampora, 2018). The notion of the CE can be viewed as an integrated framework that delves into various ideas, including biomimicry, cradle-to-cradle, life cycle assessment, industrial ecology, and industrial symbiosis. The volume of the review study is indicative of the aspiration to gain a deeper understanding of the CE. Table 1 presents the study streams that most commonly reference the establishment of CE. One of the CE concepts that is most often brought up is the idea of closed loops; biological loops are more in line with biological and environmental backgrounds, while technical closed loops are more in line with industrial and economic viewpoints. With a growing body of research on circular business models, the disciplines of strategy and management have recently begun to pay greater attention to the circular economy (CE) (Linder & Williander, 2017).

Table 1
Schools of thought pertaining to the circular economy (CE)

School of thought	**Definitions**	**Source**
Cradle-to-cradle	Goods or products are designed to provide industry with essential nutrients, components, and materials in a fully closed-loop system or to contribute to the restoration of the ecosystem as biological nutrients.	McDonough and Braungart (2002)
Industrial Ecology	Mature industrial ecosystems are designed using the cyclical resource-use patterns found in biological ecosystems as a model, with less reliance on resource extraction and waste emissions for production.	Graedel and Allenby (1995)
Biomimicry	Designers draw direct inspiration from living things, biological systems, and ecosystems.	Benyus (2002)
Laws of Ecology	There are a total of four: (i) All things must be allocated a certain location; (ii) Nature possesses the most superior wisdom; (iii) The concept of receiving something for nothing (“free lunch”) does not exist; and (iv) Every entity is interconnected with every other entity.	Commoner (1971)
Performance Economy	It enables business owners to enhance their competitiveness by reducing resource usage and preventing the externalisation of waste and risk expenses.	Stahel (2010)
Blue Economy	The need lies in determining how to harness the resources of the Earth in order to fulfil the fundamental requirements of the planet and its entire population.	Pauli (2010)
Regenerative Design	This involves replacing the current linear system of transfer flows with cyclical flows at sources, consumption centres, and sinks.	Lyle (1996)

Permaculture	The agricultural ecosystem is comprised of self-replicating or perennial plant and animal species that are beneficial to humans.	Mollison and Holmgren (1978)
Natural Capitalism	An approach that enhances profitability and competitiveness while also maintaining the ecology. Implementing incremental changes to the company's operations, based on innovative techniques to enhance resource efficiency, can yield significant benefits for both current and future generations.	Lovins, Lovins & Hawken (2005)
Industrial Metabolism, Industrial Symbiosis and Eco Parks	There are parallels in the use of matter and energy between biological organisms and ecosystems, as well as the economic system. When many discrete sectors converge, they establish an industrial symbiosis wherein each enterprise seeks optimal means of acquiring raw materials and components.	Ayres (1989); Renner (1947)

Source: Adapted from Homrich et al. (2018)

Circular Economy in Asia

Previous research has demonstrated that developing nations like Indonesia have the potential to enhance their economies in a sustainable manner by implementing the circular economy model (Rishanty & Suryahadi, 2020). The recycling industry can fulfil its raw material requirements and diminish its reliance on imported raw materials by using the circular economy concept. For instance, Indonesia's plastic recycling sector currently provides employment for 20,000 individuals and has the ability to process one million metric tonnes of plastic each year. In terms of the steel recycling industry's potential, there are currently 60 companies that have a combined annual capacity of 9 million metric tonnes. These companies mostly rely on imported raw materials (70–90%), most of which are recovered scraps. Currently, the Indonesian government has identified five industries—food and beverage, textile, construction, wholesale and retail trade, and electrical and electronic equipment—as priority sectors due to their high potential for implementing a circular economy (Habiburrahman & Daulay, 2022).

Kazakhstan is a developing nation undergoing a rapid urbanisation phase. There is a growing trend of rural-to-urban migration, resulting in an increase in urban population and a corresponding rise in demand for residential spaces. The production of construction materials has more than tripled in the past 20 years due to the growth of the construction sector. The manufacturing of building materials ranks as the second-largest economic sector in Kazakhstan. Concrete, cement, gypsum, and clay or stone materials are produced by most construction material manufacturers. Almaty, which includes the Almaty region, and Nur-Sultan, the two primary urban centres, host several manufacturing firms specialising in the production of construction materials. Nevertheless, the prescribed optimal standards for construction and demolition waste management (C&DWM) are significantly distant from reality. Approximately 5% of construction waste requires disposal in a landfill. The majority of this waste consists of elements that can potentially be recycled or reused. These materials are categorised as non-inert (35%) and inert (60%). Currently, the majority of waste is deposited in landfills, despite the fact that up to 95% of it might potentially be recycled or repurposed. Over 50% of all waste generated consists of non-reactive waste, which is

exceptionally voluminous and signifies significant opportunities for recycling or repurposing (Turkyilmaz et al., 2019).

Kuah and Wang (2020) conducted a study that examines the extent to which consumers in East and Southeast Asia embrace circular economy practices, with a specific emphasis on electronic gadgets. The findings indicate limited awareness regarding CE facilities, concerns about exploitation, low acceptance of recycled and remanufactured products, and both environmental and cost considerations. The study recommends targeting specific demographic groups, managing consumer trust, allaying concerns, improving offerings, and appealing to innovation-minded consumers to promote circular economy practices.

Methodology

Using bibliometric tools, a descriptive study was conducted to gain an understanding of the current state of knowledge and research concerning CE in Asia. In the past, bibliometric techniques were employed to identify the researchers who received the highest number of citations, the keywords that were most commonly discussed, and the sources where the articles that best demonstrated sustainability and CE principles were published (Geissdoerfer et al., 2017). These methods have been used in recent research to examine the development of scientific knowledge in the most productive political regions in the field, including China and the European Union (Türkeli et al., 2018).

The first step in the literature review process for this study was to scan the SCOPUS database for relevant material. It is imperative to emphasise that the search considered the subsequent keywords and instructions found in the title: TITLE ("…circular economy*"…) AND TITLE ("…Asia)); only 184 matches were found in the search. Results in CSV files from 159 authors were found, covering a total of 93 sources throughout a chosen 19-year period from 2005 to 2023. Most of the studied materials were articles (103), followed by book chapters (31), reviews (30), conference papers (13), editorials (3), conference reviews (2), a book (1), and a note (1). The VOSviewer software was used to conduct the study and yielded a trustworthy analysis of the data.

The CSV file was imported to facilitate the analysis of the data using tables and graphs, which effectively illustrate the importance of the findings. Notably, bibliometric studies are gaining increased recognition, and bibliometric approaches are acknowledged as a systematic method in which content analysis allows for a thorough understanding of the research and its interrelationships (Homrich et al., 2018). Figure 1 shows the information analysis process for this study. Initially, the information was analysed through a descriptive analysis that identified the following: (a) the annual scientific production; (b) the scientific production by country; and (c) the authors who were most frequently cited. To determine the primary research issues and those that have been further explored during the selected years, as well as the co-occurrence keyword network, a second stage involved an examination of the conceptual and intellectual structures.

A conceptual structure analysis was conducted to identify the primary themes and concepts that have been investigated in scientific studies, as well as the co-occurrence keyword network. To achieve this objective, the results were filtered based on the most frequently occurring terms in the article abstracts. The present study examined a total of fifty-three terms. The circle diameters represent the frequency of the abstract keywords, with the biggest diameters indicating the most thoroughly researched topics. Furthermore, the thickness of the lines denotes the strength of the association between two topics.

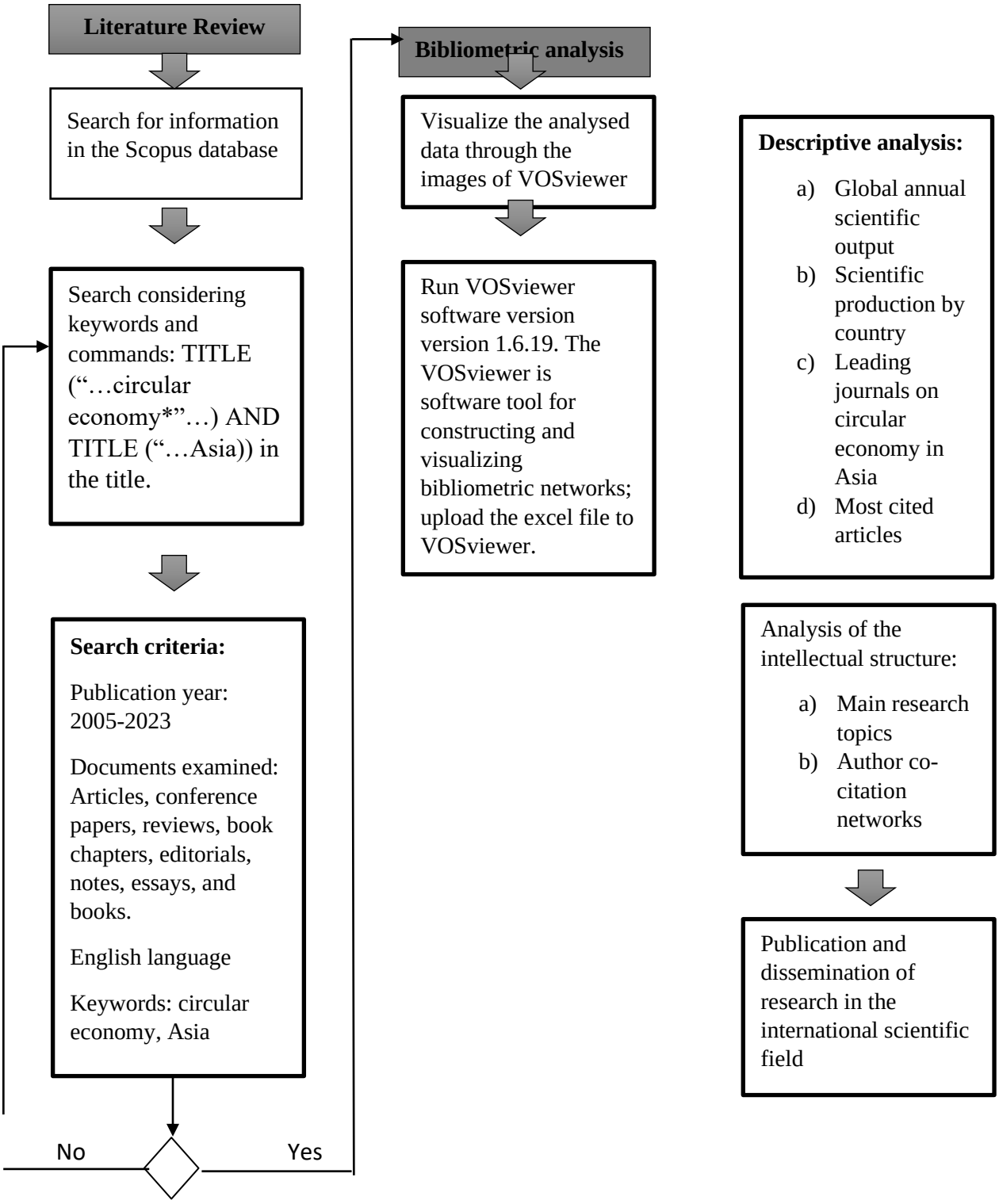


Figure 1. Literature review and analysis process
Source: Negrete-Cardoso et al (2022)

Results and Discussion

Descriptive Analysis

The current analysis encompasses a total of 184 publications that were published between 2005 and 2023. Figure 2 demonstrates a substantial rise in the annual scientific production

related to CE over the last nineteen years. Multiple sources of information were examined, revealing a substantial rise in scientific production between 2018 and 2023.

Prieto-Sandoval, Jaca and Ormazabal, (2018) assert that the academic community has shown a notable surge in interest since China initiated its efforts in the field of circular economy (CE) in 2003. Following the inclusion of CE in the European Community Agenda in 2014, there was a substantial rise in scientific output during the subsequent eight years. Notably, in 2021 and 2022, there were 37 and 45 publications produced, respectively. Even though Prieto-Sandoval et al. (2018) focused on the relationship between CE and eco-innovation from 1969 to 2016, their study's findings revealed an increase in publications, with 84% of them being published between 2018 and 2023. This assertion exemplifies the advancement of scientific research and the growing interest surrounding CE.

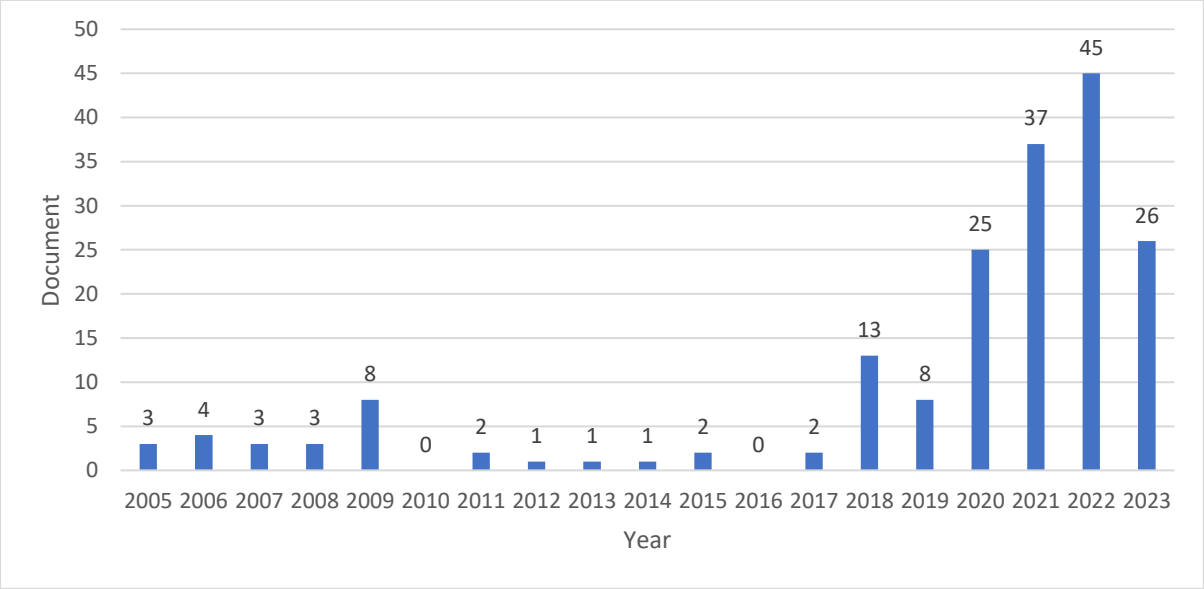


Figure 2. Evolution of published articles on circular economy from 2005 to 2023
Source: Own elaboration based on the Scopus database

Over a span of 19 years, the findings indicate a consistent upward tendency. The estimation of the publication quantity for the years 2030 and 2050 is linked to the year in which the United Nations formulated the Sustainable Development Goals and the 169 targets specified in the 2030 Agenda. The 2015 strategy was created to supervise global development initiatives. The increase in publications discussing persistent economic growth in that year, which implies long-term patterns of production and consumption, can be attributed to the aforementioned reasons.

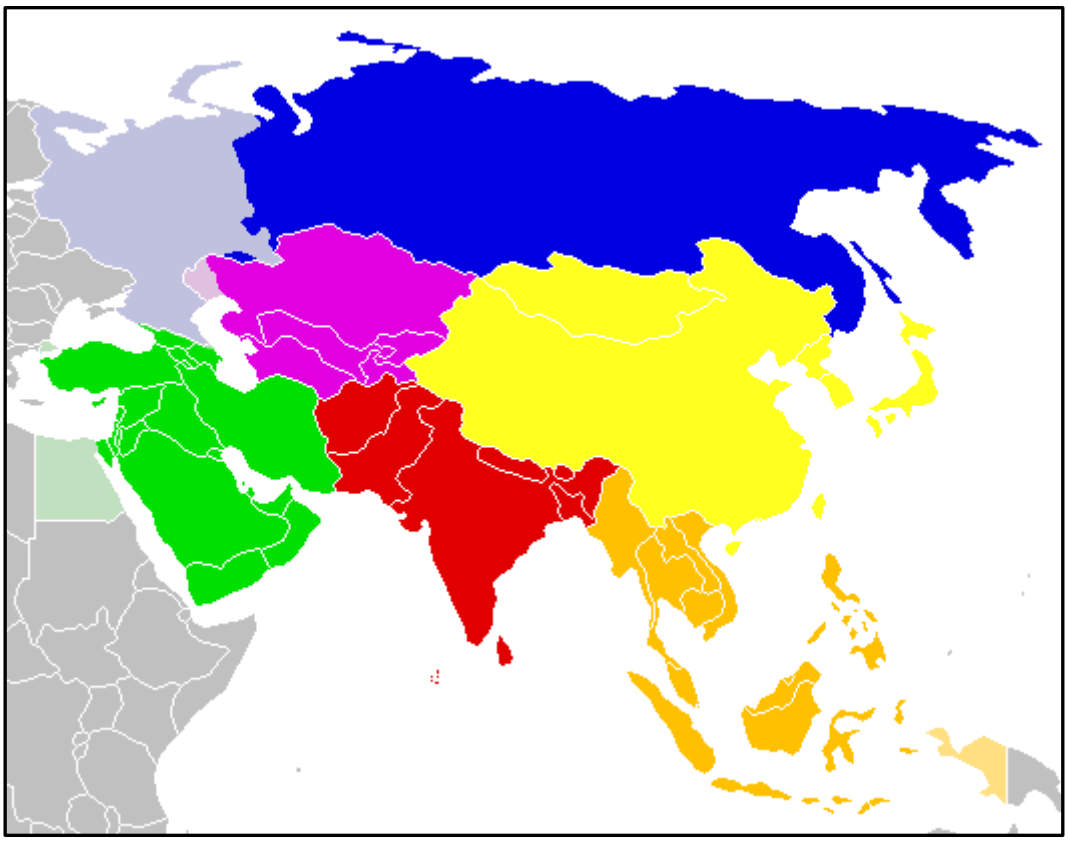
The European Commission has set the year 2050 as the target for the European Green Deal. This initiative intends to achieve a modern, resource-efficient, and competitive economy by disconnecting economic growth from resource consumption by 2015 (European Commission 2019). The findings indicate that the global scientific community is interested in adopting international agreements, such as the 2030 Agenda, especially for the European Community nations grappling with the COVID-19 pandemic. These countries must tackle emerging waste-related issues resulting from the pandemic.

The analysis centred on the Asian nations that have the highest number of scientists globally, with China alone accounting for 31 of them. India, Japan, and Singapore followed in succession. However, as stated by Geng et al. (2013), Germany and Japan emerged as frontrunners in promoting the CE concept through their extensive and all-encompassing

regulations. Nonetheless, in 2015, the European Union proposed a monitoring framework and approved the action plans for their implementation (European Commission, 2018).
In addition, as part of a developing strategy to promote a prosperous and equitable society with a modern, resource-efficient, and competitive economy, the European Commission launched the European Green Deal for the European Union and its citizens in 2019. The initiative establishes objectives to attain net zero greenhouse gas emissions and to decouple economic growth from the consumption of resources (European Commission, 2019). This clearly indicates the scientific interest in this area in European countries.

Currently, the post-COVID recovery of cities is contingent upon the green economy and declining rates of atmospheric pollution (Pérez-Hernández, et al., 2021). Within this framework, the European Green Deal is a green recovery initiative that aims to promote a clean and circular economy after the pandemic. It covers various sectors and focuses on achieving resource efficiency, restoring biodiversity, and reducing atmospheric pollution (European Commission, 2021).

The analysis of 184 articles revealed that 64 Asian countries (as shown in Figure 3) made contributions to scientific production in the field of CE (as shown in Figure 4) between 2005 and 2023. China leads the top five nations in terms of productivity, with 31 publications. India and Japan are tied for first place with 18 publications each. Singapore follows closely behind with 10 publications, and Thailand comes in fourth with 9 publications. This emphasises each nation's commitment to supporting CE as an alternative to minimising the use of raw materials, minimising waste generation, and severing the connection between natural resource consumption and economic growth as a means to achieve a fair, sustainable, and prosperous nation. Nevertheless, the results emphasise the existing disparities in this domain between affluent and impoverished nations.



Division of Asia into regions by the UNSD:

- North Asia
- Central Asia
- West Asia (Near East)
- South Asia
- East Asia (Far East)
- Southeast Asia

Figure 3. Countries in Asia

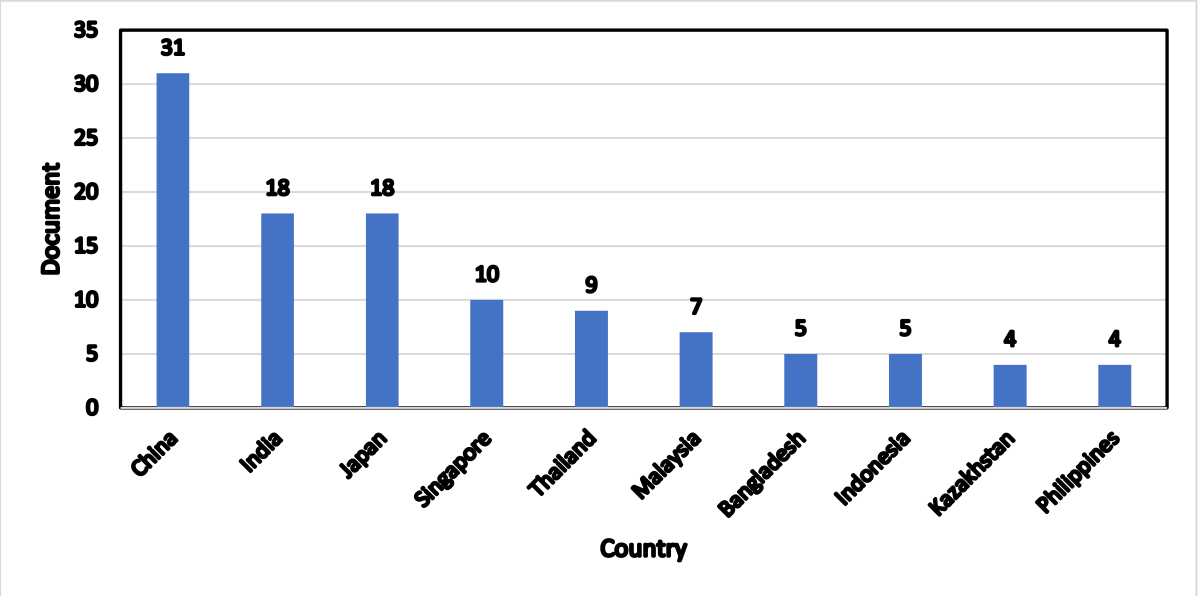


Figure 4. Top 10 countries with the highest scientific publications on Circular Economy (2005–2023)
Source: Own elaboration based on the Scopus database

The works that were most frequently cited as having the greatest impact on the field of study were identified. The 10 most referenced articles were chosen from a total of 184 reviewed documents, which originated from 93 sources and 159 authors (Table 2). In 2015, the article titled "Product services for a resource-efficient and circular economy: A review" by Tukker had 1148 citations. This article focuses on product service systems (PSS), which have been praised for their role in creating a resource-efficient, circular economy since the 1990s. The study examines the scholarly works on PSS from the preceding ten years and compares the results with a review conducted in 2006. The research output has significantly increased, with the number of peer-reviewed publications quadrupling since 2000. In addition, PSS has been integrated into other scientific disciplines and geographical regions. Contemporary literature examines the implementation of PSS by enterprises, emphasising crucial variables for success and addressing related obstacles. Nevertheless, the widespread adoption of PSS, especially in B2C contexts, has been limited due to consumers' strong demand for autonomy and their perception of excessive control by service providers.

The article by Yuan, Bi, and Moriguichi (2006) titled "The Circular Economy: A New Development Strategy in China" received a citation count of 661. It delved into the consequences of China's transition to a market-oriented economy, which has resulted in remarkable economic expansion but has also caused the depletion of resources and

environmental pollution. In response, China has actively adopted the Circular Economy (CE) idea since 1998, with a specific emphasis on closed-loop material and energy flows, resource efficiency, and eco-friendly practices. The CE is perceived as an economic approach to attaining sustainable development while concurrently advancing environmental conservation. The government has actively advocated for the adoption of cleaner production and the establishment of eco-industrial parks, with the goal of enhancing the eco-efficiency of businesses and regions. However, there are still obstacles to overcome in order to completely implement CE, necessitating endeavours in policy, technology, and public awareness to establish an enduring economy that does not compromise the environment.

The article by Geng and Doberstein (2008) titled "Developing the Circular Economy in China: Challenges and Opportunities for Achieving 'Leapfrog Development'" received a citation count of 515. The article focused on China's implementation of a circular economy model. China is currently adopting a circular economy model with the goal of addressing environmental and resource management challenges while simultaneously enhancing resource productivity and eco-efficiency. The model, officially adopted in 2002, entails a self-contained cycle of material flows within the Chinese economic system. The successful implementation of certain strategies allows for the bypassing of environmental damage caused by industrialization, a phenomenon sometimes referred to as 'leapfrogging'. However, barriers and challenges persist, so the future of the circular economy concept remains uncertain.

The article by Peters et al. (2007) examines the correlation between China's expanding economy and its escalating energy consumption, which in turn is causing environmental concerns. The article garnered a total of 503 citations. Gaining insight into the factors that influence China's energy consumption and CO_2 emissions is essential for formulating international climate policies and forecasting reduced emissions in developing countries. The growth of CO_2 emissions has not kept up with the rate of infrastructure expansion and urban household consumption. Improvements in technology and efficiency have the capacity to counterbalance the increase in consumption. However, there is a possibility of reducing emissions by enhancing production and consumption systems.

Brooks, Wang, and Jambeck (2018) address the issue of plastic waste as a substantial obstacle for solid waste management systems, with more than 50% of it being exported to other countries. Their article received 498 citations. China, which has been the recipient of 45% of plastic waste imports since 1992, has enacted a policy that prohibits the majority of these imports, leading to concerns about the future of plastic waste. By 2030, an estimated 111 million metric tonnes of plastic waste will have been displaced. Global action is imperative to reduce nonrecyclable materials, redesign products, and fund domestic waste management. Huang, Guo, and Xu (2009) address the recycling of waste printed circuit boards (PCBs) as a notable issue because of its complex nature and the increasing quantity of discarded materials. Their article received 474 citations. China's recycling technology is still in its early stages, with past research primarily concentrating on metal recovery. The aforementioned article presents a novel recycling process that is environmentally sustainable and incorporates the principles of the circular economy. The approach aims to achieve full recycling and efficient utilisation of resources for all types of materials.

Eco-industrial activities are increasingly being perceived as a viable alternative for promoting sustainability in industrial systems. China is actively implementing a circular economy, which has been officially established as a national development objective. The study published by Mathews and Tan (2011) provides a comprehensive analysis of eco-

industrial projects in China while also drawing comparisons with similar programmes in both Western and Eastern Asia. The article garnered 342 citations. The study examines the factors that motivate and hinder these attempts and introduces a Pareto eco-efficiency paradigm for their evaluation. The objective of the circular economy (CE) idea in China is to tackle environmental degradation and the limited availability of resources. The study conducted by Geng et al. (2009) garnered a total of 260 citations. Dalian, a city designated for showcasing and promoting new ideas, has successfully implemented measures aimed at conserving water, resources, energy, and land. Nevertheless, complete implementation is impeded by obstacles such as the absence of incentives for traditional companies, insufficient financial assistance, and limited public awareness. Dalian has resolved these challenges by implementing price and tax reforms, restructuring the budget, and implementing continuing education training programmes. In order for Dalian to fully achieve eco-city status, further efforts are required. The strategies implemented in Dalian can serve as a model for other cities in China (Geng, et al., 2009).

Urban areas account for 80% of the global GDP; however, the combination of rapid urbanisation, climate change, and inadequate waste management presents significant obstacles to their ability to withstand and recover from adverse circumstances. The City Blueprint research classifies cities into five distinct sustainability categories: cities that lack essential water services, cities that are wasteful in their water consumption, cities that are water-efficient and resource-efficient, cities that are adaptive to changing conditions, and cities that are efficient in their water management. Urban areas require a comprehensive and enduring plan to optimise the advantages of adaptation and limit expenses. Regional platforms are necessary to augment the exchange of knowledge between cities and strengthen their ability to govern effectively during the process of transitioning towards water-efficient cities. Koop and van Leeuwen (2017) argue that the water sector must undergo significant reframing and refocusing in order to effectively handle the global water governance challenge. Their article has gained 221 citations, indicating its impact and relevance.

The concept of the circular economy proposes that livestock reared within this framework might contribute substantially to human daily protein requirements by transforming surplus arable land and grass resources into valuable sustenance. This strategy reduces competition for land resources, specifically for the production of feed or food, thereby releasing around 25% of the world's cultivable land. According to Van Zanten et al. (2018), whose study garnered a total of 181 citations, feasible limitations on the increase in consumption of animal source foods (ASF) in Africa and Asia can be achieved, but global reductions are required to fulfil the criteria for sustainable land use.

The aforementioned articles highlight the importance of waste recovery, reduction, and efficient utilisation, along with the necessity of implementing waste treatment strategies to achieve a circular economy. The CE strategy sets forth its objectives for the elimination, avoidance, reutilization, and recycling of materials, all of which must be accomplished by 2030.

Table 2
Highly referenced documents in the domain of CE

No.	Authors	Title	Year	Source title	Cited by
1.	Tukker, A.	Product Services for a Resource-Efficient and Circular Economy: A Review	2015	Journal of Cleaner Production	1148
2.	Yuan Z., Bi J., and Moriguichi Y.	The Circular Economy: A New Development Strategy in China	2006	Journal of Industrial Ecology	661
3.	Geng, Y., and Doberstein, B.	Developing the Circular Economy in China: Challenges and Opportunities for Achieving 'Leapfrog Development'	2008	International Journal of Sustainable Development and World Ecology	515
4.	Peters G. P., Weber C. L., Guan D., and Hubacek K.	China's Growing CO_2 Emissions: A Race Between Increasing Consumption and Efficiency Gains	2007	Environmental Science and Technology	503
5.	Brooks A. L., Wang S., and Jambeck J. R.	The Chinese Import Ban and Its Impact on Global Plastic Waste Trade	2018	Science Advances	498
6.	Huang K., Guo J., and Xu Z.	Recycling of Waste Printed Circuit Boards: A Review of Current Technologies and Treatment Status in China	2009	Journal of Hazardous Materials	474
7.	Mathews, J. A., and Tan, H.	Progress Toward a Circular Economy in China: The Drivers (and Inhibitors) of Eco-Industrial Initiative	2011	Journal of Industrial Ecology	342
8.	Geng Y., Zhu Q., Doberstein B., and Fujita T.	Implementing China's Circular Economy Concept at the Regional Level: A Review of Progress in Dalian, China	2009	Waste Management	260
9.	Koop, S. H. A., and van Leeuwen, C. J.	The Challenges of Water, Waste and Climate Change in Cities	2017	Environment, Development and Sustainability	221
10.	Van Zanten H. H. E., Herrero M., Van Hal O., Röös E., Muller A., Garnett T., Gerber P. J., Schader C., and De Boer I. J. M.	Defining a Land Boundary for Sustainable Livestock Consumption	2018	Global Change Biology	181

Conceptual and Intellectual Structure

The second part of the analysis focused on the conceptual framework that facilitated the discovery and exploration of the main themes and concepts present in the scientific research, finally resulting in the identification of the network of co-occurring keywords. The search was performed by arranging the results based on the terms that were most frequently included in the abstracts of the articles. There were a total of 53 terms that were searched for, and the five most relevant topics were circular economy, recycling, sustainable development, waste management, and sustainability (Figure 5).

The keywords that appeared most frequently in this case were economic, circular, waste, management, and environment. The diameter of the circles corresponds to the frequency of the keywords in the abstract; the largest diameter represents the most extensively studied themes. Moreover, the thickness of the lines that connect the circles functions as a visual indication of the intensity of the association between two themes. The notions of economy and circularity are tightly intertwined, as are waste and management. This highlights the strong connection between reducing waste output and exploiting resources in a cyclical manner.

The interplay between waste and the circular economy establishes a strong connection among management, the environment, production, development, sustainability, and recycling. The issue of waste generation and treatment is of utmost importance for adopting CE policies, which seek to promote a shift in production and consumption practices (UN, 2015). This is due to the policies' emphasis on enabling this transition. The conceptual structure analysis further demonstrates a robust correlation between waste and CE. During their analysis of indicators for evaluating circular economy (CE) performance, Moraga et al. (2019) observed that the majority of CE indicators found in the literature focus on the preservation of materials, specifically recycling, which is also a widely discussed concept. The CE promotes recycling, but it is not the sole consideration. This highlights the necessity to explore various methodologies for the conservation of materials, as well as their products, components, functions, and energy.

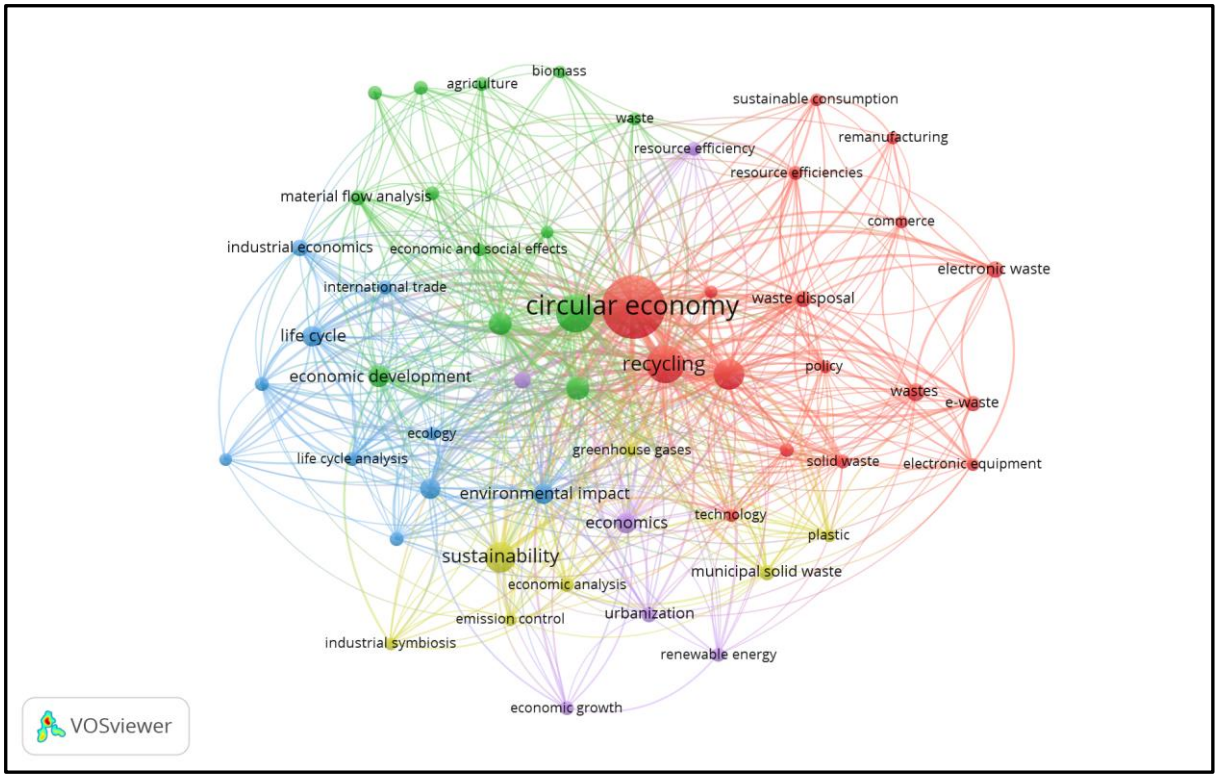


Figure 5. Research keywords in the 2005–2023 timeframe
Source: VOSviewer

Conclusion

Essentially, the present study reduces the disparity in the existing literature. This study offers a comprehensive analysis of CE based on a substantial sample, providing detailed information on the key subjects, nations, primary authors, and annual trends. While the field of CE research is growing, it remains primarily exploratory. Most publications rely on exploratory research methods, particularly case studies, and lack empirical validation or confirmatory methodologies specific to Asian countries. The majority of constructions utilised in the CE literature still require enhancement, and more consistent terminology should be employed.

The majority of articles published on CE that focus on Asian countries are from China. The articles published by Tukker (2015) and Yuan, Bi, and Moriguichi (2006) are prominently featured among the most influential publications worldwide due to their focus on closed-loop material and energy flows, resource efficiency, and ecologically friendly practices. Furthermore, it emphasised the significance of product service systems (PSS) in facilitating a transition to a resource-efficient CE.

The conceptual structure analysis demonstrates the co-occurrence network, with the terms circular economy, recycling, sustainable development, waste management, and sustainability appearing most frequently in the abstracts. Additionally, the analysis highlights the close relationship between waste management and the circular economy. This is a topic on which scientific research has become increasingly relevant in recent years, making it crucial to recognise that a circular economy model cannot exist without production that actively supports sustainable development, as outlined by SDG 12 of the 2030 Agenda.

Thus, it is critical to create new research directions that will focus on separating resource consumption from economic growth to create a clean, circular economy. Additional research areas include a comprehensive assessment of the circular economy's role in

sustainable development, the creation of a CE-promoting legal framework, and updated waste management regulations. Identified research trends relate to the implementation of policies and enforcement of rules by authorities to encourage the transition to a circular economy, promote the adoption of recycling and reuse practices, and discourage the growth of consumerism. The present study's scope was limited to searching publications from the Scopus database. Therefore, it is recommended to integrate supplementary databases, such as Web of Science, in forthcoming studies and broaden the search by considering alternative keywords.

According to Khajuria et al. (2022), on a global scale, governments, research institutes, enterprises, and other stakeholders are pushing for numerous strategies, such as cutting-edge technologies, management techniques, and real-world examples, to speed up circular economy waste management solutions. Undoubtedly, none of them possesses the capacity to independently manage all complications. Hence, it is imperative to understand and integrate them while duly focusing on areas that yield beneficial results. According to Patwa et al. (2021), converting an organisation or firm from linear to circular economy-based operations is a complex endeavour. However, as society becomes increasingly aware of the consequences that the former has on the ecology and the maintenance of this environment for future generations, there is a shifting towards a CE. A large number of stakeholders, including consumers, corporations, non-governmental organisations, and governments, must take part in this important endeavour. Based on the present study, a key factor in the transition to a CE is the requirement to increase the lifespan of consumer goods through 3R practices and prevent resource waste. The primary objectives of CE practices are to protect and preserve ecological equilibrium. Implementing waste-to-energy strategies, harnessing renewable energy sources, and optimising resource utilisation lead to waste reduction, hence fostering economic efficiency and promoting a circular economy.

Based on the present study, the government plays a vital role in promoting the acceptance of circular economy concepts in developing countries by initiating educational programmes, providing platforms for innovative ideas, and facilitating the establishment of sustainable development infrastructure. This study also highlights the need for consumer involvement in achieving the aforementioned objectives by means of attitudinal shifts and behaviour modifications. The acceptance of CE culture in society will eventually result from a generalised behavioural change brought on by communication, education, and economic advancement. Since CE is perceived as an expensive investment in emerging economies, it is necessary to properly educate businesses and organisations about the long-term benefits. To foster the adoption of CE in emerging economies, it will be imperative to showcase successful firms that have embraced these principles and leveraged innovative technology to enhance resource efficiency, reduce expenses, and explore untapped markets.

This study recommends that future research be conducted in developing nations, namely in Africa and Mainland Southeast Asia. The experiences gathered from these countries will enhance the understanding and implementation of CE adoption in other developing countries. The challenges associated with implementing CE may vary among different emerging economies; hence, it is crucial to examine them at the micro-level rather than the macro-level. A further crucial recommendation for future research is to gain a comprehensive understanding of the organisational perspective on implementing CE principles by surveying diverse businesses in emerging economies. This would offer valuable insights into the most effective strategies and the problems encountered by these companies. Undoubtedly, the implementation of CE will require a significant transformation in the entire economic

framework. This study highlights the significant amount of time that is wasted due to inadequate management of operations.

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