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Assessing Circular Economy Readiness Factors: Empirical Insights from a Developing Nation

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ABSTRACT

The Circular Economy concept has gained popularity among both researchers and practitioners. However, a comprehensive methodology for assessing a company's Circular Economy Readiness is lacking. Current assessment procedures often lack clarity in terms of metric and indicator selection. To bridge this gap, this paper introduces a novel model that integrates Circular Economy Readiness factors. To address Circular Economy Readiness in developing nations, this study amalgamates national, organizational, and individual readiness factors into a unified model, drawing from recent literature. Readiness for change models and frameworks from selected publications are synthesized to establish a comprehensive conceptual model for Circular Economy Readiness. Five Individual Readiness factors, twelve Organizational Readiness factors, and one factor under National Readiness are identified. These factors analyze CER readiness levels. The model is tested on Colombo Stock Exchange-listed companies, yielding practical insights for policymakers and practitioners to design and implement effective circular economy strategies. The study's findings can be transformed into metrics to gauge CER in developing countries and perhaps in other nations. By comprehensively investigating factors influencing CER across levels and sectors, this research empowers policymakers and practitioners to devise strategies that facilitate the transition to a circular economy.

Keywords: Circular Economy, Circular Economy Readiness, Individual Readiness Factors, Organizational Readiness Factors, National Readiness Factors, Sri Lanka, Developing Nations.

INTRODUCTION

The Circular Economy (CE) has gained increasing importance in the current sustainability debate(Kirchherr et al., 2017). As resources become scarcer and waste accumulates, the CE offers a model of economic growth designed to be regenerative and restorative (Stahel et al., n.d.). It provides a pathway to mitigate the environmental impacts of our linear take-make-dispose model and move toward a more sustainable and prosperous future(*Towards-the-Circular-Economy-Volume-3.Pdf*, n.d.).However, aligning and harmonizing CE readiness models with existing circularity indicators is crucial to avoid fragmentation and confusion(Kirchherr et al., 2017).

Notably, CE practices are more widespread in developed countries compared to developing ones (Geng et al., 2019). While developed countries have made significant progress in implementing CE practices, developing countries face unique challenges such as weak institutional frameworks, limited resources, and technology access (Gao et al., 2020). Moreover, developing countries often prioritize economic growth and job creation, which may seem incompatible with the CE's emphasis on reducing consumption and waste (Kirchherr et al., 2017).

Despite these challenges, successful CE initiatives have emerged in developing countries, such as the informal waste sector in cities like Lagos and Mumbai (Mathur and Bansal, 2021; Kirchherr et al., 2018). Nonetheless, there is a need for increased support and capacity-building efforts in developing countries to enable them to transition to a circular economy (Geng et al., 2019).

The CE approach is currently supported by the European Union and developed countries such as Japan, the United Kingdom, France, Canada, the Netherlands, Sweden, and Finland (Lopes de Sousa Jabbour et al., 2019). It has undeniably emerged as a critical topic in public debates on more sustainable industrial paradigms and practices (Urbinati et al., 2017).

Interest in CE as a means of improving sustainability has grown steadily in government, business, society, and academia in recent years (Chen et al., 2019; Ferasso et al., 2020). However, despite the importance of CE success in developing countries for achieving sustainable growth, micro-level CE studies are still lacking (Elia et al., 2017). Developing nations that are already global production centers, and potential international consumption drivers (Preston et al., 2019), lack clear insight into this strategy, and transition policies and strategies remain inadequate. Transitioning to a circular economy often requires comprehensive changes to business models or even the construction of new ones(Bocken et al., 2016).

CE that benefits everyone must be established by developing nations to achieve Sustainable Development Goals (SDGs) and ensure long-term consumption and production patterns align with the circular economy concept (Schroeder et al., 2019). Measuring CE performance is more appropriate for developed nations with established CE practices and regulatory frameworks (Zhang et al., 2019).

(Kaza & Yao, 2018) argue that measuring circular economy readiness is particularly relevant for developing countries in the early transition stages. These countries face significant barriers and challenges to implementing CE practices, such as limited access to finance, and infrastructure, and low enforcement of CE practices. Examining circular economy readiness is essential for identifying areas for development and facilitating the transition to a circular economy in emerging economies.

There has been limited research into how companies explain their transition to a circular economy through sustainability and integrated reporting (Van Loon & Van Wassenhove, 2020). States and local governments require practical strategies for global sustainability, such as the circular economy, to address solid waste challenges. International organizations like the United Nations are also concerned about circular economy development.

Despite these global efforts, many countries, including Sri Lanka, still face challenges in waste management and circular economy adoption, as indicated by the World Bank Annual Report 2013.

Circular Economy (CE) readiness is crucial for successful implementation at individual, organizational, and national

levels. Individuals can increase CE readiness through awareness and education programs, which directly impact resource consumption and waste generation. Businesses, as key drivers of resource consumption and waste generation, must adopt CE practices that align with their business models to improve CE readiness. Governments can create policies, regulations, and incentives that encourage CE practices, leading to economic growth, job creation, and sustainable development. CE readiness at all levels is critical in achieving a circular economy and creating a sustainable future (*Towards the Circular Economy*).

CE preparedness is essential for successful implementation at all levels. Individual preparation is crucial as consumer behaviors directly impact resource usage and waste generation. At the organizational level, businesses contribute significantly to resource consumption and waste generation, and adopting CE practices can reduce costs, increase competitiveness, and improve environmental performance.

Governments can create national laws, rules, and incentives that motivate CE practices, fostering economic expansion, employment creation, and sustainable development.(*WEF_Annual_Report_2020*).

In summary, a standardized model for assessing CE readiness at individual, organizational, and national levels is currently lacking. This absence hinders evaluating CE readiness initiatives' effectiveness and comparing progress across regions and sectors(Geissdoerfer et al., 2017; Kirchherr et al., 2017). Therefore, this study aims to address this gap. Consequently, this study has three main objectives: building a combined model to analyze Circular Economy Readiness (CER) by merging readiness factors (IRF, ORF, and NRF) into a single model; comparing readiness levels at different levels and sectors; and investigating and comparing CER across different industrial sectors and industry levels, by using data from listed companies in Sri Lanka.

The paper proceeds as follows: the next section reviews relevant literature, identifies various circular economy readiness factors, and highlights research gaps. The methodology section outlines the study's approach, followed by the presentation of findings. Finally, the paper concludes by discussing the main findings, conclusions, implications, recommendations, limitations, and future research areas.

LITERATURE REVIEW

The Circular Economy's primary idea is to generate growth without depleting finite resources or producing trash. These approaches help businesses, society, and the environment reintegrate trash back into the value chain. The CE is defined as an economy in which value creation is separated from the consumption of finite resources. It is becoming more and more relevant to corporate strategies (Mishra et al., 2019) since it "allows firms to gain a competitive advantage, generate new profit pools, strengthen their resilience, and provide solutions to some of the most pressing business concerns today" (PricewaterhouseCoopers, 2018).

Simultaneously, academic engagement with the CE has risen substantially in the last couple of years. Several CE definitions are suggested. While the openness of the argument over the definition of the CE is beneficial at this early stage in the field's growth, such a diversity of viewpoints introduces some criticalities in conceptual development, theoretical development, and practical implementation.

The CE is built on the regeneration cycle, which allows for the efficient reuse of obsolete products, components, and

materials, resulting in increased profitability and reduced environmental impact(Jabbour et al., 2020). However, the CE's effectiveness depends on the widespread adoption of circular practices. Organizations are aware of the benefits of

circular economic practices, but they confront numerous obstacles in implementing them (Kristoffersen et al., 2020).It also addresses economically unsustainable and problematic ownership arrangements, supply risk, terrible working conditions, high unemployment, and poverty (Khan et al., 2020). As a result, the CE attracts much interest from managers, policymakers, and academics. The adoption of the circular economy is based on several circular practices that must be identified and implemented to hasten the transition from the traditional linear economy to the CE (S. Khan et al., 2022)

The CE aims to close the supply chain loops as much as possible to create a sustainable and zero-waste environment, with a particular focus on the waste hierarchy from waste prevention at the top to waste disposal at the bottom. Waste management is critical to environmental sustainability and human health, moving from a linear to a circular economy (Aghbashlo et al., 2019). It is critical to design and operate an efficient waste management (WM) system as a basis for the CE setup (Di Foggia & Beccarello, 2021) to achieve better resource management and waste prevention (Zeller et al., 2019).There are different barriers and practice gaps in transitioning to CE (Masi et al., 2018).Garza-Reyes et al. (2019) have expanded the list of CE practices further

The CE system strives to integrate the three pillars of sustainable development (economic, environmental, and social) through a symbiotic approach to recover energy and material from waste, durable design products, and extend the service life of systems. This regenerative paradigm can produce a balanced combination of economic success, social inclusion, and environmental resilience for the benefit of current generations and future generations (Geissdoerfer et al., 2018).

According to Thorley's analysis, little information exists on how businesses get ready to implement CE(Thorley et al., 2021a). To close the knowledge gap in this area, a detailed evaluation of the body of literature on transition readiness has been done in this study.

The main objective of Khan and Haleem's study is to examine the implementation of CE practices in emerging economies, identify the contextual factors that affect their implementation, and propose a CoCoSo approach to promote collaboration, coordination, and cooperation among stakeholders to facilitate the implementation of circular economy practices in emerging economies. (S. Khan & Haleem, 2021)

This study used the literature analysis and the opinions of experts to identify fifteen CE practices to achieve this goal.(S. Khan & Haleem, 2021) The circular economy practices are prioritized according to their significance after being evaluated using the Combined compromise solution (CoCoSo) model. This research enables managers to develop an action plan for putting circular approaches into practice. Managers and professionals can best utilize organizational resources to adopt the circular practice by considering the prioritization of circular practices(S. Khan & Haleem, 2021).

Sacco mentioned that there is no recognized tool for evaluating CE (Sacco et al., 2021a). It is frequently unclear how the measurements or indicators used in the current CE assessment techniques were chosen. He introduced a model tool called the Circularity and Maturity Firm-Level Assessment Tool to close this gap (CM-FLAT)(Sacco et al., 2021a). The recent

systematic literature analysis and an extensive collection of CE metrics served as the foundation for the development of the CM-FLAT. Additionally, it aims to analyze CE maturity separately, which refers to the existence of documented actions and practices that build the groundwork for CE introduction, and circularity separately, which refers to achieved CE-related performances.

Many firms want to make the move to the CE. The CE's primary idea is to minimize the need for virgin materials and energy by extending the usable lives of products and establishing circular loops for waste, resources, and parts. To make a transition, it is required to understand all factors that motivate involved personnel to behave appropriately to reach desired results. Therefore, it is necessary to identify and then engage to facilitate this transition by understanding individual, group, and organizational change readiness.

Supply chains and other market participants must work together to implement CE, which requires their active participation, cooperation, and understanding of each other(Kazancoglu et al., 2020). The ability to motivate the members of organizations to support and contribute to the successful implementation of change is a major problem. While the majority of changes are often the result of forces and pressures from the outside, internal transformation must address these influences to influence a company's response (Neves & Caetano, 2009).Kurt Lewin, who introduced the three-step unfreeze, move, and re-freeze model in 1947, is regarded as the father of planned change. Lewin's first phase, "unfreeze," is frequently connected to the idea of change readiness(Armenakis et al., 1993).

Circulytics, a method developed by the Ellen MacArthur Foundation, is a good example. Circulytics analyses the circularity of businesses and presents their total score by combining general and industry-specific indicators. Circle Economy is another example of its Circle Assessment. In addition, the Technical University of Denmark has "adopted an online, ready-to-use assessment tool" for its CE readiness evaluation. Despite its primary focus on CE readiness, this format provides a user-friendly experience for company responses.

The CE assessment tools, techniques, procedures, and instruments proposed thus far differ significantly in terms of assessment level, focused country and industry level, method developer, and grounding on other methodologies developed outside the scope of CE. On the other hand, it must be noted that only looking at a portion of CE characteristics may result in a false impression of how well CE performs in practice.(Abdel-Ghany, 2014)

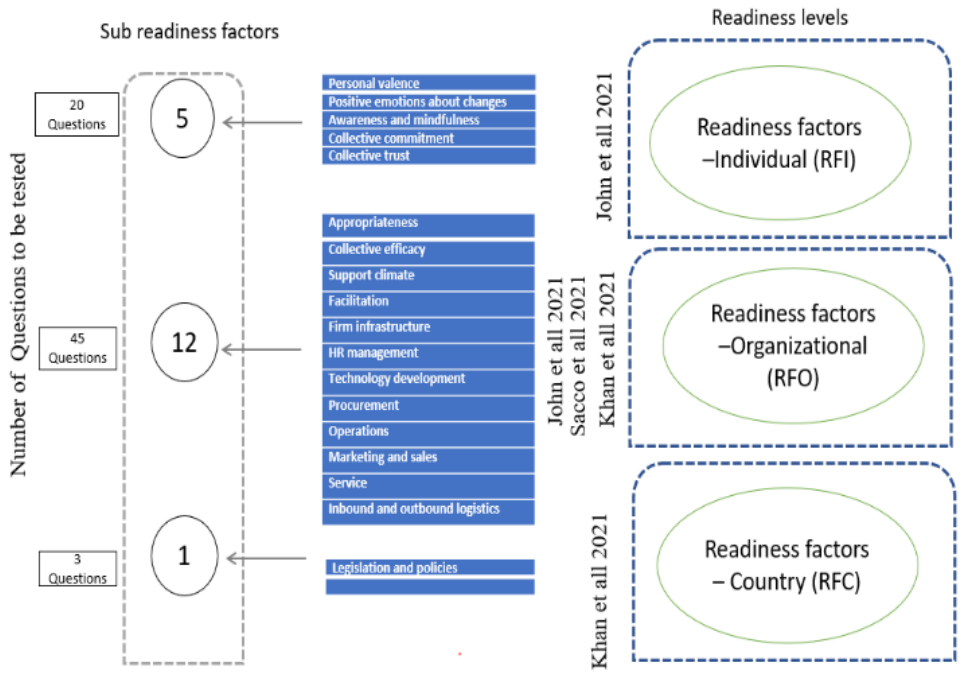

Figure 1: Combined readiness factors based on the selected 3 models

CE practices extend beyond the supply chain and are not merely restricted to firm-level operations. many assessment methodologies have been developed to provide businesses with a sense of how well they perform and prepare for CE. The firm-level assessment tool addresses the following key requirements: three triple-bottom-line sustainability dimensions, a solid link to existing tools/methodologies developed outside the scope of CE, sector-specific or general, with the ability to adapt to the situation Tested with real-world data, with a detailed description to help with implementation End-users are strongly considered to be highly involved in the development process (participatory approach) and easy and clear communication of assessment outputs/reusable(Abdel-Ghany, 2014).

Table 1: Summary of the models including Strengths, Criticisms, and potential improvements

Model Name	Authors	Strengths	Criticisms	Potential Improvements
Circular Economy Assessment Tool	Sacco et al.	- Introduces the Circularity and Maturity Firm-Level Assessment Tool (CM-FLAT) for CE evaluation. - Separates CE maturity and circularity for detailed analysis.	- Lack of recognized tools for evaluating CE maturity and circularity. -- Unclear criteria for current CE assessment techniques.	- Develop comprehensive and standardized CE assessment tools incorporating maturity and circularity metrics. - Focus on clear communication of assessment outputs for actionable insights - Establish industry standards for CE assessment methodologies. - Integrate maturity and circularity metrics for a holistic CE evaluation.
CE Implementation in Emerging Economies	Khan & Haleem (2021)	- Examines CE practices in emerging economies. - Identifies contextual factors influencing implementation - Proposes the CoCoSo approach for collaboration.	- Challenges in CE adoption due to socio-economic factors in emerging economies. - Need for collaborative approaches among stakeholders.	- Conduct in-depth studies on socio-economic challenges and policy implications in emerging economies. - Develop innovative strategies for collaboration, coordination, and cooperation among stakeholders in emerging economies. - Establish industry standards for CE implementation in emerging economies. - Develop specific interventions targeting socio-economic challenges.
Transition Readiness Models	Thorley et al. (2021)	- Provides insights into how businesses prepare for CE implementation. - Advocates for a detailed evaluation of literature on transition readiness. - Identifies transition readiness factors.	- Limited information exists on business readiness for CE implementation. - Challenges in identifying and addressing transition readiness factors.	- Conduct comprehensive studies on business transition readiness factors. - Develop strategies to enhance organizational readiness for CE adoption. - Establish industry standards for transition readiness assessment methodologies. - Develop targeted interventions to address specific barriers in business readiness for CE adoption.

METHODOLOGY

The methodology describes four planned phases, each aimed at comprehensively exploring Circular Economy Readiness (CER) across diverse levels: individual, organizational, and national. The process began with searching scholarly works from renowned experts in the field. The review not only surveyed existing literature but also extended to analyzing the most recent articles published by three prominent scholars, ensuring the incorporation of the latest developments and perspectives.

In the first phase, the paper identified key Circular Economy Readiness (CER) factors, focusing on the individual, organizational, and national levels. This comprehensive approach allowed for a comprehensive understanding of readiness factors across different contexts.

Moving to the second phase, a questionnaire was designed based on the from prior research incorporating the selected factors. To ensure the questionnaire's relevance and accuracy, it underwent a rigorous review process. Notably, the questions in these three models were curated, aligning them with the specific focus of this research. This crucial step involved the expertise of three distinguished Circular Economy (CE) Experts, who reviewed and refined the questionnaire. Their insights and feedback were invaluable in shaping the questionnaire for this study.

In the third phase, data was collected from listed companies in Sri Lanka. The survey instrument, refined through expert input, was administered to individuals, organizations, and national entities. This phase involved engaging with diverse participants to gather a rich dataset encompassing various perspectives on Circular Economy Readiness.

Finally, the fourth phase, data analysis, was conducted with a particular approach. The collected data, representing the intricate tapestry of CER across individual, organizational, and national levels, underwent thorough analysis. Advanced analytical techniques were employed to draw meaningful insights from the dataset, providing a comprehensive overview of Circular Economy Readiness factors.

In summary, this methodical approach, spanning across diverse levels and informed by the latest scholarly insights, ensures the robustness and depth of our study. Through this comprehensive methodology, we aim to contribute significant knowledge to the evolving field of Circular Economy Readiness.

Identifying the Circular Economy Readiness (CER) factors

As illustrated in Figure 1, Jhon, Khan, and Sacco identified three broad categories for classifying CER factors.

1. Individual Readiness Factors (IRF)
2. Organizational Readiness Factors (ORF)
3. National Readiness Factors (NRF)

According to Shahbaz Khan, fifteen CER factors have been identified to determine a company's CE readiness(S. Khan & Haleem, 2021). These fifteen practices can

Table 2: Categorization of sub-readiness factors

	(Thorley et al., 2021)	(Khan & Haleem, 2021)	(Sacco et al., 2021)
Individual Readiness Factors (IRF)	1.Personal valence		
	2.Positive emotions about change		
	3.Awareness and mindfulness		
	4.Collective commitment		
	5.Collective trust		
Organizational Readiness Factors (ORF)	6.Discrepancy	1. Designing products for circularity (Replaced with Sacco's Technology Development)	1. Firm infrastructure
	7.Appropriateness	2. Environmental criteria for supplier selection (Replaced with Sacco's Procurement)	2. HR management
	8. Principal support (Replaced with Sacco's HR management)	3. Processes design for waste minimisation (Replaced with Sacco's Operations)	3. Technology development
	9.Collective efficacy	4. Renewable materials and energy utilisation (Replaced with Sacco's Operations)	4. Procurement
	10. Knowledge and skills alignment (Replaced with Sacco's HR management)	5. Workforce Training related to circular practices (Workforce Training related to circular practices to Knowledge and skills alignment)	5. Operations
	11.Organisational valence (Replaced with Sacco's HR management)	6. Reuse of energy and water (Replaced with Sacco's Operations)	6. Marketing & sales
	12.Support climate	7. Cascading use of components and materials (Replaced with Sacco's Operations)	7. Service
	13.Facilitation	8. Performance evaluation consider the environmental factors (Replaced with Jhon's Appropriateness)	8.Inbound and Outbound logistics
	14.Change self-efficacy (Replaced with Sacco's HR management)	9. Develop the circular culture (Replaced with Sacco's HR management)	
		10.Consumer awareness (Consumer awareness to Marketing & sales)	
		11.Awareness among the supply chain partners (Replaced with Sacco's Procurement)	
		12. Cross-functional collaboration (Replaced with Jhon's Collective efficacy)	
		13. R's practices (R's practices to Operations)	
		14.Implementation of reverse logistics (Replaced with Sacco's Inbound & outbound logistics)	
Country Readiness Factors (NRF)		15.Legislation and policies	

be broadly classified into two categories: organizational Readiness Factors (ORF) and National Readiness Factors (NRF). (Table3)

According to John Thorley, fourteen CER factors have been identified to assess CE readiness in business(Thorley et al., 2021a). According to John Thorley, fourteen CER factors have been identified to assess CE readiness in business (Thorley et al., 2021). Furthermore, Table 4 categorizes the fourteen readiness factors into two main categories: Individual Readiness Factors (IRFs) and Organizational Readiness Factors (ORFs).

According to Sacco, eight CER factors have been identified to determine CE readiness in a company(Sacco et al., 2021a).These eight CER factors can only

be classified as Organizational Readiness Factors (ORF).

We chose unique CER factors and eliminated comparable CER factors suggested by these 3 models to eliminate similarities of CER factors which will be adopted to the proposed model for this study.

Further, according to Jhon Thorley, there are 5 sub readiness factors(Personal valence, Positive emotions about changes, Awareness and mindfulness, Collective commitment, and Collective trust) contained in Individual Readiness Factors (IRF)(Thorley et al., 2021a). Khan and

Sacco has not discussed the individual sub-readiness factors.

Although Jhon has published 9 ORFs, only 4 sub-readiness factors (Appropriateness, Collective efficacy, Support climate, Facilitation) are unique. The other 5 are replaced by Sacco's sub-readiness factors. (Discrepancy, Principal support, Knowledge and skills alignment, Organizational valance, Change self-efficacy).

There are 14 organizational sub-readiness factors developed by Khan(S. Khan & Haleem, 2021).these 14 sub-readiness factors can be replaced by Sacco and Jhon's similar sub-readiness factors.(Design products for circularity, Environmental criteria for suppliers, Process design for waste, Renewable materials and energy utilization, Workforce training related to circular practices, Reuse of energy and water, Cascading use of components and materials, Performance evaluation consider the environmental factors, Develop the circular culture, Consumer awareness, Awareness among the supply chain, Cross-functional collaboration's practices, and Implementation of reverse.).

There is only one National sub–Readiness Factor developed by Khan.(Legislation and policies). There are 8 sub-are readiness factors published by Sacco. All of these are contained in organizational readiness factors. (Firm infrastructure management, Technology development, Procurement, Operations, Marketing and Sales, Service, Inbound and outbound logistics). there are no Individual and organizational sub-readiness factors published by Sacco. As a summary 5 CER factors are included in IRF, while 12 CER factors are included in ORF, and under NRF, there is only one CER factor (Refer to table number1).

Table 2: Categorization of sub-readiness factors

IRF	ORF	NRF
Personal valence	Appropriateness	Legislation and policies
Positive emotions about changes	Collective efficacy	
Awareness and mindfulness	Support climate	
Collective commitment	Facilitation	
Collective trust	Firm infrastructure	
	HR management	
	Technology development	Legislation and policies
	Procurement	
	Operations	
	Marketing and sales	
	Service	
	Inbound and outbound logistics	

Questionnaire Development

The questionnaire for this study was crafted by drawing upon the expertise of three prominent scholars:(Khan et al., 2022; Sacco et al., 2021; Thorley et al., 2021) Jhon, Khan, and Sacco, each of whom had conducted extensive research in relevant fields. This approach aimed to leverage their collective knowledge and experience. Specifically, the questionnaire was constructed using a selection of questions derived from their respective studies. The composition of the questionnaire consisted of 67 questions from Jhon's research, 15 questions from Khan's research, and 45 questions from Sacco's research.

In addition to incorporating these questions, the questionnaire was designed to encompass the 18 sub-readiness factors suggested by the model, namely, IRF, ORF, and NRF. These factors were systematically addressed within three distinct sections of the questionnaire.

To ensure the questionnaire's comprehensiveness and relevance to the study and model, a rigorous process was undertaken. Initially, the questionnaire consisted of numerous duplicate questions, which were subsequently removed to eliminate redundancy. After this refinement process, the questionnaire was streamlined to a total of 66 questions, with a focus on covering all aspects of IRF, ORF, and NRF.

Moreover, to validate the questionnaire and affirm its applicability, a panel of experts was engaged in the assessment process. This panel consisted of three specialists, including a Senior Lecturer from the Department of Civil and Environmental Technology at the Faculty of Technology, University of Sri Jayewardenepura. Additionally, two industry experts, one of whom served as the head of Environmental Health and Safety (EHS) for a Global Multinational Fast Moving Consumer Goods (FMCG) company, and the other from the largest Textile and Apparel company with contracts for global textile brands, were actively involved in the review process.

As part of the validation process, a pre-test was conducted with these specialists. The pre-test involved a thorough examination of the questionnaire to ensure that the

questions were aligned with the specific context of the study. This comprehensive review led to necessary modifications, including the deletion of certain questions, the addition of new questions, and adjustments to existing questions. These refinements aimed to tailor the questionnaire to precisely suit the objectives and requirements of this research study.

Sample and Population

In this research paper, the analysis explores the intricate fabric of the Sri Lankan economy, specifically concentrating on the dynamic interplay between industries listed on the Colombo Stock Exchange (CSE). Within the CSE, 270 companies spanning across 20 diverse industrial categories was examined. To accurately scrutinize these industries, they were classified into four principal sectors, as outlined in Table 4, with a keen focus on the primary and secondary industrial sectors. This strategic choice was underpinned by a consideration of CE-based (Schafran et al., 2018)value chains and business models, aligning with the pioneering framework that categorizes economic activities into primary, secondary, and tertiary sectors. Leveraging the robust foundation of Colin Clark's model precisely tracing the evolution of primary and secondary sectors within the realm of the Colombo Stock Exchange. The analysis of these sectors not only adds depth to the understanding of Sri Lanka’s economic landscape but also underscores the timeless relevance of Clark's model in contemporary economic research.

The questionnaire consists of five possible answers on the Likert scale considering the degree of importance: (1 Strongly disagree); 2 (Disagree); 3 (Neutral); 4 (Agree), and 5 (Strongly agree).

IBM SPSS Statistics was chosen for its advanced analytics and user-friendly interface. This tool facilitated efficient data management and exploration,

ensuring accurate and reliable results. Its comprehensive range of statistical methods played a crucial role in deriving meaningful insights, forming the foundation of our research findings.

Table 4: CSE Companies categorization

Sector	Number of categories	Number of companies	Without duplications
Primary	2	25	24
Secondary	7	109	97
Tertiary	11	136	
Quarterly	0	0	
	20	270	121

Data Analysis

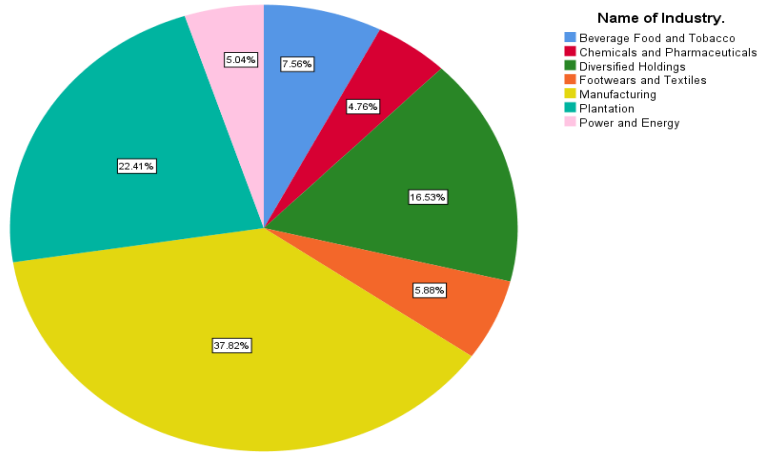

Figure 2: Industry Diversity Analysis

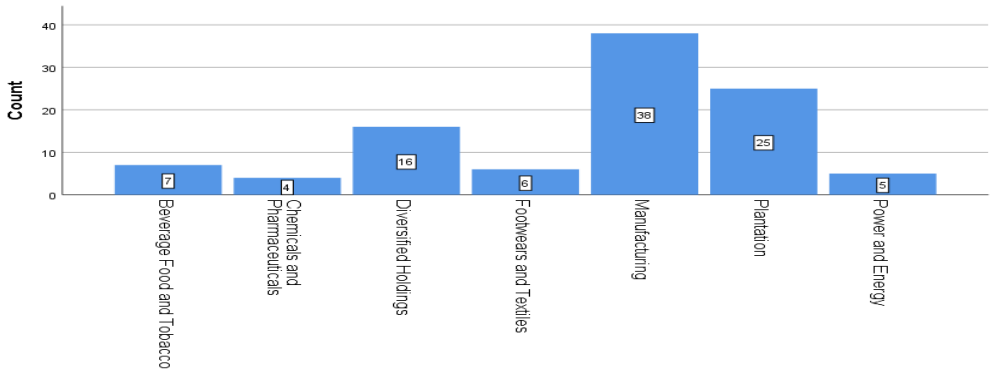

Figure 3: Count of Industries

Figure 2 represents the results of the demographic distribution of the selected sample. According to Figure 2, the manufacturing industry accounts for nearly 37.83% of the total population, while the second-largest contribution was represented by Plantation (22.42%). the least contribution was represented by chemicals and pharmaceuticals industries (4.76%).'

The highest number in the sample is represented by manufacturing while chemicals and pharmaceuticals were represented the least (4 count). Sixty-two percent of the total population was represented by manufacturing and plantation.

Table 5: Summary of descriptive statistics

Variable	Mean	Median	Variance	Std. Deviation	Minimum	Maximum	Range	Skewness	Kurtosis
IRF	3.4222	3.5167	0.5250	0.7247	1.7800	4.8000	3.0200	-0.0020	-0.8500
ORF	3.3604	3.5028	0.4540	0.6740	1.8042	4.3996	2.5954	-0.5820	-0.7630
NRF	3.2614	3.3334	0.7240	0.8509	1.0000	5.0000	4.0000	-0.8010	0.9240

According to Table 5, the mean values of IRF, ORF, and NRF show minimal variation. Additionally, the standard deviations for IRF, ORF, and NRF indicate similar observations. The chi-square test is used to examine the association among IRF, ORF, and NRF.

Table 6: Chi- square test

	IRF	ORF	NRF
Chi-Square	33.705[a]	69.500[b]	1.035E2[c]
df	62	65	12
Asymp. Sig.	**.999**	**.328**	**.000**

According to Table6, there is an association between IRF and ORF at a 95% confidence level (Asymp.Sig values are greater than 0.05). Yet, there is not any association with the NRF.

Table 7 indicates that the Sig.(2-tailed)

value is less than 0.05. Hence, there is a correlation between IRF and ORF. The covariance value for IRF vs. ORF is 0.644, which is significant with a 95%

confidence interval. (The correlation is significant at the 0.01 level (2-tailed).

At the 95% confidence level, IRF, ORF, and NRF sig. values did not adhere to the normality criteria (Shapiro Sig. 0.05). Hence, non-parametric analysis was done.

To check if there was an equal median value on IRF, ORF & NRF with primary and secondary industrial sectors, Mann Whitney U test statistics were discussed inTables8and 9.

Table7: Normality test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	**Sig.**
IRF	.077	88	.200*	.966	88	**.022**
ORF	.122	88	.002	.927	88	**.000**
NRF	.163	88	.000	.916	88	**.000**

Table 8: Ranks table-Kruskal Wallis test

	Industry name -Mean rank							
Variable	Plantation	Oil palm	Beverage food& tobacco	Manufacturing	Power and energy	Chemicals and pharmaceuticals	Diversified holdings	Footwear & textiles
IRF	36.5	7.42	51.62	50.1	48	58	29.86	67.25
ORF	31.15	14.25	70.75	50.11	59.5	50.75	34.43	39.92
NRF	41.35	64.17	53.62	38.33	47.3	60.88	36.71	53.42

There were notable mean rank value disparities on the IRF and ORF when the industrial sector-wise analysis was taken into account. However, the mean rank value difference in the NRF sector vise analysis is not statistically significant.

Table 9: Ranks table- Mann Whitney U test

	Industrial sector	Mean Rank	Sum of Ranks
IRF	Primary	**28.91**	665.00
	Secondary	**50.02**	3251.00
ORF	Primary	**26.74**	615.00
	Secondary	**50.78**	3301.00
NRF	Primary	**47.30**	1088.00
	Secondary	**43.51**	2828.00

(Asymp.sig < 0.05; Primary secondary median values do not coincide).IRF and ORF wise, there were different median values significant at 95% confidence. IRF, ORF & NRF variable's median values equableness was measured through the Kruskal Wallis test inTable11.

When considering industry 7 segments According to the industry type of IRF & ORF, there was a significant median difference observable at a 95% confidence interval.

Table 11: Kruskal Wallis test

	IRF	ORF	NRF
Chi-Square	24.896	26.480	10.334
df	7	7	7
Asymp. Sig.	**.001**	**.000**	**.170**

Table 10: Mann Whitney U test statistics

	IRF	ORF	NRF
Mann-Whitney U	389.000	339.000	683.000
Wilcoxon W	665.000	615.000	2.828E3
Z	-3.406	-3.883	-.624
Asymp. Sig. (2-tailed)	**.001**	**.000**	**.533**

Furthermore, the median differences of IRF, ORF & NRF with management level were analyzed in above table 14.

Table 12: Kruskal Wallis test Statistics

	IRF	ORF	NRF
Chi-Square	10.629	5.536	14.255
df	5	5	5
Asymp. Sig.	**.059**	**.354**	**.014**

Only IRF had a significant median value difference with management level-wise at a 95% confidence interval. The median differences between IRF, ORF & NRF with education level were analyzed in Table 14.

Table 13: Kruskal Wallis test Statistics

	IRF	ORF	NRF
Chi-Square	8.818	5.928	2.484
df	3	3	3
Asymp. Sig.	**.032**	**.115**	**.478**

Only NRF is significant at a 95% confidence interval when considering participants' education qualifications. All variables had no significant median difference on any IRF and ORF wise at a 95% confidence interval. (Table 14).

CONCLUSION, DISCUSSION, AND LIMITATIONS

Mean values were observed between "Neutral" and "Agree" for all readiness factors (IRF, ORF, and NRF) for a selected sample which represented primary and secondary industries in CSE.

Table 14: Kruskal Wallis test

	Education Qualification- Mean rank					
Variable	Upto A/L	Upto diploma	Upto degree	Upto master	M.Phil	Upto PhD/DBA
IRF	69.75	40.31	39.65	47.52	67	68.75
ORF	69.25	42.88	45.09	39.32	21	47.25
NRF	42.75	33.06	47.95	47.32	71	4.38

The fact that developing nations are already prominent global production hubs, as noted by Preston et al. in 2019, maybe one of the factors contributing to CER being at the "Neutral - Agreed" level for the chosen sample. Preston's argument will be strengthened by evidence that CER was present at a "high level" when some respondents' responses were "Strongly agreed." Additionally, "Strongly disagreed" results are noted, which could support Preston's argument that this strategy in developing countries has not yet developed and that transition policies and plans are still insufficient.

In the context of developing countries, this method can be used to compare CER in different industry sectors. To determine the model's effectiveness in various contexts, more research is required. Since there are no established standard values for CER, this model is limited to obtaining and comparing absolute values for CER. However, a model can be utilized to compare the level of readiness across different industry sectors, which will aid in industry comparison and enhance CE. With the help of this model, the CER of every industrial sample can be compared to its IRF, ORF, and NRF values. This model is therefore limited to industry-level CER absolute comparisons.

Between the Industrial segments (Primary and Secondary), IRF and ORF factors differ significantly. Similar findings were found in the industrial sectors of plantation, oil and palm, food and beverage, manufacturing, power and energy, chemicals and pharmaceuticals, diverse holdings, and footwear and textiles. Between industrial sectors and industrial segments, NRF shows minimal variation. This might be the outcome of several obstacles, difficulties, and practice gaps in the transition to CE, as stated by Masi et al.

Only IRF revealed a statistically significant readiness difference with management level. According to Kazancoglu et al., 2020, organizations must have the staff, management, and leadership commitment to change to transition to CE successfully. To implement CE, supply chains and other market participants must collaborate, requiring their active involvement, mutual understanding, and cooperation.

One of the limitations of this model is that it has not been evaluated for bigger samples; consequently, additional effort in testing via a wider industrial segment is required. With limited expert feedback, CER questions were assessed. This model can be developed as a valuable tool for measuring CER in future studies.

A comparative analysis of CER across different developing countries could be done as a future research study: A research

could be done to assess the readiness of emerging countries in different regions, such as Asia, Africa, or Latin America, to the circular economy. This could help in the identification of shared difficulties as well as best practices for fostering circular economy principles in various countries. Future research studies could be conducted across several industries: Transitioning to circular economy strategies poses unique problems for many businesses. Research could look at CER in the context of several industries, such as agriculture, manufacturing, and construction, and discover industry-specific characteristics that influence circular economy readiness. NRF can be examined more because the policy's role in boosting CER is critical in building an enabling environment for circular economy activities. Further research could look into the impact of various policy measures on CER in developing countries, such as incentives, subsidies, and regulations. Another area of further study of this model is to test MSMEs in to understand the context in more detail the readiness of CE.

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