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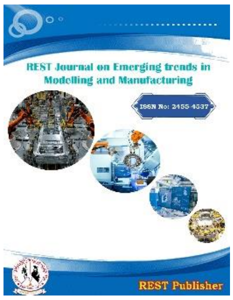

Circular Economy Industry 4.0 Technologies Using TOPSIS Technique for Order of Preference by Similarity to Ideal Solution Method

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Abstract. *Circular Economy and Industry 4.0 Technologies Introduction: Markets that promote product reuse rather than product elimination and subsequent extraction of new resources are examples of a circular economy. All waste categories, including clothing, scrap metal, and outdated technology, are recycled or put to better use in such economies. This approach can offer a solution not only to safeguard the environment but also to use natural resources more wisely and produce new industries, jobs, and skill sets. A paradigm of production and consumption known as the "circular economy" incorporates sharing, leasing, reuse, repair, refurbishment, and recycling to lengthen the package's life cycle. The primary goal of a circular economic model is to design out waste. This model is predicated on the idea that there is no such thing as waste. To accomplish this, last-generation products are made with high-quality materials and are amenable to the extraction and reuse cycle, making it easier for users to handle, modify, or update them. The circular economic model is ultimately distinguished by these short product cycles, with the exception of disposal and recycling, which waste a significant amount of embodied energy and labor. The ultimate objective is to manage finite stocks and balance renewable resource flows to protect and enhance natural capital.*

Research significance: *The circular economic model distinguishes between the cycles of technology and biology. Consumption only occurs during biological cycles when biologically-based goods are intended to replenish the system through procedures like food, compost, or anaerobic digestion of cork, linen, or other materials. These cycles recreate environments that give the economy renewable resources, such as soil or the ocean. Technical cycles, on the other hand, restore and reuse products through tactics like recycling, reusing, repairing, or producing something new. Ultimately, one of the goals of the circular economy is to increase resource yields by focusing on the components, goods, and services that are circulated and used most frequently across the technological and biological cycles. The concept of the circular economy gained popularity in China in the 1990s in response to economic expansion and the depletion of natural resources. The central idea of the circular economy concept is to strike a balance between resource and environmental use, capitalizing on material flow and recycling, and economic growth*

Methodology: *ideal solution (TOPSIS) is prioritized through unity is a technique that provides, this is a multi-criteria decision analytical method. TOPSIS stands for (PIS). Short geometric distance alternative to select is the positive ideal solution, basically distance to have ideal solution of thought (nis) negative too long from is geometry. Of TOPSIS the assumption is even greater is, is coming or going the criteria are the same are increasing. Many parameters in scaling problems or criteria often improper dimensions normalizations due to having are generally required.*

Alternative: *Reliability, Responsiveness, Agility, Costs, Active management efficiency.*

Evaluation preference: *Regenerate, Share, Optimise, Loop, Virtualise, Exchange.*

Results: From the result it is seen that Share is got the first rank where as is the Regenerate is having the lowest rank.

Keywords: *Circular economy, industry 4.0, TOPSIS, Active management efficiency*

1. INTRODUCTION

A circular economy encourages people to reuse products instead of discarding them and extracting new resources. All types of waste, including wear, scrap metal, and outdated technology, are reused or reintroduced into the economy. Two key industrial paradigms that have influenced academia and business in recent years are highly automated and life cycle assessment (CE) (i4.0). The term "CE" is frequently used to refer to a purposefully restructured or regenerated commercial enterprise [1]. This encompasses a range of business models that aim to reduce waste by design, utilize renewable energy, minimize harm from chemicals, reduce product use, and ultimately replace and recycle products. CE helps to create value, reduce costs, improve flexibility and fairness, and provide new opportunities for business while respecting resource limits and promoting economic expansion. In contrast, i4.0 is a distinct paradigm that differs from CE in its focus on advanced digital technologies, such as the Internet of things (IoT), cloud computing, blockchain, data analysis, autonomous robots and vehicles, and virtual reality [2]. These technologies can enable significant competitive advantages when integrated into industrial settings. CE, on the other hand, is focused on reducing consumption and waste by creating intelligent products, systems, and economic models that replace the traditional linear life cycle approach. Before CE, the only technique used to manage the conception, design, development, use, and disposal of products was the standard linear life cycle. Closed-loop methodologies have gradually replaced outdated industrial techniques by balancing economic, environmental, and social repercussions. While the switch to CE technologies from the current linear economy is explored in various documents, there are still societal and practical challenges that need to be addressed [4]. These difficulties aim to ensure sustainability and sustainable growth of various goods and services via distribution networks, mobilizing business models. Here is the most recent theory on the circular economy and Industry 4.0, including the bibliography we reviewed and additional related resources we created in this package. The purpose of this work is to provide a multi-step analysis model for the multiple evolutionary linkages between the circular economy and Industry 4.0. The issues addressed in this research are pertinent and contemporary, particularly for educators [5]. Additionally, countries are concerned about the influence of human and societal transformations brought about by technology up until this point. Studies have shown that most communities are ready to deal with the switch from the prevailing linear economy to a circular economy. The industrial revolution was a crucial time for technology. OECD and circular economy (CE) initiatives are extremely pertinent to human factors, environmental, technical, and social growth in the building industry 5.0. The goal of this study is to discuss how human civilization affects economic and social advancement. The economic strategy emphasizes enhancing resources and recycling waste [6]. The CE model aims to reduce waste emissions and expand the lifespan of resources while improving performance by utilizing various sources of energy. This model is now undergoing the same natural evolution based on technological advancements, and it has a significant effect on how technology is used in the modern world. It makes it possible to create infrastructure and performance models to maintain the flow of commodities. However, a lack of trust in data, gaps, abnormalities, and secrecy measurement problems are issues that prevent the identification and application of CE models specific to a locality [7]. Although the circular economy has been documented since the early 20th century, Industry 4.0 has recently emerged, with numerous kinds of literature assessing its relationship with Industry 4.0. According to established definitions of digital transformation, Industry 4.0 is the fourth industrial revolution, approached by present-day societies that exhibit signs of environmental change and a focus on the transformation of the industrial production model. According to studies, circular economy models frequently attempt to create and manufacture cost-effective goods and services, supplementing waste with modern Industry 4.0 and digital technologies designed for expansion [8]. In this regard, various studies published in the literature have heavily emphasized the connection between sustainability and sustainable development, which intends to follow CE policies and i4.0. I4.0 is seen as an industrial booster and a social enhancement. Understanding technical impacts and a lack of resources for the climate, there is a strong theoretical and practical fit in the study of the interplay between men, techniques, and capital as businesses expand in the direction of profitability. Other strategies are based on evaluating their study on supply chains and logistics, using various techniques to produce case studies and significant outcomes. These 3pls offer solutions for reverse logistics and have sufficient technical infrastructure. Access to the supply chains for goods and services is made possible through the collection of used goods and their subsequent transportation, processing, or distribution [9]. Rajput and Singh handled the reduction, reuse, and recycling (3r) concept in this way. In essence, the supply chain supports the change from linear to circular. Utilizing i4.0 as a standard and all-encompassing solution using CE and upcoming technology. Innovations. To validate its use app foundation, a company was employed, and a hybrid approach was suggested to use i4.0 and CE i4.0 policies that direct the difficulties facing supply chains. Studies exist in this area. Concentrating on its evolution with i4.0 from CE and the human aspect specifically, the effects on society and how people develop as individuals. Use of these production-related industrial policies [10]. Although industrialization has increased living standards, it has also brought about negative environmental effects due to unsustainable investment and consumption practices. Research has become interested in examining the impact of new cross-industry networks as a result of this trend. Reducing supply networks, which is more and more evident in the sophisticated industrial systems of today. In the past, efforts to increase industrial sustainability have primarily centered on vertically integrated systems with loop-close techniques in linear terminology and manufacturing systems with a supply chain including only corporate results. Instead, the multiple supply chains' cross-industry networks have developed into the circular economy (CE) model. Utilizing such strategies since the early 2000s, industrial and urban conglomerates [11]. But in such an implementation, there are no typical industrial networks that have direct matrix-like architecture. In these situations, breaking the loop requires corporate choices from numerous supply chain participants across various industries. It features several supply chains. In this sustainable industrial matrix-like design, networks with interconnected supply chains should be utilized for the effective use of resources according to the prevention 3rs of recycling, reducing, and reusing strategies. Re-examine the three-down-line decision-making process across groups from various industries [12]. The circular economy (CE) is recognized as a source of value generation, but there is a significant disconnect between its overarching notion and its actual uses due to the absence of information on economic, environmental, and social performance metrics. The goal of this study is to highlight how intelligent assets of i4.0 can enhance circular business models by using case studies and assessment tools from literature and second data from pick case studies. The study emphasizes that CE policies extend the life cycle of the complete product, from product design through product use, and switch to new business tactics. Two case studies are mentioned to illustrate how intelligent assets can support the circular economy and evaluate circular efforts. Existing innovative visualization is improved by CE-based business models and effective intellectual property evaluation of goods, goods, assets, and processes because information and indications are available to measure and monitor performance. Efforts to increase industrial sustainability have shifted from linear manufacturing towards the circular economy since the early 2000s. The concept of circular economy is gaining popularity, particularly in the EU, and encourages ethical and sustainable use of resources and advances creative business ideas. Implementing CE is a methodical change that creates long-term resilience, commercial and economic prospects, and environmental and social advantages. The necessity for adjustments in production and consumption formats aimed at environmental conservation and resources for future generations is being discussed with managers of public and private organizations, researchers, and legislators in China, Japan, the United States, and European Union member countries. However, implementing circular business models is not easy due to the big difference between the general idea of CE and its actual applications. The key obstacles to putting CE into practice were identified, such as the lack of proper information flow and technology support, which limits the creation of new prospects for sustainable growth. The right information and technology support are core resources for sustainable systems that help managers with their decision-making. [14]

2. MATERIALS & METHODS

Alternative:
Reliability - The capacity of performing tasks as expected
Responsiveness- Ability to perform tasks with speed
Agility- Ability to respond and adapt to external influences and changes (Flexibility)
Costs- Cost optimization Supply Chain
Active management efficiency- Efficiency in the management of active
Evaluation preference
Regenerate- Use and recovery of renewable materials
Share- Sharing and reuse of goods
Optimize- Increased efficiency and performance improvement
Loop- Remanufacturing and recycling of materials, products and components
Virtualize- Virtualisation of products
Exchange- Substitution of goods advanced products

Reliability: perform its intended function over time without failure. The key factors that determine reliability are the quality of the components used, the level of testing and maintenance performed, and the overall design of the system or product. Reliability engineering is a discipline that seeks to improve product and system reliability through the use of statistical analysis and other methods. In science, reliability refers to the consistency and accuracy of measurements, tests, or experiments. A reliable measurement or test is one that produces consistent results each time it is performed. Any variation in the results is usually due to random error, which can be minimized by using appropriate methods and tools.

Responsiveness: Responsiveness is an important concept in computer science that refers to the ability of an organization or operating unit to complete assigned tasks within a specific time frame. It is an important aspect of software performance that can greatly affect user experience. Responsive software can run efficiently even on slow hardware, while software with poor process management can have poor response times even on fast machines. In order to ensure a strong policy for responsiveness, there are four key requirements: responsibility, work compliance, observability, and reversibility. Responsibility refers to the ability of the system to promptly comprehend and carry out assigned tasks. Work compliance means that the system should complete its assigned tasks correctly and in a timely manner. Observability requires that the system provide adequate feedback and monitoring so that it can be easily observed and analyzed. Reversibility refers to the ability of the system to undo any incorrect or unintended actions. For lengthy tasks such as copying, downloading, or changing large files, the most important aspect for a good user experience is not the efficiency of the process itself, but rather the ability of the software to run in the background and consume only unused processor time. This allows other tasks to be performed smoothly without being disrupted by the lengthy task. It is important for a company to utilize all its resources to the fullest, and assign priorities accordingly to optimize responsiveness and user experience.

Agility: However, the reality is that resources are finite and their extraction, use, and disposal have significant environmental and social impacts. A circular economy aims to break away from this linear model of production and consumption by keeping materials and products in use for as long as possible through reuse, refurbishment, recycling, and other methods. By doing so, a circular economy can reduce the overall environmental impact of economic activity and create a more sustainable future. It also offers economic benefits such as reduced dependence on finite resources, increased resilience to supply chain disruptions, and new business opportunities in areas such as repair, refurbishment, and recycling.

Costs: In a circular economy, businesses can reduce their costs by using recycled materials, extending the life of products, and reducing waste. This can result in lower prices for consumers, while also reducing the environmental impact of production and consumption. Additionally, governments can play a role in promoting and incentivizing circular practices, which can lead to a more sustainable and cost-effective economy. By using actual prices that account for environmental costs, governments can help create a level playing field for circular products and encourage their adoption.

Active management efficiency: This closed-loop system not only helps reduce waste but also creates new economic opportunities and jobs, particularly in areas such as waste management, recycling, and remanufacturing. It can also lead to the development of new technologies and innovations that support a more sustainable and circular economy. In addition, the circular economy promotes the use of renewable energy sources, such as solar and wind power, which further reduce the environmental impact of economic activities. Overall, the circular economy offers a promising alternative to the traditional linear economic model of "take, make, dispose," and provides a pathway towards a more sustainable future.

Regenerate: The concept of rebuilding nature in the circular economy aims to restore and protect natural ecosystems and resources. It recognizes that natural systems provide essential services and resources, and that their degradation has a significant impact on the economy and society. The circular economy approach seeks to create economic value by regenerating natural capital and restoring degraded ecosystems. This involves using sustainable agricultural practices, promoting biodiversity, and reducing pollution and waste. By mimicking natural systems and cycles, we can create a regenerative economy that benefits both humans and the environment. The circular economy also seeks to eliminate waste and pollution by designing products and systems that are biodegradable, recyclable, or reusable. By doing so, we reduce the need for extraction and minimize the impact on the environment.

Share: The sharing economy is a key component of the circular economy as it promotes the efficient use of resources and reduces waste. By sharing products and resources, consumers can access the goods they need without having to own them outright, which reduces the overall demand for new products and the resources needed to produce them. In a sharing economy, manufacturers and landlords are incentivized to create products and services that are durable, high-quality, and easy to repair, as these factors will increase the lifespan of the product and maximize its value for the users. Additionally, in a sharing economy, the responsibility for maintaining and repairing products often falls to the manufacturer or landlord, which encourages them to design products that are easy to maintain and repair, and to use materials that can be easily recycled or repurposed at the end of their useful life.

Optimize: To optimize means to make something as efficient or effective as possible. In other words, it involves finding ways to improve the performance or output of a system, process, or product while minimizing resource usage or waste. When explaining something, optimization can be achieved by using clear and concise language, providing relevant examples or illustrations, and structuring the information in a logical and easy-to-follow manner. Additionally, taking into consideration the audience and their level of understanding can help optimize the explanation by tailoring it to their needs and preferences. Optimizing an explanation may also involve using analogies or metaphors to help the audience relate to and better understand complex concepts or ideas. Using visual aids such as diagrams, charts, or graphs can also help to optimize an explanation by providing a visual representation of the information. Overall, optimization in explaining involves finding the best possible way to communicate information to the audience in a way that maximizes their understanding and retention of the information presented.

Loop: In contrast, a circular economy reduces the consumption of resource inputs, waste, pollution, and carbon emissions by creating a closed-loop system of reuse, sharing, repair, refurbishment, renewal, reproduction, and recycling. The term used to refer to this type of system is a closed-loop economy, circular economy, closed-loop supply chain, or closed-loop system. In a closed-loop economy, there is no waste produced, and everything is shared, transformed, reused, or recycled.

Virtualize: Transferring analog or physical goods to digital resources is known as digitalization. Businesses can move their operations and products to the cloud or a virtual network. This can result in cost savings and positive environmental effects through dematerialization. Dematerialization takes the form of digitalization, such as using MP3 files for digital music instead of selling compact discs, replacing physical servers with virtual ones, and reducing the need for office resources, commuting time, and pollution through telecommunications. Monitoring assets and performance using cutting-edge trends like big data and the Internet of Things (IoT) is made possible for businesses by going digital

Exchange: Our particular package of articles on the circular economy focuses on the transformation from theory to practice, with subtitles that reflect this transition. The widespread adoption of circular economic principles by businesses to increase value capture has led to improvements in resource utilization and customer experience delivery. This shift can be considered a significant change, often described as a "paradigm shift," as it represents a departure from the linear value creation and extraction paradigm that has been in place since the industrial revolution for both businesses and consumers.

TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution)

TOPSIS is a method for identifying the best solution from a set of alternatives that are evaluated based on multiple criteria. It works by simultaneously reducing the distance from a nadir point and increasing the distance from the solutions in the set. The significance of TOPSIS criteria comparative weights can be combined. This paper reviews different weighing schemes and distance measurements used in TOPSIS, along with many applications and comparisons with other methods [15]. TOPSIS requires limited subjective input from decision makers, which makes it an attractive option. Only subjective input weights are needed. Thus, TOPSIS is a great alternative for reducing distance while increasing the distance to the nadir point. Although TOPSIS is widely used for many applications, it is not as widespread as attribute methods. In flexible production, variation of TOPSIS is used for selecting clippers, while in financial investment and manufacturing applications, it is used to select processes. To gain weight for TOPSIS, neural network approaches are used, and more ambiguous package extensions are implemented. Companies in specific fields use TOPSIS to compare financial ratio performance and efficiency [16]. The TOPSIS method in r value sensitivity will confirm improves weight in kind. In the formula for the value of progress has been made, i.e., the 'excessive' method. Due to the complexity of assessment problems, it is necessary to understand the relationship for better and simpler methods for the intrinsic value between alternatives [17]. In this report, a novel, modified TOPSIS method, d+ substitutes in the d−-plane, and the distance between reference points r is calculated and evaluated as a value-building process. TOPSIS has been an important branch in decision-making since its inception. Table 1 compares the characteristics of TOPSIS and AHP to clarify their features. One of the main weaknesses of TOPSIS is that it lifts weights without providing a balanced test for judgments. However, the employment of AHP is considerably restricted by the human capacity for information processing, with the ceiling being seven plus or minus two in comparison [18]. The concept of TOPSIS is that the most preferred alternative is the one that is far from the positive ideal solution but has a short distance to it, and also has a long distance to the negative ideal solution. Gelenbe also pointed out this point [19]. TOPSIS cannot directly handle this type of data, and for ranking algorithms, we adopt a TOPSIS-based approach called a-TOPSIS. In this case, there are alternatives and benchmarks [20]. In section 4, we explain our methodology with an example of the proposed algorithm. The final part concludes. The TOPSIS approach is expanded to solve non-objective linear programming problems. Jahanshaloo et al. [21] introduced the TOPSIS procedure developed by Hwang and Yoon (1981), which was adopted in this study. Hwang and Yoon (1981) recommended the use of vector normalization, which is particularly relevant for TOPSIS (Chen, 2019c). With attribute weights determined by TOPSIS, it is called e-TOPSIS, and if it is not weighted, it is called u-TOPSIS. The results can be analyzed by comparison with TOPSIS [22]. This review actually raises the issue of fairness in TOPSIS' ranking index. To answer this, a detailed analysis was conducted, which was the first objective of this study [23]. Yang and Chou also developed the TOPSIS method optimization using multiple response simulations to solve the problem with discrete factors. However, the generated design alternatives of the TOPSIS method are not likely to be applied in assessment [24]. To avoid the normalization formula used in classical TOPSIS, which increases complexity, a linear scale transformation is used to make the criteria comparable. A methodology for extending TOPSIS to the fuzzy context is proposed in this section. TOPSIS is a tool for solving decision-making problems in an ambiguous environment where a multitude of persons consider the criterion for decision-making. The data and team for decision making ambiguity in the decision-making process considering linguistic variables of all criteria weights, and depending on each criterion, estimates of each alternative are used for assessment.

3. RESULT AND DISCUSSION

TABLE 1. Circular Economy

	Reliability	Responsiveness	Agility	Costs	Active management efficiency
Regenerate	82.08	81.08	79.53	23.15	22.05
Share	96.12	97.12	94.97	33.69	27.30
Optimise	74.08	74.08	92.58	35.18	23.10
Loop	93.17	83.17	98.28	24.60	26.59
Virtualise	96.33	96.33	86.41	27.96	28.89
Exchange	83.33	73.33	86.41	27.96	28.89

Table 1 shows the Based on the table, the alternative with the highest overall score is "Virtualise" with a score of 87.18. The next best alternative is "Share" with a score of 77.24, followed by "Loop" with a score of 77.16. "Regenerate" is the fourth best alternative with a score of 57.77, followed by "Optimise" with a score of 52.87, and "Exchange" with a score of 47.68. It is important to note that the rankings are based on the evaluation preferences of "Regenerate, Share, Optimise, Loop, Virtualise, Exchange" and the criteria of "Reliability, Responsiveness, Agility, Costs, Active management efficiency". Different evaluation preferences or criteria may lead to different rankings.

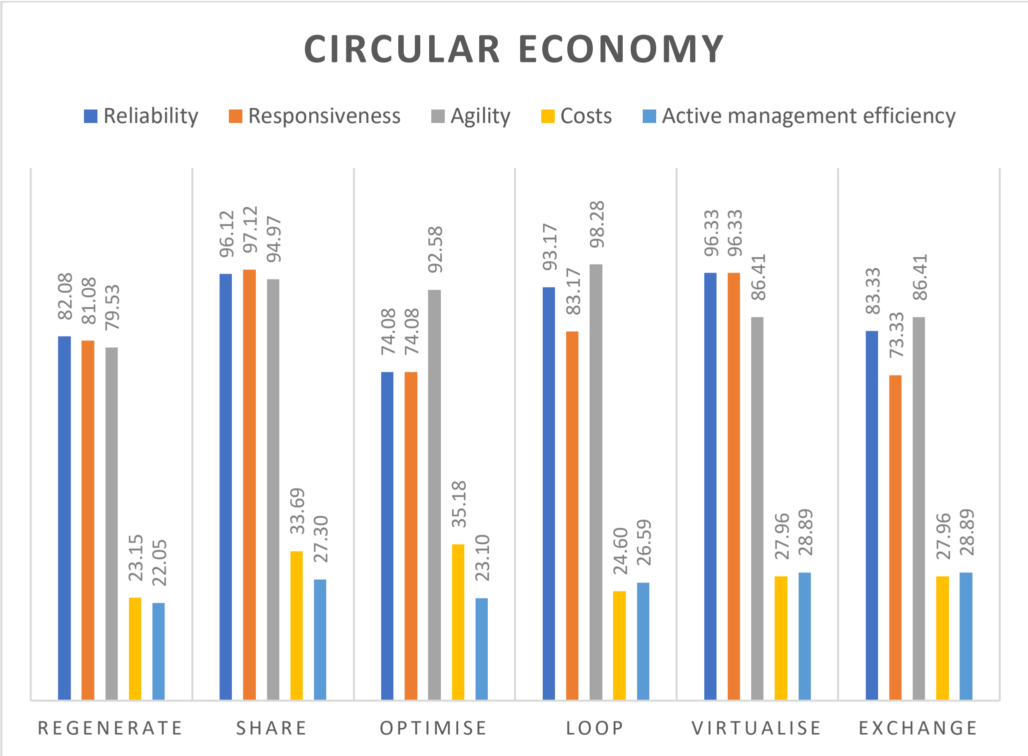


FIGURE 1. Circular Economy

Figure 1 Shows the the Reliability it is seen that Virtualise is showing the highest value for Optimise is showing the lowest value. the Responsiveness it is seen that Share is showing the highest value for Exchange is showing the lowest value. the Agility it is seen that Loop is showing the highest value for Regenerate is showing the lowest value. the Costs it is seen that Optimise is showing the highest value for Regenerate is showing the lowest value. the Active management efficiency it is seen that Virtualise; Exchange is showing the highest value for Regenerate is showing the lowest value.

$$X_{n1} = \frac{X1}{\sqrt{((X1)^2+(X2)^2+(X3)^2\ldots)}} \quad (1).$$

TABLE 2. Squire Rote of matrix

6737.1264	6325.0209	535.9225	486.2025	486.2025
9239.0544	9019.3009	1135.0161	745.2900	745.2900
5487.8464	8571.0564	1237.6324	533.6100	533.6100
8680.6489	9658.9584	605.1600	707.0281	707.0281
9279.4689	7466.6881	781.7616	834.6321	834.6321
6943.8889	7466.6881	781.7616	834.6321	834.6321

Table 2 shows the Squire Rote of matrix value.

TABLE 3. Normalized Data

Normalized Data				
Reliability	**Responsiveness**	**Agility**	**Costs**	**Active management efficiency**
0.3812	0.3765	1.1161	0.3597	0.3426
0.4464	0.4510	1.3328	0.5235	0.4242
0.3440	0.3440	1.2993	0.5467	0.3590
0.4327	0.3862	1.3793	0.3823	0.4132
0.4474	0.4474	1.2127	0.4345	0.4489
0.3870	0.3405	1.2127	0.4345	0.4489

Table 3 shows the normalized data for the Circular Economy alternatives using the TOPSIS method. The data has been normalized to bring all the criteria to the same scale, which is a value between 0 and 1. The normalization has been performed by dividing each criterion's value by the maximum value of that criterion across all alternatives. For example, in the first row of the table, the maximum value for Reliability across all alternatives is 96.33. Therefore, the Reliability score for the "Regenerate" alternative (which is 82.08) has been divided by 96.33, resulting in the normalized score of 0.3812. This process has been repeated for all the criteria and alternatives. The resulting table shows the normalized scores for each alternative on each criterion, which can be used to calculate the weighted normalized score for each alternative in the next step of the TOPSIS method.

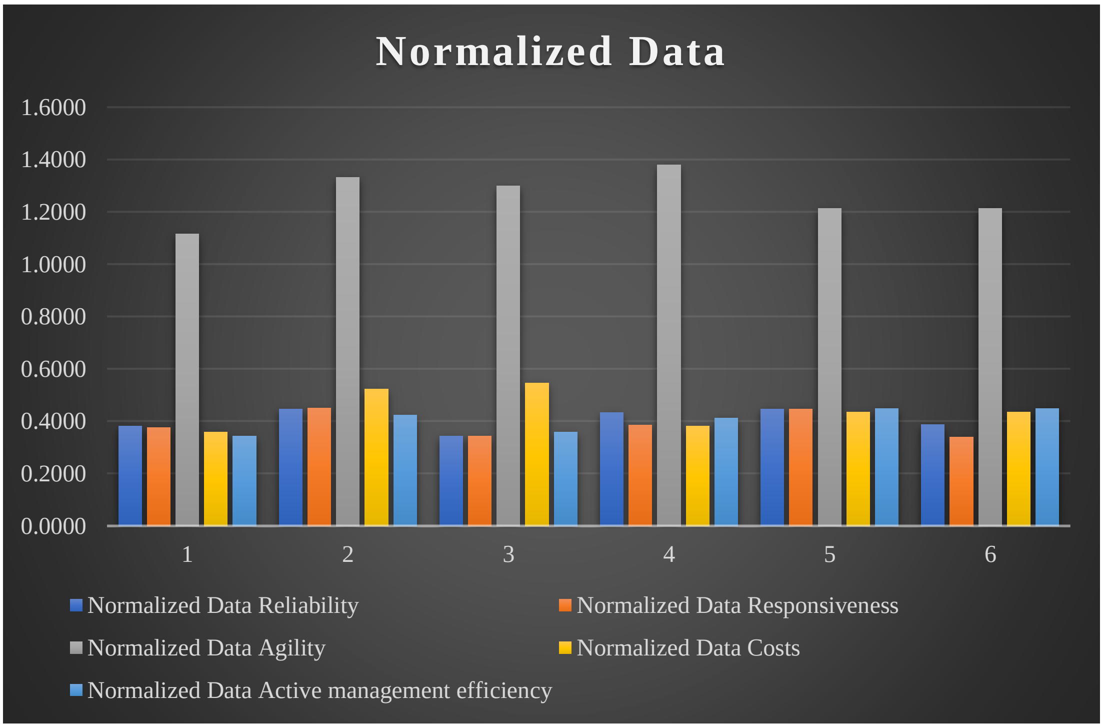


FIGURE 2. Normalized Data

Figure 2 Normalized Data Alternative: Reliability, Responsiveness, Agility, Costs, Active management efficiency. Evaluation preference: Regenerate, Share, Optimise, Loop, Virtualise, Exchange it is also Normalized Data Value.

TABLE 4. Weight

Weight				
0.25	0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25	0.25

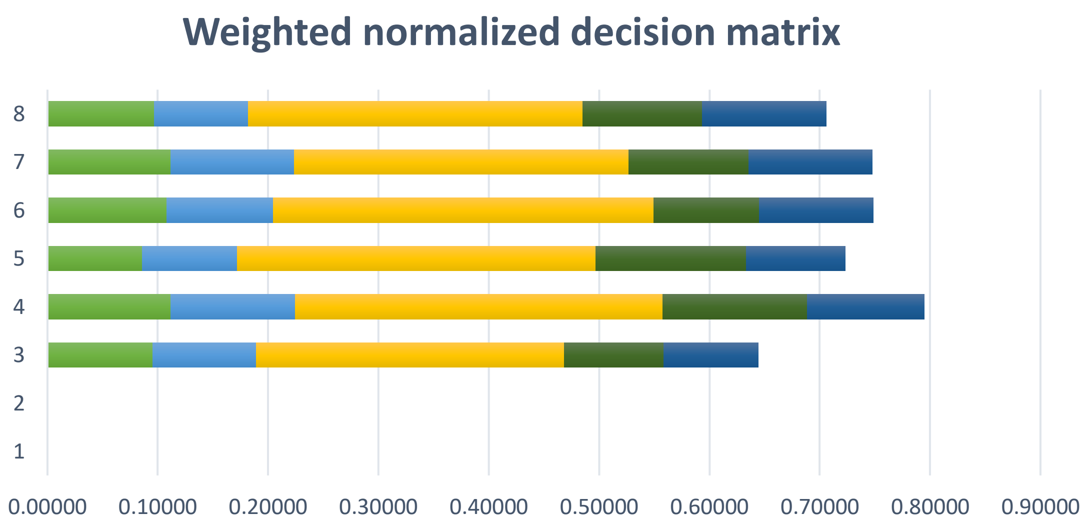
Table 4 Weight shows the informational set for the weight all same value 0.25.

$$\boldsymbol{X}_{\boldsymbol{wnormal1}} = X_{n1} \times w_1 \qquad (2).$$

TABLE 5. Weighted normalized decision matrix

Weighted normalized decision matrix				
0.095295	0.094134	0.279034	0.089933	0.085659
0.111595	0.112756	0.333205	0.130878	0.106055
0.086007	0.086007	0.32482	0.136667	0.089738
0.10817	0.09656	0.344819	0.095566	0.103296
0.111839	0.111839	0.303172	0.108619	0.112231
0.096746	0.085136	0.303172	0.108619	0.112231

Table 5 shows weighted normalized decision matrix for Alternative: Reliability, Responsiveness, Agility, Costs, Active management efficiency. Evaluation preference: Regenerate, Share, Optimise, Loop, Virtualise, Exchange.



	1	2	3	4	5	6	7	8
Series1	0.00000		0.0953	0.1116	0.0860	0.1082	0.1118	0.0967
Series2			0.0941	0.1128	0.0860	0.0966	0.1118	0.0851
Series3			0.2790	0.3332	0.3248	0.3448	0.3032	0.3032
Series4			0.0899	0.1309	0.1367	0.0956	0.1086	0.1086
Series5			0.0857	0.1061	0.0897	0.1033	0.1122	0.1122

FIGURE 3. Weighted normalized decision matrix

Figure 3 shows weighted normalized decision matrix for Alternative: Reliability, Responsiveness, Agility, Costs, Active management efficiency. Evaluation preference: Regenerate, Share, Optimise, Loop, Virtualise, Exchange.

TABLE 6. Positive Matrix

Positive Matrix				
0.111839	0.112756	0.344819	0.136667	0.112231
0.111839	0.112756	0.344819	0.136667	0.112231
0.111839	0.112756	0.344819	0.136667	0.112231
0.111839	0.112756	0.344819	0.136667	0.112231
0.111839	0.112756	0.344819	0.136667	0.112231
0.111839	0.112756	0.344819	0.136667	0.112231

Table 6 Positive Matrix shows the informational set for the value.

TABLE 7. Negetive matrix

Negative matrix				
0.086007	0.085136	0.344819	0.136667	0.112231
0.086007	0.085136	0.344819	0.136667	0.112231
0.086007	0.085136	0.344819	0.136667	0.112231
0.086007	0.085136	0.344819	0.136667	0.112231
0.086007	0.085136	0.344819	0.136667	0.112231
0.086007	0.085136	0.344819	0.136667	0.112231

Table 7 Negative matrix shows the informational set for the value

TABLE 8. Si Positive & Si Negative & Ci & Rank

	SI Plus	Si Negative	Ci	Rank
Regenerate	0.088534	0.214102	0.707457	6
Share	0.014373	0.221889	0.939165	1
Optimise	0.04784	0.202959	0.809249	4
Loop	0.04522	0.220824	0.830027	2
Virtualise	0.050219	0.232991	0.822679	3
Exchange	0.05926	0.230261	0.795316	5

Table 8 shows the final result of this paper the Regenerate is in 6th rank, Share is in 1th rank, Optimise is in 4th rank, Loop is in 2nd rank, Virtualise is in 3rd rank, Exchange is in 5th rank, The final result is done by using the TOPSIS method is used to determine the relative rankings of alternatives based on a set of evaluation criteria. For each alternative (Regenerate, Share, Optimise, Loop, Virtualise, Exchange), the table lists the following: SI Plus: This is the measure of the alternative's similarity to the ideal solution, calculated as the sum of the product of the normalized score for each criterion and the corresponding weight for that criterion. A higher SI Plus value indicates greater similarity to the ideal solution. SI Negative: This is the measure of the alternative's similarity to the negative ideal solution, calculated as the sum of the product of the normalized score for each criterion and the corresponding weight for that criterion, with the minimum value for each criterion subtracted from 1. A higher SI Negative value indicates greater dissimilarity to the negative ideal solution. Ci: This is the measure of the relative closeness of the alternative to the ideal solution, calculated as the ratio of the SI Negative value to the sum of the SI Plus and SI Negative values. A higher Ci value indicates greater closeness to the ideal solution. Rank: This is the relative ranking of the alternative based on its Ci value. The alternative with the highest Ci value is ranked 1, and so on. Therefore, the table shows that the alternative with the highest ranking is Share, followed by Loop, Virtualise, Optimise, Regenerate, and Exchange. This indicates that Share is the most optimal alternative based on the evaluation criteria and their weights used in the TOPSIS method.

$$X_{si+1} = \sqrt{}((X_{wn1} - X_{p1})^2 + (Y_{wn1} - Y_{p1})^2 + (Z_{wn1} - Z_{p1})^2 \quad (3)$$

$$X_{si-1} = \sqrt{}((X_{wn1} - X_{n1})^2 + (Y_{wn1} - Y_{n1})^2 + (Z_{wn1} - Z_{n1})^2) \quad (4)$$

$$X_{ci1} = \frac{X_{si-1}}{(X_{si+1}) + (X_{s(i-1})} \quad (5)$$

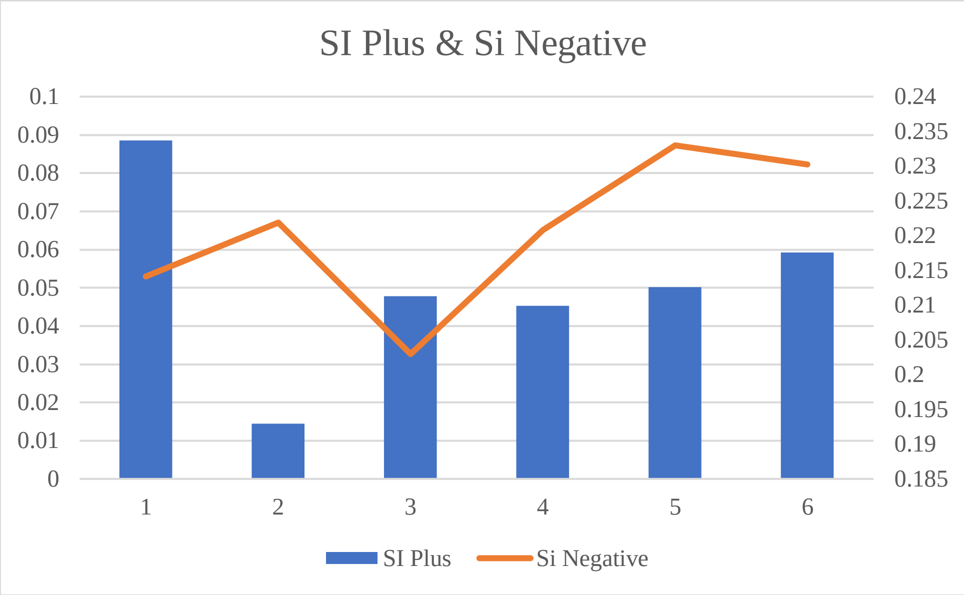


FIGURE 4. Si Positive & Si Negative & Ci

Figure 4 Si Positive & Si Negative & Ci shows the graphical representation.

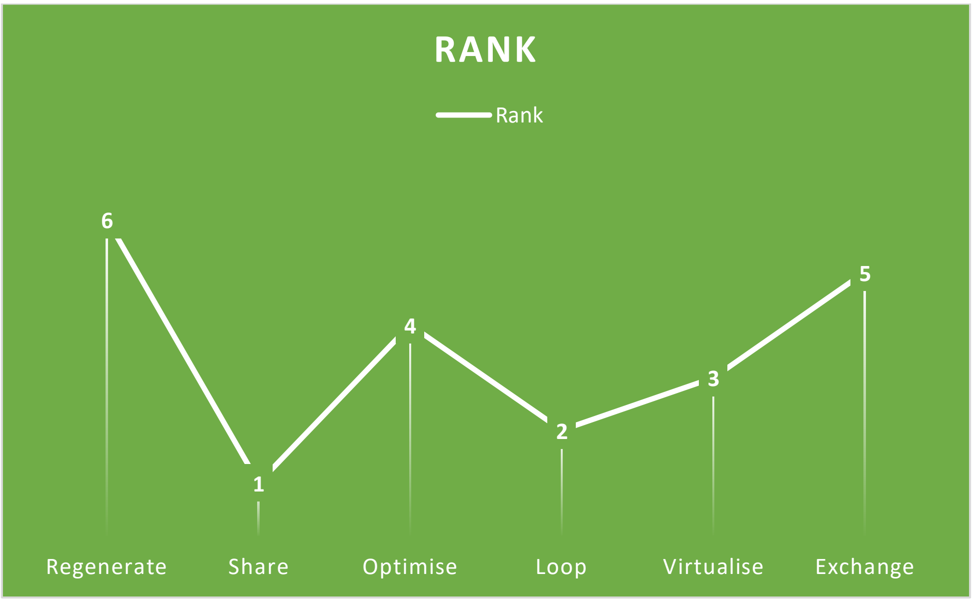


FIGURE 5. Rank

Figure 8 shows the graphical representation the final result of this paper the Regenerate is in Sixth rank, Share is in First rank, optimize is in Fourth rank, Loop is in Second rank, virtualize is in Third rank, Exchange is in Fifth rank, The final result is done by using the TOPSIS method.

4. CONCLUSION

"A model for production and consumption known as a circular economy, or CE, includes sharing, leasing, reuse, adjustment, renewal, and recycling. The paradigm has three basic principles for addressing global problems such as climate change, pollution, waste, and loss of biodiversity. To transition to a circular economy, three policies are necessary: creating waste and pollution-free systems, recycling goods, and rebuilding the environment. CE is classified as a regular economy in contrast to the linear economy. Over the past ten years, education, business, and government have all significantly conducted research on the concepts of the circular economy (CE). As it lowers emissions and raw material consumption, expands market opportunities, and, most significantly, enhances consumption stability and resource efficiency, CE is becoming more and more popular. Government officials see CE as a way to slow global warming and promote long-term growth. The European parliament, which models production and consumption, defines CE as sharing existing products as much as possible. This includes leasing, reusing, repairing, updating, and recycling. CE incorporates actors at the regional level to stop loops and create policies for resource efficiency. The product's life cycle is lengthened in this way. In a planned economy, mineral wealth is converted into products that, because of how they are created and made, must be disposed of as trash. Taking, preparing, and subtracting are common acronyms for this operation. In contrast, a circular economy decreases the consumption of resource inputs and waste, pollution, and carbon by creating a closed-loop system that includes reuse, sharing, repairing, renewing, reproducing, and recycling with minimal emissions. The circular economy seeks to maximize the lifespan of goods, machinery, infrastructure, and other resources to increase their production. Through waste assessment, waste and energy can be converted into inputs for different processes, either as part of another industrial process or as a renewable resource for natural fertilizer. The circular economy aims to conserve environmental systems and prevent the excessive use of resources. A circular economy reduces greenhouse gas emissions, decreases resource consumption, and increases agricultural production, while a linear economy has the opposite effect. A circular economy that uses renewable energy to reduce greenhouse gas emissions will benefit the environment by reducing fossil fuel contamination. Dematerialization and reuse make it possible to produce quality, useful items using fewer materials and manufacturing procedures. Because leftovers are valued and used as much as possible during the process, they are absorbed. The agricultural system follows the principles of the circular economy, which reduces the exploitation of land and natural ecosystems by ensuring that crucial nutrients are returned to the soil by anaerobic processes or composting. In this way, "trash" can be recycled back into the soil, leaving it healthy and robust with fewer residues to contend with, promoting more ecological harmony in the area. Soil degradation costs us $40 billion annually globally. Both the earth and the economy can benefit greatly from a circular economy. Finally, the results of this paper rank regeneration sixth, sharing first, upgrades fourth, the loop second, virtualization third, and exchange fifth using the TOPSIS method."

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