



Circular Economy and Sustainable Design

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Abstract

The research paper identified how sustainable design makes use of circular economy principles. Focusing on the closed loops of ecosystems, renewable energy, and systems thinking, this literature review delved into the fundamentals of the circular economy. Concepts important to the circular economy are outlined in this paper. These concepts included: trash as a resource; recycling; reuse; repair; valorisation; the functionality economy; and renewable energy. Upcycling and donated shoes are singled out as a case study to illustrate how this practice may have positive effects on the environment, society, economy, and the economy all at once. Also, the study covered the ecological modernisation theory as a theoretical lens through which to view the movement towards greener methods of operation.

This study analysed the literature on sustainable design and the circular economy to provide new insights into this topic. It stressed the need for shifting from a linear model of production and consumption to a more circular and regenerative one, as well as the benefits of such an approach. This study's results added to the increasing knowledge of sustainable design and the circular economy, laying the groundwork for further exploration and actual application in various fields. Circular economy ideas help companies and communities save money, save resources, and improve people's lives as well as the environment.

1.0 Introduction

In recent decades, there has been an eightfold increase in the global consumption rate. It is projected that the global utilisation of resources will increase by a factor of three by the year 2050, with a significant portion of this escalation occurring in developing nations.

The principle of sustainable development (SD) posits that individuals should have the capacity to fulfil their current requirements without compromising the capacity of forthcoming generations to fulfil their own needs.

The United Nations Environment Programme (UNEP) proposed 17 Sustainable Development Goals (SDG) in 2015, which were subsequently adopted by 193 member states of the United Nations (Lamba *et al.* 2023).

These goals aim to promote global sustainability and prosperity while safeguarding the planet, with a target completion date of 2030. Subsequently, public and private entities have diligently endeavoured to achieve the Sustainable Development Goals (SDGs) and their corresponding targets. At the same time, Sustainable Development (SD) has been extensively examined and investigated (Pieroni *et al.* 2019). Researchers and policymakers' attention is increasingly drawn towards sustainability principles due to the growing population, depletion of natural resources resulting from overconsumption, and increasing wealth disparity.

Concurrently, there has been a growing trend towards the adoption of the concept of a circular economy (CE) in recent years. Circular economy (CE) is a viable alternative to the prevailing linear economic model (Suárez-Eiroa *et al.* 2019). Corporate Environmentalism (CE) endeavours to sustain the growth of an organisation's performance and productivity while mitigating any negative environmental impact. Governments, businesses, and researchers have developed various frameworks to comprehend the circular economy (CE) concept. However, these frameworks and metrics have not been able to establish a uniform understanding of CE due to the lack of consensus (Agrawal *et al.* 2022). The examination of CE by researchers and practitioners is subject to contextual variation and typically encompasses multiple dimensions. The concept of CE has transformed throughout its history. The origins of this concept can be traced back to Simmonds' (1862) notion of industrial waste serving as input and the 1970s environmental movements, which brought the 3R concept of reducing, reusing, and recycling into the mainstream (Lamba *et al.* 2023).

The main goal of this research paper is to investigate how the principles of the circular economy are met by upcycling donated shoes. The paper is structured to first define upcycling and its relevance, then review successful programmes and organisations upcycling donated shoes, emphasise the environmental advantages and ask for additional research and implementation.

2.0 Literature review

2.1 Sustainable design

The concept of sustainable development delves into the fundamental motivations that prompted the World Commission on Environment and Development to introduce SD. Despite the significant economic and human development progress made by many nations, there exists a notable disparity in the distribution of benefits among their respective populations, resulting in elevated levels of income inequality. Elkington's (1997) triple bottom-line framework is a fitting model for elucidating the primary goals of sustainable development (Lamba *et al.* 2023). This framework evaluates the efficacy of an organisation or the worth of an investment based on its performance in three areas: economic prosperity, social well-being, and environmental protection. The lack of consistency in the usage of the term "sustainability" has been observed across various research papers. Some scientific publications have predominantly employed the term in reference to environmental dimensions, while others have utilised it to describe social dimensions (Rodriguez-Anton *et al.* 2019). The Brundtland Report advocates for a comprehensive and cohesive strategy that both societies and businesses ought to adopt in regard to resource consumption. Prior studies have predominantly disregarded the systemic approach and have instead concentrated on "entities" such as a single company and its stakeholders or a novel material that could replace an existing resource, frequently with an implicit emphasis on economics (Shamsuyeva and Endres, 2021).

2.2 Circular Economy

The term "circular economy" refers to an ecological system in which the value of its constituent parts, products, and byproducts is maintained to a high degree. The main principles of this system are not production, consumption, and disposal; rather, they are reduction, reuse, and recycling (Dahiya *et al.* 2020). This serves as the foundation for action-based solutions that have been begun with the purpose of achieving sustainability. The state of the environment right now leads to consumption focused on the short term, which in turn creates an unsustainable condition for planet Earth. The modern ecosystem functions in a manner that is diametrically opposed to the way that nature does so in the long run (Agrawal *et al.* 2021). It is a system in which components are reduced, reused, and recycled to the greatest extent possible. Each year, human activity results in the generation of 2.01 billion metric tonnes of municipal solid trash. A very conservative estimate suggests that at least one-third of that area is not maintained in a way that is safe for the environment (Sbmunurban.org, 2023). Every year, the urban population of India, which accounts for around 34 per cent of the overall population of 1.37 billion, produces close to 51 million tonnes of municipal solid garbage, also known as MSW

(Sbmurban.org, 2023). The average amount of garbage generated per capita, which was estimated to be 338.06 grams/capita/day in 2012, has climbed to 358.81 grams/capita/day in 2018. This represents a 3.4% increase from 2012 (Sbmurban.org, 2023). Research carried out in the year 2019 by The Energy and Resources Institute (TERI) at the Bhandwari landfill in Gurugram revealed that municipal solid trash was made up of 32.2% organics, 10.96% plastic, 4% paper, 1% metal, 0.5% glass, and 52% miscellaneous garbage including inert (Sbmurban.org, 2023). Similarly, a 2019 waste characterisation study in Varanasi that was backed by the Nationally Appropriate Mitigation Actions (NAMA) project found that solid waste collected from wards was comprised of approximately 29.2% organic waste, 5.4% paper, 4.8% plastic, 0.3% metal, 0.2% glass, 7% leather and textile, 2.1% sanitary waste, 7.7% C&D waste, 0.6% domestic hazardous waste, 0.7% tyres, 0.1% electronics, and 40.5% fines (Sbmurban.org, 2023).

2.3 Elements of circular economy

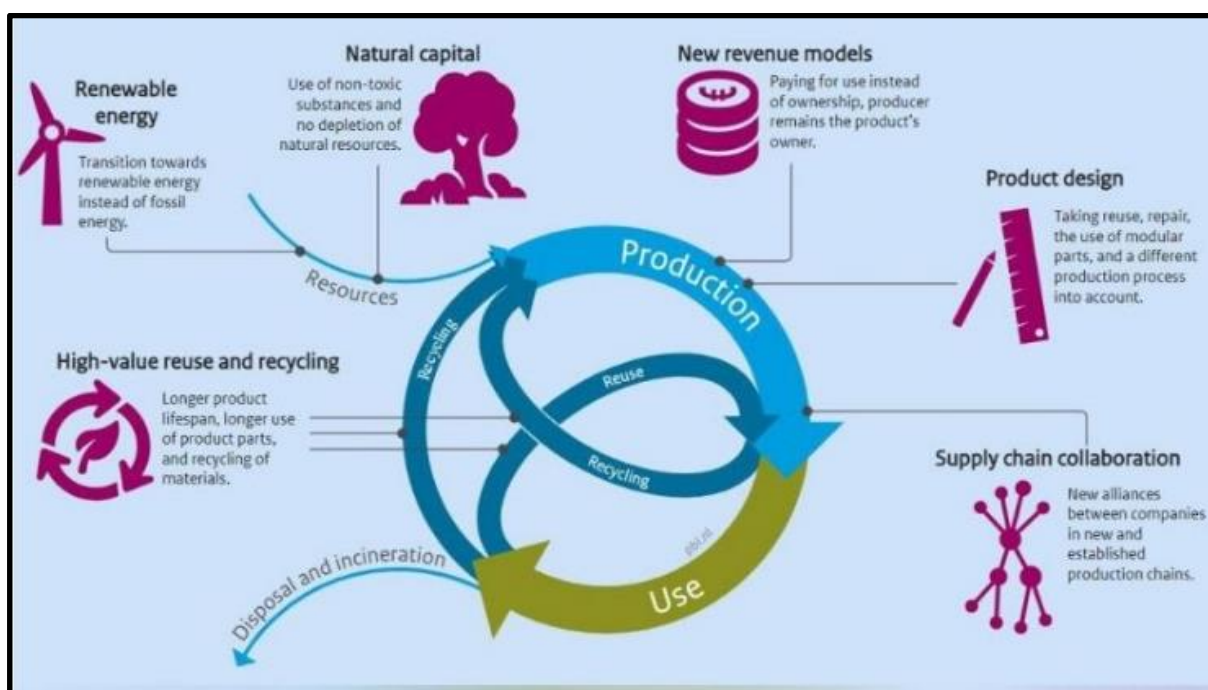


Figure 1: Elements of Circular Economy

(Source: earth5r.org, 2023)

2.3.1 Closed Loops of Ecosystem

The term "closed loops of ecosystems" describes how waste is reduced and all byproducts and scraps from the production and consumption of goods are recycled or repurposed. The strategy here is meant to preserve and put to good use whatever value these residuals have. Materials are valued for their potential to be put to other uses, recycled, or upcycled rather than thrown away (earth5r.org, 2023). This not only helps the environment by decreasing trash production, but it also boosts the economy and encourages more efficient use of materials.

Both technological and biological cycles are important to the concept of closed loops. Materials that can be safely decomposed or biodegraded back into the environment are part of biological cycles (Burmaoglu *et al.* 2022). Compost is made from organic waste from food or agricultural output to create a nutrient-rich soil supplement. Materials that are reused, repurposed, or remanufactured are at the heart of technical cycles. In a circular economy, the quality of recycled resources is essential. In order for recycled materials to be used in the manufacturing of new items, they must be of a high enough grade (Corona *et al.* 2019). To do so without compromising the quality of the recovered materials needs effective sorting and processing procedures. For recycled materials to be successfully integrated into the manufacturing processes of a wide range of sectors, stringent quality control methods are essential.

2.3.2 Renewable energy

The use of renewable energy is crucial to maintaining a closed-loop economic system. Renewable energy sources, including solar, wind, hydro, and geothermal, should be employed to power the circular economy. The circular economy lessens its impact on the environment by using fewer scarce resources and switching to renewable energy sources (de Jesus *et al.* 2018). By fostering cleaner, more environmentally friendly energy systems, renewable energy sources also contribute to the long-term viability and resilience of the circular economy as a whole.

2.3.3 Systems thinking

Systems thinking is crucial for the implementation of a circular economy. It requires thinking about how each value chain and ecosystem link affects the others. Systems thinking looks at the whole picture instead of just the parts, considering the immediate and far-reaching effects of any given choice or action (Jaeger and Upadhyay, 2020). This involves knowing how a product or service affects the environment, society, and economy at every stage of its existence. Stakeholders better anticipate and respond to problems, improve the efficiency of resource allocation, and create long-term solutions with widespread benefits by adopting a systems perspective (Kirchherr *et al.* 2018).

2.4 Principles of circular economy

2.4.1 Waste as a Resource

In a circular economy, waste isn't garbage; it's a precious resource. Composting or processing biodegradable objects like food scraps and other organic debris helps replenish soil nutrients and sustain ecological systems

(Lamba, 2021). Reusing or recycling non-biodegradable garbage, such as plastics or metals, decreases the need for new raw materials and lessens the environmental toll it has on the planet.

2.4.2 Second Use

The term "second use" refers to the practice of returning components or materials into an ecosystem for a purpose other than their initial intended usage. Such as utilising empty glass bottles as flower vases or old planks of wood for new furniture (Phulwani *et al.* 2020). Utilising materials for a second time increases their worth and longevity, hence decreasing the need for brand-new manufacturing.

2.4.3 Reuse and Reparation

One of the cornerstones of a circular economy is the practice of reusing items, either in whole or in part. Products' lifespans be extended by maintenance and refurbishment. Reducing waste and saving resources and energy that would have been used to produce new items are two benefits of fixing broken parts or updating components (Saidani *et al.* 2019). By extending the life of items, repair encourages a more environmentally responsible pattern of use.

2.4.4 Valorisation

The process of valorisation entails getting useful energy from materials that can't be reused or recycled. Waste-to-energy operations, for instance, use materials that cannot be recycled to generate either heat or power. Waste disposal is turned into a source of energy, and fossil fuel use can be cut down by using methods like incineration (Sch€oggl *et al.* 2020).

2.4.5 Functionality Economy

In the functionality economy concept, product ownership is replaced by product use. Products are rented or leased instead of being bought by customers for a limited time. Products are returned after their first usage so that they are reused, reconditioned, or recycled. Manufacturers are incentivised by this approach to create long-lasting, repairable, modular items that can be readily dismantled and reassembled for new purposes (Schroeder *et al.* 2019).

2.4.6 Renewable Energy

A circular economy prioritises the use of renewable energy sources. By transitioning away from fossil fuels and embracing renewable energy like solar, wind, or hydropower, the circular economy reduces greenhouse gas emissions and minimises the environmental impact associated with energy production (James and Kent,

2019). Renewable energy sources are essential for powering the processes of recycling, repurposing, and reusing materials within the circular economy.

2.4.7 Eco-design

Eco-design refers to a method that takes environmental factors into account during product development. It is an effort to reduce pollution at every stage of a product's existence, from manufacturing through disposal. Sustainable materials, decreased production energy use, and recyclable or biodegradable construction are all examples of eco-design goals (Phau *et al.* 2022). The move to a circular economy is facilitated by the incorporation of eco-design principles, which ensure that goods are developed with environmental sustainability in mind.

2.5 Upcycling and Donated Shoes

The term "upcycling" refers to repurposing old or unwanted items into new ones of greater quality or worth. Upcycling aims to reuse and elevate materials into new and usable objects instead of standard recycling, which often entails breaking down materials to their fundamental components for reprocessing (Korley *et al.* 2021). Repurposing is the process of giving previously used or abandoned items a new use by the application of creative thought, planning, and skill. Upcycling plays an important part in trash reduction since it keeps usable materials out of landfills and incinerators (Jehanno *et al.* 2022). When things are repurposed rather than being thrown out, they have a longer useful life and help cut down on the need for brand new materials. Upcycling reduces the need for new materials. This prevents the needless depletion of natural resources like wood, minerals, and fossil fuels that would be used in the manufacturing of new items (Ellis *et al.* 2021). Upcycling helps reduce energy consumption and greenhouse gas emissions since it reuses materials rather than producing brand-new ones. Upcycling help reduces GHG emissions and energy usage by making use of already-existent resources and minimising the need for resource-intensive extraction and manufacture (Lamba *et al.* 2023). Upcycling, the practice of making new items out of previously used ones, is a form of creative expression and innovation.

Upcycling projects help revitalise neighbourhoods and stimulate local economies. Through their partnerships with local artisans, crafters, and small businesses, these upcycling projects not only educate the public about the environmental impacts of waste and consumption patterns but also create jobs for local residents and foster a sense of pride and ownership in the community (Pieroni *et al.* 2019). It inspires people to reevaluate their attachment to material things, leading to a more minimalistic, ethical way of living. Upcycling is one example

of how these ideas might be put into practice. It aids in resource conservation and waste reduction by emphasising material repurposing and reuse (Suárez-Eiroa *et al.* 2019). It fits in with the trend away from a one-way, linear "take-make-dispose" approach towards a more circular system that uses resources better and generates less waste.

Donated shoe upcycling is consistent with the concepts of the circular economy, which seek to maximise resource utilisation, lessen waste production, and encourage the development of durable goods.

2.5.1 Efficient Resource Utilisation

One of the most significant advantages of upcycling donated shoes is that it leads to more effective utilisation of resources. Utilising the already-existing material supply by recycling and converting worn shoes is an example of upcycling, which eliminates the need to continually mine for new sources of raw materials (Agrawal *et al.* 2022). This results in a large reduction in the need for virgin resources, which often require a lot of energy to extract and process, such as leather, rubber, and textiles. Upcycling ensures that the value that can be extracted from the current circulation resources is maximised (Lamba *et al.* 2023). This is accomplished by prolonging the life of the shoes in question and combining them into new products. This is consistent with the tenets of the circular economy, which hold that resources should be utilised effectively in order to minimise the amount of new resources that must be extracted and to lessen their impact on the environment.

2.5.2 Waste Minimisation

Upcycling previously used footwear, such as shoes that have been given, plays an important part in the reduction of waste. Upcycling is a chance to save shoes from being thrown away in landfills or incineration facilities by removing them from the waste stream and giving them a new lease on life (Rodriguez-Anton *et al.* 2019). Upcycling minimises the quantity of garbage that is produced and lightens the load on the infrastructure that is responsible for its disposal. One example is the transformation of discarded shoes into new items with value. This method adheres to the idea of the circular economy known as "closing the material loop," which states that goods and components should be maintained in circulation for as long as is practically practicable (Shamsuyeva and Endres, 2021). Upcycling helps contribute to a more sustainable and resource-efficient system by reducing the amount of garbage that is generated. In such a system, waste is seen as a useful resource rather than a burden.

2.5.3 Long-Term Product Design

The process of upcycling shoes that have been generously given helps to encourage the design of items that are intended for long-term usage. Instead of following the paradigm of fast fashion, which promotes quick consumption of things and their subsequent disposal, upcycling places an emphasis on the creation of objects that are both long-lasting and pleasant to the eye (Dahiya *et al.* 2020). Shoes that have been upcycled be repurposed into a variety of things, including purses, accessories, and even whole new pairs of shoes with contemporary patterns. Because of the focus placed on excellent workmanship and durability, the upcycled items are guaranteed to have a longer lifetime compared to the form in which they were originally produced (Agrawal *et al.* 2021). This strategy lessens the effect on the environment that is caused by the manufacturing and disposal of products with a limited lifespan and a single purpose. Upcycling shoes saves important resources and reduces the demand for ongoing production and consumption since it extends the amount of time that shoes are worn before they need to be replaced (earth5r.org, 2023).

2.5.4 Value Retention and Regeneration

The practice of upcycling used footwear places emphasis on both the retention and production of value throughout the product's entire life cycle. Upcycling offers shoes a new purpose and boosts their worth using creative and inventive design ideas. This means that rather than the value of the shoes decreasing when they reach the end of their first usage, it actually increases (Burmaoglu *et al.* 2022). By using a wide variety of materials, textures, and patterns, creative craftsmen and designers are able to repurpose used footwear into one-of-a-kind goods that are highly sought after. Upcycled shoes provide customers with a more environmentally friendly and meaningful alternative to mass-manufactured things by extracting the value already there in the materials (Corona *et al.* 2019). This strategy presents a challenge to the linear "take-make-dispose" paradigm. It encourages the adoption of a circular system in which the life cycle of items is prolonged and then recycled.

2.5.5 Community and Social Benefits

Benefits to the Community and to Society One of the many benefits to the community and to society that result from the upcycling of donated shoes is that it creates jobs. Efforts to recycle materials are often carried out in conjunction with neighbourhood artisans, craftspeople, and small companies (de Jesus *et al.* 2018). Upcycling helps sustain local economies and offers job possibilities thanks to the participation of these many stakeholders. The abilities and information necessary for upcycling are handed down from generation to generation, which

helps to maintain the integrity of traditional crafts and cultivate a feeling of cultural identity (Jaeger and Upadhyay, 2020). In addition, upcycling makes a positive contribution to social welfare by increasing access to reasonably priced footwear for people or groups who do not have the financial resources necessary to buy brand-new shoes. Upcycling projects help solve social inequality and contribute to the creation of a more equitable society by reusing and redistributing shoes that have been given to the cause (Kirchherr *et al.* 2018). In addition, communities are involved in the process of sustainable consumption and trash reduction when they participate in upcycling, which fosters a feeling of ownership, empowers individuals, and educates people about sustainable practices.

For example, Used and discarded shoes are being upcycled by Greensole and Adidas India into brand-new, comfy, and lightweight slippers for poor children in India and worldwide as part of a new cooperation that embraces circular design (Stirworld.com, 2023). In the 'circular design' idea, resources are continually cycled through several iterations of the design cycle based on the reuse and recycle loop (Lamba, 2021). Many children in India between the ages of 6 and 15 from disadvantaged backgrounds go shoeless, but this sustainable effort hopes to change that. Adidas India, which has previously worked with Greensole, is clearly attempting to make a positive effect in terms of environmental protection. Together, they have been organising shoe distribution campaigns since December 2016 (Stirworld.com, 2023).



2.6 Theory

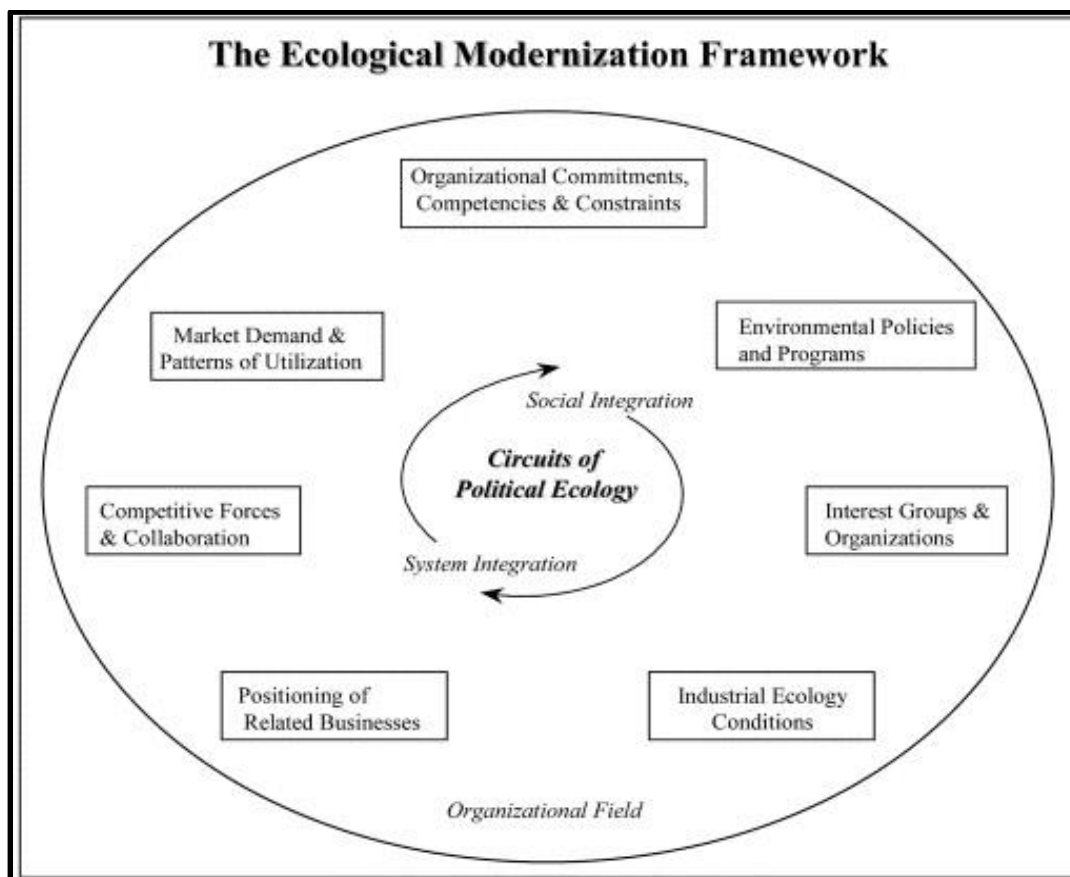


Figure 2: Ecological Modernisation Theory

(Source: Archambault, 2004)

According to proponents of the Ecological Modernization Theory, environmental sustainability be attained via a combination of new technologies, revised policies, and cultural transformations. Upcycling used footwear is a prime example of the potential of the circular economy to replace the current, unsustainable, and resource-intensive linear paradigm of production and consumption (Leipold, 2021). By repurposing and transforming discarded shoes using cutting-edge methods and design thinking, upcycling exemplifies the concepts of ecological modernity by minimising waste and maximising efficiency.

Environmental objectives, including waste reduction, resource conservation, and greenhouse gas mitigation, are attainable via the shoe industry's upcycling practices. Embracing technical and institutional shifts that allow for economic development while decreasing environmental effects is central to the ideas of ecological modernisation (Mastrangelo and Aguiar, 2019). In addition, the theory highlights the role of cultural norms and values as a primary force in environmental transformation. The trend towards more ethical and conscientious spending is reflected in the upcycling of discarded shoes. Customers that buy recycled goods are

showing their support for environmentally friendly business practices and helping to revolutionise the shoe business (James and Kent, 2019).

3.0 Conclusion

In conclusion, this research paper highlighted the idea of upcycling used shoes and how it fits into the ideas of the circular economy. Upcycling has substantial environmental advantages since it uses resources better, produces less waste, and creates products that last longer. Upcycling helps minimise the demand for virgin resources, saves important materials, and lengthens the lifetime of things by reusing and repurposing previously used items, such as reusing and repurposing old shoes. This method is consistent with the ideas of the circular economy, which include that resources should be utilised effectively, that there should be as little waste as possible, and that goods should be created with long-term usage in mind.

Donated shoes are upcycled into new goods that have value, so decreasing trash and easing the strain on landfills and other waste disposal facilities. This not only helps to save resources but also reduces the amount of pollution in the environment and the emissions of greenhouse gases (Phulwani *et al.* 2020). Upcycling helps to decrease waste generated and encourages a more sustainable attitude to consumption. It does this by removing shoes from the garbage stream and giving them a new purpose, which in turn gives the shoes a new purpose.

The effect that shoes given by the public have on landfills is reduced, resources are conserved, and greenhouse gas emissions are reduced when they are upcycled. This is only one of the many environmental advantages that result from this practice (Saidani *et al.* 2019). It does this by completing the material loop and reframing trash as a valuable resource, both of which are in keeping with the concepts of the circular economy. Upcycling is the process of reusing and recycling materials in such a way that the original value of the item is preserved while also producing new value.

It is impossible to exaggerate how important it is to further the aims of the circular economy by upcycling the shoes that have been given. It offers a concrete answer to the problems caused by linear consumption and production models (Sch€oggl *et al.* 2020). Upcycling allows us to move towards a more environmentally friendly and responsible method of product design and manufacturing, in which it produces less waste, makes more effective use of our resources, and creates items intended to last longer.

To fully realise the promise of upcycling donated shoes and advance the circular economy, however, more research and the application of sustainable design practices are required. Upcycling projects should be

evaluated for their effects on the environment and the economy, best practices should be identified, and recommendations for the design and execution of upcycling processes should be developed as the primary focus of research (Schroeder *et al.* 2019). In addition, the cooperation of stakeholders, such as governments, enterprises, and customers, is essential for creating an environment conducive to adopting upcycling practices and promoting such practices.

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