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Unlocking Creative Potential: Sustainable Art Practices Through Scrap Art and SCAMPER Design Innovation

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Abstract: ***In today's consumer-centric world, rapid technological progress has led to an alarming increase in discarded items, posing a significant environmental threat. This situation underscores the pressing need for embracing sustainable practices in artistic endeavors. Many contemporary artists are now turning to "Scrap Art" or "Junk Art," creating stunning pieces from discarded materials, not only beautifying their surroundings but also raising awareness about reuse. This paper delves into the detrimental impact of rampant consumerism on the environment and advocates for repurposing and upcycling waste materials in art. It outlines a four-stage design process: selecting waste products, developing concepts, generating ideas, and creating a series of innovative designs. The SCAMPER technique, known for its effectiveness in generating creative ideas, was applied during the concept development and idea generation stages. Through this methodology, the study showcased how waste soft drink cans could be transformed into five distinct products: a desk watch, a picture frame, a spring paper clip, a pencil holder, and a lamp. These creations not only demonstrated the potential of upcycling but also reduced the need for recycling or landfill disposal. The research emphasizes the compatibility of the design process with creative concept generation and highlights the importance of sustainable art practices in mitigating environmental challenges. By unlocking the creative potential of upcycling and addressing environmental concerns, this study aims to contribute to a more sustainable and vibrant artistic landscape, benefiting both artists and the environment.***

I. INTRODUCTION

Dealing with waste has become increasingly challenging due to uncontrolled disposal, toxic emissions, and illegal burning, leading to numerous health issues like cancer and birth defects and diminishing overall quality of life. One potential remedy involves exploring alternatives to landfilling or burning trash. Upcycling, for instance, involves repurposing waste materials into new items that align with their inherent characteristics and structure. Integrating elements that enhance aesthetics and style could make this process more appealing and acceptable, countering the negative perception often associated with products made from waste.

Design plays a pivotal role in reshaping perceptions and fostering acceptance of upcycled materials. By introducing innovative concepts and reimagining waste materials through novel designs, the market perception can shift positively, potentially attracting investment interest in upcycling ventures. Utilizing the unique qualities and architectural features of waste materials can expedite the upcycling process, especially if it results in valuable and visually appealing products.

Emerging designers stand to benefit significantly from this approach, as it promotes self-production and encourages the creation of bespoke products through creative design processes. Implementing a low volume "pilot design" strategy, supported by contemporary design techniques and leveraging the SCAMPER method for idea generation, can facilitate the development of high-quality, value-added products from waste materials. This study aims to identify suitable waste types for repurposing based on their abundance or significant environmental impact. The effectiveness of repurposing hinges on the adoption of precise and targeted techniques, integrating design expertise and creative idea generation practices. Through a program emphasizing self-product design and interdisciplinary capabilities, designers can explore innovative avenues centered on waste materials, promoting both creativity and environmental sustainability.

II. UPCYCLING

Before the concept of upcycling gained prominence, recycling was commonly associated with environmentally friendly practices involving reusing products through decomposition or synthesis with additional materials. This traditional recycling approach, known as "downcycling," differs from upcycling, which actually increases the value of a product rather than diminishing it. The term "upcycling," coined from combining "up" (indicating a higher level) and "cycling" (meaning to cycle or reuse), has been integrated into dictionaries. Essentially, upcycling refers to design efforts or outcomes that enhance the value of a recycling target for the purpose of resource recycling.

If we consider anything that undergoes upcycling as recycling, then creatively transforming it to serve a new purpose qualifies as upcycling. The fundamental aim of upcycling is to repurpose waste materials and components to create entirely new products that fit into sustainable production cycles. For instance, an obsolete mobile phone's liquid-crystal display (LCD) touch screen from Company A could be repurposed as the climate control touch screen in a car manufactured by Company B, and subsequently, as the backlit LCD panel in a data projector produced by Company C. Instead of just recycling the phone, its parts could be utilized in various products, ensuring they maintain or increase their value with each use.

However, to facilitate downstream repurposing effectively, these features need to be considered during the initial design phase of the mobile phone. This approach ensures that all materials and parts retain their value or gain value through multiple uses, contributing to sustainable resource management and circular economy practices.

Within the context of the upcycling concept, Xu and Gu (2015) propose five guiding principles for waste product redesign as follows.

A. Enhancing the Overall Value

Upcycling prioritizes enhancing the value of discarded materials to turn them into valuable resources, making it crucial for designers to focus on increasing this value from the outset. Designers have a responsibility to thoroughly assess the potential value of waste, considering factors such as function, material quality, and structural attributes. They must then take all necessary measures to maximize this value throughout the upcycling process.

B. Reprocessing as Much of the Waste as Possible

To maximize the utilization of waste materials and minimize secondary waste, it's crucial to redesign processes with waste as the primary resource. This involves a concerted effort to reduce waste generation at every stage of production. A comprehensive program for designing and manufacturing must begin at the source, requiring designers equipped with effective waste control strategies to handle unforeseen challenges. However, not all waste types can be utilized equally effectively. Thus, designers need a strong environmental consciousness to identify ways to minimize production waste and ensure proper waste treatment wherever possible.

C. Being Ecologically Friendly

Even though the source material for redesigning products often comes from items that have been discarded or used up, this doesn't imply that the quality of these products is inferior. Designers should approach these materials without bias and create them with the same level of care as conventional products to ensure their durability and prolong their usefulness. In the process of designing, using, and recycling products, it's crucial to minimize negative impacts on the environment. Designers should prioritize environmentally friendly materials as design inspirations and avoid using substances that are harmful to the environment.

D. Keeping a Close Eye on the Expenses

Effective cost management is crucial in the realm of garbage upcycling and redesigning, and this hinges on the ability to convert waste into valuable products. The initial stage of the regeneration process is the design phase, where designers must carefully consider all aspects to maintain control over redesign costs right from the start.

E. Maintaining the Aesthetic of the Populace

Following the design principle of commercialization, designers should prioritize conforming to the aesthetic preferences of the general audience. This involves ensuring high visual quality, a deep understanding of the target market's conditions and customs, and sensitivity to fashionable and popular features. Designers should strive to avoid imposing their personal views and values on the design, creating an end product that stands as a distinct entity separate from their individual aesthetic preferences.

III. RESPONSIBILITY IN WASTE FOR PRODUCT DESIGN

Product design plays a vital role in addressing household product waste, as many of these items often end up in landfills. Achieving zero waste by design entails ensuring that products and packaging are never disposed of in a way that harms the environment. Cradle-to-cradle production focuses on creating products that can be continuously used and reused, adding value throughout their life cycle. However, current design practices often fall short of this objective. There is a pressing need for a radical shift in how products are conceived, constructed, packaged, distributed, repaired, recycled, and disposed of at their end of life.

This necessitates a thorough reevaluation of product design, including materials, performance, and end-of-life considerations. Design professionals and manufacturers must consider how they can effectively support upcoming regulations on extended product responsibility and stewardship, beyond addressing landfill issues. Evidence suggests that implementing product take-back for reuse can be both profitable and cost-effective compared to purchasing new products, making it a preferable approach to recycling. Prioritizing component reuse in design can significantly contribute to reducing carbon emissions, waste, and energy consumption in production cycles, aligning with the principles of the Reduce, Reuse, Recycle, Remove movement. While recycling and upcycling are distinct concepts, it's important to delve deeper into their differences. Upcycling, especially in product design, can play a vital role in minimizing waste from household products and reducing material consumption in production. However, there is a lack of research exploring upcycling as an efficient tool for design and waste management. Embracing upcycling practices can not only minimize waste but also contribute to more sustainable product design and production processes.

IV. SCAMPER FOR GENERATING CREATIVE IDEAS FOR UPCYCLING IN PRODUCT DESIGN

The creative conceptualization process is fundamental in generating diverse and innovative design ideas and ensuring their practical implementation. Various methods such as brainstorming, mind mapping, and the SCAMPER approach have been utilized to explore the creative process and its impact on generating novel ideas. SCAMPER, developed by Bob Eberle, is a technique that combines brainstorming and mind mapping to foster unconventional thinking and generate a wide range of creative solutions to challenges.

SCAMPER stands for substitute, combine, adapt, modify, magnify, minimize, put to other use, eliminate, reverse, and rearrange, representing a sequence of processes aimed at stimulating excellent creative thinking. Before delving into problem-solving, SCAMPER aids in idea generation by posing a series of questions to identify potential hurdles. It employs checklists to ensure that important aspects are not overlooked, making it effective for creatively addressing complex problems and uncovering overlooked innovations during development.

The uniqueness of the SCAMPER method lies in its flexibility, allowing users to employ different types of creative thinking in any sequence and pose as many or as few questions as needed to arrive at optimal solutions. This approach is invaluable for sharing and refining concepts while fostering creativity in problem-solving and innovation. The questions that lead to and support the solutions for each SCAMPER method are shown in Table 1.

Table 1. Questions for each SCAMPER

Checklist	Applicable questions to product design
(S) Substitute	▪ What assets or resources can be traded to increase the product's quality? ▪ Is this product interchangeable with another? ▪ What will happen if someone has a particular opinion or viewpoint on this product?
(C) Combine	▪ What if two products were joined together to create something wholly unique? ▪ What if objectives or goals are merged? ▪ How might one merge resources to create an innovative product strategy?
(A) Adjust	▪ In what ways might this product be adjusted for a different purpose or implementation? ▪ In which of the figure's examples could the product be used? ▪ What other suggestions do you have that would be inspiring?
(M) Modify	▪ Which would you choose if you could alter the product's shape and appearance? ▪ What more could you highlight or stress to provide more significance? ▪ Could you make any changes to this product's features to make it better?
(P) Put to other uses	▪ Can this product be utilized in another sector? ▪ In what other ways do you believe this product would respond in a certain context? ▪ Can waste from this product be repurposed to create anything new?
(E) Eliminate	▪ Can you come up with any ideas to simplify or minimize this product? ▪ Do you have any parts, features, or processes you could get rid of? ▪ What if portion of this commodity was taken away?
(R) Reverse	▪ What if you reversed the process or changed the steps? ▪ What components could be changed to vary the product's pattern? ▪ What options do you have for reorganizing this product?

V. METHODOLOGY

Our group, committed to eco-conscious initiatives, adopts an autoethnographic lens to explore the untapped potential of upcycling in repurposing waste materials, particularly those with significant environmental footprints. Ellis (2003) characterizes autoethnography as a fusion of personal introspection with broader socio-cultural contexts, a framework we employ to delve deeply into the creative process of crafting innovative products from discarded materials.

Our study integrates personal experiences with rigorous research methodologies, centering on self-design as a catalyst for generating imaginative product concepts from waste materials. This approach enables us to draw upon our collective wisdom and diverse backgrounds, enriching our comprehension of upcycling within product design. The incorporation of SCAMPER, a creative ideation technique, further invigorates our design process by encouraging unconventional thinking and exploration.

Our overarching objective is to bridge the divide between imaginative idea generation and effective waste management through upcycling. Inspired by the insights of Bowen et al. (2016), we aspire to forge a blended methodology that synthesizes insights from disparate fields, fostering novel solutions for repurposing waste materials. By reframing waste as a reservoir of unique potential, we seek out alternative upcycling strategies to breathe new life into discarded items, transforming them into innovative products with enhanced functionality and aesthetic appeal.

Central to our methodology is the emphasis on creative product design, with a focus on uncovering fresh concepts and designs that accentuate the inherent qualities of waste materials. Our strategic framework encompasses critical phases such as recognizing waste as a valuable resource, integrating creative shortcuts, and harnessing natural discovery principles to inspire inventive designs. Ultimately, our approach champions sustainability by empowering the transformation of waste into valuable, creatively designed artifacts that contribute positively to the environment.

A. Selecting the Waste Products

We chose soft drink cans as our primary focus due to their inherent recyclability; aluminum, the primary material, can be recycled endlessly without any degradation in quality. However, despite approximately half of these cans being recycled in many countries, the other half poses a significant challenge, contributing to pollution in water bodies, streets, and open spaces. The lack of awareness about recycling exacerbates these environmental and health concerns.

Moreover, the production of new aluminum through mining and related processes leads to pollution and energy inefficiency. While single-use containers offer convenience, they come with severe environmental consequences, necessitating the continual replacement of discarded cans with newly manufactured ones, further compounding the issue. Unfortunately, these repercussions often escape notice in the daily routines of individuals, such as after meals or during commutes.

B. Emerging Conceptions That Interpret, Communicate, And Value The Identity Of A New Series Of Creative Products

The final product design reflects the conceptual groundwork laid during this stage. Creativity in design not only enhances quality and value but also imbues the product with a sense of originality. A key strategy at this juncture is the front-end approach, encompassing meticulous design planning and execution. This phase requires problem-solving skills to overcome challenges associated with existing waste products, paving the way for innovative ideas. It also necessitates the exploration of unconventional creative avenues beyond conventional norms.

C. Generating Ideas by Sketching

Sketching serves as a catalyst for generating original ideas, facilitating the emergence of novel concepts. According to Goldschmidt (2003), designers engage in a dynamic interplay between concepts and sketches, expanding their thoughts as they perceive evidence within the sketches. Often, creative ideas are hidden within these initial sketches, waiting to be uncovered during the sketching phase.

D. Rendering the Series of Creative ideas for New Product Design using a 3D Program

3D rendering entails the creation of realistic images of a model or design in two or three dimensions. This process follows the initial design creation using computer-aided design or 3D modeling software, showcasing various designs such as products, buildings, interiors, and facades. Specialized 3D rendering software enables designers to present designs in a photorealistic manner, capturing intricate details accurately. These rendered images serve as visual representations, enhancing the presentation by allowing scalability, navigability, and interactivity. Thus, 3D rendering ensures that the designs are not only visually appealing but also practical and functional across different contexts.

VI. RESULTS

This study has taken this design process with the mission to solve the environmental problems in the concept of upcycling. Working with the SCAMPER technique, the study later unveiled a series of creative and simple-to-make products in the expectation that they may eventually replace single-use cans.

After selecting the waste products, the next stage is to plan the innovative upcycling of a waste soft drink can. At this point, the soft drink can is divided in half. Using the SCAMPER technique, the study opted to employ the (S) substitute technique, which considers a 45-degree slit in an oval-shaped half as a replacement for a straight, circle-shaped halve. The outcome is an attractive and uncommon oblique shape that is more inventive than a circular cross-section, as shown in Figure 1.

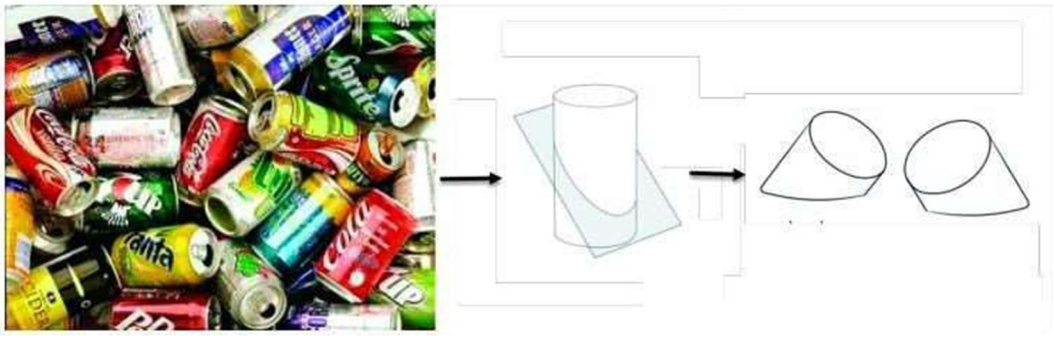
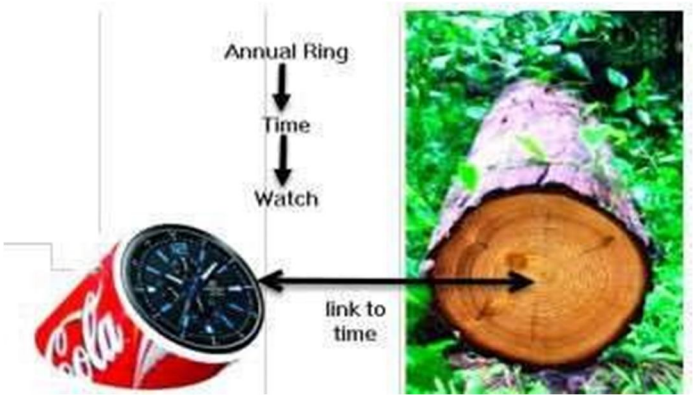


Figure 1. A 45-degree slit in an oval-shaped half of a waste soft drink can

Figure 2 shows that the first product of this study resulted from the initial concepts was a desk clock because the top and bottom of the soft drink cans are round, like a watch. By using the adapt in SCAMPER technique, the oblique-shaped face of the desk clock could be claimed to be the metaphor for a cut tree log displaying the tree's annual growth rings.



Using the (R) reverse technique, the two halves of a soft drink can are put together in a way that makes them look like binoculars. So, they are made to hold pictures of animals, whether they are on land or in the water as shown in Figure 3.

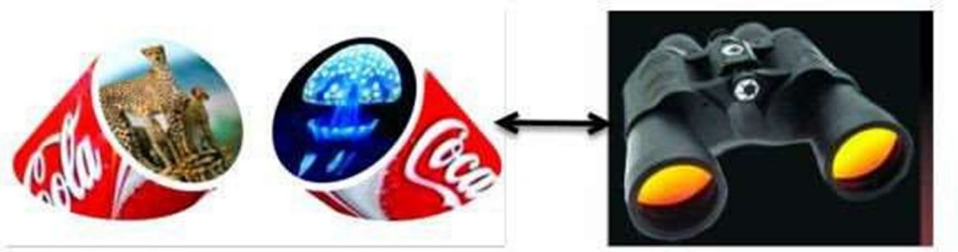


Figure 3. The two halves of a soft drink can are put together in a way that makes them look like binoculars.

Using the (C) combine technique, a toy spring was attached to connect the two sides of each of the two halves of a soft drink can, allowing the user to envision a rainbow and providing for the insertion of notes or business cards as shown in Figure 4.

Figure 4. A toy spring was attached to connect the two sides of each of the two halves of a soft drink can, allowing the user to envision a rainbow and providing for the insertion of notes or business cards.

Using the (E) eliminate technique, the top and bottom of a waste soft drink can be punched into little holes to hold pencils or pens, which, when filled with some slanted pencils and pens, resembles a meteor shower as depicted in Figure 5.

Figure 5. Inserting some pens and pencils into the holes on the top and bottom of a waste soft drink can imitate a meteor shower.

Using the (R) reverse technique, the two halves of a soft drink can be reassembled into their original form. By creating the half-top of the can to be a lamp, the hidden light within the can's half-top could be turned on and off by rotating it. The turning on and off the lamp's light mimics the rising and setting of the sun as shown in Figure 6.

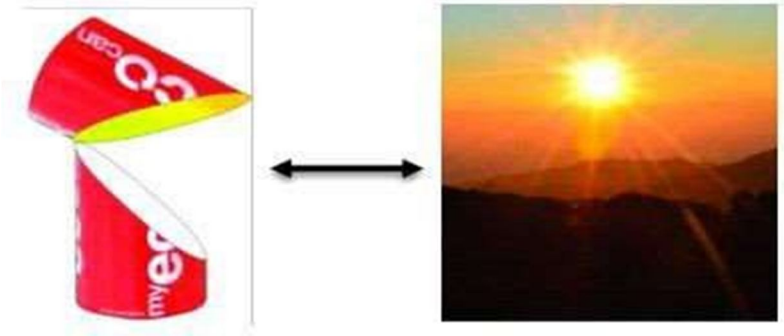


Figure 6. The turning on and off of the lamp's light mimics the rising and setting of the sun.

VII. DISCUSSION

In this study, the resulting product design diverges from conventional automated manufacturing or industrial design approaches, which aligns well with discussions on sustainable product design. During the stages of emerging conceptions and generating ideas, the SCAMPER technique played a crucial role in fostering creative idea generation.

In the process of emerging conceptions, the "adjust" aspect of SCAMPER was utilized to expand upon the concept of using natural discovery as the primary inspiration for designing innovative products. This led to the creation of diverse items such as a desk watch, picture frames, a spring clip holder, a pencil holder, and a lamp, all rooted in the concept of natural discovery.

During the idea generation phase, each SCAMPER technique was applied individually to generate creative ideas for product design that harmonized with the theme of natural discovery. These ideas were further refined and visualized in igures 1-6, showcasing the integration of SCAMPER techniques with the overarching design concept.

Drawing from Xu and Gu's (2015) principles for redesigning waste products, the consistent outcomes of upcycling product design in this study are evident. Each design iteration reflects a commitment to repurposing waste materials in innovative ways, aligning with sustainable design principles and contributing to a more environmentally conscious approach to artistic creation.

A. *Design Consideration*

Firstly, the research's design approach had limitations. It primarily focused on "trash design" for reusing waste materials, showcasing creativity in finding new uses for old items. However, this method might offer only a temporary solution to environmental issues. Without exploring other eco-design principles and methods, the study's utility and impact could be limited. Secondly, the study lacked a comprehensive examination of eco-object design from start to finish to ensure alignment with key sustainability principles. To create genuinely sustainable and eco-friendly products, it's crucial to incorporate principles like minimizing production waste, using local raw materials, avoiding diverse structural materials, reducing fittings, ensuring natural decomposition of products, and optimizing energy use.

Thirdly, there was a gap in considering real-world implementation and scalability. Most design items in the study were unique, with limited exploration of feasibility and scalability for mass production. Addressing these aspects is vital for practical implementation and making a more significant impact on environmental issues by encouraging widespread use of environmentally friendly products.

Lastly, the study acknowledged concerns about aesthetics, particularly when dealing with deformed waste materials like discarded cans. However, there was no exploration of the challenges associated with working with deformed waste materials and how that might impact the appearance of upcycled products.

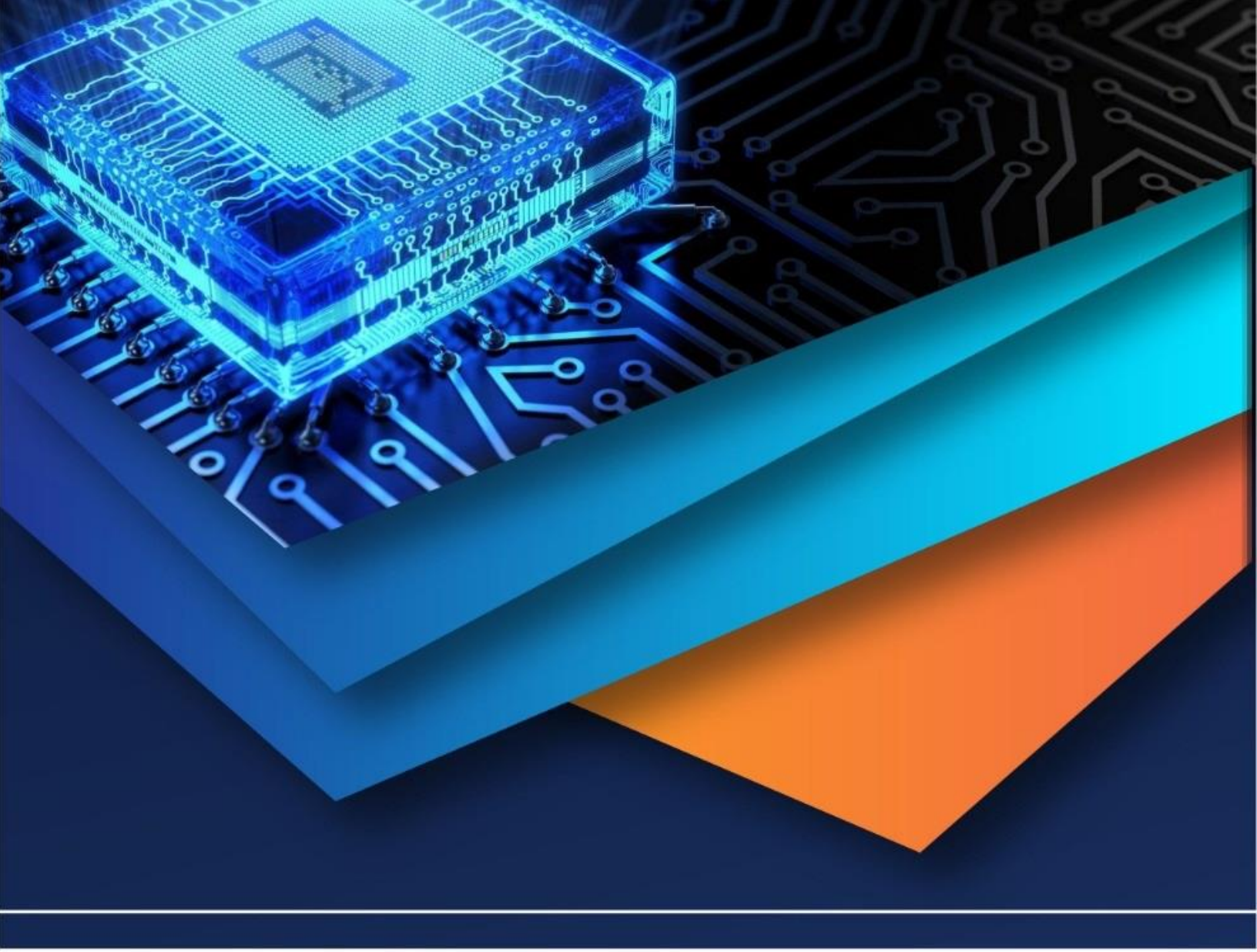
VIII. CONCLUSIONS

The five innovative products crafted from discarded soft drink cans showcase the potential of upcycling in design. By adopting an upcycling approach, the researcher repurposed waste materials that would have otherwise ended up in landfills. These findings highlight the promise of upcycling and autoethnography as vital methods in environmentally conscious design. The products created through this process serve as tangible examples of the creative and practical opportunities that arise from transforming waste materials into fresh and distinctive products. Upcycling offers designers and researchers interested in creating purposeful and socially responsible products new avenues to explore, particularly during a time when waste and environmental sustainability are pressing concerns. There are several suggestions for further exploration in the realm of upcycling and autoethnography in sustainable product design. Firstly, expanding the sample size for future studies could test the scalability of upcycling and autoethnography across various design contexts and a larger range of products. This would provide researchers with a better understanding of upcycling's potential in different sectors and business scenarios. Secondly, exploring other waste materials for upcycling beyond soft drink cans, such as plastic bags or cardboard boxes, could lead to the creation of more innovative and eco-friendly products. Lastly, evaluating sustainable design strategies by comparing them could shed light on the effectiveness of methods like participatory design and user-centered design in producing environmentally friendly and well-received goods. Although the upcycled products developed in this study are visually appealing and socially responsible, their long-term durability, utility, and practicality remain unknown. Future research could focus on studying the long-term performance and usability of upcycled items to determine their commercial viability.

REFERENCES

[1] Alaanuloluwa Ikhuoso, O. (2018). The role of educational programs to enhance stakeholder participation for sustainable waste management in developing countries: An investigation into public secondary schools in Nigeria. International Journal of Waste Resources, 8(3). https://doi.org/10.4172/2252-5211.1000350
[2] Bassi Padilha, de J., Cziulik, C., & Camargo Beltrão, de P. A. (2017). Vectors of innovation definition for application during conceptual design stage of product development process. Journal of Technology Management and Innovation, 12(1), 49–60. https://doi.org/10.4067/S0718-27242017000100006
[3] Bowen, S., Durrant, A., Nissen, B., Bowers, J., & Wright, P. (2016). The value of designers' creative practice within complex collaborations. Design Studies, 46, 174–198. https://doi.org/10.1016/j.destud.2016.06.001
[4] Brun, J., Masson, le P., & Weil, B. (2016). Designing with sketches: The generative effects of knowledge preordering. Design Science, 2. https://doi.org/10.1017/dsj.2016.13
[5] Brunetti, G., & Golob, B. (2000). A feature-based approach towards an integrated product model including conceptual design information. Computer-Aided Design, 32(14), 877–887. https://doi.org/10.1016/S0010-4485(00)00076-2
[6] Chino, M. (2011). Is it green? The biodegradable soft drink can. Inhabitat. https://inhabitat.com/is-itgreen-the-biodegradable-soft-drink-can/
[7] Choi, S. Y., & Kim, M.-J. (2014). Creative idea and an analysis of fashion design on Korean image through the SCAMPER technique. Journal of the Korean Society of Costume, 64(1), 1–17. https://doi.org/10.7233/jksc.2014.64.1.001
[8] Davis, S. C., Kauneckis, D., Kruse, N. A., Miller, K. E., Zimmer, M., & Dabelko, G. D. (2016). Closing the loop: Integrative systems management of waste in food, energy, and water systems. Journal of Environmental Studies and Sciences, 6, 11–24. https://doi.org/10.1007/s13412-016-0370-0
[9] Deng, S., Wan, Zh., & Zhou, Y. (2020). Optimization model and solution method for dynamically correlated two-product newsvendor problems based on Copula. Discrete and Continuous Dynamical Systems – S,13(6), 1637–1652. https://doi.org/10.3934/dcdss.2020096
[10] Ellis, C. (2003). Ethnographic alternatives: Vol. 13. The ethnographic I: A methodological novel about autoethnography. C. Ellis & A. P. Bochner (Eds.). AltaMira Press.Goldschmidt, G. (2003). The backtalk of self-generated sketches. Design Issues, 19(1), 72–88. https://doi.org/10.1162/074793603762667728
[11] Gündoğan, A. (2019). SCAMPER: Improving creative imagination of young children. Creativity Studies,12(2), 315–326. https://doi.org/10.3846/cs.2019.11201

[12] Hasenkamp, T., Adler, T., Carlsson, A., & Arvidsson, M. (2007). Robust design methodology in a generic product design process. Total Quality Management and Business Excellence, 18(4), 351– 362. https://doi.org/10.1080/14783360701231294
[13] Huang, Y.-Sh., Cheng, J.-H., & Yang, A.-J. (2020). A study of green printing technology application for product value-added design. In Q. Gao & J. Zhou (Eds.), Lecture Notes in Computer Science: Vol. 12207.
[14] Human aspects of IT for the aged population. Technologies, design and user experience. HCII 2020(pp. 34–44). Springer. https://doi.org/10.1007/978-3-030-50252-2_3
[15] Kathy, K. (2019). Why are eco-friendly products more expensive? Clarify Green. https://clarifygreen.com/eco-friendly-products-cost-more/
[16] Kerr, W., & Ryan, Ch. (2001). Eco-efficiency gains from remanufacturing: A case study of photocopierremanufacturing at Fuji Xerox Australia. Journal of Cleaner Production, 9(1), 75–81. https://doi.org/10.1016/S0959-6526(00)00032-9
[17] Klausner, M., Grimm, W. M., & Hendrickson, Ch. (1998). Reuse of electric motors in consumer products.Journal of Industrial Ecology, 2(2), 89–102. https://doi.org/10.1162/jiec.1998.2.2.89
[18] Mazhar, M. (2006). Lifetime monitoring of appliances for Reuse [PhD/Doctoral Thesis, University of NewSouth Wales]. Sydney, Australia [unpublished source].
[19] McDonough, W., & Braungart, M. (2002). Cradle to cradle: Remaking the way we make things. North Point Press.



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