GREEN WASTE MANAGEMENT AND COST REDUCTION STRATEGIES FOR CUTTING ROOM WASTE IN APPAREL INDUSTRIES

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Abstract: *Every year a vast amount of waste is being released into the environment through garments manufacturing processes by the garments industry that hugely impact the environment. This paper highlights an effective way of managing this garment wastage by improving cost efficiency. This eventually opens up a new window for the garments industry in the upcoming future all over the global world. Our goal is to minimize the garment waste in the cutting section by working on the marker efficiency by reducing the empty spaces of the garment pattern. Through innovative techniques, cutting waste is being converted into fashionable items, diverting waste from landfills and adding value to the economy. Our findings not only focus on the environmental goals but also show a path of waste management technique that might be followed by the industries or textile sectors.*

Key words: CAD, Pattern, Marker, Marker Efficiency.

UPRAVLJANJE ZELENIM OTPADOM I STRATEGIJE ZA SMANJENJE TROŠKOVA OTPADA U KROJAČKIM POGONIMA INDUSTRIJE ODEĆE

Apstrakt: *Svake godine ogromna količina otpada se ispušta u životnu sredinu tokom proizvodnih procesa u industriji odeće, što ima veliki uticaj na okolinu. Ovaj rad ističe efikasan način upravljanja ovim otpadom poboljšanjem troškovne efikasnosti. To ujedno otvara nove mogućnosti za industriju odeće u budućnosti na globalnom nivou. Naš cilj je da smanjimo otpad u krojačkom odeljenju unapređenjem efikasnosti markera smanjenjem praznih prostora u rasporedu krojnih delova. Kroz inovativne tehnike, otpad iz krojenja se pretvara u modne artikle, čime se otpad preusmerava sa deponija i dodaje vrednost ekonomiji. Naši nalazi ne samo da se fokusiraju na ekološke ciljeve, već i pokazuju put ka tehnici upravljanja otpadom koju bi industrije ili tekstilni sektori mogli primenjivati.*

Ključne reći: CAD, krojni delovi, marker, efikasnost markera.

1. INTRODUCTION

In the fashion industry, while tackling issues regarding waste, efficiency, and cost minimization, companies often face challenges and eventually move towards a circular economy, which is an alternative to traditional manufacturing processes. Enhancing product longevity is an important element in fashion clothing, achieved by controlling product durability and consumption. When a garment is disposed of after use, the ultimate goal is to reuse it through recy-

cling or up-cycling processes to obtain a redesigned or upgraded product. These upgraded products have a significant impact on the global market, as newly developed value-added items help achieve economic goals. In the UK alone, around 1.8 million tons of textile waste are generated every year [1]. In the European Union, this number is approximately 16 million tons per year. Therefore, industries focusing on the circular economy promote up-cycling, where useless or waste products are transformed into items of higher environmental value or better quality. Since garment waste is an alarming environmental issue, industries are striving to reduce it by analyzing production methods and manufacturing procedures. Specifically, they are looking into the efficiency of the sample and cutting sections, which typically generate the most garment waste [2]. However, industries often lack the time to address this waste during the sample and cutting stages due to strict lead times for bulk production and shipment. As a result, large quantities of waste materials end up in landfills and other areas, significantly impacting the environment. Up-cycling these products presents a promising solution, both for extending product longevity and protecting the environment. This project promotes circular fashion by up-cycling textile waste into fashionable items through improved marker efficiency, helping to reduce waste and introduce more environmentally friendly practices in garment manufacturing [3].

Project Objectives:

- Diverting textile wastage from landfills to reduce environmental impact.
- Reducing the necessity of raw materials since those are being reused & hence natural resources are preserved.
- Extending the life cycle of garments could be ensured through creative reuse which promotes a circular economy.
- Sustainable up-cycling techniques help to innovate new designs through creativity in fashion design.
- Awareness among the communities could be achieved by practicing sustainable ways that mitigate textile waste.
- Promoting ethical fashion practices by reducing consumption of raw materials in manufacturing patterns.
- CSR initiatives could be taken which could improve brand loyalty & trust issues among the stakeholders, investors & customers.

2. LITERATURE REVIEW

2.1 Background Study

At present, a new policy is being observed in the fashion industry the circular economy which is fundamentally different from the traditional linear model that negatively impacts the environment. This emerging approach promotes the reduction of waste as much as possible and encourages up-cycling of materials or discarded clothing, as these practices are more environmentally friendly [4]. The concept of circularity also introduces new methods of designing and manufacturing, where products are continuously improved and utilized until they are ultimately returned to the biosphere when they can no longer serve any purpose [5]. Recent research has been conducted on specific industries where fabric waste typically generated during the cutting process is collected and reused to create new products such as kids' t-shirts and other fashionable items. Additional studies have explored the use of fabric waste to produce carpets, scarves, tablecloths, and many other items through proper stripping, bleaching, dyeing, and printing procedures. Furthermore, some studies have investigated the re-purposing of hospital textiles, converting them into fashionable items through up-cycling techniques. Other research highlights the promotion of circular fashion through thoughtful design and the integration of up-cycling into garment manufacturing processes. These studies collectively demonstrate the ongoing progress of the circular economy, showing that effective up-cycling methods can not only reduce environmental impact but may also lower production costs compared to traditional clothing manufacturing [6].

2.2 Waste

Waste is something that could be explained as unwanted and non-functional parts or materials, basically referred to as not useful anymore, that have been disposed or discarded due to their inefficiency. It could also be explained as "waste is elaborated as anything left over or disposed of, that is inefficient, unwanted & recognized as worthless" [7].

2.3 Reasons behind Waste

In the generic scenario of daily garment production, wastage in the cutting section is a usual thing to observe. In the cutting section, a huge amount of waste fabrics is found right after the cutting process. Generally, small size of fabric cut pieces are left over on the cutting floor and some big size of fabric pieces are also found in the daily bulk production of garments manufacturing due to fabric cutting faults, fab-

ric defects or due to some other factors. These could hardly be reduced since the pattern of the fabrics is designed in the marker & according to that way the fabric spreading is done & cut. In another way, this textile waste could open up a new window for better economic benefit [8].

2.4 Environmental & Economic Impacts of Textile Waste

Due to the excessive textile waste that ends up in landfills & over a few years, it overflows. This also occupies valuable spaces & releases methane in the environment as it decomposes. Also, textile production requires resources like water, energy & raw materials. However discarded textile waste shows a significant loss of these resources. Moreover, in dyeing, finishing procedures of textiles require chemicals that might impact soil & water resources. Eventually, textile materials lose their economic value since they are discarded in landfills without having a plan for reuse. Failing to reuse the textile waste is a loss of an opportunity that could generate revenue in this sector. So innovative circular design can only help to reduce the disposal of textile waste which would positively impact the environment & also help to achieve financial savings [9].

2.5 Wastage from Cutting Section

According to some research, approximately 10 -15% cutting loss is observed in the cutting section and 1000 tons of post-consumer waste. Approximately 550 tons of fabric waste are generated in factories from fabric cutting, which is exported every day. However, the cutting section plays a pivotal role in the waste that is inevitably encountered in this section. The initial source of wastage of fabric is inefficient marker-making. Pattern designs of the cloth item are placed in the procedure of marker making using GT CAD software or OPTITEX. This wastage could be minimized by proper planning and making of markers. In Bangladesh, this cutting wastage is called by 'Cut Piece' & 'Jhoot' in where cut pieces are in small sizes whereas the jhoot are in big in size. Jhoot basically comes from two ways -1) woven fabric and 2) knit fabric. However, the price of woven jhoots is lower than that of knit jhoots. This wastage might also be found sometimes due to the overproduction of garments which are eventually discarded, and this might range from 25% to 47% in some cases. Some Bangladeshi factories generate 250 kg to 300 kg of jhoot daily; therefore, they tend to sell these in the local market or to traders. The price range usually vary from to 10-15 tk per kilogram of jhoot, whereas the cut piece prices range from to 7-8 tk per kg [10].

2.6 Up-cycling Techniques & Design for Circular Economy

Over the last few years, the concept of up-cycling has attracted global attention of the whole world. Designers are moving to the up-cycling concept and trying to make a change that could be sustainable and environment-friendly. The concept of up-cycling first arrived in William McDonough's book Cradle- to-Cradle. To save resources and textile waste, fashion designers follow the trend of up-cycling. More Brands and fashion houses are focusing on this issue since this policy is more environmentally friendly compared to traditional manufacturing [11]. Therefore, leftovers and preconsumers of textile waste are being utilized by some designers, for instance, Reet Aus from Estonia, British designer Christopher Raeburn, and Zero Waste Daniel from New York. Even in the last few decades up-cycling has been used on a very small scale let alone an industrial scale. This project highlights the marker efficiency in where pattern designs of the various items are placed for example to make a trunk pattern designs are created in CAD software considering fabric type, measurement & fulfilling other details. After pattern digitization, grading was performed using CAD tools. Then, optimization of the pattern pieces is performed for proper placement considering the fabric grain lines and pattern direction using CAD software to achieve the best usage of fabric. However, it is often found that a huge amount of fabric pieces are wasted which then referred as 'Cut piece' & 'Jhoot'. Therefore, here, the gap that is observed in marker making of the trunk pattern or any other items in CAD software, a new small pattern design could be placed there, for instance, pattern of a mask, mittens, etc. Eventually, this reduces fabric wastage by increasing marker efficiency, and new fashion items could be gained and sold in the global market. In another sense, CSR (Corporate Social Responsibility) initiatives can be taken by the industries in order to grab a good reputation among stakeholders, consumers, and investors. Besides, Brand loyalty and trust could be strengthened by taking CSR initiatives. Furthermore, it is possible to lower the turnover rate of employees by improving their morale through CSR activities. Ultimately, CSR might play a vital role by supporting community development and environmental conservation which might help achieve business and societal goals.

2.7 Cutting Waste Management

Cutting Waste Cutting Waste Management is the management of waste reduction in the garments industry through effective & innovative methods by

which efficiency in cutting fabric could be improved through the proper utilization of the resources. This not only impacts the environment but also focuses on future sustainable practices through which a new process or approach could be showcased all over the garments world. To accomplish this profitable practice by improving marker efficiency, cutting waste must be minimized [14]. By reducing the empty spaces inside the marker, cutting waste can be reduced innovatively. Moreover, Government & regulatory bodies are getting strict about garment waste since this waste is becoming more harmful to the environment day by day. Some of the NGOs (Non- Government Organizations) are taking action to reduce these wastage & they are also trying to lessen the dumping of this wastage into the water or any other places. In present practices, most of industries sell the cutting waste which is leftovers after cutting of fabric in the local market which is not that much of cost-effective. Therefore, innovative techniques should be followed by the industries by not only focusing on profit but also looking at the environmental impact caused by these wastage. Brands, investors, or government could work simultaneously to promote a new way to manage the wastage of the garment sector, and therefore could create a great example for the upcoming future [15].

3. METHODOLOGY

3.1 Materials

The raw materials that have been used in this project are leftover fabrics from the textile manufacturing processes which is basically from the cutting waste from the cutting section. These leftover materials are generally unusable for the daily manufacturing processes. So, these materials could be used for the up-cycling of the materials & adding value to the products and thus could reduce waste. Moreover, it could be a great opportunity for reducing the cost of materials & might support economic efficiency through creative reuse of resources. Raw Materials for Mask: Fabric waste from the cutting department, Sewing threads Raw Materials for Mitten: Fabric waste from the cutting department, Sewing threads, Elastic.

Figure 1: Raw Materials (Fabric)

3.2 Method of Project

The following flow chart shows the method of the project.

Small pattern making(mask/mittens) in CAD software

↓

Newly created Small pattern optimization & combined with the previous pattern (trunk etc.)

↓

Marker Efficiency Increased.

↓

Marker(after being prepared) is then placed over the fabric in the Cutting section

↓

Fabrics are cut according to pattern design.

↓

Mask or Mittens' fabric collected.

↓

Collection of binding for the mask from fabric wastage.

↓

Mask or Mittens' fabric taken to the sewing section.

↓

Mask or Mittens' fabric stitched.

↓

Inspection

↓

Ironing

↓

Final product.

↓

Packing

↓

CSR / Selling to the market.

3.3 Design & Development

To make this project successful as discussed, initially, the created marker for the conventional garments production in the CAD software has to be observed to analyze the marker efficiency & how much

wastage of fabrics might occur from this marker. Usually, a significant number of fabrics are wasted here as 'cut pieces' or 'jhoot'. Then depending on this observed wastage that might come after cutting, new patterns such as masks /mittens might be designed in the CAD software which should be strategically placed in the previous pattern of conventional garment manufacturing. Once integrated the newly created pattern of masks or mittens, the marker efficiency increases since the length of the marker is fixed here. Therefore, these new patterns cover up the empty spaces of the original marker in CAD software. Then being prepared, subsequently the marker is placed over the layer of fabrics & cutting is done. After that, the fabrics of masks or mittens are segregated & taken to the sewing section for sewing or stitching. Eventually, the final products are completed & ready for further processes. This cost-effective systematic approach not only increases production efficiency but also streamlines fabric utilization & eventually reduces wastage which provides an environment-friendly approach to the garment industry.

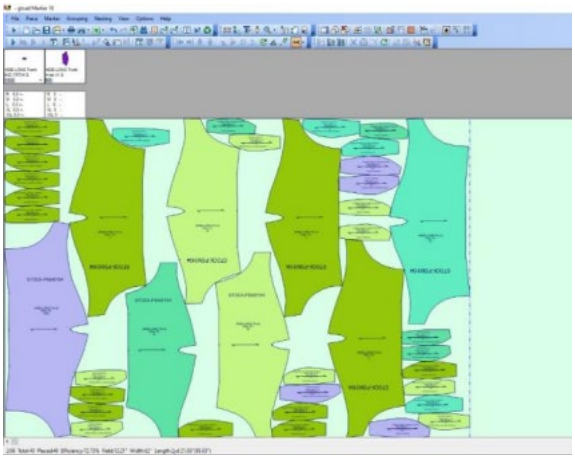

Figure 2: Previous marker of Trunk

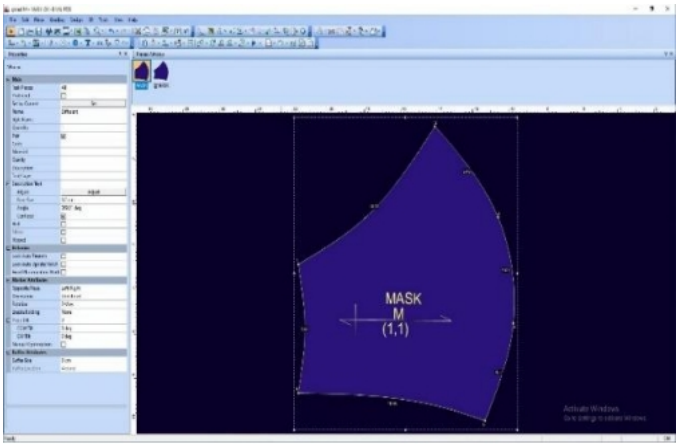

Figure 3: Pattern of Mask

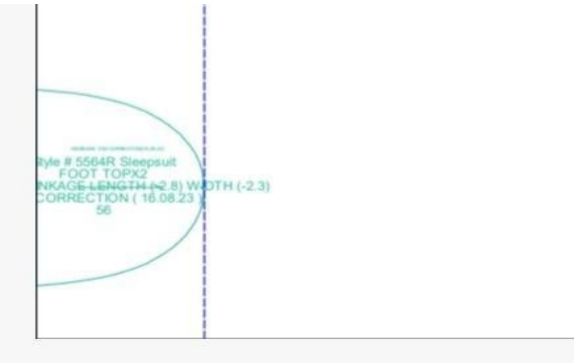

Figure 4: Pattern of Mitten

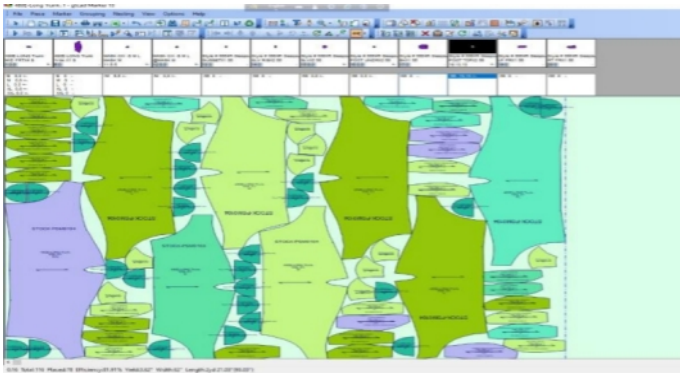

Figure 5: Newly Created Pattern of Trunk (Added Mask & Mittens pattern)

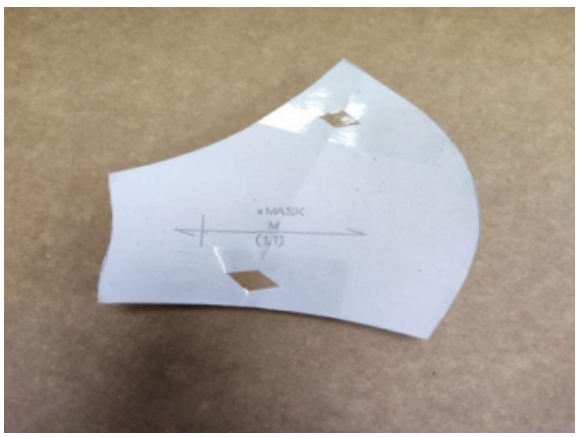

Figure 6: Pattern of mask

Figure 7: Collection of Fabric (Mask) after cutting

Figure 8: Final Product (Mask)

Figure 9: Final Product (Mitten)

Figure 10: Handkerchief

Figure 11: Decorative item(Bow)

** Other items that can be made : Handkerchief, decorative items (bow), Scrunchies, bodysuit of children etc.

4. RESULTS AND DISCUSSION

4.1 Marker efficiency and Wastage percentage

Here marker efficiency and fabric wastage were measured before and after utilizing the empty spaces in the marker plan with fashionable items like masks, mittens etc. Then calculated the cutting room waste that converted to the useable product with monetary value in Bangladeshi currency.

Table 1: Marker Efficiency Before and After Utilizing Empty Space

Empty Space Status	Marker Efficiency
Previous efficiency (Before using empty space in marker)	72.73%
Previous wastage (Before using empty space in marker)	27.27%
New efficiency (After utilizing empty space in marker)	81.91%
New wastage (After utilizing empty space in marker)	18.09%

Cutting ply's each layer's length = 2yds 21.03″ = (2*36) +21.03″ = 93.03″ = 94″

112″ length's weight = 810 gm 93.03″ length's weight = (810*93.03)/112 = 672.806 gm = 0.672806 kg

Each layer's weight = 0.672806 kg 82 layer's weights = (0.672806*82) kg = 55.17 kg

New wastage weight = 55.17*18.09% = 15.044kg

Previous wastage weight = 55.17*27.27% = 15.044kg

Saved fabric weight of wastage = 15.044-9.98 kg = 5.064 kg

In the factory generally, 1 kg of wastage sold by = 7 taka

So, Previous wastage 15.044kg sold by = (15.044*7) taka = 105.308 taka

As, New wastage weight 9.98kg New wastage 9.98kg sold by = 9.98*7 taka = 69.86 taka Saved fabric weight of wastage = 5.064 kg

Meaning, Garments (new) made by utilizing weight = 5.064 kg

** (Value of number of lays=82, lay length=112 and weight of each lay 810, price etc. received from cutting room)

4.1.1 Quantity of Garments Made

The following table shows the number of masks and mittens made from one layer of fabric and the total available 82 layers from the cutting room.

Table 2: Quantity of Garments Made

Items made from 1 layer fabric	Quantity
Mask pattern in 1 layer	12
Mitten pattern in 1 layer	24
Mask made from 1 layer	3 pcs
Mitten made from 1 layer	12 pcs
Mitten made from 1 layer	12 pcs

Masks made from 82 layers = 82*3 = 246 pcs

Mittens made from 82 layers = 82*12 = 984 pcs

4.1.2 Cost of Making

The table shows of raw materials used for making mask and mitten.

Table 3: Cost of Materials

Process or Elements	For Mask (taka)	For Mitten (taka)	Remarks
Sewing thread	0.75	1	
Elastic	-	1	No elastic used for mask
Cutting Cost	0.5	0.25	
Indirect Cost	0.125	0.125	
Direct Cost	0.125	0.125	
Other Costs	0.5	0.5	
Total Cost of Making of each Garments	2.0 taka	3.0 taka	

4.1.3 Making cost

The table shows total manufacturing cost of mask and mitten.

Table 4: Cost of Making

Garments name	Pieces	Cost of Making (Each pc)	Total Making Cost of All produced Garments
Mask	246 pcs	2 taka	492 taka
Mitten	984 pcs	3 taka	2952 taka

4.1.4 Selling Price

Table shows the selling price of the products.

Table 5: Selling Price

Garments name	Pieces	Selling Price (each pc)	Total Making Cost of All produced Garments
Mask	246 pcs	10 taka	2460 taka
Mitten	984 pcs	12 taka	11808 taka

4.1.5 Profit Calculation

Table 6: Profit Calculation

Garments name	Profit
Mask	2460-492 = 1968 taka
Mitten	11808- 2952 = 8856 taka

Here, Garments (new) made by utilizing weight = 5.064 kg Total profit from utilized portion = 1968+8856 taka = 10824 taka

And profit from new wastage of 9.98kg = 69.86 taka

Total profit from new efficiency (81.91%) = 10824+69.86 taka = 10893.86 taka

We have, Previous profit from previous efficiency (72.73%) = 105.308 taka

So, we can see that there is almost 100 times more profit achieved from this project than selling garments wastage as a jhoot in RMG industries.

4.2 Quantitative data on garments wastage of RMG Industries

- Up to 100 billion garments and fashion items are produced by the fashion industry each year.
- Every year, about 92 million tons of clothing ends up in landfills.
- Only 20% of textile waste are collected for reuse or recycling purpose globally.
- Nearly 60% of all clothing material is actually plastic. Nylon, acrylic, and polyester textiles are just a few examples of these synthetic fibers that have become so ubiquitous in our wardrobes.
- Textile production generates 42 million tons of plastic waste per year, making the textile industry the second-highest industrial sector after packaging.
- Every time a synthetic garment is washed, it releases tiny plastic microfibers into the water.

Up to 500,000 tons of microfibers end up in the ocean every year.

- Textiles and fashion waste account for 9% of annual micro plastic pollution added to our oceans.
  - 51% Post-Consumer Waste
  - 42% Pre-Consumer Waste
  - 7% Imported Waste

5. RESULT OF THE PROJECT

- **Cost-Benefit:** Comparing the costs associated with traditional waste disposal methods versus the costs of up-cycling fabric into reusable garments and considering aspects such as labor, materials, and potential market value of the up-cycled products we could say this project is notable.
- **Waste Reduction:** The project significantly lowered waste produced during garment cutting, thereby fostering sustainability within the fashion industry.
- **Environmental Impact:** This initiative has made great strides in diverting waste from landfills, thus decreasing its carbon footprint. Moreover, reduces the potential losses from unused materials.
- **Economic Viability:** The project demonstrated that up-cycling can be a practical and sustainable business model.
- **Creative Advancement:** The up-cycled products featured a clever blend of innovative design and artistic elements.
- **Company CSR:** The Garment industry can also offer the by-product to their customers, they can also use these items as CSR purposes.

5.4 Discussion and Findings

The project played a significant role in promoting sustainability in fashion, minimizing waste, ensuring economic feasibility, increasing consumer awareness, lowering costs, and providing encouraging future pathways for up-cycling in the industry. Additionally, it held potential social and policy ramifications.

Table 7: Details Information about Fabric Waste in Cutting Section of Factory A.

Cloths Items	Order Quantity (Pcs)	Fabrics Required (yards)	Quantity of Wastage (yards)	Quantity of Wastage (percentage)
Soliel Skirt	18000	18850	230	1.22%
Basic Skirt	32000	11020	47.5	0.43%
Girl's Top	25000	52450	630	1.26%
Long Shirt	12000	25092	520	2.06%
Long Pant	16000	41675	1050	2.52%

Table 8: Details Information about Fabric Waste in Sewing Section of Factory A

Cloths Items	Order Quantity (Pcs)	Fabrics Required (yards)	Quantity of Wastage (yards)	Quantity of Wastage (percentage)
Soliel Skirt	18000	18850	140	0.75%
Basic Skirt	32000	11020	112.2	1.02%
Girl's Top	25000	52450	260	0.52%
Long Shirt	12000	25092	188	0.74%
Long Pant	16000	41675	125	0.20%

6. CONCLUSSION

Primary outcomes & Implications of the Project

This project represents an effective solution or helps us to find a new way to reduce garment waste in the supply chain of garment manufacturing through transforming garment cutting & sewing waste into useful & fashionable items. Also, this project highlights re-purposing the leftover garments into decorative items by lessening the waste & selling them at higher prices to the global market compared to the 'cut piece' & 'jhoot' prices. Through this project, our findings are that we could not only enhance profit in the garments industry but also show a new approach to reduce garment waste by making profitable fashionable items that add value to the economy. Also, CSR activities could be fulfilled by succession of this project which might improve brand images & increase trust issues among stakeholders & investors through enhancing employee morale.

Limitations of this project:

- Sometimes it's difficult to secure sufficient supply of cutting waste which might impact the scaling up of this project.
- It might incur additional costs related to the man, machine, or material.
- Also, additional utility cost including energy, heat, and water is required which might increase industries' costs.
- It might require a significant amount of time alongside the conventional garments bulk production.
- Not recommended for industries that are unable to meet usual lead times.
- Continuous production of the products from the leftover garments might not happen all the time due to the huge workload in the industry.

Future Recommendations:

- If all industries open up a new small up-cycling unit within their factories to produce the up-cycled products from the leftover garments, they might find a better way to increase their revenue & minimize costs.
- Cost of making the up-cycled products should be minimized as much as possible in to get better profitability.

REFERENCES

[1] Mestre, A., & Cooper, T. (2017). Circular product design. A multiple loops life cycle design approach for the circular economy. *The Design Journal,* 20(sup1), S1620–S1635. https://doi.org/10.1080/14606925.2017.1352686

[2] Rahman, M. A., Bhuiyan, M. A. R., Ali, A., Hossain, F., & Khan, A. N. (2023). Recycling of cotton apparel waste and its utilization as a thermal insulation layer in high-performance clothing. Fashion and Textiles, 10(1), 22. https://doi.org/10.1186/s40691-023-00342-y

[3] Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., & Gwilt, A. (2020). The environmental price of fast fashion. Nature Reviews Earth & Environment, 1, 189-200. https://doi.org/10.1038/s43017-020-0039-9

[4] Rasel, M. S., Islam, M., Al Mamun, M. A., Rayyaan, R., Sowrov, K., Islam, S., & Sayem, A. S. M. (2025). Fashion and textile waste management in the circular economy: A systematic review. *Cleaner Waste Systems***,** 11(3), 100268. https://doi.org/10.1016/j.clwas.2025.100268

[5] Islam, M., Shamsuzzaman, M., Hasan, H. M. R. U., & Atik, M. A. R. (2025). Environmental sustainability of fashion products made from postconsumer waste: Impact across the life cycle. Sustainability, 17(5), 1917. https://doi.org/10.3390/su17051917

[6] Moorhouse, L., Moorhouse, G. (2021). Designing for circular fashion: Integrating upcycling into conventional garment manufacturing processes. Fashion and Textiles, 8(1), Article 21. https://doi.org/10.1186/s40691-021-00262-9

[7] Zaman, A. U. (2014). A comprehensive review of the development of zero waste management: Lessons learned and guidelines. Journal of Cleaner Production, 91, 12–25. https://doi.org/10.1016/j.jclepro.2014.12.013

[8] Ali, H., & Kumar, A. (2017). Marker making in garment industry: Techniques and waste management. Journal of Textile and Apparel, Technology and Management, 10(3), 1–10.

[9] Sandin, G., & Peters, G. M. (2018). Environmental impact of textile reuse and recycling-A review. Journal of Cleaner Production, 184, 353–365. https://doi.org/10.1016/j.jclepro.2018.02.266

[10] Uddin, M. R., & Khan, M. A. (2021). Waste management in garment production: A case study of cut-

ting room waste in Bangladesh. Waste Management & Research, 39(5), 693–702.

[11] Niinimäki, K. (2020). Sustainable fashion in a circular economy. In K. Niinimäki (Ed.), Fashion and sustainability: Design for change (pp. 123–141). Laurence King Publishing.

[12] Hasan, M., & Rahman, M. (2019). Marker making optimization to reduce fabric wastage in garment industries of Bangladesh. International Journal of Fashion Design, Technology and Education, 12(4), 431–439.

[13] Carroll, A. B. (1999). Corporate social responsibility: Evolution of a definitional construct. Business & Society, 38(3), 268–295. https://doi.org/10.1177/000765039903800303

[14] Khan, M. R., & Rahman, M. M. (2021). Cutting waste management practices in the garment industry: Enhancing marker efficiency for sustainability. International Journal of Textile Science, 10(2), 45–53.

[15] Porter, M. E., & Kramer, M. R. (2006). Strategy and society: The link between competitive advantage and corporate social responsibility. Harvard Business Review, 84(12), 78–92.

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