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4R Technique (Reduce, Reuse, Recycle, And Recover) As A Preventive Measure Towards Waste Minimization In The Garment Industry

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Abstract

The purpose of this research is to study the waste minimization practices in the garment sector and evaluate the efficiency of the 4R concept approaches (Reduce, Reuse, Recycle, and Recovery) in reducing waste. A quantitative research technique was used, with a questionnaire prepared based on a study of the literature and random systematic sampling. The study targeted the population of garment industry companies in the Rajasthan area, with a sample of four types of garment projects from a class A company: high-rise garment manufacturing projects, garment manufacturing plant projects, clothing company projects, and garment complex housing projects.Data analysis was performed using SPSS (Statistical Package for the Social Sciences), which included a reliability test to examine the instrument reliability of the questionnaire. The study assessed the instrument's dependability and investigated the link between the 4R concept procedures and waste generated on industries. In addition, the study looked at how the 4R concept methodologies were used differently in the clothing business.According to the data, waste reduction was the most widely used 4R concept practice in the local clothing sector. The survey also discovered that trash recovery was not widely done due to a lack of responder engagement. Furthermore, no significant connections were found between waste reduction, reuse, and recycling approaches and on-site trash.The study sheds light on waste management techniques in the garment sector and emphasizes the need of developing efficient waste reduction measures. The study adds to current information by identifying the most often used 4R concept approach and evaluating its efficacy in waste reduction. The findings can help the industry build long-term waste management plans and promote a greener, more environmentally conscious apparel industry.

Keywords: Reduce, Reuse, Recycle, Recover, Garment Industry, Waste management

INTRODUCTION

The accumulation of waste has a causal connection to human progress on both the social and technological levels. Procedures for the management of waste may be different in industrialized nations and in developing countries, as well as in urban and rural areas and among commercial and home producers. This action is being taken in order to mitigate the negative impact that litter has on both the natural world and human civilization.It is possible to protect the environment in a number of different ways, including making use of cutting-edge technology to cut down on trash generation, properly treating effluent to ensure that discharge conforms with standards, and recycling rubbish many times before finally throwing it away (Staicu, 2019). Textile manufacturers utilize a wide number of procedures that result in the production of waste. A portion of these tasks incorporate washing and drying, twist readiness, winding around, kicking the bucket, printing, getting done, quality and cycle control, and warehousing. Most of the waste that is produced by this business is contained strands. These incorporate offcuts, bundling, spools, and creals notwithstanding squanders from delicate fiber, squanders from yarn turning (hard fiber), squanders from radiating, and off-cuts (Balasubramanian, 2018).

1.1. Global Scenario

Urbanization and industrialization are on the rise worldwide. Due to garbage accumulations, poor air quality, contaminated water, acid rain, global warming, and other environmental issues, the environment has been severely harmed by all of this growth and development. Land, water, air, and noise pollution are all examples of such problems. Massive amounts of plastic trash are dumped, decreasing the probability of rain.Animals and people both get infectious and chronic ailments as a result of incorrect waste disposal. Human beings produce 1.3 billion tonnes of rubbish annually, enough to cover the entire planet (Rajabinejad et. al., 2019). It is anticipated that by 2025, the population would reach 2.2 billion due to the present fast urbanization and population growth. By 2050, it is anticipated that the globe would produce 27 billion tonnes of trash annually, with the two largest economies, China and India, driving much of the expansion in Asia. In the next decade, people everywhere will generate an extra 0.28 kg of trash each year, bringing the worldwide average up to 1.42 kg. Up to 1 million tonnes of garbage are produced daily in Asia. The

majority of nations' dumping grounds, including those in the US, Japan, the UK, the Netherlands, etc. (Arana et. al., 2020)

1.2. Waste Concept

Raw resources are considered waste when they are purchased but never transformed into a final product. It is an undesired item or material that, depending on the kind, may also be referred to as trash, waste, or junk (Pandey et. al., 2020).The following easy-to-understand production flow diagram (Figure-1) might be used to explain waste. Many companies in the ready-to-wear sector view waste as a typical business expense.

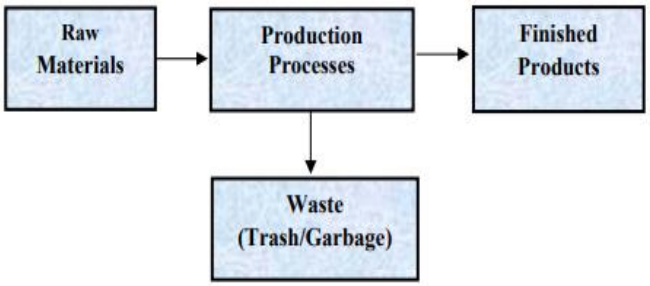

Figure-1: Manufacturing Process Flowchart

1.3. Different Phases of Waste in The Clothing Industry

The phases of waste as seen from the perspective of the ready-made clothing sector.

It is crucial to inspect the arriving cloth at the fabric store. The proper location for receiving or distributing fabric for manufacture is a fabric storage. The cloth that is brought into the storehouse from the outside should be examined for flaws.

The cutting room's waste

Waste can happen in the cutting room from a variety of causes, including the misuse of markers, cutting waste, excess rolls, etc.

Bundling Space

Since not every component is inspected thoroughly, some faulty ones pass inspection and go to the manufacturing stage. Production Floor the bundles that move down the line in accordance with the operation are put into the lines by the loaders. The item may be found to be faulty at any time by the operator, who will only discard it then.

Washing, Printing or Embroidery

The pieces either become lost or misplaced while being transported for washing, dying, printing, or embroidery, which results in waste (Kazancoglu et. al., 2020). While the embroidery may not be on the garment in the proper location or may not utilize enough threads to get the intended appearance, the printing on the clothing does not adhere to standards.

Finishing

This might involve pressing, cuts, or measurement/fit issues.

The many stages of waste, particularly during production, might be summarized as follows (Table 1):

Table 1: Different phases of manufacturing waste

Sample Production	• Mistakes in design communication. • Craftmanship problems.
Cutting Floor	• Wrong color of shades • Fabric Faults
Sewing	• Problems in sewing machines.
Outsourcing	• Printing, dyeing, embroidery.
Final Inspection	• Finishing/Ironing problems, measurement faults, size mistakes etc.

1.4. Waste Minimization

Garbage reduction is the practice of avoiding garbage from arising in the first place rather than treating it using end-of-pipe treatment techniques. It is a method that may be used to analyze all of a process's inputs and outputs (Correia et. al., 2018) Trash reduction strives to stop trash from being created and minimize its quantity and toxicity, to the Environmentally Responsible Policymaking Guide. First and foremost is prevention, next comes recycling, then treatment, and finally, safe disposal. Reducing waste at source technically and systematically is what is meant by waste reduction, which implies:

preventing waste from being created and reducing it;
efficient packing and raw material usage;
saving money by conserving resources like water and gas;
raising the standard of trash in order to facilitate recycling;
encouraging people to recycle, reuse materials, and reclaim waste.

Waste reduction or avoidance is more crucial than waste treatment since it offers the following advantages: waste production is decreased; Consumption of raw materials and associated expenses are decreased; Costs of waste treatment are decreased; Process effectiveness is raised; Employee productivity is increased (Murad et. al., 2018).

LITERATURE REVIEW

V. Jacometti (2019)-Headed straight toward supportability and the round economy, the style area should assume a huge part. Indeed, the fashion industry faces the natural impact of microplastics due to its extensive and multifaceted production network related to high water and energy consumption, material consumption, air and water pollution, waste and ultimately assembly. is taken seriously. Waste in the materials and clothing industries in particular is a major global problem. With this in mind, the motivation behind this document is to consider the ongoing EU policies affecting the development of defensible practices in the area of style and the transition to a roundabout economy to the latest of the EU waste regulation. The roundabout was adopted in the Economic Action Plan in 2015.

Rathinamoorthy(2018) studies cutting fabric lowers the cost of producing clothing. The amount of production and waste fabric is decided at the cutting section. Half of the cost of a garment is the fabric. This study looks at the financial advantages of producing clothing fabric from scraps. The development of organic materials aids in the greening of the apparel and fashion industries. In this study, used cloth is recycled into fibers. The objective is to use recycled fabrics, yarn, and fiber to make new garments. It was gathered in order to recycle knitted garments and decrease waste. Good dimensional stability, bursting strength, pilling, and abrasion resistance were all characteristics of the fabrics. Cost-effective studies of casual apparel made from the materials were conducted. Clothes created from recycled fibers were less expensive than those made from ordinary raw materials. Additionally, it enables businesses to manage waste and profit from it.

Esra and Kipöz (2019)- The typical fashion business has a linear production process that results in "pre-consumption waste," which has a terrible effect on the environment. The "Cut-and-sew waste" form of pre-consumption waste that develops during the pattern cutting stage of the design creation process is the subject of this study. The purpose of this research is to assess the magnitude of the cut-and-sew waste problem in the Turkish fashion industry and to provide strategies for reducing this type of trash. The research tackles "cut-and-sew waste" by examining the possibilities for and constraints associated with the development of a sustainable design and manufacturing system to enhance waste management. This investigation of Turkey's fashion industry focuses on this issue. A survey of women's clothing producers in the Turkish fashion industry who have their own brands was done as part of the study. The severity of the cut-and-sew waste issue was determined by 84 garment manufacturers who replied to a semi-structured questionnaire, and several waste management techniques are suggested. Data on manufacturing techniques were gathered, exposing waste rates in the run-up to the 2016 spring/summer collection. The results highlight the waste problem's current situation, the fashion industry's level of knowledge of waste's consequences on the environment, and the demand for waste management techniques.

A. Pires, G. Martinho& Others(2019)-The waste management plan for a Sri Lankan garment sector Green Production Facility is investigated in this study. This study looks at waste management tactics and how they strive to satisfy sustainability goals and KPIs for Green Production Facilities. This study will close the gap in Sri Lankan waste management practices used by eco-friendly clothing manufacturers. Sustainable management practices are in great demand because to the expectations of international garment buyers, yet Sri Lanka has few suppliers that can match this demand. For our research, we selected Brandix Eco Center, a worldwide apparel retailer based in Sri Lanka. A technique of explanation would be used in this study to explore the objectives. Observations and information indicate that Brandix Eco Centre's production line measures trash and decreases it using a variety of waste management techniques.

2.1. Objectives of the Study

To evaluate the success of 4R concept techniques (reduce, reuse, recycle, and recovery) in the textile industry in reducing waste

To investigate the application and execution of the 4R concept approaches in various garment projects, such as garment production in high-rise buildings, garment manufacturing facilities, clothing enterprises, and garment complex housing.

To ascertain the link between the use of the 4R concept methodologies and the quantity of waste generated in the clothing sector

To identify and assess the most often employed 4R concept approach in the local clothing sector in terms of waste reduction

2.2. Hypothesis of the Study

H1: The 4R concept strategies (Reduce, Reuse, Recycle, and Recovery) have a strong association with waste created in the textile business.

H2: In the local clothing sector, waste reduction is the most widely employed 4R concept approach.

H3: There are considerable variances in the adoption of the 4R concept procedures (Reduce, Reuse, Recycle) in the clothing industry.

3. RESEARCH METHODOLOGY

Based on the results of this study, we validated our speculation using quantitative techniques. To plan a survey, the scientist alluded to the writing audit to correspond the factors which are factual. Quantitative assessment was used in the polls to acquire the result of the exploration. The discoveries from this examination are assessed and dissected involving the Factual Bundles for The Sociology (SPSS) programming.

The entire garment industry in Rajasthan is a research group. The researcher takes four types of Garment project from an A class company which is: (i) garment manufacturing project in a Highrise, (ii) Project for a garment manufacturing plant, (iii) project for a clothing company and, (iv) garment complex housing project. These initiatives were chosen because to their importance and influence on the apparel sector. The examples were picked in light of their obligation and work in the Piece of clothing Industry. Arbitrary deliberate examining is utilized in this examination. This basic irregular testing technique guarantees that each unit in the populace will get a similar likelihood of being picked as an example and each subject picked is free and not reliant upon other picked subjects.

This exploration is finished in the Rajasthan region where a class an organization will be picked. Class An Organizations are picked on the grounds that they generally foster undertakings with cost above RM 1 million. This is fundamental since they have the capacity and can stand to apply a more orderly waste administration framework.

4. DATA ANALYSIS

4.1. Reliability Test

The reliability test's objective is to demonstrate the instrument's dependability. The indication used to judge whether or not an instrument is dependable is its Cronbach's Alpha value. Table 2 shows the Cronbach alpha values for each item in the test, demonstrating their reliability. For an instrument to be considered reliable, the Cronbach alpha value must be greater than 0.60, and the table value 0.923 is greater than 0.60.

Table 2: Reliability of Instruments

Cronbach’s Alpha	Number of Items
0.923	165

While the Cronbach's Alpha value indicates a dependable value, this does not necessarily imply that the value is very reliable. We shall put each component of the device through testing to ascertain its dependability. Table 3 displays the outcome.

Table 3: Reliability Test

Item	Cronbach’s Alpha	Number of Item
Reducing	0.936	1
Reuse	0.852	0.62
Recycle	0.822	0.68
Recovery	0.173	0.79

Table 3 shows that, with the exception of recovery, all the elements provided a trustworthy value. Because no one responded to the question on trash recovery in the local Garment Company, item recovery was assigned a value of = 0.173.
The researcher then looked at the many kinds of initiatives that are involved in this research. Figure 1 depicts the analysis's findings.

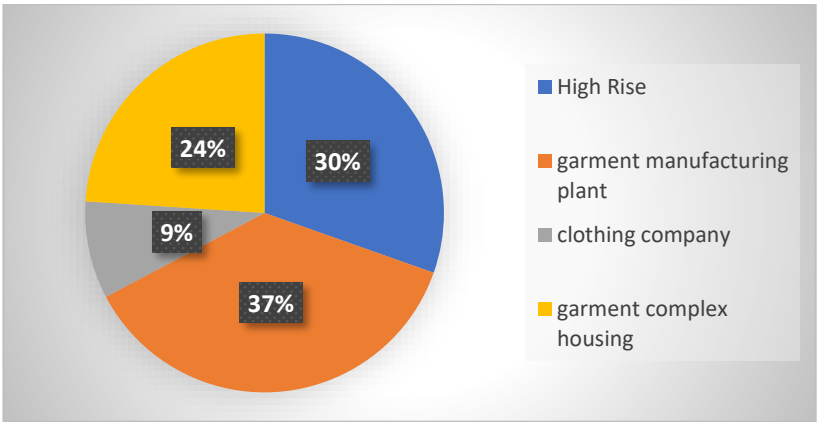

Fig.2. Majority of Respondent

The table lists the number of garment projects in several categories, such as High Rise, Clothing Company, Garment Manufacturing Plant, and Housing for Garment Complexes. While Garment production Plant projects concentrate on stand-alone production facilities, High Rise projects employ vertical integration in high-rise structures. Projects for the clothing industry include activities like increasing production capacity, establishing new facilities, or optimizing current manufacturing procedures. Projects involving residential complexes with integrated garment-related amenities or spaces for garment industry workers are known as "garment complex housing." The distribution of projects within the various categories sheds light on the different clothing initiatives' focus areas and kinds within the given environment.

4.2. Reduce, Reuse, Recycle and Recovery Technique

Usage Evaluation The most popular 4R' idea strategies are examined in this section. The outcome is presented in Table

Table 4: Ranking of 4R' Concept Techniques

4 R' Concept	Mean	Std. Deviation
Reduce	2.846	0.6822
Reuse	2.387	0.6623
Recycle	2.265	0.7826
Recovery	1.000	0.0000

The results of this analysis have been ranked according to their mean. According to Table 4, the local clothing industry's most widely used 4R' concept technique is waste reduction. The provided mean value is 2.84. The waste reuse strategy, which produced a mean value of 2.38, was the second most popular technique used. The garbage recycling strategy comes in third with a mean score of 2.26. The waste recovery approach, which had the least use, produced a mean value of 1.00.

4.3. 4R Techniques in Relation to Waste Manufacture in Industry

The correlation approach is a tool used in this study to examine the data. To assess the relationship between variables, one uses correlation. The purpose of this investigation is to ascertain how local garment businesses are affected by the 4R concept and waste products. The outcome will be decided by the significant 2-tailed value. The outcome is depicted in Table 5.

Table 5: Waste Produce and the Three R's

	Value	Reduce	Reuse	Recycle
Waste Produced	Pearson	0.03	-0.1	-0.1
	Correlation	1	35	9
	Significant	0.74	0.48	0.26
	Value (2-tailed)	0	6	8

According to table 5, The site'swasteproduction and the waste reduction plan appear to be unrelated. because it is the value of sig. = 0.85 in H01 is greater than threshold 0.05, we accept this hypothesis. The study's null hypothesis assumes that waste generation and reduction rates are unrelated. The two variables' association is consistent, as indicated by the pearson correlation value of 0.035.
Furthermore, there is no discernible connection between the trash produced on site and the waste reuse technology. This is because the significance level at which H02 is accepted, sig. = 0.48, is more than the traditionally recognized threshold of 0.05. The null hypothesis of this investigation is that recycling and landfill trash have no significant relationship. There is no need to address this because the Pearson Correlation value is negative. In addition, there is no discernible connection between the garbage produced on site and the waste recycling method. Because the value of sig. = 0.26 for H03 is greater than the threshold value of 0.05, it is allowed. The H03 for this study is that there is no meaningful correlation between recycled garbage and on-site waste production. There is no need to talk about this because the Pearson Correlation value is negative. Since many respondents did not respond to this item, H04, it states that there is no significant link between waste reduction and the unavailability of waste generated on-industry, could not be determined for the waste recovery approach.

4.4. Comparative Study of the 4R' Method's Distinctions for Use in the Apparel Industry

Table 6 shows that the waste-reduction and reuse methods do not differ much from the other methods used in the 4R approach. This is so because the value of significance is greater than 0.05.

Table 6: Different 4R Concept Methods

	Technique	Sum of Squares	Mean Square	Significant Value
Reduction	Between Groups	2.663	0.367	0.473
	Within Groups	16.26	0.482	
	Total	17.57		
Reuse	Between Groups	1.935	0.372	0.461
	Within Groups	10.57	0.361	
	Total	12.56		
Recycle	Between Groups	5.952	0.954	0.052
	Within Groups	12.25	0.417	
	Total	18.56		

The trash recycling approach differs significantly from the other 4R concept strategies in other important ways as well. This is so because Sig. = 0.052 and = 0.05 have the same significant value. Additionally, since many respondents did not complete the waste recovery strategy questionnaire, there are no results.

5. CONCLUSION

Waste reduction has been recognized as the 4R strategy that is most frequently applied. This suggests that our local clothing makers' waste management system planning and implementation are still poor. Many problems still need to be overcome, including the requirement for precise and pertinent rules and regulations. To make this work, police enforcement need take a more proactive approach to their duties.
Waste reduction, waste reuse, and waste recycling did not show any conclusive associations with the trash generated on site. Although in theory they ought to provide associations of any kind, whether favorable or unfavorable, it appears that there are none in the Rajasthan region. The researcher deduced from this finding that the 4R idea is still not being utilized to the fullest degree possible. This can be the result of increased costs for waste management components that prevented them from establishing a more formal, useful, and effective waste management system. The local Rajasthan economy was also affected by the economic slump, and as a result, parties employ any inexpensive means of rubbish disposal to reduce costs.
Waste recycling differs from the other three options. This suggests that local Rajasthan practitioners always chose the most profitable and beneficial method. Waste reduction might be viewed as conceptual since it necessitates extensive preparation throughout the project's many stages. As can be seen, intact materials can still be utilized for various reasons up until they are completely ruined, whereas waste reuse is the prevalent method of material handling.
For the industry to develop a waste minimization method that is more effective and efficient, there are still a lot of problems that need to be solved. The most difficult issues to address are likely to be those involving attitude and culture since it is simple to modify laws and regulations but difficult to alter how people behave and think. Furthermore, it is challenging to influence people's opinions on environmental concerns because of how interconnected and intricate the clothing business.

5.1. Recommendations

Recycling worn clothes has no local environmental aims. Such a goal would motivate project supporters to recycle and ultimately cut down on clothing waste. Through legislative actions, regulators should enact policy declarations on environmental goals. Additionally, the majority of the laws that govern the clothing industry's waste management. To enhance its environmental performance, the apparel sector has to boost its self-regulation. Plans for reducing unfavorable environmental effects should be in place for all forms of development. Particularly for parties to comply with permissible levels for a safe environment and to save long-term expenses, this strategy will be helpful. By implementing suitable programs to strengthen self-regulation, the environmental performance of the apparel sector should be improved.

The expense of establishing effective waste management procedures has not yet been included into the project's overall cost. To internalize waste management costs, guidelines should be established to determine appropriate and accurate funding allocations for each aspect of the environmental management plan.

Parties and developers are not aware of the connection between their professional activity and their environmental effects. Many firms don't realize that good environmental policies don't hurt profits or contract performance. Developers and parties need to know how their work impacts the environment and how to mitigate it.

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