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An Analysis of Green Operations Management by Integrated Fuzzy Six Sigma Model in the Textile Industry

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Abstract:- **The companies have changed their point of view as the changing environment and climate change conditions towards the textile industry practices to achieve consistency in the growth of the products. By practicing environmental change towards the textile industry management, it has been observed to intellect with the operational efficiency and the consistency in growth of the textile industry to enhance simultaneously. However, green operational management has involved the design of green, manufacturing of green management, logistics of green and how much purchase initiatives of green in the textile industry towards sustainable growth. This study aims to evaluate the operational management of green by using the Fuzzy AHP approach and implementing the DMIAC approach to eliminate the effects of the operation management of green towards the textile industry. The finding results show the justification to opt the operation management of green practices. A fuzzy analytical process in the hierarchy and DMAIC structure model has been used to estimate and eliminate the implementation of operational management of green towards the textile industry. However, it can also with the desirability index for the practices of operation management of green globally and compare with the prospects of the desirability index with the reliability aspects of operation management of green in the textile industry. The purpose of this study has been generalizing. It has been utilized by the managers involved in the operation management of green to evaluate the design and implementation using the Fuzzy AHP and DMAIC tools for problem-solving in green operations. This study would be considered with the conclusion of harnessing consistent profits in the operation management of green towards the textile industry without influencing environmental growth.**

Keywords:- *Climate Change, Textile Industry Management, Green Operational Management, Fuzzy AHP Approach, DMIAC Approach, Desirability Index, Harness Consistency Profits.*

I. INTRODUCTION

Operations management has been an essential tool in managing the businesses in a particular region, such as redesigning the products, producing new ideas, and controlling to maintain the yield of better productivity services from the sources. In designing a management product, the design department has considered the implication of changing the product design after planning and establishment. Managers in the textile industry also consider the procedure of planning, schedule mastering, and the ability how to plan. Operations management planning has been considered with the processes of planning that would be needed to produce the best product for consistent growth towards the environment.

However, the operation management in green has been considered similar to the operation management of convention. Still, its purpose is to achieve consistency in its products and eliminate the environmental harm it causes. Therefore, the operation management of green includes the region, such as the design of green, logistics of green, production of green, and how to evaluate a better product in green. The innovation of planning design in green has been demonstrated to emphasize using environmentally-friendly materials to recycle or redesign

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products from each side. Producing green has been considered to renovate manufacturing that has been accessing the better enterprises of friendly operations in environments. Logistics in green strives to eliminate the green management effect on the environment during planning and fulfill all the needs and requirements of customers. Purchasing green is preferable for the environment, which has helped reduce waste.

Recently, the more external aspects of an integrated approach, including the application of management of operation green towards the environment principles that have been supplying chain management addressed in the consistent growth. The main implication of the green operation practices is that it will assist a Manufacturing Industry like AR Textile, which could create more business opportunities regardless of the competitors they could address in the environmental issues to resolve successfully. Tsai (2018) revealed the effectiveness of green operation management in textile industry enterprises. Javaid et al. (2021) revealed that using environmentally friendly raw materials enhances materials that green manufacturing procedure has been addressing issues like environmental material substitution and waste elimination and declining the combustion of harmful toxic materials.

Liu et al. (2020) suggest a mixture of fuzzy AHP dealing with decision-making problems through uncertain conditions and the multiple aspects of environmental choice. Another study is considered by Mohammed et al. (2019), who revealed that the Fuzzy AHP connected with the AHP set theory, and it could not capture the logical concepts of human beings. Still, it could also focus on the relevant essentials to evaluate the significance of operational management of green towards Mason safety. Regarding the health and environmental aspects, the study of Aliyev et al. (2020) revealed the finding results showed better performance strategies in different aspects to develop the operation management of green. It is assumed to be made in the Fuzzy AHP approach has been demonstrated to involve independently.

Sadik and Masood (2022) revealed that the Six Sigma approach is a last relay on the crucial intelligence that the information has been driven to organize, focusing on the customer's experience. The study procedure has been integrated to make measurable tools as frequent as possible. Additionally, Six Sigma's practical implication has been accessing their employees' essential duties. With the overall change in a methodical DMIAC technique to handle all the problem-solving methods, i.e. it could involve defining, measuring, analyzing, improving and controlling. Six Sigma has been considered with the notion of strategic and a ratio, a goal set, an image and methods (Lim et al., 2020). Six Sigma has been helping corporations to address and eliminate errors regardless of depends on the end-procedure testing that could raise operation management in the green towards consistency. A couple of lean six sigma combined high quality with everyday processes in the textile businesses.

The goals are streamlined through Six Sigma. Lean Six Sigma makes it possible to visualize your processes. Lean Six Sigma coordinates information in your general environment by bringing it from a computer screen. Six Sigma provides the framework to enhance every aspect of your business. It offers a structured approach to critical thinking, encouraging less arbitrary decisions and leading to more excellent and trustworthy outcomes. Six Sigma has been accessing with the capability to the ability of life insights associations. It is also motivated to implement experimentation and has complex result findings.

II. LITERATURE REVIEW

The textile industry has been involved in the materials, infrastructure, personnel and investment, which would access operation planning procedures and influences all over the management stages. Enhancing productivity by effective and efficient management of the procedure and plants. In contrast, the conventional operation in green management has been determined with a required field of management, and it could also keep the size of the countries and get resources as much faster than the others. Although the conventional operation would be converted to the operation management of green and its access with the sustainable growth of planning by using the resources to fulfil the present customers' demands and desire to keep for future generations (Esmaeilian et al., 2020).

➢ *Operation Management of Green Performances*

Numerous studies have been evaluating the factors that were linked with the evaluation of operation management of green in various settings. Additionally, the evaluation of green initiates has been demonstrated with task complexity, which has yet to be considered in trading among costs and benefits. However, it could also consider in the operation management and environmental performance (Saberi et al., 2019). Green operation management has been adopted as an initiative that would lead to better organisational performance and encourage environmental performance. In a similar context, the corporation will likely face the challenges of the change in internal and external operations.

The requirement of the operation management of green has been accessing to redesign and enhance various prospects of the existing operations that would successfully enhance the adoption of these initiatives. The framework has been grounded on the manufacturing and operation literature that has been assisted with the encouraging framework of operation management of green progression has constituted in the study origins from the organizational performance, environmental performance and how these resources like Fuzzy AHP and DMAIC have been constructed to evaluate the results (Herrmann et al., 2021).

According to Chiarini et al. (2021), integrated six sigma is the one way corporations can potentially maximize profit. The benefit of DMAIC has been demonstrated with the rising

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growth, elimination of errors, waste reduction and improved effectiveness. Six sigma management has been considered to progress to the edge that it has a broader groundwork. For instance, it is an application that would require decision-making, planning and addressing the regions where the management works for and new ideas to establish the products and deal with the customer establishment and the alignment of planning to achieve consistent long-term growth.

The establishment framework connects with the six sigma model for enhancing the quality of operation management of green and reducing the environmental impact. The constitution process justifies the process that facilitates the framework, which would help determine the wastes and has been offering a complete multilevel approach for enhancing procedure and eliminating or fixing it without impacts on the environment (Jones, 2020). Operation management of the green method has been reviewed by checking compatibility through the concept of six sigma and the green aspects.

The new ideal approach of green operation management connects an eco-friendly system with six sigma and advice to achieve the goal of consistent performance through comparison effect of environmental performance and operational management. The study has demonstrated through the influence of the environment along with the managers of the organizations that could focus on the environmental-friendly corporation of best practices under the organization was investigated using Fuzzy AHP.

According to Siegel et al. (2019), who revealed that the validity of management of green operations concepts in the industrial sector must be shown, The Fuzzy Analytical Hierarchy Process (FAHP) was used to create global attractiveness indices and assess Green Operations Management strategies. The use of conventional operation management (COM) methodologies was compared. Improvement, energy effectiveness, and waste management were identified as requirements. Essential things to consider are distance reduction, cost reduction, and environmental preservation. The analysis was conducted using fuzzy AHP. GOM's global desirability index (GDI) was 0.770, whereas the COM's was 0.150. This emphasizes the necessity of thinking about GOM techniques and moving in that direction.

Tsarouhas (2021) revealed that using quantitative data, a study based on the six sigma approach was undertaken to improve the process and the working environment for the apparel industry. In this study, the DMAIC (Define, Measure, Analyze, Improve, and Control) strategy is used throughout with efficient quality tools. Experts and employees find critical problems, and the information is recorded with exploratory analysis as appropriate.

Khanzode et al. (2020) suggested that a methodology based on six sigma was implemented from the perspective of Industry 4.0 and its enablers to achieve sustainable standards. We examined how information and communication technologies (ICTs) affected how the 6R and DMAIC tools from lean six sigma interacted with sustainable manufacturing. An examination of the recommended method's effectiveness was done using a case study of manufacturing cylindrical cell batteries. The framework may be modified to meet different industrial systems and processes.

Acosta-Ramirez (2022) suggested offering an approach for applying the DMAIC cycle as part of ongoing improvement. In order to achieve it, the issue of quality and quality improvement is frequently discussed. Based on the company's stated issue, a DMAIC study was carried out. Furthermore included were improvement ideas that the company may use to boost the effectiveness of the production process.

According to Wang et al. (2021) suggested that to offer industry practitioners a systematic and valuable tool for evaluating diverse green operations initiatives, the author proposes a systematic decision-making approach based on fuzzy analysis.

Felsberger and Reiner (2020) used a combination of recent research, industrial managers, and expert opinion in the sector to quantify the accountability of twelve main green manufacturing drivers. Fuzzy Multi-Criteria Decision Making (MCDM) was used to evaluate the survey. A two-stage sensitivity analysis is used to validate the findings. It involves (1) using alternative de-fuzzification techniques, which are then assessed using the Spearman coefficient, and (2) assigning various weights to the crucial top-priority drivers of green manufacturing among all standard drivers. Because it stimulates a crucial factor for the quicker and more successful adoption of green manufacturing, this study is beneficial to businesses.

The FAHP approach has been developed to prioritize Cleaner Production implementation elements in a fuzzy environment, enabling a manufacturing company to implement one of its most crucial components used in the management process and under various conditions (Soltani et al., 2023). The critical criteria and attributes were selected based on the current business climate and the domain-specific expertise of experts. Several criteria and attributes emphasized the difficulty of choosing the implementation components for Cleaner Production. Each factor influencing the adoption of cleaner production has been investigated and discussed.

III. METHODOLOGY

Green Operations Management (GOM) is the practice of integrating environmental considerations into operations management. In addition, this practice involves managing resources to reduce the impact on the environment while maintaining efficiency and profitability (Jamal et al., 2021). In

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recent years, the textile industry has come under increased scrutiny for its environmental impact. To address these concerns, the textile industry has implemented various green initiatives, such as reducing energy consumption, minimizing waste, and using eco-friendly materials. One approach to improving GOM in the textile industry is using an integrated Fuzzy Six Sigma model.

The Fuzzy Six Sigma model combines Six Sigma principles with fuzzy logic, a mathematical framework for dealing with uncertain or imprecise data. Integrating these two methodologies allows for a more comprehensive analysis of complex systems. The Fuzzy Six Sigma model has been successfully applied in various industries to improve quality, reduce waste, and enhance productivity. In the textile industry, the Fuzzy Six Sigma model can be used to identify areas of improvement, measure the impact of green initiatives, and optimize production processes (Sharma and Agarwal, 2022).

The application of the Fuzzy Six Sigma model in the textile industry can be divided into three main stages: planning, implementation, and control. In the planning stage, the focus is on identifying the key performance indicators (KPIs) critical to green initiatives' success. This involves collecting data on energy consumption, waste generation, and other environmental factors. The data is then analyzed using fuzzy logic to identify areas of improvement.

In the implementation stage, the focus is on developing and implementing strategies to improve GOM. This involves using Six Sigma tools such as DMAIC (Define, Measure, Analyze, Improve, and Control) to identify the root causes of problems and develop solutions. The solutions are then tested and implemented to reduce waste, improve efficiency, and reduce the environmental impact of operations.

In the control stage, the focus is on monitoring and sustaining the improvements made through green initiatives. This involves using statistical process control (SPC) and other tools to ensure that processes remain within acceptable limits. It also involves continuous monitoring of KPIs to ensure that environmental impact is minimized and efficiency is maximized.

A. *Integrated DMAIC Fuzzy AHP for Green Operations Management*

DMAIC is a framework subjected to improving the problem identified and the process within the industries by involving the five elements: Defining, Measuring, analyzing, Improving, and controlling. The proposed solution for obtaining the objectives of this current study is to integrate the FUZZY AHP framework into the DMAIC framework to achieve a better and sustainable solution to the complex problems specified within the Textile industry, as the chosen Textile industry is AR Textile.

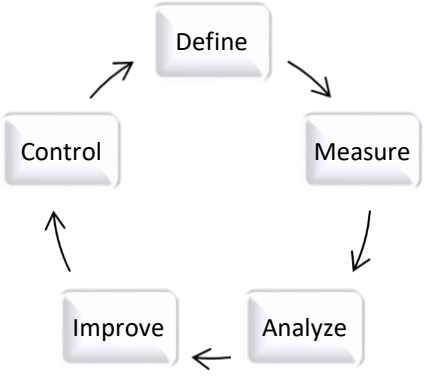

Fig 1.1: Shows the Elements of the DMAIC Framework

Table 1: Integration of Fuzzy AHP Steps with the DMAIC Model

	Define		**Measure**		**Analyze**
	Problem Specification		*Development of Model Collection of Secondary data*		*Development of Pair wise Matrix, calculation of normalized weights, alternate analysis of each factor, calculation of Global Index Value*
		Improve		**Control**	
		Brain Storming outcomes		*Proposed Green Manufacturing Control Plan*	

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B. STEP 1 - DEFINE

➢ *PROBLEM SPECIFICATION*

Managers employ operation research decision-making models like AHP and Fuzzy AHP for effective decision-making across different industries. One is the Analytical Hierarchy Process (AHP) (Asim et al., 2022). It is a technique involving the mathematical setting used in making decisions with multiple criteria. The problem is considered into 3 stages: the aim, criteria, and alternatives. In addition, a numerical scale is created to evaluate the requirements. The fuzzy set theory is the foundation for fuzzy AHP, an extension of AHP.

In some cases, subjective judgment may be used as a criterion rather than an objective evaluation. In order to incorporate intermediate numbers and fractions, the criteria are rated using a range. Triangle-shaped fuzzy numbers are used on the scale. Fuzzy AHP is employed in this study's computations and GOM evaluation. To achieve the strategic objectives, selection, and project prioritization, firms and governments utilize these methods to attain long-term progress and sustainability in different sectors, including education, Textile, Health and related.

Table 2: Fuzzy AHP Scale

Linguistic Variables	***AHP Scale***	***FuzzyAHP Scale***	
		Triangular Fuzzy Numbers (TFNs)	*Reciprocals of TFNs*
Equally Important	1	(1,1,1)	(1,1,1)
Important	2	(1,2,3)	(1/3,1/2,1)
Moderately More Important	3	(2,3,4)	(1/4,1/3,1/2)
Intermediate	4	(3,4,5)	(1/5,1/4,1/3)
Strongly More Important	5	(4,5,6)	(1/6,1/5,1/4)
Intermediate	6	(5,6,7)	(1/7,1/6,1/5)
Very strongly more important	7	(6,7,8)	(1/8,1/7,1/6)
Intermediate	8	(7,8,9)	(1/9,1/8,1/7)
Extremely more Important	9	(8,9,10)	(1/10,1/9,1/8)

The first step is finding and appropriately structuring the problem domain using the established criteria. The literature review helps to identify the criteria. This current research aims to compare green operations management strategies with traditional operations management techniques.

C. STEP 2 - MEASURE

➢ *DEVELOPMENT OF MODEL*

In the above finding problem, the diagram illustrates the different components of green operations management for the Textile industry. It has three main components: justification of Green Operations Management, Green operations Management, and Conventional Green Management. Indicated components are the first stage. The second stage includes the criteria for rationale. It involves elements such as Organizational Performance Quality (OP-Q), Environmental Performance – Waste (EW-W), and Operations Resources Inventory Control (ORIC). Moreover, the third stage in this process involves criteria for solving the problem being evaluated using the alternatives. Green operation management (GOM) and traditional operation management are the substitutes (COM).

D. COLLECTION OF SECONDARY DATA

A group of experts with diverse backgrounds in the Textile industry, including specialists in operational management and academics with knowledge of environmental matters, provided the information for the study. The experts were interviewed using questions based on standards and a literature review, and their opinions were collected. They were asked to evaluate several criteria using the AHP scale by assigning scores to each factor in a paired matrix. The two methods used in the evaluation were conventional operation management (COM) and GOM (COM). To know the responses from the Experts and Academic professionals relating the green operations management within the textile industry, some questions for interview have been produced to achieve the objectives of this study.

E. STEP 3 – ANALYSE

➢ *DEVELOPMENT OF A PAIR-WISE COMPARISON MATRIX*

To calculate the Fuzzified Pair wise Comparison using the Fuzzy AHP Scale, we can use the reciprocals of the TFNs in the scale. The Fuzzy AHP Scale is shown in Table 2. For that, there are three elements for comparison: OP-Q, EP-W, and OR-I, which indicate Factor A, Factor B, and Factor C, respectively. The factors have been compared based on their relative importance to one another. The first step is to construct

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the pairwise comparison matrix. We can use the AHP scale to assign values to each pair of factors. For example, if Factor A is "Moderately More Important" than Factor B, assign a value of 3 to that pair in the matrix. In addition, Factor A is "Intermediate" in importance compared to Factor C. We can assign a value of 4 to that pair in the matrix and the reciprocal of the TFN (1/5, 1/4, 1/3) to the reverse comparison. This provides a fuzzy number representing the pair wise comparison between Factor A and Factor C, as shown in Table 1.3.

Table 1.3: Fuzzified Pair wise comparison

		A	*B*	*C*
		OP-Q	***EP-W***	***OR-I***
	OP-Q	*(1,1,1)*	*2*	*(1/4, 1/3, 1/2)*
	EP-W	*(1/2,1,2)*	*(1,1,1)*	*(1/5,1/4,1/3)*
	OR-I	*(1/2,1/3,1/2)*	*3*	*(1,1,1)*

➢ *CALCULATION OF NORMALIZED WEIGHTS*

Calculating the fuzzy geometric mean value is the first step. The process involves taking the seventh root (7 factors) of the solution after repeatedly multiplying the first position element of the fuzzy numbers bracket. The finished bracket represents the fuzzy geometric mean of the first row or the first factor. Every row requires repeating the entire process. Making fuzzy weight calculations is the next step. It combines the first, second, and third bracket numbers in each row's fuzzy geometric mean value. The last bracket received needs to be reciprocated after that. Each row's fuzzy geometric mean value bracket is now multiplied by this reciprocal bracket. The calculation of normalized weights is the third stage. One fuzzy weight bracket's components are added together, and the result is divided by three. The collected numbers are then added together, and their sum is divided by each row to give precise values. In Table 4, the normalized weights are listed.

Table 4: Calculation of Normalized Weights

S. no	*Factors*	*Fuzzy Geometric Mean Value*	*Fuzzified Weights*	*Weights*	*Normalized Weights*
1	*OP-Q*	1	(1,1,1)	0.393	0.206
2	*EP-W*	0.365	(0.137, 0.365,1)	0.518	0.271
3	*OR-I*	0.137	(0.042, 0 19,1)	1.0	0.523

➢ *ALTERNATE ANALYSIS OF EACH FACTOR*

In order to calculate the required global desirability index, an individual analysis of each factor was conducted, and the results are presented in Tables 5 and 6, which provide clear values for the calculation.

Table 5: Alternative Analysis of each Factor

Alternate Analysis of each Factor			
Organizational Performance – Quality	***GOM***	***COM***	***NM***
Green Operations Management	*(1,1,1)*	*(1,2,3)*	*0.884*
Conventional Operations Management	*(1/3, 1/2, 1)*	*(1,1,1)*	*0.116*
Environmental Performance – Waste			
Green Operations Management	*(1,1,1)*	*(4,5,6)*	*0.98*
Conventional Operations Management	*(1/6,1/5,1/4)*	*(1,1,1)*	*0.02*
Operations Resource – Inventory			
Green Operations Management	*(1,1,1)*	*(2,3,4)*	*0.937*
Conventional Operations Management	*(1/4,1/3,1/2)*	*(1,1,1)*	*0.063*

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Table 6: Weights of Attributes for Alternatives					
	S. No	*Attributes*	*Normalized Weights from Table 04*	*GOM Normalized Weights (from each Alternative analysis)*	*COM Normalized Weights (from each Alternative analysis)*
	1	*OP-Q*	*0.206*	0.884	0.116
	2	*EP-W*	*0.271*	0.98	0.02
	3	*OR-I*	*0.523*	0.937	0.063

➢ *CALCULATION OF GLOBAL INDEX VALUE*

The Global Desirability Index (GDI) is a single value that indicates industrial quality control. It is commonly used in multi-criteria decision-making models that consider multiple variables (Poh, Chew and Tan, 2019). The weights calculated for GDI and the global weights for conventional and green operations management are presented in Table 7. Table 8 displays the total weights in the form of a desirability index. The attractiveness index value of green operations management is higher than traditional operations management

Table 1.7: Global Desirability Index of Alternatives

Global	Desirability	Index	for	GOM
0.936535				
Global	Desirability	Index	for	COM
0.062605				

The research for this paper was undertaken by following the five-step process known as DMAIC. DMAIC is used to pinpoint the underlying causes of issues and put forward long-term fixes that enhance workflow and performance (Lim et al., 2022). DMAIC is regularly used in applications of Lean and Six Sigma added by Kurdve and Bellgran (2021).

It is simple to standardize the packaging process, and if done right, it is also simple to make the process sustainable. Lean is a different methodology that can be utilized in addition to DMAIC. Lean is a way of thinking that helps manufacturers cut waste. There are seven different types of waste: waste from overproduction, waste from waiting, and waste from inventory, waste from processing, waste from motion, and waste from defective products (Awan, 2019).

The focus of this study will be on process waste. The 5S method, which is based on Lean Thinking, will be used in this study. Sort, set in Order, Shine, Standardize, and Sustain are the acronyms for the 5S method. A system known as 5S is used to organize and manage manufacturing activities such that they use less manpower, space, money, and time to produce goods with lower human error rates. It facilitates the creation of a managed, orderly, and clean workplace (Yew et al., 2019). In the section that follows, the use of these tools will be covered in more detail.

F. DMAIC IN PACKAGING

Both the packaging station and the opportunity at AR Textile required improvement. The practice was observed to understand better what all the packaging workers go through.

It was discovered through observation that there was no uniformity between the packaging stations. Each packer has a unique station that is set up differently for each of them. Some are exceptionally tidy and well-organized, while others are not. Not all stations have the same components besides the organization issue. For instance, one station might have a laptop on a stand, whereas another might only have a monitor and keyboard, and the Computers have been stored away. Finding this opportunity will result in a process modification that is simple to implement and will benefit the packers. Packers might visit any station without favoring "their" station by sketching and figuring out the best configuration for all packaging stations. In addition to making the organization more straightforward and providing visual cues when supply levels at stations are getting low, it would make training new staff simpler and more effective because they would not have to set up their station or figure out how to do things on their own.

The initial enhancement of the packaging station will concentrate on standardizing and improving the layout of each station. Lean and 5S will be applied to facilitate and enhance the station's layout as a whole. The station standardization will also help to raise the morale of the packers. AR Textile may decide to enhance some features, such as a cup holder attached to the side rather than in their working area, giving them that extra space. Boosting employee morale is usually advantageous for the business because happy employees typically work more quickly and remain productive.

When this study first began, time studies were intended to be the primary measurement method. Further analysis reveals that the lack of consistency prevents a well-conducted time study from accurately measuring the improvement if it only affects one station. The study's main objective was to standardize the packaging stations to produce a more uniform procedure throughout the plant. According to a cursory review, the fourteen packaging stations at AR Textile have various box sizes on the top shelf. The stations have all been customized with the packers' individual touches and are suited to their height, which is acceptable (which is also okay). The packing stations' bases differ from one another. The boxes should be placed in the same spot at each packaging station, and all relevant electronics should be placed in the exact location. Each station should have a monitor, keyboard, mouse, scale, scanner, fan, assortment of boxes, the most popular mailers, and extra rolls of packing tape, a roll of a packing tape dispenser, a mat, and a printer for mailing labels. Each station's

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surrounding area, which will be shared with the other stations, should feature a trash can and containers for the goods that various carriers will transport.

Reviewing the procedure as it is and the pictures collected during the observation was the first step in the analysis. After considering these factors, it was decided that standardizing the stations would benefit all parties involved. The absence of uniformity is the main reason the packaging stations cannot perform as effectively as they could. Other factors contribute to the difference between each station's characteristics. There are various clients for AR Textile, and some need specialized packaging. Only a few packing stations hold the special items, and only those stations ever package those specific items. However, orders for these commodities, which call for specialized packing, are only sometimes placed.

G. Step 4 - Improve

Standardizing the stations is the first step in streamlining the process. A recommendation to standardize the stations and place the most often used boxes at the top will be made after analysis of the most frequently used items. Using 5S principles, each station must have a clear label to motivate packers to keep their workspaces nice and orderly (Chakrabarty, Tagiya and Sinha, 2020). Everything is much simpler to clean up when it is labelled. The following enhancement would be based on the box inventory once all stations have been 5Sed and are identical or have the same basis. The packers must replenish their stations with the most popular box sizes after each workday. During the observation, it was seen that the packer was having difficulty locating a popular box of a particular size. The packer could not find the size box she needed when she approached where the extra boxes were stored. The packer finally found a box on someone else's station after searching for roughly four minutes. By adding the step into replenishing stations at the end of each workday, management will be able to detect when a specific box might be running low to prevent running out. I found that this is currently a common problem after chatting with the packer.

Given that the popular size boxes are running low or will not be accessible for a few days, this makes the packer's job more difficult because they must be even more cautious than usual about the size of the box they choose. The packers and management can easily see this visual indicator, letting them know when stock levels are low. These small process changes will assist future new employees in learning how to pack more effectively because all stations will be the same. They will also let management know when things are running low and allow packers to take pride in their workstations by keeping them tidy and orderly. Currently, new hires are trained at the station of another packer before being required to move to their own station and set it up as they see fit. Since only some hold the same viewpoints, a new hire would not be familiar with the most common and practical box sizes.

Regarding the possibility that specialty goods require various packaging. There are now a few stations that only package these specialty goods. It is deemed a waste of a station when it is focused on just one specialty item because the unique items need to be regularly ordered. The packers could have the usual items on hand and then collect the essential materials when they occasionally receive special items as a potential solution. It would not be regarded desirable to do this. Another option would be to have a single packing station with all the specialized products' packaging supplies (Rajesh Menon et al., 2021). Although there will be excess inventory in the area for packaging refills, creating a station specifically for these specialist items will free up room for this unique procedure. Since there would not be a specific packer-dedicated station, only a dedicated specialty station, each packer must receive cross-training to handle these specialty items. Because it is risky to rely on more than one individual to complete a job, cross-training is essential (Pinos, Hahladakis and Chen, 2022). All of that knowledge would be carried away by that person if they were to leave. Cross-training's goal is to spread information so everybody can carry out any task required within reason.

The picker procedure could also include a few pieces of specialist products. The workers who pull the goods for each order are known as pickers. The precise envelopes, flyers, etc., included in the box will be pulled simultaneously with the specialty products (along with the products themselves). The packing procedure would be streamlined since the packer would not have to stress remembering particular items. Upgrading this procedure to include those things would require some initial work, but the ultimate result would be worthwhile.

H. Step 5 - Control

Additional training will be necessary to manage the packers' performance supported by Kamarudin et al. (2022) Depending on the choice selected for the specialty items, this training would review the new procedure for maintaining the box inventory, replenishing after every shift, and demonstrating the new station format to the packers. As often happens with change, there will be resistance. To ensure all packers adhere to the new requirements, it might be required first to perform daily inspections of the packaging stations. AR Textile may switch to weekly/biweekly or even monthly reviews of the stations to ensure compliance overall once management determines that it is no longer necessary.

Moreover, Control Plan is a systematic approach that is used to reduce the environmental impact of manufacturing processes (Beloeil and Albaladejo, 2021). In the AR Textile, packaging plays an important role in protecting and transporting textile products. Here is a proposed Green Manufacturing Control Plan for the packaging side of the textile industry:

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Reduce packaging waste: One of the main environmental concerns in packaging is the amount of waste generated. To reduce this, the textile industry should focus on reducing the amount of packaging material used. That can be achieved through the use of lightweight and biodegradable materials (Al Faruque et al., 2022).

Use recycled materials: The textile industry should prioritize the use of recycled materials for packaging. This will aid to reduce the environmental impact of production and also reduce waste.

Implement efficient packaging processes: Efficient packaging processes can reduce the amount of material used and also minimize energy consumption. That can be achieved through automation, standardized packaging designs, and optimized packing methods (Bradu et al., 2022).

Consider end-of-life disposal: The textile industry should consider the end-of-life disposal of packaging materials. This can be attained through the use of biodegradable materials or recycling. Proper disposal will reduce the amount of waste generated and also minimize the environmental impact (Samsudin and Iñiguez-Franco, 2022).

Continuous improvement: The Green Manufacturing Control Plan should be continuously reviewed and updated to ensure that it remains effective. This can be achieved through regular monitoring and analysis of environmental impact data.
By implementing a Green Manufacturing Control Plan for the packaging side of AR Textile will not only help to reduce the environmental impact of production but also improve the industry's sustainability and social responsibility.

IV. RESULTS AND DISCUSSION

A. *Results*

The responses have been considered for the interview questions from the experts in this field. Upon asking the first question, they replied that Green Operations Management is the practice of integrating environmental considerations into a company's operations management process. That involves reducing waste, conserving energy and resources, and minimizing the environmental impact of a company's operations. The response when asked second question was that Sustainability and environmental performance are becoming increasingly important in the textile industry. Consumers are demanding eco-friendly products and companies are under pressure to reduce their environmental footprint. In addition, regulatory requirements are becoming more stringent, making it necessary for companies to adopt sustainable practices (Islam et al., 2022). When asked third question they said that textile companies face a number of challenges when implementing green initiatives. These include the high cost of implementing sustainable practices, the need to balance environmental concerns with economic growth, and the lack of awareness and education among employees and suppliers (Fernando et al., 2022). Upon asking the importance of quality management, they notified that Quality management plays an important role in Green Operations Management as it involves identifying and eliminating waste, defects, and inefficiencies in a company's operations. This can lead to cost savings, increased efficiency, and reduced environmental impact.

In addition, the question was asked regarding the Integrated Fuzzy Six Sigma Model, they demonstrated that Integrated Fuzzy Six Sigma Model is a quality management approach that combines the Six Sigma methodology with fuzzy logic. It is used to analyze and optimize processes to reduce defects and waste. In the textile industry, it can be used to identify areas for improvement, optimize production processes, and reduce environmental impact. Moreover, to achieve the sustainability goals, the responses of the experts were that the Integrated Fuzzy Six Sigma Model can help textile companies achieve sustainability goals by providing a systematic approach to process improvement. By reducing defects and waste, companies can improve efficiency and reduce environmental impact. Furthermore, regarding the benefits of the integrated system, the experts said that the benefits of using the Integrated Fuzzy Six Sigma Model in the textile industry include improved process efficiency, reduced defects and waste, and a reduced environmental footprint. It can also lead to cost savings and increased profitability.

Upon asking about the effectiveness of textile industry in balancing the economic and environmental growth, they added that the textile industry can balance economic growth and environmental sustainability by adopting sustainable practices that are cost-effective and have a positive impact on the environment. This includes reducing waste, conserving energy and resources, and minimizing environmental impact. The experts said in the response of 8th question that the Integrated Fuzzy Six Sigma Model is a methodology that combines the Six Sigma approach to quality control with the fuzzy logic theory. This model can be used by companies to measure the impact of their green initiatives. The model involves identifying key performance indicators (KPIs) related to environmental performance, such as energy consumption, waste reduction, and carbon footprint. These KPIs are then measured using data and analyzed using the Six Sigma approach. Furthermore, Fuzzy logic theory is used to handle the uncertainty and imprecision inherent in environmental data. This means that the model can account for variables that are difficult to quantify or measure precisely, such as the impact of weather conditions on energy consumption (Israr and Siddiqui, 2020). The results of the analysis can be used to identify areas for improvement and to track progress over time.

Likewise, upon asking 10th question the experts added that for textile companies looking to improve their environmental performance using the Integrated Fuzzy Six Sigma Model, there are several pieces of advice that can be provided. Firstly, it is important to identify the key environmental impacts of textile manufacturing and prioritize

areas for improvement. These may include reducing water usage, energy consumption, and waste generation. Secondly, it is important to gather accurate and reliable data on environmental performance. This may involve installing monitoring systems or working with suppliers to obtain data on their environmental impact (Norton, 2023). Once data is collected, it can be analyzed using the Integrated Fuzzy Six Sigma Model to identify areas for improvement and track progress over time. It is important to involve stakeholders throughout the process, including employees, customers, and suppliers. This can help to build buy-in for environmental initiatives and ensure that everyone is working towards the same goals.

On the other side, Global Desirability Index for Green Operations Management (GOM) was calculated as 0.936535, whereas, Global Index for Conventional Operations Management (COM) calculated as 0.062605. The GDI value for GOM is significantly higher than that of COM, suggesting that GOM is generally viewed as more desirable than COM on a global scale. This shows that for green operation management desirability in the textile industry is high and that emphasizes that the textile industry should implement the green practices within their firms for better and sustainable growth.

B. Discussion

➢ *Green Packaging in the Manufacturing Industry*

Green packaging refers to the use of environmentally friendly materials and design principles in the packaging of products (Ghazouani et al., 2022). The manufacturing industry plays a significant role in the adoption and implementation of green packaging practices. This is because the sector is responsible for the production of a vast array of goods that require packaging for distribution and marketing (Astanti, Mbolla and Ai, 2020). Green packaging in the manufacturing industry aims to reduce the environmental impact of packaging by minimizing waste, conserving resources, and reducing greenhouse gas emissions. From the literature, these given packaging can be beneficial for the AR Textile to conduct its green operation in the manufacturing section.

Biodegradable packaging: Biodegradable packaging is made from materials that can decompose naturally, such as paper, cardboard, and plant-based plastics. As companies like Dell and Hewlett-Packard use mushroom-based packaging materials that are biodegradable and compostable (Bravo, Gaston and Melamed, 2020).

Recyclable packaging: Recyclable packaging can be reused or turned into new products. For example, Coca-Cola's Plant Bottle is made from plant-based materials that are fully recyclable (Harding et al., 2021).

Lightweight packaging: Lightweight packaging reduces the amount of material required to package a product, which reduces the environmental impact of transportation. For instance, Nestlé reduced the weight of its water bottles by 30%, which saved over 1,000 tons of plastic each year (Nanda et al., 2022).

Renewable packaging: Renewable packaging is made from materials that can be replenished, such as bamboo or sugarcane. L'Oreal Company practices bamboo-based packaging for its hair care products (Amjad et al., 2022).

Minimalist packaging: Minimalist packaging uses minimal materials and design to reduce waste and conserve resources. For example, the shoe company Allbirds uses a minimalist approach to packaging by using recycled cardboard boxes and eliminating unnecessary packaging materials (Nzediegwu and Chang, 2020).

In addition, green packaging in the manufacturing industry has several benefits. It can reduce waste, conserve resources, and reduce greenhouse gas emissions. According to a report by the Sustainable Packaging Coalition, green packaging can also improve brand image and increase customer loyalty. Likewise, the report found that 57% of consumers are willing to pay more for products with sustainable packaging added by Amjad et al. 2022.

➢ *Comparison of green operations to traditional operations*

Green operations refer to environmentally sustainable practices and strategies adopted by businesses to minimize their environmental impact. Traditional operations, on the other hand, focus primarily on efficiency and profitability without considering the environmental consequences of their actions (Stabingytė, 2021). Green operations aim to minimize the environmental impact of business operations, whereas traditional operations prioritize efficiency and profitability. For instance, green operations involve reducing greenhouse gas emissions, minimizing waste, and conserving resources, while traditional operations may focus on maximizing production and minimizing costs (Cheng, 2019). Green operations can initially incur higher costs due to the use of eco-friendly materials and technologies. However, they can lead to long-term cost savings through reduced waste, improved efficiency, and decreased energy consumption supported by Martin et al. (2021). In addition, traditional operations prioritize short-term cost savings over long-term sustainability. As the people are becoming environmentally aware regarding the companies' practices, green operations aid to improve a company's brand image by demonstrating a commitment to sustainability and social responsibility backed by Prieto-Sandoval, Torres-Guevara and Garcia-Diaz (2022).

This can lead to increased customer loyalty and support. Traditional operations do not prioritize brand image and are seen as environmentally irresponsible. Green operations have to comply with environmental regulations and standards, which can be costly and time-consuming. On the other side,

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traditional operations need not to face as many environmental regulations or can choose to ignore them (Grumiller, Grohs and Raza, 2022). Green operations often require businesses to innovate and develop new products, services, and technologies that are environmentally sustainable.

Likewise, traditional operations do not prioritize innovation and can continue to rely on established practices and technologies. Moreover, green operations and traditional operations have significant differences in their approach to sustainability, cost, brand image, regulatory compliance, and innovation (Purwanto and Permana-Citra, 2019). While green operations require initial investment and regulatory compliance, they can lead to long-term cost savings, improved brand image, and environmental sustainability. Besides traditional operations prioritizes efficiency and profitability over sustainability, which can have negative environmental consequences and harm brand image (Nandy, Fortunato and Martins, 2022).

V. CONCLUSION & RECOOMENDATION

➢ *CONCLUSION*

The study has proposed a comprehensive green operations management approach that combines fuzzy logic and DMAIC, and Six Sigma methodologies in the textile industry. The study highlighted the importance of sustainable operations management in reducing environmental impact, improving efficiency, and achieving a competitive advantage in the market. It concluded that the integrated fuzzy Six Sigma model can effectively identify, analyze, improve and control the green operations of textile companies.

The fuzzy logic approach can handle the uncertainty and imprecision associated with environmental data, while the Six Sigma methodology can provide a structured approach for process improvement and waste reduction. The model can help AR Textile to develop sustainable practices, reduce waste and emissions, and improve product quality and customer satisfaction in the glove manufacturing. Moreover; the study emphasizes the importance of stakeholder engagement and collaboration in implementing green operations management. It suggests that involving employees, suppliers, and customers in the decision-making process and creating a culture of sustainability can lead to long-term success and increased stakeholder satisfaction.

Furthermore, the study provides a valuable contribution to the literature on green operations management in the textile industry. It presents an innovative approach that can help companies achieve environmental sustainability while maintaining profitability and competitiveness.

➢ *RECOMMENDATIONS*

Based on the study`s conclusion, the following recommendations have been made for AR Textile in the Packaging section of the company which is based in Nooriabad Sindh, Pakistan.

- Conduct a comprehensive environmental assessment: AR Textile conduct a detailed environmental assessment to identify the areas of improvement in their glove manufacturing processes. This can include analyzing the materials used, energy consumption, waste generation, and emissions.
- Implement the integrated fuzzy Six Sigma model: AR Textile can use the integrated fuzzy Six Sigma model to improve their green operations management. This approach can help the company to identify the critical areas of improvement and develop sustainable practices that can reduce waste, energy consumption, and environmental impact.
- Develop a culture of sustainability: AR Textile should involve all stakeholders, including employees, suppliers, and customers, in the decision-making process and create a culture of sustainability. This can be done through awareness campaigns, training, and incentives for sustainable practices.
- Use eco-friendly materials: AR Textile should consider using eco-friendly materials, such as recycled or biodegradable materials, for their manufacturing. This can help reduce waste and environmental impact while improving the brand image.
- Optimize energy consumption: AR Textile can optimize their energy consumption by using energy-efficient equipment, lighting, and HVAC systems. This can lead to significant cost savings and reduce greenhouse gas emissions.
- Reduce water consumption: AR Textile should adopt practices that reduce water consumption in their manufacturing processes. This can be achieved through the use of water-saving technologies and practices such as reusing water and optimizing water use.
- Implement a waste management system: AR Textile should develop a waste management system that includes reducing, reusing, and recycling waste generated during the manufacturing process. This can help reduce the company's environmental impact and cost.
- AR Textile can improve its green operations management in the manufacturing section by conducting a comprehensive environmental assessment, implementing the integrated fuzzy Six Sigma model, developing a culture of sustainability, using eco-friendly materials, optimizing energy and water consumption, and implementing a waste management system. These actions can lead to significant environmental and cost benefits while improving the company's brand image and competitiveness in the market.

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