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A Research Study On Optimised Production: Integrating Consistent Ingredients And The Production Methods In Commercial Product Development

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ABSTRACT

Sustainable manufacturing, which is the subject of this research, primarily aims to improve industrial product design by using eco-friendly materials and cutting-edge production techniques. The primary goal is to identify and assess design techniques that efficiently decrease environmental impact while simultaneously increasing manufacturing process efficiency. This research examines the inquiry, "The way can creative ideas materials and techniques be implemented towards product development in manufacturing environments to reduce adverse environmental effects, boost efficiency of resources, and promote sustainable development goals?" from multiple angles in order to provide a comprehensive answer. In order to find actual production demands while also addressing environmental issues, this research looks at existing approaches and case studies. A growing consciousness about the degradation of the planet and the exhaustion of its natural resources has prompted businesses to look for more environmentally friendly ways to conduct their manufacturing. The purpose of this study is to explore the potential for industrial product design to include sustainable production processes and environmentally friendly materials in order to reduce manufacturing's negative effect on the environment without compromising product quality or utility. Manufacturing procedures that minimise waste, energy consumption, and emissions are the primary focus of the research, together with materials that are non-toxic, renewable, and recyclable. The article also delves into other sustainable design ideas. Analysing present industrial practices, case studies, and expert interviews, the researchers identify key potential and limits in applying sustainable manufacturing approaches. Results show that when designing products, it's important to consider the full product life cycle, from sourcing raw materials to final disposal or recycling, and that this strategy must take economic and environmental considerations into account. The study also provides practical recommendations to assist designers and manufacturers in integrating eco-friendly materials and procedures into product production. At the same time as this promotes sustainability, it will also inspire originality. In the end, the research hopes to contribute to the development of a sustainable manufacturing framework that is compatible with global environmental objectives, reduces industrial waste, and maintains economic efficiency.

Keywords: *Sustainable structure, eco-friendly materials, production methods, retail products.*

1. INTRODUCTION

In recent times, the design and industrial sectors have taken the lead in the sustainability movement. Among its features is an expanded view of product creation that considers the whole lifecycle of a product and how it will affect people, the planet, and businesses. In the product life cycle, choices are made at several stages, including as when opportunities are found, when concepts are produced and selected, and throughout the development of the product and technology (Al-Nuaimi & Al-Ghamdi, 2023). These decisions have a significant impact on the product's sustainability performance. Better, more lasting solutions should be the result of development efforts guided by sustainable design principles. Rising consciousness about environmental threats including pollution, resource loss, and climate change has led to a discernible movement in industrial design towards more sustainable practices. A growing number of product lifecycle impact mitigation strategies are being considered by designers and manufacturers. This change required the combined efforts of many different types of experts, including environmentalists, materials scientists, industrial designers, and engineers. Innovative solutions that fairly include social, environmental, and economic factors may emerge from interdisciplinary collaborations. A sustainable production system is one that is economically robust, culturally aware, socially cohesive, resourceful, and environmentally conscientious. A more sustainable economic development approach might include promoting optimisation in industrial structures, conserving the environment, balancing economic expansion with population increase, and efficiently extracting and distributing resources. Potentially far-reaching consequences include changes to energy consumption, industrial growth,

the creation and consumption of environmentally friendly goods, and the development of cultural and touristic undertakings (Adekanmbi & Wolf, 2024).

2. BACKGROUND OF THE STUDY

More and more people are worried about how businesses and consumer goods will affect future generations and the planet. The IPCC states that the majority of the unprecedentedly high levels of carbon dioxide, methane, and nitric oxide seen in the last 800,000 years are caused by emissions of greenhouse gases that humans have caused. Greenhouse gas emissions are under unprecedented pressure from environmentalists, who are putting pressure on businesses and individuals to cut down. The academic community spearheaded the environmental movement in the late 1980s, mobilising individuals throughout the globe to take action. New worldwide accords and joint initiatives, including the Paris Agreement and the UN Sustainable Development Goals (SDG), have brought in a new age of sustainability. The level of eco-design integration into corporate product manufacturing is an area that more and more scholars are focussing on. Despite several companies announcing their intention to use eco-design practices, the level of acceptability and execution is rather low. As proof that eco-design is falling short of its aim of creating a sustainable society, its proponents refer to the field's sluggish acceptance of eco-design methods and technologies (Awan & Sroufe, 2022).

3. PURPOSE OF THE RESEARCH

The initiative's research team suggests that environmentally conscious product designs using sustainable materials and manufacturing processes would have a better chance of being sustainable in the long run. Research and assess potential eco-friendly materials for use into product concepts. Considerations for the environment should prioritise their biodegradability, recyclability, and decreased carbon impact. Examine both traditional and modern production methods to find strategies to reduce manufacturing's negative impact on the environment. Environmental friendliness, energy efficiency, and waste minimisation are all aspects that are being considered. Please provide concrete suggestions on how the design process may be enhanced to include environmentally friendly materials and manufacturing methods. Essential to this is making sure that producers and designers have access to the funds they need to implement these eco-friendly policies. Determine the extent to which the product's design benefited from the use of environmentally friendly materials and procedures. Determining the overall impact on product efficiency, cost-effectiveness, and environmental sustainability is a part of this process. Help manufacturers and industrial designers implement sustainable practices by giving them practical recommendations based on the study's results.

4. LITERATURE REVIEW

The concept of sustainable manufacturing has gained traction as a way for businesses to reduce their environmental footprint and make better use of the resources they have. Drawing on recent studies and industry successes, this literature review investigates the potential for eco-friendly materials and manufacturing processes to be included into industrial product design. The core principle of sustainable manufacturing is to reduce the environmental impact of manufacturing processes without sacrificing the quality or usefulness of the final product. A substantial amount of research suggests that sustainable materials need to be given top priority during product design (Gaha et al., 2020). Research into the creation of materials with the potential to reduce trash and carbon emissions is on the rise. Natural fibres, recyclable metals, and biodegradable polymers are all part of this category. Several studies have shown that the materials may lessen the impacts over time, but concerns about cost and functionality have also surfaced. Improvements in manufacturing processes that are more environmentally friendly have also helped a great deal. New, innovative approaches have evolved, such as closed-loop manufacturing systems that provide recycling and reusing of resources and additive manufacturing (3D printing), which permits exact material utilisation with little waste. In addition to improving production efficiency and flexibility, these methods reduce waste (Cooke et al., 2020).

5. RESEARCH QUESTIONS

- What is the impact of energy consumption on the integration of eco-friendly materials?

6. RESEARCH METHODOLOGY:

6.1 Research design:

The quantitative data analysis was conducted using SPSS version 25. The odds ratio and 95% confidence interval were used to ascertain the strength and direction of the statistical link. The researchers developed a statistically significant criterion at $p < 0.05$. A descriptive analysis was performed to determine the key characteristics of the data. Quantitative approaches are often used to evaluate data obtained from surveys, polls, and questionnaires, as well as data modified by computational tools for statistical analysis.

6.2 Sampling:

Research participants filled out questionnaires to provide information for the research. Using the Rao-soft programme,

researchers determined that there were 623 people in the research population, so researchers sent out 635 questionnaires. The researchers got 557 back, and they excluded 32 due to incompleteness, so the researchers ended up with a sample size of 525.

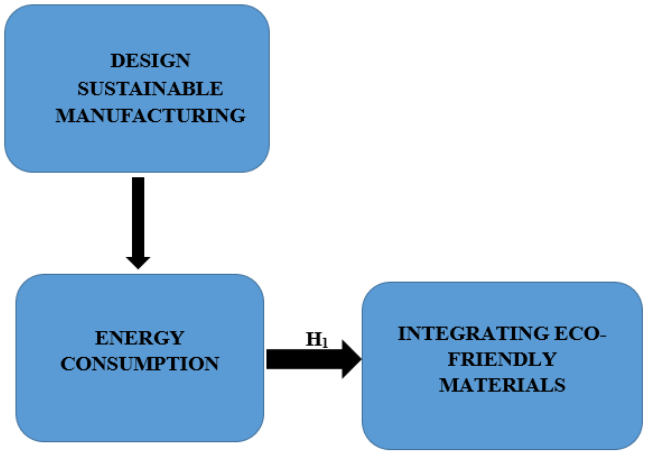
6.3 Data and Measurement:

The inquiry relied heavily on a questionnaire survey to gather data. First, participants were asked to provide basic demographic information. Then, using a 5-point Likert scale, they were asked to rate various aspects of the online and offline channels. Multiple sources, with an emphasis on online databases, provided secondary data.

6.4 Statistical Software: The statistical analysis was conducted using SPSS 25 and MS-Excel.

6.5 Statistical Tools: To grasp the fundamental character of the data, descriptive analysis was used. The researcher is required to analyse the data using ANOVA.

7. CONCEPTUAL FRAMEWORK



8. RESULT

- **Factor Analysis**

One typical use of Factor Analysis (FA) is to verify the existence of latent components in observable data. When there are not easily observable visual or diagnostic markers, it is common practice to utilise regression coefficients to produce ratings. In FA, models are essential for success. Finding mistakes, intrusions, and obvious connections are the aims of modelling. One way to assess datasets produced by multiple regression studies is with the use of the Kaiser-Meyer-Olkin (KMO) Test. They verify that the model and sample variables are representative. According to the numbers, there is data duplication. When the proportions are less, the data is easier to understand. For KMO, the output is a number between zero and one. If the KMO value is between 0.8 and 1, then the sample size should be enough. These are the permissible boundaries, according to Kaiser: The following are the acceptance criteria set by Kaiser:

A pitiful 0.050 to 0.059, below average 0.60 to 0.69

Middle grades often fall within the range of 0.70-0.79.

With a quality point score ranging from 0.80 to 0.89.

They marvel at the range of 0.90 to 1.00.

Table1: KMO and Bartlett's Test

Testing for KMO and Bartlett's

Sampling Adequacy Measured by Kaiser-Meyer-Olkin .970

The results of Bartlett's test of sphericity are as follows: approx. chi-square

df=190

sig.=.000

This establishes the validity of assertions made only for the purpose of sampling. To ensure the relevance of the correlation matrices, researchers used Bartlett's Test of Sphericity. Kaiser-Meyer-Olkin states that a result of 0.970 indicates that the sample is adequate. The p-value is 0.00, as per Bartlett's sphericity test. A favorable result from Bartlett's sphericity test indicates that the correlation matrix is not an identity matrix.

Table: KMO and Bartlett's

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.970
Bartlett's Test of Sphericity	Approx. Chi-Square	3252.968
	df	190
	Sig.	.000

Applying Bartlett's Test of Sphericity provided further confirmation of the correlation matrices' overall significance. Kaiser-Meyer-Olkin sampling adequacy is 0.970. A p-value of 0.00 was discovered by researchers using Bartlett's sphericity test. The researcher knows the correlation matrix isn't a correlation matrix since Bartlett's sphericity test produced a significant result.

❖ **INDEPENDENT VARIABLE**

- **Design Sustainable Manufacturing**

Sustainable manufacturing processes aim to minimise resource consumption without compromising product quality in order to create goods that do not hurt humans or the environment. Use renewable, recyclable, or environmentally friendly materials to lessen the researcher's influence on the planet. Ensure that they use energy-saving strategies and technologies tailored to the industrial industry. A focus on waste reduction should guide the development of products and processes that facilitate resource recycling or reuse. A product's environmental impact is multi-faceted and should be examined during its entire lifespan, not just during production. Incorporating concepts of resource preservation and environmental standards into product and production systems is one way designers may contribute to these goals (Ilieva et al., 2022).

❖ **FACTOR**

- **Energy Consumption**

An entity's or a population's energy consumption may be defined as the sum of all the energy that it uses during a certain time frame. Energy from nuclear power, renewable sources (solar, wind, hydro, geothermal, biomass), fossil fuels (coal, oil, natural gas), and other sources are all part of it. A variety of measures are used to measure energy consumption, including kilowatt-hours (kWh) for electricity, joules (J), or British thermal units (BTU) wherever applicable. Energy consumption is an important factor in many contemporary societal processes, including manufacturing, transportation, daily life, and the functioning of digital technologies. Saving money, working more efficiently, and avoiding negative effects on the environment including carbon emissions, resource loss, and climate change all depend on energy efficiency. The goal of governments and corporations is to maximise energy consumption while promoting environmental sustainability via the implementation of energy efficiency methods, sustainable energy solutions, and smart grid technology. Direct use of raw materials prior to transformation (e.g., burning coal to generate electricity) is an example of primary energy consumption; processed energy forms, such as fuel and electricity, are examples of secondary energy consumption. One of the most important parts of sustainable development and fighting climate change is controlling and lowering energy use (Ilugbusi et al., 2020).

❖ **DEPENDENT VARIABLE**

- **Integrating Eco-Friendly Materials**

Choosing and using materials that reduce environmental effects during their whole lifespan is at the heart of eco-friendly material integration in industrial product design. Less dependence on non-renewable resources is a result of their use of recycled materials or renewable resources. Made to decompose organically, reducing its impact on the environment in the long run. No harmful substances that might endanger humans or the environment are present. Produced with minimal energy

use and emissions of greenhouse gases to lessen the environmental effect. Less pollution, less waste, and better resource utilisation are just a few advantages. Full utilisation of environmentally friendly materials presents difficulties for the researcher, including increased prices, reduced performance, and the need for new manufacturing methods (Saxena & Awasthi, 2020).

- **Relationship Between Energy Consumption and Integrating Eco-Friendly Materials**

Since the quantity of energy required to produce and build a product is directly related to the materials used for those processes, there is a strong correlation between energy usage and the incorporation of environmentally friendly materials. Reduce the researcher carbon footprint and make the researcher production, shipping, and product maintenance procedures more eco-friendly by switching to sustainable, low-impact materials. An important component of this connection is the amount of energy required to produce materials. Greenhouse gas emissions are a result of the large energy inputs needed to collect, refine, and process traditional materials like plastic, steel, and concrete. Alternatively, by including eco-friendly materials such as recycled metals, organic fabrics, biodegradable plastics, and bamboo, energy consumption may be decreased. This is due to the fact that these materials often need less processing, lower temperatures, or manufacture driven by renewable energy. Reducing operating energy usage is also greatly assisted by lightweight and high-efficiency materials. Insulated, energy-efficient, and environmentally friendly materials help save heating, cooling, and fuel costs in the building and vehicle sectors. The use of lightweight composite materials in automobiles improves fuel economy, which in turn reduces total energy consumption, while energy-efficient buildings constructed with environmentally friendly insulation reduce the electrical demand for temperature control. The trend towards a circular economy, in which products are not thrown away but rather reused, recycled, or repurposed, is another critical component. Reusing and recycling materials like aluminium, glass, and plastic drastically cuts down on industrial power use compared to making them from scratch. Similarly, unlike conventional synthetics, which need energy-intensive waste management methods to disintegrate, renewable and biodegradable materials break down spontaneously. To further reduce energy usage, businesses that use environmentally friendly products often team up with renewable power sources. Maximum energy efficiency with lowest environmental effect is achieved via sustainable supply chains, wind power, solar power, and other renewable energy sources. Finally, by encouraging low-energy manufacturing methods, improving product energy efficiency, and supporting circular economic concepts, including eco-friendly materials effectively contributes to lowering energy consumption across sectors. The world's energy demand can be drastically cut if companies and consumers start using sustainable materials. This would lead to a future that is both more efficient with resources and less harmful to the environment (Singh et al., 2023).

Because of the above discussion, the researcher formulated the following hypothesis, which was analyse the relationship between Energy Consumption and Integrating Eco-Friendly Materials.

"H_{01}: There is no significant relationship between Energy Consumption and Integrating Eco-Friendly Materials."

"H_1: There is a significant relationship between Energy Consumption and Integrating Eco-Friendly Materials."

Table 2: H_1 ANOVA Test

ANOVA					
Sum					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	39588.620	301	6235.824	1150.096	.000
Within Groups	492.770	223	5.422		
Total	40081.390	524			

In this study, the result will significant. The value of F is 1150.096, which reaches significance with a p-value of .000 (which is less than the .05 alpha level). This means the ***"H1: There is a significant relationship between Energy Consumption and Integrating Eco-Friendly Materials"*** is accepted and the null hypothesis is rejected.

9. DISCUSSION

Sustainable industrial design has come a long way, yet there are still obstacles. One way is to use environmentally friendly production methods and sustainable materials. To help inform future industrial product design, the researcher in this study synthesised the most important results from previous research and discussed their potential consequences. As people become

more conscious of the environmental impact of conventional materials, industrial product designers are looking for alternatives. Biodegradable polymers, recyclable metals, and natural fibres are some of the materials that have shown promise in the research. Among the many ways in which these materials aid in the attainment of larger sustainability objectives are the reduction of waste and carbon emissions. For instance, recycled metals may help save resources by reducing the energy needed for extraction and processing, while biodegradable polymers can break down faster in natural settings, reducing long-term pollution. Meanwhile, working with these materials isn't exactly a picnic. The higher starting cost of acquiring environmentally friendly materials is a major obstacle to their broad usage, according to academics. The issue of whether sustainable materials are appropriate for certain applications arises from the fact that they may not always perform as well as traditional materials. Research into ways to enhance material properties while decreasing prices via technical advancements and economies of scale must continue in order to meet these difficulties.

10. CONCLUSION

There are new possibilities and old challenges that have emerged from research on environmentally friendly manufacturing techniques and materials. Opportunities to reduce environmental effects have become available due to advancements in manufacturing methods and materials. However, challenges, such worries about the product's cost and efficiency, must also be taken into account. To attain sustainability goals, industrial product designers must have a thorough design process, realistic implementation techniques, and a commitment to continual research and innovation. The removal of these barriers will improve the industry's prospects of adopting eco-friendly practices that can adjust to a changing world.

REFERENCES

[1] Adekanmbi, A.O., & Wolf, D. (2024). Solid Mineral Resources Extraction and Processing

[2] Al-Nuaimi, S.R., & Al-Ghamdi, S.G. (2022). Sustainable consumption and education for sustainability in higher education. Sustainability, 14(12), 7255.

[3] Awan, U., & Sroufe, R. (2022). Sustainability in the circular economy: insights and dynamics of designing circular business models. Applied Sciences, 12(3), 1521.

[4] Cooke, S.J., Nguyen, V.M., Anastakis, D., Scott, S.D., Turetsky, M.R., Amirfazli, A., Hearn, A., Milton, C.E., Loewen, L., Smith, E.E., & Norris, D.R. (2020). Diverse perspectives on interdisciplinarity from Members of the College of the Royal Society of Canada. Facets, 5(1), 138-165.

[5] Gaha R, Durupt A, Eynard B. Towards the implementation of the Digital Twin in CMM inspection process: Opportunities, challenges and proposals. Procedia Manuf. 2020; 54:216–221.

[6] Ilieva, L., Ursano, I., Traista, L., Hoffmann, B., & Dahy, H. (2022). Biomimicry as a sustainable design methodology—introducing the 'Biomimicry for Sustainability 'framework. Biomimetic, 7(2), 37.

[7] Ilugbusi, S., Akindejoye, J.A., Ajala, R.B., & Ogundele, A. (2020). Financial liberalization and economic growth in Nigeria (1986-2018). International Journal of Innovative Science and Research Technology, 5(4), 1-9.

[8] Saxena KK, Awasthi A. Novel Additive Manufacturing Processes and Techniques in Industry 4.0. 2020.

[9] Singh, L., Yahya, M. M., Singh, B., Sehgal, S., Saxena, K. K., & Mohammed, K. A. (2023). Investigation of the Effects of Overlapping Passes on Friction Stir Processed Aluminum Alloy 5083. Metal Science and Heat Treatment, 1-5.

[10] Using Innovative Technology in Nigeria. ATBU Journal of Science, Technology and Education, 12(1), 1-16.

[11] Van Dam, K., Simeone, L., Keskin, D., Baldassarre, B., Niero, M., & Morelli, N. (2020). Circular economy in industrial design research: a review. Sustainability, 12(24), 10279.

[12] Zheng P, Hong Lim KY. Product family design and optimization: A digital twin-enhanced approach. Procedia CIRP. 2020; 93:246–250.