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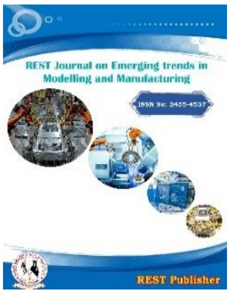

An Analysis on Sustainable Automotive Car Body Material Using Weighted Sum method

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Abstract: *Introduction: In order to reduce its influence on the environment, the automobile industry must overcome a significant obstacle and switch to sustainability car body materials. This overview examines the demand for cutting-edge materials that enhance vehicle performance, increase recycling, and minimize carbon emissions. The sector can meet expanding transportation demands while promoting a greener future by using sustainable options. The automotive industry plays a major role in the global carbon footprint, with car body products being a major contributor. As sustainability becomes a major concern, the need for eco-friendly alternatives to traditional materials is clear. This introduction explores the concept of sustainable automotive car body materials, highlighting their importance in reducing emissions, conserving resources and promoting a greener future. By exploring innovative solutions, the industry can embrace sustainability while maintaining high-performance standards. Research significance: Research on sustainable automotive car body materials is significant in addressing the pressing challenges facing the automotive industry. By focusing on the development and use of environmentally friendly alternatives, this research aims to reduce the environmental impact of the industry. By reducing carbon emissions and promoting resource conservation, sustainable car body materials can contribute to a greener and more sustainable future. Furthermore, this research has the potential to improve energy efficiency and vehicle performance, leading to safer and more efficient vehicles. Additionally, by meeting growing consumer demand for sustainable options, this research will help automakers gain a competitive edge in the market and align their products with the values and expectations of environmentally conscious consumers. Method: The weighted sum method is a decision-making technique that assigns weights to different criteria and calculates an overall performance score of the alternatives. By assigning relative importance to each criterion, this method allows decision makers to objectively evaluate options and make informed choices. The weighted sum method combines the weighted scores of each criterion to obtain a comprehensive performance measure that enables a systematic approach to decision making. The method provides a structured framework for analyzing complex decision-making problems, finding applications in fields as diverse as project selection, supplier evaluation, and product design. Alternate parameters: Steel Alloy (AHSS), Aluminium Alloy (A7075 T6), Carbon Fiber/ epoxy laminate (CL), Titanium Alloy (Ti6Al4 V). Evaluation parameters: Tensile Strength (Mpa), Stiffness (Gpa), Damping capacity, Cost (Rs), CO2 Emission (Ton/Ton), Results: The Steel Alloy (AHSS) is in 1st rank. The Aluminium Alloy (A7075 T6) is in 4th rank. Carbon Fiber/ epoxy laminate (CL) is in 2nd rank. Titanium Alloy (Ti6Al4V) is in 3rd rank. The result is done by using the WSM method. Conclusion: sustainable automotive car body material in the Steel Alloy (AHSS) is in 1st rank. The Aluminium Alloy (A7075 T6) is in 4th rank. Carbon Fiber/ epoxy laminate (CL) is in 2nd rank. Titanium Alloy (Ti6Al4V) is in 3rd rank. The result is done by using the WSM method.*

Keywords: *MCDM, Steel Alloy (AHSS), Aluminium Alloy (A7075 T6), Carbon Fiber/ epoxy laminate (CL).*

1. INTRODUCTION

The automotive sector is pushing for European regulations as well as the greatest standards of financial and environmental efficiency. The latter is a major driving force for the use of sustainable materials. According to Directive 2000/53/EG of the European Commission, recycling must account for eighty-five percent of a vehicle's weight by 2005. By 2015, this recycling rate will grow to 95% [1]. Durability continues to become a significant priority for the automotive industry, promoting an ever-greater reduction in the overall ecological effect of automobiles globally and ensuring that each machine is an item that is ecologically sustainable. Due to this tendency, the initial equipment makers (OEMs) are under increased pressure to not only discover creative methods to minimize their environmental impact utilizing material saving, improved procedures, but also to produce quantitative criteria to gauge their success [2]. However, it should be highlighted that lightweight materials aren't always the most environmentally beneficial choice when considering the entire life cycle. For instance, a study to evaluate the possible benefits of lightweight components like metal found that major modification in present manufacturing and assembly methods was needed. It was found that parts made of steel work best with the equipment and processes currently in use. thus, a complete redesign of this equipment and processes is required to produce aluminium components (Ungureanu, 2007b). The choice of material and manufacturing technique has an impact on the facilities for car recovery as well [3]. It should be noted, nevertheless, that from a whole life cycle perspective, lightweight materials aren't necessarily the most environmentally friendly option. For instance, a study to assess the potential advantages of lightweight materials like aluminium discovered that significant change was required in current manufacturing and assembly technology. The production of aluminium components will necessitate a full redesign of the equipment and procedures now in use because they are more appropriate for steel-based components (Ungureanu, 2007b). The infrastructure for car recovery is also impacted by the selection of material and production method [4]. Sustainable product development, when applied to automobile construction, necessitates a harmony between the technological, economic, and environmental domains. The current study examines crucial input variables and multiple indicators to choosing materials of DFS, which is (Design for Sustainable) and generally eco-friendly lightweight vehicle building. This study offers a set of criteria for material selection that takes into account every sustainability-related factor. These metrics cover the product's productivity, usefulness, and environmental impact in addition to its economic and social benefits. The remainder of the manuscript reveals the topic selection strategy's flaws [5]. The choice of materials that support protecting the environment and environmentally friendly design is aided by a complete life cycle assessment, or LCA, of material candidates using environmental indicators. In this material selection procedure, environmental indicators, material costs, the physically most effective layout with respect to lowest mass are calculated [6]. Vehicle usage and production have significantly expanded in China. Between 2008 to 2017, China's car manufacturing and sales increased by more than 10%, reaching 29.00 million in 2017. According to the "the People's Vehicles Environmental Management Company Group Annual Report 2018" released with the Ministry of Environmental & Environmental of the People's Republic of China, 240 million vehicles were owned in China as of the end of 2018, a rise of 10%. Despite the fact that having a car makes life easier, it also adds to issues like severe air pollution and resource scarcity, which are currently affecting the way people live. Additionally, Chinese has served as the world's biggest manufacturer and marketer of automobiles for a period of nine years, and vehicle emissions have become an important factor and contributor to global warming Despite the fact that having a car makes life easier, it also adds to issues like severe air pollution and resource scarcity, which are currently affecting human activity. Car emissions have become an important contributor and contributor to air pollution, and during the past decade, Chinese has become the biggest global manufacturer and marketer of automobiles. At the exact same time, China's automobile ownership increased by 10% over the five years prior, reaching 240 million vehicles at the completion of 2018. The Department of Environmental and Ecology of the Republic of China published "China Vehicles Environmental Management Committee Annual Report 2018" Although a vehicle makes life more convenient, it also contributes to issues like resource shortages and harmful air pollution, which now have an impact on human activity. Additionally, during the past nine years, China has emerged as the biggest global manufacturer and marketer of automobiles, and vehicle emissions have grown to be an important contributor and reason for air pollution. The following succinctly describes these techniques: enhancing drivetrain effectiveness, creating new energy vehicles, changing fuel systems, or substituting lightweight components are a few examples [8]. Until the expected large storage capacity of nanotubes for hydrogen is proven, and sustainable hydrogen generation (e.g., electrolysis with solar energy) and hydrogen transport strategies are not available in the centers of cities, and storage filling stations are not a solution. It will be a vision. Fortunately, the automotive industry and the oil production industry are trying to address this topic in a concerted effort [9]. Advances in certain areas are needed to make aluminium an environmentally friendly material for the automobile sector. To accommodate the processing requirements for aluminium, the automobile industry's current manufacturing and assembly techniques must be updated, and recycling systems must concentrate on developing efficient ways to recycle resources. All material qualities are advantageous. We can use more aluminium and other lightweight components if we can get beyond these technical obstacles and produce it more cheaply in road vehicles, keep their usefulness and contribution to the preservation of the natural world. effective recycling of resources [10]. Lightweight automobile ideas that minimise emissions began to be produced sustainably in 2004, began in 2005, and finished in 2009. 38 partners, including Ten R&D companies, ten suppliers, eight universities, three SMEs, and seven original equipment manufacturers are going to evaluate new and existing technologies and provide their insights on how to reduce CO2 emissions and fuel usage. The inspiration the creation of a new lightest car was integrated with the planning and construction of a smaller vehicle framework. Benefits to the local economy, the environment, and customers globally. The SLC vehicle needs to be cutting-edge. (multiple) material vehicle architecture that can be economically manufactured and suitable for large series production [11]. NFCs are employed in the automotive industry, especially to lighten components by up to 34% in weight. Due to the use of decomposing materials, the latest Lotus Green Elise, which was released in the latter part of 2008, weighed thirty-two kilograms less than the conventional model. In the creation of its E-Class vehicles, Mercedes-Benz is also utilizing more bio-composites. Most vegetable fibers have distinctive mechanical properties as a result of their biochemical difficulty, various biopolymers (such cellulose, crystal a substance called and gelatin), and nanostructured design. Movement. Jute, cotton, and linens are the three fibers from nature that perform the best. They are primarily selected due to their outstanding durability against bend and bending stretching, low heat, electricity, and noise conductivity, electromagnetic transparency, and low energy requirements during production, and finally, that they are biodegradable, recyclable, and ultimately derived from renewable sources. [12]. As the first large wave of mixed turbines accomplish their end-of-life (EoL) and shut down in 2019 or 2020, flights due to the Covid-19, a global epidemic accelerated by dissatisfaction, as well as a rise in composite materials in manufactured cars due to the development of massive technologies centred on thermoplastic material composites, such socio-technical pressure will only increase. The pressure on the creation of eco-friendly hybrid recycling systems would only grow under such socio-technical circumstances [13]. In particular for structure and semi-structural automotive applications, natural-based fibre technologies are resurging in the creation of composites for ecologically friendly product design. In this work, the analytical hierarchy procedure, or AHP, method was used to select the best-suited fibres to be hybridised using glass fibre reinforcing polymers for the fabrication of the passenger vehicle central lever park brake component [14]. While physical energy production uses more effective pollution management strategies like carbon sequestration, commercial use of energy is more likely to come from renewable energy sources (hydro, wind, nuclear, etc.). Second, the principles of this analysis substantially change if we believe that any or all of the vehicle parts have been reused after reaching the conclusion of their useful lives. We may firmly assert the energy content of the recycled materials if all of the component parts are recycled [15].

2. MATERIALS AND METHOD

In addition to continually adjusting the weights to produce several solution points, the weighted sum approach for multi-objective optimisation (MOO) is still frequently employed to produce only one solution location that reflects the alternatives available when choosing a single set of weights. The method's efficacy in this later capacity hasn't been properly investigated, though. There are a variety of methods for assigning weight (Marler and Arora 2004, to be sure), but in the end, they are all different ways to arrange one's tastes and priorities. We concentrate on the mathematical characteristics of the solution and the conceptual underpinnings of the weights rather than suggesting a different method for converting preferences into weights. [16]. In the setting of multicriteria truss optimisation, a weighted sum technique. Skye and Geasy (1988) discuss the use of multiobjective optimisation in the design of flight control systems. The -constraint approach was created by Marklin in 1967 and involves minimising one objective function while imposing a greater constraint on additional objective function (Steuer 1986). The equality constraint approach was created by Lin (1976), reducing objective functions one at a time while simultaneously stating limits on other objective functions [17] . The Pareto surface is easily approximated using the traditional weighted sum method, and an array of Maximum front connections is found. Each Pareto front is improved by adding additional equality constraints to the individually flat hypersurface in the m-dimensional goal space that connect the pseudo nadir point with anticipated Pareto optimum solutions. It has been demonstrated that the method discovers solutions in convex regions and creates a well-distributed Proportional front mesh for usable visualisation. With the weighted sum method, the weights are consistently changed, and each single goal optimisation yields a unique optimal solution. These are Pareto front estimates of the solutions. Weights with no values could result in weak Pareto optimum solutions if they have non-unique Sore points. There is historical development of the weighted sum approach. Zathe (1963). The weighted sum approach was utilised for structural optimisation by Koski (1988). The control method was created by Marklin in 1967, and equality control method by Lin in 1976. The use of simulated annealing in multiobjective optimisation is discussed by Subpabitnorm et al. (1999), and multiobjective optimisation using genetic algorithms is covered by Goldberg (1989) and Fonseca and Fleming (1995). [18]. The weighted sum approach is employed locally in the MOEA/D-LWS, an innovative decomposition-based EMO algorithm. This means that in every direction, the best answer is only chosen from its nearby solutions. A hyper cone is used to define the neighbourhood. A hypercone's apex angle is automatically and deterministically determined. Using a Using the weighted sum approach, the PF can be quickly approximated, and the mesh of ideal front links can then be created. By incorporating equality restrictions between the anticipated Macro best solution and the nadir point, patches on one plane of region in the goal space are further enhanced. It is asserted that this strategy is effective. It is more challenging to create a network of optimum front linkages in multi-objective problems. For multi-objective optimisation, it is suggested to use a multilayer weighted sum. The theory is nevertheless supported by the usage of Pareto front connections, but [19]. The weighted sum strategy for MOP is used to find Pareto optimum points, where the weight combination is adaptively selected by considering all currently undominated points. Our numerical results show that the strategy can produce uniform Despite having a curved front, it has Pareto front coverage. In PAWS, two well-known methodologies—the weighted average method & the confidence region method (TRM)—are combined. If the structure for every of the goals or function in the MOP is known, we may utilise roughly represent the front of the Pareto solution resulting in the Wald solution in (1) merging to a proportionate optimum point (Zadeh 1963). To produce an estimate within a finite confidence zone, we use the TRM, which continuously builds a simple sector approximation model., for complex function objectives when the cost of estimation is computationally expensive. [20]. By emphasising uncommon mutations in unaffected individuals, the weighted sum technique prevents frequent mutations from totally dominating the test. Common mutations have a significant impact on the collective signal in the CAST approach, and if the group has a lot of them, practically every member will carry a mutation or two. The weighted sum technique contrasts samples from affected as well as unrelated individuals based on the total amount of mutations in a particular category of variations. [21]. In order to lower production costs, increase the effectiveness of the manufacturing process, and improve product quality, optimisation studies have received a lot of interest in a variety of areas. Taguchi and the method of response surfaces are two optimisation approaches frequently used in concrete design. Recent Taguchi optimisation experiments have demonstrated that getting superior mechanical and durability qualities requires the best handling of concrete materials/concrete. The wastewater spray volume, temperature, carbonation time, and pre-drying process were among the experimental variables that were optimised using a linear weighted sum method. While treatments soaking in water for 5 s was employed as a comparison, the amount of effluent spray on the surface varied between 20% to 80% of the RMA's water absorption value. Reduce maintenance expenses through increasing production costs, the effectiveness of the production process, and product quality. Taguchi, the and the Response Surface Method are two optimisation approaches frequently used in solid design. Recent Taguchi optimisation experiments have demonstrated that getting superior mechanical and durability qualities requires the optimum handling of concrete materials/concrete. The wastewater spray volume, temperature, carbonation time, and pre-drying process were among the experimental variables that were optimised using the principle of linear weighted sum method. Between 20 and 80 percent of the surface's absorbent value of the wastewater was sprayed on it. [22]. An intelligent sample approach (ISA) led by an adaptable weight-sum approach (AWS) is suggested to lower the computational expense of multi-objective optimisation (MOO) with costly black-box simulation models. Step-by-step MOO metamodel. Latino Hypercube Sampling (LHS) and the Radial Basis Function, or RBF, are used to disperse the samples around the design space in an initial metamodel. Based on the structured metamodel, the effective Pareto Frontier (POF) is obtained using an adaptive weighted-sum approach. The design variables pertaining to the boundary's extreme points and the additional point that is interpolated between the boundary's maximum-minimum distance point and the closest boundary point are chosen as pertinent indicates for updating the metamodel, which may slowly improve the accuracy of the metamodel. This incremental updating technique [23]. The objective of this study is to create a multi-objective CSSO approach that offers a broadly spread, roughly equally spaced Pareto front. Early design is greatly aided by a consistent and widely dispersed Pareto front because it provides a thorough awareness of all potential outcomes. The Adapted Weighted Sum (AWS) approach, a multi-objective optimisation technique, may spread the Pareto front fairly and address the drawbacks of the traditional weighted sum method. To find more Pareto optimum solutions, the weighted sum approach is applied to these possible domains in the following phase. The process of Pareto prior connection size estimate is repeated when new optimal Pareto solutions are produced to identify potential improvement areas. Repeating these actions results in a conclusion [24]. First, the WS method has been calibrated using spherical particles; therefore, it is unclear whether a method built around this technique or an alternative one would be capable of detecting particles of random form, so further studies should be performed out. Second, considering WS and SMPS particles are spherical may cause doubt if doing measurements in the field due to the various shapes of particles in the environment [25].

Steel Alloy (AHSS): Alloy Steel (AHSS), which stands for Advanced High Strength Steel, refers to a class of steel alloys that exhibit exceptional strength and improved performance properties compared to conventional steels. AHSS is specifically designed to provide high tensile strength, good formability, and enhanced energy absorption capabilities, making it well suited for various automotive and industrial applications.

Aluminium Alloy (A7075 T6): alloy of aluminium High-strength aluminium alloy A7075 T6 is a member of the 7000 class of aluminium alloys. It is widely employed in a variety of sectors, including those that require lightweight materials with outstanding strength, like aerospace, automotive, and sporting goods. The notation "A7075" denotes the alloy composition, whereas "T6" denotes the alloy's nature or state after heat treatment. T6 tempering results in increased strength and hardness CL through solution heat treatment, quenching, and artificial ageing. These fibres offer an excellent stiffness-to-weight ratio and are extremely strong. They give the laminate structural sturdiness. A robust composite structure is produced by the carbon fibres adhering to the epoxy resin matrix. In addition to giving the carbon fibres cohesiveness, the epoxy resin also serves as a stress-distribution medium that acts as a load transfer for the laminate.

Carbon Fiber/ epoxy laminate (CL): Carbon fibre/epoxy laminate (CL) is a composite material that combines carbon fiber reinforcement with an epoxy resin matrix. It is known for its high strength, light weight and excellent stiffness properties. Carbon fibers, thin filaments of carbon atoms, are the primary reinforcement in CL. These fibers are very strong and have a high stiffness-to-weight ratio. They provide structural strength to the laminate. The epoxy resin matrix binds the carbon fibers around, creating a rigid composite structure. The epoxy resin not only provides cohesion to the carbon fibers but also acts as a load transfer medium, distributing stresses across the laminate.

Titanium Alloy (Ti6Al4 V): The grade 5 titanium alloy, often known as titanium alloy (Ti6Al4V), is a well-liked and frequently utilised titanium alloy. 90% of the material is titanium, 6% is aluminium, and 4% is vanadium. The high strength-to-weight ratio, corrosion resistance, and biocompatibility of Ti6Al4V are well known. Durability and size, corrosion resistance, and biocompatibility are benefits of Ti6A14V.

Tensile Strength (Mpa): Tensile strength, expressed in megapascals (MPa), is a measure of the maximum stress a material can withstand before failing or breaking under tensile (pulling or stretching) forces. It refers to a material's resistance to being stretched or stretched. Tensile strength is determined by subjecting a test specimen of the material to a controlled tensile force until it breaks. Ultimate tensile strength (UTS), often referred to as tensile strength, is the maximum stress achieved during this test. It is measured in MPa, which is equal to one million pascals.

Stiffness (Gpa): A material's stiffness or resistance is described by the mechanical attribute of stiffness, which is measured in gigapascals (GPa). It describes a material's capacity to withstand bending, stretching, or compression forces without suffering considerable elastic deformation. The degree to which a substance resist alteration to size or form when tested with external loads is known as its stiffness. It has to do with the substance's Young's modulus, also known as a material's modulus of elasticity, that gauges its capacity to withstand deformation due to elasticity in response to stress. This implies that greater effort is needed to cause an amount of deform or strain in a harder material.

Damping capacity: Damping capacity refers to the ability of a material or system to dissipate or absorb energy during vibration or oscillation. When a material or structure is subjected to mechanical vibrations or oscillations, it will exhibit a certain amount of energy loss or damping. This loss of energy is referred to as damping, and damping efficiency refers to the effectiveness of a material or system in reducing or controlling vibrations. Damping is essential in a variety of fields and applications, including mechanical engineering, civil engineering, automotive engineering, and structural design. It plays an important role in preventing excessive vibrations, reducing noise, improving stability and improving the overall performance and life of structures and systems.

Cost (Rs): Cost, in this context, refers to the monetary value or price of a product, service or item. The unit "Rs" stands for the Indian currency, the Indian Rupee. It is used to indicate the price of goods or services in India. The price of a product or service varies depending on various factors such as product type, quality, market demand, competition, production costs and other economic factors. It is usually expressed in the currency of the country in which the transaction takes place. The price of goods or services is an essential consideration when businesses and consumers make purchasing decisions.

CO2 Emission (Ton/Ton): CO2 emissions, expressed in tons per ton (t/t), refer to the amount of carbon dioxide (CO2) gas released into the atmosphere per metric ton of a specific activity, process, or product. It measures the amount of CO2 emitted as a by-product of a specific activity or the carbon footprint associated with a specific unit of output or consumption. CO2 emissions are typically associated with a variety of human activities, including industrial processes, transportation, energy production, and agriculture. The release of CO2 into the atmosphere is a significant contributor to climate change and global warming, as CO2 is a greenhouse gas that traps heat in the Earth's atmosphere. Measuring CO2 emissions per ton allows standardized comparisons across different activities and industries. By expressing emissions in this way, it becomes possible to assess the carbon intensity or environmental impact of a particular process or product.

3. RESULT AND DISCUSSION

TABLE 1. Material properties

Materials	Tensile Strength (Mpa)	Stiffness (Gpa)	Damping capacity	Cost (Rs)	CO2 Emission (Ton/Ton)
Steel Alloy (AHSS)	1000	193	0.05	145	1.9
Aluminium Alloy (A7075 T6)	572	72	0.002	486	4.8
Carbon Fiber/ epoxy laminate (CL)	3500	70	0.048	2000	20
Titanium Alloy (Ti6Al4 V)	862	110	0.015	1600	7.2

The material characteristics of the substitute materials used for the sustainable car body are displayed in Table 1. Steel alloys (AHSS), aluminium alloys (A7075 T6), carbon fibre/epoxy laminates (CL), and titanium alloys (Ti6Al4 V) are available as alternatives. Tensile strength (Mpa), stiffness (Gpa), dampening ability, cost (Rs), and CO2 emission (Ton/Ton) are the evaluation criteria listed here. The characteristics of tensile strength (Mpa), stiffness (Gpa), and damping capability are advantageous. Cost (Rs) and CO2 Emissions (Ton/Ton) are unfavourable requirements.

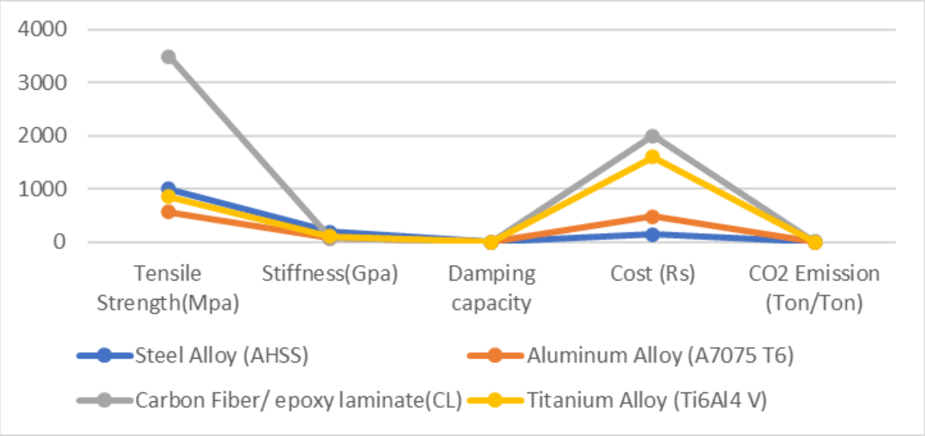

FIGURE 1. material properties

Figure 1 illustrates the material properties of alternative materials used in material selection for sustainable car body. Here alternatives are Steel Alloy (AHSS), Aluminium Alloy (A7075 T6), Carbon Fiber/ epoxy laminate (CL), Titanium Alloy (Ti6Al4 V). Here evaluation parameters are Tensile Strength (Mpa), Stiffness (Gpa), Damping capacity, Cost (Rs), CO2 Emission (Ton/Ton). Tensile Strength (Mpa), Stiffness (Gpa), Damping capacity are beneficial criteria. Cost (Rs), CO2 Emission (Ton/Ton) are non-beneficial criteria.

TABLE 2 normalized matrix

0.285714	1	1	1	1
0.163429	0.373057	0.04	0.298354	0.395833
1	0.362694	0.96	0.0725	0.095
0.246286	0.569948	0.3	0.090625	0.263889

Table shows the normalized matrix values for the given decision matrix following weighted sum method.

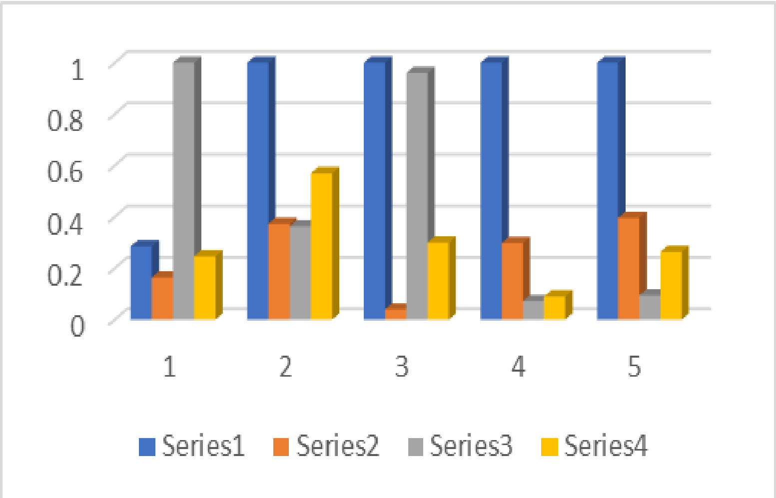

FIGURE 2. Normalized matrix

This graph shows the normalized matrix values for the given decision matrix following weighted sum method.

TABLE 3. Weight matrix

0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2

Table shows the Weight distributed among evaluation parameters. Sum of the weight distributed among evaluation parameters (Tensile Strength (Mpa), Stiffness (Gpa), Damping capacity, Cost (Rs), CO2 Emission (Ton/Ton)) is one.

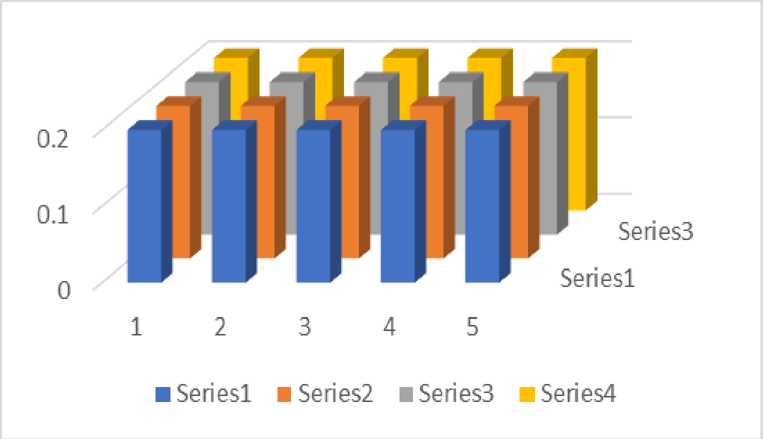

FIGURE 3. Weight matrix

This graph shows the Weight distributed among evaluation parameters. evaluation parameters (Tensile Strength (Mpa), Stiffness (Gpa), Damping capacity, Cost (Rs), CO2 Emission (Ton/Ton)

TABLE 4. Weighted normalized decision matrix

0.057143	0.2	0.2	0.2	0.2
0.032686	0.074611	0.008	0.059671	0.079167
0.2	0.072539	0.192	0.0145	0.019
0.049257	0.11399	0.06	0.018125	0.052778

This table shows the weighted normalized decision matrix. In this table we multiply the the values of normalized and weight matrix. The evaluation parameters are (Tensile Strength (Mpa), Stiffness(Gpa), Damping capacity, Cost (Rs), CO2 Emission (Ton/Ton).

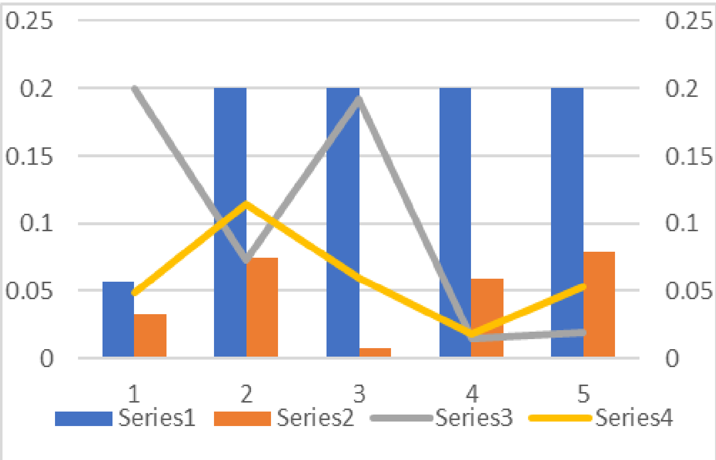

FIGURE 4. Weighted normalized decision matrix.

This graph shows the weighted normalized decision matrix. for the given decision matrix following weighted sum method.

TABLE 5. Preference Score & Rank

	Preference score	Rank
Steel Alloy (AHSS)	0.857143	1
Aluminium Alloy (A7075 T6)	0.254135	4
Carbon Fiber/ epoxy laminate (CL)	0.498039	2
Titanium Alloy (Ti6Al4 V)	0.29415	3

This table shows the Table final rank of this paper. The Steel Alloy (AHSS) is in 1st rank. The Aluminium Alloy (A7075 T6) is in 4th rank. Carbon Fiber/ epoxy laminate(CL) is in 2nd rank . Titanium Alloy (Ti6Al4V) is in 3rd rank. The result is done by using the WSM method.

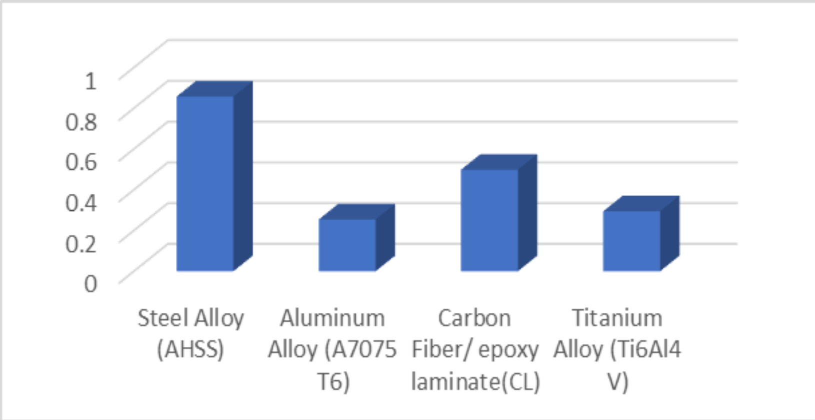

FIGURE 5. Preference Score

Figure 5 graph shows the preference Score for Steel Alloy (AHSS) 0.857143, Aluminium Alloy (A7075 T6) 0.254135, Carbon Fiber/ epoxy laminate (CL) 0.498039, Titanium Alloy (Ti6Al4 V) 0.29415.

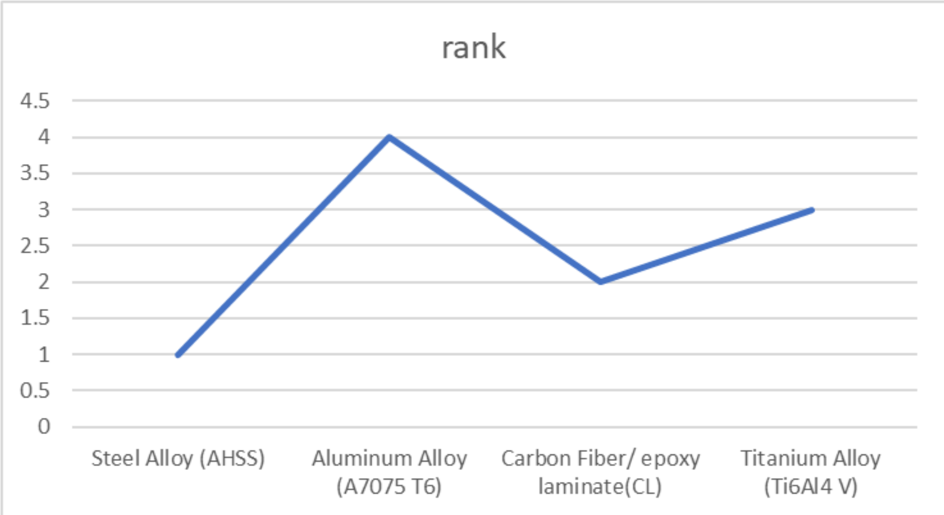

FIGURE 6. Rank

Figure 6 shows the final rank. The Steel Alloy (AHSS) is in 1st rank. The Aluminium Alloy (A7075 T6) is in 4th rank. Carbon Fiber/ epoxy laminate (CL) is in 2nd rank. Titanium Alloy (Ti6Al4V) is in 3rd rank. The result is done by using the WSM method

4. CONCLUSION

The automotive sector must overcome a big barrier and convert to recyclable car body materials in order to lessen its environmental impact. This overview looks at the requirement for cutting-edge materials that enhance vehicle performance, boost recycling rates, and lower carbon emissions. By utilising sustainable choices, the sector may support a more sustainable future while still meeting rising transportation needs. In the automotive sector, sustainable building not only calls for higher costs and environmental effectiveness, but also requires European standards. The latter serves as a powerful catalyst for the use of sustainable products. By the year 2005, recycling must account for 85% of a vehicle's weight, according to European Commission Directive 2000/53/EG. By 2015, this rate of recycling will rise to 95%. Sustainability is still a major concern for To make certain that the automobile is a product that is environmentally sustainable, the automotive industry advocates for continual decreases on the total environmental effect of vehicles worldwide. Due to this trend, OEMs (original equipment manufacturers) face increasing pressure to not only create new methods for reducing their environmental impact using resource-saving, more effective processes, but also to create quantifiable measurements for evaluating their success. A single solution site is produced using a sum-weighted approach for multi-objective optimisation (MOO), with weights being continuously changed to yield several solution points. The method's efficacy in this latter application has not been sufficiently studied. Although there are other techniques to assign weight, they are all ultimately just different methods to arrange one's preferences and priorities. We focus on the mathematical features of the solution and the philosophical underpinnings of the weights rather than offering a different way for translating preferences into weights. Tensile power (MPA), stiffness after exercising (GBA), dampening capacity, cost (Rs), and CO2 emission (T/T) are the evaluation metrics. AHSS (Steel Alloy) is ranked first. Fourth place goes to aluminium alloy (A7075 T6).

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