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Integrated DFMA, Sustainability, and Finite Element Assessment of a Vacuum Thermos Flask Redesign

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ABSTRACT

This study evaluates a redesigned vacuum thermos flask by integrating Design for Manufacturing and Assembly (DFMA), computer-aided sustainability assessment, finite element analysis (FEA), and cost comparison. The baseline and redesigned models were developed in SolidWorks 2019. The redesign increased the reported part count from 2 to 6 and assembly time from 120.25 to 360.48 s, while assembly cost rose from RM1.30 to RM2.80; however, the reported design-efficiency score increased from 30% to 48%. Replacing the principal AISI 304 body material with high-density polyethylene reduced modelled product mass from 1107.81 to 149.69 g. The software outputs indicated reductions of 88.78% in carbon footprint, 99.59% in water eutrophication, 83.30% in air acidification, and 87.14% in total energy consumption. Injection-moulded component cost decreased by 30.76%. FEA results under a 100 N load were mixed: most cases remained below the reported yield strength, but one stress result and one displacement result were physically inconsistent and require model verification. The redesign therefore offers substantial environmental and material benefits but introduces assembly and structural-validation trade-offs. The study supports Sustainable Development Goals 9 and 12 through resource-efficient product development and digital engineering.

Keywords: Design for manufacturing and assembly, Finite element analysis, Product redesign, Sustainable design, Vacuum thermos flask.

1. INTRODUCTION

Contemporary sustainable product development treats environmental, economic, and functional requirements as concurrent design criteria rather than downstream checks. Recent research shows that the greatest opportunity to influence resource use and life-cycle impacts occurs while product architecture, materials, manufacturing routes, and recovery strategies remain adjustable [1-5]. Current Design for Excellence research also emphasises that circularity should prioritise reduction, service-life extension, repair, reuse, and recovery rather than relying only on end-of-life recycling [6]. A redesign should therefore be assessed across manufacture, assembly, use, durability, and end-of-life performance instead of being judged by one favourable indicator.

Design for Manufacturing and Assembly (DFMA) provides a structured basis for simplifying product architecture, reducing non-value-adding features, improving handling and insertion, and aligning geometry with feasible production processes. Recent reviews and case studies show that DFMA is most informative when part count, theoretical minimum part count, assembly sequence, operation time, cost, reliability, and end-of-life considerations are evaluated together [7-12]. Consequently, an increase in a reported design-efficiency score does not by itself establish an

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assembly improvement when part quantity, assembly time, and assembly cost simultaneously increase.

Early-stage environmental assessment complements DFMA by quantifying design trade-offs before tooling and production commitments are fixed. Parametric life-cycle assessment (LCA), eco-design software, and computer-aided engineering tools can link CAD geometry to material, process, and scenario data to rapidly compare alternatives [13-15]. Their outputs are nevertheless sensitive to the functional unit, system boundary, database, manufacturing assumptions, transport, use profile, end-of-life model, and uncertainty treatment. CAD-integrated results should therefore be presented as comparative screening indicators unless the underlying inputs and validation procedures are fully documented.

Material substitution is a multi-criteria decision involving environmental burden, density, mechanical and thermal properties, chemical compatibility, manufacturing feasibility, safety, and expected service life [16]. Comparative life-cycle evidence also demonstrates that material rankings depend on the production route, quantity used, operating conditions, maintenance, and lifespan rather than mass alone [17]. In the present case, replacing AISI 304 stainless steel with high-density polyethylene (HDPE) may reduce modelled mass and environmental indicators, but it does not by itself demonstrate equivalent thermal, structural, hygienic, or durability performance.

A vacuum thermos flask relies on the combined performance of its inner vessel, outer body, evacuated or insulated region, neck, cap, seals, and structural supports. Recent numerical and experimental studies show that heat retention is strongly affected by insulation material, thermal conductivity, neck geometry, radiative behaviour, and the interaction between material selection and component architecture [18-20]. Accordingly, a redesigned flask should be validated through heat-retention, external-surface-temperature, leakage, vacuum-integrity, cleaning, and repeated-use tests before material substitution is accepted.

Finite element analysis (FEA) provides an additional structural screening stage by estimating stresses and displacements under prescribed loads. Recent verification and quality-assessment frameworks emphasise transparent reporting of material properties, element formulation, mesh convergence, contacts, fixtures, loading, unit consistency, sensitivity, and comparison with experimental evidence [21-23]. A stress value below nominal yield strength is insufficient to establish structural adequacy when boundary conditions are incomplete or when predicted deformation is physically implausible.

This study critically evaluates a vacuum thermos flask redesign by integrating DFMA-oriented metrics, SolidWorks Sustainability outputs, static FEA, and a partial component-cost comparison. The objective is to compare the baseline and redesigned models in terms of product architecture, reported assembly performance, modelled environmental indicators, structural response, and manufacturing cost, while explicitly identifying trade-offs and data limitations. Because the flask is a reusable product, polymer durability under repeated handling and cleaning is also relevant to the interpretation of service life [24]. The study contributes to SDG 9 through digital product-development methods and to SDG 12 through resource-efficient product redesign.

2. MATERIAL AND METHODS

2.1 Case Study and CAD Model Development

The case study used baseline and redesigned vacuum thermos flask assemblies created in SolidWorks 2019. The baseline architecture was represented by two principal assembled parts: the body and the cap. The redesigned product was reported as six parts. The source image panel includes an assembled cap view together with its subcomponents, so the visual count is not itself used as the quantitative part-count basis. Figure 1 compares the complete baseline and redesigned products, while Figure 2 shows the body and cap architecture used in the redesign.

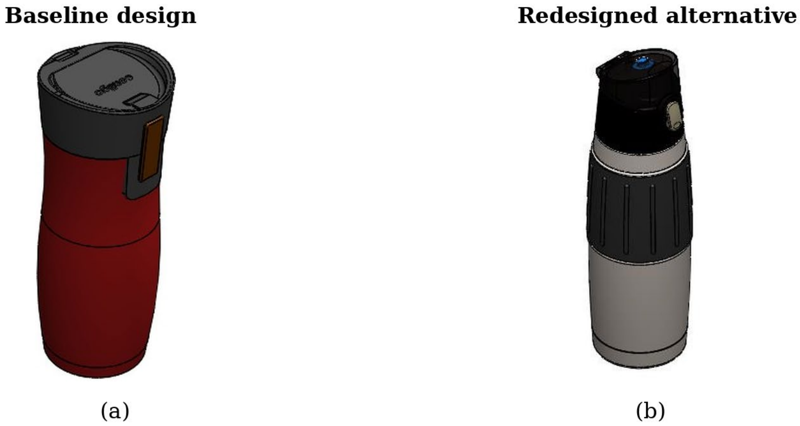

Figure 1: Complete vacuum thermos flask models: (a) baseline design and (b) redesigned alternative.

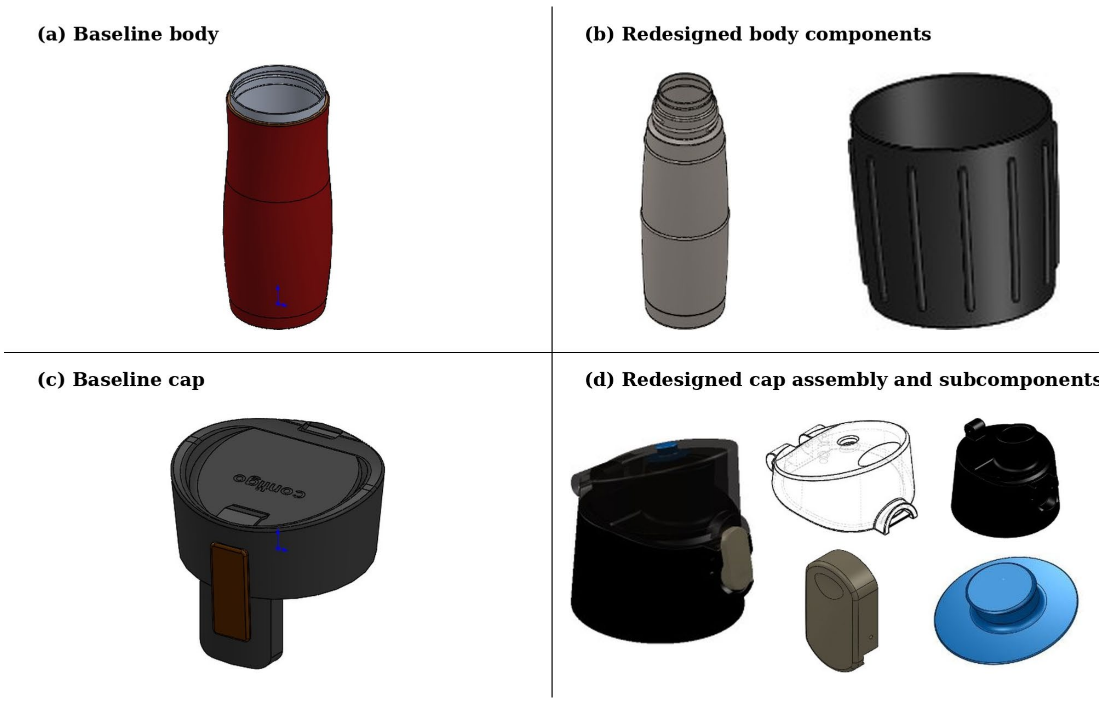

Figure 2: CAD architecture used in the redesign: (a) baseline body, (b) redesigned body components, (c) baseline cap, and (d) redesigned cap assembly and subcomponents.

2.2 DFMA-Oriented Assessment

The available DFMA dataset contained four aggregate metrics: reported part quantity, assembly time, assembly cost, and design efficiency. Table 1 reproduces these values and adds the calculated absolute and relative changes. The source manuscript did not provide the theoretical minimum part count, handling and insertion sequence, operation-level times, calculation sheet, or equation used to obtain the reported design-efficiency score. Recent DFMA literature treats these inputs as essential for a reproducible assessment [7-12]. The present analysis is therefore classified as DFMA-oriented rather than a complete quantitative DFA study.

Table 1: Reported DFMA-related comparison between the baseline and redesigned vacuum thermos flask.

Metric	Baseline	Redesign	Absolute change	Relative change
Reported part quantity	2	6	+4	+200.00%
Assembly time (s)	120.25	360.48	+240.23	+199.78%
Assembly cost (RM)	1.30	2.80	+1.50	+115.38%
Reported design efficiency (%)	30	48	+18 percentage points	+60.00%

For an indicator in which a lower value is preferable, the percentage reduction was calculated using Equation (1).

$$R = [(X_b - X_r) / X_b] \times 100 \quad (1)$$

where R is the percentage reduction, X_b is the baseline value, and X_r is the redesigned value. For metrics that increased, the same denominator was used, and the result was reported as a percentage increase.

2.3 Sustainability Assessment

The environmental comparison was performed using the SolidWorks 2019 Sustainability module. The source study reports the substitution of AISI 304 stainless steel with HDPE for the principal redesigned body material. The reported outputs were product mass, carbon footprint, water eutrophication, air acidification, and total energy consumed. However, the archived records do not specify the exact material assigned to every part, wall thicknesses, manufacturing region, transport distances, use-phase profile, end-of-life scenario, database version, functional unit, or uncertainty analysis. In line with recent eco-design, CAE, and material-selection research [13-17], the results were interpreted as a comparative screening exercise rather than a complete, independently reproducible LCA.

2.4 Finite Element Analysis

Static FEA was conducted in SolidWorks 2019 for six reported component cases. Each case used a maximum applied force of 100 N, and the source tables listed a common yield strength of 172.339 N/mm^2. Maximum von Mises stress and translational displacement were extracted. Stress values reported in N/m^2 were converted to N/mm^2, which is numerically equivalent to MPa. A screening factor of safety was calculated using Equation (2).

$$n = S_y / \sigma_{vm,max} \quad (2)$$

where n is the screening factor of safety, S_y is the reported yield strength, and σ_vm,max is the maximum von Mises stress. The source does not specify mesh density, element type, contact definitions, fixture locations, load distribution, geometric nonlinearity, or the material associated with the stated yield strength. The FEA results were therefore used to identify potential concerns rather than to certify structural performance [21-23].

2.5 Component-Cost Comparison

A separate injection-moulding comparison was reported for an HDPE component set. The available data comprised part quantity, component-set mass, and estimated total cost for the baseline and redesigned alternatives. The percentage cost reduction was calculated using Equation (1). Because tooling investment, production volume, cycle time, scrap, labour beyond the separately reported assembly cost, quality control, overhead, maintenance, and life-cycle cost were not reported, this dataset provides only a partial manufacturing cost comparison.

3. RESULTS AND DISCUSSION

3.1 Product Architecture and Assembly Trade-Offs

The redesigned architecture divides the body into a principal vessel and an external sleeve and introduces a more modular cap arrangement. This configuration may support ergonomic handling, access, and visual differentiation, but it also increases the number of assembly operations. The reported part quantity rose from 2 to 6, corresponding to a 200% increase. Assembly time increased from 120.25 to 360.48 s, or 199.78%, and assembly cost increased from RM1.30 to RM2.80, or 115.38%.

In contrast, the reported design-efficiency score increased from 30% to 48%, an improvement of 18 percentage points or 60% relative to the baseline. Because its calculation basis is absent, this score cannot override the measured increases in part quantity, time, and cost. Recent DFMA research stresses the need to interpret efficiency together with theoretical minimum part count, handling, insertion, sequence, reliability, and end-of-life requirements [7-12]. On the evidence available, the redesign may improve a broader functional or ergonomic criterion, but it does not reduce the reported assembly burden. A repeat assessment should document every assembly operation and calculate the DFA index and labour cost using a recognised method.

3.2 Environmental Performance

Table 2 presents the sustainability outputs. The modelled product mass decreased from 1107.80865 to 149.6855 g, representing an 86.49% reduction. Carbon footprint decreased from 7.629 to 0.856 kg CO_2, water eutrophication from 0.2204 to 0.000913 kg PO_4, air acidification from 0.0437 to 0.0073 kg SO_2, and total energy consumption from 88 to 11.318 MJ. These changes correspond to reductions of approximately 88.78%, 99.59%, 83.30%, and 87.14%, respectively.

Table 2: SolidWorks Sustainability outputs for the baseline and redesigned models.

Indicator	Unit	Baseline	Redesign	Absolute change	Reduction (%)
Product mass	g	1107.80865	149.6855	-958.12315	86.49
Carbon footprint	kg CO_2	7.629	0.856	-6.773	88.78
Water eutrophication	kg PO_4	0.2204	0.000913	-0.219487	99.59
Air acidification	kg SO_2	0.0437	0.0073	-0.0364	83.30
Total energy consumed	MJ	88	11.318	-76.682	87.14

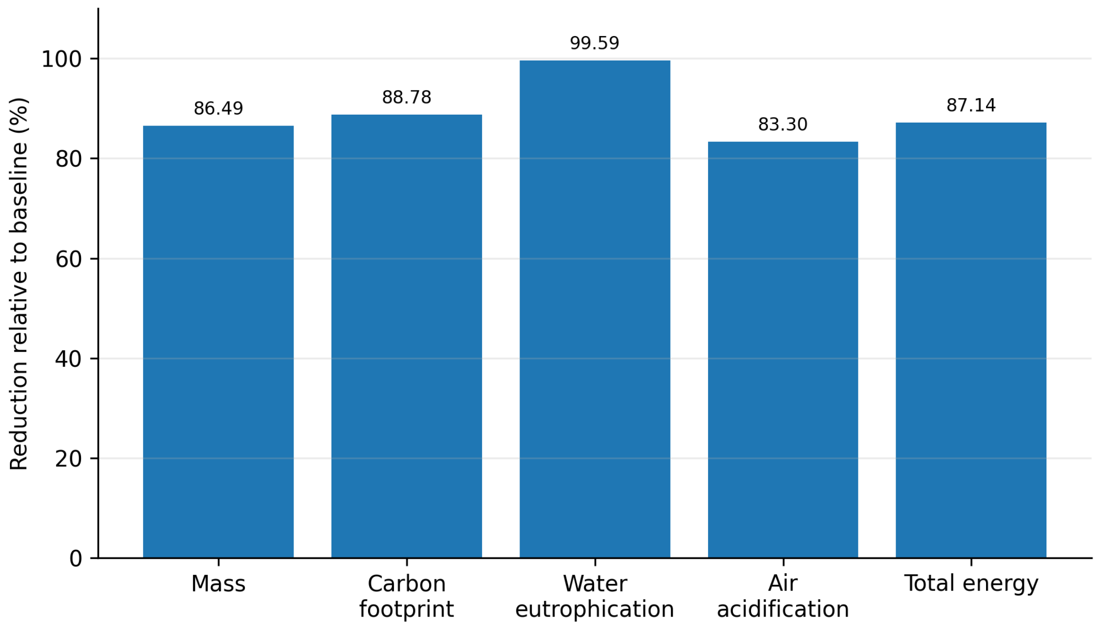

Figure 3: Percentage reduction in the reported product mass and environmental indicators relative to the baseline model.

The environmental reductions are consistent with the large decrease in modelled mass and the reported substitution of AISI 304 with HDPE. However, the magnitude of each output is determined by the combined effects of material data, manufacturing process, region, transport, use, and end-of-life assumptions, not by mass alone. The missing settings prevent independent reproduction of the absolute values. Consistent with recent parametric LCA, eco-design software, CAE, and material-selection studies [13-17], the results support the redesigned concept only within the reported SolidWorks scenario; they should not be presented as a verified environmental product declaration or a complete comparative LCA.

Material substitution also introduces functional questions that were not resolved by the sustainability module. The redesigned flask must preserve heat retention, vacuum or insulation integrity, sealing, dimensional stability, chemical resistance, cleanability, food-contact suitability, impact resistance, and durability over repeated use. Recent thermos-flask studies show that changes in material and geometry can significantly alter thermal performance [18-20], while research on reusable polymers demonstrates that wear and repeated cleaning can affect long-term functionality [24]. The lower environmental indicators are therefore meaningful only if the redesigned flask provides equivalent service for a comparable lifetime.

3.3 Structural Screening and Model Credibility

Figure 4 reproduces the six FEA contour cases. Table 3 standardises their units and compares the maximum stress with the single reported yield strength. Cases A, B, C, E, and F produce stresses below 172.339 MPa, whereas Case D reports 1099 MPa and a screening factor of safety of 0.16. On the reported basis, Case D exceeds yield and cannot be described as structurally acceptable.

Case E reports a maximum displacement of 972 mm despite a low stress of 0.2479 MPa. Such deformation is not credible at the illustrated component scale and is consistent with an under-constrained model, unit inconsistency, a disconnected body, an unsuitable contact definition, or a transcription error. Case C also reports an extremely small displacement that should be checked for unit consistency and over-constraint. These anomalies illustrate why contour plots alone cannot validate a design. In accordance with current FEA reporting and model-updating guidance

[21-23], the analysis should be repeated with documented materials, contacts, fixtures, mesh-convergence checks, load paths, sensitivity studies, and experimental validation.

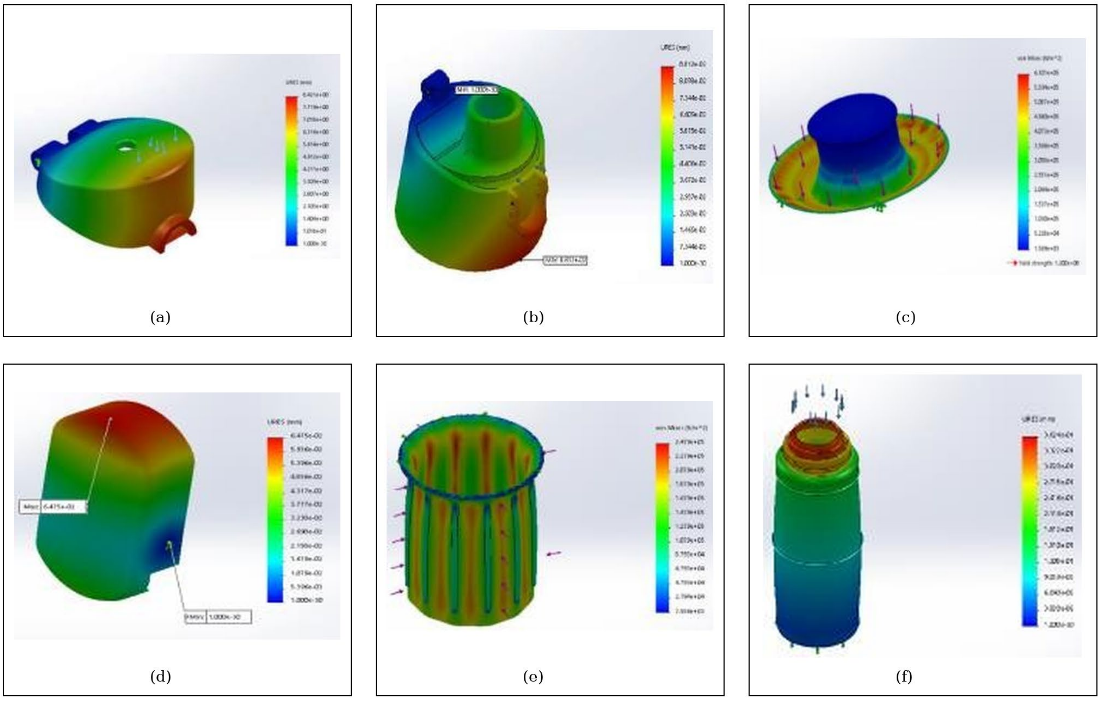

Figure 4: Reported SolidWorks FEA contour plots for Cases A-F under a 100 N load.

Table 3: Standardized screening interpretation of the six reported FEA cases under a 100 N load.

Case	Maximum von Mises stress (MPa)	Maximum displacement (mm)	Screening factor of safety	Interpretation
A	121.7	8.421	1.42	Stress is below the reported yield strength; deformation requires functional review.
B	0.7463	0.08812	230.92	Stress and displacement are below the reported limits.
C	0.6101	0.000007919	282.48	Stress is below the reported yield strength; extremely small displacement should be checked against units and constraints.
D	1099	0.06475	0.16	Maximum stress exceeds the reported yield strength; the case does not demonstrate structural adequacy.
E	0.2479	972	695.20	The displacement is physically implausible for the component scale and indicates a likely modelling, constraint, or unit problem.
F	9.249	0.3624	18.63	Stress is below the reported yield strength; the result remains provisional without mesh and boundary-condition verification.

3.4 Cost Performance

Table 4 compares the separately reported estimate for HDPE injection moulding. Although the part quantity increased from 1 to 3, component-set mass decreased from 135.0125 to 105.8274 g, a reduction of 21.62%. The estimated cost decreased from RM18.27 to RM12.65, corresponding to a 30.76% reduction. This result indicates that material reduction can offset the cost-effect of additional moulded pieces within the specific estimate.

Table 4: Reported injection-moulding comparison for the HDPE component set.

Metric	Baseline	Redesign	Change
Material	HDPE	HDPE	No change
Reported part quantity	1	3	+2 parts
Component-set mass (g)	135.0125	105.8274	-21.62%
Estimated total cost (RM)	18.27	12.65	-30.76%

The cost result must be interpreted together with the assembly data. Although the reported injection-moulded component set cost decreased, the assembly cost increased by 115.38%. The two values cannot be combined into a total product cost because the source omits tooling investment, production volume, cycle time, scrap, overhead, quality assurance, maintenance, and warranty exposure. The redesign is therefore favourable for the reported component estimate but is not demonstrated to be lower in total manufacturing or life-cycle cost.

3.5 Integrated Interpretation and Limitations

Table 5 consolidates the evidence. The redesign is favourable for the reported environmental indicators and partial component cost, unfavourable for the documented assembly metrics, and inconclusive for structural performance. This mixed outcome is consistent with contemporary sustainable product development and DfX research, which treat redesign as a multi-objective problem rather than a search for a single dominant indicator [1-6]. The integrated assessment reveals that an apparent improvement in one domain can create a trade-off or verification requirement in another.

The study is limited by the absence of a documented functional unit, complete material bill, software input settings, DFA calculation sheet, mesh-convergence study, boundary-condition definition, thermal-retention experiment, leakage test, drop test, fatigue assessment, food-contact verification, and prototype cost. Future work should archive the complete SolidWorks sustainability and simulation reports; verify material properties, units, contacts, and constraints; and repeat the FEA with convergence and sensitivity checks [21-23]. A physical prototype should then be evaluated for heat retention, surface temperature, sealing, handling, impact resistance, cleaning durability, and service life in accordance with the functional concerns identified in recent thermos and reusable-polymer studies [18-20, 24].

Table 5: Integrated interpretation of the reported redesign outcomes.

Assessment domain	Outcome	Evidence-based interpretation
Assembly burden	Unfavourable	Part quantity, assembly time, and assembly cost all increased.
Reported design efficiency	Favourable, provisional	The score increased from 30% to 48%, but its calculation basis is not documented.
Environmental indicators	Favourable, screening-level	All five reported indicators decreased substantially in the CAD-based assessment.
Injection-moulded component cost	Favourable, partial	The reported HDPE component-set cost decreased by 30.76%; tooling and total product cost were not included.
Structural response	Inconclusive	One stress result exceeds yield and one displacement result is implausible.
Thermal and service performance	Not assessed	Heat retention, vacuum integrity, leakage, drop resistance, and food-contact compliance were not reported.

4. CONCLUSION

An integrated DFMA, sustainability, FEA, and cost assessment was applied to a redesigned vacuum thermos flask. The redesign reduced modelled mass by 86.49% and produced reductions of 88.78% in carbon footprint, 99.59% in water eutrophication, 83.30% in air acidification, and 87.14% in total energy consumption. The estimated injection-moulded component cost decreased by 30.76%. These results demonstrate the potential of material reduction, material substitution, and CAD-based environmental screening to support resource-efficient product development.

The redesign did not improve every engineering domain. Reported part quantity, assembly time, and assembly cost increased, although the reported design-efficiency score rose from 30% to 48%. The FEA evidence was also mixed: one case exceeded the reported yield strength and another produced an implausible displacement. The redesigned alternative should therefore be regarded as environmentally promising but not yet validated for assembly efficiency, structural integrity, thermal performance, durability, or total cost. The next stage should combine a reproducible DFA calculation, documented sustainability inputs, verified FEA, and prototype testing. With these qualifications, the work contributes to SDG 9 through digital engineering and to SDG 12 through material-efficient product redesign.

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REFERENCES

[1] Diaz, A., Schöggl, J.-P., Reyes, T., & Baumgartner, R. J. Sustainable product development in a circular economy: Implications for products, actors, decision-making support and lifecycle

information management. Sustainable Production and Consumption, vol. 26 (2021) pp.1031-1045. https://doi.org/10.1016/j.spc.2020.12.044

[2] Han, J., Jiang, P., & Childs, P. R. N. Metrics for measuring sustainable product design concepts. Energies, vol. 14, issue 12 (2021) 3469. https://doi.org/10.3390/en14123469

[3] Lee, A. W. L., Chung, S. Y., Tan, Y. S., Koh, S. M. H., Lu, W. F., & Low, J. S. C. Enhancing the environmental sustainability of product through ecodesign: A systematic review. Journal of Engineering Design, vol. 34, issue 10 (2023) pp.814-843. https://doi.org/10.1080/09544828.2023.2261094

[4] Hallstedt, S. I., Villamil, C., Lövdahl, J., & Nylander, J. W. Sustainability Fingerprint - guiding companies in anticipating the sustainability direction in early design. Sustainable Production and Consumption, vol. 37 (2023) pp.424-442. https://doi.org/10.1016/j.spc.2023.03.015

[5] Vilochani, S., McAloone, T. C., & Pigosso, D. C. A. Consolidation of management practices for Sustainable Product Development: A systematic literature review. Sustainable Production and Consumption, vol. 45 (2024) pp.115-125. https://doi.org/10.1016/j.spc.2024.01.002

[6] Bielecki, M., Đukić, G., & Trstenjak, M. Design for Excellence in the Era of Circular Economy Challenges. Sustainability, vol. 18, issue 9 (2026) 4597. https://doi.org/10.3390/su18094597

[7] Naiju, C. D. DFMA for product designers: A review. Materials Today: Proceedings, vol. 46 (2021) pp.7473-7478. https://doi.org/10.1016/j.matpr.2021.01.134

[8] Formentini, G., Boix Rodríguez, N., & Favi, C. Design for manufacturing and assembly methods in the product development process of mechanical products: A systematic literature review. The International Journal of Advanced Manufacturing Technology, vol. 120 (2022) pp.4307-4334. https://doi.org/10.1007/s00170-022-08837-6

[9] Subbaiah, A., & Antony, K. M. Integration of DFMA and sustainability - A case study. International Journal of Sustainable Engineering, vol. 14, issue 3 (2021) pp.343-356. https://doi.org/10.1080/19397038.2020.1871443

[10] Postacchini, L., Cicconi, P., Ciarapica, F. E., Germani, M., & Bevilacqua, M. A design method for improving assembly and environmental sustainability in packaging solutions: A case study in household appliances. International Journal of Sustainable Engineering, vol. 14, issue 4 (2021) pp.574-589. https://doi.org/10.1080/19397038.2021.1920644

[11] Juniani, A. I., Singgih, M. L., & Karningsih, P. D. Design for Manufacturing, Assembly, and Reliability: An Integrated Framework for Product Redesign and Innovation. Designs, vol. 6, issue 5 (2022) 88. https://doi.org/10.3390/designs6050088

[12] Shahhoseini, A., Heydari, S., & Pedrammehr, S. Manufacturing and Assembly for the Ease of Product Recycling: A Review. Designs, vol. 7, issue 2 (2023) 42. https://doi.org/10.3390/designs7020042

[13] Kamalakkannan, S., & Kulatunga, A. K. Optimization of eco-design decisions using a parametric life cycle assessment. Sustainable Production and Consumption, vol. 27 (2021) pp.1297-1316. https://doi.org/10.1016/j.spc.2021.03.006

[14] Camañes, V., Tobajas, R., & Fernandez, A. Methodology of Eco-Design and Software Development for Sustainable Product Design. Sustainability, vol. 16, issue 7 (2024) 2626. https://doi.org/10.3390/su16072626

[15] Favi, C., Landi, D., Garziera, R., & Rossi, M. Fostering Design for Sustainability through the Adoption of Computer-Aided Engineering Tools in the Development of Energy-Related Products. Sustainability, vol. 16, issue 9 (2024) 3516. https://doi.org/10.3390/su16093516

[16] Italia, M., Papile, F., Santi, R., & Del Curto, B. Sustainable Material Selection Framework: Taxonomy and Systematisation of Design Approaches to Sustainable Material Selection. Sustainability, vol. 15, issue 24 (2023) 16689. https://doi.org/10.3390/su152416689

[17] Pryce, D., Memon, F. A., & Kapelan, Z. Life cycle analysis approach to comparing environmental impacts of alternative materials used in the construction of small wastewater treatment plants. Environmental Advances, vol. 4 (2021) 100065. https://doi.org/10.1016/j.envadv.2021.100065

[18] Anyanwu, C. S., Gad, A., Bilal, H., & Ewim, D. R. E. Heat Analysis of a Vacuum Flask. The Journal of Engineering and Exact Sciences, vol. 8, issue 11 (2022) 15174-01e. https://doi.org/10.18540/jcecvl8iss11pp15174-01e
[19] Chien, C.-C., Lin, P.-H., Chiang, C.-C., & Chen, Y.-B. Realization of energy harvesting and temperature indication functions for zero-energy thermos flask. Energy, vol. 257 (2022) 124718. https://doi.org/10.1016/j.energy.2022.124718
[20] Ikwuagwu, C. V., Iroegbu, C. C., Onodu, J. C., & Okoh, I. E. Comparative Simulation Studies on Fabrication of Thermos Flask Using Glass Fibre Reinforced Plastics and Stainless Steel. FMDB Transactions on Sustainable Energy Sequence, vol. 2, issue 1 (2024) pp.21-32. https://doi.org/10.69888/FTSES.2024.000189
[21] Oefner, C., Herrmann, S., Kebbach, M., Lange, H.-E., Kluess, D., & Woiczinski, M. Reporting checklist for verification and validation of finite element analysis in orthopedic and trauma biomechanics. Medical Engineering & Physics, vol. 92 (2021) pp.25-32. https://doi.org/10.1016/j.medengphy.2021.03.011
[22] Wong, D. W.-C., Chen, T. L.-W., Peng, Y., Lam, W.-K., Wang, Y., Ni, M., Niu, W., & Zhang, M. An instrument for methodological quality assessment of single-subject finite element analysis used in computational orthopaedics. Medicine in Novel Technology and Devices, vol. 11 (2021) 100067. https://doi.org/10.1016/j.medntd.2021.100067
[23] Ereiz, S., Duvnjak, I., & Jiménez-Alonso, J. F. Review of finite element model updating methods for structural applications. Structures, vol. 41 (2022) pp.684-723. https://doi.org/10.1016/j.istruc.2022.05.041
[24] Tenhunen-Lunkka, A., Parikka, R., Korostavyi, A., Palola, S., & Ronkainen, H. Durability and Functionality of Conventional Polymeric Packaging Materials in Reusable Packaging Systems. Materials Circular Economy, vol. 6, issue 1 (2024) 40. https://doi.org/10.1007/s42824-024-00133-w

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