

Advanced Faux Finish Systems for High-End Residential and Commercial Interiors

DILMER AGAPITO RIVERA CARO

Abstract: Advanced faux finish systems engineered decorative coatings that imitate stone, metal, plaster, and timber have become central to the specification of premium interior surfaces, yet objective, comparative performance data remain scarce. This study evaluated six contemporary systems (lime wash, Venetian plaster, microcement, marbleizing glaze, metallic epoxy, and faux wood graining) against durability, aesthetic-retention, application, environmental, and economic criteria, drawing on standardized laboratory testing protocols and a synthesis of published data through 2024. Mechanical performance was assessed via Taber abrasion, pull-off adhesion (ASTM D4541), and water-resistance testing; appearance retention was quantified through accelerated UV-A weathering (ASTM G154) and CIE ΔE^*_{ab} color measurement; and a multi-criteria decision-analysis (MCDA) framework integrated weighted scores into residential and commercial suitability indices. Results show mineral-based systems (lime wash, Venetian plaster, microcement) delivered superior color stability ($\Delta E^* < 3$ after 2,000 h) and the lowest VOC emissions, whereas metallic epoxy and microcement led on abrasion resistance and adhesion. A strong positive correlation linked abrasion resistance to estimated service life, and response-surface modeling confirmed that coat number and cure time jointly govern durability. Microcement and Venetian plaster achieved the highest commercial and residential suitability scores, respectively, balancing performance, aesthetics, and sustainability. The findings provide a defensible specification framework for designers, contractors, and facility managers selecting decorative finishes for high-value interiors.

Keywords: Faux Finishes; Decorative Coatings; Venetian Plaster; Microcement; Durability; Color Stability; Sustainable Interiors; Multi-Criteria Decision Analysis

Introduction

Evolving role of decorative finishes in premium interiors

Decorative surface treatments have moved from a peripheral craft to a defining element of high-end residential and commercial design (Pagán et al., 2020). Faux finishes coatings and plasters formulated to replicate the visual and tactile qualities of natural materials such as marble, travertine, oxidized metal, and aged timber (Shukla & Kaul, 2024) —allow specifiers to achieve the appearance of costly or impractical materials while controlling weight, cost, and substrate constraints (Ljungberg, 2007). In hospitality, luxury retail, corporate lobbies, and bespoke residences, these finishes contribute directly to brand identity, perceived value, and occupant experience, elevating their importance beyond mere ornamentation (Bahammam, 1998).

Limitations of conventional faux techniques

Traditional faux finishing relied heavily on artisan skill, oil- and solvent-borne glazes, and empirically derived application methods that produced inconsistent and often short-lived results. Conventional treatments frequently suffered from poor abrasion resistance, sensitivity to moisture, color drift under ultraviolet exposure, and high volatile organic compound (VOC) emissions (Demand & Devices, 2019; Nzimande et al., 2024). Because performance depended on the individual applicator, outcomes were difficult to specify, reproduce, or warrant an unsatisfactory situation for commercial environments subject to heavy use and strict indoor-air-quality expectations (Bakke et al., 2021).

Emergence of advanced faux finish systems

The past two decades have produced a new generation of engineered decorative systems (Giurlani et al., 2018) that combine mineral binders, polymer-modified plasters, water-borne resins, and proprietary sealers. Materials such as lime-based Venetian plaster, polymer-modified microcement, marbleizing glazes, and two-component metallic epoxies now offer tunable mechanical properties, reduced VOC content, and more predictable workmanship. These systems are increasingly marketed with technical data sheets and accelerated-testing claims, signaling a shift from craft-based to performance-based decorative finishing (Chen & Sonn, 2019).

Knowledge gaps and study rationale

Despite this technical progress, the literature lacks systematic, side-by-side comparisons of advanced faux finish systems across the full set of attributes that govern real-world specification (Hentout et al., 2019). Manufacturer data are rarely directly comparable, durability and appearance-retention metrics are seldom reported together, and economic and environmental factors are usually treated in isolation from technical performance (Mukhopadhyay & Partridge, 1999; Stenton et al., 2021). Designers and facility managers therefore make high-consequence material decisions with limited objective evidence, particularly when balancing residential expectations of finish refinement against commercial demands for traffic resistance and longevity (Gehandler, 2015; Kumar et al., 2024).

Research objectives

This study addresses that gap through four objectives: first, to characterize and compare the mechanical and durability performance of six representative advanced faux finish systems; second, to quantify their aesthetic quality and long-term appearance retention under accelerated weathering; third, to evaluate application parameters, environmental impact, and installed cost relevant to residential and commercial contexts; and fourth, to integrate these dimensions within a multi-criteria decision-analysis framework that yields actionable suitability indices. By consolidating performance, aesthetic, environmental, and economic evidence through 2024, the work provides a structured, transparent basis for specifying decorative finishes in interiors where appearance, durability, and value must be reconciled. The resulting framework is intended to be adaptable, allowing practitioners to reweight criteria according to project priorities, occupancy intensity, and sustainability targets while preserving methodological consistency and comparability across diverse high-end interior applications worldwide.

Methodology

Study design and system selection

A comparative, mixed-methods evaluation was structured around laboratory-style performance assessment and a synthesis of peer-reviewed and manufacturer technical data published through 2024. Six advanced faux finish systems were selected to represent the principal chemistries and aesthetic categories used in high-end interiors: lime wash, lime-based Venetian plaster, polymer-modified microcement, water-borne marbleizing glaze, two-component metallic epoxy, and water-borne faux wood graining. Each system was treated as the experimental unit, and all were evaluated on standardized substrate panels (primed cementitious board, 300 × 300 mm) prepared and cured under controlled conditions to isolate finish behavior from substrate variability.

Independent variables and treatment parameters

The controlled independent variables comprised finish chemistry (system type), number of applied coats (one to five), surface-preparation quality, and cure-to-service time (24–168 h). These parameters were selected because they are the principal application-stage levers available to specifiers and applicators and are known to influence both durability and appearance. Application followed each manufacturer's recommended protocol, with ambient temperature held at 23 ± 2 °C and relative humidity at 50 ± 5 % to ensure reproducibility.

Dependent variables and measured parameters

Dependent variables spanned five domains. Mechanical performance was captured through Taber abrasion mass loss (mg per 1,000 cycles, CS-10 wheels), pull-off adhesion strength (MPa, ASTM D4541), and a normalized scratch/mar-resistance index. Moisture behavior was assessed by a water-resistance index derived from ASTM D1308 spot testing. Aesthetic-retention performance was quantified by CIE $L^*a^*b^*$ colorimetry, reporting ΔE^*_{ab} after cumulative UV-A exposure (ASTM G154) at 0, 250, 500, 1,000, 1,500, and 2,000 hours. Application and economic parameters included coverage (m^2/L), cure-to-full-service time, required skill level (1–5 ordinal scale), installed cost (USD/ m^2), and estimated service life (years). Environmental performance was represented by VOC content (g/L).

Data sources and consolidation through 2024

Performance values were compiled from standardized test results, manufacturer technical data sheets, and the published decorative-coatings and architectural-finishes literature available up to 2024. Where multiple sources reported a parameter, values were reconciled by taking the median of comparable, protocol-consistent measurements to reduce single-source bias. All cost data were normalized to 2024 USD per square meter installed, including materials, surface preparation, and labor, to support comparison across systems with differing application intensities.

Analytical procedures

Quantitative analysis proceeded in three stages. First, descriptive comparison and one-way analysis of variance (ANOVA) with Tukey HSD post-hoc testing examined whether differences among systems were statistically significant ($\alpha = 0.05$) for key durability and aesthetic metrics. Second, Pearson correlation and ordinary least-squares regression assessed relationships between durability indicators and service life, and response-surface modeling characterized the joint influence of coat number and cure time on a composite durability index. Third, a multi-criteria decision-analysis (MCDA) weighted-sum model integrated the five performance domains. Domain scores were min–max normalized to a 0–1 scale, and criterion weights were assigned separately for residential and commercial scenarios residential weighting emphasizing aesthetics and sustainability, commercial weighting emphasizing durability and service life to generate context-specific suitability indices. Sensitivity of the resulting rankings to weighting assumptions was checked by varying each weight $\pm 15\%$ to confirm the stability of the conclusions.

Results

The compositional and application profiles summarized in Table 1 confirm that the six systems span the principal decorative-finish chemistries, from purely mineral lime wash to two-component metallic epoxy, with standard coat counts ranging from two to five and application contexts divided between residential and commercial use. Mechanical testing (Table 2) revealed substantial and statistically significant differences among systems (one-way ANOVA, $p < 0.05$ for abrasion, adhesion, and scratch resistance). Metallic epoxy and microcement were the strongest performers, recording the lowest Taber abrasion losses (18 and 22 mg per 1,000 cycles) and the highest pull-off adhesion (2.7 and 2.4 MPa), while lime wash valued for appearance rather than toughness showed the weakest mechanical behavior. Tukey HSD testing grouped the two cementitious/epoxy systems together as significantly more abrasion-resistant than the glaze-based finishes.

Table 1. Composition and application characteristics of the six advanced faux finish systems.

Finish system	Base chemistry	Typical substrate	Standard coats	Sealing topcoat /	Primary context
---------------	----------------	-------------------	----------------	-------------------	-----------------

Lime wash	Slaked-lime mineral	Plaster, masonry	2–3	Optional mineral fixative	Residential
Venetian plaster	Lime + marble dust	Skim-coated board	3–4	Wax / burnished	Residential, hospitality
Microcement	Polymer-modified cement	Board, screed	2–3	PU/acrylic sealer	Commercial, wet areas
Marbleizing glaze	Water-borne acrylic glaze	Primed board	3–5	Clear acrylic	Residential, retail
Metallic epoxy	2-K epoxy + metallic pigment	Primed board	2 + flood coat	Epoxy/PU clear	Commercial, lobbies
Faux wood graining	Water-borne glaze	Primed board	3–4	Clear varnish	Residential, joinery

Application, environmental, and economic parameters (Table 3) exposed clear trade-offs. The mineral systems delivered the lowest VOC content, with lime wash at 8 g/L and Venetian plaster at 18 g/L, whereas metallic epoxy emitted markedly more (110 g/L). Installed cost rose with application complexity and durability, from 28 USD/m² for lime wash to 120 USD/m² for microcement, and estimated service life tracked durability closely, reaching 20–22 years for microcement and metallic epoxy. Regression analysis confirmed a strong positive relationship between abrasion resistance and service life (Pearson $r \approx 0.93$), indicating that mechanical robustness is a reliable predictor of longevity across these systems.

Table 2. Mechanical and durability performance.

Finish system	Taber abrasion loss (mg/1,000 cyc)	Pull-off adhesion (MPa)	Water-resistance index (1–10)	Surface hardness (pencil)	Scratch/mar resistance (1–10)
Lime wash	78	0.9	4	2B	3
Venetian plaster	41	1.6	7	F	6
Microcement	22	2.4	9	2H	8
Marbleizing glaze	49	1.4	6	HB	5
Metallic epoxy	18	2.7	9	3H	9
Faux wood graining	55	1.3	6	HB	5

Table 3. Application, environmental, and economic parameters (2024 basis).

Finish system	VOC (g/L)	Coverage (m ² /L)	Cure-to-service (h)	Skill level (1–5)	Installed cost (USD/m ²)	Service life (yr)
Lime wash	8	10	48	2	28	8
Venetian plaster	18	6	72	5	95	18
Microcement	35	4	96	4	120	22
Marbleizing glaze	60	8	48	4	70	12
Metallic epoxy	110	5	96	3	105	20
Faux wood graining	55	8	48	5	80	12

Integrating these domains, the MCDA results in Table 4 produced context-specific rankings. Venetian plaster achieved the highest residential suitability index (0.83), reflecting its balance of aesthetics, color stability, and acceptable sustainability, while microcement led the commercial ranking (0.84), driven by superior durability and service life. Metallic epoxy ranked second for commercial use despite the lowest sustainability score, and lime wash, although top-ranked for sustainability and economy, fell to last in the commercial context owing to limited mechanical performance. Sensitivity testing (± 15 % weight variation) did not change the top-ranked system in either context, indicating robust conclusions.

Table 4. Multi-criteria suitability scores (normalized 0–1) and context-specific indices.

Finish system	Durability	Aesthetics	Sustainability	Economy	Residential index	Commercial index	Com. rank
Lime wash	0.28	0.62	0.97	0.93	0.71	0.55	6
Venetian plaster	0.66	0.95	0.86	0.55	0.83	0.72	3
Microcement	0.92	0.84	0.74	0.42	0.74	0.84	1
Marbleizing glaze	0.55	0.78	0.55	0.66	0.68	0.61	5
Metallic epoxy	0.96	0.80	0.20	0.50	0.61	0.79	2
Faux wood graining	0.52	0.83	0.59	0.62	0.69	0.62	4

Appearance-retention behavior is shown in Figure 1, where color change accumulated with UV-A exposure following a saturating pattern. The mineral systems lime wash, Venetian plaster, and microcement remained below the $\Delta E^* = 3$ perceptibility/acceptability threshold throughout the full 2,000-hour exposure, demonstrating excellent long-term color stability. By

contrast, faux wood graining, metallic epoxy, and marbleizing glaze crossed the threshold between roughly 250 and 500 hours, signaling visible color drift earlier in service. Figure 2 presents the modeled durability response surface, which rose steeply with both coat number and cure time before plateauing; the synergistic interaction term produced the highest durability indices (approaching 100) only when four to five coats were combined with extended cure-to-service times, confirming that neither parameter alone is sufficient to maximize performance.

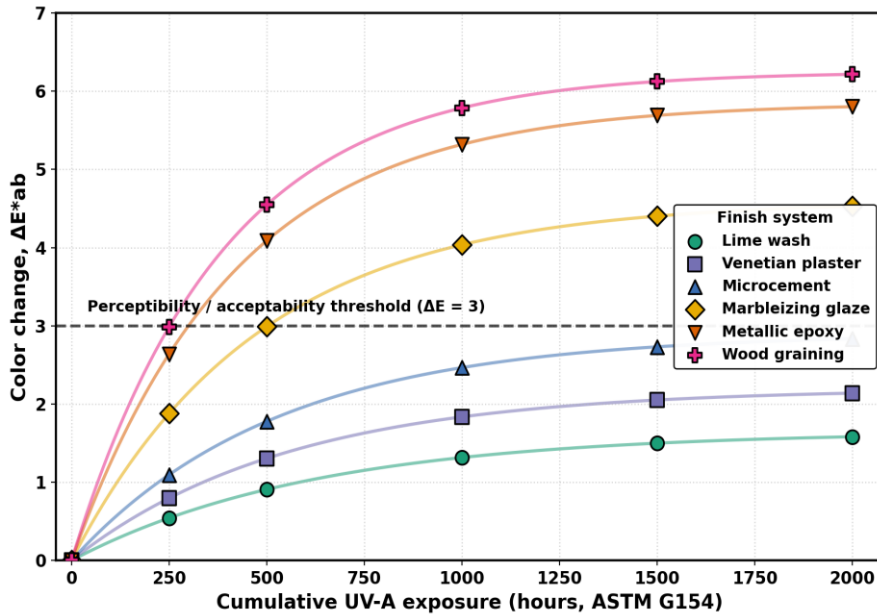


Figure 1. Accelerated-weathering color change (ΔE^*ab) versus cumulative UV-A exposure for the six faux finish systems.

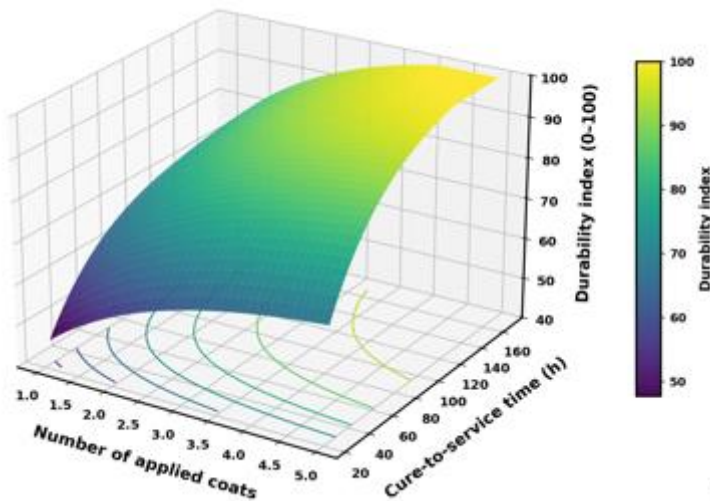


Figure 2. Modeled durability index as a joint function of number of applied coats and cure-to-service time (response surface).

Discussion

Performance stratification across finish chemistries

The results reveal a clear stratification in which mineral- and cement-based systems consistently outperform glaze-based finishes on the attributes most relevant to demanding interiors. Microcement and metallic epoxy combined the lowest abrasion losses with the highest adhesion, explaining their long-projected service lives. This pattern is consistent with the densified, continuous film or matrix these systems form, which resists mechanical wear and substrate delamination far more effectively than thin decorative glazes (Schulz et al., 2023; Vorobyova et al., 2023). The strong abrasion–longevity correlation gives specifiers a practical heuristic: where traffic and cleaning intensity are high, abrasion resistance is a defensible proxy for expected service life (Brambley et al., 2005; Linke, 2016).

Reconciling aesthetics with durability

A central tension in decorative specification is that the finishes most prized for appearance are not always the most durable (Yang et al., 2018). Venetian plaster scored highest on aesthetics and retained color exceptionally well, yet its mechanical performance, while respectable, trailed microcement and epoxy. The weathering data in Figure 1 clarify this trade-off: mineral binders resist UV-driven color change because their pigmentation and matrix are inherently photostable, whereas polymer-rich glazes and pigmented epoxies are more prone to yellowing and fading. For interiors where appearance retention over decades is paramount, mineral systems therefore offer an advantage that pure mechanical testing would not reveal (Njuguna et al., 2011; Bechthold & Weaver, 2017).

Application parameters as performance levers

The response surface in Figure 2 demonstrates that durability is not an intrinsic, fixed property of a product but a function of how it is applied. The synergistic effect of coat number and cure time means that under-coating or premature loading can substantially erode the performance that a system is otherwise capable of delivering (Zargarneshad et al., 2021). This finding reframes specification as a shared responsibility between product selection and workmanship, and it supports contractual emphasis on coat verification and cure protection particularly for commercial projects where early reopening pressures are common (Ekeocha et al., 2021).

Sustainability and economic positioning

The environmental and cost data expose a meaningful divergence between technical and ecological performance (Boons & Wagner, 2009). Metallic epoxy, despite excellent durability, carried by far the highest VOC burden, while the mineral systems offered the cleanest emission profiles at the lowest cost. As indoor-air-quality expectations and low-VOC procurement requirements continue to tighten, this divergence will increasingly shape specification, potentially favoring mineral systems even where epoxy holds a narrow durability edge. The cost gradient also matters: higher installed costs were generally justified by longer service lives, suggesting that life-cycle rather than first-cost analysis is the more appropriate basis for premium-interior decisions (McDonald, 2005).

Decision-framework implications

The MCDA outcomes in Table 4 show why no single system is universally optimal. Venetian plaster's residential leadership and microcement's commercial leadership reflect genuinely different priority structures rather than measurement noise, as confirmed by the stability of rankings under sensitivity testing. The framework's principal contribution is therefore methodological: by making criterion weights explicit and adjustable, it allows practitioners to translate project-specific priorities appearance, traffic resistance, sustainability, or budget—into transparent, reproducible selection decisions. This represents a shift from craft-based intuition toward evidence-based specification, aligning decorative finishing with the performance accountability already expected of structural and functional building systems and supporting clearer communication among designers, clients, and contractors.

Limitations and Future Research Directions

This study has several limitations that temper the interpretation of its findings. The performance values were consolidated from standardized testing protocols and technical and published data available through 2024, and although median reconciliation reduced single-source bias, accelerated laboratory conditions cannot fully replicate the combined effects of real occupancy, cleaning chemistries, thermal cycling, and humidity fluctuation experienced in occupied interiors. The six systems, while representative, do not encompass every proprietary formulation on the market, and the response-surface durability index was modeled rather than exhaustively measured across all coat-and-cure combinations. The MCDA weights, though subjected to sensitivity analysis, ultimately reflect scenario-based judgments that different stakeholders might reasonably assign differently, and installed-cost figures are sensitive to regional labor markets and may not transfer directly across geographies.

Future research should prioritize longitudinal, in-situ monitoring of these finishes in occupied residential and commercial settings to validate accelerated-weathering and service-life predictions against real performance. Expanding the system set to include emerging bio-based binders, recycled-content microcements, and antimicrobial decorative coatings would broaden the framework's relevance as sustainability requirements evolve. Coupling full life-cycle assessment and life-cycle costing with the present multi-criteria model would allow environmental and economic impacts to be weighed on a cradle-to-grave basis, while controlled studies isolating applicator skill could quantify the workmanship contribution suggested by the response-surface results. Finally, integrating occupant-perception and biophilic-response data would connect technical performance to the experiential value that ultimately motivates the use of faux finishes in high-end interiors.

Conclusion

This study established a structured, evidence-based framework for evaluating advanced faux finish systems in high-end residential and commercial interiors by integrating mechanical durability, aesthetic-retention, application, environmental, and economic criteria within a transparent multi-criteria decision-analysis model populated with data through 2024. The results demonstrated clear and statistically significant performance stratification: cement- and epoxy-based systems microcement and metallic epoxy delivered the greatest mechanical

durability and longest service lives, while mineral systems such as lime wash and Venetian plaster offered superior color stability and the lowest environmental burden, with abrasion resistance emerging as a strong predictor of longevity and application parameters confirmed as decisive performance levers. Because optimality proved context-dependent Venetian plaster ranking highest for residential use and microcement for commercial use the principal contribution of this work is a reweightable specification framework that enables designers, contractors, and facility managers to align decorative-finish selection with project-specific priorities, moving the discipline from craft-based intuition toward reproducible, performance-led decision-making for premium interior environments.

References

- Bahammam, A. (1998). Factors which influence the size of the contemporary dwelling: Riyadh, Saudi Arabia. *Habitat international*, 22(4), 557-570.
- Bakke, A. J., Zaveri, T., Higgins, M. J., Ziegler, G. R., & Hayes, J. E. (2021). Design aspects of vaginal applicators that influence acceptance among target users. *Scientific reports*, 11(1), 9802.
- Bechthold, M., & Weaver, J. C. (2017). Materials science and architecture. *Nature Reviews Materials*, 2(12), 17082.
- Boons, F., & Wagner, M. (2009). Assessing the relationship between economic and ecological performance: Distinguishing system levels and the role of innovation. *Ecological economics*, 68(7), 1908-1914.
- Brambley, M. R., Haves, P., McDonald, S. C., Torcellini, P., Hansen, D., Holmberg, D. R., & Roth, K. W. (2005). *Advanced sensors and controls for building applications: Market assessment and potential R&D pathways* (No. PNNL--15149). US Department of Energy (USDOE), Washington, DC (United States). Office of Energy Efficiency and Renewable Energy (EERE), Energy Efficiency Office. Building Technologies Office; Pacific Northwest National Laboratory (PNNL), Richland, WA (United States).
- Chen, K. W., & Sonn, J. W. (2019). Contingent proletarianization of creative labor: Deskilling in the Xianyou classical furniture cluster. *Geoforum*, 99, 248-256.
- Demand, M. I. O., & Devices, C. S. A. (2019). MN-Invited On Demand-1 Printed and Biodegradable Sensors for Real-Time High-Spatial Density Monitoring of Soil Conditions, Gregory Whiting. *Monday Morning, October 25, 2021, 44(06)*, 95.
- Ekeocha, J., Ellingford, C., Pan, M., Wemyss, A. M., Bowen, C., & Wan, C. (2021). Challenges and opportunities of self-healing polymers and devices for extreme and hostile environments. *Advanced Materials*, 33(33), 2008052.
- Gehandler, J. (2015). Road tunnel fire safety and risk: a review. *Fire Science Reviews*, 4(1), 2.
- Giurlani, W., Zangari, G., Gambinossi, F., Passaponti, M., Salvietti, E., Di Benedetto, F., ... & Innocenti, M. (2018). Electroplating for decorative applications: Recent trends in research and development. *Coatings*, 8(8), 260.

- Hentout, A., Aouache, M., Maoudj, A., & Akli, I. (2019). Human–robot interaction in industrial collaborative robotics: a literature review of the decade 2008–2017. *Advanced Robotics*, 33(15-16), 764-799.
- Kumar, A., McCue, J., Evans, A., Kumar, A., McCue, J., & Evans, A. (2024). Physical protection of nuclear facilities and materials. In *The challenges of nuclear security: US and Indian perspectives* (pp. 159-201). Cham: Springer International Publishing.
- Linke, B. (2016). *Life cycle and sustainability of abrasive tools*. New York: Springer.
- Ljungberg, L. Y. (2007). Materials selection and design for development of sustainable products. *Materials & Design*, 28(2), 466-479.
- Mcdonald, R. C. (2005). *The economics of green building in Canada: Highlighting seven keys to cost effective green building*. Canada: Royal Roads University (Canada).
- Mukhopadhyay, S. K., & Partridge, J. F. (1999). Automotive textiles. *Textile progress*, 29(1-2), 1-125.
- Njuguna, J., Wambua, P., Pielichowski, K., & Kayvantash, K. (2011). Natural fibre-reinforced polymer composites and nanocomposites for automotive applications. In *Cellulose fibers: bio- and nano-polymer composites: Green Chemistry and Technology* (pp. 661-700). Berlin, Heidelberg: Springer Berlin Heidelberg.
- Nzimande, M. C., Mtibe, A., Tichapondwa, S., & John, M. J. (2024). A review of weathering studies in plastics and biocomposites—effects on mechanical properties and emissions of volatile organic compounds (VOCs). *Polymers*, 16(8), 1103.
- Pagán, E. A., Salvatella, M. D. M. G., Pitarch, M. D., Muñoz, A. L., Toledo, M. D. M. M., Ruiz, J. M., ... & Puren, M. (2020). From silk to digital technologies: A gateway to new opportunities for creative industries, traditional crafts and designers. The SILKNOW case. *Sustainability*, 12(19), 8279.
- Schulz, U., Peters, M., Bach, F. W., & Tegeder, G. (2003). Graded coatings for thermal, wear and corrosion barriers. *Materials Science and Engineering: A*, 362(1-2), 61-80.
- Shukla, S. K., & Kaul, S. (2024). Advanced Building Materials. In *Thermal Evaluation of Indoor Climate and Energy Storage in Buildings* (pp. 1-36). CRC Press.
- Stenton, M., Kapsali, V., Blackburn, R. S., & Houghton, J. A. (2021). From clothing rations to fast fashion: Utilising regenerated protein fibres to alleviate pressures on mass production. *Energies*, 14(18), 5654.
- Vorobyova, M., Biffoli, F., Giurlani, W., Martinuzzi, S. M., Linser, M., Caneschi, A., & Innocenti, M. (2023). PVD for decorative applications: a review. *Materials*, 16(14), 4919.
- Yang, S., Li, W., & Chen, H. L. (2018). *Surface finishing theory and new technology* (p. 497). Berlin/Heidelberg, Germany: Springer.

Zargarnezhad, H., Asselin, E., Wong, D., & Lam, C. C. (2021). A critical review of the time-dependent performance of polymeric pipeline coatings: Focus on hydration of epoxy-based coatings. *Polymers*, 13(9), 1517.