Classification of the drivers, barriers, and actors influencing the adoption of green behaviors in the construction sector.

[1] Color codes indicate factors that promote or hinder the adoption of green behaviors in the construction sector: General driver (), Behavioral Driver (), and Barrier ().

[2] Letters indicate the level of responsibility attributed to a practice. The four levels are: Site Workers Level (W), Site Management Level (M), Firm-Level (F), and External Level (E).

Table S2. Classification based on Category C1 factors: Materials and technology management.

Reference	Practice	Factor	Level
Durdyev et al. (2018)	Mobilisation of sustainable building tools		F
	Environmentally-friendly energy technologies		F
	Sustainable construction materials		F
Lu and Yuan (2010)	Waste management systems		F
	Low waste-producing construction technologies		F E
Narcis et al. (2019)	Improved resource efficiency		M F
Rasdorf et al. (2012)	Equipment emission estimates to support project management		F
Ajayi et al. (2017)	Use of safe materials storage facilities		M F
Durdyev et al. (2018)	Low-hazardous substances product design		E
	Life cycle assessment to assess products' environmental load		F E
	Ensure that product packaging is reusable		F
	Employing packaging take-back system		F
	Salvaging the company's end-of-life products		F
	No environmentally undesirable elements in purchased products		F
	Use of environmental packaging by suppliers		F E
	Use of bio-based construction materials and building components		F
Elbers (2022)	Partnerships with online platforms to promote sustainable practices		F E
Gangolells et al. (2014)	Reusable elements from earlier buildings introduced in the design phase		F
	Materials stored in a protected area to prevent premature damage		W M
	Mobile crushers available on-site to recycle and reuse inert wastes		F
Kabirifar et al. (2021)	Use of technologies to reduce construction and demolition (C&D) waste		F E
	Select reusable and recyclable materials at the planning and design phases		M F E
Lim et al. (2019)	Considering the life cycle of materials		F E
	Maximizing resource reuse and recycling		M F
Oke et al. (2019)	Creating technologies to mitigate impacts		E
Rios et al. (2021)	Explore opportunities for using prefabrication and modular design		F
	Develop and implement material tracking technologies		F E
	Create databases for reusable components; urban mining		F E
Cha et al. (2009)	Collecting packed materials back by supplier		E
	Use of recycled materials		F
	Minimizing rework on a construction phase		M F
	Preventing easily fragile materials from being used		M
	Preventing the ordering of excess materials		M F
	Minimizing loss of materials during carrying and storing		W M
	Recycling of temporary materials used once in general		W M F
	Design and construction using standardized materials		F E
Wiguna et al. (2021)	Consideration to reduce the use of hazardous materials		M F
	Consideration for energy-efficient heating and air conditioning systems		M F
	Provision for the use of prefabricated components		F
	Consideration of materials with high recycled content		M F
	Consideration for the energy-efficient lighting system		M F
	Provision for natural lightning		M F
	Consideration of materials with low embodied energy		F
	Provision for natural ventilation		M F
	Provision for wastewater recycling systems		F
	Integration of photovoltaic panels		F
	Purchasing eco-labeled material		F
	Purchasing nontoxic material		F
	Purchasing recycled material		F
Zaid et al. (2018)	Reuse, recycling and recovery of materials and components via product design		F
Chan et al. (2024)	Incompatibility issues with different software packages		E
	Lack of supporting sustainability analysis tools		E
	User-unfriendliness of BIM (Building Information Modeling) analysis software programs		E
	Non-implementation of open-source principles for software development		F E
	Domination of the market by commercial assessment tools		E
	Technological and financial constraints		F
	Non-standardized data and models		F
	Non-standardized data and compatibility issues		F
Elbers (2022)	Complexity of recyclability of structural components		E
Giorgi et al. (2022)	Technological aspects		F
Lim et al. (2019)	Lack of environmentally sustainable materials and technologies		F E
	Lack of sustainable measurement tools		F E
Luangcharoenrat et al. (2019)	Material ordering problems		M F E
	Improper material handling		W M
	Materiel quality problems		F E
	Misuse of material		W M
Narcis et al. (2019)	Lack of on-site material control and management plans		M F

Reference	Practice	Factor	Level
Rios et al. (2021)	Lack of sorting and processing technologies for salvaged components	⊘	F E
	Lack of infrastructure for salvaged components	⊘	E
	Lack of technology and infrastructure to assess salvaged components	⊘	E
	Lack of tools to identify and classify salvageable materials	⊘	M F
	Market for prefabrication heavily dependent on imports	⊘	F E
	Structural over-dimensioning when using salvaged materials	⊘	F
	Difficulty in identifying the content of salvaged components and material	⊘	F
	Hazardous or contaminated materials	⊘	W M F
	Lack of data about salvaged building components	⊘	E
	Not all materials can be environmentally effectively recycled	⊘	E
	Lack of bio-based construction materials and component	⊘	E
	Lack of standards for reused and recycled building products	⊘	E
Yin et al. (2018)	Uncertainty in the performance of green materials and equipment	⊘	E
	Imperfect or immature green technology specifications	⊘	E
	High cost incurred in green practices and technologies	⊘	E
Zhou et al. (2018)	Differences in implementation levels between large- and small-scale projects	⊘	F
	Lack of knowledge of technologies	⊘	F

Table S3. Classification based on Category C2 factors: Construction methods

Reference	Practice	Factor	Level
Begum et al. (2009)	Source reduction measures		M F
Elbers (2022)	Reuse and adaptation of existing buildings		F E
Gangolells et al. (2014)	Standardization and dimensional coordination of construction materials		F
Hao et al. (2022)	Supervision and management systems to reduce construction waste		M F
Mendis et al. (2015)	Division of quality inspection responsibilities to reduce construction waste		F
Wiguna et al. (2021)	Waste management plan		F
Yin et al. (2018)	Environmental requirements considered in construction methods		F
Yusof et al. (2016)	Environmental practices to promote eco-responsible behavior		F
	Energy-efficiency practices to promote eco-responsible behavior		F
Zhang and Zhou (2016)	Making a considerable impact on contractors		F E
	Adapting to the construction market environment		F E
	Direct carbon regulations for the construction industry		F E
Zhou et al. (2018)	Environmental protection		W M F
	Material saving		W M F E
	Energy saving		W M
	Sustainable land usage		M F
Ahmad et al. (2014)	Reuse on site		W M
	Recycle on site		W M
	Disposal to land fill / Sell to other person		M F
	Reuse off site		F
	Recycle off site		F
	Give to other person		W M F
	Disposal off site		W M F
	Burning on site		W M F E
	Buried off site		M F
	Buried at site		M
	Leave at site		M
Ajayi et al. (2017)	Waste target set for sub-trades		F E
	Recycling target to be set for every project		F
	Use of demolition and excavation materials for landscape		F
	Maximisation of on-site reuse of materials		M F
	Waste segregation		W M
	Materials reuse		M F
	Ensuring fewer design changes during construction		F
Durdyev et al. (2018)	Resource conservation		W M F
	Greater energy efficiency		M F
	Reduce the environmental impact of building		F
	Improving indoor environmental quality		F
	Waste reduction		W M F
	Greater water-efficiency of building		F
Gangolells et al. (2014)	Selective dismantling or disassembly prioritized over massive demolition		F
	Keep the construction site clean and well-organized		W M
	On-site waste sorting as it is generated		W M
	Hazardous waste properly separated and conveniently stored		W M
Lim et al. (2019)	Minimizing damage to sensitive landscape		W F
	Minimizing air, land, and water pollution at global and local levels		W F
	Using serviceability and maintainability to promote sustainability		F
	Infill and revitalize existing urban infrastructure with a focus on rebuilding mixed-use pedestrian neighborhood		F
Mamter et al. (2014)	Minimize waste of material and labor		W M
Newaz et al. (2022)	On-site sorting / Site management / C&D waste / Demolition		W M
Oke et al. (2019)	Modifying the construction process		F
	Resource efficiency		F
Radziejowska and Linczowski (2019)	Reducing environmental impact of construction activities by controlling soil erosion and dust emissions / Reduction of water consumption		F
	Verification of installing and calibrating energy-related systems in accordance with the values included in building investors' project		F
	Providing an easily accessible area for collecting and storing materials for recycling		M F
	Prevention of soil contamination and erosion		M F
	Prevention of air pollution		M F
	Implementation control		M F E
	Waste management		M F
	Ensuring the quality of air		W M F
	Water equipment		F
	Use of regional and recycled materials		F
	Adequate quality paints, glues and adhesives / Certified windows, doors and curtain walls		F
Rios et al. (2021)	Develop more life cycle cost case studies on short-, medium-, and long-term savings favored by circular economy (CE) strategies		F
	Choose integrated project delivery and other collaborative project execution methods		F
	Develop guidelines for the transportability of construction elements		F
	Integrate CE strategies into information and communication technologies (e.g., design for disassembly to BIM)		F
	Promote existing salvage yards to integrate their inventory into digital databases		F
	Set goals for reducing the intrinsic energy of buildings		F
Ruparathna and Hewage (2015)	Waste recycling / Management at the site		W M
	Reduce power consumption		M
Saez et al. (2013)	Contracting suppliers to manage their waste		M F
	On-site sorting out waste categories		W M F
	Distributing small containers in the working areas		M F

Reference	Practice	Factor	Level
	Conducting regular checks on the use of C&D waste containers		M F
	Buying materials bulk to avoid unnecessary packaging		F
Sapuay (2016)	Reduced construction waste at the time of purchase		F
	Reduce the accumulation of materials on the site		F E
	Use of recycled demolition materials		F E
	Sorting materials on site		F
	Active policy on the construction site or in the organization to recycle		F
Cha et al. (2009)	Setting up separated bins by waste type		M
	Sorting out individual waste by type from mixed wasted		W M F
	Designate a place for storing wastes in an early stage of construction		M
	Setting up temporary bins at each building zone		M
	Storing wastes at an easily accessible area		M F
	Providing bins for collecting wastes for each subcontractor		M F
	Notice recyclable materials to laborer		M
	Installing equipment for recycling in a site		M F
	Preventing mixing wastes with soil		W M F
	Prohibiting use of pipe for dumping down mixed wastes		F E
	Installing an information board on waste sorting categories		M F
	Informing methods to deal with rest of the waste		M F
Wiguna et al. (2021)	Green transportation		E
	Use of video conferencing		F
	Provision of accommodation to employees near project sites		F
	Transport materials in fuel-efficient vehicles		F E
	Transport materials in full truckload quantities		F E
	Use of shared transport and public transport		W
	Green warehousing		F
	Sell used products and scrap components		F E
	Sell excess capital		F
	Green construction		F E
	Use of prefabricated components		F
	Use of fuel-efficient equipment/machinery		F
	Use of automation		F
	Use of materials with high recycled content and low embodied energy		F
	Reducing the use of hazardous materials		F
	Implementation of wastewater recycling technology		F
	Green recycling		F
	Utilize waste produced		F
	Recycle material from the demolished projects		F
	Environmental impact assessment during end-of-life projects		F
	Recover scrap from projects		F
Yin et al. (2018)	Reduce material and construction waste		W M
Zaid et al. (2018)	Provide design specification (e.g., environmental requirements for purchased items) to suppliers		F E
	Practicing remanufacturing		F E
	Reducing waste and recycling materials during the manufacturing process		E
Zhang and Zhou (2016)	Soft carbon instruments, such as green procurement practices and green building certification schemes		F

Reference	Practice	Factor	Level
Zhou et al. (2018)	Do not pump groundwater		F E
	Separate living and working areas and disinfect regularly / Close or cover vehicles transporting soil and work generating dust		W M F E
	Separate collection and recycling of construction waste		W M F E
	Do not burn wood waste		W
	Set a drain and discharge sewage and rainwater separately		M F
	Take measures to prevent intense light leakage		M
	Take measures to absorb sound and reduce noise		M F
	Give high priority to green and sustainable materials		F E
	Optimize the material plan and utilize remnants properly		F
	Water saving		W
	Adopt water-saving and water-recycling devices		M F
	Adopt energy-efficient machines and monitor energy use data		M F
	Adopt natural light and ventilation systems		M F
	Adopt less energy-intensive building technology		F
	Organize the site layout in a compact way		M F
	Take measures to prevent soil erosion and restore vegetation after completion		F
Ajayi et al. (2017)	Provision of waste skips for specific materials		F
Chan et al. (2024)	Difficulty in assessing environmental parameters of building properties		F
	Inaccuracy and uncertainty in sustainability assessments for projects		F
Luangcharoenrat et al. (2019)	Improper material strage		W M
	Design errors		F
	Construction methods		F
Narcis et al. (2019)	Construction site congestion		M F
	Material ordering errors		F
	Lack of implementation of green building codes and specifications		F E
	Excessive mixing of materials		W M
Radziejowska and Linczowski (2019)	Meet minimum energy performance requirements for building		F
	Meet the basic requirements for managing refrigeration systems		F
	Ensuring a minimum indoor air quality indicator according to specific standards		F
Rios et al. (2021)	Limited viable circular business models for construction		F
	Composite structures hinder reuse		F
	Current buildings were not designed for disassembly		E
	Damages during deconstruction		W M F
	Complexity of building design		F E
Yin et al. (2018)	Incremental time caused by green construction		W M E

Table S4. Classification based on Category C3 factors: Management strategies

Reference	Practice	Factor	Level
Ajayi et al. (2017)	Contract management		F
	Materials logistic management		F
Albino and Berardi (2012)	Involvement of companies specializing in sustainable construction		F E
	Involvement of certified sustainable construction companies		F E
	High level of integration between general contractor and suppliers		F E
	High level of integration between general contractor and design team		F E
Begum et al. (2009)	Management policies		F
Durdyev et al. (2018)	Re-engineering the design process, new types of partnerships and project stakeholders, product innovation and/or certification		E
	Requirement management		F
	Reliability and quality of specification, leadership and responsibility, stakeholder involvement, guides and benchmarking systems		F
Elbers (2022)	Holistic planning considering different levels (e.g., buildings, construction elements and materials) to encourage eco-responsible practices		F
Gangolells et al. (2014)	Stakeholders involved in coordinating the waste management plan		F
	Designate a waste management plan coordinator		M F
	Familiarity of all staff on-site staff with the waste management plan		M F
	Estimate the types and quantities of C&D waste		M F
	An individualized waste management plan		F
	Resources for each site to ensure compliance with the waste management plan		M F
	Tracking waste movements		F
	Detailed costing of waste management strategies in the budget		F
	Implementing the waste management plan and ensuring compliance		M F
	Construction staff properly trained in on-site waste management		M F
	Accurate forecasts of materials requirements		M F
	Subcontractors' commitment to on-site waste management policy		F
	Coordination among stakeholders during the project's design phase		F
	Future dismantling and reuse or recycling of building components and materials considered in the design phase		F
	Priority to the nearest authorized managers		F
Giorgi et al. (2022)	Reliable information sharing throughout the construction process (BIM)		F
Luangcharoenrat et al. (2019)	Ineffective planning and scheduling		M F
	Control and supervision		M F
Mamter et al. (2014)	Trust between stakeholders		F E
	Better quality of information		M E
	Time predictability		M E
	Better quantity of information		M E
Newaz et al. (2022)	Waste management plan / Waste characterization		F
Oke et al. (2019)	Clarification of roles and responsibilities		F
	Benchmarking and assessment		F
	Cooperation and partnership		M F E
Onubi et al. (2019)	Waste management		M F
	Material management		M F
	Energy management		M F
Rios et al. (2021)	Uncertainty about future spatial needs		F
	Uncertainty about end-of-life (long life span)		F
Ruparathna and Hewage (2015)	Environmental stewardship		F
	Waste management and recycling		F
Cha et al. (2009)	Waste management rules by waste producers		F
	Contractual clauses in waste treatment for a subcontractor		F E
	Positive incentive for decreasing waste or recycling by subcontractors		F E
	Contractual clauses concerning the method of waste treatment by a waste disposal agency		F E
	Checklist for implementing a detailed waste management plan		M F
	Checklist of documents to be prepared and submitted		M F
Yin et al. (2018)	Collaborative research and development with industry for new and/or improved technologies		E
Zaid et al. (2018)	Employees hired based on the company's environmental criteria		F
	Employees become preferable through their environmental commitment		M F
	Enhancement in the company's environmental state		F
	Reduction in the frequency of environmental mishaps		M F
	Managers' environmental objective		F
	Top-level management's dedication to green supply chain management		F
	Mid-level managers' backing for green supply chain management		F
	Creation of environmental reports for internal assessment		F
	Execution of total quality environmental management		F
	Suppliers expected to build and sustain an environmental management system		F E
Ajayi et al. (2017)	Making sub-contractors responsible for waste disposal		F E
Kabirifar et al. (2021)	Prioritize sorting and separating waste at the source for the management of C&D waste		M
	Management of material ordering, handling, and storage during the procurement phase		M F
	Implement precise supervision and a waste management plan during the construction/demolition phases		M F
Lim et al. (2019)	Managing construction activities through setting targets, monitoring evaluation, feedback, and self-regulation of progress		M F
Ofori-Boadu et al. (2020)	Sharing of project challenges and training of employees by subcontractors		E
	Subcontractors: share information with general contractor and reward employees who enhance performance		E
	Subcontractors: attend project meetings; visit general contractor premises to improve knowledge; apply risk premium on bids; state performance goals in strategic plans; work with experts and consultants		E
	General contractors: provide one generic plan to improve subcontractor performance		M E
	General contractors: provide each subcontractor with customized plan to improve subcontractor performance; visit subcontractor premises to provide guidance; provide training to subcontractor; mentor subcontractors; encourage peer mentoring among subcontractors		M E

Reference	Practice	Factor	Level
	General contractors: lend their employees to subcontractors / Subcontractors: join general contractor staff for mentoring, invest into subcontractor operation; pay for professional tests for subcontractors; pay for LEED training for subcontractors; use their own internal subcontractor certification	+	M E
Oke et al. (2019)	Strengthening implementation mechanisms	+	M F
Ruparathna and Hewage (2015)	Establish initiatives for water efficiency.	+	F E
	Design considering project life cycle, effects on air, water, and energy use	+	F E
	Establish an environmental management plan	+	F
Sapuay (2016)	Employer's Requirements (client/owner): minimize construction wastes at the worksite	+	F
	Mitigation measures for construction waste specified in environmental management plans	+	W M
	Contractors: produce waste management plan, including construction waste	+	E
Cha et al. (2009)	Keeping a record about waste management (amounts, kinds, etc.)	+	M F
	Shortening a period of collecting wastes in a site	+	M F
	Establishing a waste management plan in an early stage of construction	+	F
	Shortening a period of taking wastes out of site	+	M F
	Confirming capability of a firm which treats wastes	+	F E
	Deciding an objective rate for recycling wastes	+	F
	Keeping a record about recycling wastes	+	M F
	Informing recycling methods and uses in a site	+	M F
	Checking the route periodically for a waste agency to carry wastes	+	M F
	Checking the last status for a waste agency to treat wastes	+	F
	Changing the subject of a legal report from an owner to a contractor who manages wastes in practice	+	F E
	Managing data for wastes by a head office	+	F
Yusof et al. (2016)	Positive effect of firms' waste management practices and practitioners' environmental behavior during project implementation	+	F
Zaid et al. (2018)	Managers' assessment includes their environmental performance	+	F
Albino and Berardi (2012)	Lack of supplier compliance	−	E
Chan et al. (2024)	Fragmented nature of the construction industry	−	E
Luangcharoenrat et al. (2019)	Poor waste management	−	M F
	Wrong teams / Subcontractors selection	−	F
	Documents problems	−	M
	Reworks	−	M
	Coordination problems	−	M F
	Lack of suppliers involvement	−	F E
McGrath (2001)	Recycling not considered for recyclable packaging materials on the site	−	M
Mendis et al. (2015)	Lack of coordination between designers and subcontractors	−	E
Narcis et al. (2019)	Lack of material recycling facilities	−	F E
	Lack of customer support for C&D waste management	−	E
Rios et al. (2021)	Circular economy hampered by tradeoffs between different sustainability strategies	−	F
Yin et al. (2018)	Lack of management support and time to implement green practices	−	F
	Lack of communication and interest amongst project team members	−	M F

Table S5. Classification based on Category C4 factors: Industrial policies and markets

Reference	Practice	Factor	Level
Albino and Berardi (2012)	Lack of local policies		E
	Certification and labeling		E
Durdyev et al. (2018)	Regulations.		E
	Building regulations		E
	Building regulations, planning policy, taxes/levies		E
	Land-use regulations and urban-planning policies, recognition of commercial buildings as productivity assets		E
	Innovation / R&D		F E
	Commericial viability		F E
	Competitive industry		E
Giorgi et al. (2022)	Strategies promoting the circular economy, networking to learn about best practices		F E
	Laws, regulations, sustainable certification (ISO standard, etc.), company policy, taxes		E
	Obligation to trace materials/waste		E
	Audit before demolition		E
	Legislation to encourage reuse		E
Kabirifar et al. (2021)	Government regulations in C&D waste management (e.g., landfill taxes)		E
Lim et al. (2019)	Adopting policies and practices that advance sustainability		F
Narcis et al. (2019)	Increased implementation of green building codes, standards, and specifications		F
	Increased landfill charges		F
	Introduction of penalties for poor waste management practices		F E
Oke et al. (2019)	Planning policy		F
	Legislation / Legal requirements.		E
	Construction regulation		E
	Competitive advantage		F E
Pinkse and Dommisse (2009)	Significant impact on business processes due to architectural innovation		E
Sapuay (2016)	Include a penalty clause in the contractual provision for improper construction waste management		F E
Cha et al. (2009)	Obligatory cost estimation for quantity of waste treatment in a bill		F
	Incentive in bidding for contractor having plan about decreasing waste and increasing recycle		F
	Database management system for construction wastes		F
Teo and Loosemore (2001)	Legislation / Law		E
	Government intervention		E
Wang et al. (2017)	Clear environmental policies and support measures		F E
Wiguna et al. (2021)	Application of an environmental management system by suppliers		F E
	Cooperation with suppliers		F E
Wu et al. (2017)	Positive effect of governmental supervision on behavior		E
Yin et al. (2018)	Implementation of green construction enforced by government		E
Zhang and Zhou (2016)	Direct carbon regulations		E
	Economic carbon instruments		F E

Reference	Practice	Factor	Level
Jain et al. (2020)	Positive influence of regulatory pressure on firm's behavioral intention towards C&D waste recycling		E
Kabirifar et al. (2021)	Change client attitudes towards waste management, shifting from a profit-based approach to sustainability considerations		F E
	Decisive role of clients and developers in selecting and auditing other stakeholders in relation to C&D waste management		E
	Conduct more oversight of demolition companies to prevent them from illegally dumping (e.g., asbestos)		E
	Development of financial incentives to promote the reuse and recycling of C&D waste and to develop a market for recycled material		E
	Provide attractive incentives over strict punitive mechanisms for better C&D waste management		E
	Include incentive/punishment mechanisms in contractual documents		F E
	Unify regulations across different states and territories for more effective management of C&D waste		E
Lim et al. (2019)	Complying with relevant sustainability legislation and regulations		F
Ofori-Boadu et al. (2020)	Reward high-performing subcontractors with increased work volume		F
	General contractors: maintain preferred subcontractors list; share cost savings from improved subcontractor performance with subcontractor		F E
Oke et al. (2019)	Attracting and retaining good employees		F
	Developing regulatory mechanisms		E
Rios et al. (2021)	Set goals for landfill diversion and 'zero waste' policies that differentiate between reuse and recycling / Set targets for reclaimed components		F
	Integrate circular economy into contractual requirements related to design		F
	Assign circular economy consultants for design assistance		F
	Implement sustainable sourcing aligned with circular economy		F
	Implement construction regulation reform to remove barriers to material reuse and building renovation and to promote eco-design in the construction sector		F
	Increase demolition taxes		E
	Increase landfill taxes		E
	Promote carbon taxes		E
	Incorporate circular economy into building codes (e.g., mandatory building deconstruction plan)		E
	Increase taxes on foreign prefabricated components to strengthen the domestic market		E
	Create explicit guidelines on different circular economy strategies		E
	Allocate public funds to provide financial assistance to small and medium-sized firms and individuals engaging in circular design and construction		E
Ruparathna and Hewage (2015)	Comply with federal environmental guidelines		F
	Comply with LEED		F
	Incorporate LEED		F
	Follow the guidelines of sustainable procurement manual		F E
	Follow green procurement guidelines		F E
Cha et al. (2009)	Simplifying legal procedures to install waste treatment equipment		E
	Activating development of technique to treat and recycle wastes		F E
	Establishing criteria for quality and safety of recycled materials		F E
	Constructing marketing structure for recycled materials		E
	Enhancing punishment for illegal treatment of wastes		E
	Raising fees for mixed wastes		E

Reference	Practice	Factor	Level
	Reducing fees for separated wastes		E
Wiguna et al. (2021)	Require suppliers to have ISO 14001		F E
	Require the adoption of an environmental management system		F E
	Require the supplier to have prior experience in providing green		F E
Yin et al. (2018)	Implementation of green construction by the public sector		E
Zhang and Zhou (2016)	Impacts of direct carbon regulations on contractors		F E
	Direct carbon regulations for the construction market environment		E
	Direct carbon regulations for the construction industry		E
	Impacts of economic carbon instruments on contractors		F E
	Economic carbon instruments for the construction market environment		E
	Economic carbon instruments for the construction industry		E
Bilal et al. (2020)	Lack of support/backing from public institution		E
Chan et al. (2024)	Lack of support and involvement of the government		E
	Lack of legal framework and contract uncertainties		E
	Lack of suitable procurement policy and contractual agreements		F E
	Non-uniformity of sustainability evaluation criteria and measures		F E
	Lack of a comprehensive framework and implementation plan for sustainability		F
	Absence or non-uniformity of industry standards for sustainability		E
	Lack of client demand and top management commitment		E
	Hesitation and stakeholder engagement		F E
	Insufficient adoption by the industry		E
Durdyev et al. (2018)	Lack of government incentives		E
	Lack of statutory requirements that cover sustainable procurement		E
Lim et al. (2019)	Lack of legislation		E
	Lack of building codes on sustainability		E
Mendis et al. (2015)	Unclear contractual clauses		F
Pinkse and Dommisse (2009)	Increased risks associated with outsourcing activities		E
	Carbon lock: adoption of energy-efficient technologies perceived as a break with core competencies and a reputational risk		F
	Negative influence of industry and competitor projects on adoption decisions		E
	Difficulty convincing homebuyers of the added value of energy-efficient technologies		E
	Lack of binding requirements created by government regulations		E
	Consumer preferences that do not put energy efficiency at the top of the list		E
Rios et al. (2021)	Ambiguous or inadequate end-of-life policies		F
	Downcycling due to the policy emphasis on recycling		F
	Lack of building codes on sustainability		E
	Lack of legislation		E
	Reuse and repair hindered by existing regulations and codes		E
	Lack of circular economy regulations		E
	Collaboration impeded by anti-trust legislation		E
	Warranty issues of using reused materials		E
	Matching the old to the new		F E
	Walmart effect		E
Yin et al. (2018)	Lack of expressed interest from stakeholders and market demand		E
	Insufficient incentives from government for sustainable construction		E

Table S6. Classification based on Category C5 factors: Resistance to change

Reference	Practice	Factor	Level
Durdyev et al. (2018)	Retention of skilled labour	↑	F
Pinkse and Dommisse (2009)	Changing traditional practices	↕	W M F
Chan et al. (2024)	Attitudes of subcontractors and suppliers	⊘	E
	Industry's resistance to change from traditional working practices	⊘	E
	Societal reluctance to change from traditional values or culture	⊘	W E
	Longer time in adapting to new technologies (steep learning curve)	⊘	F E
Durdyev et al. (2018)	Resistance to change	⊘	W M F
Elbers (2022)	Resistance to change from conventional to green practices by company's employees	⊘	W M F
Lim et al. (2019)	Structure of the construction industry with a few large companies operating in a similar way and resisting external influences	⊘	E
	Culture of the construction industry	⊘	E
	Attitudes of clients	⊘	E
	Attitude of main contractors	⊘	E
Rios et al. (2021)	Resistance of suppliers and/or subcontractors	⊘	E
	Skepticism about the future resale of used building components	⊘	E
Sakr et al. (2010)	Tendency to maintain current practices	⊘	W M F
	Construction industry culture	⊘	F E
Teo and Loosemore (2001)	Lack of initiative and hesitance on future investments	⊘	F E
Yin et al. (2018)	Tedious construction process leading to fatigue, waste and overuse of materials	⊘	W F

Table S7. Classification based on Category C6 factors: Education and knowledge

Reference	Practice	Factor	Level
Chan et al. (2024)	Experience and technical know-how	↑	F
Durdyev et al. (2018)	Knowledge and common language, availability of methods and tools, innovation	↑	F
	Knowledge management, retention of skilled labour	↑	F
	Development of designers' competence and team-working	↑	E
	Ecological knowledge	↑	F E
	Urban-planning policies, education and training	↑	E
Gangolells et al. (2014)	Construction staff properly trained in on-site waste management	↑	F
	Knowledge of the waste management plan by site personnel	↑	F
Lu and Yuan (2010)	Professional training in waste management	↑	F
Mendis et al. (2015)	Promote high standards of workmanship to reduce construction waste	↑	F
Newaz et al. (2022)	Knowledge, experience and training / Roles and responsabilities	↑	F
Ofori-Boadu et al. (2020)	Pre-qualification of subcontractors	↑	F
	Qualified subcontractors' staff	↑	E
	Prior experience of subcontractors; top management's commitment to support subcontractor development practices programs	↑	E
	Subcontractors' commitment to subcontractor development practices programs	↑	E
	Subcontractors: members of trade associations	↑	E
	Subcontractors mentoring other subcontractors	↑	E
Oke et al. (2019)	Knowledge sharing	↑	F
	Educational programs	↑	E
	Creation of regional centers of excellence	↑	E
Ruparathna and Hewage (2015)	Worker training	↑	F
	Experience in sustainable construction	↑	F
	Experience in sustainable building construction	↑	F
Teo and Loosemore (2001)	Experience / External support or opinion group	↑	E
	Education / Training / Knowledge / Culture / Ethics / Values / Family	↑	F E
Yin et al. (2018)	Raising awareness through education, sharing platform via conferences and exhibitions	↑	F E
Zaid et al. (2018)	Job description including environmental responsibility	↑	F
Lim et al. (2019)	Undertaking prior assessment of proposed activities	↗	F
Oke et al. (2019)	Connecting research with implementation actors	↗	F E
Rios et al. (2021)	Exercise leadership and educate stakeholders	↗	F E
	Educate designers and project owners on life cycle cost	↗	F E
	Incorporate circular economy in university programs across all sectors	↗	E
	Incorporate eco-design training in professional license renewal requirements for architects, engineers, and contractors	↗	E
	Integrate eco-design into primary and secondary education	↗	E
	Integrate client requirements into architecture education	↗	E
Zaid et al. (2018)	Arrange ecological training for employees	↗	F
	Arrange environmental training for managers	↗	F
Begum et al. (2009)	Education level	⊘	F
	Employee training in construction	⊘	F E
	Lack of knowledge	⊘	F
	Construction experience	⊘	F
	Factors affecting contractors' waste management behavior (e.g., construction-related education among employees, contractor's experience in construction work, source reduction measures, reuse of materials, waste disposal behaviors, and attitudes toward waste management)	⊘	F
	Cost, lack of knowledge about the consequences of waste and the potential for waste reduction or minimization	⊘	F
Chan et al. (2024)	Inadequacy of requisite experience, knowledge, and skills from the workforce	⊘	F
	Lack of understanding of the processes and workflows required for BIM and sustainability	⊘	F
	Inadequate in-depth expertise and know-how to operate sustainability-related analysis software programs	⊘	F
	Shortage of cross-field specialists in BIM and sustainability.	⊘	F
	Difficulty in allocating and sharing BIM-related risks	⊘	F
	Increased risk and liability	⊘	F
	Insufficient level of support from the BIM software developers	⊘	F
	Inadequacy of BIM data schemas to semantically represent sustainability-based knowledge	⊘	F
	Low level of research in the industry and academia	⊘	E
	Limited cross-disciplinary expertise	⊘	F
Durdyev et al. (2018)	Lack of awareness on sustainable building, lack of training and education	⊘	F
	Limited knowledge and skills of subcontractors	⊘	E
Elbers (2022)	Lack of awareness and training	⊘	F
Hao et al. (2022)	Waste reduction training received or not	⊘	F
Lim et al. (2019)	Lack of education and knowledge in sustainable design	⊘	E
	Lack of skilled professional	⊘	F
	Lack of technical ability	⊘	F
Luangcharoenrat et al. (2019)	Incompetent workers	⊘	F E
	Designer's experience	⊘	E
Mendis et al. (2015)	Lack of knowledge of constructability	⊘	F
Pinkse and Dommisse (2009)	Dependence on external players to acquire technical knowledge	⊘	E
Rios et al. (2021)	Stakeholders' lack of experience and skills about circular economy strategies	⊘	E
	Lack of education and knowledge in sustainable design	⊘	F
	Confusion between reuse and recycling	⊘	F
Ruparathna and Hewage (2015)	Lack of professional capabilities / designers	⊘	F E
	Lack of training and education	⊘	F E
Sakr et al. (2010)	Lack of adequate knowledge about ISO 14001 benefits	⊘	F
Cha et al. (2009)	Education of the contractor's staff (engineers)	⊘	F
	Education of the subcontractor's staff (laborers)	⊘	F E
Yin et al. (2018)	Lack of knowledge on sustainable construction	⊘	F E

Table S8. Classification based on Category C7 factors: Perception and values

Reference	Practice	Factor	Level
Begum et al. (2009)	Organizational culture	+	F
Durdyev et al. (2018)	Company awareness, suppliers	+	F E
	Development of the awareness of clients about the benefits of sustainable building, new concepts and services	+	F E
	Company awareness	+	F
Hao et al. (2022)	Personal values	+	W
	Environmental awarness	+	W M F
	Sense of responsability	+	W M F
Jain et al. (2020)	Positive influence of perceived benefits on individual's attitude towards C&D waste recycling	+	W M F
	Positive influence of individual's attitude on their behavioral intention towards C&DW recycling	+	W
	Positive influence of perceived behavioral control on individual's behavioral intention towards C&DW recycling	+	W
	Positive influence of individual's behavioral intention towards C&D waste recycling on their C&D waste actual behavior	+	W
Kaluarachchi et al. (2021)	Positive influence of personal norm on the environmental behavior of employees	+	W
	Positive influence of awareness of consequences on the personal norm of employees	+	W
	Positive influence of awareness of consequences on ascription of responsibility of employees	+	W
	Positive influence of a company's behavior on the environmental behavior of employees	+	F
	Positive influence of a company's behavior on the personal norm of employees	+	F
Swarna Swetha et al. (2022)	Positive impact of favourable attitude towards construction waste on intention to adopt construction waste management (CWM)	+	F
	Positive impact of perceived behaviour control on intention to adopt CWM	+	F
	Positive impact of knowledge on intention to adopt CWM	+	F
	Positive impact of knowledge on attitude to adopt CWM	+	F
	Positive impact of perceived usefulness on attitude to adopt CWM	+	F
Lu and Yuan (2010)	Awareness of C&D waste management	+	F
Narcis et al. (2019)	Increased support of C&D waste management from client	+	E
	Increased awareness and dissemination of knowledge about C&D waste management	+	F
Oke et al. (2019)	Advocacy and awareness	+	F
Pinkse and Dommisse (2009)	Active employee participation in conferences and exhibitions on sustainability innovations	+	W M F
	Interest in sustainability and energy efficiency in industry	+	W M F
	Membership of a cleantech-oriented association	+	F
	Wider adoption of energy-efficient technologies by certain companies	+	F E
	Ability to acquire technical knowledge in-house and incorporate new technologies	+	F
Wang et al. (2017)	Individual Initiative and participation in environmental activities	+	W M F
Wu et al. (2017)	Positive effect of social norm on behavioral intention	+	E
Zaid et al. (2018)	Employees' environmental objective	+	W M F
	Job description including environmental responsibility	+	F
	Employees participate in matters concerning environmental issues	+	W M F
Zhang and Zhou (2016)	Know the concept of construction carbon emissions	+	W M F
	Know the negative effects of construction carbon emissions	+	W M F
	Know the facts of construction carbon emissions	+	W M F
	Recognize contractors' carbon reduction responsibility	+	F
	Recognize contractors' environmental protection responsibility	+	F
	Recognize contractors' corporate social responsibility	+	F
Zhou et al. (2018)	Emissions awareness	+	M F
Lim et al. (2019)	Establishing a voluntary commitment to continual improvement of performance in the built environment	+	F
	Promoting interdisciplinary collaborations and multi-stakeholder partnerships	+	F
Rios et al. (2021)	Raise public awareness of circular economy through public campaigns	+	E
	Raise awareness of the environmental impact difference between reuse and recycling, and between recycling and downcycling	+	F E
Yin et al. (2018)	Enhancing the company's competitiveness in bidding jobs	+	F
Zhang and Zhou (2016)	Make change in organizational structure	+	F
	Make change in organizational human resource	+	F
	Make change in organizational goals	+	F
Bilal et al. (2020)	Lack of customer/public awareness	−	E
Chan et al. (2024)	Lack of awareness and collaboration among project stakeholders	−	F E
	Difficulty in accessing sustainability-related data (e.g., safety, health, pollution index, etc.)	−	F
	Low level of involvement of BIM users in green projects.	−	F E
Durdyev et al. (2018)	Lack of client awareness	−	E
	Lack of client demand	−	E
	Lack of environmental concern	−	W M F
Hao et al. (2022)	Physical stess	−	W M F
	Psychological stress	−	W M F
Lim et al. (2019)	Lack of awareness of construction professionals	−	M F E
	Lack of awareness of benefits in sustainable construction involved	−	M F E
	Ignorance and misunderstanding about sustainability	−	W M F
Rios et al. (2021)	Stakeholders' lack of interest in circular economy	−	E
	Lack of awareness of construction professionals	−	E
	Lack of stakeholder knowledge and awareness of circular economy strategies and benefits	−	E
Sakr et al. (2010)	Nonawareness	−	W M F

Table S9. Classification based on Category C8 factors: Reputation and image

Reference	Practice	Factor	Level
Durdyev et al. (2018)	Corporate image		F
	Company image/reputation or marketing strategy		F
Jain et al. (2020)	Positive influence of normative pressure on firm's behavioral intention towards C&D waste recycling		E
Oke et al. (2019)	Reputation / Image		F
Gangolells et al. (2014)	Improve the company's public image		F
Wang et al. (2017)	Implementation of megaproject environmental responsibility focused on human needs practices to obtain organizational rewards and promote organizational citizenship behaviors for the environment among project participants		M F
Yin et al. (2018)	Enhancing the company's public image		F

Table S10. Classification based on Category C9 factors: Financial viability

Reference	Practice	Factor	Level
Gangolells et al. (2014)	Budget including cost data for waste management strategies	◠	F
Narcis et al. (2019)	Purchase cost savings due to reduced wastage of materials	◠	F
	Waste disposal savings	◠	F
	Offering of incentives and tender premiums related to waste management.	◠	F
Newaz et al. (2022)	Economic values	◠	F E
Oke et al. (2019)	Financial incentives	◠	F
	Cost reduction	◠	F
Wu et al. (2017)	Positive effect of economic viability on behavior	◠	F
Zhou et al. (2018)	Financial and technical support	◠	F
	Compensating contractors for additional costs related to green activities	◠	F E
Lim et al. (2019)	Consideration of financial affordability for target beneficiaries	◠	F E
	Promoting employment creation and labor-intensive in construction	◠	F E
Rios et al. (2021)	Grants, tax credits, and low-interest loans to businesses engaged in circular economy practices	◠	E
	Increase taxes on new constructions and reduce taxes on adaptive reuse of buildings	◠	E
Begum et al. (2009)	Costs	⊘	F
Bilal et al. (2020)	Inadequate financial resources	⊘	F
Chan et al. (2024)	High cost of BIM software, license, and associated applications	⊘	F E
	Recurring need for additional and associated resources and high economic expenses	⊘	F
	High initial investment in staff training costs	⊘	F
	Risk of losing intellectual property and rights	⊘	F E
	Financial constraints	⊘	F
Durdyev et al. (2018)	Lack of financial incentives, economic needs of higher priority, environmental costs not included in the cost structure, affordability	⊘	F
	Affordability	⊘	F
	Construction cost efficiency / Lifecycle cost / Commercial viability / Cost of operation and maintenance	⊘	F E
	Higher cost of sustainable-building option	⊘	F E
	Economic needs of higher priority	⊘	F
	Long pay-back periods from sustainable practices	⊘	F
Elbers (2022)	Perceived costs	⊘	F
Jain et al. (2020)	Negative influence of perceived costs on individual's attitude towards C&D waste recycling	⊘	F
Lim et al. (2019)	High initial investment costs	⊘	F
	Long pay-back period	⊘	F
	Uncertainty in cost savings	⊘	F
	Ignorance of life cycle cost	⊘	F
Pinkse and Dommisse (2009)	High communication costs and increased complexity of business processes	⊘	F
Rios et al. (2021)	Low virgin material prices	⊘	F
	Increase taxes on virgin materials	⊘	E
	Limited funding	⊘	F
	Split incentives	⊘	F
	Lack of fiscal and regulatory incentives for circular economy	⊘	E
Ruparathna and Hewage (2015)	Fair wages to the workers	⊘	F
Saez et al. (2013)	Additional costs associated with increased vigilance and control in implementing C&D waste management best practices due to lack of awareness among agents involved in the process	⊘	F
Sakr et al. (2010)	Increased costs	⊘	F
Teo and Loosemore (2001)	Monetary incentive	⊘	F
	Time / Cost / Work processes	⊘	F
Yin et al. (2018)	Lost in competitiveness due to competitors using less environmentally friendly materials at lower costs	⊘	F E
Zhou et al. (2018)	Additional costs, extra time, lack of knowledge of technologies	⊘	F