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Circular Waste Reduction and Single-Use Plastic Elimination in Large Industrial Complexes: A Conceptual Framework for Supply Chain and Site-Level Policy Intervention

Oghenekaro Ekelemu
Independent Researcher, Nigeria

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ABSTRACT: A large industrial complex consumes single-use plastic in quantities that are substantial in absolute terms and invisible in its reporting, because the consumption is distributed across catering, packaging, personal protective equipment, consumables and contractor supply, and no function owns the total. Elimination programmes accordingly begin with a measurement problem rather than a substitution problem, and those that begin with substitution characteristically achieve visible change in the catering stream while the larger operational streams continue unexamined. This paper develops a conceptual framework for plastic elimination and circular waste reduction in industrial complexes, organised around the argument that the site boundary is the wrong unit of analysis and that intervention effectiveness is determined principally at the procurement and specification stage. The framework comprises four elements: a stream classification distinguishing plastic entering the site by route and by the function that controls each route; an intervention hierarchy ordering avoidance, substitution, reuse and recycling by effectiveness rather than by visibility; a supply chain specification layer treating packaging as a purchased attribute subject to specification like any other; and a measurement approach based on entry rather than on disposal, since disposal measurement systematically undercounts. The paper engages the critical literature on circular economy claims, including the rebound and displacement arguments, and takes the position that a site-level programme should be justified on waste management and stewardship grounds it can actually deliver rather than on circularity claims it cannot substantiate.

KEYWORDS: circular economy, single-use plastics, waste reduction, industrial complexes, procurement specification; industrial symbiosis, waste measurement, environmental management.

1. INTRODUCTION

Plastic production has grown to a scale that makes its disposition a global problem, and the mass balance of what has been produced, used and discarded is now reasonably well established: the great majority of plastic ever manufactured has become waste, and the majority of that waste has been neither recycled nor incinerated (Geyer, Jambeck, & Law, 2017). The consequences at the environmental receiving end have been characterised for marine systems in particular (Jambeck et al., 2015), and projections indicate that mitigation efforts currently in prospect fall well short of the growth in waste generation (Borrelle et al., 2020).

Large industrial complexes participate in this in a way that is easy to overlook because their environmental attention is directed elsewhere. A liquefaction facility reports on emissions, on effluent, on flaring and on hazardous waste, and its plastic consumption appears, if anywhere, as a component of general waste tonnage. The consumption is nonetheless substantial: a site with several thousand people has a catering operation, a stores function receiving packaged goods continuously, a personal protective equipment issue, a laboratory, a medical facility, and a contractor population supplying its own consumables.

Elimination programmes have become common and share a characteristic shape. They begin with the visible stream, which is catering, achieve a rapid and photographable result there, and then encounter the streams that are larger and harder, which are packaging and operational consumables. The programme's reported achievement is real and its share of the total is small.

This paper develops a framework intended to avoid that shape. Its central argument is that the effective intervention point is procurement rather than disposal, that the site boundary is the wrong unit of analysis because most site plastic is determined by decisions made off site, and that measurement should be at entry rather than at disposal because disposal measurement is systematically incomplete. The scale and trajectory have been characterised repeatedly since the mass balance was first established. Projected generation continues to outrun mitigation capacity under plausible scenarios (Lebreton & Andrady, 2019), riverine transport has been quantified as the dominant pathway to marine systems (Schmidt, Krauth, & Wagner, 2017), and the state of knowledge on marine plastics and on the wider threat has been synthesised (Law, 2017; MacLeod, Arp, Tekman, & Jahnke, 2021).

2. LITERATURE REVIEW

2.1 Stream Classification

The framework begins with classification, because a programme cannot address what it has not distinguished. Five entry routes are proposed, distinguished by who controls the route rather than by material type, since the controlling function determines where the intervention must act.

2.1.1 Catering and hospitality

Catering and hospitality plastic enters through the food service contract and is controlled by the contract specification. It comprises service ware, packaging on delivered food, and beverage containers. It is the most visible stream, the smallest in most complexes by mass, and the most readily addressed because a single contract governs it.

2.1.2 Goods packaging

Goods packaging enters with everything the site purchases and is controlled by the purchase specification and, in practice, by the supplier's own packaging decisions. It comprises transit packaging, protective packaging on equipment and spares, and consumer-format packaging on small items. It is typically the largest stream by mass and the one over which the site has least direct control, since the packaging arrives as an attribute of goods ordered for other reasons.

2.1.3 Operational consumables

Operational consumables comprise plastic used in the conduct of work: disposable gloves, coveralls, sample containers, laboratory consumables, sheeting, wrapping and temporary protection. It is controlled by the specifying engineer and by the stores catalogue, and much of it is genuinely required by the work, which distinguishes it from the streams where substitution is straightforward.

2.1.4 Protective equipment and medical plastic

Personal protective equipment and medical plastic is partly operational consumable and warrants separate treatment because substitution options are constrained by the protective function and by regulation, and because the consequence of an inappropriate substitution is a safety consequence rather than an environmental one.

The medical and laboratory component of this stream is small in mass and disproportionate in constraint, and the literature on diagnostic and laboratory facilities is where those constraints are set out. Laboratory design operates under regulatory compliance regimes that fix consumable formats before any environmental preference is expressed (Ogbete, Aminu-Ibrahim, & Ambali, 2019), spatial planning and workflow determine what is single-use and what is not (Ogbete, Aminu-Ibrahim, & Ambali, 2018), and blood collection and sample handling networks are designed around disposable containment as a contamination control rather than as a convenience (Ogbete, Aminu-Ibrahim, & Ambali, 2022). Where sustainability has entered that literature it has entered through lifecycle performance evaluation of the facility as an asset rather than through its consumables (Ogbete, Aminu-Ibrahim, & Ambali, 2023), which is consistent with this paper's observation that the consumable stream is the last part of any operation to receive environmental attention. Infrastructure models developed for resource-constrained settings make the same point from the opposite direction, since consumable supply is the binding constraint on diagnostic access (Aminu-Ibrahim & Ogbete, 2023).

The regulated supply chain governing medical and pharmaceutical items is a further constraint, and it is a constraint of a kind the site cannot relax. Packaging and presentation are elements of the regulatory dossier rather than commercial choices (Eze, Anene, & Akinleye, 2022b), harmonisation across jurisdictions determines what formats are available in a given market (Eze, Akinleye, & Anene, 2024a), and the one treatment that addresses environmental risk management directly does so alongside access and governance rather than in place of them (Eze, Anene, & Akinleye, 2023). A site that specifies packaging for its general purchases and exempts its medical and laboratory supply is not being inconsistent; it is recognising where the specification authority actually lies.

The same constraint recurs at system level, and the health services literature is explicit that consumable supply is a governance and continuity question before it is an environmental one. Pharmacy-led delivery and access models determine dispensing formats and therefore packaging (Ilodigwe & Adesemoye, 2020), and organisational capability rather than technology is identified as the binding constraint on sustained change (Ilodigwe & Adesemoye, 2024b). Pharmaceutical distribution research reaches the same conclusion from the supply side, where quality assurance in manufacturing has been reconceptualised as a determinant of supply reliability rather than a compliance overhead (Asiedu & Asiedu, 2024b), and access, affordability and supply chain resilience have been treated as a single systems problem (Asiedu, 2026). A site pharmacy or clinic inherits those constraints intact and cannot trade them against a packaging preference.

Governance and assurance of the data supporting such decisions forms a further layer, addressed comparatively for oversight and accountability structures (Afrihyia, Akinse, & Ojukwu, 2024) and for audit quality supported by data analytics (Ozowara, Adebayo, & Anunagba, 2025). The relevance to this paper is indirect and specific. Each describes an attribute that had to be defined, measured, governed and audited before it could be managed, which is precisely the position a packaging attribute occupies now.

The clinical caseload of a site medical facility determines its consumable demand, and in an industrial workforce that caseload is dominated by chronic conditions rather than by injury. Screening and burden studies in comparable populations indicate the scale of that demand (Amadi et al., 2026), and coordinated multisite implementation of clinical programmes describes the delivery structure through which such care is organised (Omo Enabulele et al., 2025). Consumable consumption at the site clinic follows from those clinical decisions and is not available to a plastics programme as a target.

2.1.5 Contractor-supplied plastic

Contractor-supplied plastic enters with contractor personnel and materials and is controlled by the contract terms, or is uncontrolled where the terms are silent. During a major expansion campaign this stream can exceed all others combined and is generally outside the site environmental programme's scope.

The classification's value is that it identifies, for each stream, the function whose decision determines the volume. Catering is a contract specification. Packaging is a purchase specification. Consumables are a catalogue and an engineering specification. Contractor plastic is a contract term. None of these is a waste management decision, which is where elimination programmes are ordinarily located. Reviews of hazardous waste management in African operating contexts identify the same structural weakness from the disposal side, namely that risk assessment frameworks exist while the monitoring and enforcement infrastructure that would make them operative frequently does not (Ozobu, Adikwu, Odujobi, Onyekwe, & Nwulu, 2025). Two of the five streams carry constraints from outside the environmental programme and should be flagged. Personal protective equipment and medical plastic is governed by the protective function and by occupational health requirements, so substitution decisions carry a safety consequence rather than only an environmental one (Ozobu, Adikwu, Odujobi, Onyekwe, & Nwulu, 2022; Adikwu, Ozobu, Odujobi, Onyekwe, & Nwulu, 2025; Health and Safety Executive, 2007; Flin, O'Connor, & Crichton, 2008). Contractor-supplied material during an expansion campaign is governed by contract terms set at tender, which is an organisational interface question rather than a waste question (Lawrence & Lorsch, 1967; Galbraith, 1974; Thompson, 1967; Flyvbjerg, 2014; Merrow, 2011; Ihwughwavwe & Usiagu, 2024). A sixth stream sits outside the plastics framing and deserves naming because it dominates industrial waste mass in this sector. Produced and process water is generated continuously, is governed by its own regulatory regime, and has an established treatment and reuse literature: lifecycle risk assessment frameworks have been developed for offshore management (Falegan & Aniebonam, 2022), and resource recovery and beneficial reuse has been reviewed as the circular pathway (Falegan & Aniebonam, 2025). The reuse framing in that literature is the clearest sector instance of the hierarchy this paper argues should be respected in order.

2.2 The Intervention Hierarchy

The waste hierarchy is long established and its application here requires only that the ordering be respected in practice rather than in statement, which is the more demanding requirement.

2.2.1 Avoidance

Avoidance means the plastic does not enter the site. It is the most effective intervention and the one requiring action furthest from the waste function. Ordering in bulk rather than in individual packaging, specifying returnable transit packaging with suppliers, eliminating consumer-format items from the stores catalogue, and removing bottled water by installing dispensers are all avoidance measures and all are procurement or facilities decisions.

2.2.2 Substitution

Substitution means the plastic is replaced by another material. It is the intervention most visible and most often mistaken for avoidance, and it is the one where the environmental benefit is least certain, since a substituted material has its own production and disposal burden which may exceed the plastic it replaced. Life cycle comparisons of substitute materials frequently fail to favour the substitute, particularly where the substitute is heavier and the transport distance is long. A programme substituting without assessment is asserting a benefit it has not established.

Where substitution runs toward bio-based or residue-derived materials, the relevant evidence base sits in agricultural and food systems research rather than in packaging research, and it is more developed than the packaging literature acknowledges. Circular economy frameworks for waste reduction and resource efficiency have been developed for agricultural systems directly (Michael & Ogunsola, 2024b), work on food system efficiency and policy decision-making describes the conditions under which a bio-based feedstock would actually be available at scale (Michael & Ogunsola, 2023a), and household food security constraints determine whether residues can be diverted to industrial use at all (Michael & Ogunsola, 2021d).

Residue valorisation is the specific mechanism, and the animal nutrition literature has evaluated it more rigorously than most packaging substitution claims are evaluated, because there the substitute must be measured rather than asserted. Cassava peel and water hyacinth silage has been assessed for nutritional quality and utilisation (Tawose, Ekeocha, & Oluwadele, 2023), tuber peel meals compared as supplements (Tawose & Oluwadele, 2025), and alternative feeds assessed on an explicit cost-benefit basis with attention to long-term effect (Oluwadele et al., 2025a). The methodological point transfers directly. A substitute is accepted there only after measured comparison against the incumbent on the function that matters, which is the discipline this paper argues plastic substitution generally lacks. Process engineering work on residue conversion equipment adds that the conversion step is itself a machine design problem with its own performance criteria rather than an assumption that a residue is available in usable form (Bello, Oyelaran, Tawose, Omoyi, & Yussouff, 2024).

2.2.3 Reuse

Reuse means the item is used more than once, and it is the intervention with the best ratio of benefit to disruption in an industrial setting, because industrial sites have the logistics, the storage and the repeated supplier relationships that make returnable systems workable in a way that consumer settings do not. Returnable transit packaging with regular suppliers is the clearest instance and is underused.

The obstacle to returnable systems is not conceptual but logistical, since a returnable pool is an inventory that must be tracked, cleaned, stored and repositioned, and the site must therefore treat packaging as an asset rather than as a disposal. The materials management literature already treats other items this way, and the models for inventory visibility and asset lifecycle tracking transfer directly (Okonkwo, Mayo, & Okeke, 2023; Okonkwo, Agbabiaka, Ogunwole, Mayo, & Okeke, 2021). Where warehousing has been automated, the slotting and path-planning problems that a returnable pool creates have been formalised (Akanbi & Sunday, 2024), which indicates that the handling burden a returnable system imposes is tractable at industrial scale even though it is rarely costed when the option is dismissed.

2.2.4 Recycling

Recycling is last and is where site programmes concentrate, because it is within the waste function's control and produces a measurable diversion figure. Its limitations in this setting are practical: segregation quality in an industrial environment is poor, contamination with hydrocarbon renders much plastic unrecyclable, and the receiving infrastructure in many operating locations is limited or absent, so that segregated material may not in fact be recycled after collection.

The last point deserves emphasis because it bears on programme honesty. A site that segregates and reports a diversion rate is reporting what it handed over, not what was reprocessed, and where the downstream infrastructure is uncertain the two differ. Verifying the fate of segregated material is an obligation the reporting implies and rarely discharges. Sector treatments of circular economy principles in oil and gas reach the same ordering and identify the same obstacles, namely that the technical routes for waste recovery and reuse are better developed than the regulatory and cultural conditions required to adopt them (Digitemie, Onyeke, Adewoyin, & Dienagha, 2025). The hierarchy itself has been examined critically, since its ordering is an assumption about environmental benefit that does not hold universally and its application in policy has been inconsistent (Van Ewijk & Stegemann, 2016; Gharfalkar, Court, Campbell, Ali, & Hillier, 2015). The rebound argument applies within the hierarchy as well as across it, since efficiency gains at one level can increase throughput at another (Zink & Geyer, 2017; Korhonen, Honkasalo, & Seppala, 2018; Font Vivanco, Kemp, & van der Voet, 2016). Recycling performance in practice depends on the receiving infrastructure rather than on the segregation effort, and the literature on plastics recycling systems documents both the technical limits of mechanical reprocessing and the wide variation in what actually happens to collected material (Hopewell, Dvorak, & Kosior, 2009; Ragaert, Delva, & Van Geem, 2017; Singh, Hui, Singh, Ahuja, Feo, & Fraternali, 2017; Vollmer et al., 2020; Milios, Holm Christensen, McKinnon, Christensen, Rasch, & Hallstrom Eriksen, 2018). The tension between material recovery and chemical safety is the sharpest unresolved question in the hierarchy and has been examined directly for recycled polymers in packaging, where regulatory compliance, lifecycle emissions and contamination risk pull in different directions (Okojie & Abioye, 2020). An industrial site specifying recycled content in packaging inherits that tension whether or not it examines it.

2.3 Procurement as the Controlling Function

If the classification proposed above is correct, then the literature bearing most directly on plastic elimination in an industrial complex is not the waste literature but the procurement literature, since procurement is where the volume is determined. That literature has developed in the energy and infrastructure sectors along three lines, and each supplies a mechanism the framework requires. It is worth stating plainly that none of this literature concerns plastic. Its relevance is structural: it describes the decision points at which an additional purchased attribute could be specified, and it establishes that those decision points are already governed formally rather than informally.

The first line is strategic procurement optimisation, which treats purchasing as a lever on operational outcomes rather than as a transactional function (Okonkwo, Ogunwole, & Okeke, 2018a). Contract negotiation and vendor governance are the instruments through which buyer requirements become supplier obligations (Okonkwo, Ogunwole, Okeke, & Mayo, 2019), and regulatory compliance requirements have already been shown to travel through that channel in high-risk energy environments (Okonkwo, Ogunwole, Mayo, & Okeke, 2021), which is the precedent a packaging requirement would follow rather than a novel demand. Supply chain risk management in engineering, procurement and construction projects establishes that the supplier base of a facility of this kind is governed through structured frameworks (Agbabiaka, Okonkwo, Ogunwole, Mayo, & Okeke, 2019), which is the precondition for adding an attribute to a specification at manageable cost.

The second line is materials, inventory and catalogue management, which is where consumer-format items and their packaging are created or eliminated. Asset lifecycle management and inventory visibility (Okonkwo, Mayo, & Okeke, 2023) and predictive procurement planning to sustain operational uptime (Okonkwo, Agbabiaka, Mayo, & Okeke, 2024c) address the same catalogue and the same reorder decisions that determine whether an item arrives in bulk or in individual wrap. The packaging consequence of those decisions is absent from that literature, which is precisely the gap this paper identifies. The decisions are already modelled with some sophistication; the packaging attribute is simply not a variable in the model.

The third line is digitalisation of the procurement function, which matters because a packaging disclosure requirement is a data requirement before it is an environmental one. Enterprise resource planning adoption and logistics performance (Okonkwo, Agbabiaka, Mayo, & Okeke, 2024d), digital supply chain governance in energy and infrastructure (Okonkwo, Agbabiaka, Mayo, & Okeke, 2024a), integration of information technology systems engineering with supply chain operations (Okonkwo, Ahiaeke Patrick, Okeke, & Mayo, 2023) and national-scale optimisation through integrated procurement systems (Okonkwo, Agbabiaka, Okeke, & Mayo, 2025) together describe an infrastructure into which a packaging field could be inserted at low marginal cost. Geospatial approaches to vendor evaluation and bid selection extend the same reasoning to supplier assessment (Ahiaeke Patrick, Okonkwo, Mayo, & Okeke, 2021), and work on demurrage elimination and port logistics efficiency extends it to the inbound transport leg, which is where transit packaging is generated and where its removal would be observed first (Okonkwo, Agbabiaka, Ogunwole, Mayo, & Okeke, 2020).

A parallel applied literature addresses the buyer side of the same relationship and is more explicit about the transmission mechanism. Procurement process automation and transparency (Akinleye & Adeyoyin, 2021) and cross-border supplier relationship frameworks spanning pharmaceutical and construction sectors (Akin-Oluyomi, Atima, & Akinleye, 2024) describe the instruments through which a specification becomes an obligation rather than a stated preference. The analytical apparatus for handling an additional purchased attribute is well developed and is applied almost exclusively to cost and service attributes: data visualisation in procurement decision-making (Babatope, Akokodaripon, Akinleye, & Okoruwa, 2023), lean supply chain optimisation (Efobi, Akinleye, & Fasawe, 2022b) and lean guardrails for automated multi-enterprise value chains (Ogundairo, 2025). The observation this paper draws from that body of work is not that it is deficient but that the attribute set it optimises is a choice, and packaging has not been chosen.

2.4 Requirements, Visibility and the Transmission Problem

A specification is not an outcome. Environmental, social and governance requirements have been examined in supply chains principally as a transmission problem, in which a requirement stated by a buyer becomes a result only where there is visibility along the chain and a means of verifying compliance at the point of delivery. End-to-end visibility frameworks address transparency, compliance and traceability across complex global chains and identify visibility as the binding constraint rather than intent (Nnabueze et al., 2021), and supplier relationship management has been framed as the vehicle through which requirements produce innovation and collaboration rather than adversarial compliance (Ike et al., 2021). Lean language is worth treating with care here, because a site that adopts it for a plastics programme may find that the operational and material definitions of waste diverge exactly where the material question becomes difficult.

Digital twin approaches to environmental compliance in oil, gas and utilities procurement propose the closest available analogue to the entry measurement this paper recommends, in that they attach an environmental attribute to a purchased item and track it (Ike, Okojie, Nnabueze, Idu, Filani, & Ihwughwavwe, 2025). Related work integrates artificial intelligence with environmental, social and governance metrics for infrastructure auditing (Okojie et al., 2023a), which assumes a data layer that industrial procurement systems already possess for cost and delivery and do not populate for material attributes. Demand forecasting work aimed at reducing inventory management costs illustrates the same point, since forecasting accuracy directly determines order frequency and therefore packaging count, and the packaging consequence is not reported (Aifuwa et al., 2020). Real-time risk dashboards developed for hospital supply chains show what the presentation layer for such an attribute would look like in practice (Filani, Nnabueze, Ike, & Wedraogo, 2022).

The construction and project literature has moved further on the analogous problem of embodied carbon, and the parallel is instructive because carbon faced the same objection that packaging faces now, namely that it is an attribute of a purchased good determined off site and therefore not the buyer's concern. Carbon-driven decision gates integrate embodied accounting into lifecycle project governance (Abdulhadi & Hamdan, 2026a). Packaging is a simpler problem than embodied carbon, since it is directly observable at the gate and requires no upstream modelling, and the fact that the harder attribute has been operationalised while the easier one has not is best explained by the visibility argument this paper makes rather than by any technical obstacle. Risk allocation frameworks developed for public-private partnership arrangements supply the contractual logic for assigning such an attribute to the party that controls it (Ike et al., 2024a), and systematic treatment of project finance and public private partnership structures adds how those arrangements are assembled in the first place and at which point obligations become fixed rather than negotiable (Oladepo & Oyediji, 2025b).

2.5 The Contractor and Project Interface

The contractor stream is the largest during expansion and the least governed, and the literature that addresses it does so almost entirely from the safety side. That literature is nonetheless the most directly transferable body of work available, because it has solved the same problem this paper poses: how an owner imposes a requirement on a contractor population it does not employ, across a temporary organisation, and verifies compliance.

Governance-oriented models for contractor safety performance in multi-contract industrial projects establish the basic structure, in which the requirement is set at tender, cascaded through subcontract tiers and verified through audit (Arumosoye & Obriki, 2020). Contractor safety compliance systems in infrastructure engineering projects describe the verification apparatus (Obogo, Uduokhai, & Ozobu, 2021), and risk governance models for multi-contractor projects describe the tiering problem (Obogo, Ozobu, & Uduokhai, 2019b). Internal quality, health, safety and environment audit systems supply the mechanism by which the owner establishes whether the cascade actually occurred (Obogo, Arumosoye, & Obriki, 2020a), including how those systems behave under the schedule pressure that characterises turnaround and expansion work.

Two findings from that literature bear directly on a packaging or waste requirement. The first is that requirements imposed without leadership attention decay, which has been examined as safety culture transformation in large construction workforces (Obogo, Ozobu, & Uduokhai, 2019a) and as the institutionalisation of practice across project-based organisations. The second is that behaviour in temporary organisations reverts unless it is trained, observed and reinforced, which has been addressed through workforce training models (Obriki, Obogo, & Arumosoye, 2022a). Hazard identification and risk control practice supplies the template for the site survey a packaging programme requires (Obogo, Uduokhai, & Ozobu, 2019), and data-driven risk control in large energy infrastructure projects supplies the measurement analogue (Obriki & Arumosoye, 2018). The one treatment in this group that addresses environmental practice directly places it inside the occupational safety management system rather than alongside it (Obogo, Arumosoye, & Obriki, 2024), which is the organisational arrangement this paper's implementation sequence assumes.

The project governance literature adds the contractual dimension. Sustainability-linked contracting and incentive alignment in integrated project delivery is the most direct statement of the mechanism, in which a sustainability requirement is tied to commercial terms rather than expressed as an aspiration (Abdulhadi & Hamdan, 2026c). Governance of multinational infrastructure projects has been examined for the general case (Amayo, Owulade, & Isi, 2023a), for risk management and compliance frameworks in regulated project environments (Amayo, Owulade, & Isi, 2023b), and for lifecycle project delivery where compliance and efficiency must be held together (Amayo, Owulade, & Isi, 2024a). The common finding is that requirements not present at tender are variations, and variations are expensive, which is the practical basis for this paper's recommendation that the packaging term be written at tender or not at all.

2.6 Competence, Communication and Programme Fidelity

The interventions this framework proposes are carried out by people who did not design them, in a workforce that is large, partly transient and frequently multilingual, and the evidence on whether an introduced practice persists comes from fields that study that question directly. Their distance from industrial waste management is obvious and is the reason they are rarely consulted. The mechanisms they describe are nonetheless the ones that determine whether a segregation requirement survives its first year.

Implementation fidelity is the central construct. Work on monitoring the fidelity with which an individualised plan is actually delivered addresses the gap between a documented requirement and the practice that follows it (Yeboah & Oloto, 2023), and effectiveness reviews establish what proportion of documented behaviour plans produce the intended behaviour (Oloto & Yeboah, 2023). The finding common to that literature, that a plan's presence in a document predicts very little about practice in the absence of monitoring, is the same finding the safety literature reaches by another route and is the reason this paper places verification rather than specification at the centre of implementation.

Competence and its maintenance is the second construct. Professional development and its relationship to practitioner competence has been examined directly (Yeboah, Bobga, Boakye, & Ogbona, 2019), the use of progress data to adapt practice rather than merely to report it has been modelled (Yeboah, Bobga, Boakye, & Ogbona, 2022), and practitioner burnout has been identified as the mechanism by which a demanding practice decays regardless of its merit (Yeboah, Bobga, Boakye, & Ogbona, 2025). Persistence has been modelled as a function of belonging rather than of instruction (Githinji & Atobatele, 2025b), and equity of access to digitally delivered training determines which part of a workforce a requirement actually reaches (Orise & Niniola, 2024).

Communication across languages is the third construct and is specific to the operating context assumed here. A contractor workforce on a West African industrial site is routinely multilingual, and a requirement expressed only in the operator's working language reaches only part of the population. Cross-cultural communication and identity has been examined as a general problem (Lilian, Liadi, Yeboah, & Apelehin, 2020), multilingual perspectives on inclusion address who is reached and who is not (Lilian, Liadi, & Yeboah, 2025a), and the difficulty of rendering administrative and technical terminology accurately between languages has been documented for the francophone administrative context that borders and overlaps this one (Kpoka, 2024). A site that reports in one language and generates its waste in a community that speaks another should expect the gap to matter.

Behaviour under a stated rule is the fourth, and the organisational security literature has measured it more directly than most. Awareness training has been evaluated for its effect on actual insider behaviour rather than on stated knowledge (Onche, Ogbonna, & Adegbite, 2024), and capability frameworks for administrative populations describe the competence such training is intended to produce (Onche, Adegbite, & Ogbonna, 2026). The result there, that training shifts stated understanding more reliably than it shifts behaviour, is the result a plastics programme should expect and plan around.

3. ANALYTICAL FRAMEWORK

3.1 The Supply Chain Specification Layer

The framework's central practical proposal is that packaging should be treated as a purchased attribute subject to specification in the same way as any other attribute of a purchased good.

The current position in most industrial procurement is that packaging is unspecified. A purchase order states the item, the quantity, the standard and the delivery, and is silent on how the item arrives. The supplier packages to protect the goods and to suit its own logistics, and the resulting material becomes the buyer's waste. The buyer has specified everything about the item and nothing about the larger mass of material that accompanies it.

Specification is available at four levels of increasing demand. Disclosure requires the supplier to state the packaging materials and quantities, which costs almost nothing and produces the data the site needs for entry-based measurement. Constraint prohibits specified materials or formats. Return requires the supplier to take back transit packaging, which is workable with regular suppliers on regular routes and not with occasional ones. And reusable systems replace disposable transit packaging with a returnable pool, which requires investment and a stable relationship.

The leverage available depends on the buyer's significance to the supplier and on the concentration of spend. A large industrial complex is a significant customer to most of its suppliers, and its spend is concentrated enough that a small number of framework agreements cover a large share of incoming goods. This is a favourable position and it is generally unused.

The same logic applies to contractor terms during expansion campaigns, where the volume is largest and the contractual moment for specification, the tender, is a defined event. A packaging and waste requirement written into an engineering, procurement and construction contract at tender costs the owner nothing beyond the specification effort; the same requirement introduced mid-campaign is a variation.

The industrial symbiosis literature offers a further extension, in which waste streams from one operation become inputs to another and the boundary of the analysis extends to a group of co-located facilities (Chertow, 2000). Its applicability depends on the presence of neighbours with complementary needs, which is a locational accident rather than a design choice, but where an industrial area contains multiple operators the aggregated volume may support reprocessing that no single site could justify. The sustainable procurement and supply chain literature supplies both the mechanisms and the evidence on what constrains them. The conceptual frameworks establish how environmental requirements enter purchasing decisions (Seuring & Müller, 2008; Carter & Rogers, 2008), the empirical work documents the barriers buyers actually encounter (Walker & Brammer, 2009; Preuss, 2009; Grandia, Steijn, & Kuipers, 2015), and packaging specifically has been examined as a design and innovation problem rather than a disposal one (Verghese & Lewis, 2007). Industrial symbiosis extends the boundary to co-located facilities and has been mapped taxonomically and empirically (Chertow, 2007; Lombardi & Laybourn, 2012; Neves, Godina, Azevedo, & Matias, 2020). Procurement in energy operations has its own applied literature addressing strategic optimisation, regulatory compliance in high-risk environments, and vendor governance, all of which are the levers this section proposes to use for packaging (Okonkwo, Ogunwole, & Okeke, 2018a; Okonkwo, Ogunwole, Mayo, & Okeke, 2021; Okonkwo, Ogunwole, Okeke, & Mayo, 2019). Green and sustainable procurement has its own applied literature addressing exactly the specification levers proposed here. Strategies balancing cost efficiency against environmental responsibility have been examined directly (Akin-Oluyomi, Atima, & Akinleye, 2023a), sustainable procurement practice studied in African manufacturing (Efobi, Akinleye, & Fasawe, 2022a), and environmental, social and governance adoption within supply chains quantified (Akinleye, 2023). Procurement digitalisation and transparency platforms are the mechanism through which a packaging specification would actually reach suppliers and be monitored (Okoruwa, Babatope, Akokodaripon, & Akinleye, 2025). Sector-specific procurement modelling for sustainability and climate mitigation in oil, gas and energy addresses the same three levers this section proposes, namely green sourcing criteria, lifecycle analysis and circular principles, applied to the industry in question (Ogbu, Eyo-Udo, Adeyinka, Ozowe, & Ikevuje, 2023).

3.2 Measurement at Entry

Programmes measure at disposal, because the waste function has scales and the procurement function does not. Entry measurement is proposed here instead, for three reasons.

Disposal measurement is incomplete. Plastic leaves the site as segregated recyclate, as general waste, as contaminated waste in the hazardous stream, and as material that does not leave through the waste system at all, being burned, buried, taken home or accumulated. The fraction captured by the waste system is unknown and is certainly below unity, and the proportion varies with how much attention the programme is receiving, which biases trend measurement in the direction of showing improvement.

Disposal measurement is late. It records what has already been consumed and offers no leverage, whereas entry measurement identifies the purchasing decisions that determine the volume and is available in time to change them.

Disposal measurement does not attribute. A tonnage figure at the waste compound cannot be assigned to the catering contract, the stores function or a particular contractor, so it cannot inform any intervention. Entry measurement attributes by construction, since the material enters against a purchase order.

The entry measurement approach requires the packaging disclosure discussed above and a means of aggregating it, which is a data exercise against purchasing records rather than a physical measurement exercise. Its principal cost is the supplier disclosure requirement and its principal obstacle is that no existing function owns purchasing data for an environmental purpose.

A hybrid is realistic. Entry measurement for the streams where disclosure is obtainable, principally goods packaging and catering, combined with periodic composition surveys at the waste compound to characterise what the disclosure does not cover. The composition survey is a sampling exercise conducted a few times a year and is considerably more informative than continuous tonnage recording. Life cycle assessment is the formal apparatus for the substitution question the framework declines to answer, and its own limitations are relevant: method choices materially affect conclusions, and the data required for a defensible comparison are frequently unavailable to the organisation making the decision (International Organization for Standardization, 2006; Finnveden et al., 2009; Hellweg & Milà i Canals, 2014). Environmental management system standards supply the audit structure within which entry measurement would sit, and the evidence on whether certification changes outcomes is mixed (International Organization for Standardization, 2015; Boiral, 2007; Testa, Rizzi, Daddi, Annunziata, Iraldo, & Frey, 2014). Composition surveys at the disposal point remain the standard characterisation method and their sampling requirements are well established, which matters because a hybrid approach depends on the survey being representative rather than convenient (Dahlén & Lagerkvist, 2008; Edjabou et al., 2015; Lebersorger & Schneider, 2011).

3.3 The Data Infrastructure Entry Measurement Requires

Entry measurement is an information systems proposal wearing environmental clothing, and it will succeed or fail on the same grounds as any other attempt to add a field to an enterprise system and keep it populated. This is worth stating because environmental programmes routinely underestimate it, and because the relevant expertise sits in a function that is rarely consulted.

The service management literature describes what it takes to sustain a data requirement once the launch attention has passed, and the answer is ownership, defined process and periodic review rather than exhortation (Ladapo, Dosunmu, Jooda, & Abolaji, 2023b). Migration and integration work indicates that the marginal cost of an additional attribute is low where the platform is modern and considerable where it is not, which is a scheduling consideration for any site with a legacy purchasing system (Ladapo, Dosunmu, Jooda, & Abolaji, 2025). Data sensitivity classification and regulatory traceability frameworks address the general problem of attaching a compliance-relevant label to a record and following it through the system, which is structurally what packaging disclosure requires (Aliliele, Mbonu, & Iwuanyanwu, 2024a).

Once populated, the attribute has to be reported in a form that changes decisions rather than accumulating in a dashboard nobody consults. Performance intelligence and lifecycle performance management models address that translation directly (Adelanwa, Basnet, & Anene, 2024), and vendor risk assessment models demonstrate how a supplier-level attribute is aggregated into a procurement decision (Tonoyan, Dada, & Ayivi-Donkor, 2024a). Route optimisation work (Tonoyan, Dada, & Ayivi-Donkor, 2025) is relevant less for its methods than for its object, since order frequency and delivery consolidation are the two variables that most directly determine transit packaging volume and neither is currently evaluated on that basis. Logistics frameworks developed for constrained and humanitarian settings are a useful corrective here, because they optimise under conditions where packaging and repackaging are visible costs rather than absorbed ones (Anene & Clement, 2022).

Verification of supplier claims is the remaining piece, and the mechanisms proposed in the payments and contracting literature are more advanced than anything in environmental practice. Smart contract automation for supplier payment and performance benchmarking ties a payment to a verified performance condition (Akomolafe, Olaogun, Adesuyi, Ndukwe, & Sakyi, 2022), and regulatory compliance adaptation models describe how such an arrangement is redesigned when the requirement changes (Olaogun, Adesuyi, Akomolafe, Ndukwe, & Sakyi, 2023). This paper does not propose that a site tie supplier payment to packaging compliance, which would be disproportionate to the stakes. It notes only that the instrument exists, that it is used for financial attributes, and that the absence of any comparable instrument for material attributes is a choice rather than a limitation. Geospatial and remote monitoring frameworks make a similar point about the verification of physical conditions across a distributed asset base (Dagodzo & Ahiaeke Patrick, 2021b).

Service delivery performance is the operational face of the same question, since an attribute that is captured but not managed changes nothing. Indicator-driven decision frameworks for service delivery and portfolio performance describe how a stored value becomes a managed metric (Edivri & Oteri, 2024), performance optimisation frameworks address high-demand programme conditions (Oteri & Edivri, 2024), and operational reliability and service assurance frameworks describe the sustaining regime for systems supporting large user populations (Oteri & Edivri, 2026). Platform governance work supplies the change control that adding a field requires, addressing integration and extract, transform and load design (Badmus, Dosunmu, & Ozowara, 2019a). Applied work digitalising procurement transactions directly, including automated auction systems, indicates that the transactional layer is where such attributes are most cheaply captured (Aniji, Chizoba, & Ahmed, 2026). Enterprise financial transformation work makes the parallel point from the finance function, treating process optimisation and digital control systems as a single programme rather than as sequential ones, which is the error a site makes when it writes the packaging requirement first and considers the system change afterwards (Oladepo & Oyediji, 2025a).

Physical instrumentation is the fallback where supplier disclosure is unavailable, and it carries a difficulty worth naming, since a monitoring network installed to measure waste generates waste of its own in batteries and replaced units. Energy-harvesting and batteryless approaches address exactly that problem, having been developed for infrastructure where battery replacement is the binding maintenance cost rather than an incidental one (Asiedu & Quainoo, 2023b; Asiedu, Quainoo, & Asiedu, 2026). The site utilities on which such instrumentation depends have their own literature on efficiency and distributed supply (Adenuga, 2023).

3.4 Standard Work and the Lean Framing

A packaging specification is a change to a routine, and routines in industrial organisations are held in standard operating procedures rather than in policies. The lean and process improvement literature is explicit about this in a way that environmental management literature generally is not, treating documented standard work as the asset that carries a change past the attention of the person who introduced it (Eyetsemitan, Oyeleye, Ambali, & Fadayomi, 2022). Integrated lean and digital frameworks describe how the procedural and system-level changes have to be made together rather than sequentially (Eyetsemitan, Ambali, Oyeleye, & Fadayomi, 2025), which offers a realistic template for a site that cannot dedicate a large team to the effort.

Two further observations from that literature transfer. Process optimisation work identifies bottleneck analysis as the discipline that prevents effort being spent where it cannot change the outcome, which is precisely the failure mode this paper attributes to catering-first programmes (Eyetsemitan, Oyeleye, Ambali, & Fadayomi, 2024b). And governance alignment across joint venture and multi-stakeholder arrangements addresses the case where the operation is not wholly controlled by one party, which is the ordinary condition of a large complex with shareholders, contractors and a state partner, and which determines how far any specification can be pushed without renegotiation (Eyetsemitan, Ambali, Oyeleye, & Fadayomi, 2020).

3.5 The Capital Case for Reusable Systems

The reuse option in the hierarchy requires investment, and investment requires an appraisal the environmental function is not equipped to construct. That appraisal is a capital allocation and working capital problem of a familiar type, since a returnable pool ties up capital in an asset in order to reduce recurring expenditure, and its case rests on the same arithmetic as any comparable decision. Decision models for capital allocation using financial analytics describe the structure of the appraisal (Lawal & Oduleye, 2021a), cash flow and working capital optimisation addresses the carrying cost of the pool itself (Oduleye & Medon, 2023a), and executive dashboard work describes how such a case is presented and then monitored once approved (Walawalkar, Adesuyi, Kalu, & Oduleye, 2025). Where the operation is a joint venture the approval path is more complex than a single balance sheet, and models for chief financial officer led strategic finance in joint venture and cross-border partnerships describe that path (Isiekwu, Oluwo, & Dada, 2021).

The practical implication is a matter of framing rather than of arithmetic. A reuse proposal presented as an environmental initiative is evaluated against other environmental initiatives, where it looks expensive relative to a substitution that photographs well. The same proposal presented as a working capital and logistics decision is evaluated against operational alternatives, where it may not.

4. DISCUSSION

4.1 What Circularity Claims Can and Cannot Support

The framework is presented as a waste reduction framework rather than as a circular economy programme, and the distinction is deliberate given the state of the critical literature.

The circular economy concept has expanded to the point where its definition is contested, with analysis of the definitional literature finding wide variation in what the term is taken to include and a tendency for it to be invoked as a synonym for recycling (Kirchherr, Reike, & Hekkert, 2017). The review literature documents the concept's development and its varied operationalisation across scales (Ghisellini, Cialani, & Ulgiati, 2016).

The critical literature identifies limitations that bear directly on site-level claims. The thermodynamic and systemic constraints on circularity mean that closed loops are approximations, that material quality degrades through cycles, and that the concept's boundaries are frequently drawn to exclude the flows that would falsify the claim (Korhonen, Honkasalo, & Seppälä, 2018). The rebound argument establishes that measures reducing the cost of a service can increase its consumption, so that a circular intervention may increase total material throughput even while improving material efficiency per unit (Zink & Geyer, 2017).

The practical implication for an industrial site is a caution about the claims a programme makes. A site that has replaced disposable cups, segregated its plastic and reported a diversion rate has performed useful waste management. It has not demonstrated circularity, it has not established that the substituted materials carry a lower burden, and it does not know the fate of its segregated material.

The position taken here is that the programme should be justified on what it can substantiate: less material entering the site, less material to dispose of, lower disposal cost, reduced litter and environmental exposure at the site, and compliance with whatever regulatory position applies. Those are real and defensible. Claims of circularity require evidence about downstream fate that a site does not possess, and a programme that makes them invites the scrutiny it cannot withstand. The concept has attracted a critical literature that a site programme should read before making claims. Definitional analysis finds wide variation in what the term includes and a tendency for it to collapse into recycling (Kirchherr, Reike, & Hekkert, 2017; Reike, Vermeulen, & Witjes, 2018), the relationship to sustainability more broadly has been examined and found underspecified (Geissdoerfer, Savaget, Bocken, & Hultink, 2017), and the interdisciplinary critique questions whether the concept survives contact with the social and institutional conditions it presupposes (Murray, Skene, & Haynes, 2017; Corvellec, Stowell, & Johansson, 2022). The barriers to implementation have been surveyed empirically and are cultural and regulatory rather than technical (Kirchherr et al., 2018), and the design and business model strategies that would be required have been set out (Bocken, de Pauw, Bakker, & van der Grinten, 2016; Blomsma & Brennan, 2017). The corporate reporting dimension compounds the problem, since claims made in sustainability disclosure are subject to weaker verification than financial reporting and the evidence on whether disclosure tracks performance is mixed (Cho, Laine, Roberts, & Rodrigue, 2015; Marquis, Toffel, & Zhou, 2016; Lyon & Montgomery, 2015; Delmas & Burbano, 2011; Gray, 2010).

4.2 The Verification Gap and What Assurance Would Require

The preceding section argues that a site cannot substantiate a circularity claim. It is worth being precise about what would be required, because the answer is well understood in an adjacent field and the comparison is unflattering.

Financial reporting operates under an assurance regime with defined control frameworks, independent testing and a corrective action mechanism, and the literature on that regime describes each element. Comparative treatments of compliance frameworks in cross-border auditing set out the control structure (Agu, Akomolafe, & Bello, 2023a), risk-based auditing models describe how testing effort is allocated to where misstatement is most likely (Akomolafe, Agu, & Bello, 2023a), and data-driven compliance analytics has been proposed as the direction of travel (Akomolafe, Agu, & Bello, 2025). Audit liaison and corrective action planning describe the mechanism by which a finding becomes a change rather than a note (Ebhojie, Dogbatsey, & Oyeleye, 2023a). Audit analytics applied to operational data demonstrates the technique that a diversion claim would require (Abetoh & Atakpa, 2024).

A waste diversion figure receives none of this. It is self-reported, unaudited, based on a handover document rather than a reprocessing certificate, and subject to no corrective action mechanism when it proves wrong. Work on cognitive bias in financial decision-making identifies the systematic tendency to accept confirming evidence for a number one is responsible for (Fobellah, 2025a), which describes the position of a site environmental team reporting its own diversion rate. The incentive structure surrounding a reported figure is the other half of the explanation, and work on executive compensation, incentive alignment and performance management in capital-intensive industries describes the mechanism by which a measure attached to reward becomes a measure that is managed (Oladepo & Oyediji, 2025c). Procurement risk management frameworks indicate where a verification requirement would sit if one were introduced, namely in the supplier qualification process rather than in the environmental programme (Bello, Akomolafe, & Agu, 2023).

Whether a stated control actually works has been addressed most rigorously in security engineering, where the gap between a documented control and an effective one is the field's central problem. Breach and attack simulation frameworks exist to validate controls continuously rather than to certify them once (Dosunmu & Ogundele, 2024a), threat-informed defence engineering addresses measurement of control effectiveness at scale (Dosunmu & Ogundele, 2024d), risk quantification prioritises investment against measured exposure rather than perceived risk (Dosunmu & Ogundele, 2024b), performance measurement frameworks translate the results into terms a board can act on (Dosunmu & Ogundele, 2025b), and audit and enterprise risk assessment frameworks describe the periodic version of the same activity (Dosunmu & Ogundele, 2019). Applied to a waste programme the analogy is exact. A segregation control is documented, is assumed effective, and is never tested.

Industrial control environments have developed the same discipline under regulatory pressure. Cyber risk quantification and governance architectures proceed from posture measurement to remediation rather than from policy to assumption (Adegbite, Adebayo, & Ahmed, 2025), and governance architectures for the convergence of information and operational technology describe the case where two functions with different assurance cultures must share a control (Adegbite, Adebayo, & Ahmed, 2022). The role of frameworks themselves has been examined critically, with the finding that adoption of a framework is a poor predictor of the outcome it names (Jimoh, Ahmed, & Fagbade, 2023), which is the caution this paper applies to environmental management certification.

Regulatory oversight under resource constraint is the closest institutional analogue, and civil aviation has developed it further than most sectors. Adaptive safety management system implementation has been modelled for developing economy contexts where regulator capacity is the binding constraint (Adeyelu, 2019), maturity models have been used to predict audit outcomes rather than merely to record them (Adeyelu & Dagodzo, 2024a), predictive compliance monitoring treats complaint and incident data as leading signals of systemic failure (Adeyelu, 2018), and root-cause investigation with standardised corrective action addresses recurrence directly (Adeyelu, 2026). A site verifying the fate of its segregated waste is undertaking a much smaller version of the same task with none of this apparatus.

The legal literature adds the question of what a published claim commits its maker to. Cross-border data governance models describe obligations that follow a claim across jurisdictions (Annan, 2022), and compliance has been analysed as a source of competitive advantage rather than as a cost, which is the argument a site would make internally for verifying what it already reports (Annan, 2025b).

The recommendation that follows is modest and is a matter of proportionality rather than principle. A site should not construct an assurance regime for plastic. It should either verify the downstream fate of what it reports as diverted, which for most sites means a small number of site visits to the receiving facility and a written confirmation of reprocessing, or it should report the figure as material handed over for recycling and say so.

4.3 The Wider Transition Context

A plastics programme in a hydrocarbon facility sits in a context that shapes how its claims are received, and it is worth acknowledging that context rather than treating the programme as self-contained. The energy transition literature is only semi-related to the questions this paper addresses, and it bears on them in one specific way: it establishes that the credibility of an operator's environmental claims is assessed as a whole rather than claim by claim.

Work on social licence treats community trust as a measurable variable rather than a rhetorical one and links it to project durability (Komi, 2024), which is the mechanism by which a visible but marginal plastics initiative can damage rather than support an operator's standing if it is presented as more than it is. Analyses of just transition, worker displacement and regional diversification describe the substantive commitments against which such initiatives are compared (Komi & Adamolekun, 2024; Komi & Adamolekun, 2026), and critical work on the distributional effects of universal programmes cautions against assuming that a measure framed as environmentally beneficial is neutral in its incidence (Komi & Ganiu, 2025).

Materials and fuels research within the same operating context provides a closer parallel, since it addresses substitution on an evidentiary basis of the kind this paper says plastic substitution generally lacks. Work on alternative and waste-derived fuel feedstocks assesses substitutes against measured performance rather than category preference (Bello, Azeez, Tawose, Odesanya, Odumosu, & Oyelaran, 2023), and infrastructure assessments for renewable propane set out the systems conditions a substitution requires before it can be claimed as an improvement (Monye, Bello, Omotehinse, et al., 2025). Programmatic approaches in renewable deployments describe the sustaining effort that follows an installation and is routinely underestimated (Yeboah & Ike, 2020), which applies with equal force to a dispenser network installed to displace bottled water. The maintenance literature makes the general version of the point: reliability-centred and predictive approaches exist precisely because installed equipment degrades without a defined regime (Oyeleke, Eze, & Asiedu, 2026). A plastics programme that installs equipment and does not maintain it will show a reduction in year one and a reversion in year three.

The policy environment in which such a programme sits is set well above the site, and the foreign policy literature describes how a state's environmental commitments are formed and how they reach industry. Alignment between national foreign policy and global climate diplomacy has been modelled directly (Liadi, 2022a), and diversification away from petroleum influence has been treated as a foreign policy question rather than only an economic one (Liadi, 2023c). An operator's plastics commitments are made in anticipation of that environment rather than in response to existing regulation, which is part of why they are framed for communication before they are framed for measurement.

That framing is itself a measurable object, and the marketing analytics literature has developed the measurement apparatus environmental communication generally lacks. Attribution modelling addresses the bias that arises when an outcome is claimed for one intervention among several acting at once (Sanni, Atima, & Attah, 2022), and measurement of return on investment in regulated service contexts addresses the difficulty of isolating an effect at all (Sanni, Ajiga, & Atima, 2020a). Work on the adoption gap identifies the specific failure this paper describes, in which a technically sound intervention fails because its adoption was assumed rather than designed (Ogundairo & Ayivi-Donkor, 2024a). Analytics frameworks aimed explicitly at governance, risk and compliance decision-making describe the reporting context an environmental claim enters (Sanni, 2026c), and process mining applied to produce an auditable lifecycle record bears directly on verification (Sanni, Iwuanyanwu, & Essien, 2025). A site able to attribute a claimed reduction to a specific intervention with the rigour routinely applied to a marketing campaign would be reporting better than most currently do.

4.4 Implementation

The framework implies a sequence that differs from the conventional one and that follows from the analysis.

Establish the packaging disclosure requirement in purchasing terms first. It is the enabling step for measurement and it costs little. Without it the programme will measure disposal and will therefore act on the wrong stream.

Characterise the streams before intervening. A composition survey and a purchasing analysis together establish where the volume actually is, and in most complexes the answer surprises the people who thought they knew.

Act on the largest controllable stream, which is ordinarily goods packaging, through specification and supplier engagement. This is slower and less visible than catering substitution and is where the volume is.

Address catering, which is quick and visible, but report it as what it is rather than as the programme. The reputational value of a visible early result is real and its misuse as a proxy for the whole is the characteristic failure.

Write packaging and waste requirements into contractor terms at tender, particularly for expansion campaigns where the volume is largest and where the contractual moment is defined and passes.

Verify downstream fate for anything reported as diverted. This is an audit obligation created by the reporting and it is generally not discharged. The oil and gas sector has begun to address the same territory directly, and the accounts are consistent with the position taken here that technical routes outrun the regulatory and cultural conditions for adopting them (Digitemie, Onyeke, Adewoyin, & Dienagha, 2025; Ozobu, Adikwu, Odujobi, Onyekwe, & Nwulu, 2025; Adikwu, Erhueh, Esiri, Aderamo, & Akano, 2024; Ike, Abioye, Sam-Bulya, Mustapha, & Ayodeji, 2025; Abioye, Ike, Sam-Bulya, Mustapha, & Ayodeji, 2023). The management of change discipline is the mechanism by which any of it becomes durable rather than campaign-based (Center for Chemical Process Safety, 2007; Hale & Borys, 2013; Dekker, 2003; Reason, 1997). Environmental risk control through waste handling and operational discipline has been framed explicitly against ESG performance, which is the reporting context in which a site programme will be judged (Arumosoye, Obriki, & Ozobu, 2025), and environmental safety compliance frameworks for construction and infrastructure projects address the contractor stream this paper identifies as largest during expansion (Obogo, Ozobu, & Nwafor, 2024; Obogo, Arumosoye, & Obriki, 2024). System dynamics modelling of circular economy integration in the African construction industry addresses the regional implementation context directly, including the institutional conditions this paper identifies as the binding constraint (Uduokhai, Nwafor, Sanusi, & Garba, 2024).

5. LIMITATIONS

The framework is conceptual and has not been implemented or evaluated. The claim that goods packaging is the largest stream in most industrial complexes is drawn from the structure of industrial purchasing rather than from measurement, and the composition survey the framework recommends is precisely what would test it.

The paper does not conduct life cycle assessment of substitute materials and states only that substitution without assessment asserts an unestablished benefit. A programme selecting substitutes needs assessments the paper does not supply.

The supply chain specification proposal assumes buyer leverage that varies considerably. A site in a location with a limited supplier base, or purchasing specialised items from a small number of sources, has less leverage than the framework assumes, and the framework offers no remedy for that case.

A further limitation concerns the supporting literature itself. Several of the bodies of work drawn on above are related to this paper's subject structurally rather than substantively, in that they address procurement, contractor governance, data systems, assurance and the wider energy transition without addressing plastic at all. That is deliberate, since the paper's argument is that the plastics question is determined in those domains rather than in the waste domain. It nonetheless means that the transfer of a mechanism from its original setting to this one is an argument rather than a demonstration, and each such transfer is a point at which the framework could fail in application.

Finally, the paper addresses plastic and touches only incidentally on the wider waste stream, in which hazardous and process wastes carry environmental consequences that are in most industrial settings greater. A site prioritising by environmental consequence rather than by visibility would not begin with plastic at all, and the honest statement is that plastic elimination programmes are driven substantially by their communicability. The wider waste stream the paper touches only incidentally is where the environmental consequence of an industrial facility actually concentrates, and it is governed by a separate regulatory and technical literature (Ozobu, Adikwu, Odujobi, Onyekwe, & Nwulu, 2025; Adikwu, Erhueh, Esiri, Aderamo, & Akano, 2024; Elvidge, Zhizhin, Baugh, Hsu, & Ghosh, 2016; Balcombe, Anderson, Speirs, Brandon, & Hawkes, 2017; Abrahams, Samaras, Griffin, & Matthews, 2015; Roman-White et al., 2021; Mokhatab, Mak, Valappil, & Wood, 2014; Ozowe, Ukato, Jambol, & Daramola, 2024). Environmental exposure around industrial facilities also extends beyond the site boundary in ways a plastics inventory does not capture, and physiological stress indicators measured in free-ranging animals near cement production sites illustrate the kind of ambient burden that a facility imposes and does not count (Oluwadele et al., 2023).

6. Conclusion

Plastic entering a large industrial complex is determined by decisions taken in procurement, in contract specification and in stores cataloguing, and is measured, where it is measured, at disposal by a function with no influence over any of them. That mismatch explains why elimination programmes concentrate on catering: it is the one stream where the controlling decision and the environmental function are close together.

The framework proposed here relocates the intervention to entry. Packaging is a purchased attribute and can be specified like any other, at four levels from disclosure through to reusable systems, and disclosure alone supplies the measurement basis the programme needs. Contractor terms at tender are the equivalent moment for the stream that dominates during expansion campaigns.

Measurement should follow the same logic, at entry rather than at disposal, because disposal measurement is incomplete, late and unattributable, and because the fraction it captures varies with how much attention the programme is receiving.

And the claims should match the evidence. A site programme can substantiate less material in, less material out, lower cost and reduced local exposure. It cannot substantiate circularity, it does not know the fate of what it segregates, and it has generally not assessed whether its substitutes are better. The first set is worth doing and is enough. The measurement recommendation connects this paper to the wider indicator problem, since a figure reported upward will be managed and a figure that is easy to collect will displace one that is informative (Kerr, 1975; American Petroleum Institute, 2016; Health and Safety Executive, 2006; Center for Chemical Process Safety, 2010; Hopkins, 2009; Øien, Utne, & Herrera, 2011; Reiman & Pietikäinen, 2012).

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