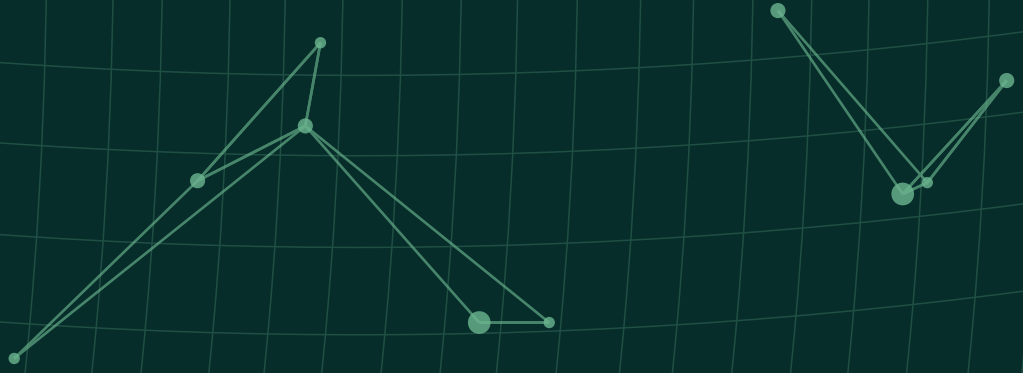
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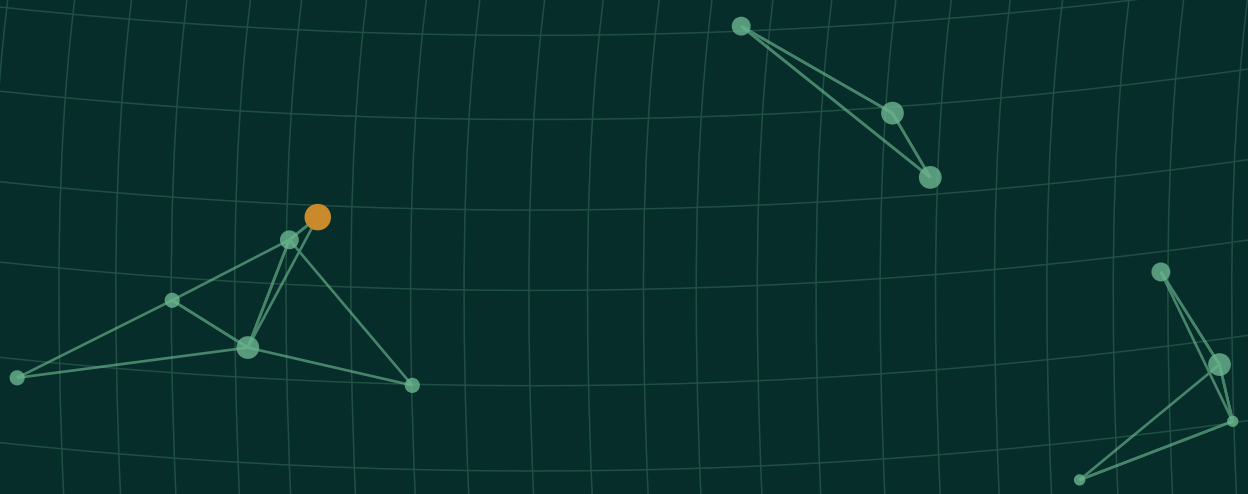
Traceable by Design

Cotton provenance, chain of custody and digital product passports for African supply chains



wp05
RESEARCH EDITION

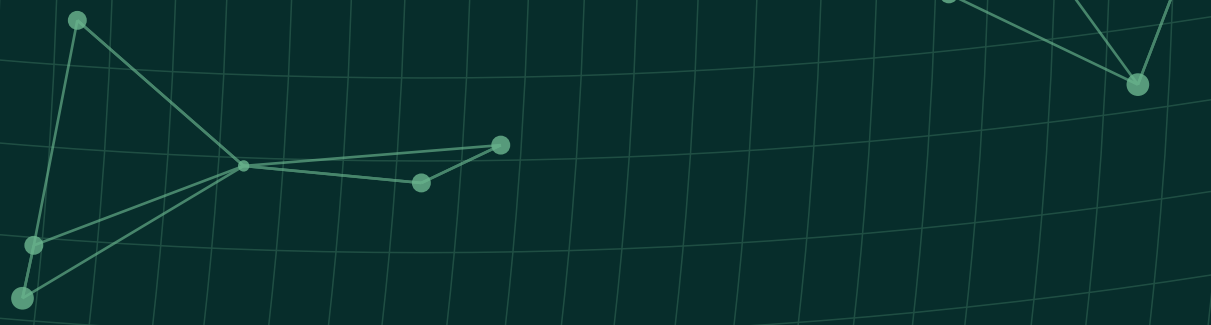
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HONG KONG SAR



THE GFT THESIS

Value is made where it is measured.

GFT engineers sustainable factories that capture their own data from the first shift, so raw-material economies can keep the value they grow.



Read the evidence before acting on the recommendation.

ISSUER	Green Future Tech Limited, Hong Kong SAR
DOCUMENT	wp05 / Traceable by Design
EDITION DATE	2026-10-30
AUDIENCE	African cotton and garment manufacturers, Ginnery, spinning and fabric supply-chain managers, Brands, sourcing teams and institutional buyers, Quality, sustainability and assurance practitioners, Industrial digital-system designers, Development-finance and industrial-policy teams assessing evidence readiness
STATUS	Research edition. Generated locally. Publication and operating-performance acceptance are separate decisions.
PROGRAMME	GFT's Cameroon textile programme: feasibility, performance-management system design and digital strategy. Prepared 31 January 2024; source-refresh annotations retained in 2026.

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A: official. B: institutional or major research. C: trade or local press and market-research vendors. D: unverified; excluded from use. A grade describes the supplied register and does not certify accuracy.

Inherited publication dates unrecorded: R01, R02, R03, R04, R06, R07, R09, R10, R12, R14, R15, R16, R27, R29, R32. Temporal eligibility is unverified; these are inherited source-text checks, not independent source validation.

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Build the factory and its evidence as one system.

African cotton can move through many hands before it becomes a garment, while the evidence needed to defend its origin can disappear at a single transfer or blending step. GFT argues that traceability should therefore begin with a precise claim and a workable chain of custody. A digital passport should expose the resulting evidence boundary rather than imply certainty that the factory cannot establish. This paper follows a proposed cotton chain from producer records and ginning through trading, spinning, fabric processing, garment production and dispatch. It distinguishes physical provenance from certified-content allocation, customs origin and sustainability performance. It specifies practical controls for identifiers, input-output genealogy, volume reconciliation, subcontracting, evidence review, correction and claim release. Standards and institutional guidance inform these controls, while hypothetical examples remain visibly illustrative. The analysis separates future textile passport requirements from current design choices and treats cryptographic credentials as tools for preserving assertions. It addresses constrained connectivity, supplier inclusion, privacy, service continuity and the recurring work required to maintain reliable records. A bounded pilot then tests normal transactions, missing evidence, duplicate allocations, copied labels and recovery failures. The closing roadmap defines what GFT would measure before recommending scale. The result is a research and writing specification for an evidence-led white paper, not proof of an operating deployment, certification or regulatory conformity.

01 A custody framework alone cannot verify the production characteristics asserted by a product claim. [S01] [S02]

02 Mass-balance allocation and physical cotton provenance need distinct registers and distinct consumer statements. [S02] [S06] [S07] [S08]

03 Certified-material tracking requires documentation through receiving, processing and transfer, supported by volume reconciliation. [S03] [S05] [S06]

04 A chain's possible origins become broader when inputs are blended, so a downstream record must retain its input set and limitations. [S01] [S02] [S10]

05 Event semantics and stable identifiers can support inter-company exchange without assuming item-level RFID tracking. [S10] [S11] [S12]

06 The Commission describes textile-specific passport fields as future delegated-act requirements, so an indicative adoption date is not a compliance deadline. [S14] [S15]

07 A valid digital credential preserves an issuer's assertion; accepting its physical claim also requires a trust policy and admissible evidence. [S21] [S23] [S24] [S29]

08 Isotope analysis offers a corroboration route, but no Cameroon-specific classification accuracy is established by the source opened here. [S33]

09 Traceability must limit personal-data collection and keep supplier mapping separate from labour due diligence and remediation. [S17] [S19] [S20]

10 GFT should expand only after an independently reviewed pilot demonstrates supported claims, reproducible quantities and recovery from adverse cases. [S03] [S06] [S10] [S27]

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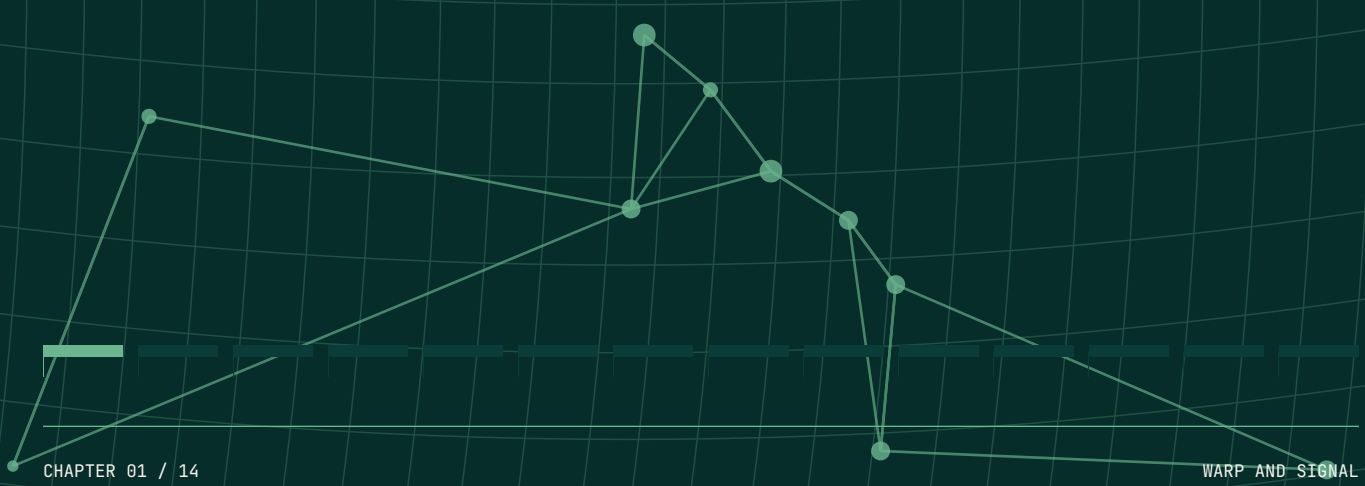
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01

PART I: CLAIMS MUST MATCH THE CHAIN / THE POSITION

Cotton value needs evidence that survives the factory

GFT argues that provenance becomes useful when custody controls preserve the evidence behind a saleable claim.



CHAPTER 01
DECISION TEST

GFT argues that provenance becomes useful when custody controls preserve the evidence behind a saleable claim.

Provenance creates commercial value for an African cotton-to-garment supply chain only when operational custody controls preserve the documentary and physical evidence required to defend a specific, bounded product claim across every transfer and transformation. [S01] When cotton lint leaves a ginnery for export as a raw commodity, its origin claim crosses a single primary commercial boundary at dispatch, whereas converting that same lint domestically into yarn, grey fabric, dyed cloth and finished apparel multiplies the storage bays, machine laydowns, wet-processing baths and subcontracted work centres where material identity can be diluted or lost. [S02] Green Future Tech Limited (GFT), Hong Kong SAR, argues that traceability must therefore be engineered backward from the exact proposition a buyer or regulator needs to inspect, establishing a workable chain of custody before any digital product passport or consumer label is published. [S03] Under the Warp and Signal operating concept, physical production forms the warp of the factory and measurement forms the weft: a mill that spins yarn or sews garments must capture its own batch genealogy and mass-balance reconciliations at the point of work so that public product records never outrun shop-floor evidence. [S10]

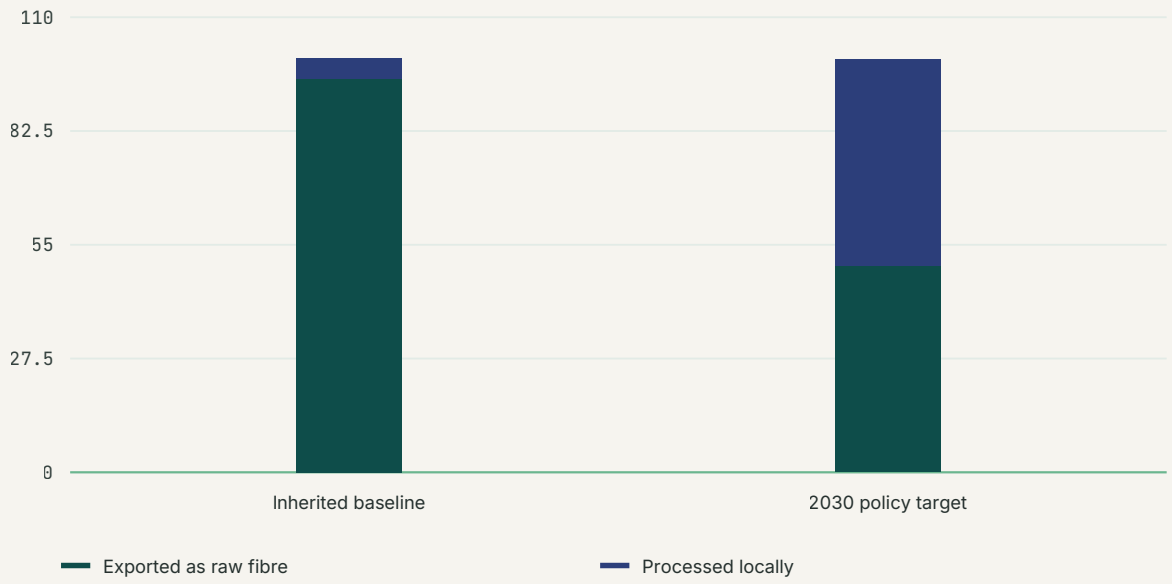
1.1

The local-processing gap makes provenance commercially relevant

Cameroon's cotton sector exhibits a sharp structural split between agricultural fibre output and domestic industrial conversion, which directly frames the engineering problem of supply-chain provenance. [R06] According to the inherited sector register drawn from Cameroon Trade Hub source text (original publication date unrecorded), approximately 95 percent of Cameroon's cotton fibre is exported raw while approximately 5 percent is processed locally. [R06] National industrial policy, restated under Cameroon's National Development Strategy 2020 to 2030 (SND30) as reported by Ecofin Agency in the inherited register, sets a target of processing 50 percent of national cotton fibre locally by 2030. [R07] These figures are inherited sector-level observations and policy targets rather than fresh primary surveys or GFT operating measurements, yet they establish the physical boundary within which any domestic textile programme must operate. [R06]

EXHIBIT 01 / PERCENT OF COTTON FIBRE

Cameroon's inherited processing split frames the evidence problem



SOURCED [R06] [R07] Approximate inherited sector baseline from R06 (original publication date not recorded) compared with the 2030 national policy target restated in R07. Figures describe sector cotton-fibre shares, not seed-cotton harvest mass or GFT operating results.

As shown in **Exhibit 1**, p. 15, moving a national cotton economy from an approximate 5 percent local-processing baseline toward a 50 percent domestic transformation target shifts fibre from bulk lint export channels into multi-stage domestic manufacturing. [R06] In interpreting **Exhibit 1**, p. 15, decision-makers must keep cotton-fibre shares strictly separate from upstream seed-cotton harvest weights. [R01] In the inherited register, Business in Cameroon reports national seed-cotton production of 330,000 tonnes in 2022, 314,455 tonnes in 2023 and approximately 340,000 tonnes in 2024. [R01] Seed cotton weighed at farm collection centres contains both lint fibre and cottonseed prior to ginning, meaning that seed-cotton tonnage cannot be plotted on the same denominator as ginned lint exports or yarn mill intake without an explicit ginning-yield conversion. [S03] Furthermore, **Exhibit 1**, p. 15 establishes only the macro-level policy ambition and inherited sector split; it cannot establish that any individual mill possesses the custody controls needed to prove that its finished garments contain Cameroonian lint. [R07]

1.2 PROCESSING STAGES MULTIPLY CUSTODY BOUNDARIES AND EVIDENCE FAILURE POINTS

Adding domestic conversion stages increases the value retained within the national economy, but every added machine centre and warehouse transfer also introduces a new opportunity to sever the evidentiary link between raw fibre and finished product. [S01] When ginned lint is compressed into high-density bales and sold directly to an international merchant, the physical unit of trade remains an intact bale carrying a ginnery mark from press to spinning-mill opening room. [S06] Once that bale enters a domestic integrated mill or a network of spinners, weavers, knitters, dyehouses and garment factories, the original bale identity ends at the blowroom laydown. [S10]

Dozens of bales are plucked and blended simultaneously to achieve uniform staple length, micronaire and strength, converting discrete fibre units into continuous sliver, roving and yarn packages. [S02]

Each subsequent stage compounds this genealogical complexity. [S10] Yarn cones from multiple frames are creeled onto warping beams or fed to knitting machines; grey fabric rolls are batched into dyeing vessels or finishing ranges; finished rolls are spread in multi-ply cutting lays; and cut garment bundles move through sewing, washing and packing stations. [S03] Under ISO 22095:2020 (*Chain of custody: General terminology and models*), a chain of custody is the sequence of custody or control transfers through which materials and their associated attributes pass across a supply chain. [S01] As the ISEAL Alliance notes in its 2025 *Chain of Custody Models and Definitions Guidance*, chain of custody models enable the transfer of materials and associated attributes through certified supply chains, determining which specific claims can be credibly supported at the end of the process. [S02]

Macroeconomic feasibility, tariff structures and capacity economics for Cameroon's cotton-to-textile transition belong to companion paper wp01. [R06] This white paper (wp05) addresses a narrower engineering question: when a factory in an African cotton-producing country offers a yarn lot, fabric roll or finished garment to a buyer or customs authority, what exact documentary and physical evidence can that counterparty inspect to verify the claim for that specific lot? [S03] Without engineered custody controls across spinning, wet processing and garment assembly, expanding local processing simply converts traceable raw lint bales into untraceable domestic textiles. [S01]

1.3

A provenance claim is a proposition that needs a boundary

In industrial assurance, a product claim is not a marketing slogan; it is an inspectable proposition whose truth depends on an explicit boundary. [S01] ISO 22095:2020 establishes that a chain-of-custody mechanism provides rules for linking inputs to outputs, but a custody framework alone cannot define or verify the production characteristics asserted by a product claim. [S01] Before selecting barcode formats, database schemas or certification schemes, a manufacturer must specify the boundaries of the proposition it intends to defend. [S02] GFT formalises this requirement through an eight-element engineering artefact termed a **claim card**, which binds commercial messaging to shop-floor custody rules: [S03]

1. **Material scope:** Whether the assertion applies to 100 percent of product mass, strictly to the cotton fibre fraction excluding sewing thread, interlinings, buttons and elastane trims, or to a specified percentage of certified fibre inputs. [S03]
2. **Claimed attribute:** Whether the proposition asserts geographic agricultural origin, organic farming practices, social and environmental scheme compliance, or recycled content. [S02]
3. **Geographic granularity:** Whether the origin boundary is an entire country (such as Cameroon), an administrative region or ginning basin, a named producer organisation, or an individual farm plot. [S06]

4. **Temporal period:** The crop year, ginning campaign or manufacturing window during which eligible inputs were harvested and processed. [S03]
5. **Product unit and granularity:** Whether evidence resolves to a seasonal product model, a garment production batch, a cutting lay, a fabric roll, or a serialised item. [S12]
6. **Chain-of-custody model:** Whether separation follows identity preservation, physical segregation, controlled blending, volume-reconciled mass balance, or book-and-claim rules under a named scheme version. [S02]
7. **Claimant identity:** The legal entity issuing the assertion on the invoice, hangtag or digital product passport. [S21]
8. **Evidence owner:** The operational role holding the weighbridge tickets, transaction certificates, transformation logs and reconciliation ledgers for third-party review. [S03]

1.4 FOUR PRODUCT PROPOSITIONS THAT BUYERS AND MILLS ROUTINELY CONFLATE

Commercial teams routinely conflate four legally and physically distinct propositions: agricultural cotton origin, garment manufacturing location, certified sustainability content, and customs origin. [S18] Each relies on a different rulebook and demands a different evidentiary trail. [S02]

First, **cotton grown in Cameroon** is a physical agricultural provenance claim requiring unbroken custody records linking seed-cotton receipts at Cameroonian ginneries to lint bales, spinning laydowns, fabric rolls and cutting lays under an identity-preserved or segregated custody model. [S07] Second, **garment made in Cameroon** describes the location of industrial assembly or last substantial transformation; a factory in Douala or Garoua can import Asian yarn spun from non-African lint, knit and sew locally, and record Cameroonian assembly even when zero percent of the cotton fibre grew in Cameroon. [S18]

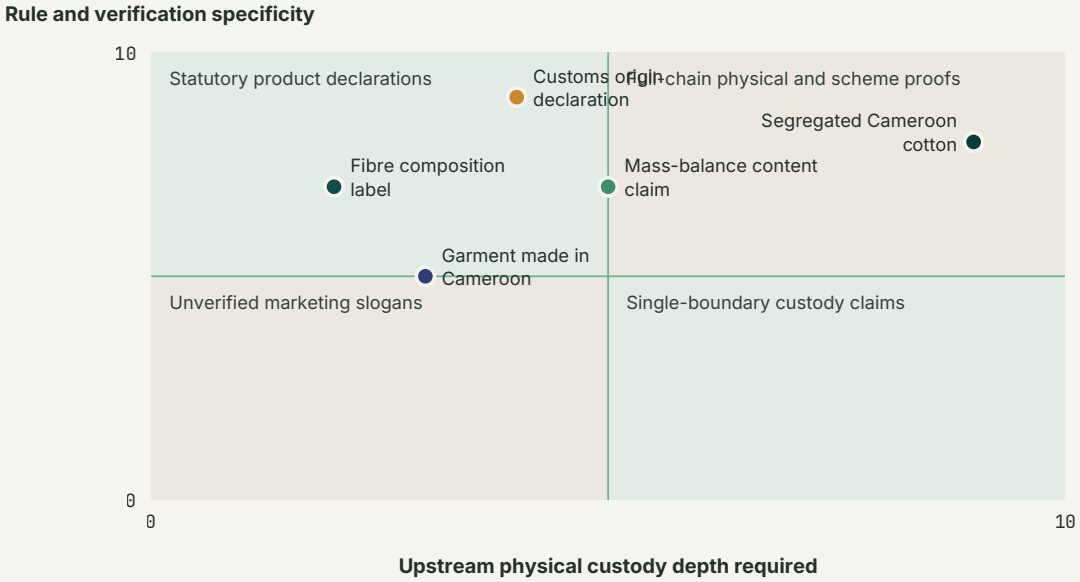
Third, a **certified-content claim** asserts compliance with a voluntary sustainability standard, such as Textile Exchange's Content Claim Standard (CCS) or Organic Content Standard (OCS), the Global Organic Textile Standard (GOTS), or the Aid by Trade Foundation's Cotton made in Africa (CmiA) standard. [S03] Under OCS, an accredited certification body audits each supply-chain stage, while GOTS uses Transaction Certificates to confirm material movement through certified chains. [S04] Under CmiA, certified cotton travels either through physical Segregation (termed Hard Identity Preserved in the June 2025 *Transparency Standard, Version 1.0*) or through volume-based Mass Balance, where administrative accounting tracks eligible quantities without guaranteeing that certified fibres physically reside in a specific garment. [S06] A mass-balance certificate therefore proves volume allocation, not physical fibre provenance in an individual shirt. [S07]

Fourth, **customs origin** and **fibre composition labelling** obey statutory rules independent of voluntary schemes. [S18] The World Trade Organization defines rules of origin as the legal criteria needed to determine the national source of a product for duties and trade preferences. [S18] Similarly, European Commission Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) notes that European Union rules under Regulation (EU) 1007/2011 govern fibre names and

mandatory fibre composition marking. [S34] Proving that a shirt is 100 percent cotton by mass satisfies composition rules, but establishes neither where the cotton grew nor how custody was maintained. [S34]

EXHIBIT 02 / ILLUSTRATIVE POSITION (0 TO 10 CONCEPTUAL SCALE)

Different labels require different evidence



ILLUSTRATIVE [S01] [S02] [S18] [S34] Illustrative conceptual placement designed by GFT from S01, S02, S18 and S34. Coordinates place five product propositions by required upstream physical custody depth (x) and rule or verification specificity (y); positions are analytical categories, not empirical scores.

Exhibit 2, p. 18 maps these five propositions across required upstream physical custody depth (x) and rule specificity (y) on an illustrative 0 to 10 conceptual scale. [S02] A factory holding evidence for fibre composition (x = 2, y = 7 illustrative position) or garment assembly (x = 3, y = 5 illustrative position) cannot reuse that file to claim segregated Cameroonian cotton provenance (x = 9, y = 8 illustrative position). [S34] Conversely, **Exhibit 2**, p. 18 is an analytical categorisation and cannot determine legal compliance for specific tariff headings, which belongs to wp08 and wp17. [S18]

CLAIM-CARD SPECIFICATION AND LABEL REWRITE PROTOCOL

To prevent unsupported origin labels from reaching buyers, GFT recommends a pre-release claim-card review that rewrites promotional copy to match the narrowest boundary supported by inspected documents: [S02]

- **Unsupported draft label (rejected):** *"100% Sustainable Traceable Cameroon Cotton Polo: Farm-to-Fashion Verified."* [S01]
- **Engineering critique:** The draft fails four checks: the shirt includes 4 percent elastane collar and polyester thread by illustrative garment mass (S34); *"Sustainable"* lacks a specific scheme edition (S03); *"Farm-to-Fashion"* implies individual farm identity preservation whereas ginnery receipts were pooled across a regional campaign (S06); and any uncertified dyehouse buffer stock under mass-balance rules voids physical origin in the garment (S07). [S07]
- **Rewritten boundary-compliant statement:** *"Main body fabric knitted from 100 percent cotton lint ginned in northern Cameroon during the 2026 campaign (illustrative batch LOT-CM-2026-01), tracked from ginnery bale dispatch through spinning, dyeing and garment assembly under GFT physical batch-segregation controls; excludes sewing thread and collar trim (4 percent of illustrative garment mass). Custody records held by Mill Quality Assurance."* [S03]

1.5

A passport distributes evidence without creating it

Digital product passports (DPPs), quick-response (QR) codes and web portals are distribution mechanisms for product records, not primary sources of physical truth. [S28] Scanning a code on a garment care label can only display assertions previously captured, reconciled and linked across the manufacturing chain. [S10] Credible system design separates four distinct information artefacts: the product identifier, the event history, the certificate or credential, and the passport record. [S12]

First, a **product or batch identifier** names an object class, production lot, logistics unit or serialised item. [S12] Under the GS1 Digital Link Standard (URI Syntax, Release 1.7.0, ratified August 2026), identification keys and batch qualifiers are encoded inside HTTP or HTTPS Uniform Resource Locators so that an optical carrier resolves over the web. [S12] However, URL syntax conformance only makes an identifier routable; it does not prove that the physical garment carrying the label matches the server record. [S12]

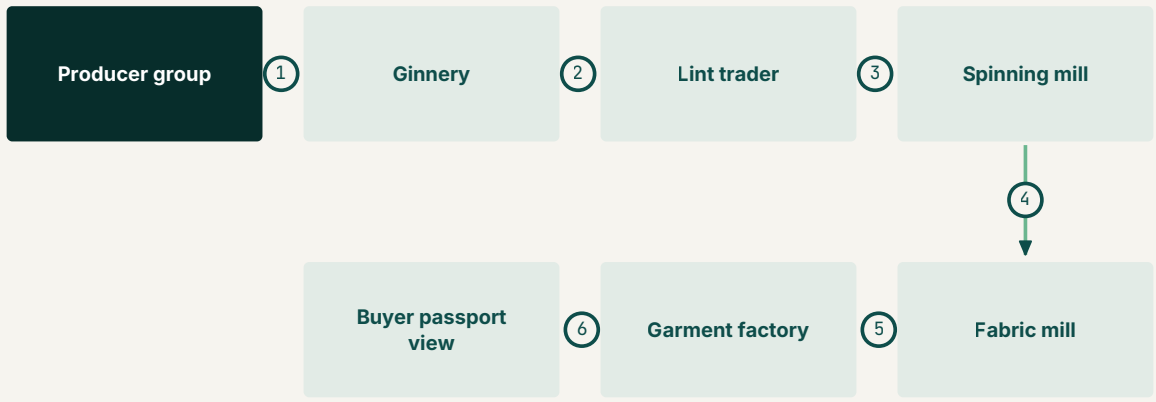
Second, an **event history** records operational observations across time and space. [S10] GS1's Electronic Product Code Information Services (EPCIS) Standard, Release 2.0 (ratified June 2022), paired with the GS1 Core Business Vocabulary (CBV) Standard, Release 2.0, captures what happened to which material, when, where, and why across shipping, receiving, transformation and aggregation steps without requiring item-level radio-frequency identification (RFID) tags. [S10] A spinning lay-down or fabric-roll split is recorded as a transformation event linking consumed input identifiers and masses to produced output identifiers. [S11]

Third, a **certificate or conformity credential** is a bounded attestation issued under stated criteria. [S29] Textile Exchange's Content Claim Standard and GOTS separate a facility's Scope Certificate (confirming site audit eligibility during a validity window) from a Transaction Certificate (confirming that a specific shipment moved between certified counterparties). [S05] Digitally, the UNECE / UN Transparency Protocol (UNTP) Conformity Credential specification (a pre-production pilot specification accessed 30 October 2026) and the World Wide Web Consortium (W3C) *Verifiable Credentials Data Model v2.0* (published 15 May 2025) define machine-readable envelopes in which an issuer signs claims for verifier inspection, where independent assurance credentials are issued by the conformity assessment body rather than self-declared. [S21]

Fourth, a **digital product passport** is the structured summary record aggregating product identity, composition, bounded provenance claims and evidence pointers for public or restricted inspection. [S28]

EXHIBIT 03 /

Evidence must cross every custody boundary



1. Seed-cotton receipt
2. Bale lot dispatch
3. Custody transfer
4. Yarn lot genealogy
5. Finished roll link
6. Bounded claim release

ILLUSTRATIVE [S03] [S10] Illustrative seven-stage cotton-to-garment custody chain structured using S03 material tracking principles and S10 visibility event semantics. Represents a hypothetical control boundary, not an active GFT supply chain.

Exhibit 3, p. 20 shows the seven sequential stages across which custody evidence must travel, grounded in CCS tracking rules and EPCIS event semantics. [S03] If any link in **Exhibit 3**, p. 20 breaks, such as an unrecorded lint-trader warehouse swap or an unlinked fabric-roll batch, the buyer passport view can no longer assert unbroken provenance. [S10] As an illustrative process flow, **Exhibit 3**, p. 20 defines the control sequence but cannot prove that physical separation occurred inside any plant. [S03]

1.6 UNRESOLVED REGULATORY SCHEMAS REQUIRE SEPARATION OF PROTOTYPE AND COMPLIANCE

Exporters targeting the European Union must separate current engineering prototypes from future statutory compliance. [S14] Under the Ecodesign for Sustainable Products Regulation (ESPR), the European Commission notes that the Ecodesign Forum is the main arena for consulting stakeholders on developing product rules. [S15] On its DG GROW portal for textile apparel and the Digital Product Passport (accessed 30 October 2026), the Commission states that exact information requirements will be defined through delegated acts and supporting technical specifications, citing an indicative planned adoption target of Q4 2027 for the textile delegated act. [S14]

An indicative Q4 2027 adoption target is neither a finalised field list nor a current compliance deadline, and UNTP's Digital Product Passport specification explicitly notes that it is suitable for pre-production pilot implementations rather than legal certification. [S28] GFT's inference is direct: a web passport or W3C Verifiable Credential preserves an issuer's digital assertion against tampering, but cannot restore a missing custody transfer or verify physical fibre in a bale. [S21]

1.7

Greenfield design creates a chance to capture evidence early

Retrofitting traceability onto legacy mills is difficult because older enterprise systems track financial invoices and aggregate stock weights rather than batch genealogy. [S10] Where a manufacturing programme is in its design phase, engineers can embed custody identifiers and volume-reconciliation checks directly into primary production controls before the first bale is opened. [S03]

GFT's only engagement in the sector is its three-part Cameroon textile programme, prepared on 31 January 2024 with source-refresh annotations retained in 2026, comprising a feasibility study, a performance-management system design and a digital strategy. [R06] Those deliverables form an engineering design baseline built from public-source figures; they do not represent a constructed factory, an operating line, an audited certification scope or a live software deployment. [R06]

1.8 EMBEDDING RECEIVING AND TRANSFORMATION IDENTIFIERS INTO SHIFT DISCIPLINE

In companion paper wp02, GFT designs a performance-management cadence in which supervisors and operators record production counts, downtime and defects at cell boundaries. [R06] In wp05, GFT recommends extending that data-first discipline: every material receipt, warehouse release, spinning laydown, fabric batch, dye lot and cutting lay should carry a mandatory custody identifier and measurement-basis record as part of shift sign-off. [S10] Recording input bale lot identifiers at the blow-room laydown simultaneously opens the shift yield order and writes the input side of an EPCIS transformation event, while weighbridge intake logs satisfy both stock accounting and CCS volume reconciliation. [S03]

1.9 SEPARATING SECTOR ACTORS FROM ESTABLISHED SUPPLIER RELATIONSHIPS

Evidence governance also requires separating public facts about upstream Cameroonian organisations from claims about GFT partnerships. [R03] In the inherited register, SODECOTON's profile states that it supports more than 220,000 cotton producers in northern Cameroon and operates nine ginning plants and two oil mills. [R03] That Grade C source-text record shows that northern Cameroon has an organised ginning base concentrated across nine industrial plants, but [^R03] describes an external upstream actor rather than a GFT partnership, contract or certified supply chain. [R03] Until upstream receiving documents are inspected in a pilot, supplier capability remains a design interface to test. [S06]

EXHIBIT 04 /

The programme is a design basis rather than a proven deployment

Operational domain	Authorised programme baseline	Proposed wp05 traceability extension	Current evidence status
Industrial scope	Feasibility, performance-system design and digital strategy	Batch-level custody and claim-release controls	Design specification only; no operating factory
Upstream cotton context	Public sector baseline (R03, R06, R07)	Ginnery receipt and bale-lot identifier capture	No GFT supplier partnership or certified offtake
Shop-floor data capture	Shift performance and quality-inspection cadence	EPCIS transformation links from laydown to garment batch	Proposed control workflow; pilot not yet executed
Buyer disclosure	Digital-strategy reporting architecture	Bounded digital passport prototype with claim card	Pre-production concept; no legal conformity claimed
Commercial impact	Feasibility scenarios and benchmark comparisons	Zero assumed price premium in baseline control test	Unmeasured in the field; requires pilot verification

ILLUSTRATIVE [R03] [R06] [S01] [S03] Illustrative editorial boundary distinguishing GFT's authorised Cameroon textile programme deliverables (prepared 31 January 2024, sources refreshed 2026) from proposed traceability extensions and unmeasured operating outcomes.

Exhibit 4, p. 22 codifies this boundary across five operational domains so readers can separate designed controls from untested field outcomes. [R06] Every workflow in **Exhibit 4**, p. 22 extends the 31 January 2024 programme design (refreshed in 2026) using ISO 22095 and CCS principles, while actual compliance rates await the pilot specified in Chapter 13. [S01]

GFT NOTE

Do not purchase a consumer-facing passport portal before configuring the warehouse receiving scale and blowroom release ticket. [S03] GFT recommends making two fields mandatory on every internal work order from day one of pilot operations: the **consumed input batch list** and the **declared custody model code**. [S10] Requiring operators to link physical bale lot or fabric roll identifiers before closing a shift order captures genealogy at the point of work; deferring capture to export invoicing fails as soon as two lots share a storage aisle. [S06]

1.10

Claims can fail even when each database is complete

Mandatory database fields and automated application programming interfaces (APIs) do not guarantee trustworthy provenance. [S10] A traceability database can show 100 percent field completion while the physical claim it publishes is invalid. [S01] Grounded in Textile Exchange's Content Claim Standard and the Aid by Trade Foundation's *Transparency Standard, Version 1.0* (June 2025), GFT models four operational failure hypotheses where physical reality diverges from clean database rows: [S03]

1. **Unrecorded material substitution:** A spinning or knitting machine runs short of segregated Cameroonian lint or yarn on a night shift, and an operator substitutes four bales or twelve cones of uncertified buffer stock to avoid downtime while logging only the scheduled segregated batch identifier. [S06]
2. **Duplicate allocation and double claiming:** A mill logs 10,000 kilograms of eligible origin-verified input material, then allocates 7,000 kilograms to Customer A and 6,000 kilograms of the same lot to Customer B. [S06] Section 7.3 of the June 2025 CmiA standard prohibits double claiming of transaction volumes, requiring volume reconciliation so outbound claims never exceed eligible inputs adjusted for conversion losses. [S06]
3. **Unrecorded subcontracting:** A certified producer logs fabric rolls at its primary plant, but dispatches 1,500 kilograms of grey fabric to an unrecorded external commission dyehouse during a bottleneck, breaking custody under GOTS and CmiA subcontracting rules. [S05]
4. **Missing input-output transformation links:** Departmental tables are complete (warehouse bale receipts, spinning yarn outputs, dyehouse batches and cutting bundles), but the system lacks transformation events linking specific input lots to specific output lots when multiple origins coexist in the plant. [S10]

When reconciliation checks detect an anomaly, engineers must distinguish **missing or contradictory documentation** from **proven wrongdoing**. [S17] Under power fluctuations or transcription delays, an unlinked roll or a 15-kilogram weighbridge gap is usually an administrative or measurement-basis error rather than fraud. [S03] Even so, absent evidence cannot support a claim: GFT requires placing affected output lots into an explicit **unknown or quarantined state** and withholding the provenance claim during investigation rather than inventing a default origin. [S02]

1.11 THE RECURRING HYPOTHETICAL COTTON LOT (LOT-CM-2026-01)

To test these controls across all fourteen chapters of wp05 and the trace-a-garment educational tool, GFT defines a recurring hypothetical reference lot: LOT-CM-2026-01. [S10] Every mass, yield, loss and garment count in LOT-CM-2026-01 is an **explicitly illustrative engineering construction**; none represents an observed shipment, a SODECOTON or CICAM result, or a GFT factory measurement. [R06]

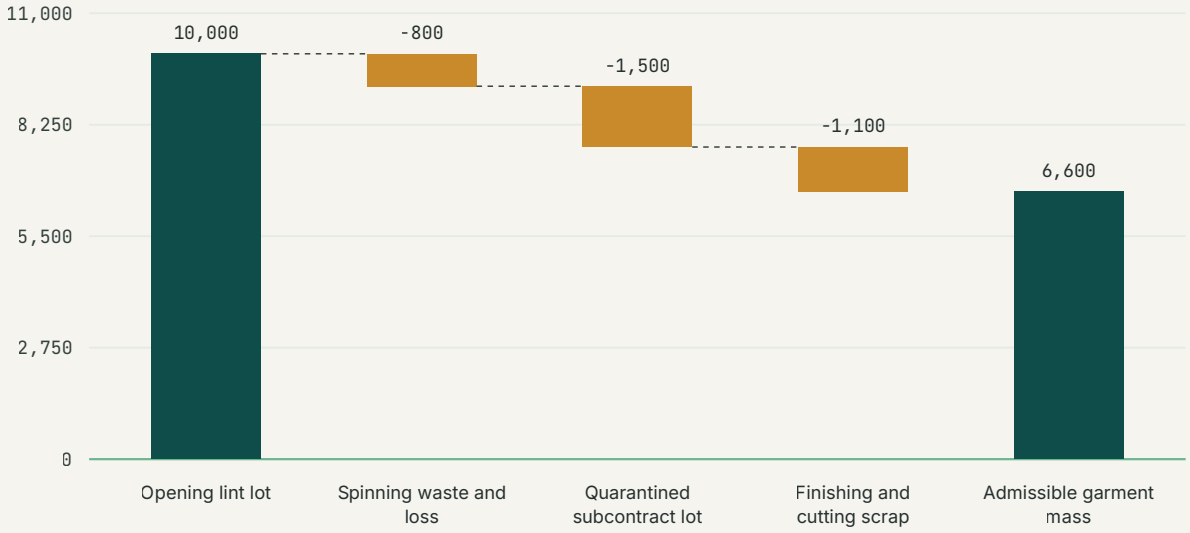
WORKED EXAMPLE: RECURRING HYPOTHETICAL COTTON LOT LOT-CM-2026-01

Assume an illustrative reference lot LOT-CM-2026-01 governed by a proposed physical-segregation claim card for northern Cameroonian lint. [S06] All quantities are illustrative model inputs:

- **Opening ginned lint intake (illustrative):** A spinning mill receives 40 illustrative bales at 250 kg net mass per bale at reference moisture, giving 40 x 250 kg = 10,000 kg opening eligible lint. [S03]
- **Stage 1: Spinning transformation (illustrative):** All 10,000 kg enter segregated laydown LAY-2026-01. Combing and spinning record 500 kg of recoverable noils and sliver waste (moved to a secondary ledger) and 300 kg of unrecoverable fly and dust loss, leaving 10,000 kg - 500 kg - 300 kg = 9,200 kg of net eligible yarn (YARN-CM-2026-01). [S10]
- **Stage 2: Wet-processing custody exception (illustrative):** After knitting 9,200 kg into grey jersey rolls, an illustrative dyehouse breakdown causes 1,500 kg (SUB-LOT-01B) to be sent to an external dyehouse lacking verified custody transfer and segregation logs, while 9,200 kg - 1,500 kg = 7,700 kg (MAIN-LOT-01A) are dyed in-house under full batch segregation. [S06] Under GFT's rule grounded in S06, the 1,500 kg unrecorded subcontractor lot is quarantined and stripped of segregated provenance eligibility. [S06]
- **Stage 3: Finishing and cutting scrap (illustrative):** Across the 7,700 kg in-house branch (MAIN-LOT-01A), trim, selvedge and cutting scrap consume 1,100 kg of cotton mass, leaving 7,700 kg - 1,100 kg = 6,600 kg of admissible segregated cotton fabric in finished garments. [S03]
- **Stage 4: Claim-release denominator (illustrative):** At 0.25 kg finished cotton mass per polo shirt (excluding non-cotton thread and trims), the batch supports a maximum claim release of 6,600 kg / 0.25 kg = 26,400 illustrative garments. [S03] Attempting to issue segregated passports for the 1,500 kg quarantined branch (5,140 additional illustrative garments) triggers an automatic ledger block. [S06]

EXHIBIT 05 / KILOGRAMS OF COTTON MASS

Unrecorded transfers shrink the mass eligible for a provenance claim



ILLUSTRATIVE [S03] [S06] Illustrative mass-balance accounting for hypothetical benchmark lot LOT-CM-2026-01 (10,000 kg opening lint) under S03 and S06 volume-reconciliation principles. All quantities are hypothetical teaching inputs, not observed factory data.

Exhibit 5, p. 25 reconciles LOT-CM-2026-01 from its 10,000 kg illustrative opening lint mass to its 6,600 kg closing admissible garment mass. [S03] Both physical conversion losses (1,900 kg combined illustrative spinning and cutting deductions) and custody exceptions (1,500 kg illustrative quarantined subcontract transfer) shrink the denominator of garments eligible for a segregated claim, though these illustrative figures are not empirical mill yield benchmarks. [S06]

1.12

The paper tests a control system rather than a technology promise

Traceability is an operational control discipline before it is a software product. [S01] Success in wp05 means that an independent reviewer can select a released garment batch, inspect its claim card, and reconstruct an unbroken, volume-reconciled trail back to admissible upstream evidence with an accountable owner at every handover. [S03] Consequently, this paper rejects three unproven assumptions: [S02]

- **No assumed automatic price premium:** No field evidence establishes that printing a passport on Cameroonian textiles automatically raises free-on-board (FOB) prices; Chapter 12 sets the baseline price premium to zero (0 XAF and 0 US$ illustrative base case) unless a buyer contract specifies otherwise. [S03]
- **No assumed automatic defect-rate improvement:** Batch identifiers do not replace manual or computer-vision fabric inspection (R29), whose quality mechanics belong to wp02. [R29]

- **No assumed regulatory or forensic shortcut:** Prototype passports do not guarantee European Union ESPR acceptance (S14) or WTO customs preference eligibility (S18). Similarly, while a 2026 review confirms that stable isotope analysis can corroborate natural fibre origin through region-specific signatures, the opened repository abstract establishes no Cameroon-specific classification accuracy, making isotope testing a conditional hypothesis requiring qualification in Chapter 7. [S33]

> **SCOPE AND LEGAL BOUNDARY**
>
> This white paper (wp05) is an engineering research specification prepared by Green Future Tech Limited, Hong Kong SAR; it is not investment, legal, customs or tax advice. [S14] No statement asserts that GFT, any Cameroonian cotton actor (R03) or any announced project holds certification under CCS (S03), OCS (S04), GOTS (S05) or CmiA (S06), nor does any prototype schema constitute legal conformity with Regulation (EU) 1007/2011 (S34), future ESPR delegated acts (S14) or rules of origin (S18). [S34] Obtain consolidated legal texts and counsel before issuing market claims. [S15]

1.13 DECISION SEQUENCE AND HANDOFFS ACROSS THE GFT WHITE-PAPER LIBRARY

wp05 progresses through four parts across fourteen chapters: [S01]

1. **Part I (Chapters 1 to 3):** Define the claim card (Chapter 1), select the custody model and scheme version (Chapter 2), and establish the producer-to-bale boundary with smallholder privacy controls (Chapter 3). [S02]
2. **Part II (Chapters 4 to 7):** Control dispatch-and-receipt handovers (Chapter 4), preserve factory genealogy across blending and conversion (Chapter 5), reconcile physical and claim ledgers (Chapter 6), and qualify certificates and isotope assays (Chapter 7). [S03]
3. **Part III (Chapters 8 to 11):** Standardise identifiers and EPCIS events (Chapter 8), map bounded passport fields (Chapter 9), separate cryptographic integrity from physical truth (Chapter 10), and make governance operable under outages and privacy rules (Chapter 11). [S10]
4. **Part IV (Chapters 12 to 14):** Price bottom-up control work per eligible garment (Chapter 12), test adversarial failure cases in a bounded pilot (Chapter 13), and gate scaling on independent reconstruction (Chapter 14). [S28]

Companion papers own adjacent domains: wp01 (cotton-value-flow) owns capacity economics; wp02 (kpi-cascade) owns shop-floor KPIs; wp06 and wp16 own water and carbon accounting; wp07 (edge-architecture) owns offline resilience; wp08 owns trade preferences; wp11 owns circularity; wp12 owns inventory buffers; wp14 and wp18

own data governance and architecture; and wp17 owns legal review. [S18] On the GFT platform, trace-a-garment implements the LOT-CM-2026-01 equations as an educational scenario simulator rather than a certification engine. [S28]

A factory can sell only the provenance its custody records can reconstruct.

CHAPTER SOURCE NOTES

S01 International Organization for Standardization. 2020.

S02 ISEAL Alliance. 2025.

S03 Textile Exchange. 2026-10-30.

S10 GS1. 2022.

R06 Cameroon Trade Hub. Publication date unrecorded; inherited source-text check.

R07 Ecofin Agency. Publication date unrecorded; inherited source-text check.

R01 Business in Cameroon. Publication date unrecorded; inherited source-text check.

S06 Aid by Trade Foundation. 2025.

S12 GS1. 2026.

S21 World Wide Web Consortium. 2025-05-15.

S18 World Trade Organization. 2026-10-30.

S07 Aid by Trade Foundation / Cotton made in Africa. 2026-10-30.

S04 Textile Exchange. 2026-10-30.

S34 European Commission, DG GROW. 2026-10-30.

S28 UNECE / UN Transparency Protocol. 2026-10-30.

S11 GS1. 2022.

S29 UNECE / UN Transparency Protocol. 2026-10-30.

S05 Global Standards gGmbH. 2026-10-30.

S14 European Commission, DG GROW. 2026-10-30.

S15 European Commission. 2026-10-30.

R03 SODECOTON. Publication date unrecorded; inherited source-text check.

S17 OECD. 2018-03-07.

R29 MDPI; industry inspection literature. Publication date unrecorded; inherited source-text check.

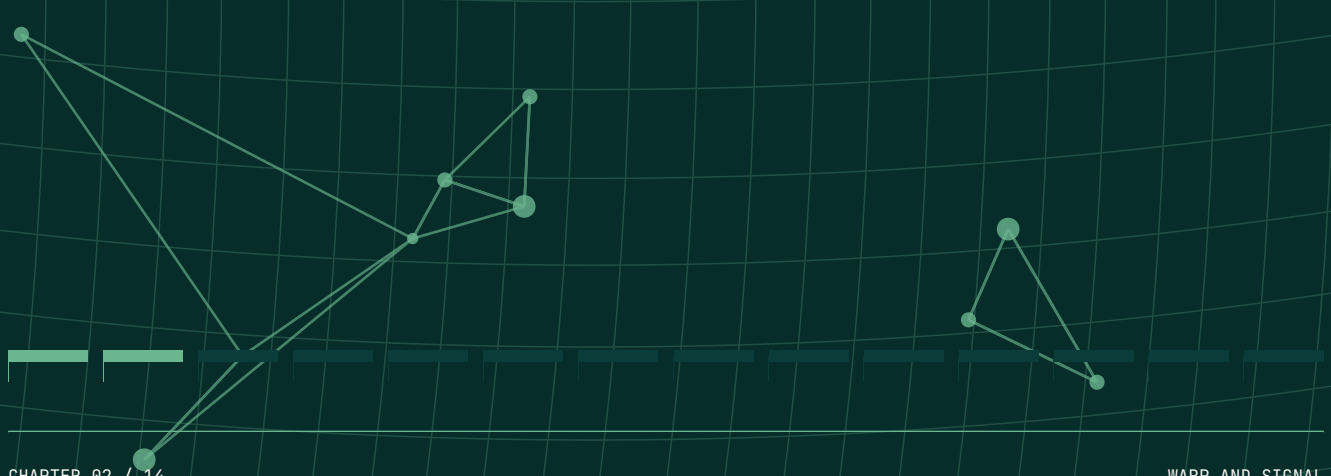
S33 Jin, Shi and Wang / Taylor & Francis, hosted by Hong Kong Polytechnic University. 2026.

02

PART I: CLAIMS MUST MATCH THE CHAIN / CLAIM BOUNDARIES

The custody model sets the limit of the claim

Select the custody model by the attribute that must survive, then design operations to maintain that attribute.



CHAPTER 02
DECISION TEST

Select the custody model by the attribute that must survive, then design operations to maintain that attribute.

A custody model should be selected from the attribute that must remain true at the point of sale, not from available software or a preferred label. If the buyer needs an individual source to remain identifiable, pooling that source with others destroys the required evidence even when every input is eligible. If the buyer instead needs a reconciled account of certified production, physical source identity may be unnecessary, but the resulting statement must not imply that particular certified fibres sit inside a particular garment. The chosen model therefore sets a ceiling on the claim before any database, certificate or passport is designed. [S01] [S02] [S0202]

GFT's answer is to write the intended proposition, its prohibited stronger interpretation and the applicable scheme edition before approving procurement. Operations then receives a physical control problem: keep sources apart, preserve a claimed class, maintain a known mixture, reconcile allocated quantities, or administer credits separately from goods. Commercial communication receives the corresponding language boundary. ISO's public abstract expressly warns that a chain of custody system alone neither specifies production characteristics nor verifies a product claim, so conformity cannot be inferred from the presence of tracking records. [S01]

2.1

Physical identity and quantity allocation answer different questions

A chain of custody transfers material and associated attributes under stated rules. It does not make every attribute travel in the same way. Physical identity asks which material units entered a defined output. Quantity allocation asks how much of a claimed attribute may be assigned to outputs under an accounting rule. Book-and-claim asks a third question: whether an attribute record may be transferred independently of the physical goods. These questions can share identifiers and documents, but their affirmative answers support different propositions. [S02] [S0202]

The distinctions below are GFT's working design patterns drawn from ISEAL's guidance overview and explanatory article. They are not a substitute for the clauses of a selected standard. A scheme may narrow the eligible sources, impose a reconciliation period, restrict mixing, require a particular register or prohibit a consumer statement that the generic pattern seems to allow. The scheme edition, certification scope and claims policy must therefore be resolved before the model name enters a purchase order. [S02] [S03]

2.2 EACH MODEL PERMITS A STATEMENT AND FORBIDS A STRONGER ONE

Identity preservation retains a specified source. Material from that source remains distinguishable from other sources through the agreed boundary. A supportable illustrative statement is: "This yarn lot was produced from the identified bale group recorded in its transformation record." The overstatement is: "Every fibre in every garment can be traced to an individual farm," when the bale group itself pooled several producers or later transformation records do not preserve that granularity. Identity preservation is therefore about the declared source unit, not an automatic promise of farm-level resolution. [S02] [S0202]

Segregation preserves a claimed class rather than one source. Eligible inputs may be combined while material outside the class is kept apart. A supportable illustrative statement is: "This fabric batch contains only inputs accepted under the named claimed class, subject to its scheme rules." The overstatement is: "This fabric comes from producer group A," when eligible inputs from groups A and B were mixed. The model can preserve country origin where every admitted input shares that origin, but it cannot preserve an attribute on which the admitted inputs differ. [S06] [S0202]

Controlled blending preserves a known composition under a defined recipe. Eligible and other inputs are mixed according to controlled criteria, and the proportion is carried through the batch record. A supportable illustrative statement is: "This batch has the calculated claimed-input proportion shown in its approved composition record." The overstatement is: "All cotton in this batch is eligible," or any item-level percentage that ignores unequal distribution, process losses or the scheme's allocation method. The recipe must be reconciled with what was actually consumed, not merely copied from the purchase specification. [S02] [S06]

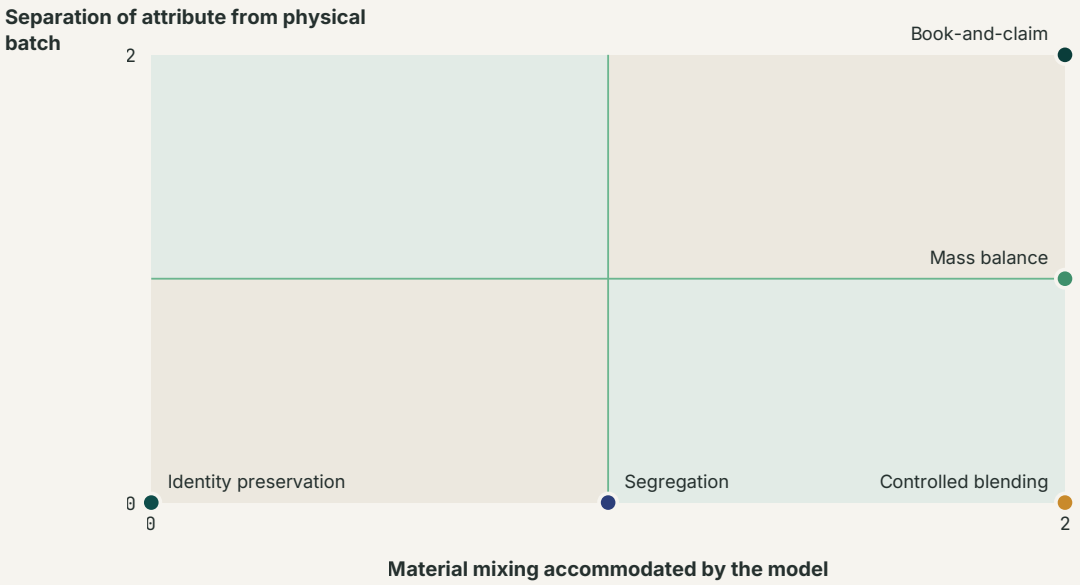
Mass balance allocates an eligible quantity rather than identifying physical content. Eligible material may mix with other material while records control the volume available for claims. A supportable illustrative statement is: "The seller has allocated a reconciled eligible quantity to this output under the named scheme's Mass Balance rules." The overstatement is: "This shirt physically contains cotton from the certified farms in the allocation register." ISEAL distinguishes support for sustainable production from a claim that the final product contains sustainably produced material, which is precisely the communication boundary a mill must encode. [S0202] [S07]

Book-and-claim separates the attribute instrument from physical supply. A credit or certificate is transferred under its own rules while the goods may follow an unrelated physical route. A supportable illustrative statement is: "The buyer has retired the stated instrument to support eligible production, subject to the issuing scheme's rules." The overstatement is: "The goods delivered with this report contain the credited material," or any suggestion of physical provenance created by the certificate. This model requires especially strict separation between the physical stock ledger and the credit register. [S02] [S0202]

Exhibit 6, p. 31 arranges the five working patterns by operational mixing freedom and by the way the attribute reaches the output. The positions are categories, not quality scores. A higher coordinate is not a better sustainability outcome, and a lower coordinate is not automatically preferable. The exhibit asks only whether the physical and administrative linkage matches the proposition that the seller intends to make. [S02] [S0202]

EXHIBIT 06 / CATEGORICAL POSITION, NOT A PERFORMANCE SCORE

Custody models permit different claim strengths



ILLUSTRATIVE [S01] [S02] [S03] [S07] [S0202] Illustrative GFT classification based on the opened custody guidance and scheme pages. X categories: 0 = one declared source, 1 = mixing within an eligible class, 2 = mixing with other material permitted by the model. Y categories: 0 = attribute tied to the physical batch, 1 = attribute allocated by quantity, 2 = attribute instrument transferred separately. Positions are not measured scores or scheme equivalence findings.

The exhibit also exposes a common design error: treating physical segregation as a general measure of evidence quality. Segregation can preserve a class while destroying individual source identity. Mass balance can preserve a reliable eligible-volume account while saying nothing about the physical fibres in one output. Book-and-claim can support an approved production attribute without establishing any physical connection to the buyer's goods. Evidence quality must be judged against the question asked, not against how difficult the operating model appears. [S01] [S0202]

ISEAL's current explanatory material also describes controlled mass balance, where all inputs meet minimum requirements while volumes with additional attributes are tracked. That variant should be entered separately in a scheme register rather than silently folded into ordinary mass balance or controlled blending. The existence of a named generic category does not prove that a textile scheme offers it, accepts it at every site, or permits the same claim language. [S02] [S0202]

GFT NOTE

GFT recommends that the commercial owner write two sentences before supplier onboarding: the narrow statement the buyer may repeat, and the stronger statement the buyer must not repeat. Operations, quality and the evidence approver should sign both against the named scheme edition. If they cannot agree which physical fact or allocated attribute the first sentence asserts, procurement should pause rather than choose a custody label by convention. [S02] [S03]

SCHEME-SELECTION DECISION TREE

Apply the following GFT decision sequence in order, then confirm the answer against the selected scheme's current rules: [S02] [S0202]

1. **Must one declared source remain identifiable?** If yes, test identity preservation. Define whether that source is a farm, producer group, ginnery campaign or bale group. Stop if any planned pool combines sources that the claim requires to remain distinct.
2. **If individual identity is unnecessary, must every physical input belong to one claimed class?** If yes, test segregation. Write the admission rule and every attribute shared by the class. Do not infer source identity from class membership.
3. **Must a known proportion survive in a defined batch?** If yes, test controlled blending. Specify the recipe, measurement basis, actual-consumption record and treatment of losses before approving composition language.
4. **Is a reconciled allocation sufficient without physical content certainty?** If yes, test mass balance. Define the accounting boundary, eligible quantity, allocation rule and prohibited physical-content wording.
5. **Should the attribute move independently of the goods?** If yes, test book-and-claim only where the issuing scheme permits it. Keep credit issuance, transfer, retirement and physical delivery in separate records.
6. **Is the required answer still unclear?** Release no claim. Record the unresolved attribute, owner and evidence needed. A software workflow or supplier declaration cannot answer a question that the commercial claim leaves undefined.

2.3

A country claim may survive some mixtures and fail in others

Geographic origin behaves like a set of admissible input histories. A same-country pool can preserve a country-level proposition if every admitted input has sufficient origin evidence and the scheme permits the pool. It cannot preserve a narrower farm or producer-group claim when those sources have been combined. The surviving claim is therefore the intersection of the attributes evidenced across the input set, not the most attractive attribute attached to any one input. [S02] [S06]

This rule separates two questions that procurement documents often combine. "Certified under scheme X" describes an assessed attribute under that scheme. "Grown in country Y" describes a geographic proposition. One may imply the other only where the scheme's actual scope and evidence make that connection explicit. A certified-class label should never be used as a convenient substitute for an origin record, nor should a country of ginning be treated automatically as the country where the cotton grew. [S03] [S07]

A mixed-country batch creates a different boundary. It may support a documented statement about its set of possible origins, or a composition claim if the applicable rules and measurements allow one. It cannot support an unqualified single-country

statement for the whole batch. Segregating the finished output into smaller lots does not repair the boundary, because a later split cannot recreate knowledge about which input fibres entered each item. [S02] [S0202]

Unknown-origin material is more restrictive than a documented second origin. A second origin can be named in an input set. An unknown origin cannot be converted into a named country, assigned to a residue stream, or spread across production merely to make the remaining claim look complete. GFT's conservative design rule is to carry the unknown state into the affected output until original evidence resolves it. Any different treatment requires an explicit scheme rule and a visible calculation. [S01] [S06]

WORKED EXAMPLE: THE POOL DETERMINES THE SURVIVING ORIGIN STATEMENT

Consider three illustrative spinning batches, each with a total lint input of 1,000 kg. These are training quantities chosen to make the arithmetic visible, not observed production, standard conversion factors or GFT results.

- **Same-country pool:** batch A consumes 800 kg from documented Cameroon bale group A and 200 kg from documented Cameroon bale group B. The input total is 800 + 200 = 1,000 kg. A country-level Cameroon proposition can remain within the evidence boundary, subject to the applicable scheme and transformation records. A claim that the output comes only from group A is unsupported because the sources were mixed. [S02]
- **Mixed-country pool:** batch B consumes 700 kg with documented Cameroon origin and 300 kg with documented origin in another country. The input total remains 1,000 kg, but an unqualified Cameroon-cotton claim for the entire output fails. The record may retain both possible origins. Any percentage statement would require a compatible measurement basis and an approved claim rule. [S0202]
- **Unknown-origin pool:** batch C consumes 900 kg with documented Cameroon origin and 100 kg whose origin is unresolved. The illustrative documented share is 900 / 1,000 × 100 = 90 percent, and the unresolved share is 100 / 1,000 × 100 = 10 percent. The calculation does not make the output 90 percent Cameroon by physical fibre content. It describes only the input evidence share on the stated mass basis. The whole-batch single-country claim remains blocked until the unknown input is resolved, or until that input is excluded before mixing under a documented control. [S06]

The practical control belongs at input admission, before the mixing decision. Receiving should show which origin granularity each lot can support, and the production release should prevent a laydown whose combined input set would fall below the intended claim. If commercial needs require a single-country output, an unknown or differently sourced lot must follow another approved route rather than enter the batch and trigger a later relabelling exercise. [S03] [S07]

2.4

Sustainability schemes carry different assurance boundaries

A scheme name is not a complete description of the assurance purchased. The Content Claim Standard (CCS) provides a framework for tracking certified materials and supporting certified-content claims. The Organic Content Standard (OCS) concerns third-party certification of organic materials and chain of custody. GOTS describes certified processing requirements and Transaction Certificates across the organic textile chain. These published scopes overlap in places, but they are not interchangeable labels for the same production, origin or processing proposition. [S03] [S04] [S0201]

Exhibit 7, p. 34 summarises only the opened public scope descriptions. It is a selection aid, not a determination of certification equivalence. Detailed eligibility thresholds, approved inputs, exceptions, audit rules and claims language must be checked in the applicable normative documents before a real shipment is assessed. [S03] [S04] [S05]

EXHIBIT 07 / QUALITATIVE COMPARISON OF PUBLISHED SCOPE SUMMARIES

A standard title does not reveal its full scope

Instrument	Published focus	Evidence described	Not established by the overview
CCS	Tracking certified material for certified-content claims	Receiving, processing and transfer records; volume reconciliation; segregation controls; scope and transaction certificates	Farm production attributes, geographic origin or automatic mark permission
OCS	Third-party certification of organic materials and chain of custody	Eligible certified organic input and third-party audit at each supply-chain stage	A particular country's origin, every processing impact or an uninspected supplier's status
GOTS	Certified organic textile processing and manufacturing with supply-chain traceability	Certified processing requirements and Transaction Certificates linking material movement	Certification of an uninspected organisation or permission to apply a mark to any shipment

SOURCED [S03] [S04] [S05] [S0201] Sourced from opened public overviews, accessed 30 October 2026. This is not a certification equivalence determination or a substitute for current normative documents, certificate scope and claims rules. Exclusions state what the cited overview alone does not establish.

Four separate checks follow from this comparison. First, the **scheme criteria** define the attribute and custody requirements that the claimant seeks to meet. Second, the **certification-body scope** establishes which organisation, site and activities have been assessed, during which validity period and under which standard. Third, **transaction evidence** concerns specified material movements rather than the general existence of a certified organisation. Fourth, **permission to use a mark** depends on the applicable claims and licensing rules, not simply on possession of a certificate PDF. [S03] [S05] [S06]

The distinction prevents both under-reading and over-reading evidence. A scope certificate alone should not be treated as proof that every shipment from a certified site carries every possible claim. Conversely, a transaction document should not be dismissed merely because it does not answer wider questions about farm practices or processing impacts that sit outside its stated purpose. Each item should be admitted for the proposition it actually supports, with its issuer, scope and limitations retained. [S03] [S05]

No certification is assigned here to Cameroon cotton, GFT's textile programme, a proposed supplier or any illustrative batch. The public scheme pages establish what their publishers say about the frameworks. They do not inspect a particular certificate, confirm a supplier's current status or authorise a product label. A project evidence room must obtain those artefacts directly and check them with the relevant issuer where necessary. [S04] [S05] [S06]

2.5

Current terminology can differ from the archived standard

The opened CmiA documents provide a practical version-control warning. The June 2025 Transparency Standard uses Hard Identity Preserved (HIP) and Mass Balance. The current traceability webpage uses Segregation for the physically separated route, while the legacy FAQ still describes HIP and Mass Balance. These texts must remain distinguishable in the evidence register. Replacing every older term with a newer one would obscure which rulebook a supplier actually applied. [S06] [S07] [S08]

Exhibit 8, p. 36 records the document observations without inventing the date on which terminology changed. An access date establishes what this chapter's author could read on that date. It does not establish when the page was published, when a contract changed, or which document governed an earlier shipment. [S06] [S07]

EXHIBIT 08 / ORDERED DOCUMENT OBSERVATIONS, NOT ELAPSED TIME

Terminology changes need version control

0

June 2025 Transparency Standard

HIP and Mass Balance terminology; section 7.2 governs the stated downgrade.



1

Live pages accessed 30 October 2026

Traceability page uses Segregation; legacy FAQ retains HIP and Mass Balance.

SOURCED [S06] [S07] [S08] Sourced document observations. Position 0 is the June 2025 standard; position 1 groups the live pages accessed 30 October 2026. The sequence does not infer a terminology-change date or establish that the legacy FAQ is the current rulebook.

A useful scheme register preserves both the normative and interpretive trail. For each document, record publisher, title, version, publication or access date, effective window, claimed-material scope, custody terms, claim rules consulted, file location and reviewer. Add a terminology crosswalk rather than overwriting the original wording. The June 2025 entry should therefore retain HIP, while a separate current-page entry records Segregation and notes the unresolved relationship for the shipment under review. [S06] [S07]

Exhibit 9, p. 37 populates those fields for the three CmiA documents used here. It is the starting register for a shipment review, not a decision that all three documents carry equal authority. The reviewer must add the applicable contract, claims framework and any later normative document before releasing a real claim. [S06] [S07] [S08]

EXHIBIT 09 / POPULATED DOCUMENT REGISTER

The version register keeps terminology and authority visible

Document record	Version and dates	Scope and terminology	Register status
Transparency Standard	Version 1.0, June 2025; effective 1 June 2025; transition ends 28 February 2026	HIP and Mass Balance; section 7.2 downgrade rule	Retain HIP wording; confirm shipment applicability
Traceability webpage	Undated; accessed 30 October 2026; no effective window stated	Segregation and Mass Balance; physical and volume routes	Current explanatory page; shipment rules still to be proved
Legacy FAQ	Undated; accessed 30 October 2026; no effective window stated	Legacy HIP and Mass Balance downstream description	Comparison only; not treated as a newer rulebook

SOURCED [S06] [S07] [S08] Sourced from the opened standard and webpages. Access dates are not publication dates. The register records unresolved applicability and does not treat the legacy FAQ as the current rulebook.

The register also needs a discrepancy state. If a supplier contract says HIP, a current webpage says Segregation and an old FAQ describes a different downstream boundary, the reviewer should not choose the most convenient text silently. Record whether the discrepancy is editorial, temporal or substantive, identify the scheme owner who can resolve it, and block the affected claim if the answer changes what the buyer may say. Marketing statements on a scheme webpage remain that publisher's assertions until shipment-specific evidence establishes applicability. [S07] [S08]

The same discipline applies to ISO 22095. This chapter opened its public abstract, not the paid clauses. The catalogue also identifies an amendment and revision activity. A generic design pattern can therefore be informed by the abstract, but no ISO conformity statement should be made until the applicable licensed edition, amendment and clause set have been obtained and reviewed. [S01]

2.6

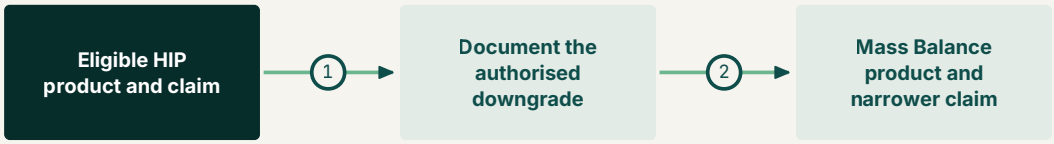
A downgrade must remove the stronger claim

Section 7.2 of the June 2025 CmiA Transparency Standard permits an eligible HIP product to be converted to Mass Balance when the affected actors meet its registration and authorisation conditions. It also states that the conversion is irreversible and final. Once downgraded, the product can no longer carry CmiA HIP claims or on-product communications, and the volume and supporting documentation must remain traceable. This is a scheme-specific rule for the opened edition, not a universal downgrade law for every standard. [S06]

Exhibit 10, p. 38 shows only that permitted direction. It deliberately does not draw a return path from Mass Balance to HIP. A later purchase, certificate or software status change cannot restore the physical claim that the downgrade removed. [S06]

EXHIBIT 10 / CLAIM-STATE TRANSITION UNDER THE CITED CMIA EDITION

A downgrade ends the stronger physical claim



1. Conversion permitted under stated conditions
2. Irreversible: HIP claim removed

SOURCED [S06] Sourced from section 7.2 of the June 2025 CmiA Transparency Standard. Applies only where that edition and its conditions apply. The conversion is irreversible; no reverse transition or cross-scheme equivalence is asserted.

The operational state change must reach more than the accounting total. The claim register should mark the affected quantity as downgraded, retain the former HIP history and stop further release of the stronger wording. Labels, invoices, product pages and buyer data feeds should be reviewed for stale claims. The record is corrected by appending the downgrade and its evidence, not by deleting the earlier state and pretending that the product had always followed Mass Balance. [S06]

For an illustrative control case, suppose 500 kg of eligible HIP product is validly downgraded and a separate 500 kg HIP purchase arrives later. The new purchase may enter its own eligible HIP route if all requirements are met, but it cannot be used to reclassify the first 500 kg retrospectively. These quantities are chosen only to demonstrate claim-state separation. They are not stock observations or evidence that such a transaction occurred. [S06]

Three registers must therefore remain distinct. The **physical stock register** records material on hand and its observed movements. The **scheme-volume register** records eligible purchases, transformations, allocations, downgrades, sales and cancellations under the applicable rules. A **credit register**, where relevant, records instruments that may travel separately from material. Reconciliation should expose their relationships without treating a positive scheme balance as physical identity or a retired credit as inventory. [S03] [S06]

Detailed duplicate-allocation controls belong with the paper's quantity-reconciliation chapter. At this model-selection stage, the specification only needs to identify the register that owns the applicable rule and the release control that prevents incompatible claims. [S06]

2.7

Procurement terms must preserve the chosen boundary

A custody model fails commercially when it remains a design note while purchasing accepts material under broader or different terms. The purchase specification must carry the claim boundary into supplier selection, order acceptance, receiving, sub-contracting, evidence delivery and failure handling. A supplier cannot infer the required physical separation from a product name, and a buyer cannot repair an incompatible purchase by adding a stronger statement at dispatch. [S02] [S03]

GFT's proposed control is a procurement evidence schedule attached to the claim card. The schedule identifies the admissible material, the exact custody model and scheme edition, the evidence due with each lot, and the decision when evidence is absent or contradictory. It also names the operational owner who can release material and the commercial owner who can approve wording. These are separate decisions: physical acceptance does not automatically authorise a public claim. [S03] [S06]

2.8 THE SCHEDULE MUST MAKE THE BOUNDARY INSPECTABLE

Exhibit 11, p. 40 provides a proposed schedule structure. Its entries are illustrative GFT controls derived from the opened CCS and CmiA requirements. They are not represented as enforceable contract wording or as a complete list for any scheme. Each project should adapt the schedule to the applicable rulebook and have its contractual effect reviewed by qualified advisers. [S03] [S06]

EXHIBIT 11 / PROPOSED CONTROL SCHEDULE

Procurement acceptance must test the claim boundary

Schedule term	Required entry	Evidence to inspect	Release response
Claim	Permitted statement, prohibited stronger statement, material and product boundary	Approved claim card and buyer requirement	Stop if the proposition is ambiguous
Material	Eligible source class, origin granularity, composition and exclusions	Supplier declaration and eligibility records matched to the lot	Reject or route ineligible material
Custody and version	Model, scheme, edition, effective window and permitted transitions	Version register and applicable requirements	Quarantine unresolved model mismatches
Supplier and site	Legal entities, sites, activities, validity and certification scope	Registration or scope evidence checked with the issuer where needed	Stop claims outside the inspected scope
Lot evidence	Identifiers, quantities, dates, references, transport and transaction documents	Purchase, delivery, production and transfer records matched on receipt	Hold incomplete or inconsistent lots
Physical control	Storage, separation, cleaning, marking and authorised mixing rules	Work instructions and completed storage or campaign records	Investigate unrecorded mixing and narrow the claim
Subcontracting	Approved activities, sites, ownership, records, access and further outsourcing	Signed agreement, current subcontractor list and input-output records	Stop undisclosed or unapproved processing
Failure and change	Notification, quarantine, correction, downgrade, withdrawal and evidence retention	Exception log, original records, decision and approved corrective action	No claim release while the exception remains unresolved

ILLUSTRATIVE [S02] [S03] [S06] Illustrative GFT procurement schedule informed by the opened custody and scheme documents. It is not legal wording, a complete scheme checklist or evidence that any supplier satisfies these controls. Project-specific normative and legal review remains required.

The schedule should be completed before a request for quotation, not after a supplier has been selected. Otherwise commercial pressure can determine the custody model retroactively. A supplier that cannot provide individual source identity may still be suitable for segregation or Mass Balance, but only if the buyer accepts the narrower proposition before the order. Changing the model is a claim-design decision with operational consequences, not a clerical substitution of one acronym for another. [S02] [S0202]

2.9 EVIDENCE DELIVERY NEEDS AN ACCEPTANCE STATE

Every required document needs a due point and an acceptance state. GFT proposes **expected**, **received**, **matched**, **queried**, **quarantined** and **released** as working states. "Received" means a file or record has arrived. "Matched" means its supplier, site, material, identifiers, quantities and model have been reconciled with the physical lot

and purchase terms. Only the appropriate reviewer can move a matched evidence pack to released status. These states are proposed controls, not terms borrowed from a particular scheme. [S03] [S06]

An attachment count is not a completeness test. A delivery can contain an invoice, certificate and photograph while lacking the lot reference that connects any of them to the goods. Receiving should therefore test relationships across the pack: the supplier on the order matches the eligible entity, the site falls within the accepted scope, the delivery identifier appears on the transport record, and the claimed model agrees with the purchase specification. Missing links remain unknown and visible rather than being filled from a supplier master record. [S03] [S06]

Evidence due after shipment also needs a controlled path. The schedule should state whether material may be processed while transaction evidence is pending, which claim must remain blocked, who follows up and when the lot becomes an exception. The opened CmiA standard separates material handling, tracking entries and claim release, which illustrates why physical receipt alone cannot close the evidence review. Other schemes require their own timing and acceptance rules. [S06]

2.10 SUBCONTRACTING BELONGS INSIDE THE CUSTODY BOUNDARY

A subcontractor is not outside the claim merely because no sale occurs between the contracting parties. The proposed schedule must identify the activity, site, material identifiers, quantities dispatched and returned, applicable custody rules and records to be delivered. Under the opened CmiA standard, outsourcing controls include signed agreements, accurate input and output records, restrictions on further outsourcing and assessment access. These specific duties should be cited only where that standard applies, but the underlying design question is general: can the principal reconstruct what happened to the claimed material? [S06]

Change control should cover a replacement site, an additional process step, a new material class and a changed recipe. The supplier should not be able to move claimed work to an unreviewed subcontractor because the commercial product description remains unchanged. Procurement and operations need a trigger that submits such changes to the evidence approver before work starts. If the change has already occurred, the output enters an exception state until its admissible claim is reconstructed from records. [S03] [S06]

2.11 FAILURE HANDLING MUST REMOVE CLAIMS BEFORE DISPUTES ARE SETTLED

The schedule should distinguish a documentation delay, a physical nonconformity and a claim contradiction. Each requires containment, but the commercial response may differ. A missing delivery reference may be resolved from original evidence. An unrecorded mixture may force a narrower custody model. A contradiction about source or certificate scope may require quarantine and issuer confirmation. None of these situations justifies deleting the original record or releasing the preferred claim while investigation continues. [S03] [S06]

Where a downgrade is available, its effect on labels, invoices and buyer communications must be executed with the accounting change. Where no valid route remains, the material should be sold or used without the claim, subject to the applicable rules.

Commercial remedies, warranties, indemnities, termination rights and notification duties require legal review. This chapter specifies evidence and operating controls, not legal advice or an enforceable contract template. [S06]

> **PROCUREMENT APPROVAL IS A CLAIM-RELEASE GATE**
>
> GFT recommends that no procurement approval be granted until operations, quality and commercial owners agree on the intended claim, custody model, applicable version and admissible evidence. The approval record should name the reviewers, their decision date, unresolved exceptions and the exact statement authorised for use. If one of those elements is absent, the order may need to proceed without the claim or wait for further evidence. This is a proposed GFT design gate, not evidence of an implemented programme. [S02] [S03]

The result is a closed design loop. The claim card defines what must be true. The custody model determines which physical and administrative controls can preserve it. The scheme register fixes the terminology and rules against which evidence will be judged. The downgrade procedure removes stronger claims when the boundary changes. Procurement then makes those choices binding on ordinary acceptance work, so that a product passport can publish only what the chain has actually preserved. [S01] [S06]

For the companion tool, **Exhibit 6**, p. 31 and the claim-card fields are proposed model-specific inputs to `trace-a-garment`, whose scenarios remain educational rather than certificates. Legal review of claims and procurement wording remains with wp17; this chapter supplies the evidence boundary for that review, not a legal conclusion. [S01] [S03]

Choose the custody model for the claim that must survive, and let every weaker record narrow the words.

CHAPTER SOURCE NOTES

S01 International Organization for Standardization. 2020.

S02 ISEAL Alliance. 2025.

S0202 ISEAL Alliance. 2025-10-30.

S03 Textile Exchange. 2026-10-30.

S06 Aid by Trade Foundation. 2025.

S07 Aid by Trade Foundation / Cotton made in Africa. 2026-10-30.

S04 Textile Exchange. 2026-10-30.

S0201 Global Standards gGmbH. 2026-06-14.

S05 Global Standards gGmbH. 2026-10-30.

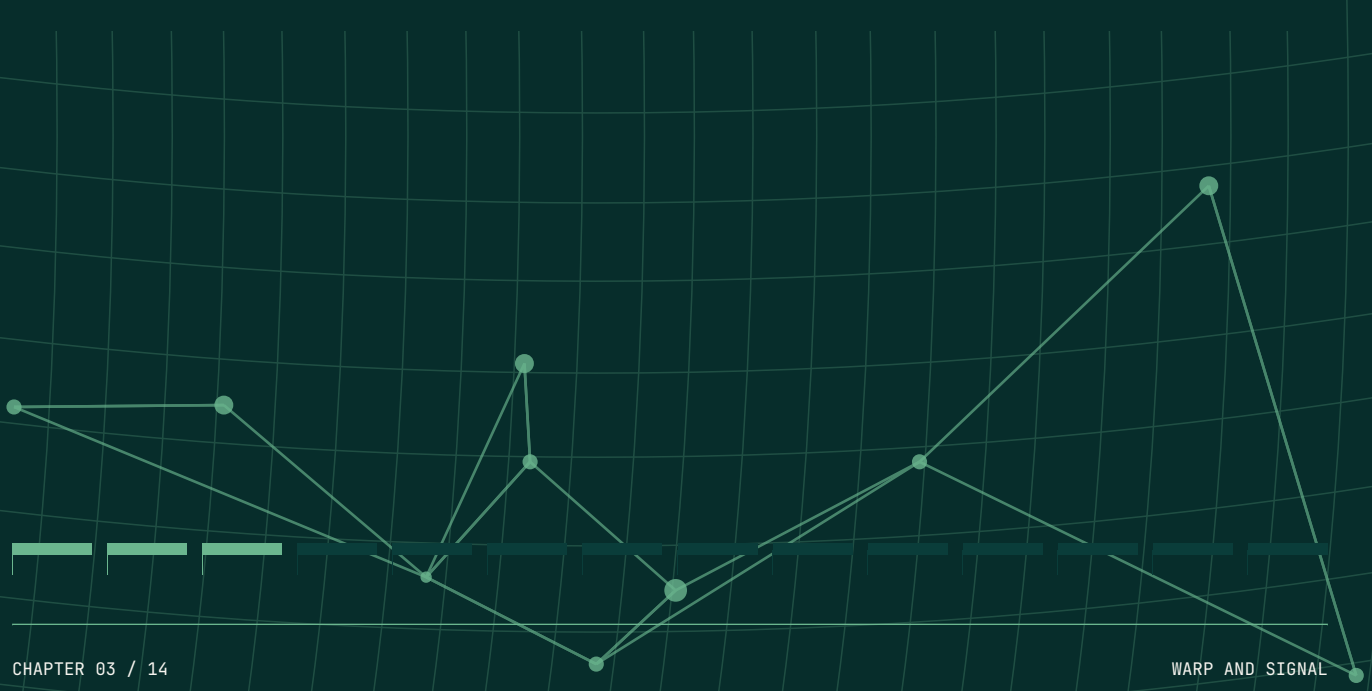
S08 Aid by Trade Foundation / Cotton made in Africa. 2026-10-30.

03

PART I: CLAIMS MUST MATCH THE CHAIN / PRODUCER TO BALE

Provenance begins with an identifiable supply unit

An origin claim needs a defined producer boundary and a documented link from receipts to ginned fibre.



CHAPTER 03
DECISION TEST

An origin claim needs a defined producer boundary and a documented link from receipts to ginned fibre.

A cotton provenance claim is defensible only if the supply chain defines the upstream unit of origin before harvest delivery and preserves a documented link from each seed-cotton receipt to the lint bales exiting the ginnery. [S01] [S06] When a garment brand or textile mill asserts that fibre was grown in a specific country, administrative region, producer group or individual farm, that assertion rests on the first physical handover where harvested seed cotton enters industrial custody. [S02] If the receiving weighbridge records a delivery without a verified supplier boundary, or if the ginnery pools deliveries across multiple collection zones without binding the resulting bale identifiers to a declared input campaign, no downstream database, transaction certificate or digital product passport can reconstruct the lost geographic specificity. [S03] [S10] Green Future Tech Limited (GFT), Hong Kong SAR, therefore treats the producer-to-bale boundary as the foundational control gate of its traceability architecture, extending the data-first operating discipline established in GFT's three-part Cameroon textile programme (feasibility study, performance-management system design and digital strategy, prepared 31 January 2024 with source-refresh notes retained in 2026).

In smallholder cotton economies, designing this upstream boundary requires balancing evidential precision against operational feasibility and personal-data protection. [S06] [S19] An engineering specification that demands individual farm polygon coordinates and segregated single-farmer ginning runs where cotton is grown on small rain-fed plots and pooled at village collection points will either exclude smallholders from the eligible supply base or invite fabricated paperwork at the ginnery gate. [S02] [S17] Conversely, an intake procedure that accepts unverified trader declarations without weighing controls, moisture records or campaign cut-offs cannot prevent unrecorded cross-border or uncertified material from entering an origin-labelled lot. [S03] [S06] The practical engineering answer is to match the declared claim unit to the actual aggregation grain of primary collection, assign pseudonymous identifiers that protect farmer privacy on public interfaces, and enforce strict transformation records from seed-cotton intake to baled lint dispatch. [S10] [S19] [S28]

3.1

Producer identity needs a justified level of detail

An upstream traceability system must first define what entity constitutes the identifiable supply unit, because the precision of any downstream provenance statement is bounded by the coarsest aggregation step prior to ginning. [S01] [S02] In international cotton standards and tracking workflows, four distinct upstream roles govern primary production and initial aggregation: the individual farmer who cultivates the crop, the producer group or village association that organises local collection, the managing entity that coordinates agricultural extension, input credit and scheme compliance across an outgrower area, and the ginnery that receives seed cotton and separates lint from seed. [S06] [S09] Confusing these four roles leads to overstated claims, such as presenting a ginnery's corporate registration address as proof of farm-level provenance, or treating a managing entity's regional scope as proof that every bale came from a single village cooperative. [S02] [S06]

3.2 UPSTREAM ROLES DETERMINE THE FINEST SUPPORTABLE GEOGRAPHIC BOUNDARY

Under the Aid by Trade Foundation's June 2025 Transparency Standard (Version 1.0) and the accompanying Sustainable Cotton Tracker (SCOT) operational framework, upstream registration and verification operate through defined supply-chain roles rather than ad hoc commercial invoices. [S06] [S09] A managing entity organises smallholder producers within a defined geographic catchment and oversees delivery to verified ginneries, while SCOT distinguishes upstream cotton producers and traders from downstream spinning mills and fabric producers. [S06] [S09] In Cameroon, the inherited programme evidence register records that SODECOTON supports more than 220,000 cotton producers in northern Cameroon and operates nine ginning plants and two oil mills. [R03] That inherited figure is graded C (verified: source-text, original publication date unrecorded in the GFT data annex prepared 31 January 2024) and describes SODECOTON as an upstream sector institution rather than a GFT partner or client. [R03] Crucially, an aggregate producer headcount and a count of ginning plants provide macro-level industrial context, which companion paper wp19 uses for cross-country structural comparisons, but they do not constitute a live farmer-level registry or a verified shipment-specific origin dataset. [R03] [S01]

When GFT designs an upstream provenance specification for a proposed African textile value chain, the first design decision is to select the supply-unit granularity that primary collection can actually observe and maintain. [S01] [S02] If individual smallholder harvests are weighed and bagged per farmer at a village market but immediately tipped into a shared truck or storage bay assigned to a registered producer group, the finest physical unit that survives transport to the ginnery is the producer-group collection lot, not the individual farmer's sack. [S02] [S10] If several producer groups from the same administrative subdivision deliver into a single ginnery storage pad before a ginning campaign begins, the surviving physical boundary widens further to the ginnery catchment or campaign pool. [S02] [S07] Attaching a single farmer's name to a finished garment spun from that pooled lint is an evidential falsehood, whereas stating that the fibre originated from registered producer groups within the documented ginnery catchment is an accurate, bounded proposition. [S01] [S02]

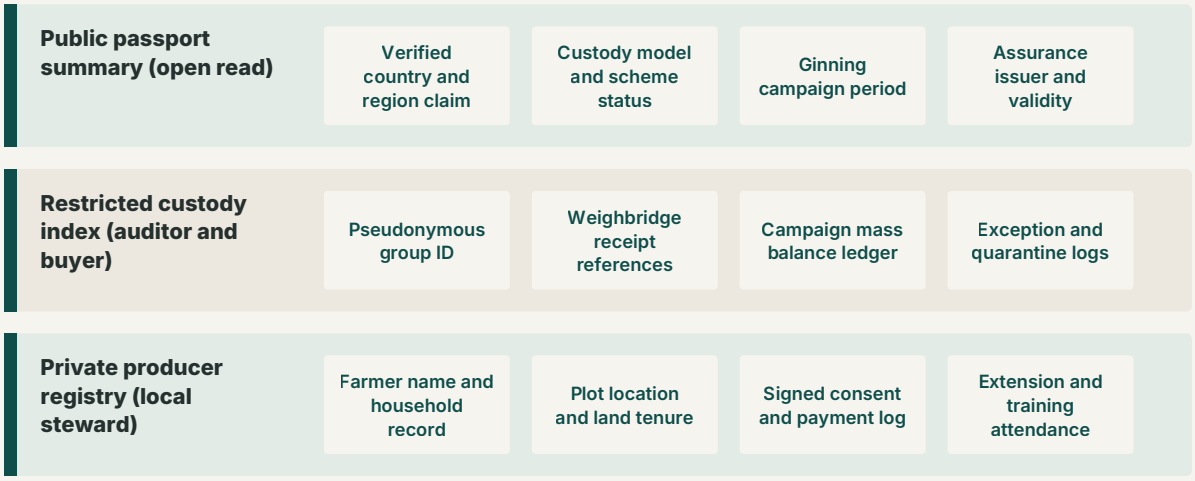
3.3 PSEUDONYMOUS IDENTIFIERS PROTECT SMALLHOLDERS WHILE PRESERVING AUDITABILITY

Defining an identifiable supply unit does not require exposing the personal identities, household finances or exact home plots of smallholder farmers to downstream commercial buyers or public consumers. [S19] [S28] As guidance from the European Data Protection Board states, "Your organisation can only process personal data that is necessary and proportionate in light of the purpose envisaged." [S19] In a smallholder agricultural setting, a farm plot coordinate frequently coincides with a family residence, and a delivery receipt records household income. [S19] Publishing such personal data on a consumer-facing web page or passing unredacted farmer rosters across commercial tiers violates data-minimisation principles and exposes rural households to commercial profiling without improving custody integrity. [S19] [S28] While the territorial scope of European Union data-protection law depends on controller establishment and market targeting, and Cameroonian privacy regulations require separate legal review before deployment, GFT applies data minimisation as an engineering baseline across all proposed designs. [S19]

To reconcile auditability with privacy, GFT specifies a three-tier information architecture illustrated in **Exhibit 12**, p. 46. At the base tier, the managing entity or primary cooperative maintains a private producer registry under restricted local access, linking each registered grower's legal identity, consent record, village affiliation and extension log to a stable pseudonymous code such as illustrative identifier PRG-GAR-014-F089. [S19] At the middle tier, the custody and assurance index records only the pseudonymous producer-group code (PRG-GAR-014), the verified administrative district, the crop season, the receipt references and the conformity assessment status, allowing accredited auditors and authorised supply-chain stewards to verify volume reconciliation without handling personal names. [S03] [S19] [S28] At the top tier, the public digital product passport summary exposes only the substantiated geographic boundary, the applicable custody model and the verification status, following the pre-production pilot design principles of the UN Transparency Protocol (UNTP). [S19] [S28]

EXHIBIT 12 / ACCESS TIER

Private producer data need not appear on a public label



ILLUSTRATIVE [S19] [S28] Illustrative GFT three-tier privacy and disclosure design grounded in EDPB data-minimisation principles (S19) and UNTP pre-production passport architecture (S28). Not an implemented deployment.

The layered separation shown in **Exhibit 12**, p. 46 demonstrates how a supply chain can preserve a verifiable audit trail back to primary collection while restricting personal data to the local boundary where farmer payment and agronomic support occur. [S19] [S28] What **Exhibit 12**, p. 46 cannot establish on its own is whether the local steward actually verified field deliveries before entering them into the private registry, or whether access controls have been tested in production; those operational and cybersecurity controls require explicit receiving procedures and independent pilot verification. [S03] [S19]

GFT NOTE

Never use a public digital product passport as a repository for smallholder personal names, national identity numbers or household GPS coordinates. [S19] [S28] GFT recommends assigning a structured pseudonymous identifier at the producer-group and collection-centre level for all inter-company custody records, while retaining farmer-level identity linkages inside a locally governed register accessible only to the managing entity and accredited auditors under explicit confidentiality controls. [S06] [S19]

3.4

Delivery evidence must identify what was actually received

A producer registry defines who is eligible to supply cotton, but provenance for a specific shipment begins only when a physical quantity of seed cotton is observed, weighed and documented at an intake boundary. [S03] [S06] Under both the Textile Exchange Content Claim Standard (CCS) and the Aid by Trade Foundation Transparency Standard, tracking certified or origin-attributed material requires documented receiving controls that verify the source, status and quantity of incoming inputs before processing. [S03] [S06] If a ginnery or collection centre records only an aggregate daily cash payout without capturing structured delivery attributes, the evidential link between the agricultural boundary and the industrial ledger is severed before ginning starts. [S01] [S03]

3.5 STRUCTURED RECEIPT FIELDS ANCHOR THE PHYSICAL OBSERVATION

To support downstream volume reconciliation and origin verification, GFT specifies an eight-field intake record for every primary seed-cotton delivery or consolidated village-group receipt. [S03] [S06] As set out in the illustrative template in **Exhibit 13**, p. 48, each receipt must capture: (1) a unique receipt identifier and event timestamp; (2) the pseudonymous supplier or producer-group identifier linked to the approved register; (3) the physical receiving site and scale identifier; (4) the harvest crop period and declared geographic origin boundary; (5) the gross mass, packaging tare mass and calculated net mass in kilograms; (6) the measured or declared moisture basis and foreign-matter status; (7) the eligibility or custody class assigned at intake; and (8) the accountable receiving officer's signature or credential together with references to physical waybills or collection tallies. [S03] [S06] [S10] [S19]

EXHIBIT 13 / ILLUSTRATIVE INTAKE RECORD FIELDS

A receipt links an observation to a bounded origin claim

Receipt ID	Group ID	Origin boundary	Net mass (kg)	Moisture (%)	Custody status
REC-2026-0301	PRG-GAR-014	Benoue North Group A	18,400	8.2	Accepted: Segregated Group
REC-2026-0302	PRG-GAR-019	Benoue North Group B	16,200	8.5	Accepted: Segregated Group
REC-2026-0303	PRG-MAY-007	Mayo-Louti East Pool	14,600	11.4	Hold: Moisture re-check
REC-2026-0304	UNVERIFIED-TRD	Unconfirmed trader lot	9,500	9.1	Quarantined: Conventional only

ILLUSTRATIVE [S03] [S06] [S19] Illustrative receiving register entries designed by GFT using CCS volume-tracking principles (S03), AbTF receiving requirements (S06) and EDPB pseudonymisation rules (S19). All identifiers and quantities are fictional teaching values.

The four illustrative records in **Exhibit 13**, p. 48 show how a receiving ledger distinguishes admissible provenance inputs from conditional or ineligible deliveries at arrival. [S03] [S06] Deliveries REC-2026-0301 and REC-2026-0302 carry verified pseudonymous producer-group identifiers (PRG-GAR-014 and PRG-GAR-019), net seed-cotton masses of 18,400 kg and 16,200 kg, and illustrative moisture readings of 8.2 percent and 8.5 percent, allowing immediate release into a segregated northern Cameroon ginning campaign. [S06] [S19] Delivery REC-2026-0303 (14,600 kg illustrative net mass at 11.4 percent moisture) is placed on conditioning hold before its dry-equivalent mass is finalised, while delivery REC-2026-0304 (9,500 kg illustrative net mass arriving via an unconfirmed trader without producer-group tallies) is quarantined and downgraded to conventional stock. [S03] [S06] What **Exhibit 13**, p. 48 cannot prove is that the weighbridge was calibrated or that bags inside REC-2026-0301 were not substituted during transit; those physical risks require seal checks, calibration logs and counterparty dispatch matching covered in Chapter 4. [S03] [S10]

3.6 MISSING OR ILLEGIBLE INTAKE DOCUMENTS REQUIRE QUARANTINE RATHER THAN RETROSPECTIVE INVENTION

In field operations across rural collection centres, paper tally sheets are frequently stained, torn or partially completed, and lorries occasionally arrive at a ginnery weighbridge before the village collection clerk's summary sheet arrives. [S06] [S10] A common failure mode in poorly governed traceability programmes is retrospective data fabrication: a receiving clerk, faced with a mandatory software field for a producer-group code, selects a default cooperative from a drop-down menu so that the truck can be unloaded. [S01] [S10] Once a default identifier is written into the database, the fabricated origin becomes indistinguishable from a genuine observation, corrupting every downstream custody record and passport derived from that lot. [S01] [S02]

GFT's control design prohibits mandatory-field workarounds by making UNKNOWN and PENDING_EVIDENCE explicit, valid system states at receiving. [S10] [S11] When a delivery arrives with missing, illegible or contradictory origin documentation, the receiving

officer records the physical weight observation, assigns a temporary quarantine lot identifier, stores the seed cotton in a segregated holding bay, and opens a timestamped exception ticket. [S03] [S06] [S11] The lot may be elevated to an origin-eligible status only if the original primary collection records and counterparty confirmations are produced, checked against the village group's seasonal harvest capacity, and approved by a custody supervisor within a defined review window. [S03] [S06] If the documentary gap cannot be closed from primary records, the cotton remains permanently in the conventional pool, and no origin or certified-content claim may be released against its volume. [S02] [S06]

3.7 MATERIAL FORM AND MOISTURE BASIS GOVERN WEIGHT INTERPRETATION FROM THE START

Recording mass at the ginnery gate also requires strict discipline regarding material form and measurement basis. [S03] [S0302] As USDA Agricultural Research Service ginning literature states, "Cotton enters the gin as seed cotton but exits the gin as packaged bales of cotton lint." [S0302] In Cameroon's national statistics, the inherited evidence register reports seed-cotton production of 330,000 tonnes in 2022, 314,455 tonnes in 2023 and about 340,000 tonnes in 2024 (R01), with a 2025 seed-cotton projection above 350,000 tonnes (R02), whereas the approximate 95 percent raw-export versus 5 percent local-processing split (R06) and the 50 percent local-processing target by 2030 (R07) refer to ginned cotton fibre (lint). [R01] [R02] [R06] [R07] All four inherited entries are graded C (`verified: source-text` from the 31 January 2024 programme annex with 2026 refresh flags on R02). [R01] [R02] [R06] [R07] Treating seed-cotton intake mass as equivalent to lint mass, or applying an unverified rule-of-thumb ginning ratio as if it were an observed physical measurement, creates immediate volume reconciliation errors. [S03] [S0302]

METHOD

System boundary and calculation check for primary seed-cotton intake

1. **Physical boundary:** Primary weighbridge or calibrated platform scale at the ginnery or authorised collection depot, prior to module building or ginning pad storage. [S06] [S0302]
2. **Net seed-cotton mass calculation:** For each delivery `i`, subtract verified vehicle and packaging tare mass (`M_tare`) from measured gross mass (`M_gross`) in kilograms: `M_sc_wet = M_gross - M_tare`. [S03]
3. **Dry-basis normalisation:** When comparing intake mass against post-drying ginning outputs, record the measured moisture mass fraction `w` (for example `0.085` for an illustrative 8.5 percent moisture reading) and compute dry-equivalent mass `M_sc_dry = M_sc_wet * (1 - w)`, or normalise to a declared reference moisture fraction `w_ref` using `M_sc_std = M_sc_wet * (1 - w) / (1 - w_ref)`. [S03]
4. **Sanity and eligibility checks:** Quarantine any receipt where `M_tare ⩽ 0`, where moisture is unmeasured on a lot exceeding the pilot threshold, or where cumulative seasonal deliveries from a producer group exceed its registered planted area multiplied by the upper regional yield bound without an independent field inspection. [S03] [S06]

3.8

Ginning creates products that need explicit input links

Once seed cotton passes intake inspection, it enters the ginnery, which is the decisive transformation point in the upstream cotton chain. [S06] [S0302] Mechanical ginning does not merely repackage an existing object; it irreversibly consumes raw seed cotton and generates multiple distinct physical outputs: baled cotton lint, whole cottonseed (directed to planting seed or oil-mill crushing), recoverable fibrous residues (such as gin motes and linters) and unrecovered cleaning trash (leaves, stems, soil and moisture loss). [S10] [S0302] If a traceability database models a ginnery using simple shipping and receiving notices without an explicit transformation event, the genealogy graph breaks between the kilogrammes of seed cotton bought from producer groups and the numbered bales of lint sold to spinning mills. [S10] [S30]

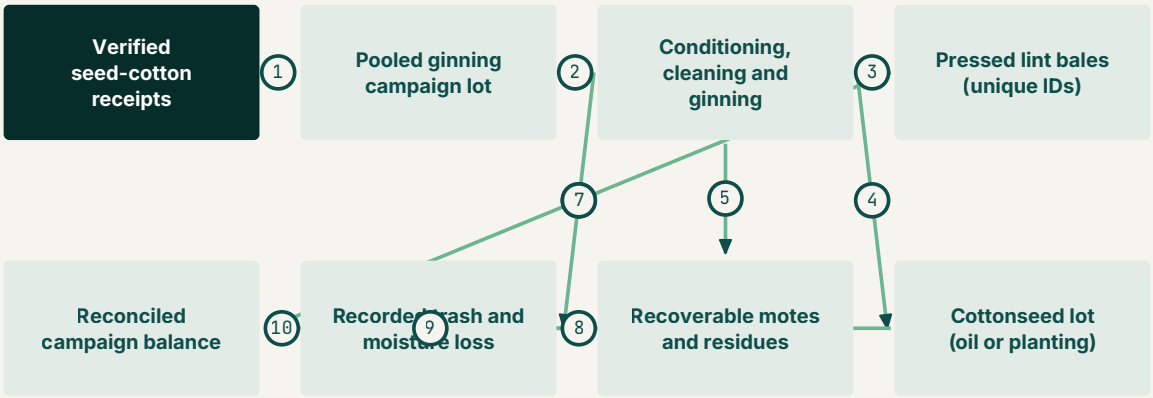
3.9 EPCIS transformation semantics link consumed seed cotton to produced lint bales

To represent ginning accurately, GFT applies the event semantics of the GS1 Electronic Product Code Information Services (EPCIS) standard (`Release 2.0`, ratified June 2022) alongside the pre-production Digital Traceability Event (DTE) vocabulary of the UN Transparency Protocol. [S10] [S30] In EPCIS 2.0, a `TransformationEvent` captures the relationship between one or more input objects or class-level quantities consumed in a process and one or more output objects or quantities created by that process, without requiring radio-frequency identification (RFID) tags. [S10] Simultaneously, the Core Business Vocabulary (CBV `Release 2.0`) supplies standardised business steps (`commissioning`, `transforming`, `packing`) and dispositions (`active`, `in_progress`, `non_conformant`) so trading partners interpret the event record identically. [S11]

As shown in **Exhibit 14**, p. 51, a compliant ginning record connects the eligible seed-cotton intake pool through conditioning and gin-stand separation to every resulting output stream. [S10] [S0302] Each lint bale compressed at the bale press receives a unique bale identifier commissioned at pressing and linked directly to the `TransformationEvent` identifier of the ginning campaign, while co-produced cottonseed and recoverable mote lots receive batch identifiers tied to the same transformation record. [S10] [S0302]

EXHIBIT 14 / PROCESS AND EVENT SEQUENCE

Ginning changes material identity and creates multiple outputs



1. Assign to campaign
2. Consume input mass
3. Commission bale IDs
4. Record co-product
5. Record by-product
6. Log mass difference
7. Verify lint total
8. Verify seed total
9. Verify residue total
10. Close campaign balance

ILLUSTRATIVE [S10] [S30] [S0302] Illustrative process and EPCIS 2.0 TransformationEvent graph designed by GFT using GS1 EPCIS 2.0 (S10), UNTP DTE concepts (S30) and USDA ARS ginning sequence descriptions (S0302). No empirical ginning yield percentage is asserted.

The transformation structure in **Exhibit 14**, p. 51 enforces mass conservation and prevents a ginnery from commissioning more origin-eligible lint bales than the physical ginning of its verified seed-cotton inputs produced. [S03] [S10] It also shows why cottonseed and recoverable gin motes must be recorded in the same mass balance even when the textile programme only tracks lint downstream: without accounting for co-products and cleaning losses, an auditor cannot verify whether an apparent jump in lint output reflects higher fibre turnout or the covert addition of uncertified seed cotton into the gin stand. [S03] [S06] However, **Exhibit 14**, p. 51 is a logical process topology rather than an empirical yield benchmark; it cannot establish the actual lint turnout percentage of any Cameroonian ginnery, which varies with cotton variety, harvesting cleanliness, moisture content and equipment condition and must be measured during operations. [S03] [S0302]

3.10 POOLED GINNING CAMPAIGNS MUST BE DISTINGUISHED FROM SINGLE-DELIVERY PRESERVATION

In commercial ginning across Sub-Saharan Africa, where thousands of smallholders deliver small lots of hand-picked seed cotton, ginneries rarely stop and clean out the entire drying, cleaning and gin-stand line after each individual farmer's bags. [S06]

[S07] Instead, deliveries sharing the same eligibility class and regional boundary are stacked into storage modules or ginning pads and processed in continuous campaigns lasting a shift, a day or a multi-day block. [S06] [S07] The Aid by Trade Foundation's traceability documentation notes that it updated its physical separation terminology from "Hard Identity Preserved (HIP)" in the June 2025 standard to "Segregation" on its current traceability page, stating: "This change serves solely to harmonise terminology; the underlying requirements regarding traceability and material separation remain unchanged." [S06] [S07] Under those segregation rules, eligible cotton must be kept physically separate from conventional cotton and processed in dedicated, cleaned campaigns, while deliveries from multiple verified producers within the eligible scope may be pooled inside that campaign. [S06] [S07]

GFT's data model reflects this operational reality by distinguishing two upstream transformation modes:

- **Individually preserved delivery run (Identity Preservation):** A single producer group's delivery is fed into a cleaned ginning line with an explicit start-of-run and end-of-run purge, so the resulting lint bales link exclusively to that single receipt. [S01] [S02]
- **Segregated campaign pool (Segregation / Controlled Campaign):** Multiple verified receipts sharing a declared origin and scheme status are consolidated into an identified campaign lot (such as illustrative campaign `CMP-GAR-2026-W04`), processed after a documented line clean-down, and linked collectively to the sequence of lint bales pressed during that campaign. [S02] [S06] [S07]

Where inputs are pooled into a campaign, the transformation record must bind every output bale to the complete set of input receipts consumed in that campaign rather than arbitrarily assigning Bale 1 to Receipt 1 and Bale 2 to Receipt 2. [S01] [S10] Sequential bale-to-receipt assignment inside a mixed pad creates false precision; if a contamination or documentation failure is later discovered in one pooled receipt, the entire campaign's bale range must be identifiable so all affected bales can be quarantined or downgraded together. [S06] [S10]

WORKED EXAMPLE

Illustrative ginning campaign link and mass reconciliation

Consider a hypothetical segregated ginning campaign `CMP-GAR-2026-W04` at a northern Cameroon ginnery, constructed solely to demonstrate GFT's transformation and mass-balance method (all figures are illustrative teaching assumptions, not observed GFT or SODECOTON operating results). [S03] [S10]

1. **Pooled eligible inputs:** The campaign consumes three verified northern Cameroon producer-group deliveries from **Exhibit 13**, p. 48 after conditioning release:
2. `REC-2026-0301` (`PRG-GAR-014`): gross mass 18,680 kg, bag and vehicle tare 280 kg, net seed-cotton mass `18,680 - 280 = 18,400 kg` (illustrative).
3. `REC-2026-0302` (`PRG-GAR-019`): gross mass 16,450 kg, tare 250 kg, net seed-cotton mass `16,450 - 250 = 16,200 kg` (illustrative).
4. `REC-2026-0303` (`PRG-MAY-007`, released after aeration and moisture re-check): gross mass 14,870 kg, tare 270 kg, net seed-cotton mass `14,870 - 270 = 14,600 kg` (illustrative).
5. Quarantined trader lot `REC-2026-0304` (9,500 kg illustrative net mass) is excluded and held in a conventional bay. [S06]
6. Total consumed eligible seed cotton: `M_in = 18,400 + 16,200 + 14,600 = 49,200 kg` (illustrative).

1. **Measured campaign outputs:** After line clean-down and a 12-hour illustrative shift, the ginnery weighs and records four output streams:
2. **Packaged lint bales:** 90 bales pressed in sequence `BAL-GAR-2026-00401` to `BAL-GAR-2026-00490`, with total net lint mass (excluding bagging and ties) `M_lint = 19,680 kg`, giving an illustrative mean net bale mass of `19,680 / 90 = 218.67 kg` per bale and an illustrative campaign lint turnout of `19,680 / 49,200 = 40.0 percent`. [S03] [S0302]
3. **Cottonseed co-product:** `M_seed = 26,568 kg` routed to oil-mill storage lot `CSD-GAR-2026-04` (an illustrative 54.0 percent of input mass). [R03] [S10]
4. **Recoverable gin motes and fibrous residue:** `M_motes = 1,968 kg` baled as secondary residue lot `MOT-GAR-2026-04` (an illustrative 4.0 percent of input mass). [S10]
5. **Measured cleaning trash and dryer moisture loss:** Collected foreign matter weighs 640 kg and calculated dryer moisture evaporation accounts for 344 kg, giving total documented loss `M_loss = 640 + 344 = 984 kg` (an illustrative 2.0 percent of input mass). [S03] [S0302]

1. **Campaign reconciliation check:** Total accounted output `M_out = 19,680 + 26,568 + 1,968 + 984 = 49,200 kg`, yielding an illustrative campaign residual `R_cmp = 49,200 - 49,200 = 0 kg` (in a live pilot, small non-zero residuals arise from scale tolerances and uncaptured dust and are checked against a pilot-calibrated uncertainty band as specified in Chapter 6). [S03]

1. **Admissible provenance statement for the 90 bales:** Every bale from `BAL-GAR-2026-00401` to `BAL-GAR-2026-00490` carries a verified transformation link to input set {`PRG-GAR-014, PRG-GAR-019, PRG-MAY-007`} in northern Cameroon, with

> an eligible lint mass ceiling of 19,680 kg (illustrative). [S02] [S10] None of the 90 bales can claim single-group origin (PRG-GAR-014 alone), because the three groups were pooled prior to ginning. [S01] [S02]

3.11

Bale identification must survive storage and sale

Commissioning a unique identifier at the bale press is useful only if that identifier remains physically attached to the lint bale and matches every warehouse receipt, sales invoice, bill of lading and spinning-mill intake log until the bale is opened for spinning. [S06] [S0302] As USDA Agricultural Research Service packaging researchers emphasise, bale packaging is the final ginning step and "is critical to protecting and preserving the quality of the ginned lint during shipping and storage before consumption at the textile mill", with the Permanent Bale Identification (PBI) tag, bale covering and strapping forming an integrated physical unit. [S0302] Similarly, the Aid by Trade Foundation's June 2025 Transparency Standard requires that sales and transport documents accompanying segregated cotton clearly identify the relevant bales or lots so physical material and documentary records stay aligned at every transfer. [S06]

3.12 RECEIVING CHECKLISTS MUST BIND PHYSICAL BALE TAGS TO TRANSPORT DOCUMENTS

When ginned bales move from the press to a gin yard, regional warehouse, export port or domestic spinning mill, custody breaks typically occur through documentary omission: a commercial invoice lists "90 bales of northern Cameroon lint, 19,680 kg net" as an illustrative single line item without attaching the individual bale numbers or campaign lot code. [S06] [S10] If the warehouse stores both segregated eligible bales and conventional bales in adjacent stacks, an unitemised delivery note allows warehouse staff to ship any 90 bales of similar grade against the order, substituting unverified cotton while keeping the total bale count unchanged. [S03] [S06]

To prevent silent bale substitution, GFT translates the documentary requirements of S06 and S03 into a mandatory five-point bale-receiving checklist for every post-ginning handover: [S03] [S06] 1. **Packing-list completeness:** The seller's dispatch advice and transport waybill must annex a machine-readable and human-readable bale list enumerating every individual bale identifier, its ginning campaign reference, its net and gross mass at pressing, and its declared custody class. [S06] [S10] 2. **Physical tag inspection at unloading:** Receiving operators must scan or visually read the physical tag on each unloaded bale, confirming that the plant code and sequential bale number match the packing list and show no signs of removal or re-gluing. [S06] [S0302] 3. **Packaging integrity and tare check:** The receiver must verify that bale bagging and strapping are intact and weigh a defined sample (or 100 percent of bales where a bale scale is installed, as an illustrative receiving rule) to confirm that observed gross mass aligns with the gin's recorded mass within the declared moisture and scale band. [S03] [S0302] 4. **Segregated bay assignment:** Confirmed bales must be placed immediately into a physically demarcated warehouse bay reserved for their custody model and origin boundary, logging the bay location against the bale identifiers. [S06] [S10] 5. **Counterparty confirmation or exception lock:** Only when all bale

identifiers and weights reconcile does the receiver issue a positive receipt confirmation (matching the counterparty confirmation principle exemplified by SCOT in S09); any unmatched bale triggers an immediate quarantine lock. [S09] [S10]

3.13 DUPLICATE, DAMAGED AND REPLACED BALE LABELS REQUIRE LINKED EXCEPTION RECORDS

Harsh handling by bale clamps, fork-lifts, tropical rain and lorry transport frequently damages or tears exterior bale tags between the ginnery and the spinning mill. [S0302] In addition, manual numbering errors at a gin press occasionally produce duplicate bale numbers within the same crop year if sequential counters are reset improperly. [S10] [S0301] If a warehouse worker prints a fresh label with a new number when a tag is torn off, the link to the ginning campaign is broken; conversely, if a ginnery reprints an existing bale number without voiding the damaged tag, two physical bales can circulate under the same identifier, creating a double-claiming vector. [S06] [S10]

GFT's exception protocol applies EPCIS 2.0 error-declaration and association rules (S10) to three specific label anomalies: [S10] [S11]

- **Damaged but legible tag (in-place replacement):** When a physical tag is torn or faded but the full identifier (`BAL-GAR-2026-00412` in our illustrative sequence) remains readable and corroborated by stencilled lot markings and bale weight, the custodian prints a replacement tag bearing the exact original identifier plus a replacement flag, photographs the destroyed original tag alongside the new tag, and logs a signed maintenance event. [S06] [S10]
- **Detached or illegible tag (unidentified bale):** If a tag is missing or unreadable and the bale's identity cannot be uniquely deduced from a sealed, fully enumerated container where all other bales are accounted for, the custodian must never guess which missing packing-list number belongs to the bale. [S01] [S10] The bale is assigned a new quarantine identifier, downgraded out of the origin-verified pool, and recorded as an unexplained loss against the campaign balance. [S06] [S10]
- **Duplicate bale identifier collision:** If an intake scan flags that illustrative bale identifier `BAL-GAR-2026-00412` is already active in inventory or was previously consumed, the system blocks both bales (`disposition: non_conformant` under CBV S11) until the ginnery produces press logs and weight tickets proving which physical bale is legitimate and issues a corrective declaration voiding the erroneous record. [S10] [S11]

3.14 FIBRE CLASSING AND QUALITY GRADES DO NOT ESTABLISH GEOGRAPHIC PROVENANCE

A widespread misconception in textile procurement is that a cotton classing certificate or High Volume Instrument (HVI) laboratory printout serves as proof of geographic origin. [S01] [S0301] As USDA Agricultural Research Service researchers explain, "Cotton classification is the process of using official standards and standardized procedures to measure the physical attributes of raw cotton", assessing fibre length, strength, colour, micronaire, uniformity and non-lint content, while a human classer checks for extraneous matter. [S0301] In the United States system, each bale's classing sample is matched to a unique Permanent Bale Identification (PBI) number so physical quality measurements follow the bale from the gin to the textile mill floor. [S0301]

While linking quality metrics to a unique bale number is an essential engineering practice that GFT adopts in its factory data architecture, a fibre quality measurement answers what the cotton is like physically, not where it was grown. [S01] [S0301] Two bales grown in different countries or under different sustainability regimes can exhibit identical staple length, strength and micronaire values, while weather variations within a single Cameroonian harvest season can cause grade differences between neighbouring villages. [S0301] [S33] Consequently, GFT keeps quality classification records and provenance custody records in separate logical fields linked by the bale identifier: a spinning mill uses classing parameters to optimise bale laydown and yarn strength (connected to `wp02`'s performance metrics), whereas the claim-release reviewer inspects the custody and transformation chain (`S01`, `S06`, `S10`) to determine whether an origin claim is admissible. [S01] [S06] [S10] [S0301]

3.15

Producer inclusion depends on workable evidence capture

Designing a rigorous receipt, campaign and bale-tagging architecture on paper fails in practice if the capture workflow assumes that rural smallholders or village collection clerks possess continuous internet connectivity, smartphones, fluency in European administrative languages or unpaid spare time to complete complex digital forms. [S17] [S19] In Cameroon and across West and Central Africa, cotton cultivation is predominantly a rain-fed smallholder activity, and the inherited evidence register notes that across the wider Cameroonian economy the informal share of employment is about 90 percent (`R16`, graded C, `verified: source-text`). [R16] If a traceability system imposes high digital or administrative barriers at the first handover without accessible capture tools and fair compensation, either smallholders are excluded in favour of large estates or local intermediaries fabricate clean digital records in town offices disconnected from field deliveries. [S06] [S17]

3.16 ASSISTED CAPTURE AND OFFLINE-FIRST PAPER-TO-DIGITAL WORKFLOWS PREVENT EXCLUSION

GFT's upstream capture design never assumes direct smartphone or web-portal entry by individual farmers, nor does it assume any benchmark local digital adoption rate. [S10] [S17] Instead, GFT proposes a hybrid, assisted-capture workflow engineered around existing primary collection cadences:

- **Pre-printed carbon tally books with barcode or QR stickers:** Before harvest, the managing entity issues each registered producer group a bound receipt book pre-printed with the group's pseudonymous identifier, local-language visual icons and plain-language field labels, alongside sheets of pre-printed peel-off lot stickers. [S06] [S10]
- **Assisted entry at the village weighbridge:** During primary market days, a trained collection clerk or cooperative secretary weighs the seed cotton alongside the farmer's representative, writes the gross weight, tare weight and bag count onto the two-part paper receipt, attaches matching barcode stickers to the farmer's copy and the group ledger sheet, and signs the observation. [S03] [S06]

- **Controlled batch synchronisation at the ginnery or district hub:** When the consolidated truck arrives at the ginnery (or when the extension agent reaches a connected district office), the paper tally sheet is scanned and keyed into the local custody queue, preserving both the original `eventTime` of the village weighing and the later `recordTime` of digital ingestion as distinct EPCIS 2.0 timestamps. [S10]

Separating `eventTime` (when physical weighing occurred in the village) from `recordTime` (when the record reached the database) is critical for audit integrity. [S10] In a poorly designed system that records only the upload timestamp, an illustrative three-day rural connectivity delay makes it appear that seed cotton was weighed at the village market after the truck had already arrived at the factory, triggering false sequence errors or encouraging clerks to backdate system clocks. [S10] Companion paper `wp07` specifies the edge-computing, local storage and power resilience engineering required to keep local queues intact during outages; this chapter establishes the custody rule that a delayed upload remains admissible provided the signed paper tally and physical bag tags reconcile at the ginnery gate. [S06] [S10]

3.17 CONSENT, LABOUR DUE DILIGENCE AND ORIGIN TRACKING REQUIRE SEPARATE ASSESSMENTS

As brands face regulatory scrutiny over human rights and environmental conditions in textile supply chains, there is a strong temptation to bolt social-compliance checkboxes or worker identity capture directly onto cotton delivery receipts. [S17] [S20] GFT explicitly rejects conflating material custody tracking with labour due diligence. [S17] [S20] The International Labour Organization (ILO) defines forced labour as encompassing "all types of work occurring in any activity, industry or sector including in the informal economy" where work is exacted involuntarily under the menace of a penalty. [S20] Similarly, the OECD Due Diligence Guidance for Responsible Supply Chains in the Garment and Footwear Sector emphasises a risk-based, collaborative approach to identifying, preventing and mitigating adverse impacts across supply chains. [S17]

A weighbridge ticket or EPCIS transformation event proving that a bale of lint came from producer group `PRG-GAR-014` establishes material location and custody; it cannot prove the absence of coercion, child labour or unfair wage deductions on farms within that group. [S17] [S20] Conversely, forcing smallholders to sign boilerplate legal declarations on a delivery receipt, or collecting sensitive personal data about family members and farm workers without informed consent and independent grievance channels, violates data-protection principles (S19) while generating hollow self-declarations that mask real labour risks. [S17] [S19] [S20] Therefore, GFT's governance architecture keeps three processes strictly distinct: 1. **Informed consent and data-protection notice:** Before any farmer's information enters the local producer registry, the managing entity explains in the relevant local language what data are recorded, why they are needed, who can access them, and how a producer can inspect or correct their record. [S19] 2. **Material custody and volume capture:** Weighbridge receipts and ginning logs capture only the pseudonymous group reference, physical mass, moisture basis and custody class needed to substantiate the material claim. [S03] [S19] 3. **Risk-based labour due diligence and remediation:** Working conditions, freedom of association, occupational safety and child-labour prevention are assessed through dedicated participatory fieldwork, independent community grievance channels and extension programmes following OECD and ILO frameworks (S17, S20), never deduced from a barcode scan. [S17] [S20]

3.18 EXTRA CAPTURE AND CORRECTION WORK MUST BE BUDGETED AND PAID FOR

Capturing structured receipt data, maintaining physical separation between eligible and conventional cotton pads, cleaning down ginning lines between campaigns, and investigating weight or label exceptions require human labour and equipment time. [S03] [S06] In Cameroon, where the inherited evidence register notes that the statutory monthly minimum wage (SMIG) was raised from XAF 41,875 in 2023 to XAF 43,969 from 23 February 2024 (about US$76, a rise of 5 percent, R14, graded C) and the average cross-sector salary is about US$359 a month (R15, graded C), rural producer associations operate on tight cash margins. [R14] [R15] If a buyer demands farm-group traceability and segregated ginning but assumes that farmers and village cooperatives will absorb the cost of paper ledgers, weighing scales, storage tarpaulins and clerk hours without remuneration, the control system will degrade under economic pressure. [S06] [S17]

GFT therefore requires every upstream traceability proposal to include an explicit responsibility and cost-allocation schedule before pilot launch (linking to the commercial cost model in Chapter 12): [S06] [S17]

- **Producer group responsibilities (funded via programme or buyer service fee):** Maintain harvest tallies, supervise village weighing alongside the managing entity clerk, and store bagged seed cotton on clean tarpaulins separated from conventional lots; compensated through a transparent per-campaign handling allowance rather than an unpaid mandate. [S06] [S17]
- **Managing entity and ginnery responsibilities (recovered in ginning and custody service tariff):** Supply calibrated scales, pre-printed receipt books, moisture meters and bale tags; execute line clean-downs; log EPCIS transformation events; and maintain the private producer registry and restricted custody index. [S06] [S10] [S19]
- **Downstream buyer and brand responsibilities:** Fund third-party assurance audits, specify claim boundaries before the harvest season begins, and pay agreed custody-handling differentials independently of whether retail garment prices achieve a market premium. [S02] [S03] [S17]

> **WARNING**
>
> **Uncompensated administrative burdens corrupt upstream data**
>
> When a traceability programme requires village clerks or ginnery operators to complete duplicate forms, re-weigh bags or hold disputed lots without funding the extra staffing time and storage space, staff face an incentive to record estimated weights and copy prior-day identifiers to clear queues. [S03] [S17] This risk is closed only by measuring actual capture minutes during a pilot, paying for the administrative work explicitly in the procurement contract, and removing any penalty on operators who place an undocumented delivery into quarantine. [S06] [S17]

3.19

Origin confidence must be visible at the first handover

When ginned lint bales leave the ginnery yard for a trader's warehouse or a spinning mill, the handover record must communicate not only a geographic name (such as "Cameroon" or "Northern Province") but also the evidential confidence and granularity boundary that the upstream records actually support. [S01] [S02] Treating every bale that leaves a Cameroonian ginnery as carrying identical origin certainty hides critical differences between a segregated producer-group campaign, a multi-depot regional blend and an unverified spot purchase. [S02] [S06]

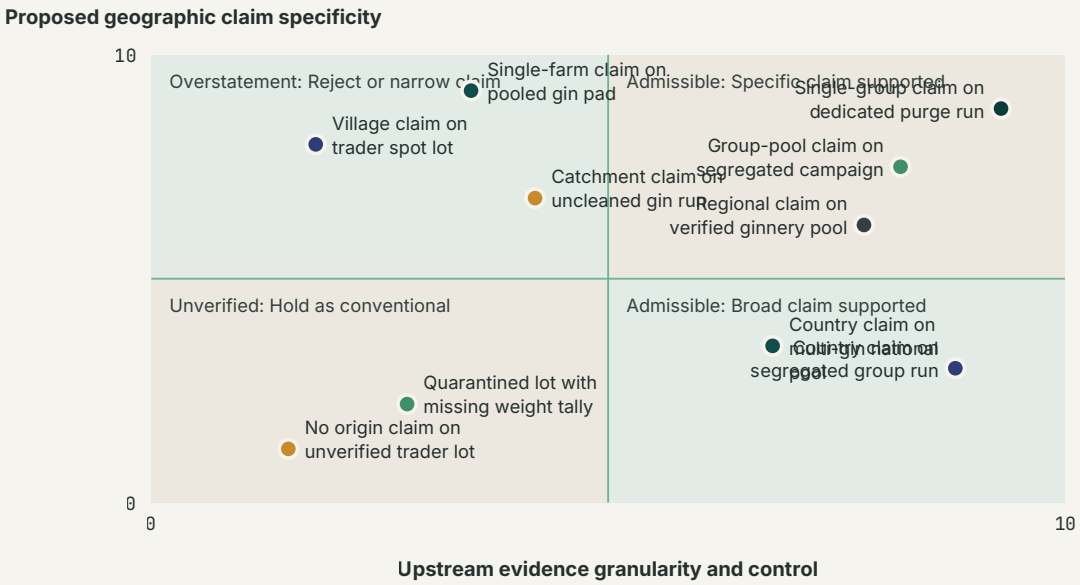
3.20 THREE UPSTREAM ORIGIN STATES PREVENT OVERCLAIMING AT DISPATCH

Grounded in the custody definitions of ISO 22095 (S01) and ISEAL (S02), GFT classifies outgoing ginnery bales into three explicit upstream origin states: [S01] [S02] 1. **Documented segregated origin (**ORIGIN_DOCUMENTED_SEGREGATED**):** Every input receipt feeding the ginning campaign was weighed and verified against registered producer groups within a single declared geographic boundary, stored in a segregated bay, ginned after a documented line clean-down, reconciled within the campaign mass balance, and tagged with unique bale identifiers. [S02] [S06] This state supports claims down to the producer-group pool or ginnery catchment level, as well as regional and national origin claims. [S01] [S02] 2. **Bounded pooled origin (**ORIGIN_BOUNDED_POOLED**):** Input seed cotton came from multiple verified collection zones or ginnery catchments within the same country (or a declared multi-region pool) without group-level separation, or from a controlled blend where all inputs share a verified national boundary (Cameroon) under mass-balance or controlled-blending rules. [S01] [S02] [S07] This state supports a bounded national or multi-region claim (where permitted by the scheme), but prohibits any village, cooperative or single-catchment claim. [S02] 3. **Unverified or conventional origin (**ORIGIN_UNVERIFIED**):** Any delivery or campaign where primary intake receipts are missing, where trader lots lacked verifiable collection tallies, where a duplicate label or mass-balance residual remains unresolved, or where physical segregation broke down. [S01] [S03] [S06] No geographic provenance or certified-content claim may be released for bales in this state. [S02] [S06]

To make the relationship between upstream evidence and permissible geographic claims operational for procurement and assurance teams, **Exhibit 15**, p. 60 maps ten illustrative claim-and-evidence scenarios across two defined dimensions: the granularity of the upstream evidence captured at the ginnery (horizontal axis, from 0 to 10) and the geographic specificity of the proposed provenance claim (vertical axis, from 0 to 10). [S01] [S02]

EXHIBIT 15 / ILLUSTRATIVE INDEX (0 TO 10)

Evidence granularity limits geographic precision



ILLUSTRATIVE [S01] [S02] [S06] Illustrative GFT decision matrix mapping upstream evidence completeness (x-axis) against proposed geographic claim precision (y-axis), grounded in ISO 22095 (S01), ISEAL (S02) and AbTF (S06) custody boundaries. Coordinates are conceptual categories, not empirical scores.

In **Exhibit 15**, p. 60, any point falling into the upper-left quadrant ("Overstatement: Reject or narrow claim") represents a fatal mismatch where the commercial label claims a narrower geography than the ginnery records can prove, such as asserting a single-farm origin on a pooled ginning pad (x: 3.5, y: 9.2 illustrative coordinates) or a village claim on an undocumented trader spot lot (x: 1.8, y: 8.0 illustrative coordinates). [S01] [S02] Points in the upper-right quadrant ("Admissible: Specific claim supported") represent cases where dedicated purge runs or segregated producer-group campaigns (x: 8.2 to 9.3) substantiate group-pool or catchment claims (y: 6.2 to 8.8). [S02] [S06] Points in the lower-right quadrant ("Admissible: Broad claim supported") show that high-granularity or multi-gin national pools (x: 6.8 to 8.8) can safely support a broader country-level origin claim (y: 3.0 to 3.5), because a broader claim lies within the evidence boundary. [S01] [S02] What **Exhibit 15**, p. 60 cannot establish is whether a country-level cotton provenance claim satisfies preferential customs rules of origin for garment exports, which depend on tariff-shift or value-added manufacturing rules under World Trade Organization principles (S18 in Chapter 1) and are analysed in wp08.

3.21 SELF-DECLARATION, THIRD-PARTY ASSURANCE AND ISOTOPE TESTING ANSWER DIFFERENT QUESTIONS

Even when a ginnery records complete intake and campaign data, the downstream buyer must know how those records were verified. [S03] [S29] Following the conformity vocabulary of the UN Transparency Protocol (S29) and the assurance rules of Textile Exchange (S03), GFT requires the bale handover record to separate three distinct modes of origin support: [S03] [S29]

- **First-party self-declaration:** The supplier or managing entity attests to intake receipts and ginning campaign records using its internal quality controls, without independent external verification of that specific lot. [S29]
- **Independent conformity assessment:** An accredited third-party certification or verification body audits the managing entity, ginnery controls and volume reconciliation within a defined standard scope and validity period, issuing a scope or transaction certificate (S03, S06, S29). [S03] [S06] [S29]
- **Laboratory physical corroboration:** Analytical testing of physical fibre samples tests whether the cotton's intrinsic chemical or isotopic profile is consistent with the declared growing region. [S33]

On physical testing, a 2026 peer-reviewed review by Jin, Shi and Wang in the *Journal of Natural Fibers* notes: "Stable isotope analysis provides a powerful means to verify the geographical origin and authenticity of plant and animal fibers through region-specific isotopic signatures." [S33] Stable isotope ratios of elements such as hydrogen, oxygen, carbon and nitrogen in cotton cellulose reflect local precipitation, temperature, altitude and soil characteristics during boll development. [S33] However, as the repository abstract of S33 and GFT's methodological review in Chapter 7 emphasise, isotopic signatures are influenced by seasonal weather variations, agricultural inputs and downstream wet processing, and the opened source establishes no validated classification accuracy, reference database or country-level decision threshold for Cameroonian cotton. [S33] Accordingly, GFT treats stable isotope analysis as a candidate for a future reference-sample qualification study (detailed in Chapter 7), never as an off-the-shelf substitute for weighbridge receipts, segregated ginning campaigns and bale-level custody records. [S01] [S06] [S33]

3.22 THE WRITER DELIVERABLES LOCK THE UPSTREAM BOUNDARY BEFORE HANDOVER

To make this chapter's controls directly usable in GFT's pilot specification (Chapter 13) and the interactive `trace-a-garment` educational tool, the upstream boundary is governed by four operational rules: 1. **Receipt gate:** No seed cotton enters an origin-eligible storage pad without a completed eight-field receipt (**Exhibit 13**, p. 48) linking net mass and moisture basis to an approved pseudonymous producer-group code. [S03] [S06] [S19] 2. **Campaign transformation gate:** Every ginning run that processes eligible cotton logs an explicit EPCIS 2.0 `TransformationEvent` (**Exhibit 14**, p. 51) reconciling lint bales, cottonseed, recoverable motes and cleaning loss against the exact set of consumed receipts. [S10] [S0302] 3. **Bale identity and privacy gate:** Every pressed bale receives a non-repeating identifier linked to its campaign and quality classing record (S0301), while personal farmer data remain inside the local steward's private registry (S19, **Exhibit 12**, p. 46). [S19] [S28] [S0301] 4. **Geographic downgrade gate:** At the first handover from the ginnery, any claim whose geographic specificity

exceeds the granularity of its admissible intake and campaign evidence (**Exhibit 15**, p. 60) is narrowed or downgraded to conventional status before dispatch. [S01] [S02] [S06]

A bale can carry no narrower origin than the boundary at which its seed cotton was last kept apart.

CHAPTER SOURCE NOTES

S01 International Organization for Standardization. 2020.

S06 Aid by Trade Foundation. 2025.

S02 ISEAL Alliance. 2025.

S03 Textile Exchange. 2026-10-30.

S10 GS1. 2022.

S19 European Data Protection Board. 2026-10-30.

S17 OECD. 2018-03-07.

S28 UNECE / UN Transparency Protocol. 2026-10-30.

S09 Cotton made in Africa / Sustainable Cotton Tracker. 2026-10-30.

R03 SODECOTON. Publication date unrecorded; inherited source-text check.

S07 Aid by Trade Foundation / Cotton made in Africa. 2026-10-30.

S11 GS1. 2022.

S0302 USDA Agricultural Research Service. 2024-11-03.

R01 Business in Cameroon. Publication date unrecorded; inherited source-text check.

R02 Fibre2Fashion; Business in Cameroon. Publication date unrecorded; inherited source-text check.

R06 Cameroon Trade Hub. Publication date unrecorded; inherited source-text check.

R07 Ecofin Agency. Publication date unrecorded; inherited source-text check.

S30 UNECE / UN Transparency Protocol. 2026-10-30.

S0301 USDA Agricultural Research Service. 2020-12-15.

S33 Jin, Shi and Wang / Taylor & Francis, hosted by Hong Kong Polytechnic University. 2026.

R16 WageIndicator. Publication date unrecorded; inherited source-text check.

S20 International Labour Organization. 2026-10-30.

R14 WageIndicator. Publication date unrecorded; inherited source-text check.

R15 wage.is. Publication date unrecorded; inherited source-text check.

S29 UNECE / UN Transparency Protocol. 2026-10-30.

GREEN FUTURE TECH

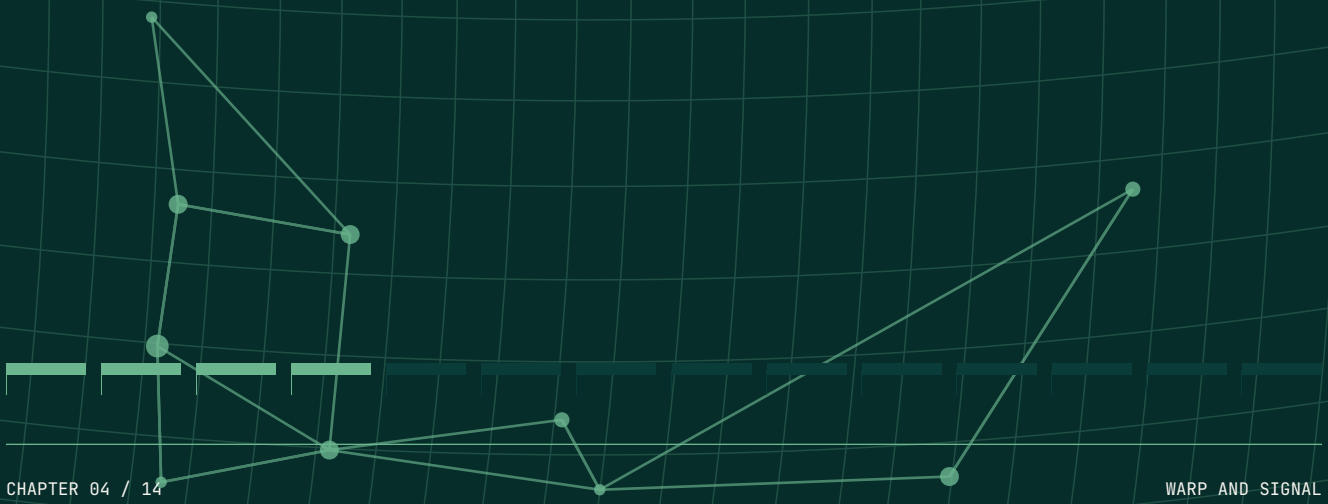
LIMITED / HONG KONG SAR

04

PART II: EVERY TRANSFORMATION NEEDS A RECORD / HANDOVER CONTROLS

Custody changes need matching evidence on both sides

A shipment is traceable only when dispatch and receipt refer to the same material and discrepancies remain visible.



CHAPTER 04
DECISION TEST

A shipment is traceable only when dispatch and receipt refer to the same material and discrepancies remain visible.

A custody transfer closes only when the sender's dispatch observation and the receiver's independent receipt observation match the same material, quantity basis, parties, sites and transport reference. An invoice, a dispatched message or a carrier scan cannot close that gap on its own. Green Future Tech Limited (GFT), Hong Kong SAR, therefore proposes a paired handover record: preserve both observations, compare them under explicit rules, and hold the affected claim whenever identity, evidence or quantity remains unresolved. The physical goods may move while their stronger provenance claim stays restricted. [S01] [S03] [S10] [S11]

This chapter supplies the dispatch-receipt matching procedure and discrepancy decision tree for GFT's Cameroon textile programme. The authorised programme record covers feasibility study, performance-management system design and digital strategy. The controls below are proposed extensions for a pilot, not evidence of a running factory, certified supplier, completed integration or accepted customs outcome. All shipment identifiers, quantities and operating scenarios are illustrative. The chapter is not investment, legal or tax advice.

4.1

Dispatch and receipt describe different observations

4.2 AN INVOICE CANNOT STAND IN FOR A PHYSICAL HANDOVER

A seller can issue an invoice before loading, a carrier can depart before the buyer inspects the goods, and a warehouse can receive material while its commercial owner remains unchanged. These are related but distinct occurrences. GS1's Electronic Product Code Information Services (EPCIS) Release 2.0 records completed visibility events, while its Core Business Vocabulary (CBV) gives shared meanings to business steps such as shipping and receiving. A purchase-order reference can connect those observations to a commercial agreement, but it does not turn either observation into the other. [S10] [S11]

The minimum handover therefore contains two signed observations linked by one proposed transfer identifier. The dispatch side states what the sender released. The receipt side states what the receiver actually observed. Neither side should be copied silently into the other. Where a value was not observed, the record says `UNKNOWN` rather than inheriting a convenient value from the dispatch advice. EPCIS distinguishes event time from the business context in which an identifier was read, so the proposed record also separates the physical event time from later data entry and transmission. [S10] [S11]

Field group	Dispatch observation	Receipt observation	Matching rule for the proposed pilot
Transfer	Transfer ID, shipment reference, order reference	Same references, or a documented crosswalk	One transfer ID links both records; an unmatched reference creates an exception. [S10]
Parties and sites	Sender, releasing custodian, dispatch site, carrier	Receiver, accepting custodian, receiving site, carrier	Legal owner, physical custodian and evidence issuer remain separate fields. [S01] [S11]
Material	Lot or bale identifiers, material class, claim class, package count	Identifiers and classes actually read or inspected	Every claimed identifier must resolve; unexpected identifiers are added, not ignored. [S03] [S06]
Quantity	Net mass, unit, moisture basis, tare treatment, scale ID	Independently observed net mass and the same basis fields	Compare only compatible bases; retain both original values after correction. [S03] [S06]
Time and transport	Event time, recording time, vehicle or container, seal reference	Arrival and inspection times, vehicle or container, seal observation	Late entry remains visible; a seal reference is evidence to inspect, not proof of origin. [S06] [S10]
Evidence	Delivery note, weigh slip, packing list, claim evidence pointers	Received documents, exception images or files, reviewer reference	Each evidence item has an issuer, scope and relation to the transfer. [S03] [S10]

The Aid by Trade Foundation's June 2025 Transparency Standard provides a scheme-specific example of the documentary boundary. Its purchase and sales provisions call for identified parties, product descriptions, unique product and transaction references, quantities, dates and transport details. Its receiving provisions call for inspection of accompanying documents against the material received. Those requirements should be applied only where that scheme and edition govern the claim, not treated as a universal template for every cotton movement. [S06]

The Sustainable Cotton Tracker (SCOT) FAQ supplies another bounded example. It distinguishes tracking from commercial ordering and describes counterparty acknowledgement of transactions entered by a seller. This supports the design principle that a commercial order and a custody confirmation are different records. It does not establish that SCOT is required for this programme, that any proposed supplier participates, or that its workflow applies under other schemes. [S09]

4.3 MATCHING MUST END IN AN EXPLICIT DECISION

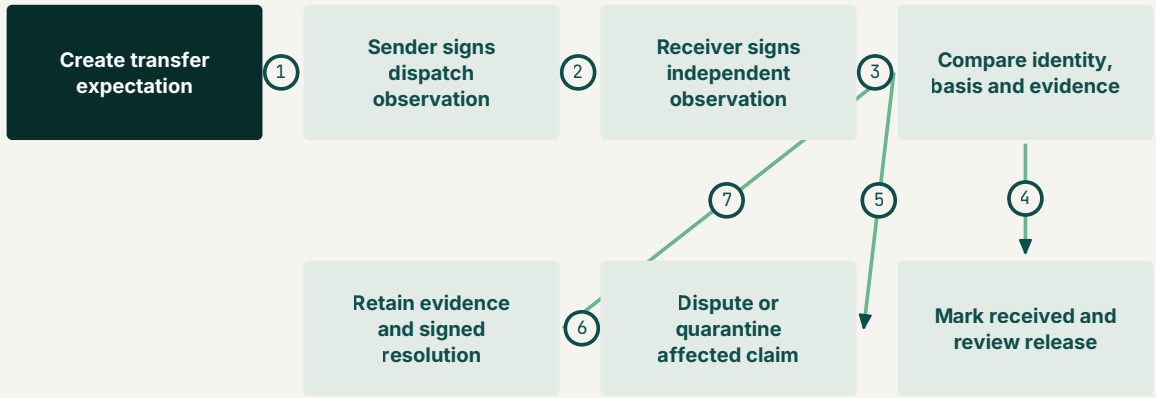
GFT's proposed matching procedure has seven operational steps:

1. **Create the expectation.** The releasing custodian records the transfer identifier, intended receiver, material identifiers, quantity basis, transport references and evidence pointers before or at dispatch. The shipment enters the local state `EXPECTED`; this is a proposed workflow state, not a claim that goods have arrived. [S10] [S11]
2. **Preserve the dispatch observation.** The sender signs the shipping event with event time, recording time and responsible role. Any later change references the original record rather than replacing it. [S10]
3. **Capture an independent receipt.** The receiving custodian identifies what arrived, repeats the relevant measurements and records missing, additional or substituted items. The receiver does not merely accept the sender's electronic form. [S03] [S06]
4. **Normalise only for comparison.** A calculation service converts units or derives net mass where the declared method permits. It retains the original units, formula, rounding and measurement basis beside the comparison. [S03]
5. **Compare claim-critical fields.** The matcher checks transfer reference, counterparties, sites, material IDs, claim class, packages, quantity and evidence scope. A transport delay alone does not prove a custody failure, just as an on-time arrival does not prove identity. [S01] [S10]
6. **Route the outcome.** A complete match enters `RECEIVED`, pending any unrelated quality or assurance holds. A mismatch enters `DISPUTED`; uncertain conformity or unresolved identity enters `QUARANTINED`. These local states require a documented crosswalk before anyone maps them to a partner vocabulary. [S06] [S11]
7. **Authorise release separately.** A reviewer releases the affected provenance or scheme claim only after admissible evidence resolves the mismatch. Physical acceptance, commercial acceptance and claim release remain different decisions. [S01] [S03] [S06]

Exhibit 16, p. 67 shows the proposed pairing and the branch that preserves a mismatch instead of forcing closure. [S09] [S10] [S11]

EXHIBIT 16 /

Matching dispatch and receipt closes a handover



1. expected transfer
2. physical movement
3. paired records
4. supported match
5. mismatch or unknown
6. investigate
7. corrective evidence

ILLUSTRATIVE [S09] [S10] [S11] Illustrative GFT handover procedure using distinct shipping and receiving observations, scheme-specific counterparty acknowledgement as an example, and a retained mismatch branch. It is a proposed control design, not a record of transit time or an implemented integration.

The important output of **Exhibit 16**, p. 67 is not a green shipment icon. It is a reviewable pair of observations and an outcome with an owner. A RECEIVED state confirms only the defined receipt checks. It does not prove farm origin, product quality, legal conformity or the truth of every document attached to the shipment. Those propositions retain their own evidence requirements. [S01] [S03]

4.4

Ownership and possession can move separately

4.5 THE ENTITY MAKING THE OBSERVATION IS NOT ALWAYS THE INVOICE ISSUER

Chain-of-custody design must identify who controlled the material and who observed the transfer, not merely who bought or sold it. ISO 22095's public abstract presents a generic framework for custody across materials and products, while warning that a custody system alone does not establish production characteristics or verify a product claim. GFT applies that distinction by recording commercial owner, physical custodian, transport provider and evidence issuer as separate roles. The paid ISO text was not opened, so this chapter does not claim clause-level ISO conformity. [S01]

Consider an illustrative trader selling lint to a spinner while the bales remain in a third-party warehouse. Ownership may change on the contract date, but no bale moves. Later, the warehouse releases the bales to a carrier for delivery. The trader can issue the invoice, yet only the warehouse can attest to the physical removal it observed, and only the carrier can attest to what it accepted for transport. The receiving spinner then observes arrival. Combining all four assertions into one seller event would erase the people and sites whose evidence a reviewer needs. [S01] [S10] [S11]

Illustrative arrangement	Commercial event	Physical event that still needs evidence	Required handover consequence
Third-party storage	Trader sells material to buyer	Warehouse moves stock between locations or releases it to a carrier	Warehouse signs the observed move; contract reference alone cannot establish the location change. [S10]
Consignment stock	Supplier retains the agreed ownership position while buyer holds stock	Buyer receives, stores and later draws material	Record possession and observation roles separately from the contract's ownership clause. [S01] [S11]
Toll processing	Principal supplies material and purchases a processing service	Subcontractor receives, converts and returns material	Pair both handovers and link the processor's input-output record; do not infer a sale to the processor. [S06] [S10]
Direct delivery to a subcontractor	Buyer purchases from a seller but nominates another receiving site	Seller dispatches and subcontractor receives	Capture the nominated receiver and actual site, not just the buyer's registered address. [S06] [S11]

These role assignments are design choices, not legal conclusions about title, risk or liability. Applicable contracts and law require separate review. The custody record must identify the physical observer even where that party does not issue the invoice. [S01] [S06]

4.6 ROLE SEPARATION MAKES THE EVIDENCE PACK AUDITABLE

Exhibit 17, p. 69 places illustrative roles on two qualitative dimensions: authority over the commercial ownership decision and responsibility for the physical observation. The coordinates make the role distinction visible; they are not performance scores or findings about actual organisations. [S01] [S09] [S10]

EXHIBIT 17 / ILLUSTRATIVE QUALITATIVE INDEX (0 TO 10)

Owners, custodians and evidence issuers have separate duties



ILLUSTRATIVE [S01] [S09] [S10] Illustrative role map. Horizontal position represents the role's typical direct responsibility for physical observation in the hypothetical arrangements; vertical position represents its typical authority over the commercial ownership decision. Coordinates are qualitative teaching positions, not measured scores, legal determinations or universal role definitions.

A reviewer should use **Exhibit 17**, p. 69 to ask whether each required assertion has a competent issuer. A trader's signed statement may support its own commercial transaction, but not a warehouse movement it did not observe. A warehouse record may establish a location and lot list, but not the legal validity of the sale. A scheme acknowledgement can confirm that counterparties used a specified workflow, but not replace all underlying dispatch and receipt evidence. [S01] [S06] [S09]

> **GFT NOTE**
>
> GFT recommends adding `observed_by`, `custody_from`, `custody_to`, `ownership_reference` and `evidence_issuer` to every proposed transfer record. `UNKNOWN` is mandatory when a role cannot be established. The receiving reviewer must be able to identify which organisation accepted physical custody at each site before approving the related claim. The scheme edition and contract determine the precise duty; the data model must not guess it from the invoice issuer. [S01] [S06] [S10]

4.7

Storage controls preserve the approved material class

4.8 A LOCATION IS PART OF THE CUSTODY EVIDENCE

Storage is not a pause in traceability. It is a period during which labels can be damaged, lots can move, eligible and ineligible materials can share equipment, and records can drift away from physical stock. The June 2025 Aid by Trade Foundation standard requires identification to be maintained during storage and handling under its

HIP provisions. It describes physical and temporal segregation, clear labelling or marking, and accompanying storage documents that identify relevant bales or lots. These are scheme- and edition-specific controls to map where applicable, not a declaration that every warehouse follows them. [S06]

GFT's proposed warehouse record therefore links each material identifier to a site, storage location, claim class and custody state. A move creates a new observation rather than an edit that leaves only the latest aisle. The record retains the prior location, destination, event time, responsible custodian, authorising instruction and any associated cleaning or release evidence. EPCIS location fields and business-step vocabulary can carry parts of that history, while the material's evidence state remains a separate application decision. [S10] [S11]

A useful location register answers four questions without consulting a spreadsheet maintained elsewhere:

- **What is present?** The material or lot identifiers, package count and quantity basis observed at that location.
- **Under which class?** The claimed material class, custody model, scheme and edition where relevant, plus any hold or restriction. [S02] [S06]
- **How did it get there?** The preceding receipt or internal move, the responsible custodian and the source evidence.
- **What may happen next?** Whether the lot may enter a campaign, move to another custodian, be dispatched, or must remain quarantined pending review. [S03] [S06]

The physical arrangement must make those answers credible. Dedicated areas can separate eligible from non-eligible stock. Temporal separation can use a defined campaign, a line-clearance check and a documented release before another material class enters. Under the opened CmiA edition, machinery must be free of non-claimed material before claimed material is processed, and precautions are needed against unintentional mixing. GFT would translate that principle into site instructions only after the applicable scheme, equipment and operating conditions have been confirmed. [S06]

4.9 A LABEL CANNOT EXPLAIN AN UNRECORDED MOVE

A labelled aisle is a useful signal, but it is not a complete control. If bales can be moved without an identifier scan, written transfer or accountable sign-off, the location register can remain reassuring while becoming false. Likewise, replacing a damaged tag without preserving the original identifier can break the chain even where the replacement is physically correct. The proposed exception record links the old and new identifiers, the reason for replacement, the evidence inspected and the reviewer who authorised it. [S03] [S06] [S10]

Campaign cleaning needs the same discipline. The proposed record identifies the equipment, prior and next material classes, work performed, responsible role and release decision. Actual cleaning methods and acceptance criteria must be established for the site. [S03] [S06]

Transport extends the same boundary beyond the warehouse. The opened CmiA standard calls for suitable packaging, containers or vehicles so that substitution or mixing cannot occur without tampering or damage. It also calls for sales and transport documents that identify corresponding products or materials. GFT therefore proposes recording package condition, vehicle or container reference, seal reference where used, exceptions observed at loading and the receiver's corresponding inspection. A seal number supports a physical check; it does not establish cotton origin or prove that every listed bale is present. [S06]

4.10

Quantities must reconcile on compatible measurement bases

4.11 A MASS VALUE IS INCOMPLETE WITHOUT ITS BASIS

Two scales can produce different observations without either being dishonest, and two documents can report the same nominal mass while using different tare or moisture conventions. The comparison must therefore record unit, gross or net status, packaging treatment, moisture basis, scale identity, observation time and any conversion formula. Textile Exchange's Content Claim Standard overview calls for documentation of receiving, processing and transfer, together with volume reconciliation. The CmiA edition likewise requires receiving documents to be checked against description, quantity, quality, source and blend or mix percentage. [S03] [S06]

GFT's comparison routine begins with the original observations. In the illustrative worked case, `1,000 kg net` at dispatch and `990 kg net` at receipt are comparable only if both net values use compatible packaging and moisture bases. If one document reports gross mass, the routine cannot silently subtract an assumed bale or wrapping weight. It requests the actual tare observation or marks the comparison `BASIS_UNKNOWN`. Any unit conversion states its input, operation, output unit and rounding. These are proposed controls, not an assumed industry tolerance. [S03] [S06]

Measurement uncertainty and administrative discrepancy must also remain separate. Measurement uncertainty concerns the observations and instruments. Administrative discrepancy includes a missing delivery line, a transposed identifier, an unrecorded return or an incompatible unit. A numerical match can hide an administrative error, while a numerical mismatch can have a documented physical explanation. Neither condition should be resolved by changing the receiver's mass to equal the sender's. [S03] [S10]

The sign convention must be declared before interpretation. This chapter uses `receipt minus dispatch` for the transfer difference. A negative result means less mass was observed at receipt on the stated basis. It does not, by itself, establish physical loss, theft, moisture change or scale error. Investigation uses contemporaneous evidence such as weigh slips, packaging observations, vehicle inspection, returns and instrument records. The original pair remains intact throughout that review. [S03] [S06] [S10]

WORKED EXAMPLE: PRESERVE THE DIFFERENCE BEFORE EXPLAINING IT

An illustrative lint shipment `SHP-ILL-044` has dispatch gross mass of 1,020 kg, observed dispatch tare of 20 kg and calculated dispatch net mass of `1,020 - 20 = 1,000 kg`. At receipt, an independent observation records gross mass of 1,008 kg, tare of 18 kg and calculated net mass of `1,008 - 18 = 990 kg`. Every value is an illustrative teaching assumption, not a GFT operating measurement or an accepted tolerance. [S03] [S06]

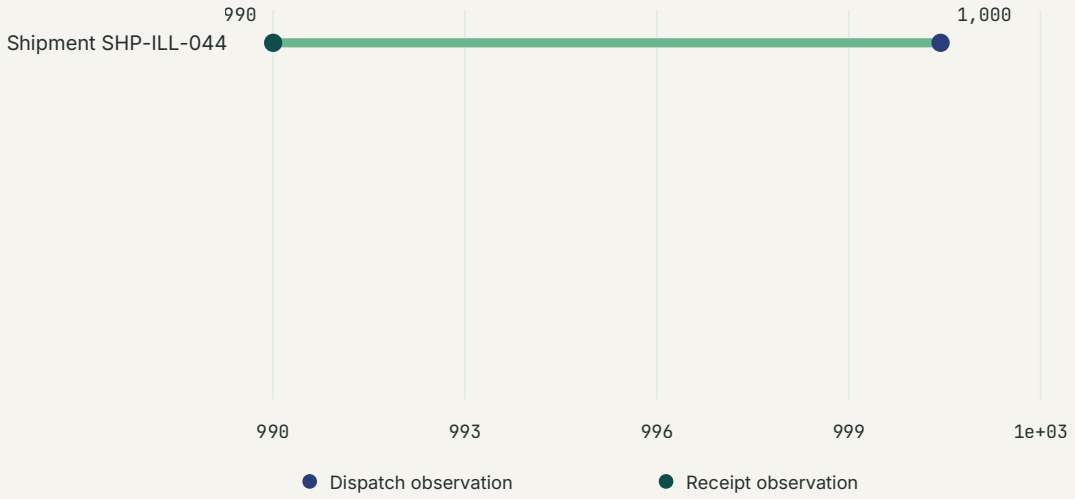
The illustrative net transfer difference is `990 - 1,000 = -10 kg`, or `-10 / 1,000 = -1.0 percent` relative to dispatch net mass. The gross difference is `-12 kg` and the tare difference is `-2 kg`, so comparing gross mass alone would describe a different discrepancy. No cause is inferred from these calculations. The receiver stores both net observations, the tare evidence, scale identifiers and the calculated difference under one exception reference.

If later evidence establishes a unit-entry error, the proposed system adds a corrective event referencing the erroneous record. If it establishes material left in the vehicle, a return or second delivery creates its own physical event. If the evidence remains inconclusive, the exception remains open and the affected claim is not released. The arithmetic does not manufacture an explanation. [S06] [S10]

Exhibit 18, p. 72 displays the worked net-mass pair without hiding the difference inside a single reconciled value. [S03] [S06]

EXHIBIT 18 / KG NET MASS (ILLUSTRATIVE)

A shipment difference needs an explained basis



ILLUSTRATIVE [S03] [S06] Illustrative worked case only: dispatch net mass 1,000 kg derives from 1,020 kg gross less 20 kg observed tare; receipt net mass 990 kg derives from 1,008 kg gross less 18 kg observed tare. Difference, receipt minus dispatch, is -10 kg or -1.0 percent of dispatch net mass. These are teaching inputs, not observed loss, measurement uncertainty or accepted tolerance.

The single comparison in **Exhibit 18**, p. 72 is enough to trigger review under this illustrative procedure, but not enough to determine its cause or materiality. The organisation must define investigation and escalation thresholds from the governing scheme, instrument performance, material behaviour and observed operating vari-

ation. The opened CmiA edition contains its own volume-deviation investigation rule, but that scheme-specific rule must not be relabelled as a general receiving tolerance or applied automatically to a different claim. [S06]

4.12 RESOLUTION MUST PRESERVE THE EVIDENCE THAT CREATED THE EXCEPTION

A discrepancy log should carry the original dispatch and receipt event IDs, difference and basis, evidence requested, responsible investigator, due review point, decision and claim effect. Where a correction is appropriate, EPCIS 2.0 provides error-declaration concepts for declaring an earlier event erroneous and linking corrective information. GFT would use that structure to retain history, while treating the business acceptance of the correction as a separate review. [S10]

A signed reconciliation adds evidence rather than replacing the underlying records. It states what was agreed, what remains uncertain and who authorised release. The quantity ledger records each physical implication once. The quantity-reconciliation chapter develops the full stock and eligible-claim accounts. [S03] [S06]

4.13

Unresolved handovers restrict downstream claims

4.14 THE STATE MODEL MUST DISTINGUISH ARRIVAL FROM ACCEPTANCE

A handover needs states that describe evidence, not just the location of a truck. GFT proposes `EXPECTED` for a dispatch-linked transfer awaiting receipt, `RECEIVED` for a completed observation with no open handover mismatch, `DISPUTED` for a counterparty or documentary disagreement, `QUARANTINED` for material whose affected claim must not be released, and `RELEASED` for an authorised claim decision. These are local workflow labels. CBV supplies shared business steps and dispositions, but a partner crosswalk must verify the exact meaning before treating any local label as a standard equivalent. [S11]

The states are not necessarily sequential for every attribute. A lot may be physically received and immediately quarantined for a provenance question. Its quality review may continue while its scheme claim remains blocked. A disputed commercial document may coexist with a complete physical receipt. Recording one generic `accepted` flag would conceal those distinctions and could make an unresolved handover appear to support a public origin statement. [S01] [S03] [S06]

The discrepancy decision tree begins with material identity, because quantity arithmetic cannot repair an unknown lot:

1. **Can the receiver resolve every claim-critical material identifier?** If not, isolate the affected items where practicable, mark their identity `UNKNOWN`, and quarantine the dependent claim. Do not assign the expected lot merely because the package count matches. [S03] [S06]
2. **Do the parties, sites and custodian match the authorised route?** If not, establish who actually observed and accepted the material. An unexpected subcontractor or storage site requires scope and custody review, not an address edit. [S01] [S06]

3. **Are quantities compared on a compatible basis?** If not, obtain the missing tare, unit or moisture information. Keep `BASIS_UNKNOWN` visible rather than importing a standard deduction. [S03]
4. **Does documentary evidence support the claimed class and transaction?** If not, request the relevant original records and record their issuer and scope. A certificate or invoice is reviewed for the proposition it can support, not accepted by title alone. [S03] [S06]
5. **Can the parties sign one resolution without erasing either observation?** If yes, retain the resolution and corrective event, then repeat the affected checks. If no, escalate with both positions and keep the claim restricted. [S10]
6. **Which downstream records inherit the restriction?** Trace dependent transformations and dispatches, but limit the hold to the affected attribute and material set. Unknown is not evidence of wrongdoing, and it is not zero. [S01] [S03] [S10]

Exhibit 19, p. 74 applies that decision tree to illustrative exceptions. Each row carries a status, accountable role, evidence requirement and release consequence so that closure means a reviewable decision rather than a disappeared warning. [S06] [S10] [S11]

EXHIBIT 19 /

Every mismatch needs a retained resolution

Illustrative exception	Status and owner	Evidence retained	Resolution path	Claim decision
Receipt lot differs from dispatch lot	QUARANTINED; receiving custodian and evidence reviewer	Both lot observations, labels, packing lists and vehicle record	Identify physical lot and authorised route; issue linked correction if supported	Dependent origin and scheme claims held
Net mass differs on compatible bases	DISPUTED; warehouse reviewer	Gross, tare and net records, scale IDs and difference calculation	Inspect vehicle, packaging and return records; retain signed reconciliation	Release only after scope and quantity review
Receipt message arrives before physical inspection	EXPECTED; receiving custodian	Message event time, arrival record and inspection record when complete	Do not convert message delivery into physical receipt	No release from message alone
Damaged label replaced during storage	DISPUTED; storage custodian	Old and new identifiers, damage evidence and replacement authorisation	Create identifier-link event and verify against source documents	Hold until identity link is supported
Duplicate upload of the same dispatch	REVIEW; data steward and dispatch owner	Shared event ID, payload hash where used and ingestion logs	Deduplicate the message without deleting the business event history	No duplicate quantity allocation

ILLUSTRATIVE [S06] [S10] [S11] Illustrative exception log for a proposed pilot. Identifiers and cases are fictional. Owners are roles, not named GFT staff. The outcomes demonstrate a retained correction and claim-restriction method informed by the opened scheme and GS1 sources; they are not observed incidents or universal scheme decisions.

The cases in **Exhibit 19**, p. 74 show why deletion is not correction. A duplicate message should not double the dispatched quantity, but removing all copies from the audit trail would also destroy evidence of the ingestion defect. EPCIS error declarations allow an erroneous event to be identified with corrective references. The proposed operational log additionally records who reviewed the business effect and whether any claim or stock allocation changed. [S03] [S10]

4.15 CLAIM RELEASE NEEDS A MEASURABLE QUEUE, NOT AN IMPROVISED CHASE

The release reviewer should work from an exception queue with explicit denominators and observation sources. GFT proposes four pilot measures, each owned by the traceability lead and reviewed weekly during the bounded pilot. These are measurement specifications, not reported performance. An empty queue caused by missing data is reported as UNKNOWN, never as a perfect result.

Proposed measure	Numerator and denominator	Observation source	Decision use
Unmatched handover share	Open or unresolved matched pairs divided by all handovers due for review	Dispatch-receipt register and exception log	Directs investigation capacity; unknown required records stay in the denominator with their status visible.
Receipt observation completeness	Required receipt fields populated from actual observation divided by required fields across due receipts	Signed receipt forms and field audit	Distinguishes a working capture procedure from copied dispatch data.
Exception closure evidence share	Closed exceptions with retained evidence and authorised decision divided by all closed exceptions	Exception log and linked evidence index	Prevents closure by deletion or unsupported supervisor override. [S10]
Restricted-claim propagation completeness	Affected downstream records correctly restricted divided by affected records identified through genealogy	Custody graph and claim-release register	Tests whether a handover hold reaches every dependent claim and no unrelated attribute. [S01] [S03]

The denominator, owner and cadence should be frozen before the pilot. Results must include the review period, participating sites and unknown-status count. No threshold is asserted here; buyer or scheme requirements and pilot acceptance criteria need separate agreement. [S03] [S06]

An unresolved handover ultimately narrows what the buyer can receive. The evidence pack should show the matched pair, any open exception and the exact claim restriction. If the transfer cannot establish that the claimed material crossed the boundary, the public origin statement is withheld or narrowed to the remaining supported boundary. This does not prove that the original declaration was false. It records that the chain has not preserved enough evidence to repeat it. [S01] [S03]

4.16

Controls must work across a border and a weak connection

4.17 TRANSPORT EVIDENCE AND CUSTOMS ORIGIN ANSWER DIFFERENT QUESTIONS

A border crossing adds documents, parties and possible changes of custodian, but it does not change the matching principle. Material identifiers must remain linked to transport and receipt records, while each organisation records what it actually observed. The World Trade Organization defines rules of origin as criteria for determining a product's national source. That legal or customs determination is distinct from evidence that a particular bale or lot moved between two sites. The handover pack must not infer tariff preference or customs eligibility from a delivery note. [S18] [S10]

For an illustrative cross-border shipment, the seller's dispatch, carrier acceptance, border-related references, any warehouse transfer and final receipt should share a transfer crosswalk. Each document keeps its issuer and purpose. A customs reference can identify a declaration; a packing list can identify packages; a weigh slip can support a quantity observation. None should be treated as universal proof of every other field. Applicable origin analysis belongs with the relevant legal and trade review, not with an automatic passport rule. [S18] [S03]

Weak connectivity creates a different risk: the physical event may be valid but its digital message may arrive late, twice or out of order. EPCIS event data can preserve event time and business context, while application records can separately preserve recording time. GFT's proposed offline procedure uses pre-issued transfer and event identifiers, protected local storage and a signed paper or local electronic fallback. A later upload carries the original identifiers rather than creating a new business event at the time of reconnection. [S10] [S11]

Before departure, the sending custodian downloads the minimum transfer record, authorised material list and evidence references needed to work locally. The receiver obtains the expected transfer identifier where the communication channel permits. If no expectation arrives, the receiver still captures an independent observation and marks the transfer `UNMATCHED`, rather than reconstructing the expected record from memory. These are proposed pilot controls whose usability and security still require testing. [S03] [S10]

At reconnection, four reconciliations are required:

1. **Message reconciliation.** Compare local queues with received partner messages by event identifier. Repeated uploads must not create repeated business events or quantity allocations. [S10]
2. **Chronology reconciliation.** Preserve event time, local time offset and recording time. Investigate impossible sequences without replacing uncertain timestamps with the server arrival time. [S10] [S11]
3. **Physical reconciliation.** Compare actual stock, packages, vehicle or return observations with the reconstructed transfers. Message delivery alone is not custody confirmation. [S03] [S06]

4. **Claim reconciliation.** Re-run restrictions and releases against the complete evidence set. A claim held while offline must not become releasable merely because the connection has returned. [S01] [S03]

Conflict handling should prefer evidence over recency. If two records share an event identifier but carry different material IDs or quantities, the system quarantines the conflict and retains both payloads, their senders and their recording times. If two different event identifiers describe what may be one physical dispatch, a reviewer compares source documents before merging any operational view. The merge creates a resolution record; it does not delete either original assertion. [S10]

> **GFT NOTE**
>
> GFT recommends treating `SYNCED` and `CUSTODY_CONFIRMED` as independent fields in the proposed transfer store. `SYNCED` reports a technical exchange state. `CUSTODY_CONFIRMED` requires the matched physical observations and evidence review defined in this chapter. The public passport and buyer pack must expose pending or disputed handovers, with an as-of timestamp, rather than showing a verified state inferred from successful message delivery. [S01] [S03] [S10]

4.18 RECOVERY TESTS MUST INCLUDE THE PHYSICAL LEDGER

The pilot should rehearse a delayed dispatch message, a duplicated receipt upload, an out-of-order return and an offline identifier replacement. Each case needs expected physical stock, expected claim status and independently prepared source records for comparison. Success means that another reviewer can reconstruct the handover, the quantities and the claim decision after reconnection. It does not mean that every message reached a server. [S03] [S10]

The rehearsal should also test controlled file exchange. A signed export carries transfer identifiers, event times, material references, evidence pointers and correction links; the importer records conversions and repeats matching. Companion papers `wp07` and `wp18` own infrastructure design, which must preserve custody meaning and restricted release during recovery. [S10] [S11]

Custody is confirmed when both sides agree on the evidence, not when one side sends a message.

CHAPTER SOURCE NOTES

S01 International Organization for Standardization. 2020.

S03 Textile Exchange. 2026-10-30.

S10 GS1. 2022.

S11 GS1. 2022.

S06 Aid by Trade Foundation. 2025.

S09 Cotton made in Africa / Sustainable Cotton Tracker. 2026-10-30.

S02 ISEAL Alliance. 2025.

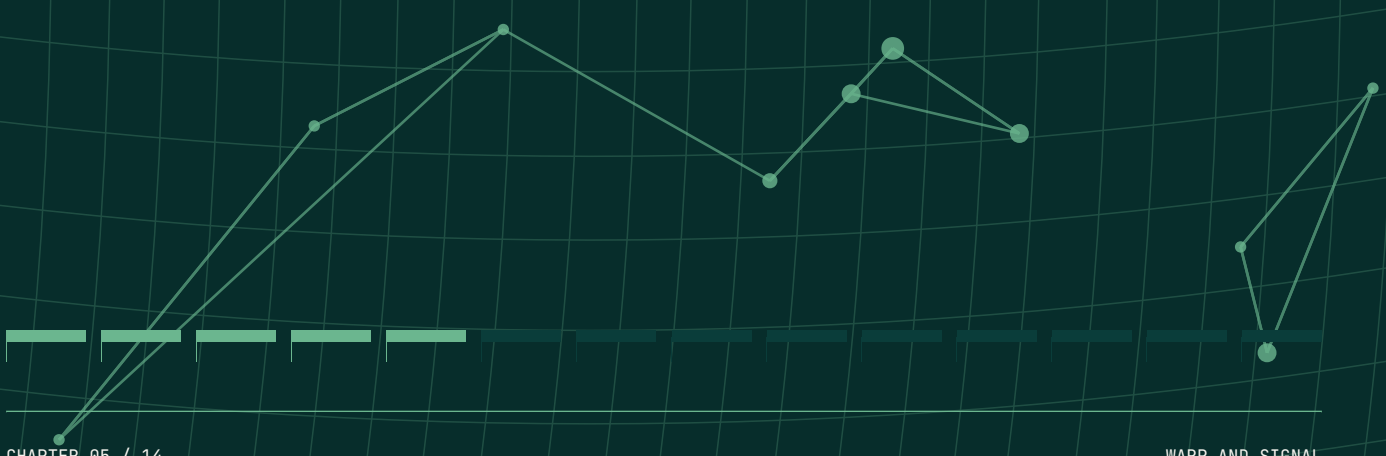
S18 World Trade Organization. 2026-10-30.

05

PART II: EVERY TRANSFORMATION NEEDS A RECORD / FACTORY GENEALOGY

Blending and conversion determine what can still be traced

Each production step must preserve enough input-output linkage to support the claim carried by its outputs.



CHAPTER 05
DECISION TEST

Each production step must preserve enough input-output linkage to support the claim carried by its outputs.

A cotton garment can carry only the provenance and custody claims supported by the transformations that produced it. Green Future Tech Limited (GFT), Hong Kong SAR, therefore proposes a directed, bipartite genealogy graph rather than a linear chain of handovers. Identified material lots and recorded activities form separate nodes. Edges show which inputs each activity consumed and which outputs it generated. The operating rule is conservative: for each claimed attribute, an output inherits its admissible input set, while undocumented or ineligible inputs restrict the claims that depend on that attribute. [S0501] [S10] [S0503]

This chapter specifies that architecture for GFT's Cameroon textile programme. It follows observable batch boundaries rather than assuming item-level fibre identity, and distinguishes conversion, splitting, grouping, subcontracting, rework and missing evidence. The schemas, identifiers and calculations below are design specifications and illustrative cases for a proposed pilot and the educational `trace-a-garment` tool. They do not prove a running GFT factory, supplier certification, legal conformity or realised operating performance. Nothing here is investment, legal or tax advice. [S28]

5.1

A genealogy graph must follow the production grain

5.2 IDENTIFIERS MUST ATTACH TO OBSERVABLE PHYSICAL BATCH BOUNDARIES

A useful genealogy graph is acyclic and bipartite. Material nodes identify bales, yarn lots, rolls, bundles and garment batches. Activity nodes record conversions, splits and groupings. Directed input and output edges connect the two. The World Wide Web Consortium (W3C) PROV Data Model supplies the general distinction between entities, activities and responsible agents, while GS1's Electronic Product Code Information Services (EPCIS) Release 2.0 supplies visibility-event semantics for what changed, when, where and under which business step. [S0501] [S10] [S11] The factory-specific design decision is the grain at which those relations can be observed.

The grain should be the smallest lot whose inputs and outputs operators can actually observe. Serialising each garment cannot resolve which farm supplied each fibre, while pooling all output into one monthly lot cannot isolate a roll. GFT therefore proposes batch or campaign identifiers for bulk conversion, roll identifiers for fabric, and bundle or batch identifiers for cutting and sewing. Item serials are optional where they answer a separate service or claim need. These are pilot design choices, not claims that a supplier already captures them. [S10] [S0503]

Production stage	Physical unit observed	Illustrative identifier	EPCIS 2.0 event class	Required upstream parent links	Claim survival boundary
Spinning lay-down	Lint bales at blow-room	`LOT-LAY-2026-001` (illustrative)	`TransformationEvent`	All ginnery bale IDs in laydown (`inputEPCList` or `inputQuantityList`)	Union of possible origins; each attribute retains its own custody model. [S02] [S10] [S0503]
Ring or rotor spinning	Yarn lot doffed by shift	`LOT-YRN-2026-014` (illustrative)	`TransformationEvent`	Active laydown ID, roving reference and recorded noil or waste outputs	Bounded by laydown input set; single-bale identity is not separable. [S07] [S10]
Knitting or weaving	Greige fabric roll	`ROL-GRG-2026-108` (illustrative)	`TransformationEvent`	Warp beam lot ID and weft or creel yarn lot IDs consumed	Multi-yarn intersection; differing warp and weft status must be declared. [S03] [S10]
Wet processing	Dye batch and finished roll	`BAT-DYE-2026-022` and `ROL-FIN-2026-108A` (illustrative)	`TransformationEvent`	Greige roll IDs loaded to vessel; split suffix assigned if cut	Preserves fibre origin only if vessel segregation and custody hold. [S05] [S06]
Cutting room	Cutting lay and bundles	`LAY-CUT-2026-055` and `BND-SEW-2026-055-01` (illustrative)	`TransformationEvent`	All finished roll IDs spread in lay, plus splice and remnant records	Unless ply separation holds, every bundle inherits the lay's roll set. [S02] [S10]
Sewing and packing	Garment batch and carton	`GAR-BAT-2026-310` and `CTN-SHP-2026-880` (illustrative)	`TransformationEvent` and `AggregationEvent`	Cut bundle IDs, separate non-cotton trim records and carton ID	Cotton claim covers cotton component only; carton grouping is reversible. [S10] [S34]

MINIMUM GENEALOGY RECORD

A material node needs an identifier, material class, site, quantity, unit, measurement basis and evidence status. An activity node needs an event identifier, event type, event time, recording time, responsible role, site, ordered input references, output references and links to source documents. A correction references the record it amends rather than replacing its history. These fields apply EPCIS event semantics and W3C's distinction between entities, activities and responsibility to the proposed factory model. [S10] [S0501] [S0502]

Claim state sits beside the material record, not inside a single `traceable: true` flag. For each attribute, the proposed schema stores the claimed geography or class, custody model, scheme and edition, evidence state, allocation rule and release status. Quantity entries also distinguish measured, estimated and derived values. `Unknown` remains a deliberate state, different from zero, absence or a failed test. A reviewer should be able to reproduce the output's parent set and claim decision from these fields without reading a narrative dashboard. [S02] [S0503]

5.3 SYSTEM DESIGN MUST REMAIN SEPARATE FROM ASSUMED SUPPLIER READINESS

A schema does not establish supplier readiness. An upstream partner may provide paper packing lists, campaign references or aggregate weights rather than the proposed identifiers. The receiving graph must record that actual granularity instead of inventing intermediate lots. If the finest admissible upstream unit is a campaign-level bale group, the campaign becomes the receiving node and downstream claims inherit its geographic and temporal boundary. A pilot must test whether each participant can capture, correct and export these links; no current supplier capability is assumed. [S01] [S02] [S03]

5.4

Spinning often replaces a single origin with an input set

5.5 BALE LAYDOWN TRANSFORMS DISCRETE DELIVERIES INTO A POOLED YARN LOT

In the proposed model, bale laydown is a pooling boundary. Where several bale lots feed one mixed yarn lot, a single-bale parent pointer no longer describes the observable output. The record must list every bale or bale group that could enter the shared run, including substitutions and undocumented inputs. Opening, carding, drawing, combing and spinning can then be represented as one campaign or as separate activities, depending on the boundaries at which operators actually record consumption and production. [S02] [S10]

EPCIS represents the conversion as a `TransformationEvent`. Identified objects belong in `inputEPCList` and `outputEPCList`; measured class quantities belong in `inputQuantityList` and `outputQuantityList`. Recoverable material and recorded losses need their own outputs or linked quantity records on a compatible measurement basis. [S10] [S03] The UN Transparency Protocol (UNTP) Digital Traceability Events page offers a work-in-progress credential mapping for such events, suitable

here only as a pilot comparison. [S30] Once the model boundary is a mixed lot, a downstream scan can retrieve the recorded input set but cannot create a fibre-level observation that was never captured.

5.6 AN INPUT SET BOUNDS PROVENANCE WITHOUT PRESERVING SINGLE-FARM IDENTITY

A mixed laydown therefore produces a bounded input set, not a single origin pointer. Whether that set supports a claim depends on the attribute and its governing custody model. UNTP's pilot guidance states the key distinction directly: "A chain of custody model applies to a claimed attribute, not to a facility or a process." Country of growth, scheme eligibility and producer-group identity can consequently have different outcomes on the same run. [S02] [S0503]

Identity Preservation keeps a defined source separate. **Segregation** permits eligible material from several sources to combine while excluding non-eligible material. Thus, an illustrative laydown of bales from three documented Cameroonian ginneries could retain a country and scheme-class claim if every input and control satisfies the applicable rules, but not a single-ginnery claim. [S02] [S07] Version labels matter: the Aid by Trade Foundation's June 2025 standard uses Hard Identity Preserved (HIP), while the current Cotton made in Africa webpage uses Segregation and says the underlying separation requirements are unchanged. [S06] [S07]

Controlled Blending tracks a known fixed proportion. **Mass Balance** reconciles eligible input and claimed output volumes administratively rather than preserving their physical separation. [S02] [S0503] An illustrative laydown mixing documented Cameroonian and Benin cotton cannot support an unqualified single-country physical claim. Its record should retain the multi-origin input set and any supportable percentage statement, while a scheme claim follows that scheme's edition, model and allocation rules rather than an automatic factory-wide downgrade. [S02] [S06] [S0503]

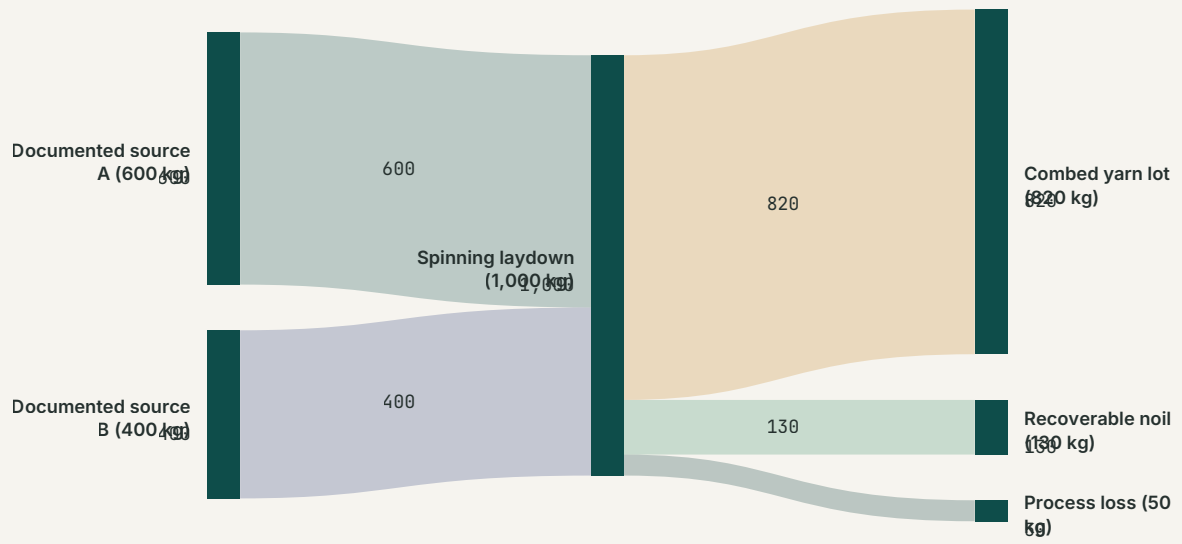
GFT keeps three operations separate when evaluating that input set. The **union of possible origins** answers where material in the batch may have come from. The **intersection of shared attributes** answers what can be said without qualification about every input. A **mass-weighted allocation** answers a different question again and is valid only where the selected custody model and compatible quantities permit it. [S02] [S0503]

For example, two documented producer groups in one country have a union containing both groups but an intersection that can still contain the shared country attribute. If one group's country evidence is missing, the country intersection becomes unknown rather than defaulting to the documented group. Scheme eligibility follows its own rule set and is not inferred from that geographic intersection. This is why the graph stores an attribute vector rather than collapsing provenance into one score or one country field.

Exhibit 20, p. 83 illustrates a hypothetical 1,000 kg spinning laydown combining 600 kg of lint from documented Cameroon Source A with 400 kg of lint from documented Cameroon Source B, converting the blended fibre into 820 kg of combed yarn, 130 kg of recoverable comber noil and 50 kg of process loss. [S02] [S10]

EXHIBIT 20 / KG (ILLUSTRATIVE MASS)

A batch's possible origins follow its input graph



ILLUSTRATIVE [S02] [S10] Illustrative transformation mass balance: 600 kg documented source A and 400 kg documented source B enter a 1,000 kg spinning laydown and allocate to 820 kg combed yarn, 130 kg recoverable comber noil and 50 kg process loss. Quantities are hypothetical teaching inputs under S10 transformation semantics and S02 claim boundaries, not empirical yield claims or GFT factory measurements.

In **Exhibit 20**, p. 83, the illustrative 820 kg yarn lot and 130 kg recoverable noil link to the whole 1,000 kg laydown, not exclusively to Source A or Source B. A genealogy query returns `{Source A: 60 percent, Source B: 40 percent}` by recorded input mass. [S10] It cannot establish the fibre ratio inside a single 200-gramme shirt, because no fibre-level measurement is in the model. The illustrative 82 percent yarn yield, 13 percent noil share and 5 percent loss demonstrate conservation only. Actual campaign yields require compatible input, output, by-product and loss measurements, which Chapter 6 reconciles. [S03] [S06]

5.7

Fabric and wet processing add custody and process boundaries

5.8 KNITTING, WEAVING AND DYEING REQUIRE EXPLICIT PARENT-CHILD ROLL LINKAGE

Fabric formation adds another convergence boundary. In an illustrative weaving run, warp Lot `LOT-YRN-2026-014` and weft Lot `LOT-YRN-2026-015` both become parents of greige roll `ROL-GRG-2026-108`. The transformation record must also capture creel substitutions that change the possible input set. Textile Exchange's Content Claim Standard and the Global Organic Textile Standard provide scheme-specific reasons to preserve processing and transaction evidence, but they do not remove the need to define the physical batch grain. [S03] [S05] [S10]

Wet processing adds shared baths, external custody and physical splits to the model. For example, an illustrative 100-metre parent roll `ROL-GRG-2026-108` becomes a 70-metre roll `108A`, a 25-metre roll `108B` and a 5-metre rejected piece `108C`. The pro-

posed transformation event retires the parent for further allocation and issues three child identifiers, with length and mass retained on their respective measurement bases. [S03] [S10] Reusing the parent barcode for all three pieces would allow the same material identity to enter more than one later allocation. [S06] [S10]

5.9 SUBCONTRACTED WET PROCESSING AND RECIPE LOGS MUST STAY DISTINCT FROM MATERIAL GENEALOGY

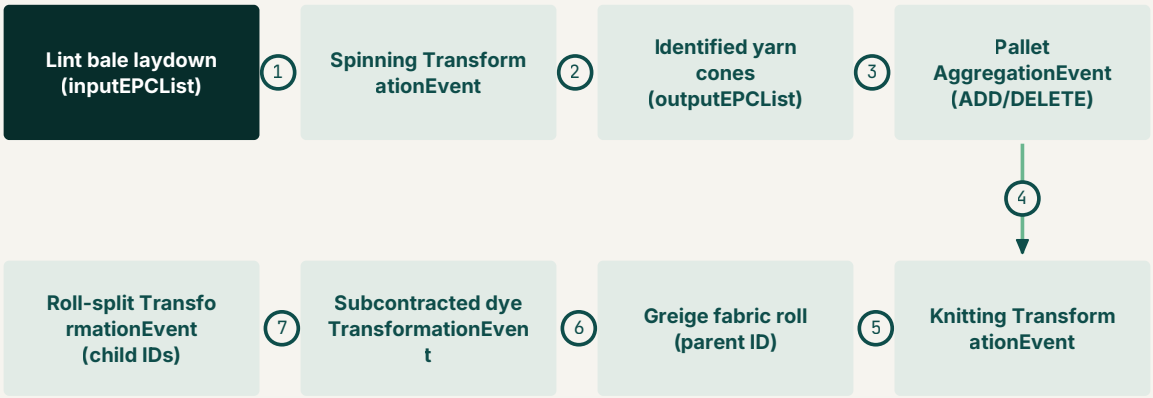
Subcontracted wet processing must remain explicit in the same graph. The proposed sequence pairs sender and receiver shipping observations with the subcontractor's transformation record at its own location, followed by the return handover. The June 2025 Aid by Trade Foundation standard and Textile Exchange's CCS make outsourcing, marking, transport evidence and volume control important scheme-specific review points. [S03] [S06] [S10] [S11] If the processor or its records fall outside the admissible scope, GFT would withhold the affected scheme claim and restrict any origin statement to the evidence that remains valid; the gap is not proof that the material's declared origin was false.

Material genealogy must also remain distinct from recipe and resource accounting. Greige rolls are substrate inputs; bath conditions, chemical lots, water and energy belong to process and impact records with their own methods. Companion paper wp06 treats those resource questions. Linking the records allows an analyst to ask which process acted on which roll without pretending that a dyestuff or a kilowatt-hour is a cotton-origin parent. [S05] [S10] [S28]

Exhibit 21, p. 85 maps the event grammar separating irreversible material conversions, roll splits, reversible logistics groupings and subcontracted loops across mid-chain stages. [S10] [S30]

EXHIBIT 21 /

A split and a conversion are different events



1. consume bales
2. new lot ID
3. reversible pack
4. keep cone IDs
5. new roll ID
6. custody loop
7. retire parent

ILLUSTRATIVE [S10] [S30] Illustrative event sequence distinguishing irreversible material conversion (EPCIS TransformationEvent), reversible logistics grouping (AggregationEvent) and roll splitting or subcontracted wet finishing. Normative event semantics follow GS1 EPCIS 2.0 (S10); credential-wrapped event mapping follows the pre-production UNTP Digital Traceability Events specification (S30).

Exhibit 21, p. 85 separates reversible grouping from material identity change. An EPCIS `AggregationEvent` with `action: ADD` places identified children under a `parentID`; a later `DELETE` can release the same child identifiers. [S10] In the proposed model, conversion and roll splitting instead consume the recorded parent and generate new outputs through a `TransformationEvent`. UNTP's Digital Traceability Events page offers a credential wrapper for comparison, but GFT treats it strictly as a pre-production pilot mapping because the opened specification is work in progress. [S30]

The release routine should query the graph in both directions. A backward query from a garment batch returns every contributing lot and its evidence state. A forward query from a suspect bale or roll returns every output requiring review. Orphan outputs, repeated consumption of a retired parent, cycles created by unversioned rework, unresolved corrections and incompatible quantity bases are proposed blocking conditions. Packing or unpacking a pallet must not change the underlying genealogy, while a split must carry the parent's input set to each child. These are acceptance tests for the future `trace-a-garment` implementation, not tests already passed by GFT. [S10] [S0502]

5.10

Cutting and sewing require defensible allocation rules

5.11 MULTI-ROLL CUTTING LAYS POOL THE GENEALOGY OF EVERY SPREAD ROLL

A cutting lay becomes a pooling boundary whenever plies from several rolls can enter shared bundles. GFT's default allocation rule is conservative: unless roll-separated plies and bundles remain physically and digitally linked, the transformation record connects every spread roll to every garment batch from that lay. If separation is demonstrated, the graph can use the narrower observed parent set. This is a proposed allocation rule using EPCIS transformation semantics, not an assertion that all cutting rooms operate identically. [S02] [S10] [S0501]

5.12 PRODUCT CLAIMS MUST SEPARATE MAIN COTTON FABRIC FROM TRIMS AND CUSTOMS ORIGIN

A cotton-origin statement about main fabric does not establish the origin of sewing thread, interlining, labels or buttons. GFT therefore gives non-cotton components their own material and supplier records rather than silently extending the cotton claim to the whole garment. Composition, provenance and customs origin remain separate propositions. [S18] [S34]

Three claim boundaries must remain separate at the sewing and packing boundary:

1. **Fibre-origin and certified-cotton claims** apply only to the specified cotton component ("Main body fabric: 100 percent cotton grown and spun in Cameroon"), provided the transformation graph preserves eligible custody across every parent roll in the cutting lay. [S02] [S03]
2. **Fibre-composition labelling** is governed in the European Union by Regulation (EU) No 1007/2011 on textile fibre names and related labelling and marking of fibre composition, which as the European Commission's sector overview (accessed on 30 October 2026) notes is distinct from geographic provenance and future Ecodesign Digital Product Passport fields. [S14] [S34]
3. **Customs origin** ("Made in Cameroon" for tariff and border declaration purposes) is determined by applicable rules of origin (tariff-shift or value-added criteria under World Trade Organization principles and trade agreements, analysed in wp08), which are legally distinct from where the raw cotton fibre grew. [S18]

WORKED EXAMPLE: MULTI-ROLL CUTTING LAY AND CLAIM SURVIVAL

Consider an illustrative cutting-room run LAY-CUT-2026-055 for a batch of 1,000 knitted cotton polo shirts (GAR-BAT-2026-310). Every quantity in this worked case is an illustrative assumption chosen to demonstrate the genealogy allocation method, not a GFT factory measurement. [S02] [S10]

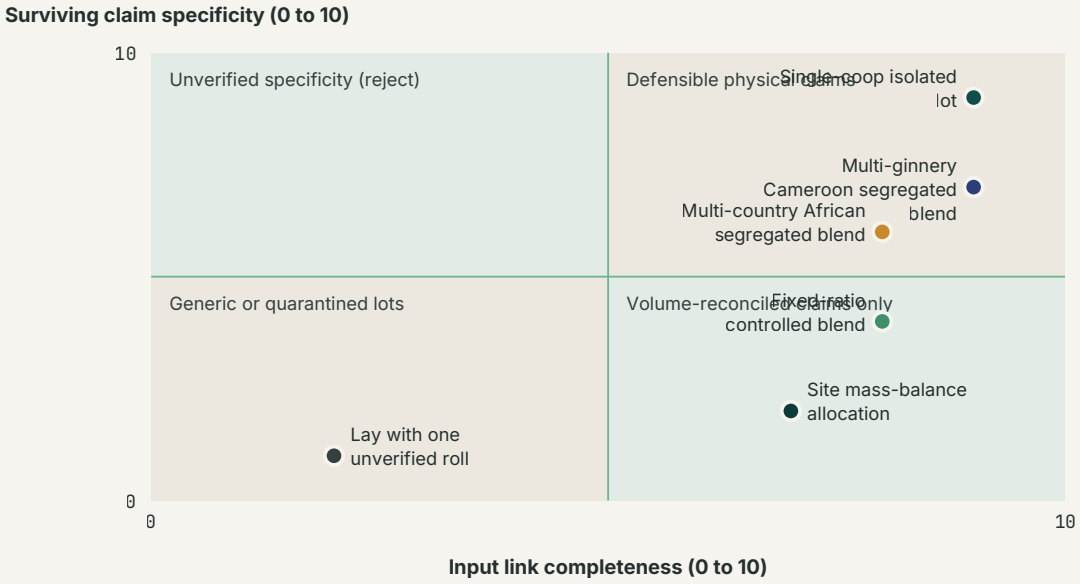
- **Inputs spread on the cutting table:** The supervisor spreads four finished knitted cotton rolls totalling an illustrative 250.0 kg of fabric: [S10]
- ROL-FIN-2026-101: 70.0 kg, traced through segregated spinning and dyeing to documented Northern Cameroon Producer Group Alpha (Segregation / CmiA Traceable eligible). [S07]
- ROL-FIN-2026-102: 65.0 kg, traced through the same segregated mill to documented Northern Cameroon Producer Group Beta (Segregation / CmiA Traceable eligible). [S07]
- ROL-FIN-2026-103: 65.0 kg, traced to an illustrative controlled blend containing 50.0 percent documented Cameroon cotton (32.5 kg) and 50.0 percent documented Benin cotton (32.5 kg). [S02]
- ROL-FIN-2026-104: 50.0 kg, purchased from a domestic trader with an invoice stating West African ginnery origin, but missing the spinning and fabric input-output records needed to connect this roll to that declaration. [S03]
- **Outputs from the cutting and sewing transformation:**
- 1,000 finished polo shirts (GAR-BAT-2026-310) with a net cotton fabric mass of 210.0 kg (0.210 kg per shirt), plus 8.0 kg of polyester thread, buttons and labels tracked on a separate trim ledger. [S10] [S34]
- 37.5 kg of clean cotton cutting clips (WST-CLIP-2026-055) collected for mechanical recycling (wp11), and 2.5 kg of sweepings and lint loss (WST-LOSS-2026-055). [S10]
- Mass balance check: 70.0 kg + 65.0 kg + 65.0 kg + 50.0 kg = 250.0 kg cotton input, equal to 210.0 kg + 37.5 kg + 2.5 kg = 250.0 kg cotton output. [S03]
- **Genealogy intersection and admissible claim calculation:**
- Because all four rolls were spread in one lay without ply-bundle isolation, every bundle and all 1,000 garments in GAR-BAT-2026-310 inherit the parent set {101, 102, 103, 104}. [S10]
- **Single-producer-group claim:** Not supportable for the pooled batch, because Groups Alpha and Beta were mixed with each other and with Rolls 103 and 104. [S02]
- **Unqualified single-country physical origin claim ("100 percent Cameroon cotton"):** Not supportable, because Roll 103 contains 32.5 kg of Benin cotton and Roll 104 (50.0 kg) lacks the records needed to verify Cameroon provenance. [S02] [S03]
- **Documented Cameroon physical cotton share:** Documented Cameroon cotton accounts for 70.0 kg + 65.0 kg + 32.5 kg = 167.5 kg, or 167.5 / 250.0 = 67.0 percent of the batch mass, while 32.5 kg (13.0 percent) is documented Benin cotton and 50.0 kg (20.0 percent) is unverified West African cotton. [S02]
- **Scheme Segregation claim:** Not supportable for GAR-BAT-2026-310 under this illustrative rule set because unverified Roll 104 enters the shared lay. [S06] [S07] A separate lay using only Rolls 101 and 102 would contain 135.0 kg. Applying the

> case's illustrative net-fabric ratio gives `135.0 × (210.0 / 250.0) / 0.210 = 540` shirts, for which a segregated Cameroon country-class claim could remain supportable if all other scheme conditions hold. [S02] [S07]

Exhibit 22, p. 88 positions six illustrative scenarios according to input-link evidence completeness (horizontal axis) and surviving claim specificity (vertical axis). [S02] [S03] [S07]

EXHIBIT 22 / ILLUSTRATIVE INDEX (0 TO 10)

The narrowest admissible claim survives the process



ILLUSTRATIVE [S02] [S03] [S07] Illustrative analytical positioning of six hypothetical blending and conversion cases across input evidence completeness (x-axis, 0 to 10) and surviving geographic or scheme claim specificity (y-axis, 0 to 10), derived from S02, S03 and S07 rules. Coordinates are qualitative analytical placements for comparison, not empirical measurements.

Exhibit 22, p. 88 makes the release logic visible. High specificity with weak input links is not admissible. Moving from an isolated producer-group lot to a documented multi-ginnery or multi-country blend reduces geographic specificity, but need not remove every supported claim. Controlled blending and mass balance support different percentage or administrative statements, while an unverified roll places the affected provenance claim on hold. The integer coordinates are illustrative visual positions, not measurements, assurance scores or scheme rankings. [S02] [S03] [S0503]

5.13

Rework and recovered material cannot inherit every old claim

5.14 DOUBLE-CLAIM PREVENTION REQUIRES RETIRING CONSUMED ELIGIBILITY UPON TRANSFORMATION

The proposed graph must handle returned partial cones, re-dyed rolls, repaired bundles and recovered cutting clips without treating them as one generic loop. Each pathway creates a different allocation question. If an output receives eligibility while the same eligibility remains available on its parent or a recovered stream, the factory could claim one eligible input twice. [S03] [S06]

Section 7.3 of the Aid by Trade Foundation's June 2025 standard prohibits double claiming of transaction volumes. Section 7.2 states that this edition's downgrade from HIP to mass balance is irreversible. [S06] Textile Exchange describes verified tracking and volume reconciliation for certified content. [S03] GFT therefore separates **returns to stock**, **in-process rework** and **by-product or waste recovery**, each with its own parent links, quantities and claim-allocation rule. [S06] [S10]

TRANSFORMATION AND REWORK ACCOUNTING BOUNDARY

In GFT's proposed factory genealogy engine, every transformation and recovery loop must satisfy four formal state rules grounded in EPCIS 2.0 (S10), W3C PROV constraints (S0502) and scheme volume-reconciliation principles (S03, S06): [S03] [S06] [S10] [S0502]

1. **Conservation at initial transformation:** For any transformation event `T_k` consuming input mass `M_in` and producing primary output `M_good`, recoverable stream `M_rec` and unrecoverable loss `M_loss`, the physical balance must satisfy `M_in = M_good + M_rec + M_loss` on a compatible moisture basis. [S03] [S10]
2. **Partition of eligible claim balance:** Eligible claim quantity `E_in` entering `T_k` is allocated without reuse so `E_good + E_rec + E_loss = E_in`, with every term non-negative and with the scheme's conversion rules defining each quantity. [S03] [S06] If all available eligibility is allocated to `M_good`, then `E_rec = 0` unless the governing scheme expressly permits another allocation. Physical mass and claim eligibility remain separate accounts.
3. **Acyclic versioned rework nodes:** Re-dyeing rejected roll `ROL-FIN-2026-108A` must not overwrite its history. The proposed activity consumes the old node and generates `ROL-RWK-2026-108A-V2`, with links to every additional roll loaded into the same rework batch. W3C PROV-CONSTRAINTS supplies the broader requirement for a consistent history, while the versioned-node pattern is GFT's implementation choice. [S10] [S0502]
4. **Irreversible downgrade propagation:** If a rework bath mixes a segregated Cameroon roll with a conventional or mass-balance roll in the same vessel, `ROL-RWK-2026-108A-V2` permanently loses segregated status under S06. [S02] [S06]

5.15 PROVENANCE GENEALOGY MUST REMAIN DISTINCT FROM RECYCLED-CONTENT ELIGIBILITY

Recovered noil and cutting clips raise two separate questions: what origin evidence their parent graph carries, and whether a particular standard accepts the stream as recycled content. The first is a genealogy question. The second requires the applicable circularity definition, facility scope and claim rules, which companion paper wp11 addresses. UNTP's work-in-progress event page and GS1's Core Business Vocabulary provide working terms for a pilot mapping, not recycled-content eligibility. [S11] [S30]

In the illustrative cutting case, clips retain the lay's recorded origin distribution of 67.0 percent documented Cameroon, 13.0 percent documented Benin and 20.0 percent unverified West African cotton. Their initial transformation already records 37.5 kg as a separate output. A later recovery claim must not reuse eligibility already allocated to the garments, and it must not deduct the same physical mass a second time. [S03] [S06] This separation keeps physical stock, provenance and recycled-content eligibility visible as related but distinct registers.

5.16

Unknown input links must propagate downstream

5.17 AN OUTPUT CLAIM CAN NEVER BE MORE SPECIFIC THAN ITS WEAKEST INPUT LINK

The decisive test of the architecture is an imperfect record: a replacement bale without a readable tag, an unlabelled yarn cone or an omitted roll scan. The graph must represent these as explicit exceptions rather than fill them with likely values. [S10] [S0502]

GFT's **conservative propagation rule** is a design choice informed by claim-specific custody models and consistent provenance histories: *for each attribute, an output claim cannot be more specific than the admissible evidence shared by every input that could have entered its batch.* [S02] [S0502] [S0503] An unknown origin parent therefore restricts dependent origin claims on every child. It does not automatically invalidate unrelated fields such as measured composition, and it does not prove that the declared origin was false.

> **GFT NOTE**
>
> GFT recommends **automated claim-ceiling inheritance** in the transformation-event ingestion logic. On commit, the proposed engine computes each output attribute from its parent evidence and the applicable allocation rule. A parent with `origin_status = UNKNOWN` or `custody_status = QUARANTINED` places the affected provenance or scheme claim in `HOLD`, not the entire product record. The hold propagates to dependent outputs until an authorised reviewer reconstructs the link from admissible documents or approves a narrower statement. Any percentage claim must use reconciled quantities rather than bale counts. [S02] [S03] [S10] [S0503]

5.18 RECONSTRUCTION REQUIRES PRIMARY DOCUMENTS AND EPCIS ERROR DECLARATIONS

A dangerous configuration lets a supervisor or enterprise system replace `unknown` with the usual supplier or predominant warehouse lot. That substitution turns missing evidence into an unsupported assertion and prevents a reviewer from distinguishing an observation from a software guess. [S02] [S0502]

> **WARNING**
>
> Never configure a manufacturing execution system, warehouse management system or enterprise resource planning interface to populate a default supplier, default country of origin or default bale laydown ID when an operator leaves a scan field blank. [S10] [S0502] Silent default values destroy the evidential value of the genealogy graph because an independent reviewer can no longer distinguish a genuinely observed scan from an automated software guess. [S03] [S0502] Missing links must be stored explicitly as an `UNKNOWN_INPUT` node with its measured or estimated mass, blocking physical provenance release until resolved through documented investigation or narrowing the batch claim to the remaining verified boundary. [S01] [S02]

Reconstruction is permissible only where contemporaneous evidence establishes the physical event. In an illustrative omission, the spreading sheet, rack issue log and remnant weigh-back ticket all identify `ROL-FIN-2026-102`. If an earlier event exists but is wrong, EPCIS 2.0 provides an `ErrorDeclaration` with its reason and corrective event references. If no event was captured, the proposed system creates a late record that preserves actual event time and later recording time. Both paths retain the evidence and reviewer identity. [S03] [S10] If the documents cannot establish which roll was spread, the unknown parent remains and the affected claim is narrowed or withheld. [S01] [S06]

Exhibit 23, p. 92 traces five exception scenarios from defect to passport disclosure. [S01] [S02] [S10]

EXHIBIT 23 /

Missing links restrict output claims

Defect stage and scenario	Graph representation	Downstream propagation	Admissible claim outcome	Permitted recovery path
Spinning: 2 of 40 bales in laydown lack ginnery origin tags	Insert UNKNOWN_BALE nodes with measured or estimated masses into Transformatio nEvent	All yarn cones, greige rolls and garments from lot inherit an unknown input parent	Unqualified single-country physical claim blocked; any percentage uses reconciled mass and scheme rules	Match physical bale-tie serials to ginnery dispatch manifest via EPCIS ErrorDeclaration, or keep downgrade
Knitting: creel topped up with unlabelled buffer yarn cones	Link UNKNOWN_YARN node to affected greige roll IDs only	Only rolls knitted during buffer top-up inherit unknown yarn parent; earlier rolls unaffected	Affected rolls quarantined from segregated orders and routed to conventional garment lines	Physical isolation of affected rolls; no retrospective origin reconstruction allowed without cone lot tags
Wet processing: rolls sent to subcontractor outside approved scope	Custody gap flagged on subcontractor ObjectEvent and Tr ansformationEvent	All finished rolls in dye batch inherit the affected scheme evidence gap	Scheme claim withheld; origin statement limited to separately admissible evidence	Recovery depends on the governing scheme; otherwise release without the unsupported scheme claim
Cutting: 1 of 5 rolls spread in lay omitted from digital scan	Reconciliation shows an unexplained residual after recorded outputs and waste	All bundles and garment batch GAR-BAT placed on automatic claim HOLD	Passport provenance field withheld pending investigation	Reconcile spreading sheet, rack issue log and remnant weight; issue corrective event with reviewer sign-off
Sewing: reworked garments from two batches mixed on repair rail	Rework Transformat ionEvent merges parents from both source batches	Repaired sub-batch inherits union of both batches' upstream input graphs	Claim narrows to the common attribute shared by both source batches	Segregate repair rails by batch ID in future runs; keep merged claim for already-mixed garments

ILLUSTRATIVE [S01] [S02] [S10] Illustrative exception propagation across fabric roll, cutting lay, sewing bundle and garment batch under GFT's conservative design rule, using the generic custody framework in S01, attribute-specific models in S02 and EPCIS event semantics in S10.

Exhibit 23, p. 92 shows why precise boundaries limit the scope of a hold. A recorded creel-change window can restrict an exception to the rolls produced in that window, while an unverified input to a shared laydown or cutting lay affects every dependent

output. These rules supply adverse scenarios for `trace-a-garment` and the genealogy inputs for Chapter 6, where physical stock, process yield and claim ledgers are reconciled separately. [S02] [S03] [S10]

A factory may blend its fibre, but it cannot blend away an unknown input.

CHAPTER SOURCE NOTES

S0501 World Wide Web Consortium. 2013-04-30.

S10 GS1. 2022.

S0503 UNECE / UN Transparency Protocol. 2026-10-30.

S28 UNECE / UN Transparency Protocol. 2026-10-30.

S11 GS1. 2022.

S02 ISEAL Alliance. 2025.

S07 Aid by Trade Foundation / Cotton made in Africa. 2026-10-30.

S03 Textile Exchange. 2026-10-30.

S05 Global Standards gGmbH. 2026-10-30.

S06 Aid by Trade Foundation. 2025.

S34 European Commission, DG GROW. 2026-10-30.

S0502 World Wide Web Consortium. 2013-04-30.

S01 International Organization for Standardization. 2020.

S30 UNECE / UN Transparency Protocol. 2026-10-30.

S18 World Trade Organization. 2026-10-30.

S14 European Commission, DG GROW. 2026-10-30.

06

PART II: EVERY TRANSFORMATION NEEDS A RECORD / QUANTITY INTEGRITY

Reconciliation prevents claims from outrunning material

Physical stock, processing yield and eligible claims need related but separate accounts.



CHAPTER 06
DECISION TEST

Physical stock, processing yield and eligible claims need related but separate accounts.

Reconciliation should stop a claim before it exceeds the material and eligibility that its records can support. Green Future Tech Limited (GFT), Hong Kong SAR, therefore treats three accounts as distinct: a physical ledger asks where material is, a transformation account explains how inputs became outputs, and a claims ledger records which attributes remain available for allocation. They must agree through explicit rules, not through a single balance that silently substitutes for all three. A warehouse can hold cotton whose origin evidence is inadmissible. A scheme account can hold eligible quantity without proving which fibres sit in a particular garment. Reconciliation makes those differences visible and gives a release reviewer a reason to stop.

This chapter specifies that control for GFT's proposed Cameroon textile work. It is a design for a later pilot, not a report of an operating factory, certified supplier, completed reconciliation or realised saving. All named identifiers, quantities, conversion factors and warning bands below are illustrative teaching inputs. They do not describe a GFT result or an industry tolerance. Scheme requirements belong to their stated editions and scopes. This chapter is not investment, legal or tax advice.

6.1

A physical ledger needs an explicit boundary

A physical balance is meaningful only after its account boundary is fixed. The account card should name the site, material class, custody model, stock locations, opening time, closing time and measurement basis. It should also state whether work in progress and recoverable material sit inside or outside the account. Seed cotton, lint, yarn, fabric and garments cannot share an unqualified kilogram balance. Their forms, additives and units differ. The Content Claim Standard overview expressly connects volume reconciliation with documentation for receiving, processing and transfer, while the opened Aid by Trade Foundation standard requires ongoing reconciliation by lot or batch within its own scope. [S03] [S06]

For an eligible processing account, GFT would use `C_model = O + R + U - D - Q - W - L`. Here `O` is opening stock, `R` is admitted receipts, `U` is returned material accepted back into the same account, `D` is dispatches, `Q` is good output transferred out, `W` is recoverable material transferred to a separate recovery account, and `L` is recorded loss. `C_model` is the modelled closing quantity. The equation does not estimate the physical count. It predicts what the count should be if every flow is complete and measured on the same basis.

6.2 EACH MOVEMENT MUST CROSS THE BOUNDARY ONCE

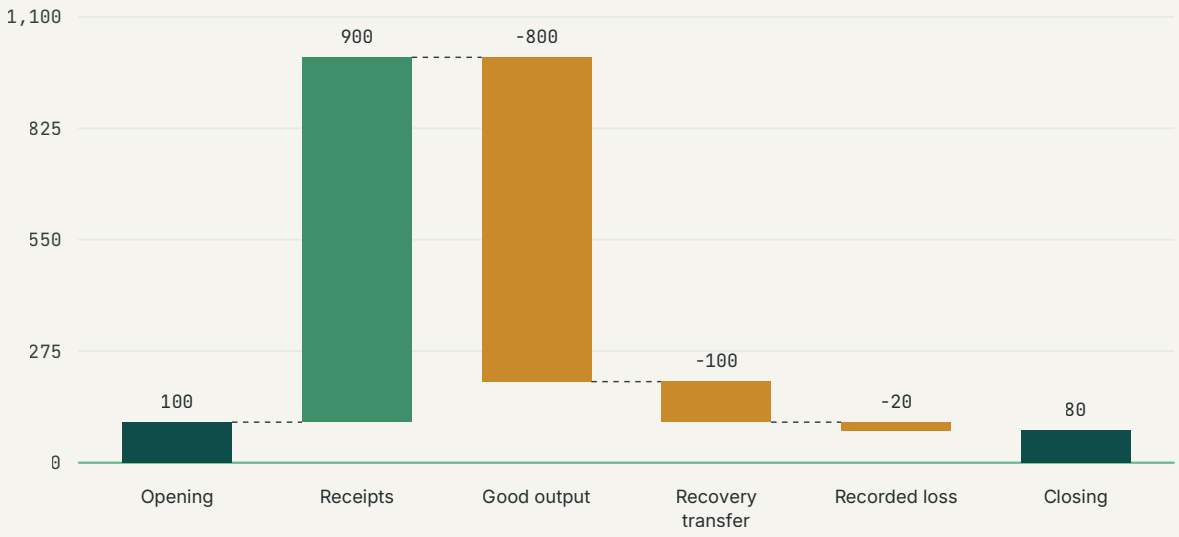
The sign of a flow comes from the account card, not from the document title. A supplier return is an outward movement when the original receipt remains in the account history. A customer return is an inward movement only when the material has actually re-entered the defined boundary and its identity has been accepted. A transfer to a subcontractor is not process consumption. It is a movement to another custody location, with a corresponding account and return or output linkage. These distinctions prevent a dispatch and a transformation input from removing the same quantity twice.

Cut-off discipline matters as much as the formula. A receipt entered after the close but physically present before it creates a timing exception, not free stock. A late message must retain its physical event time and later recording time. GS1's event model separates the observation of a business step from the systems that exchange it, and its vocabulary gives parties shared meanings for steps and dispositions. [S10] [S11] Reconciliation should use those meanings to include each physical event once, in the correct period, without treating database arrival as the movement itself.

The illustrative balance in **Exhibit 24**, p. 96 starts from disclosed training quantities. Recoverable material is subtracted because it leaves this account for a separately identified recovery account, not because it vanishes. A different account boundary would require a different presentation.

EXHIBIT 24 / KG ON ONE DECLARED ILLUSTRATIVE BASIS

A reconciled balance accounts for every stated flow



ILLUSTRATIVE [S03] [S06] Illustrative training case, not a GFT result. Opening 100 + receipts 900 - good output 800 - recoverable transfer 100 - recorded loss 20 = modelled closing 80 kg. Returned material and dispatches are zero in this case. The recovery transfer leaves this account but remains identified elsewhere.

The waterfall accounts for the modelled flow, but it does not prove the physical count or the admissibility of any origin claim. Those are separate tests. The reviewer must still inspect the count record, scale basis, material identifiers, event references and evidence supporting the claim class. A balanced spreadsheet can be arithmetically correct and commercially unsupported.

WORKED EXAMPLE: CLOSE THE ELIGIBLE PROCESSING ACCOUNT

Assume an illustrative opening balance of `100 kg`, receipts of `900 kg`, good output of `800 kg`, a recoverable transfer of `100 kg` and recorded loss of `20 kg`. There are no illustrative returns or dispatches in this case. The model gives `100 + 900 - 800 - 100 - 20 = 80 kg`. If the observed closing count is also `80 kg`, the residual defined later as observed minus modelled quantity is `80 - 80 = 0 kg`. This is an arithmetic demonstration only. It does not show that the receipts were eligible, that the loss was acceptable or that any product can carry a claim.

GFT NOTE

GFT should refuse to calculate a residual until the account card is complete. The reviewer should be able to answer: which material, which site, which custody model, which period, which stock locations, which measurement basis, and which recovery and work-in-progress accounts? If any answer is unknown, the close remains provisional and the affected claim remains unreleased.

6.3

Process yield is measured rather than imported from a benchmark

A conversion factor is an output of measured production, not a licence to create eligible output. For a completed process and a declared material basis, GFT would calculate good-output yield as `Y_good = M_good / M_in`. Separate ratios should describe recoverable outputs and recorded losses. Their purpose is to explain the observed process, including material still in production, rather than to force every batch towards a benchmark. The opened Aid by Trade Foundation standard calls for actual input and output records, physical inventory and comparison of actual with expected waste factors in its volume-reconciliation procedure. [S06]

The denominator must match the numerator. A lint-to-yield ratio cannot use seed-cotton receipts without a measured ginning link. A fabric-to-garment calculation cannot switch silently between kilograms, metres and garment counts. Where several input lots feed one campaign, the transformation record must preserve the eligible input set and its quantities. GS1's TransformationEvent explicitly records the relationship between inputs and outputs, including the possibility that any listed input contributed to each output. [S10] That relationship supports calculation, but it does not justify a more precise physical origin than the process can establish.

6.4 WORK IN PROGRESS BELONGS TO THE PERIOD ACCOUNT

A period close rarely coincides with empty machines. Material may be opened, partly processed, awaiting inspection or held for rework. The account therefore needs identified work-in-progress quantities and states. Completed-output yield should use completed output and the inputs consumed to produce it. A separate movement balance should explain changes in work in progress. Combining the two without adjustment can make a process appear to gain material merely because opening work was completed, or lose material because closing work has not yet emerged as output.

The practical record is a campaign bridge. It lists opening work, new inputs, completed good output, recoverable outputs, recorded losses and closing work. Each quantity carries the same material and moisture basis, or an explicit measured conversion. The reviewer checks that opening work equals the prior period's accepted closing work and that a batch cannot be counted both as closing work and as completed output. Any estimated work-in-progress quantity remains labelled as an estimate, with its method and approver, rather than becoming a precise observed mass.

6.5 MOISTURE AND FINISHING CAN IMITATE EXCESS PRODUCTION

Mass changes that have an explained physical basis must not be read as new cotton. Consider an illustrative constant dry mass of `900 kg`. At an illustrative moisture share of `10 percent`, its wet mass is `900 / 0.90 = 1,000 kg`. At an illustrative moisture share of `20 percent`, its wet mass is `900 / 0.80 = 1,125 kg`. The `125 kg` difference is water in this constructed case, not additional fibre. A wet-mass comparison without the moisture basis could falsely present that difference as excess output.

Finishing creates a similar risk. If an illustrative `800 kg` fabric receives `40 kg` of documented non-cotton finishing additions, the resulting `840 kg` as-is fabric mass does not contain `840 kg` of cotton. The cotton account, additive account and total product-mass account must retain their separate quantities. The correct treatment depends on the process and claim rule, but the arithmetic boundary is constant: an additive cannot inherit cotton eligibility merely because it changes the weighed total.

> **METHOD**
>
> For each process family, pin a yield record containing the input and output material classes, campaign and site, quantity unit, moisture or additive basis, opening and closing work in progress, good output, recoverable output, recorded loss, measurement references and rounding rule. Store the formula version beside the result. Recalculate a sample from raw quantities during review. Replace a provisional conversion factor only through an approved revision that leaves the prior calculation reproducible.

Expected yields remain useful as questions. A shift away from an established range can prompt a check of scale condition, input quality, machine settings, waste handling or record completeness. It cannot prove substitution or error by itself. Nor should a favourable yield automatically increase the claims ledger. Eligibility follows the chosen scheme's rules and the evidence attached to the actual input and output, not the mere existence of a calculated gain. [S02] [S03]

6.6

The claims ledger has its own eligibility rules

The claims ledger records a right to allocate a defined attribute under specified rules. It is not a second name for physical inventory. ISEAL describes custody models as transferring materials and associated attributes, while Cotton made in Africa's current overview describes Mass Balance as quantity-based tracking with equivalent verified

volumes accounted for. [S02] [S07] Neither proposition says that a positive account balance identifies the physical fibres in one garment. The claim statement must retain that limit.

GFT would write the account as `E_close = E_open + E_admit + E_reverse - E_alloc - E_expire - E_downgrade`. `E_open` is the accepted opening eligible balance, `E_admit` is quantity admitted after purchase and evidence review, `E_reverse` is a permitted cancellation reversal, `E_alloc` is quantity allocated to released claims, `E_expire` is quantity no longer eligible, and `E_downgrade` is quantity moved to a narrower claim account. The unit may be a scheme-defined equivalent quantity rather than observed mass. Each term needs a rule reference and transaction evidence.

6.7 ADMISSION IS A DECISION, NOT A RECEIPT DEFAULT

Physical receipt does not automatically create eligibility. The admission review should test supplier and site scope, material class, custody model, transaction evidence, quantity basis and any required confirmation. The ISO public abstract warns that a chain-of-custody framework alone is not intended to make or verify a product claim. [S01] The same limitation applies here: an account structure cannot decide admissibility without the evidence and rules that give an entry meaning.

A rejected or pending quantity remains visible. It should appear as `PENDING`, `INELIGIBLE` or `UNKNOWN`, as appropriate, rather than being entered as zero eligible stock and forgotten. Zero can be a calculated balance. Unknown means that the required fact has not been established. This distinction stops an evidence gap from disappearing inside an apparently clean close.

The illustrative registers in **Exhibit 25**, p. 100 deliberately produce different closing balances. They show why a reviewer must reconcile the relationship between accounts rather than expect numerical identity. The figures do not represent any scheme's conversion rule.

EXHIBIT 25 / ILLUSTRATIVE KG AND SCHEME-DEFINED KG EQUIVALENT

Physical stock and claim eligibility answer different questions

Account question	Physical processing ledger	Eligible claims ledger
Purpose	Where is the material?	Which attribute can still be allocated?
Opening	100 kg	40 kg equivalent
Admitted increase	900 kg received	850 kg equivalent admitted
Released or allocated	800 kg good output	700 kg equivalent allocated
Other decreases	100 kg recovery transfer; 20 kg loss	50 kg equivalent expired or downgraded
Permitted reversal	No return in this case	30 kg equivalent cancellation reversed
Closing	80 kg	170 kg equivalent
Release evidence	Count, basis, genealogy and custody	Eligibility, rule version and unique allocation

ILLUSTRATIVE [S02] [S03] [S06] Illustrative training registers, not an operating account or a scheme conversion example. Physical closing: 100 + 900 - 800 - 100 - 20 = 80 kg. Claim closing: 40 + 850 + 30 - 700 - 50 = 170 kg equivalent. The difference is not itself a nonconformity; the account boundaries, rule versions and transaction links must explain it.

A difference between the two closing quantities is not automatically an error. It may follow from their different definitions, periods or scheme rules. It becomes an exception when the declared relationship between the accounts cannot explain it. For example, an allocation that cites no admitted input, uses an obsolete conversion rule or exceeds the available balance is unsupported even if the physical warehouse is full. Conversely, destroying physical material does not necessarily tell the reviewer how every scheme requires the corresponding attribute account to be adjusted. That adjustment needs its own rule and approval.

6.8 EVERY ALLOCATION NEEDS A COMPLETE KEY AND LINEAGE

The minimum allocation record should identify the claim account, scheme and edition, custody model, site, period, input transactions, transformation or conversion rule, output lot, quantity, unit, allocation time and release reference. It should also identify the evidence approver and any cancellation that later affects the allocation. These fields let another person reconstruct why the quantity was available and where it went.

> **GFT NOTE**
>
> Do not implement `eligible = physical stock × standard yield` as a dashboard shortcut. GFT should calculate physical yield from observed production and calculate eligibility from admitted inputs and versioned scheme rules. A comparison control can then ask whether the two accounts have a credible relationship. The release service should treat absent rule versions, unknown evidence status and missing genealogy as blocking conditions, not default values.

6.9

Duplicate allocation needs a control at the time of release

Duplicate claiming is a release failure, not merely a reporting defect. A nightly reconciliation can discover that two sales consumed the same eligible quantity, but by then both buyers may hold an unsupported statement. The control must therefore execute when an allocation is proposed. The opened Aid by Trade Foundation standard prohibits the same CmiA or RCS volumes being claimed under both that programme and another certification or sustainability programme, within its stated scope. [S06] It is a scheme-specific rule, not a complete definition of every conflict that a factory should prevent.

GFT would give each allocation a unique identifier and bind it to one claim account, one output set and one released claim statement. Before acceptance, the release transaction should confirm that the input allocation is active, the output genealogy is admissible, the conversion rule is current for the intended claim, the available balance is sufficient and no incompatible allocation already exists. All checks and the debit should succeed or fail together. A separately generated label or passport entry must not become visible before that transaction commits.

6.10 UNIQUENESS MUST SURVIVE RETRIES AND CANCELLATIONS

A retry after a network failure should return the original allocation result, not create a second debit. This requires an idempotency key supplied by the requesting process and a stored response tied to that key. A cancellation should append a linked reversal that identifies the original allocation, the quantity reversed, the reason and the authority. It should not delete the original record. Shared event vocabulary helps parties distinguish a physical movement from its later business state, but the uniqueness rule remains an application control. [S10] [S11]

Returns need the same discipline. Physical return of a garment, cancellation of an invoice and restoration of an eligible balance are different events. The last should occur only if the governing rule permits it and the complete original allocation can be identified. A downgrade also needs an explicit destination account. A later purchase must not be used to repair an earlier unsupported physical claim or to erase a sale recorded under a narrower claim.

> **WORKED EXAMPLE: STOP THE SECOND INCOMPATIBLE ALLOCATION**
>
> Assume an illustrative claim account has `700 kg equivalent` available after all admissions and prior adjustments. A proposed first order allocates `500 kg equivalent`, leaving `200 kg equivalent`. A second order then requests `300 kg equivalent` from the same account. Its requested amount exceeds the remaining balance by `100 kg equivalent`. The release control should block the second request and preserve both the first allocation and the failed attempt. It should not silently issue a partial claim for `200 kg equivalent`, because commercial approval, output genealogy and the buyer's agreed statement may not support that smaller quantity. These figures are illustrative and do not represent a scheme rule.

The failed request is useful evidence. It should record the requested quantity, available balance, conflicting allocation where relevant, rule version and reviewer decision. Operations can then investigate whether the cause is a genuine shortage, a duplicated message, an incorrect conversion, an expired input or a commercial attempt to make incompatible claims. The system should not infer intent from the arithmetic.

Where staffing permits, the person who enters an adjustment should not be the only person who approves its release. Independent review is particularly important for manual balance corrections, cancelled sales and changes to conversion rules. The Content Claim Standard overview links credible content claims with verified tracking and documentation, which supports a release decision grounded in inspectable records rather than dashboard availability alone. [S03]

6.11

Exceptions need uncertainty as well as a residual

The residual is a diagnostic quantity, not a verdict. GFT defines it as `r = C_obs - C_model`, where `C_obs` is the observed closing quantity and `C_model` is the modelled closing quantity. A positive residual means that observed stock exceeds the model. Possible causes include an omitted receipt, an overstated outbound flow, a duplicated outbound record or an incorrect count. A negative residual means that observed stock is below the model. Possible causes include an omitted dispatch, an unrecorded loss, a duplicated receipt or an incorrect count. The sign convention must travel with every report.

A zero residual is narrower than it appears. It says that the observed and modelled closing quantities agree under the stated basis. It does not prove that each input was genuine, every output carried a valid claim or two offsetting errors were absent. Nor does a non-zero residual establish theft, substitution or false origin. It locates a question for investigation.

6.12 UNCERTAINTY DESCRIBES WHAT THE RESIDUAL CANNOT RESOLVE

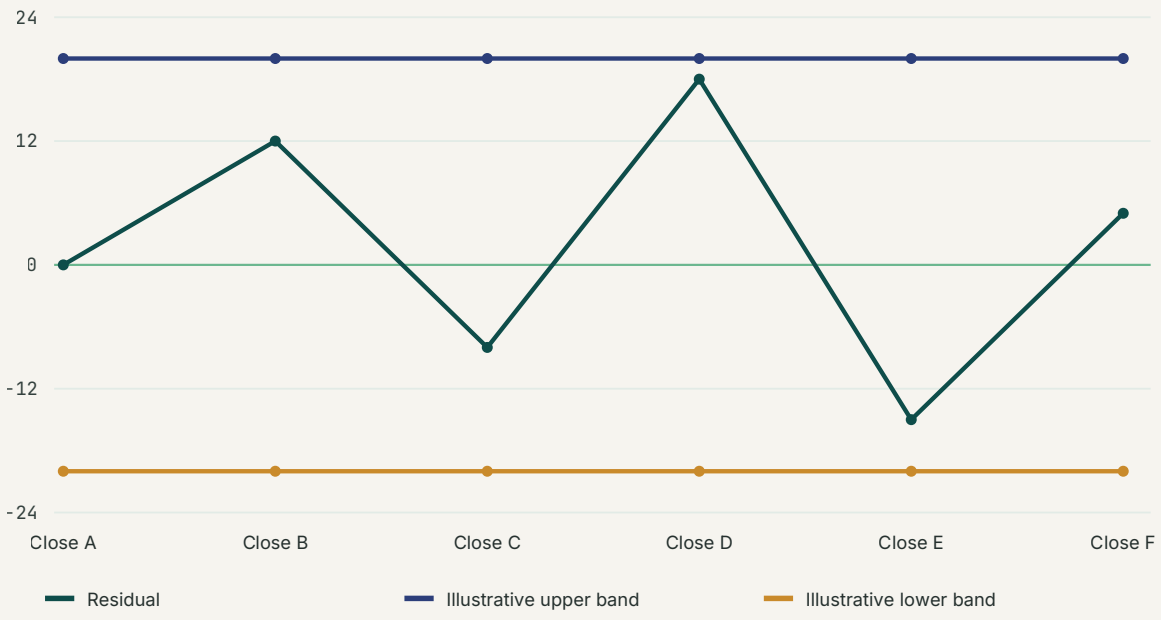
Every observed quantity has a measurement context. Scale resolution, container tare, moisture assessment, roll-length conversion, work-in-progress estimation, timing and rounding can all affect the close. The review should record which components are measured, which are estimated and which are unknown. It should not attach an invented confidence interval to the result. Where an uncertainty allowance is used, its derivation, coverage meaning and source observations must be stated.

GFT would report the residual together with an explicitly derived review allowance `U`, rather than present `r` as an exact physical truth. The comparison `r` against `U` can help prioritise investigation, but it cannot make an unsupported claim eligible. If the inputs needed to derive `U` are missing, the allowance is `UNKNOWN`, not zero. A pilot should gather repeated counts and process variation before proposing an operational warning band.

The training series in **Exhibit 26**, p. 103 uses a fixed teaching band solely to demonstrate why the band's basis matters. It is not measured process variation and not an accepted tolerance.

EXHIBIT 26 / KG, ILLUSTRATIVE OBSERVED-MINUS-MODEL RESIDUAL

A residual becomes useful only beside its declared review band



ILLUSTRATIVE Illustrative teaching series. Residuals are 0, 12, -8, 18, -15 and 5 kg for six synthetic closes. The selected review band is plus or minus 20 kg at every close, chosen only for display. It is not a statistical interval, measured process limit, GFT tolerance or scheme requirement.

All six illustrative residuals sit inside the selected band, yet that fact alone would not justify automatic release. A real review needs the band's empirical basis and must still examine systematic errors that a wide band could hide. Equally, a value outside a band is an investigation trigger, not proof of misconduct.

Scheme rules must remain separate from internal review allowances. The opened June 2025 Aid by Trade Foundation standard requires deviations of more than five percent from expected volumes to be investigated and communicated for volume correction within its scope. [S06] That obligation must not be universalised to another scheme, and it does not mean that a smaller deviation is necessarily immaterial. The illustrative `20 kg` band above has no relationship to that requirement.

> **WARNING**
>
> Never set an exception to zero by deleting the original observation, and never let a tolerance silently absorb an unknown quantity. Preserve the first close, append any recount or correction with its evidence, and keep the affected claim on hold until an authorised reviewer accepts the revised account. A discrepancy is not proof of wrongdoing, but an unresolved discrepancy can be sufficient reason to restrict a claim.

6.13

The reconciliation should be reproducible by another person

A close is complete only when another competent person can reconstruct it without asking the preparer which hidden adjustment made it balance. The reproducibility pack should contain the signed account card, opening balance reference, source-event extract, physical count records, measurement bases, claim-account entries, conversion-rule versions, rounding rules, calculations, exceptions and approvals. It should identify excluded records and explain each exclusion. A reviewer begins with those source records, calculates an independent expected result and compares that result with the preparer's work.

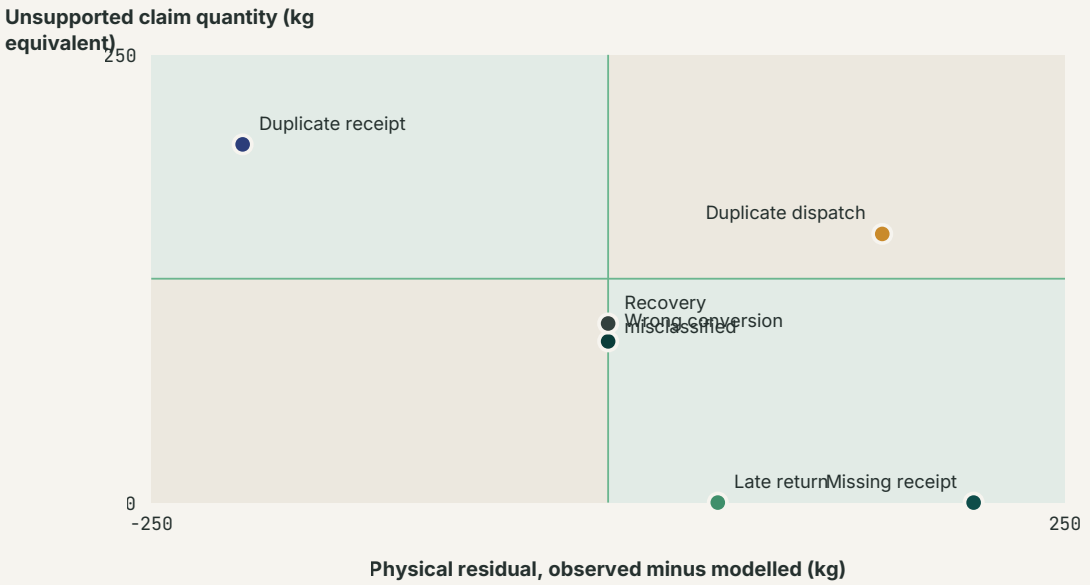
This is more than retaining a spreadsheet. The pack must preserve the relationship between a physical movement, its transformation genealogy and its claim allocation. EPCIS supplies a pinned way to describe transformation inputs and outputs, while the Core Business Vocabulary supplies agreed business-step and disposition meanings for exchanging events. [S10] [S11] Those standards do not calculate the factory's balance. They reduce ambiguity in the records from which the balance is rebuilt.

6.14 DEFECTS LEAVE DIFFERENT ARITHMETIC SIGNATURES

The illustrative cases in **Exhibit 27**, p. 105 start from the earlier balanced account, with observed and modelled closing stock both equal to 80 kg. Each case changes one stated condition. The horizontal position is the resulting physical residual, observed minus modelled quantity. The vertical position is the unsupported claim quantity created by the accompanying claim error. A zero on either axis means no effect under that particular constructed case, not safety in every operating condition.

EXHIBIT 27 / KG, ILLUSTRATIVE RESIDUAL AND UNSUPPORTED CLAIM QUANTITY

Ledger defects produce distinct physical and claim effects



ILLUSTRATIVE [S03] [S06] [S10] Illustrative arithmetic from the base closing balance of 80 kg. Missing receipt 200: model -120, residual +200, no claim allocation. Duplicate receipt 200: model 280, residual -200, duplicate eligibility 200. Duplicate dispatch 150: model -70, residual +150, duplicate claim 150. Late return 60: model 20, residual +60, no claim allocation. Wrong conversion on 900 eligible kg: 900 x (0.80 - 0.70) = 90 kg unsupported, physical residual 0; both factors are hypothetical. Recovery misclassification: 100 kg incorrectly admitted, physical residual 0. No factor or effect is a scheme benchmark.

The matrix separates defects that a stock count can reveal from defects that can survive a perfect stock count. A missing receipt changes the physical residual in this case because the actual material is counted while its inflow is absent from the model. A duplicated receipt has the opposite sign because the model expects material that does not exist. A duplicated dispatch creates a positive residual because the model removes too much stock. These are conditional signatures, not automatic diagnoses. Other combinations of errors can produce the same result.

The wrong-conversion and recovery-misclassification cases are more dangerous for claim release because they leave the illustrative physical residual at zero. Only the claims ledger and its rule lineage expose the overstatement. That is why a clean physical close cannot serve as the sole release gate. The reviewer must test eligibility, conversion and duplicate allocation even when $r = 0$.

6.15 A FIXED REVIEW SEQUENCE PREVENTS CONVENIENT CORRECTIONS

GFT would apply the same investigation order to every exception. First, preserve the original close and block the affected claim allocations. Second, confirm the account boundary, cut-off, material identity and measurement basis. Third, recount or inspect the relevant physical material where practicable. Fourth, replay receipts, dispatches, returns, transformations and claim allocations from their identifiers. Fifth, test conversion versions and duplicate keys. Finally, append the evidenced correction and obtain release approval. The sequence avoids choosing whichever explanation most quickly produces a zero residual.

Corrections must identify their cause at the level actually known. `MISSING_RECEIPT`, `DUPLICATE_EVENT`, `CUT_OFF_REVIEW`, `BASIS_REVIEW` and `RULE_VERSION_REVIEW` are useful working states while evidence is gathered. They should not be replaced with a definitive fraud or loss category without supporting facts. If the cause remains unresolved, the correction can make the arithmetic transparent but it cannot make the original uncertainty disappear.

A repeatable specification for the educational trace-a-garment calculation should therefore accept an account card and an ordered event set, then produce separate physical, transformation and claim balances. It should expose every input, formula, rule version, exclusion, residual and warning. It should reject incompatible units and unresolved references rather than coerce them. Replaying the same event set should produce the same result, and repeating one event identifier should not create another business movement or allocation. The output is an educational calculation until real inventory and evidence are independently checked.

> **GFT NOTE**
>
> GFT should make independent reconstruction a pilot acceptance condition. Give a reviewer the source documents and the calculation specification, not the preparer's final workbook. The pilot passes this control only when the reviewer reproduces the physical balance, follows each claim allocation to an eligible input set, identifies injected duplicates and reaches the same release or hold decision. Any manual override needs its own evidence, approver and retained reason.

The release decision should end with three explicit outcomes. `SUPPORTED` means that the physical, genealogy and eligibility checks required for the stated claim have passed. `RESTRICTED` means that only a narrower statement is supported. `HOLD` means that the available records cannot support release. Each outcome needs a scope, reviewer, time and link to the reconciliation pack. The commercial team then receives a claim it can explain, while operations retains a precise list of what still needs correction. This turns reconciliation into an operating control: it does not merely explain the past, it determines what may be said next.

A claim is ready only when its quantity, evidence and account can be reconstructed by someone else.

CHAPTER SOURCE NOTES

S03 Textile Exchange. 2026-10-30.

S06 Aid by Trade Foundation. 2025-06.

S10 GS1. 2022-06.

S11 GS1. 2022-06.

S02 ISEAL Alliance. 2025.

S07 Aid by Trade Foundation / Cotton made in Africa. 2026-10-30.

S01 International Organization for Standardization. 2020-10.

GREEN FUTURE TECH

LIMITED / HONG KONG SAR

07

PART II: EVERY TRANSFORMATION NEEDS A RECORD / ASSURANCE LIMITS

A certificate and a laboratory result answer bounded questions

Assurance is credible when its issuer, scope, validity and sampling limitations remain attached to the claim.

CHAPTER 07
DECISION TEST

Assurance is credible when its issuer, scope, validity and sampling limitations remain attached to the claim.

A certificate and a laboratory result are evidence about defined subjects, not general proof that a cotton claim is true. A scope certificate concerns an organisation, site, activity, material and period within a certification boundary. Transaction evidence concerns specified material movements. A laboratory result concerns samples tested by a stated method. Green Future Tech Limited (GFT), Hong Kong SAR, therefore recommends that claim release answer four separate questions: who issued the evidence, which object and proposition it covers, how the evidence was selected and tested, and whether it remains acceptable for the intended decision. [S03] [S05] [S29] [S33]

This chapter turns those questions into an evidence review procedure, an assay qualification brief and a contradiction-response playbook for GFT's Cameroon textile programme. They are proposed controls for a future pilot. They do not establish supplier certification, laboratory accreditation, a validated Cameroon origin classifier or an operating GFT assurance service. The examples are illustrative, and the sampling curve uses disclosed mathematical assumptions rather than observed defect rates. This chapter is not investment, legal or tax advice.

7.1

Scope certification does not identify every shipment

7.2 CERTIFICATION SCOPE AND TRANSACTION EVIDENCE MUST MATCH DIFFERENT PARTS OF THE DOSSIER

A scope certificate answers whether a named organisation and its stated sites, activities and materials fell within a certification scope during a stated period. It does not, by its existence alone, identify each bale, yarn lot or garment batch sold during that period. Textile Exchange describes scope and transaction certificates as distinct parts of the Content Claim Standard audit trail. Global Standards states that Transaction Certificates confirm that materials and products move through certified supply chains. [S03] [S05] The operational conclusion is not that one document is superior. It is that the dossier needs the document appropriate to each proposition.

Consider an illustrative spinner whose scope certificate covers the intended site and fibre activity but whose dispatch concerns one particular group of lint bales. The certificate can support the review of organisational eligibility within its stated scope. It cannot, without transaction and physical receiving evidence, establish that the bales on the lorry are the certified bales described in the commercial documents. GFT would match the certificate to the legal entity and site, match the transaction evidence to the seller, buyer, material and quantity, then match both to the bale identifiers and receiving observations. A mismatch restricts the affected claim; it does not automatically prove substitution or misconduct. [S03] [S05]

The review must also preserve the standard and edition. A live scheme webpage can explain how a framework is intended to work, but it is not a certificate for GFT or any proposed supplier. Textile Exchange states that the Content Claim Standard is being revised, so the applicable edition and transition rules belong in the claim record. [S03] A reviewer should not silently apply a current webpage's language to an older certificate or treat an archived document as the current rulebook. Where the edition is unclear, the evidence remains pending until the issuer or scheme owner clarifies it.

7.3 CERTIFICATE REVIEW NEEDS A STOP DECISION RATHER THAN A DOCUMENT ARCHIVE

An evidence folder can be complete and still be unusable for the proposed claim. GFT's intake procedure therefore begins with the claim card and identifies the required proposition before requesting documents. Country of growth, certified content and processing-site conformity need different evidence maps. The reviewer records the exact certificate version, its issuer, the assessed object and the relevant assessment period. A portable document file is preserved as received, while any registry check is recorded with its retrieval time and result. A screenshot without an issuer or retrieval context is not treated as an independent status check. [S24] [S29]

Exhibit 28, p. 109 specifies the proposed review. Each row has a failure action because a checklist that only collects fields cannot govern release. The actions are GFT's illustrative control design, not additional rules attributed to a scheme.

EXHIBIT 28 / ILLUSTRATIVE REVIEW PROCEDURE

Certificate review must test scope as well as date

Review question	Evidence to retain	Illustrative failure action
Who issued and assessed?	Issuer identity, assessment body, authority basis and version	Hold issuer-dependent claims and verify through an approved channel
Which organisation and site?	Legal entity, facility address and role in the transaction	Exclude unmatched sites and subcontractors from the supported scope
Which activity and material?	Certified activity, material class, scheme and edition	Do not extend the claim to uncovered materials or processes
Which period and status?	Validity dates, assessment period, status result and retrieval time	Separate historical acceptance from current release; resolve unavailable status
Which transaction object?	Seller, buyer, lot identifiers, quantity, unit and movement references	Quarantine the affected transaction claim and reconcile the physical lot
Which evidence was selected?	Evidence-selection owner, sample frame, criteria and assessed performance	Record the selection limitation; do not infer population-wide conformity
What remains contradicted?	Original documents, exception, explanation and reviewer decision	Keep the claim on hold or narrow it; never overwrite the earlier evidence

ILLUSTRATIVE [S03] [S05] [S24] [S29] Illustrative GFT checklist informed by the CCS audit-trail overview, GOTS transaction-certification overview, W3C credential status model and UNTP working conformity model. It is not a scheme conformity decision or legal opinion. A failure restricts only the claims dependent on the failed check.

The table separates an expired certificate from an irrelevant one. Expiry concerns time. Irrelevance concerns the fit between evidence and proposition. A currently valid certificate for a different site cannot support the intended transaction, while an expired certificate may remain relevant to reconstructing what a reviewer accepted at an earlier event. Neither case should be collapsed into a generic valid or invalid flag. Current release needs current acceptance evidence, while historical review needs the evidence and policy that applied at the time. [S24] [S29]

EVIDENCE INTAKE AND RELEASE PROCEDURE

GFT would assign one evidence reviewer and one claim release owner, keeping the roles separate where staffing permits. Intake preserves the original files and their hashes or other controlled version references. Review records each required check as passed, failed, pending or not applicable, with a reason. Physical receiving may proceed into a controlled holding state under an operating decision, but public claim release waits for every required evidence check. The release record names the approved wording, material boundary, evidence versions, reviewer, decision time and remaining limitations. [S03] [S29]

7.4

Evidence needs an issuer and a claim-specific scope

7.5 AN EVIDENCE ITEM SUPPORTS A PROPOSITION RATHER THAN A GENERAL REPUTATION

A supplier declaration, weighbridge record, transaction certificate, audit report and test result answer different questions. A supplier declaration records what the supplier asserts and takes responsibility for. A weighbridge record links a measured mass to a vehicle, lot or movement under stated weighing conditions. A transaction certificate concerns specified certified-material movement. An audit report records assessment against criteria over a defined object and period. A test result reports measurements on submitted or sampled material under a stated method. Textile Exchange and Global Standards describe certification and transaction controls, while the UN Transparency Protocol (UNTP) working model distinguishes the assessed object, criteria, outcome and evidence references. [S03] [S05] [S29]

None of these items should acquire a claim by association. A weighbridge ticket can support quantity reconciliation without identifying where the cotton grew. An audit of receiving procedures can support a process finding without certifying every lot received. A transaction certificate can support a scheme-specific content statement without establishing a single-farm identity. A laboratory report can characterise a sample without proving that every item in the dispatch had the same properties. The claim map must state the proposition each item can carry and the proposition it cannot carry. [S03] [S29] [S33]

GFT's proposed evidence register consequently uses a proposition-level key rather than a folder-level approved flag. The key combines the claim, material or product unit, site, period and custody model. Each linked evidence item records its issuer, subject, method, observation or assessment period, selection route, status and limitations. The reviewer also records whether the evidence is an original observation, an issuer's assertion, an independent assessment or a derived calculation. These categories prevent a dashboard from presenting a calculated field as if it were a direct measurement. [S29]

7.6 INDEPENDENCE AND OBJECT SPECIFICITY ARE SEPARATE DIMENSIONS

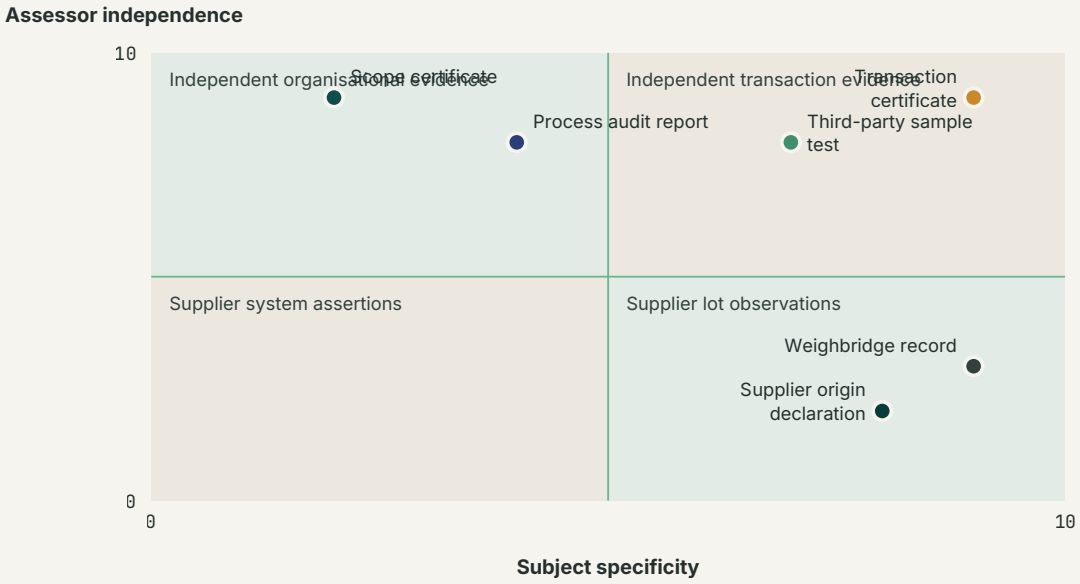
An independent document about a broad organisation is not interchangeable with a self-declared record about an identified consignment. For example, a buyer may need both an independently assessed scope and a supplier's lot-specific dispatch declar-

ation. The first addresses the certification boundary; the second connects the physical movement to a responsible counterparty. Requiring one document to answer both questions would either weaken the physical link or overstate the assessment scope. [S03] [S05]

Exhibit 29, p. 111 places common evidence configurations on those two dimensions. The horizontal axis runs from organisation-level to consignment-specific subject matter. The vertical axis runs from first-party assertion to third-party assessment. Positions are categorical illustrations, not credibility scores. An item can move when its issuer, sampling design or subject changes.

EXHIBIT 29 / ILLUSTRATIVE CATEGORICAL POSITIONS

Each evidence type supports a specific proposition



ILLUSTRATIVE [S03] [S05] [S29] [S0701] Illustrative configurations, not measured quality, reliability or assurance scores. Horizontal positions represent assessed-object specificity from organisation to identified consignment. Vertical positions represent assessor independence from first party to third party. Actual evidence can occupy a different position depending on issuer, method and sampling.

The matrix explains why an evidence hierarchy should not be a single ladder. A third-party sample test sits high on assessor independence but only as far along subject specificity as its sample-to-lot link permits. A weighbridge record may be highly specific to the consignment while remaining a first-party or second-party observation. A scope certificate has independent assessment value but does not become lot-specific because it is attached to a dispatch email. The release rule is conjunctive: every required proposition needs admissible support, not a high average across unrelated documents. [S03] [S29] [S0701]

> **GFT NOTE**
>
> Build a claim-to-evidence register before building an evidence repository. For each proposed public statement, require a named evidence owner to identify the admissible issuer, assessed object, method, period, selection basis and acceptable status. Reject a document for the proposition it cannot support, not necessarily for every purpose. Preserve the same document for any narrower proposition it can support, and show the reader the unresolved boundary rather than replacing it with a generic assurance badge.

This register also makes buyer-specific acceptance explicit. One buyer may require independent transaction evidence for certified content, while another may ask only for a documented country-level origin statement supported by custody records. GFT would not treat either requirement as a universal legal rule. The commercial claim, scheme edition and buyer criteria determine the admission policy. Where those criteria conflict, the release owner records which intended use is supported and prevents the stronger use from inheriting the weaker review. [S03] [S05] [S29]

7.7

Independent assessment differs from self-declaration

7.8 ASSESSOR INDEPENDENCE DOES NOT DETERMINE WHO SELECTED THE EVIDENCE

UNTP's pre-production conformity model distinguishes first-party declarations, second-party statements and third-party certificates or reports. It also records evidence selection separately. Its warning is directly relevant to cotton assurance: a third-party assessor may still assess evidence chosen by the assessed party. [S29] GFT would therefore record assessor independence and evidence-selection control as different fields. A credible review cannot infer independent sampling from the assessor's logo, nor can it infer independent assessment from an independently sourced sample whose interpretation was performed by the supplier.

The same model separates the assurance attached to the assessment process from the outcome asserted about a product, facility or organisation. [S29] This prevents a category error. Recognition of an assessment body concerns its authority or competence for specified work. It does not mean that every claim made by every certificate holder is true. Conversely, a supplier's first-party declaration is not automatically useless. It can be the appropriate evidence for a directly observed dispatch or process event, provided the issuer had the opportunity to observe it and the declaration remains open to contradiction and verification.

GFT's proposed assurance record therefore names the claimant, assessment body, criteria, assessed object, assessment period, outcome, assessor level, evidence-selection route and assurance basis. It also records any authority evidence and its current status. These are fields to inspect, not a numerical scoring formula. A buyer may accept a second-party audit for one operational purpose while requiring third-party assessment for a public certification statement. The acceptance decision belongs to the claim policy, not to an arbitrary rank assigned by the database. [S29]

7.9 VOCABULARY ADOPTION CREATES NEITHER ACCREDITATION NOR LEGAL RECOGNITION

Using terms such as first party, third party or conformity credential does not make an organisation accredited. UNTP marks its conformity specification as suitable for pre-production pilot implementations and separates scheme-derived from authority-derived assurance. [S29] GFT would use that vocabulary to make pilot records comparable while preserving the actual authority documents and scheme rules. A software field labelled `third-party` is only an assertion until the reviewer verifies the issuer and its relevant recognition.

The distinction also limits what fibre evidence can say about working conditions. OECD guidance treats due diligence as an ongoing process for identifying, preventing, mitigating and accounting for actual and potential adverse impacts. It recommends measures commensurate with the likelihood and severity of harm. [S17] A complete producer map or certified-material chain may help organise enquiries, but it does not establish that forced labour is absent or that an identified harm has been remedied. Those conclusions require their own assessment, stakeholder engagement, corrective action and follow-up.

The International Labour Organization's definition of forced labour includes work exacted under menace of penalty and not offered voluntarily, across formal and informal activity. [S20] A bale location, certificate scope or isotope ratio does not measure coercion, consent or a worker's freedom to leave. GFT would therefore keep fibre provenance, labour-risk assessment and remediation in linked but separate registers. No labour allegation about a named Cameroon actor is made here. Equally, no clean labour conclusion should be inferred from missing labour data or a successful origin test. [S17] [S20]

This separation has a practical release consequence. A claim reviewer may approve a bounded country-of-growth statement while a labour-risk review remains open, provided the public wording does not imply broader social assurance. If the proposed statement is a comprehensive responsible-production claim, the open labour review becomes a blocking gap. The evidence map follows the exact wording. Broad language imports broad evidence duties, and a polished passport cannot narrow those duties by omission. [S17] [S20] [S29]

7.10

Physical testing can corroborate an origin hypothesis

7.11 AN ASSAY TESTS A SAMPLE AGAINST REFERENCES, NOT AN ABSTRACT MAP

Stable isotope analysis offers a possible corroboration route for geographic provenance. The opened review abstract describes region-specific isotopic signatures in natural fibres and examines fractionation alongside environmental and processing effects. [S33] That scope supports a qualified hypothesis: measurements on a sample may be compared with suitable reference material to assess whether the result is consistent with a proposed origin. It does not support a universal country detector, a claimed accuracy for Cameroon, or exclusion of another country without a relevant validation study.

The reference library is therefore part of the method, not an administrative accessory. GFT's proposed qualification study would assemble known-origin cotton references that represent the intended growing regions, seasons, production conditions and relevant processing stages. Each reference needs its own provenance evidence and sample custody. A model trained or assessed on raw lint cannot simply be assumed to perform identically on yarn, dyed fabric or a finished garment. The qualification boundary must state which material forms and processes were actually represented. [S33]

Sampling must also represent the decision. A convenient sample taken from a bale selected by the supplier may test that bale, but it does not establish the composition of an entire delivery or the origin of fibres in every downstream garment. The proposed study would separate method validation from routine lot assurance. Method validation asks whether the assay and classification procedure can discriminate the defined origin classes under controlled conditions. Routine assurance asks whether a new, independently linked sample falls within the qualified decision boundary. Both questions can return inconclusive results. [S29] [S33]

7.12 LABORATORY COMPETENCE AND CLAIM VALIDITY REQUIRE SEPARATE CHECKS

ISO describes ISO/IEC 17025 as setting requirements for laboratory competence, impartiality and consistent operation, and notes that accreditation bodies use it as criteria for assessing and accrediting laboratories. [S0701] GFT would check the laboratory, method and relevant scope rather than treating any accreditation mark as universal approval for origin classification. Competence for one test does not establish competence for every analyte, material or interpretation. The report still needs to identify the tested item, method, result and applicable limitations. [S0701] [S29]

The sample-to-report chain remains equally important. The review should identify who selected and sealed the sample, which lot it represents, how subsamples were formed, what happened to retain material and how the laboratory received it. A technically sound measurement on an unlabelled bag cannot repair the missing connection to a shipment. Evidence-selection control and assessor independence must again be read separately: an independent laboratory can test a supplier-selected sample, and a buyer-selected sample can be sent to a laboratory whose method is outside the required scope. [S29] [S0701]

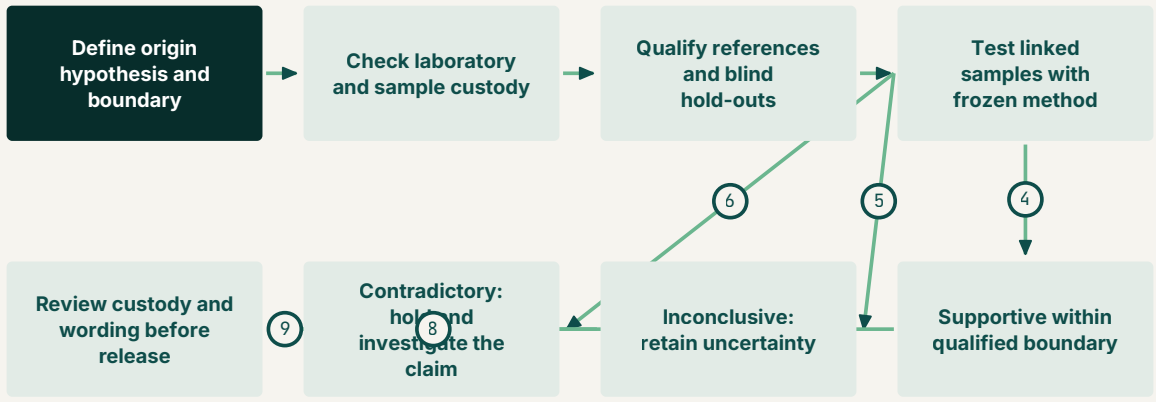
> **ASSAY QUALIFICATION BRIEF**
>
> Before commissioning an origin assay, GFT would issue a qualification brief containing the exact origin hypotheses and allowable outcomes; the material forms and processing history; the reference populations and their provenance evidence; the sampling frame and independent selection procedure; sample custody, preparation and retention; the laboratory's relevant competence scope; the analytical and classification methods; blind hold-out samples; the treatment of repeats and outliers; and the predetermined supportive, contradictory and inconclusive decision rules. The study report must retain the complete result set and failures, not only successful classifications. No accuracy statement or country exclusion may be published until results from that qualified design support it. [S29] [S33] [S0701]

Blind hold-out testing is a distinct check on the classification procedure. The party interpreting the result should not receive the hold-out origins before issuing its determinations. The qualification owner then compares those determinations with the documented references and reports errors by origin class and material form. A small or unrepresentative reference set cannot be repaired by an apparently precise percentage. GFT would retain confidence intervals and sample counts where the eventual statistical method uses them, with the unit of independence made explicit. At this chapter's research boundary, no such Cameroon performance results are available. [S33]

Exhibit 30, p. 115 makes an inconclusive outcome a normal terminal state rather than a failed software branch. It also prevents a supportive assay from bypassing documentary custody. The flow is a proposed qualification design based on the isotope review's abstract and laboratory-competence overview, not a description of an assay already performed. [S33] [S0701]

EXHIBIT 30 / ILLUSTRATIVE QUALIFICATION SEQUENCE

A physical test can be supportive or inconclusive



4. qualified match
5. outside decision rule
6. qualified mismatch
8. keep limitation
9. after investigation only

ILLUSTRATIVE [S33] [S0701] [S29] Illustrative GFT assay qualification and claim-review flow. No assay outputs, reference-library coverage or classifier performance are asserted. Supportive evidence corroborates only the qualified hypothesis and sample boundary; documentary custody and claim release remain separate checks.

A supportive result does not upgrade the claim beyond the reference library or sample frame. If the qualified hypothesis is consistency with a bounded Cameroon reference group, the result cannot establish a particular farm or exclude every alternative origin. An inconclusive result leaves the documentary assessment unchanged and may jus-

tify more sampling or a narrower statement. A contradictory result triggers investigation of the sample link, method suitability and documentary claim. It is not, on its own, proof of fraud. [S29] [S33]

7.13

Sampling determines what an assurance conclusion covers

7.14 RISK DETERMINES WHERE TO LOOK, WHILE PROBABILITY REQUIRES A SELECTION MODEL

OECD guidance says due diligence should be risk-based, with measures commensurate to the likelihood and severity of harm. [S17] GFT applies that principle to assurance coverage by proposing more scrutiny where suppliers, process changes or evidence gaps create greater uncertainty. This is a design recommendation, not an OECD sampling formula for cotton claims. Risk-based selection can direct expert attention, but it does not produce the detection probability associated with a simple random sample unless the required probability model is separately justified.

Every sampling instruction should name the target population, sampling unit, frame, selection method and intended inference. A population might be all bales in an identified delivery, all transformation records for a campaign, or all garment cartons in a dispatch. These are not interchangeable denominators. The frame must list the eligible units before selection, and the reviewer must account for missing, substituted or inaccessible units. Testing only the bales nearest the warehouse door describes that convenient subset unless another defensible selection procedure was used.

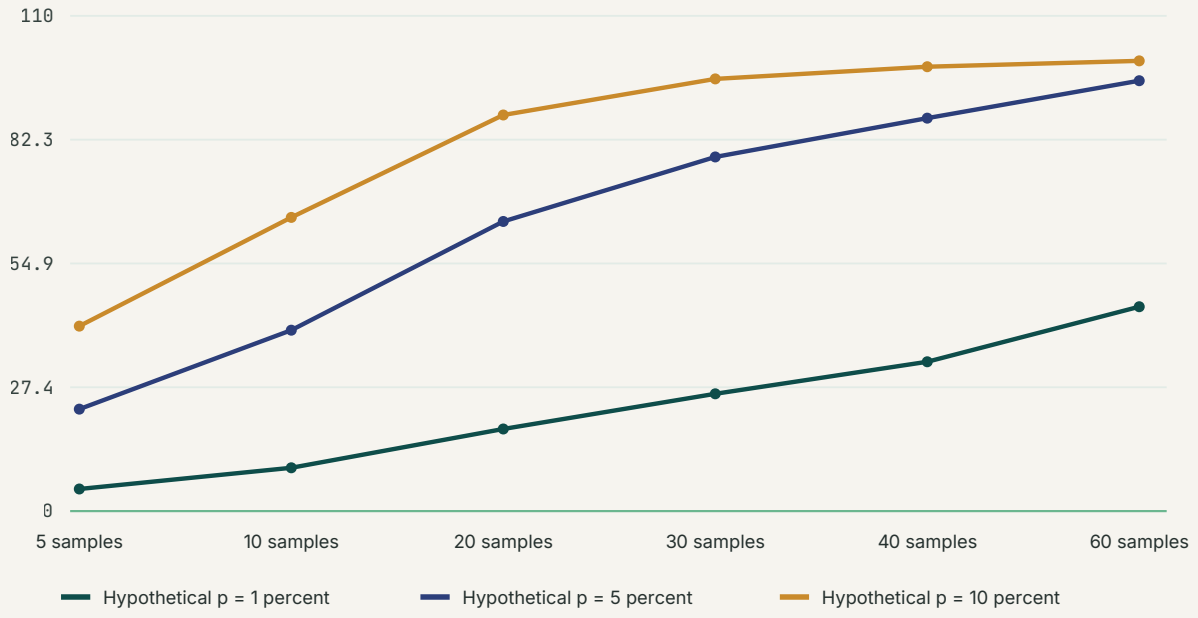
The illustrative probability model assumes independent draws from a population in which each sampled unit has the same hypothetical nonconformity prevalence `p`, with a perfect test and no selection bias. For `n` independent samples, the probability of detecting at least one nonconforming unit is `1 - (1 - p)^n`. These assumptions are deliberately explicit. They make the curve useful for teaching and planning, but they are not evidence that a real supplier has any particular prevalence or that an actual test is perfect.

> **WORKED EXAMPLE: DETECTION IS NOT A GUARANTEE OF CLEANLINESS**
>
> Assume an illustrative prevalence of 5 percent nonconforming units and an independent random sample with a perfect test. For 20 samples, the illustrative detection probability is `1 - (1 - 0.05)^20 = 0.6415`, or 64.2 percent after rounding. For 60 samples under the same assumptions, it is `1 - (1 - 0.05)^60 = 0.9539`, or 95.4 percent. The first design still has an illustrative 35.8 percent probability of detecting no nonconforming unit under the model, and the second has 4.6 percent. Zero observed nonconformities therefore cannot prove zero prevalence.
>
> Now remove the independence assumption. If the illustrative sample consists of 20 adjacent bales from one suspect production block, a shared cause could make their outcomes correlated. The 64.2 percent calculation no longer describes the design. If the 5 percent value was chosen from a previous supplier rather than the current population, it is a planning assumption rather than an observed current rate. The worked example demonstrates why sample size alone cannot carry an assurance conclusion.

Exhibit 31, p. 117 extends the same illustrative arithmetic across three hypothetical prevalence values. It shows detection probability, not confidence that the whole lot conforms. The series use the formula above with no empirical defect or fraud data.

EXHIBIT 31 / DETECTION PROBABILITY (PERCENT)

Sampling confidence depends on explicit assumptions



ILLUSTRATIVE Illustrative mathematical model only. For each series, probability = 100 x [1 - (1 - p)^n], with n independent samples, constant hypothetical prevalence p, a perfect test and no selection bias. Values are rounded to one decimal place. Hypothetical p values are 1, 5 and 10 percent. Clustering, targeted fraud, imperfect tests and non-random selection invalidate the simple interpretation.

The curve rises more slowly at lower assumed prevalence. That does not mean a higher assumed prevalence is worse for detection alone: under this model, rare non-conformities require more samples to reach the same probability of at least one detection. Nor does a high point on the curve justify calling the lot clean when nothing is found. The result must be interpreted using the actual selection design, test performance and remaining possibility of targeted concealment. The formula also ignores finite-population effects, so it must not be presented as an exact acceptance-sampling standard for every dispatch.

7.15 SAMPLE CUSTODY AND TEST ERROR BELONG IN THE SAMPLING PLAN

GFT's proposed sampling plan assigns a selection owner who is independent of the party being assessed where the claim requires it. The owner freezes the frame, generates or witnesses the selection, records replacements and seals the samples. Another record links each sample to its source unit and to the laboratory report. Any refusal, missing unit or substitution remains visible as an exception rather than being silently replaced with a more convenient item. [S29] [S0701]

The plan must also distinguish document review from physical testing. A documentary sample can reconstruct whether required records exist and agree, while a physical sample can test material characteristics. A mixed design may be appropriate, but the denominators and inference remain separate. If a laboratory test has imperfect sens-

itivity or specificity, the simple detection formula needs extension rather than a footnote claiming perfection. Until those performance parameters are qualified for the intended assay, GFT would keep them out of a numerical assurance promise. [S33] [S0701]

Risk-based and probability sampling can coexist when their roles remain clear. Stratification can ensure that suppliers, shifts or process changes receive coverage, while random selection within defined strata can support a stated probability model. Targeted samples can investigate a red flag without being counted as random coverage. A pilot should record the effort and outcomes of each route before setting a recurring sample size. No universal percentage or acceptance threshold is proposed here, because the necessary population, risk and test performance have not been measured. [S17] [S29]

7.16

Expired or contradicted evidence changes the release decision

7.17 CURRENT STATUS AND EVENT-TIME EVIDENCE ANSWER DIFFERENT QUESTIONS

A reviewer needs to know both what was accepted when a transaction occurred and what may be relied upon now. W3C's status-list specification provides a mechanism for publishing suspension or revocation information about verifiable credentials. It also cautions that credential status concerns the credential itself and may not determine the status of an underlying or backing object. [S24] GFT would therefore avoid a single rule that declares every historical physical observation false when a credential is withdrawn, or every current claim safe because an old certificate was once valid.

Suspension, revocation, expiry and unavailable status need distinct reason codes. Suspension may be reversible under the governing policy, while revocation cancels credential validity under that profile. Expiry marks the end of a stated validity interval. An unavailable status service establishes none of those outcomes. [S24] For final claim release, GFT's proposed default is to hold the dependent assertion until fresh evidence resolves the required check. For historical reconstruction, the reviewer retains the earlier acceptance decision, its status observation and the policy version used at that time.

Scheme-specific integrity procedures can add another evidence route. Global Standards states that its Quality Assurance Unit performs random checks of Scope Certificates, Transaction Certificates and Letters of Approval, and that Transaction Certificates linked to fraud will be revoked by the relevant certification bodies under its procedure. [S0702] This example shows why issuance is not the end of assurance. It does not give GFT authority to revoke a document, and it does not make every later discrepancy proof of fraud. The applicable scheme owner and certification body must resolve their own processes.

7.18 CONTRADICTION HANDLING MUST CONTAIN THE CLAIM WITHOUT DESTROYING THE RECORD

A contradiction can arise when a transaction certificate names a different seller, a registry shows a suspended scope, a laboratory result conflicts with a qualified origin expectation, or a physical lot does not match the reviewed document. GFT's first response is to identify the exact proposition and affected material set. The claim owner places only the dependent claims on hold, while operations decides separately whether material must be physically quarantined. This avoids both unsafe release and unnecessary implication that every unrelated lot or attribute is defective. [S03] [S29] [S33]

The investigation then preserves the original evidence, retrieval times, sample custody and release decision. The reviewer requests an explanation through an authorised counterparty channel and checks the issuer's current scope and status. New documents are added with their own versions; they do not overwrite the files that created the original concern. If the contradiction is resolved, the release owner records the evidence that justifies reopening. If it remains unresolved, the claim is narrowed or withdrawn and the affected disclosure is corrected. [S24] [S29]

> **WARNING**
>
> Do not treat absent information as a clean result. An unavailable registry, missing laboratory reference or silent counterparty leaves the evidence state unknown. Do not accuse a supplier of misconduct merely because a document is inconsistent, and do not delete the inconsistency to restore commercial continuity. Record what is established, what is disputed, which claim is restricted and who owns the next decision. Any public correction should protect personal data and preserve the evidence needed for later review.

GFT's proposed contradiction playbook assigns four roles. The evidence owner preserves the dossier and exception chronology. The issuer-contact owner seeks clarification without altering the original record. The claim owner decides hold, reopening, narrowing or withdrawal under the applicable policy. The disclosure owner identifies every passport, buyer pack or other statement that used the affected claim and records the correction. Where staffing cannot separate these roles, an independent reviewer should examine the decision before the claim resumes. [S03] [S29]

An illustrative case shows the boundary. A transaction document remains authentic, but its current status is suspended after the related goods have entered production. The suspension does not rewrite the earlier receiving observation, and it does not prove the cotton origin was false. It does block new reliance on that credential where the release policy requires current acceptable status. The reviewer maps affected inputs to outputs, examines the reason and effective interval, and decides which downstream claims must pause. Physical genealogy and quantity reconciliation continue as separate evidence, not as automatic substitutes for the suspended certification. [S03] [S24]

Closure requires more than a replacement file. The reviewer must show that the new evidence addresses the original contradiction, covers the same claim boundary and has its own acceptable issuer and status. A renewed certificate for a different site,

period or material does not close the exception. If the underlying physical evidence remains insufficient, a newly signed assertion cannot repair it. The final record therefore includes the decision rationale and any residual uncertainty, ready for independent reconstruction in the pilot. [S24] [S29] [S0702]

Across all six sections, the release principle is conservative but workable. Accept evidence for the bounded question it can answer, combine it with the other required evidence, and stop when a necessary proposition remains unsupported. Assurance becomes more useful, not less, when its limits are explicit: a buyer can see why the claim was accepted, what was sampled, which evidence was current and what remains unknown.

Trust the result only with its issuer, scope, method and sampling boundary attached.

CHAPTER SOURCE NOTES

S03 Textile Exchange. 2026-10-30.

S05 Global Standards gGmbH. 2026-10-30.

S29 UNECE / UN Transparency Protocol. 2026-10-30.

S33 Jin, Shi and Wang / Taylor & Francis, hosted by Hong Kong Polytechnic University. 2026.

S24 World Wide Web Consortium. 2025-05-15.

S0701 International Organization for Standardization. 2017-11.

S17 OECD. 2018.

S20 International Labour Organization. 2026-10-30.

S0702 Global Standards gGmbH. 2026-10-30.

08

PART III: PASSPORTS MUST PRESERVE EVIDENCE / DATA EXCHANGE

Shared identifiers and event meanings make records portable

Interoperability requires common semantics, stable identifiers and a tested way to exchange corrections.

CHAPTER 08
DECISION TEST

Interoperability requires common semantics, stable identifiers and a tested way to exchange corrections.

A supply-chain record is portable only when a receiving partner can reconstruct the same physical custody history, transformation links and claim boundaries without telephoning the sender to ask what a column header or status code meant. [S10] [S11] In Cameroon's cotton sector, where about 95 percent of cotton fibre is exported raw and about 5 percent is processed locally against a 50 percent target by 2030, adding local spinning, fabric processing and garment assembly multiplies the handovers through which provenance evidence must travel. [R06] [R07] Green Future Tech Limited (GFT), Hong Kong SAR, argues that interoperability across those handovers begins not with a shared database vendor or item-level radio-frequency tags, but with an explicit custody exchange contract: separate product, batch, logistics, location and party identifiers, granularity matched to physical observations, controlled event vocabularies, distinct observation and entry timestamps, and non-destructive error declarations verified by round-trip tests. [S10] [S11] [S12]

This chapter defines that exchange contract for GFT's Cameroon textile programme (feasibility study, performance-management system design and digital strategy, prepared 31 January 2024, sources refreshed 2026). [R06] Within the library, this chapter owns inter-company custody exchange, while `wp14` owns enterprise data governance, `wp18` owns plant and cloud architecture, and `edge-architecture` models local queueing under weak connectivity. [S10] [S27] Every specification here is a proposed design for pilot verification rather than a live deployment. [S01] [S28]

8.1

Identify products, places and organisations separately

Traceability databases fail at company boundaries when one reference string is overloaded to encode what moved, who owned it, where it sat and which order paid for it. [S09] [S10] When a ginnery builds a bale code by concatenating crop year, region, buyer initials and warehouse bay into one text field, a downstream spinning mill that splits the delivery or redirects a pallet to a third-party warehouse either mutates the identifier or loses the link to the ginning campaign. [S06] [S10] Interoperable record design starts by separating five orthogonal identity classes: product class, batch or lot, physical logistics unit, physical location, and legal or operational party. [S10] [S11] [S12]

8.2 FIVE DISTINCT IDENTIFIER CLASSES PREVENT OVERLOADED PRIMARY KEYS

Visibility and web-resolution standards keep these five domains separate so that a change in storage bay, carrier or commercial title never alters the identity of the cotton batch itself. [S10] [S11] [S12] In GS1 Electronic Product Code Information Services (EPCIS) Release 2.0 and GS1 Digital Link URI Syntax Release 1.7.0, each domain answers a distinct question. [S10] [S12]

- **Product class identity (`what class`):** Identifies the catalogue specification of a trade item, such as a lint grade, yarn count or garment style, corresponding to a Global Trade Item Number (`/01/`) path segment or internal material code. [S10] [S12]

- **Batch or lot identity (`which production group`):** Qualifies the product class with a bounded group sharing a uniform transformation history and eligible input set, such as a ginning campaign, spinning laydown, dye batch or cutting lay (`/10/` qualifier). [S02] [S10] [S12]
- **Logistics or serial unit identity (`which handling unit`):** Identifies an individual package or transport container, such as a pressed bale, numbered fabric roll, serialised garment (`/21/`) or shipping container (`/00/`), which can be packed and unpacked without changing batch identities. [S10] [S12]
- **Location and read-point identity (`where observed`):** Separates the site (such as a northern Cameroon ginnery or spinning mill) from the specific read point (such as weighbridge scale B or press chute 2) where an observation occurred. [R03] [S10] [S11]
- **Party identity (`who acted`):** Identifies the organisation or role that observed the event, held custody, issued evidence or took title, keeping commercial buyers distinct from toll processors or warehouse operators. [S01] [S09] [S10]

To keep these responsibilities clear, **Exhibit 32**, p. 123 organises the exchange contract into four conceptual layers: master identifiers at the base, visibility events above them, evidence assertions in the third tier, and bounded passport disclosures at the top. [S10] [S12] [S21] [S28]

EXHIBIT 32 /

Identity, events and evidence serve different purposes



ILLUSTRATIVE [S10] [S12] [S21] [S28] Illustrative conceptual stack based on GS1 EPCIS 2.0 (S10), GS1 Digital Link 1.7.0 (S12), W3C Verifiable Credentials 2.0 (S21) and UNTP DPP v0.8.0 work in progress (S28). Full plant and cloud infrastructure remains in wp18.

As **Exhibit 32**, p. 123 illustrates, a passport at the top layer never substitutes for missing identifiers or broken event links underneath it. [S10] [S28] While **Exhibit 32**, p. 123 clarifies how GFT separates data responsibilities in design, an architectural diagram cannot establish that any given Cameroon supplier currently maintains separate master registers or holds licensed global keys. [S01] [S12]

8.3 CONTROLLED CROSSWALKS MAP INTERNAL KEYS TO EXTERNAL SCHEMES WITHOUT INVENTING ALLOCATIONS

A common flaw in pilot projects is fabricating global keys, such as synthetic GTINs or Global Location Numbers (GLNs), before licensing a GS1 Company Prefix or confirming partner prefixes. [S10] [S12] Invented numeric prefixes create collision risks when records reach buyers or resolvers, so GFT prohibits fabricating allocated GS1 keys in documentation, fixtures or pilot databases. [S10] [S12] [S13]

Until an entity licences an official prefix, internal pilot records must use namespaced Uniform Resource Names (URNs) or Universally Unique Identifiers (UUIDs) under Internet Engineering Task Force (IETF) RFC 9562, paired with a versioned crosswalk table. [S10] [S0802] Under RFC 9562, a 128-bit UUID guarantees uniqueness across space and time during offline capture. [S0802] GFT pairs UUIDs with illustrative URN prefixes such as `urn:gft-pilot:party:gin-north-01` for a ginnery, `urn:gft-pilot:site:garoua-wh-02` for a store, and `urn:gft-pilot:lot:2026-cmp-0014` for a lint batch. [S10] [S0802]

When a partner already uses a scheme registry, such as a Cotton made in Africa (CmiA) Sustainable Cotton Tracker (SCOT) account, a Textile Exchange Content Claim Standard (CCS) site code or a licensed GS1 GLN, the crosswalk binds the internal URN to the external key alongside scheme owner, effective dates and verification document reference, linking internal logs, scheme reconciliations and EPCIS queries without duplication. [S03] [S09] [S10] [S12]

8.4 NAMESPACE GOVERNANCE DEFINES OWNERSHIP, LIFECYCLE AND COLLISION HANDLING

Every identifier class requires an owner, a syntax rule, a uniqueness scope, a lifecycle and a collision protocol. [S10] [S12] [S0802] In GFT's design, the party that physically creates or first observes a material boundary allocates its identifier: ginneries allocate bale and ginning-lot keys, spinners allocate yarn-lot keys, fabric mills allocate roll keys, and garment factories allocate cutting-lay and garment-batch keys. [S06] [S10]

Lifecycle rules forbid recycling identifiers across seasons. [S10] [S0802] A bale tag such as `BALE-0402` that resets every harvest will collide in multi-year queries whenever carryover bales are blended with new-crop bales. [S06] [S10] Embedding facility code, harvest year and a monotonic sequence or RFC 9562 UUID suffix prevents cross-season collisions. [S10] [S0802] If an offline printer produces a duplicate bale tag during a power cut, the collision rule never overwrites the first record; it quarantines both units, issues a fresh key to the verified second bale, and logs a replacement link. [S06] [S10]

GFT NOTE

Practical recommendation on identifier allocation: Do not buy item-level RFID tags or invent unallocated GS1 prefixes to make a pilot look complete. [S10] [S12] Enforce non-reusable internal batch and unit keys (`urn:gft-pilot:...` backed by RFC 9562 UUIDs) at every weighbridge, press, spinning frame, inspection table and cutting room, paired with a crosswalk mapping internal keys to partner GLNs, GTINs or scheme codes only after inspecting the partner's licence or certificate. [S03] [S10] [S12] [S0802]

8.5

Granularity must match the claim and the available observation

Identification granularity balances claim specificity against the finest boundary at which material is physically separated and observed. [S01] [S02] [S12] Both GS1 Digital Link Release 1.7.0 and the United Nations Economic Commission for Europe (UNECE) United Nations Transparency Protocol (UNTP) Digital Product Passport v0.8.0 pre-production specification distinguish three levels: product model, batch or lot, and serialised item. [S12] [S28] Choosing the wrong level either sacrifices a defensible narrower claim or adds high tagging costs with zero upstream evidential gain. [S02] [S12] [S28]

8.6 MODEL, BATCH AND SERIAL IDENTIFIERS SUPPORT DIFFERENT PROVENANCE QUESTIONS

Each granularity level binds claims and evidence to a different denominator. [S12] [S28]

- **Product model granularity:** Every garment of a style and size shares one class key without batch or serial qualifiers. [S12] [S28] Model records support static specifications such as fibre composition under European Union (EU) Regulation 1007/2011, but cannot isolate which cotton harvest or transaction certificate backed a specific delivery when a defect or revocation occurs. [S03] [S24] [S28] [S34]
- **Batch or lot granularity:** All garments from a bounded batch share a class key plus a `/10/` batch qualifier. [S10] [S12] [S28] Because textile plants operate in batch grains (ginning campaigns, bale laydowns, yarn lots, dye batches, fabric rolls and cutting lays), batch keys align with transformation and reconciliation boundaries, confining any quarantine or downgrade to affected batches. [S03] [S06] [S10] [S28]
- **Serialised item granularity:** Every garment carries a unique `/21/` serial qualifier, supporting unit-specific post-sale events such as customs sampling, customer returns, repair or resale. [S12] [S16] [S28]

8.7 DOWNSTREAM SERIALISATION CANNOT MANUFACTURE UPSTREAM FARM GRANULARITY

Printing a serialised QR code on every finished shirt does not create item-level farm-to-closet traceability. [S10] [S12] [S28] In northern Cameroon, more than 220,000 producers supply seed cotton across nine ginning plants according to the inherited SODECOTON profile (a Grade C source-text record about that upstream actor, not a GFT partnership or farm registry). [R03] Even under strict segregation or Hard Identity Preserved (HIP) rules in the Aid by Trade Foundation (AbTF) Transparency Standard

Version 1.0 (June 2025) and its current Segregation wording, deliveries from multiple registered producers are pooled during ginning campaigns, and dozens of bales are blended in a spinning laydown to balance staple length and strength. [S02] [S06] [S07] [S10]

Once 30 or 40 bales from multiple collection centres are blended in a blowroom, every metre of yarn contains an inseparable mixture of fibres from that input set. [S02] [S10] Assigning a /21/ serial number to each of 500 shirts cut from a multi-roll lay distinguishes the shirt downstream, but its upstream cotton provenance still resolves to the exact same pooled set of fabric rolls, yarn lots, bale laydowns and ginning campaigns as the other 499 shirts in that batch. [S10] [S12] [S28]

8.8 BATCH TRACKING PROVIDES A TESTABLE CANDIDATE BASELINE FOR PILOT EXECUTION

GFT selects batch-level identification across ginning lots, yarn lots, dye batches, cutting lays and garment batches, paired with unit keys for individual lint bales and fabric rolls, as the candidate pilot baseline. [S06] [S10] [S12] As the European Commission's DG GROW states as of 30 October 2026, exact textile passport fields and granularity under the Ecodesign for Sustainable Products Regulation (ESPR) await future delegated acts (indicatively planned for Q4 2027). [S14] [S15] Batch-qualified identifiers (/01/ ... /10/ ...) with optional serial qualifiers (/21/ ...) capture accurate genealogy without imposing item-level tagging on every garment before buyer contracts or regulations require it. [S12] [S14] [S28]

WORKED EXAMPLE

Illustrative comparison of identifier scale and unit-conversion drift across a 10,000 kg cotton pilot run

Consider an illustrative calculation constructed to test identifier scaling and partner unit-conversion arithmetic (not an observed GFT result or Cameroon benchmark). [S03] [S10] Suppose a pilot tracks **10,000 kg** of seed cotton through four stages:

1. **Ginning:** **10,000 kg** of seed cotton in **1** campaign lot (`LOT-GIN-01`) yields **4,000 kg** of lint across **20** bales (`BALE-001` to `BALE-020`) of **200 kg** each, plus **5,600 kg** of seed and **400 kg** of residue and moisture loss. [S06] [S10]
2. **Spinning:** All **20** bales (**4,000 kg**) enter **1** laydown to produce **3,600 kg** of yarn across **12** lots (`LOT-YRN-01` to `LOT-YRN-12`) of **300 kg** each (at **8.5 percent** moisture regain), with **400 kg** of carding and combing waste. [S03] [S10]
3. **Fabric:** The **12** yarn lots (**3,600 kg**) convert into **3,400 kg** of finished fabric across **68** rolls (`ROLL-001` to `ROLL-068`) of **50 kg** each, with **200 kg** of process loss. [S03] [S10]
4. **Garment:** The **68** rolls (**3,400 kg**) are cut across **24** lays into **12,000** shirts grouped into **24** batches (`BATCH-GRM-01` to `BATCH-GRM-24`) of **500** shirts each (**0.250 kg** net fabric per shirt, or **3,000 kg** total, plus **400 kg** of cutting offcuts). [S03] [S10]

Part A: Identifier and event volume (`batch` vs `serialised`). Batch-and-package tracking allocates `1 + 20 + 12 + 68 + 24 = 125` identifiers and, at an illustrative **3** events per identifier group (commissioning/conversion, shipping, receiving), records `125 * 3 = 375` events. [S10] [S12] Adding item-level garment serialisation (`/21/` on **12,000** shirts) raises identifiers to `125 + 12,000 = 12,125` (a **97.0-fold** increase) and, at **2** item events per shirt, adds **24,000** events (`24,375` total, a **65.0-fold** increase), while upstream cotton provenance still resolves to the same **20** bales and **1** ginning lot. [S10] [S12]

Part B: Unit-conversion rounding drift in partner exchange. Suppose the spinner exports its **12** yarn lots in pounds (`lb`) at `661.387 lb` per lot (`7,936.644 lb` total). [S03] [S10] Using the exact international pound (`0.45359237 kg/lb`), each lot equals `300.000 kg` (`3,600.001 kg` total). [S03] If the fabric mill's import script uses a truncated factor of `0.454 kg/lb`, each lot imports as `300.270 kg` and the **12** lots import as `3,603.240 kg`, injecting **3.240 kg** of phantom mass into a single shipment (**32.400 kg** over **10** deliveries) and masking physical losses during reconciliation. [S03] GFT prevents this drift by requiring every quantity record to carry both canonical kilograms (`kg` to three decimal places) and the original observed value, unit and moisture basis. [S03] [S10]

8.9

Events need shared meanings as well as matching field names

Two systems can exchange valid JSON with identical field names and still corrupt custody records if they attach different operational meanings to the same event verb. [S10] [S11] If a spinner emits `shipped` when accounting prints an invoice, whereas a weaver records `received` only when cones pass laboratory inspection four days after truck arrival, automated reconciliation flags phantom transit losses or releases claims

before physical receipt. [S09] [S10] [S11] As the CmiA SCOT FAQ states, a cotton tracker is not an order system; material custody and commercial ordering are separate processes. [S09]

8.10 FIVE VISIBILITY PATTERNS REPRESENT PHYSICAL HANDLING AND TRANSFORMATION

GFT anchors its event contract in GS1 EPCIS Release 2.0 and the GS1 Core Business Vocabulary (CBV) Release 2.0 (both ratified June 2022). [S10] [S11] EPCIS represents supply-chain history through five distinct event types paired with controlled CBV `bizStep` and `disposition` values. [S10] [S11]

- **Object observation (`ObjectEvent`):** Observes objects or batches without consuming them into a new product or grouping them into a parent container, covering steps such as `receiving`, `inspecting`, `storing` and `shipping`. [S06] [S10] [S11]
- **Irreversible conversion (`TransformationEvent`):** Consumes input objects or batch masses (`inputEPCList`, `inputQuantityList`) to create new output objects or batches (`outputEPCList`, `outputQuantityList`), such as ginning, spinning, knitting, dyeing and cutting. [S02] [S10] [S11]
- **Reversible grouping (`AggregationEvent`):** Packs or unpacks child objects inside a parent container (`parentID` with `ADD` or `DELETE` actions under `packing`, `loading`, `unloading` or `unpacking`) while preserving child identities. [S10] [S11]
- **Documentary binding (`TransactionEvent`):** Links objects or batches to commercial or scheme documents (`bizTransactionList`) such as purchase orders, bills of lading or GOTS/CCS transaction certificates. [S03] [S05] [S10] [S11]
- **Asset or sensor pairing (`AssociationEvent`):** Pairs or unpairs reusable crates or environmental loggers with material batches during storage or transit. [S10] [S30]

To make these distinctions operational, **Exhibit 33**, p. 129 presents the sourced crosswalk between EPCIS Release 2.0 (S10), CBV Release 2.0 (S11) and the UNECE UNTP Digital Traceability Events (DTE) v0.8.0 pre-production specification (S30). [S10] [S11] [S30]

EXHIBIT 33 / NORMATIVE AND PILOT MAPPING

Standard event categories separate movement, grouping and conversion

Physical cotton-chain operation	EPCIS 2.0 event type (S10)	CBV 2.0 bizStep / disposition (S11)	UNTP DTE v0.8.0 pilot comparison (S30)
Seed-cotton receipt or bale dispatch at gate	ObjectEvent (action: OBSERVE)	receiving or shipping / in_progress or in_transit	ObjectEvent wrapped in DTE credential (WIP)
Ginning, spinning, knitting, dyeing or cutting	TransformationEvent	commissioning or transforming / active or conformant	TransformationEvent linking inputs to outputs (WIP)
Packing bales in container or cartons on pallet	AggregationEvent (ADD / DELETE)	packing, loading, unloading or unpacking / in_progress	AggregationEvent preserving child identities (WIP)
Linking shipment to invoice or transaction cert	TransactionEvent (or bizTransactionList)	shipping or receiving / active	Referenced evidence link inside DTE or DPP (WIP)
Pairing reusable pallet or humidity logger	AssociationEvent (ADD / DELETE)	installing or removing / active	AssociationEvent for asset/sensor link (WIP)

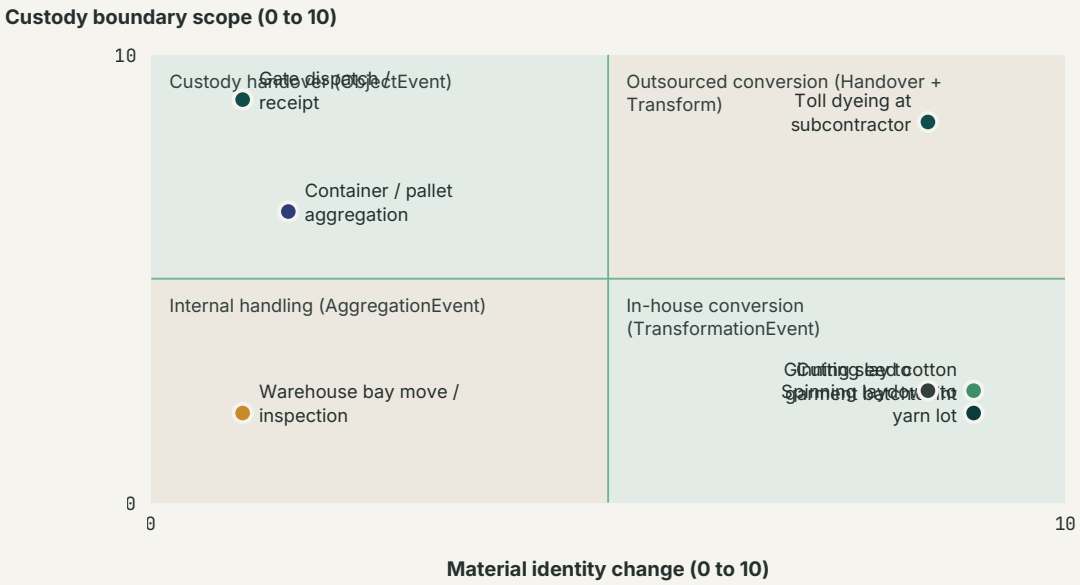
SOURCED [S10] [S11] [S30] Qualitative crosswalk compiled from GS1 EPCIS 2.0 (S10), GS1 CBV 2.0 (S11) and UNTP Digital Traceability Events v0.8.0 work-in-progress specification (S30). UNTP mappings are suitable for pre-production pilots, not legal compliance.

As **Exhibit 33**, p. 129 shows, separating `TransformationEvent` from `AggregationEvent` and `ObjectEvent` stops a partner from recording a warehouse repacking step as a manufacturing conversion or hiding outsourced wet processing inside a shipping notice. [S06] [S10] [S11] While **Exhibit 33**, p. 129 summarises the published structures of S10, S11 and S30, a reference table cannot establish that a supplier's ERP system exports these distinctions without custom mapping and testing. [S10] [S30]

To complement the table, **Exhibit 34**, p. 130 maps cotton-chain operations across two analytical dimensions: material identity change (horizontal axis) and custody-boundary scope (vertical axis). [S10] [S11] [S30]

EXHIBIT 34 / ILLUSTRATIVE OPERATIONAL COORDINATES (0 TO 10)

Event types must reflect the physical operation



ILLUSTRATIVE [S10] [S11] [S30] Illustrative GFT classification matrix grounded in S10, S11 and S30. Coordinates place operational patterns by identity change (x) and custody-boundary scope (y); positions are analytical placements, not empirical measurements.

The upper-right quadrant of **Exhibit 34**, p. 130 explains why subcontracted processing (such as toll dyeing) requires strict controls under the AbTF Transparency Standard (S06) and Textile Exchange CCS (S03). [S03] [S06] [S10] Because toll processing crosses both a legal custody boundary and a material conversion boundary, it requires a matched shipping-and-receiving `ObjectEvent` pair to the subcontractor, a `TransformationEvent` at the subcontractor's site, and a return shipping-and-receiving `ObjectEvent` pair. [S06] [S10] [S11] Like any classification diagram, **Exhibit 34**, p. 130 illustrates design rules rather than measured plant compliance. [S10]

8.11 CREDENTIAL-WRAPPED TRACEABILITY EVENTS REQUIRE PINNED SCHEMA VERSIONS

The UNECE UNTP Digital Traceability Events (S30) specification wraps GS1 EPCIS events in W3C Verifiable Credentials (S21) so issuers can sign event assertions across low-trust supply chains. [S10] [S21] [S30] GFT treats UNTP DTE (S30), alongside UNTP Digital Product Passport (S28) and Conformity Credential (S29), as a useful pilot comparison rather than a final legal standard. [S28] [S29] [S30] Because the UNTP pages opened on 30 October 2026 are labelled Work in Progress (`v0.8.0` candidates for `v1.0`) and note that an earlier sample format was withdrawn, any pilot testing credential-wrapped events must pin exact JSON Schema and JSON-LD context hashes locally rather than fetching live external URLs at runtime. [S27] [S30] [S0803]

8.12 CONTROLLED VOCABULARY TERMS AND JSON-LD NAMESPACES PREVENT SILENT SEMANTIC DRIFT

Cotton supply chains need domain attributes beyond core GS1 terms, such as lint moisture regain basis, custody model code (`HIP`, `Segregation` or `MassBalance`) and weighbridge certificate references. [S02] [S06] [S10] [S11] EPCIS Release 2.0 uses W3C JSON-LD 1.1 (S0803) `@context` declarations so standard terms and scoped user extensions coexist without field-name collisions. [S10] [S11] [S0803] Under GFT's

exchange rules, partners must never replace standard CBV terms (`receiving`, `shipping`, `commissioning`, `active`, `in_transit`, `non_conformant`) with local synonyms, must attach hold reasons (`gftCustody:holdReason`) inside a documented extension namespace, and must publish a versioned definition for every extension term in the partner conformance pack. [S10] [S11] [S27] [S0803]

8.13

A minimum record must distinguish observation from entry

A visibility event asserts that a specific actor observed a specific material quantity at a specific place and time. [S10] In ginneries and mills across Cameroon, physical handling and database entry often occur hours apart. [R03] [S06] [S10] A clerk may weigh incoming seed-cotton trucks at 07:15 local time during a connectivity outage on a paper ticket or local tablet queue and upload the batch at 19:40 that evening. [S10] Overwriting the observation time with the server insertion timestamp can make the log claim that lint bales were pressed and shipped three hours before the seed cotton arrived. [S10] [S0801]

8.14 MANDATORY EVENT FIELDS BIND PHYSICAL QUANTITIES TO A SPECIFIC OBSERVATION BOUNDARY

Grounded in EPCIS Release 2.0 (S10), CBV Release 2.0 (S11), IETF RFC 3339 timestamps (S0801) and IETF RFC 9562 UUIDs (S0802), **Exhibit 35**, p. 132 specifies GFT's twelve-field minimum event record dictionary. [S10] [S11] [S0801] [S0802]

EXHIBIT 35 / GFT PILOT FIELD DICTIONARY

A minimum event record retains its observation context

Field name	Standard mapping (S10 / S11)	Type and unit rule	Null / unknown rule and custody role
event_id	EPCIS eventID	URI: RFC 9562 UUIDv4/v7 or hash URN	Mandatory, non-null; unique idempotency key across retries
event_time	EPCIS eventTime	RFC 3339 timestamp with UTC offset	Mandatory; records when physical operation occurred
record_time	EPCIS recordTime	RFC 3339 UTC timestamp at repository	System-assigned on ingestion; never overwrites event_time
time_offset_quality	EPCIS eventTimeZoneOffset + ext	Offset (+01:00) + enum: SYNCED|DRIFT|PAPER	Mandatory; flags offline clock drift or paper transcription
event_type_step	EPCIS type + CBV bizStep	Controlled enum URI (S10 / S11)	Mandatory; separates shipping, receiving and conversion
disposition	CBV disposition + custody ext	Controlled enum URI + hold reason	Mandatory; restricts claim release if on_hold or disputed
actor_and_site	CBV source/dest + readPoint + bizLocation	Party URI + site URI + read-point URI	Mandatory; distinguishes custodian, owner and scale/line
material_identities	epcList / inputEPCList / outputEPCList	Array of batch or unit URIs (S12)	Mandatory; transformations require both inputs and outputs

ILLUSTRATIVE [S10] [S11] [S0801] [S0802] Illustrative GFT minimum field specification grounded in GS1 EPCIS 2.0 (S10), CBV 2.0 (S11), IETF RFC 3339 (S0801) and IETF RFC 9562 (S0802). Defines field types, null rules and custody meaning for pilot validation.

EXHIBIT 36 / GFT PILOT FIELD DICTIONARY

A minimum event record retains its observation context, continued

Field name	Standard mapping (S10 / S11)	Type and unit rule	Null / unknown rule and custody role
quantity_and_basis	quantityList + gftCustody:basis	Numeric kg + original unit + moisture basis	Mandatory for bulk/lots; prevents unit and moisture drift
custody_model_claim	gftCustody:model + claimBoundary	Enum: IP|SEG_HIP|CTRL_BL END|MB|UNKNOWN	Mandatory; propagates narrowest admissible input claim
evidence_pointers	bizTransactionList + gftCustody:docHash	Array of doc URIs, types, SHA-256 hashes	Empty array allowed only if disposition is pending_evidence
error_declaration	EPCIS errorDeclaration	Object: declarationTime, reason, correctiveIDs	Null on normal events; populated only on retraction notice

ILLUSTRATIVE [S10] [S11] [S0801] [S0802] Illustrative GFT minimum field specification grounded in GS1 EPCIS 2.0 (S10), CBV 2.0 (S11), IETF RFC 3339 (S0801) and IETF RFC 9562 (S0802). Defines field types, null rules and custody meaning for pilot validation.

As **Exhibit 35**, p. 132 establishes, no field allows a silent zero or default value when evidence is absent. [S10] [S11] If bales arrive before their transaction certificate, `evidence_pointers` logs only the weighbridge ticket and sets `disposition` to `pending_evidence`, blocking claim release until a follow-up event attaches the verified certificate. [S03] [S10] [S11] Because **Exhibit 35**, p. 132 is a design specification, pilot trials in Chapter 13 must measure operator capture effort against these fields. [S10]

8.15 LOCAL TIME OFFSETS AND UNCERTAINTY MARKERS PRESERVE THE SEQUENCE OF OFFLINE WORK

EPCIS Release 2.0 (S10) records `eventTime`, `eventTimeZoneOffset` (such as `+01:00` in Cameroon) and `recordTime`, formatted under IETF RFC 3339 (S0801). [S10] [S0801] Because offline terminals can suffer clock drift during power outages (addressed at the hardware level in `wp07` and `edge-architecture`), GFT includes `time_offset_quality` in **Exhibit 35**, p. 132 with three states: `SYNCED_NTP` (network-synchronised clock), `LOCAL_UNSYNCED_SEQ` (offline clock with causal order guaranteed by a local monotonic sequence counter), and `RETROSPECTIVE_PAPER_ENTRY` (transcribed from a dated paper receipt whose scan hash is attached). [S03] [S10] [S0801]

8.16 SOURCE OBSERVATIONS, CORRECTIONS AND DERIVED CLAIMS OCCUPY DISTINCT GOVERNANCE TIERS

GFT separates three record tiers: primary source observations, remedial error declarations, and derived claims (such as calculated batch yields or passport origin statements). [S02] [S03] [S10] While `wp14` governs wider enterprise data stewardship, the custody rule in `wp05` is that every derived claim must store the exact list of `event_id` values and document hashes supporting it, so any retracted observation immediately flags affected downstream claims. [S10] [S24] [S27]

8.17

Corrections must preserve the original evidence trail

Operators and sensors make mistakes: a pallet is scanned twice, purchase order `PO-104` is typed instead of `PO-140`, `2,000 kg` is keyed instead of `200 kg`, or segregated CmiA HIP bales are stacked into a conventional bay. [S06] [S10] Allowing `UPDATE` or `DELETE` statements to overwrite captured rows destroys the audit trail and leaves trading partners with conflicting histories. [S03] [S10]

8.18 ERROR DECLARATIONS AND REMEDIAL EVENTS REPLACE SILENT DATABASE OVERWRITES

GS1 EPCIS Release 2.0 (`S10`) forbids editing events in place and defines a normative `errorDeclaration` block containing `declarationTime`, `reason` (`did_not_occur` or `incorrect_data`) and `correctiveEventIDs`. [S10] [S11] The standard distinguishes a capture mistake from a later physical reversal: [S10]

- **Factual capture mistake (use `errorDeclaration`):** If a clerk typed `2,200 kg` instead of `200 kg` for `BALE-019` and the weighbridge ticket proves `200 kg`, an error declaration retracts the erroneous event and links via `correctiveEventIDs` to a new event carrying `200 kg`, the original `eventTime`, the current `recordTime` and the ticket hash. [S03] [S10]
- **Subsequent physical reversal (use a new event):** If a spinner receives 20 bales at 09:00, rejects 2 wet bales at 11:00 and ships them back at 14:00, the 09:00 receipt was true and must remain intact; the mill logs an 11:00 `inspecting` event (`non_conformant`) and a 14:00 return `shipping` event. [S06] [S10] [S11]

8.19 DUPLICATE MESSAGES, WRONG ORDER LINKS AND MISTAKEN IDENTITIES REQUIRE DISTINCT REMEDIES

GFT specifies three standard remedial patterns grounded in `S06`, `S10` and `S11`: [S06] [S10] [S11]

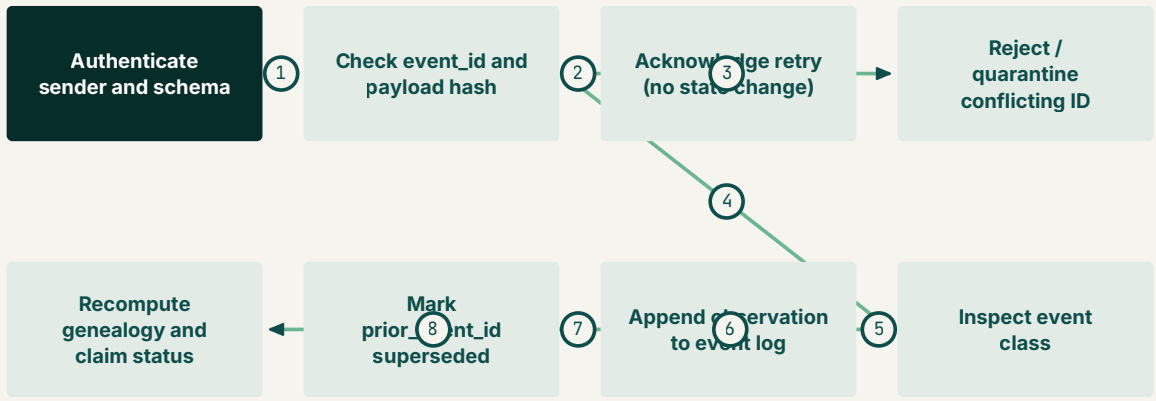
1. **Duplicate network submission:** When an edge queue retries an unacknowledged transmission with the identical `event_id` and canonical payload hash, the receiver's idempotent gate acknowledges the retry without adding a second row or doubling mass. [S03] [S10]
2. **Wrong order or certificate reference:** When physical mass and bale IDs are correct but `bizTransactionList` cites the wrong order or certificate, an error declaration (`reason: incorrect_data`) points to a corrective event that preserves `eventTime` and `quantityList` while fixing the document link. [S05] [S10]
3. **Mistaken material identity discovered after blending:** If 5 conventional bales were mislabelled as segregated CmiA HIP and blended into a 20-bale spinning laydown, the mill must issue error declarations correcting the 5 input bales and execute an irreversible downgrade on the entire yarn lot under AbTF Transparency Standard Section 7.2 (or to uncertified status), propagating a claim restriction to all linked fabric rolls and garment batches. [S06] [S10]

8.20 IDEMPOTENT INGESTION AND REPLAY GATES PROTECT LEDGER INTEGRITY DURING RECONNECTION

To show how a receiving repository handles normal events, retries and error declarations without corrupting genealogy or volume balances, **Exhibit 37**, p. 135 maps the ingestion workflow. [S10] [S26] [S27]

EXHIBIT 37 /

Correction and replay should leave one usable history



1. valid auth + JSON
2. same ID + same hash
3. same ID + diff hash
4. new event_id
5. normal observation
6. errorDeclaration
7. link corrective ID
8. trigger balance check

ILLUSTRATIVE [S10] [S26] [S27] Illustrative event-ingestion, idempotency and error-declaration workflow informed by GS1 EPCIS 2.0 (S10), NIST SP 800-207 (S26) and NIST SP 800-161 Rev. 1 (S27). Design specification only; not a deployed software result.

In **Exhibit 37**, p. 135, the deduplication check (`dedup`) separates benign retries (`same ID + same hash`, acknowledged without state change) from conflicting ID reuses (`same ID + diff hash` without an error declaration, routed to `quarantine`). [S10] [S26] While **Exhibit 37**, p. 135 defines a deterministic ingestion gate, it cannot ensure that staff resolve quarantined conflicts unless the management cadence in Chapter 11 and `wp02` enforces daily review. [S03] [S10]

METHOD

Canonical event hashing and idempotent replay verification

GFT's exchange specification defines a four-step verification boundary grounded in S10, S26, S0801, S0802 and S0803: [S10] [S26] [S0801] [S0802] [S0803]

1. **Sender authentication:** Authenticate subject and device identity before session establishment under NIST SP 800-207 (S26) and verify authority for the stated `bizLocation` and `readPoint`. [S10] [S26]
2. **Canonical normalisation:** Strip repository-assigned `recordTime`, format `eventTime` under RFC 3339 with explicit offset (S0801), sort JSON keys and URI arrays lexicographically (S0803), and express canonical masses in kilograms to three decimal places. [S10] [S0801] [S0803]
3. **Idempotency evaluation:** Compute `payload_sha256`. Accept unseen `(event_id, False, hash)` tuples; acknowledge identical retries without ledger impact; accept `(event_id, True, hash)` error declarations only when `event_id` exists and `declarationTime ⩾ eventTime`; quarantine all other collisions. [S10] [S0802]
4. **Graph re-evaluation:** When an error declaration supersedes a prior event, traverse forward links, recompute Chapter 6 volume balances, and restrict any affected downstream claim. [S03] [S06] [S10]

8.21

A partner exchange is proven by round-trip tests

Adopting a standard name in a contract does not prove two systems interoperate. [S10] [S27] Integrations fail when CSV exports strip leading zeros, scripts turn `null` moisture into `0.0`, firewalls block resolver redirects or weavers ignore spinner error declarations. [S10] [S12] [S13] GFT requires every partner interface to pass round-trip conformance tests before live onboarding. [S10] [S27]

8.22 FIVE CONFORMANCE TEST FIXTURES VERIFY SYNTAX, SEMANTICS, UNITS, ACCESS AND CORRECTIONS

Grounded in S10 to S13, S19, S26 and S27, GFT defines five mandatory staging test fixtures: [S10] [S11] [S12] [S13] [S19] [S26] [S27]

- **Fixture 1 (`FX-08-SYNTAX`):** Exchange 10 valid events across all five EPCIS types and 5 invalid payloads (missing time offset, unallocated GS1 prefix without crosswalk, negative mass, unescaped batch URI characters, and a `TransformationEvent` lacking outputs). [S10] [S12] Pass rule: all 10 valid payloads store lossless values and all 5 invalid payloads fail with explicit field errors. [S10] [S12]
- **Fixture 2 (`FX-08-SEMANTICS`):** Exchange a synthetic chain with a segregated ginning lot, a mixed-origin spinning laydown, a pallet `AggregationEvent` and a toll-dyeing transfer. [S02] [S06] [S10] [S11] Pass rule: CBV URIs remain intact, aggregation is not treated as conversion, and the mixed laydown narrows the downstream origin claim. [S02] [S10] [S11]

- **Fixture 3 (FX-08-UNITS):** Exchange masses in kilograms, tonnes and pounds across 7.0 percent and 8.5 percent moisture regain bases and gross/tare weights. [S03] [S06] [S10] Pass rule: import and re-export preserve observed values, units and bases plus canonical kilogram mass within 0.001 kg per lot. [S03] [S10]
- **Fixture 4 (FX-08-ACCESS):** Query event endpoints and the GS1-conformant resolver (S13) using public consumer, buyer and auditor credentials under zero-trust checks (S26). [S12] [S13] [S19] [S26] Pass rule: public queries return bounded summaries without personal data or prices (S19), while buyer and auditor queries resolve authorised evidence links. [S13] [S19] [S26]
- **Fixture 5 (FX-08-CORRECTION):** Submit a triple retry of one ObjectEvent, a conflicting ID reuse without an error declaration, and a valid errorDeclaration downgrading an input bale in a spinning transformation. [S06] [S10] Pass rule: the triple retry creates one entry, the conflict is quarantined, and the error declaration supersedes the prior event and restricts the downstream garment claim. [S06] [S10]

8.23 CONTROLLED FILE TEMPLATES INCLUDE PARTNERS WITHOUT REAL-TIME APPLICATION INTERFACES

Not every ginnery, warehouse or wet-processing subcontractor in Cameroon runs a live REST API. [R03] [S10] [S27] Requiring live APIs would exclude capable suppliers or push staff back to ad-hoc spreadsheets. [S10] [S17] GFT therefore supports two transport bindings over the twelve-field dictionary (**Exhibit 35**, p. 132): an EPCIS 2.0 JSON-LD HTTPS interface and a schema-validated flat-file bundle (UTF-8 CSV or JSON with a SHA-256 manifest for attached tickets and certificates). [S03] [S10] [S0803] File bundles pass through the identical authentication, deduplication and error-declaration workflow (**Exhibit 37**, p. 135) and must pass all five fixtures (FX-08-SYNTAX to FX-08-CORRECTION). [S10] [S26] [S27]

8.24 INDEPENDENT GENEALOGY RECONSTRUCTION GATES PARTNER ONBOARDING AND SERVICE EXIT

Under NIST SP 800-161 Rev. 1 (S27) and the GS1-Conformant Resolver Standard (S13), every software service must support complete bulk export of events, error declarations, crosswalks and evidence files in open EPCIS 2.0 JSON-LD format without proprietary locks. [S10] [S13] [S27] [S0803] Before accepting an integration (and

during Chapter 13 pilot review), an independent reviewer must load a blind export into a standalone script and confirm that reconstructed genealogy, volume balances and claim boundaries match source records. [S03] [S10] [S24] [S27]

WARNING

Unresolved interoperability constraints requiring pilot and legal verification

1. **Pre-production status of UNTP specifications:** The UNECE UNTP Digital Product Passport (S28), Conformity Credential (S29) and Digital Traceability Events (S30) pages accessed on 30 October 2026 are Work in Progress (`v0.8.0` candidates for `v1.0`) and do not establish conformity with future EU textile delegated acts (S14, S15). [S14] [S15] [S28] [S29] [S30]
2. **Unconfirmed supplier software capabilities:** Neither the inherited evidence register (R03, R06) nor the opened standards establish which ERP or weighbridge systems Cameroon ginneries and mills currently run; file and API readiness must be verified during pilot scoping. [R03] [R06] [S10] [S27]
3. **Prefix licensing and domain custody:** Public deployment of GS1 Digital Link URIs (S12) and resolvers (S13) requires licensing a GS1 Company Prefix and securing multi-year domain governance; pilot testing must use internal or test namespaces (`urn:gft-pilot:` or `.example`) until licensing is complete. [S12] [S13] [S27]

A record is portable only when another engineer can reconstruct the same physical history without calling the sender to ask what the fields meant.

CHAPTER SOURCE NOTES

S10 GS1. 2022-06.

S11 GS1. 2022-06.

R06 Cameroon Trade Hub. Publication date unrecorded; inherited source-text check.

R07 Ecofin Agency. Publication date unrecorded; inherited source-text check.

S12 GS1. 2026-08.

S27 National Institute of Standards and Technology. 2024-11-01.

S01 International Organization for Standardization. 2020.

S28 UNECE / UN Transparency Protocol. 2026-10-30.

S09 Cotton made in Africa / Sustainable Cotton Tracker. 2026-10-30.

S06 Aid by Trade Foundation. 2025-06.

S02 ISEAL Alliance. 2025.

R03 SODECOTON. Publication date unrecorded; inherited source-text check.

S21 World Wide Web Consortium. 2025-05-15.

S13 GS1. 2026-08.

S0802 Internet Engineering Task Force. 2024-05.

S03 Textile Exchange. 2026-10-30.

S24 World Wide Web Consortium. 2025-05-15.

S34 European Commission, DG GROW. 2026-10-30.

S16 European Commission, DG Environment. 2022.

S07 Aid by Trade Foundation / Cotton made in Africa. 2026-10-30.

S14 European Commission, DG GROW. 2026-10-30.

S15 European Commission. 2026-10-30.

S05 Global Standards gGmbH. 2026-10-30.

S30 UNECE / UN Transparency Protocol. 2026-10-30.

S29 UNECE / UN Transparency Protocol. 2026-10-30.

S0803 World Wide Web Consortium. 2020-07-16.

S0801 Internet Engineering Task Force. 2002-07.

S26 National Institute of Standards and Technology. 2020-08.

S19 European Data Protection Board. 2026-10-30.

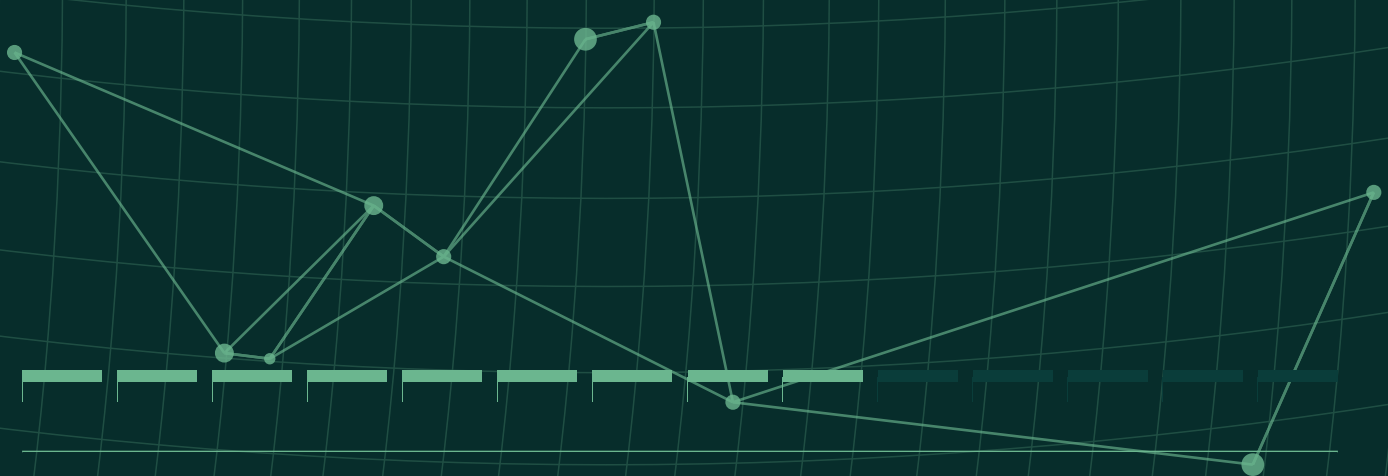
S17 OECD. 2018-03-07.

09

PART III: PASSPORTS MUST PRESERVE EVIDENCE / PASSPORT DESIGN

The passport should disclose a bounded product record

A useful passport identifies its product, states who makes each claim and reveals the limits of the supporting evidence. Proposed fields must remain distinct from future legal requirements.



CHAPTER 09
DECISION TEST

A useful passport identifies its product, states who makes each claim and reveals the limits of the supporting evidence. Proposed fields must remain distinct from future legal requirements.

A product passport should publish the narrowest useful record that its evidence can defend. GFT proposes a product identifier, a declared product boundary, field-level evidence links, an accountable issuer and an explicit release state. The record should reveal unknowns and restrictions rather than turn them into reassuring blanks. This chapter supplies a proposed schema, a field-status register and illustrative reader views. These are design recommendations for an educational prototype, not evidence of a deployed system, an approved certificate or present legal conformity.

9.1

Current policy does not settle the final textile schema

As of 30 October 2026, the European Commission's textile passport page places adoption of the textile delegated act in Q4 2027 on an explicitly indicative timeline. It says exact information requirements will be defined through delegated acts and supporting technical specifications. That planned adoption is not a universal application deadline. A supplier should therefore distinguish preparing data from asserting compliance with a final textile schema. [S14]

The Commission describes the Ecodesign for Sustainable Products Regulation as framework legislation under which concrete product or horizontal rules are developed subsequently. Its implementation page describes working plans, impact assessments and consultation. Those stages explain why a useful data project can begin before every product-specific requirement is settled. They do not make a prototype's fields legally sufficient. [S15]

GFT recommends a policy register with separate entries for the framework, product-specific rulemaking, technical specifications and application conditions. Each entry should retain the official document, its status, the responsible reviewing role and the decision it affects. An entry without an established application condition should say that the condition remains to be confirmed. The register must not turn a consultation milestone into a shipment authorisation.

The proposed release process has distinct legal and evidential questions. The legal reviewer determines the applicable market and product obligations from current authoritative texts. The evidence reviewer determines whether the supplied records support the particular statement. A positive answer to either question cannot substitute for the other. This chapter is not investment, legal or tax advice. Clause-level legal analysis belongs to the companion legal paper and requires the relevant texts before any compliance claim is made.

A practical procurement brief should separate stable capabilities from changeable mappings. Stable capabilities include preserving evidence references, identifying the issuer, controlling disclosure and exporting the record. Changeable mappings include which fields a particular market requires, which vocabulary expresses them and which person must supply them. GFT recommends buying the ability to update those mappings under change control, with an auditable comparison of the old and new definitions.

Consider an illustrative buyer request for a passport described simply as compliant. The proposed response is a requirements clarification sheet within the project, not a compliance badge on the product. The sheet identifies product scope, intended market, applicable instrument, responsible operator and acceptance evidence. Until that mapping is approved, the interface should describe a voluntary product record. Commercial urgency does not resolve an unspecified legal test.

The Commission lists possible information categories including identification, composition, origin and use or repair information, subject to final requirements. Its sector overview separately describes rules on fibre names and composition labelling. GFT therefore recommends treating composition labelling, provenance evidence and future passport requirements as distinct review items. A composition statement does not establish where cotton grew, and an origin narrative should not displace the applicable composition review. [S14] [S34]

> **GFT NOTE**
>
> Freeze the prototype's field dictionary and the policy register separately. Require a dated legal refresh before publication, procurement acceptance and market entry. Allow supported voluntary information to proceed through its own approval route, but withhold any legal conformity wording until its applicable basis and reviewer are recorded.

A useful policy register also records what would trigger reconsideration: a revised requirement, a changed product category, a new destination market or an altered operator role. The proposed owner should assess the impact on existing records as well as future releases. Replacing the interface template without reviewing already issued claims would leave readers with inconsistent meanings under an apparently stable product identity.

9.2

A proposed passport needs a field-level evidence map

The UN Transparency Protocol product-passport specification distinguishes product information, performance claims, conformity links and upstream traceability links. The opened page is explicitly work in progress and suitable for pre-production pilots. It offers a useful comparison vocabulary for this proposal, not a declaration that an implementation meets EU law. GFT recommends pinning the compared version and recording every local extension before using its terms in an exchange. [S28]

For this chapter, each proposed field has a semantic classification as well as a value. A source-backed concept means an opened reference discusses that category. A GFT proposal means this chapter recommends its local structure or control. A future requirement to confirm means the relevant legal obligation is unresolved for the intended use. These classifications can coexist: a composition concept may be source-backed while its local evidence-pointer format remains a proposal.

The field-evidence register in **Exhibit 38**, p. 143 defines the proposed minimum review surface. The entries are qualitative design choices, not collected factory data. Public availability is conditional on lawful disclosure, current evidence and release approval. The table deliberately avoids describing any row as a final mandatory textile passport field.

EXHIBIT 38 / PROPOSED FIELD CLASSES

Every proposed field needs evidence and a disclosure decision

Field	Concept status	Evidence	Default view
Product and batch	Source-backed	Identity record	Public summary
Composition	Source-backed	Scoped declaration	Public if released
Manufacturing site	Source-backed	Production record	Approved detail
Cotton provenance	Source-backed	Custody chain	Bounded summary
Care instructions	Source-backed	Approved guidance	Public
Evidence pointer	GFT proposal	Indexed document	Role restricted
Release status	GFT proposal	Review decision	Public
Legal field set	Future to confirm	Applicable text	Review register

ILLUSTRATIVE [S14] [S19] [S28] [S34] Illustrative GFT field register. Source-backed concepts do not establish a final mandatory textile schema. Local evidence and access rules are proposals.

The table establishes a review obligation, not a guarantee of evidence quality. A link to a declaration supports only what that declaration actually covers. A product model's generic bill of materials should not silently become the measured composition of every finished batch. GFT proposes recording whether composition is declared, tested or calculated, together with the covered component, unit basis and version. Differences between those bases should remain visible to the reviewer.

A proposed machine-readable record should contain a record identifier and revision, a product reference and granularity, an issuer reference, a publication timestamp, a field collection and a release decision. Each field should carry its value or explicit non-value state, evidence reference, method reference where needed, observation period, review date and disclosure class. These are local design requirements. They should be mapped to an external schema only after the mapping is tested for meaning as well as syntax.

GFT proposes distinct states for absent, unknown, withheld and not applicable. Absent means the expected field or observation was not supplied. Unknown means the question was considered but the value remains unresolved. Withheld means a value is held under a stated restriction. Not applicable needs a recorded reason tied to the product boundary. None is equivalent to measured zero, independently verified or permission to infer a favourable result.

The proposed field-status register should also name the person acting in the responsible role and identify the blocking condition. An absent origin record may require upstream retrieval; a withheld record may require an access decision; a disputed record requires adjudication. A generic incomplete flag would conceal those different actions. The public view can simplify the wording, but the internal state must remain specific enough to direct the next decision.

An illustrative record might identify a garment batch, describe its cotton-rich outer fabric and state that a bounded country-of-cultivation claim is under review. Its sewing location could have separate production evidence. Care instructions could already be approved. The record should publish those independently assessed fields without presenting an overall green badge that implies the pending provenance claim has passed. A shared screen is not a shared evidential boundary.

The proposed export must preserve the distinction between missing data and restricted data. A receiving system should not infer missing evidence merely because it lacks access to a protected file, and should not infer evidential adequacy from a protected link. GFT recommends separate machine states for evidence existence, access availability and review outcome. That separation allows a buyer to request the right permission without changing the claim itself.

9.3 THE PROPOSED SCHEMA SHOULD REJECT AMBIGUOUS FIELD STATES

GFT proposes explicit types and consistency rules for the local schema. Product and evidence identifiers are strings with declared namespaces. A timestamp carries a timezone and distinguishes observation from publication. Quantities are numeric values paired with units and a stated basis; a percentage without its denominator is incomplete. Enumerated states use controlled terms rather than free-text approximations. These are proposed validation rules, not an assertion that an external standard mandates this particular record structure.

The proposed value rule is exclusive: a field contains either an admissible value or a non-value state with its reason. A withheld field may reference a restricted evidence index, but must not export its protected value in another attribute. A released claim must identify its approving decision and supporting evidence version. A superseded claim must point to its replacement, while a withdrawal may have no replacement. The validator should reject contradictory combinations instead of choosing whichever attribute is easiest to display.

An illustrative public record could read: product, demonstration garment batch; composition, declared outer-fabric composition available; cotton provenance, pending evidence; manufacturing location, manufacturer declaration; independent assessment, not supplied; care, approved instructions available. Its restricted counterpart could expose the relevant document references and reviewing role. These examples deliberately contain no allocated commercial identifier or real supplier identity. Their purpose is to show how bounded wording can remain useful before every desired claim is admissible.

The proposed record examples should be retained as fixtures for the later implementation. An expected-output file should show the public, buyer and audit renderings of the same input, including withheld and disputed fields. A schema change should be

checked against those expected meanings. Technical acceptance would require the implementation to produce the intended disclosure, not merely accept a syntactically valid record. No implementation or fixture execution is claimed by this writing lane.

9.4

A data carrier points to information and can be copied

GS1 Digital Link provides syntax for representing identification keys in web addresses, including batch and serial qualifiers. The resolver standard addresses discovery of related information and services through typed links. These standards help organise addressing and resolution. They do not by themselves establish that a physical garment carrying an address is the garment described at that address. [S12] [S13]

GFT proposes treating carrier selection as an operating decision. The pilot should compare the intended label substrate, print process, attachment point and expected handling conditions. It should test whether people can find the identifier after ordinary use, whether the printed alternative remains readable and how replacement labels are authorised. No durability interval or scan-success result is assumed here; both need measurement under an agreed protocol.

The copied-code case should be demonstrated explicitly in the prototype. An illustrative legitimate batch record can be reached by a label attached to an unrelated item. The page can be technically available and the product record internally consistent while the attachment is wrong. GFT therefore proposes a reader message that explains what the code identifies, together with a discrepancy route for mismatched product descriptions. The message should avoid promising authentication from a successful scan.

The proposed operating controls include controlled label issue, reconciliation of replacement requests and retained links from retired labels to their replacements. A replacement should preserve the product identity where the physical identity has been established. It should not create an apparently new product merely to erase an unresolved mismatch. The responsible release role must decide whether a disputed attachment requires a warning, an identity investigation or suspension of the associated claim.

An illustrative counterfeit exercise should give the reviewer both a copied label and the original record, then ask what each proves. The expected conclusion is bounded: the label reveals a pointer, the record reveals the issuer's statements and the physical checks determine whether the attachment is credible. Designing the public interface around those separate questions prevents the familiar but unsupported inference that reachable information proves an authentic item.

GFT recommends an explicit carrier-to-record mapping with creation, replacement and retirement events. This is an interface requirement, not a replacement for the event exchange design in the preceding chapter. The mapping should reference the controlled product identity and retain the authorising decision for each change. A buyer receiving a record export should be able to distinguish a replaced carrier from an altered product claim without guessing from file names.

The reader also needs a route that does not require scanning. GFT proposes a printed identifier and a short route to a search form, with understandable error messages when the identifier is not found. The search result should show the product boundary before offering deeper evidence. A failure to resolve should remain a retrieval failure until investigated; it should not automatically accuse a supplier or certify the item as false.

Operational acceptance should include deliberately awkward conditions: partial print damage, a replaced label, the wrong batch suffix and an unavailable evidence link. The proposed review should record what the user saw and whether the next action remained clear. Passing only the pristine-label case would leave the design's central uncertainty untreated. The full adverse-case pilot remains the responsibility of the later pilot chapter, while this chapter defines the required disclosure behaviour.

9.5

Public and restricted views need different disclosures

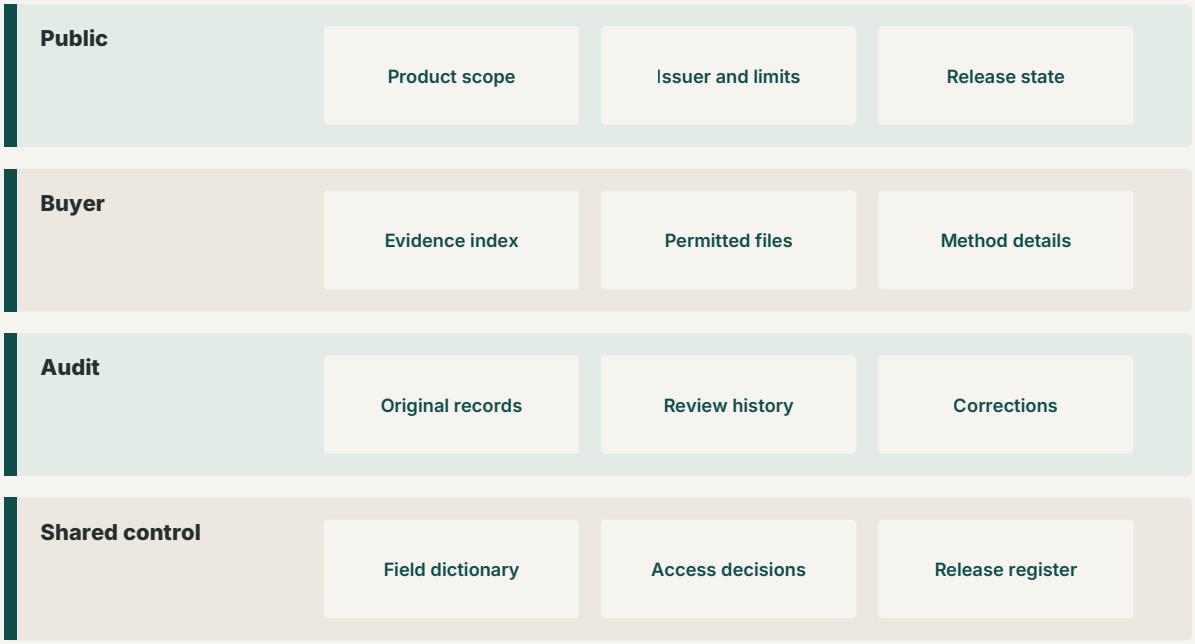
The European Data Protection Board explains purpose limitation and proportionate collection of personal data, and discusses when the GDPR applies. GFT uses these principles as a design reference, without assuming that every Cameroon operation falls within that regulation. Applicable local and cross-border requirements need separate assessment. Public farmer identities, personal contact details and unnecessary precise locations should not be a default condition for explaining a garment's provenance. [S19]

GFT proposes a public summary, a controlled buyer view and an audit evidence view. The public summary should identify the product and disclose approved claim wording, its scope, the issuer and material limitations. The buyer view should expose the relevant evidence index and permitted supporting documents. The audit view should permit reconstruction of the decision under an authorised mandate. These are proposed views of a governed record, not independent copies with unrelated facts.

The architecture in **Exhibit 39**, p. 147 separates reader purposes from the common release register. It is an illustrative disclosure model, not a deployed access system. A change in a claim's release state should be reflected wherever the claim appears. Restricting a document should affect access to that document, not erase the record that a review occurred or expand what the public wording is allowed to imply.

EXHIBIT 39 / PROPOSED DISCLOSURE LAYERS

Different readers need different access to the same claim boundary



ILLUSTRATIVE [S19] [S21] [S26] [S29] Illustrative GFT design. Public visibility, evidence access and evidential acceptance are independent decisions. No deployed access control or independent assessment is claimed.

The common control layer does not require every reader to see every underlying identity. GFT proposes that the public summary use an appropriate aggregation while the evidence index retains the controlled reference needed for an authorised review. Aggregation must preserve meaning: a regional statement cannot become a farm-specific claim through attractive map design. Where the available evidence supports only a broader location, the public statement should retain that broader boundary.

NIST's zero trust guidance separates authentication and authorisation and rejects implicit trust based solely on network location. GFT's proposed consequence is field-specific access after the user and permitted purpose have been established. A buyer's commercial relationship should not automatically grant access to worker records or unrelated supplier contracts. Access approval, evidence review and claim release should have distinct recorded outcomes. [S26]

GFT recommends keeping contract prices and sensitive commercial terms outside the public view unless a separately authorised disclosure has a defined purpose. The evidence owner should document what is shared, with whom and why. An audit pack may require different detail from a purchasing pack. The passport should state an evidence-access route without suggesting that every requester has an unconditional right to all underlying documents.

A restricted link must not serve as a decorative assurance badge. Proposed wording should distinguish evidence available to authorised reviewers, evidence reviewed by the manufacturer and evidence independently assessed for a defined claim. If no

independent review occurred, the interface should say so. A public reader cannot judge a hidden document, and the interface should not invite the reader to treat inaccessibility as proof of rigour.

The proposal should also account for the traces generated by using the passport. A product-information request should not become a reason to build an unnecessary history of individual readers. GFT recommends separating service diagnostics from product evidence and collecting only what the defined function requires. The operational design should specify retention, deletion and authorised access for those diagnostics before enabling analytics. These controls remain proposals until implemented and examined.

An illustrative access challenge should ask a buyer to open a permitted declaration, then attempt an unrelated restricted file. The expected result is usable access to the former and a clear denial for the latter, without leaking content in previews, search results or exports. This is a proposed acceptance case, not a reported security test. Wider identity administration and governance remain with the companion governance and infrastructure papers.

9.6

Product claims need visible issuers and method boundaries

The W3C credential model distinguishes issuers, holders and verifiers and explicitly separates verifiability from the truth of encoded claims. The UNTP conformity-credential draft separately describes an assessment body as the issuing party for that credential. GFT's proposed interface should therefore show who made a product statement and who, if anyone, assessed it, without merging those roles into an undifferentiated verified label. [S21] [S29]

A proposed claim object should hold the claim text, subject boundary, issuer, issue date, method reference, evidence references, assurance basis and current release state. Where an assessor exists, its identity and assessment scope should appear separately. Where none exists, the record should describe the claim as the issuer's declaration. This chapter specifies disclosure; detailed signature checks and issuer trust policy belong to the following chapter.

Release should be claim-specific. GFT proposes draft, pending evidence, released, suspended, withdrawn and superseded states, each with an authorised transition and retained reason. A withdrawn origin statement should not cause approved care information to disappear. Equally, a released identity field should not let a pending sustainability claim inherit approval. The public record should present the current decision and provide enough historical context to explain material changes.

The illustrative example below measures release coverage only. It does not estimate the proportion of certified cotton or prove geographical origin. The assumed decision units are finished garments grouped into distinct batches. This keeps the arithmetic tied to an administrative release decision, rather than implying that missing evidence can be spread evenly through a physical blend.

WORKED EXAMPLE: RELEASE COVERAGE IS NOT COTTON PROVENANCE

Assume an illustrative shipment contains 1,000 garments in separately identified batches. Original custody evidence supports the proposed origin statement for a batch containing 600 garments. A batch containing 250 garments has an unresolved evidence gap. A batch containing 150 garments has conflicting records. These are hypothetical decision counts, not GFT or supplier observations.

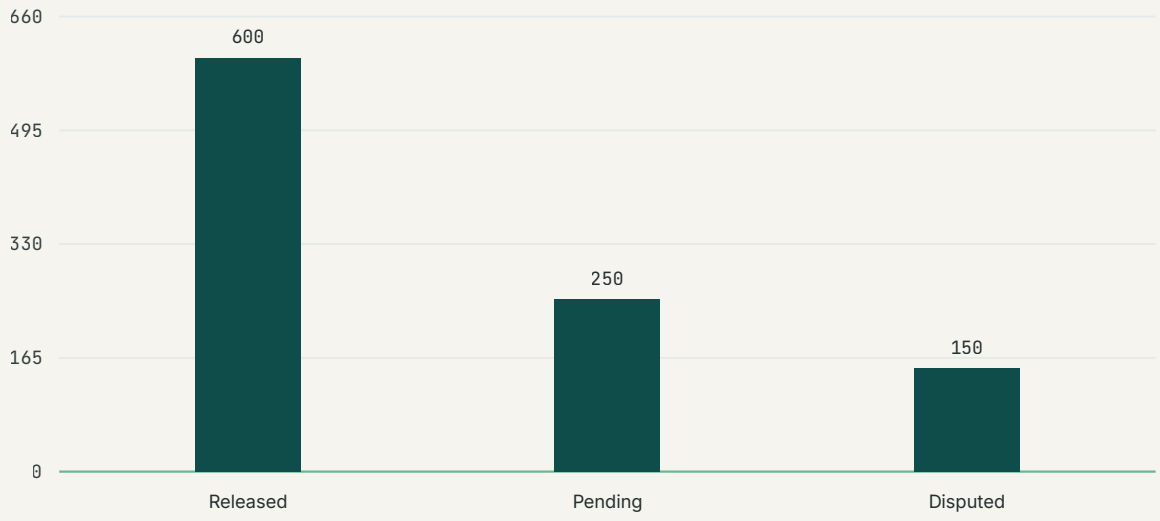
Under the illustrative rule that a claim is released only for a supported batch, released coverage is 600 / 1,000 = 60 percent of garments. Pending coverage is 250 / 1,000 = 25 percent, and disputed coverage is 150 / 1,000 = 15 percent. The counts reconcile because 600 + 250 + 150 = 1,000. The denominator includes every garment in the assumed shipment, including unresolved units.

The illustrative public record for the supported batch may display its approved statement and evidence boundary. The pending and disputed batches must retain their own visible states. A shipment summary may disclose the 60 percent administrative release coverage, but it must not say that every garment contains 60 percent cotton from the claimed country. No fibre mass fraction has been measured or calculated in this case.

The release profile in **Exhibit 40**, p. 149 preserves the unresolved denominator. Each column is a decision state under the hypothetical case. The illustration cannot establish certificate eligibility, the truth of the assumed evidence or the physical distribution of cotton. Those require the custody and reconciliation methods developed earlier in the paper.

EXHIBIT 40 / ILLUSTRATIVE GARMENTS

Unresolved garments remain outside the released origin statement



ILLUSTRATIVE Illustrative inputs: 1000 garments in separate batches, comprising 600 supported, 250 pending and 150 disputed. Counts sum to 1000. Coverage is respectively 60, 25 and 15 percent by garment count, not fibre mass fraction or certification.

GFT proposes showing the denominator beside any completeness or release statistic. The reviewer should know whether coverage refers to garments, batch records, mass or required evidence fields. A product with a complete identity record and unresolved

origin evidence should not be scored as partly proven origin merely because most form fields are populated. A metric must describe its decision unit, not reward data-entry activity.

Water and carbon statements need their own methods, units, periods and system boundaries. GFT proposes linking them only after the relevant assessment has been reviewed under the companion water and impact methods. Cotton's declared origin should never populate an impact field automatically. In the illustrative prototype, an unavailable assessment should remain unknown, with no favourable default value and no substitution of a sector average for a product result.

A proposed correction notice should identify the affected claim, the previous wording, the reason for change and the current permitted use. The notice should distinguish a clerical repair from newly discovered contradictory evidence. GFT recommends preserving the original decision record for authorised review while ensuring the public view no longer promotes an unsupported statement. The goal is to make a changed conclusion understandable without requiring the reader to reconstruct internal event logs.

9.7

A passport must remain useful when a supplier or service changes

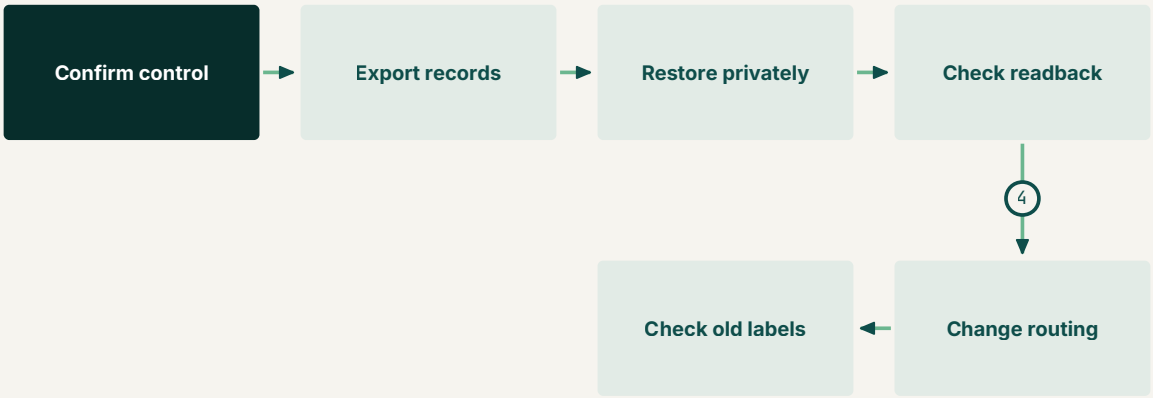
The resolver standard describes links, discovery and redirection; it does not remove the need to govern the domain carrying the identifier. NIST's supply-chain risk guidance addresses risks arising from technology products and services. GFT's proposed consequence is to make continuity, controlled export and service replacement explicit procurement conditions, rather than assume that a supplier's current interface will persist for the product's useful life. [S13] [S27]

GFT recommends assigning responsibility for the identifier namespace, domain renewal, routing configuration and evidence custody. Those responsibilities may sit with different roles, but their handoffs must be recorded. A platform change should not require replacing every physical label where the existing identifier remains valid. The proposed design keeps a controlled address stable while the authorised service destination changes under review.

The transition in **Exhibit 41**, p. 151 requires an independent readback before routing is changed. It is a proposed continuity sequence with no promised duration. If the export loses access restrictions, revision links or evidence attachments, service exit has not succeeded merely because a replacement page opens.

EXHIBIT 41 / PROPOSED CONTINUITY STEPS

Service exit requires a readable export before routing changes



4. Pass

ILLUSTRATIVE [S13] [S27] Illustrative GFT procedure informed by resolver functions and supplier-risk guidance. Proceed only after readback passes; retain the existing route or publish an explicit status notice if safe continuity cannot be demonstrated.

An illustrative abandoned-service case should include a product whose original supplier can no longer answer questions. GFT proposes preserving the last approved record with a visible status date and an explicit warning where ongoing confirmation is unavailable. A successor operator should identify its authority before making changes. Custody of a database does not alone authorise that operator to restate another party's claim as its own. If no lawful continuity route exists, a limited historical record is preferable to a current-looking assurance statement.

The proposed exit package should include the field dictionary, vocabulary versions, identifier crosswalk, release decisions and attachment index alongside the records themselves. Export acceptance should test relationships, not only file counts. The reviewer should establish that a former public link reaches the intended replacement, that a historical claim is still recognisable and that an unresolved restriction remains visible. Any missing relationship should enter the exit defect register before the routing decision.

The proposed readback should reconstruct the product identity, current release state and material historical changes using the exported data. It should retrieve the permitted supporting files and demonstrate that restricted files remain restricted. It should also expose unresolved references rather than quietly discard them. GFT recommends acceptance by a reviewer who can interpret the record without access to the former vendor's private dashboard.

Accessibility is part of continued usefulness. WCAG provides testable web-content criteria covering keyboard operation, alternatives for non-text content, reflow and understandable interaction. GFT proposes a text-first product record with labelled

controls, visible focus and status messages that do not depend only on colour. These are design requirements informed by the standard, not a claim of tested accessibility or a conformance result. [S31]

The proposed acceptance session should include keyboard access to product search and evidence requests, enlarged text, a narrow display and an unavailable image. It should check whether claim limitations appear before a reader acts on the summary. GFT recommends reporting observed barriers and their fixes, rather than awarding accessibility status from a component library's description. Language support should preserve claim meaning and mark whether an approved translation or only the source text is available.

The Commission's textiles strategy takes a lifecycle perspective, and its passport overview discusses information relevant to repair, reuse and recycling. GFT proposes preserving the original manufacturing record while appending clearly attributed life-cycle observations. Circular-process design belongs to the companion circularity paper. A repair entry should describe the intervention and evidence available; it should not automatically reissue the original manufacturing claim for replacement material. [S16]

An illustrative resale record could state that a garment has an observed repair and a replacement label linked to its existing identity. If the repairer cannot establish the replacement fabric's origin, the new component should remain outside the original provenance claim. The useful outcome is a more informative bounded record, rather than an apparently unbroken claim created by overwriting the first composition declaration.

GFT recommends closing the design review with a release memorandum containing the proposed field dictionary, current policy-status register, approved wording, unresolved evidence list, disclosure permissions and continuity test specification. The educational trace-a-garment prototype should present these distinctions directly. It should remain labelled as a prototype until actual implementation and evidence review support a narrower operational claim. The passport earns its usefulness by carrying limits as carefully as it carries product information.

A passport should carry the product's evidence and the boundary of its certainty.

CHAPTER SOURCE NOTES

S14 European Commission, DG GROW. 2026-10-30.

S15 European Commission. 2026-10-30.

S34 European Commission, DG GROW. 2026-10-30.
S28 UNECE / UN Transparency Protocol. 2026-10-30.
S19 European Data Protection Board. 2026-10-30.
S12 GS1. 2026.
S13 GS1. 2026.
S21 World Wide Web Consortium. 2025-05-15.
S26 National Institute of Standards and Technology. 2020.
S29 UNECE / UN Transparency Protocol. 2026-10-30.
S27 National Institute of Standards and Technology. 2024-11-01.
S31 World Wide Web Consortium. 2024-12-12.
S16 European Commission, DG Environment. 2022.

GREEN FUTURE TECH

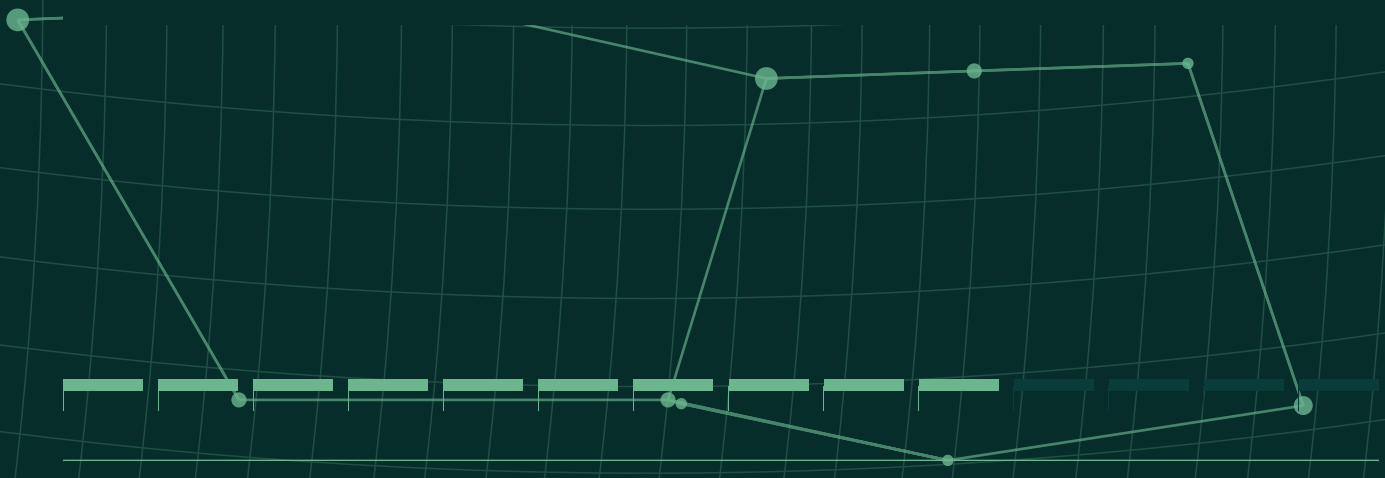
LIMITED / HONG KONG SAR

10

PART III: PASSPORTS MUST PRESERVE EVIDENCE / TRUST DESIGN

Digital signatures preserve assertions while trust needs governance

Cryptography can preserve an assertion and identify its signing authority, but accepting a textile claim still requires physical evidence and an explicit trust policy.



CHAPTER 10
DECISION TEST

Cryptography can preserve an assertion and identify its signing authority, but accepting a textile claim still requires physical evidence and an explicit trust policy.

A digital signature should preserve accountability for a claim without becoming a substitute for investigating it. GFT recommends separate decisions for technical verification, evidence admissibility and commercial claim release. W3C explicitly distinguishes credential verifiability from the truth of its claims. [S1001] For cotton provenance, the practical consequence is straightforward: an authorised signature over an unsupported origin declaration remains an unsupported declaration. The proposed control system must identify who asserted what, establish the evidence boundary and record who accepted that boundary. This chapter specifies those controls as design recommendations, not as a description of a deployed GFT service.

10.1

An issuer's identity does not prove a physical claim

The W3C credential model distinguishes the issuer that makes claims, the holder that retains or presents credentials, and the verifier that evaluates them. [S1001] In a proposed cotton transaction these roles might belong to a ginnery, a trader and a buyer respectively. That mapping is illustrative, not a required organisational structure. GFT would require a role map for each workflow because the party presenting a declaration may have neither observed the cotton nor performed the assessment. A transport intermediary carrying an authentic document should not acquire authority to extend its conclusions.

Consider an illustrative origin declaration signed by a genuine processing organisation using its properly controlled key. The declaration identifies the intended lint lot, passes technical checks and states that the cotton was grown in Cameroon. The receiving dossier, however, contains an unresolved substitution between the inbound bale group and the recorded production input. GFT's proposed decision is to retain the signed assertion as evidence of what the organisation said, place the origin claim on hold and investigate the substitution. The signature provides an accountable starting point. It cannot supply the missing physical connection.

The converse case matters too. A warehouse may possess credible receiving and production documents while its digital credential has an invalid proof. GFT would reject that credential for automated acceptance, preserve the underlying dossier and seek an authorised replacement. The physical claim might eventually be supported through another approved channel. This distinction prevents technical failure from being misreported as proof of false origin. It also prevents commercial urgency from being used to excuse a failed digital control. The incident record should say which question remains unresolved.

The proposed issuer trust policy is a governed register, with an accountable policy owner and an effective version. Each entry should bind a stable digital identifier to a checked legal entity, authorised facilities, permitted claim classes and evidence obligations. Admission should state who checked the business identity, who granted the authority and how a buyer can challenge it. A record for dispatch acknowledgements should not automatically authorise environmental assessments or statements about farms beyond the issuer's documented knowledge. Trust must be granted to a defined activity rather than to an attractive organisation name.

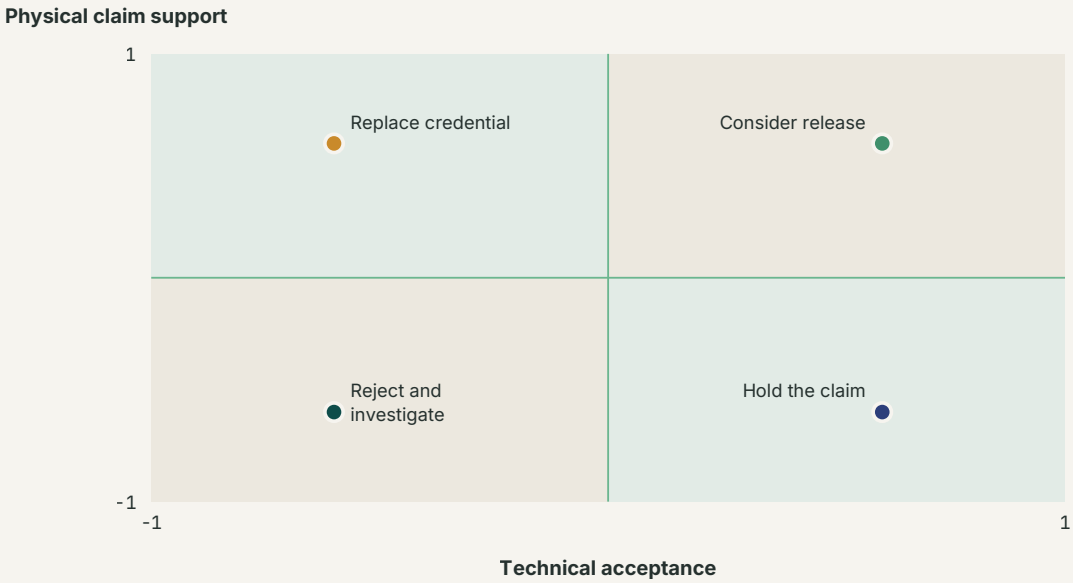
GFT further recommends recording the custody model, material and geographic scope, validity conditions, suspension route and appeal owner alongside each permission. An issuer may be accepted for a receiving observation while remaining unapproved for a consumer origin statement. An assessment body should have its assessment scope checked separately from the manufacturer's own declaration. The working UN Transparency Protocol conformity model assigns issuance to the conformity assessment body and distinguishes assessment and authority information. It is a pre-production specification, not evidence of legal recognition or of any organisation's competence. [S29]

The proposed policy should also state what happens when authority changes. A merger, facility transfer or withdrawn assessment scope should trigger review of the affected permission, rather than automatic inheritance by the next organisation controlling the identifier. GFT recommends retaining both the earlier admission evidence and the decision authorising the new relationship. Buyers should receive a clear boundary for continued reliance. This requirement concerns permission to make a claim; it does not presume that a business change invalidates all previously recorded physical observations.

The illustrative positions in **Exhibit 42**, p. 156 make the separation visible. The coordinates are categorical placements, not measured reliability scores. Their purpose is to stop a single green verification symbol from merging independent judgements.

EXHIBIT 42 / ILLUSTRATIVE CATEGORICAL POSITIONS

Technical acceptance and claim support require separate decisions



ILLUSTRATIVE [S1001] [S1002] Illustrative policy map. Negative and positive positions mean failed or unsupported and passed or supported respectively. Coordinates are arbitrary placements, not probabilities, scores or observed GFT results. Technical acceptance includes the required policy checks.

Even the supported and technically accepted position means consider release rather than automatic approval. GFT's proposed release owner must still check the intended wording, product boundary and buyer use. Evidence supporting a lot-level statement

should not be silently extended to every item after an unrecorded transformation. The diagram diagnoses decision categories; it neither certifies a product nor resolves the custody modelling questions treated elsewhere in this paper.

> **GFT NOTE**
>
> Adopt separate fields for technical verification, evidence review and claim release. Give each field an owner, a reason and a review timestamp. Present missing evidence as pending or unsupported, with a useful explanation. Reserve any public assurance statement for the precise claim that the release owner has approved.

10.2

Credential verification needs more than a signature check

W3C Data Integrity distinguishes proof purpose from the verification relationship that authorises a key for that purpose. A key's presence in an identifier document alone is insufficient. The verifier must check that its authorised relationship matches the intended use. [S1002] GFT's proposed implementation checklist should therefore name the supported securing mechanism and document profile before procurement. It should reject unsupported mechanisms explicitly rather than attempting an improvised conversion that changes what was protected. A successful library operation is an input to acceptance, not the whole acceptance procedure.

GFT proposes a staged checklist recorded as individual results. Intake should preserve the received object and its identifier, identify the requested action and select the applicable policy version. Structural checks should confirm the supported credential type, required fields and interpretable units. Identity checks should resolve the issuer through the approved trust route and establish the relevant permission. Proof checks should use the supported implementation, check the declared purpose and verification relationship, and retain a useful diagnostic. These are proposed operating requirements, not claims that a particular software package implements them.

The checklist should then test the relevant validity period and status under the chosen profile. W3C's status-list specification provides a mechanism for publishing suspension or revocation information; it does not decide a buyer's commercial acceptance policy. [S1003] GFT recommends recording the list issuer, authenticated status result, retrieval time and permitted age. A credential without a status mechanism is not automatically defective under every possible profile. It should nevertheless fail the proposed workflow if that workflow requires withdrawable assertions. The required control must be declared before a transaction reaches the release desk.

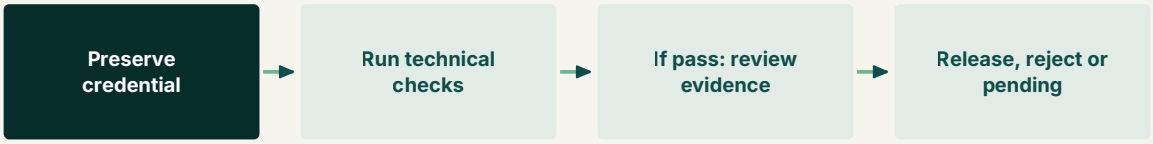
Evidence checks should bind the signed proposition to the specific physical subject. GFT proposes matching lot identifiers, material description, relevant period, site and input-output references. Where a credential protects only a reference to a document, the reviewer should determine whether the referenced content is bound to that reference and whether it remains retrievable. An accessible attachment is not automatic-

ally the attachment originally assessed. The evidence owner should retain the reviewed version and the reason for accepting it. The release decision should cite that version rather than whichever document later occupies the same web address.

The proposed control flow in **Exhibit 43**, p. 158 gives uncertainty its own destination. A failed signature is different from an unavailable status service, while an unsupported origin claim is different from either. The flow is an operating design and deliberately leaves implementation detail to the selected credential profile.

EXHIBIT 43 / ILLUSTRATIVE DECISION SEQUENCE

An inconclusive check must stop final claim release



ILLUSTRATIVE [S1001] [S1002] [S1003] Illustrative conditional procedure. Stop if a required check fails or is unavailable. Failed requirements mean rejection; unavailable dependencies or missing evidence mean pending. Only technical acceptance and supported evidence permit release. Not a certification rule or implemented verifier.

An illustrative offline receiving workflow may preserve the document and permit physical unloading into a controlled holding area while online checks remain pending. That permission should be an explicit operational decision, not a claim that the origin was verified. Before claim release, the reviewer would complete the missing checks, reconcile any changed status and record the approved wording. Commercial movement, inventory posting and public disclosure need distinct permissions so that an outage does not force an all-or-nothing decision about the material.

For the proposed reviewer interface, the first question should be the intended decision: receive material, acknowledge a transfer or publish an origin statement. The interface should then display the requirements for that action and the evidence already available. A technical pass should remain visible beside an unresolved physical link. A reviewer should be able to request missing evidence without changing the signed assertion. This keeps the original statement available for investigation and prevents a corrected screen label from disguising an uncorrected evidence gap.

GFT recommends retaining the checker version, policy version, decision time, dependency references and reason codes in the decision record. A later reviewer should be able to distinguish an authentic technical pass from an operator override. Repeating the procedure with the same preserved evidence should explain the earlier result, even if current policy produces a different result. The acceptance log should expose that difference instead of editing the earlier decision to look as though the new rule had always applied.

10.3

Identifiers need a recovery and control model

A decentralised identifier can associate a subject with an identifier document and verification methods. W3C makes the method specification responsible for important operational details, so the identifier prefix alone does not establish a complete recovery service. [S1004] GFT would treat DID support as an optional design choice. Procurement should identify the exact method, permitted updates, resolution dependencies and available historical information. Calling a design decentralised should not replace a demonstration that the buyer can discover which authority controlled an issuer identifier when a disputed assertion was made.

An illustrative managed-register option would place issuer admission and identifier-to-key bindings under an agreed operator. A DID-based option would obtain control information using the selected method and then apply the same business admission policy. GFT recommends comparing these options against the actual counterparties' ability to resolve identities, replace keys and export evidence. Neither route should be assumed to identify a legal business without a separate identity check. The trust register must record the relationship between technical control and the organisation authorised to make the commercial assertion.

A published research preprint examines using DIDs and verifiable credentials for passport management and reports evaluating performance in selected scenarios. Its abstract supplies a research hypothesis for comparison, not field evidence for a Cameroonian cotton chain. [S1008] GFT would require a bounded demonstration using the intended issuer and buyer workflows before selecting either approach. The demonstration should include a lost signing device, a changed service provider and a disputed historical document. A favourable result on ordinary issuance should not compensate for failure to recover the records needed to defend an earlier transaction.

The proposed key-custody register should distinguish the organisation responsible for issuing assertions, the operator of the signing service and the authority permitted to change its configuration. It should record authorised uses, backup arrangements, replacement procedure and the person or role accountable for incident escalation. GFT recommends keeping issuance keys separate from ordinary user login credentials and restricting administrative actions independently from routine document preparation. These are design controls to specify and test, not assertions about the security of an unidentified hosting platform.

Rotation should be rehearsed as a business event. The proposed exercise would issue a test assertion, rotate the key through the approved process, issue another assertion and ask an independent reviewer to reconstruct both decisions. The reviewer should receive the relevant trust-register versions and controller evidence. Historical checking must not depend on silently treating today's key as yesterday's authority. GFT would document whether the selected method supports the necessary historical view and what additional archived records are required where it does not.

Recovery creates a separate authority question. If the person who lost a device can also approve a replacement without further evidence, an attacker may gain a route around the signing control. GFT therefore proposes a documented recovery request, an independent identity and authority check, controlled replacement and notification

through an established counterparty channel. The procedure should preserve the old identifier relationship where justified and record any discontinuity. A recovered account must not retrospectively make questionable assertions acceptable merely because a new key is now available.

10.4

Revocation changes what a reader should accept

Suspension and revocation concern the acceptability of a credential under its governing rules. They should be distinguished from expiry, issuer removal and the technical failure of a proof. W3C's bitstring design supports publication of credential status and discusses verifier caching and privacy considerations. [S1003] GFT recommends a status policy that states which authority publishes each status, what each value means and how changes affect outstanding claims. A buyer should not have to guess whether an unavailable declaration was withdrawn, temporarily suspended or simply inaccessible.

The proposed historical review separates event occurrence, assertion issuance, verification and later discovery. A credential may have been accepted under the available information before a compromise was detected. That historical acceptance is a fact about a decision, not conclusive evidence that its physical claim was true. Equally, discovering a compromised key does not establish that every earlier document was fabricated. GFT would quarantine the affected set according to the best supported compromise interval, retain the uncertainty about its start and commission a claim-specific review before deciding what can be restored.

The illustrative sequence in **Exhibit 44**, p. 161 uses elapsed days solely to make ordering inspectable. Discovery occurs after the possible start of compromise. The timeline therefore prevents an investigator from equating the discovery timestamp with the first unsafe signature.

EXHIBIT 44 / ILLUSTRATIVE ELAPSED DAY

Discovery time cannot define the start of compromise

0
Issue assertion
Preserve evidence

4
Buyer accepts
Record policy and status

6
Publish status
Notify affected buyers



2
Possible compromise
Investigate interval

5
Discover incident
Contain issuance

ILLUSTRATIVE [S1003] [S1004] Illustrative incident chronology, not observed events or recommended response deadlines. Day 0 is a chosen reference. Day 2 is an assumed earliest plausible compromise; the actual start could remain unknown. Day 5 is discovery and day 6 is status publication.

GFT proposes preserving the original assertion, evidence dossier, status observation and acceptance record when a later correction occurs. A correction should identify the superseded claim, state the reason and show the replacement's narrower or changed boundary. If evidence remains unavailable, the replacement should say so. Renewing a signature over the same unsupported statement is not remediation. The affected buyer needs to know whether the material may still move, whether the claim may still be used and which further review is required.

WORKED EXAMPLE: AN AUTHENTIC QUANTITY CAN EXCEED ITS EVIDENCE BOUNDARY

This illustrative dossier contains a signed declaration covering 100 bales. Assume that 72 bales have admissible origin records, 18 depend on credentials withdrawn after review, and 10 lack a resolved input link. The illustrative reconciliation is 72 + 18 + 10 = 100 bales. The potentially supportable count is 100 minus 18 minus 10 = 72 bales, or 72 percent of the declared bale count. These are assumed counts for testing the decision procedure, not observed operating data.

Assume additionally, for this illustrative case, that the supported bales have remained physically identified and segregated. Only their bounded origin claim may proceed to the remaining release checks. If the entire lot has already been blended without a defensible input allocation, the 72 percent cannot become a physical-content statement about the output. Counts also cannot substitute for fibre mass when bale masses differ. The signed total describes the issuer's assertion; the custody model and admissible evidence determine what the reviewer can accept.

For the illustrative withdrawn group, record the reason for withdrawal and review the physical evidence independently. Reissuance may restore a claim if a credential error was the sole defect and the evidence supports it. It cannot restore an unsupported origin by changing the key. Keep the unresolved group pending until an approved investigation supplies the missing link or the claim is removed.

A proposed dispute procedure should preserve the difference between withdrawing reliance and deleting evidence. The issuer may dispute the buyer's interpretation, while the buyer may need to suspend public wording during investigation. GFT would give the dispute a reference, identify the contested proposition and appoint a review owner with the necessary independence. The outcome should record which documents changed the decision and whether affected recipients were informed. Reopening a claim requires an accountable decision, even when the original issuer objects to the hold.

GFT recommends permitting cached status only for actions and durations stated in advance by the policy owner. A cache record should show when it was retrieved, what it covered and why its use was permitted. The proposed default during an unplanned status outage is to restrict final claim release until fresh acceptance evidence is available. A business choosing another rule must document the consequence it accepts and disclose the status boundary to the reviewer. This is a proposed risk decision, not a universal requirement of the status-list standard.

10.5

A shared ledger needs a business reason

NIST describes blockchains as distributed, tamper-evident and tamper-resistant ledgers, with transaction persistence under normal operation. [S1005] GFT's engineering inference is that preserving a recorded assertion cannot improve the truth of the original physical observation. A ledger could faithfully retain the illustrative false origin statement described earlier. The purchasing question is therefore which shared control the participants require, who operates it and what failure it addresses. The answer should name a business obligation before it names a preferred storage technology.

An illustrative controlled database is appropriate for evaluation where an agreed operator can maintain the authoritative register and the participants accept that operator's governance. Signed exports provide another candidate where counterparties need portable snapshots for independent checking. A permissioned ledger becomes a candidate where participants need shared write governance and can sustain the associated membership and recovery arrangements. GFT does not assign a cost or performance ranking without a measured workload, a dependency map and contractual responsibility for the service.

The comparison in **Exhibit 45**, p. 163 is an illustrative procurement worksheet rather than a benchmark. Each option still requires evidence review and an accountable release decision. More distributed storage does not eliminate the need for an authority to resolve disputed cotton claims.

EXHIBIT 45 / ILLUSTRATIVE PROCUREMENT QUESTIONS

Storage choices move governance duties rather than remove them

Candidate	Business basis	Duty to test
Controlled database	Accepted register operator	Audit, restore and export
Signed exports	Portable assertions	Version, status and retrieval
Permissioned ledger	Shared write governance	Membership, dispute and exit

ILLUSTRATIVE [S1005] [S1007] Illustrative GFT comparison informed by the NIST ledger overview and supply-chain risk overview. No price, throughput, legal status or deployment result is asserted. Verify each feature for the actual product and contract.

GFT proposes correction by addition of a governed superseding record. The original assertion should remain available to authorised investigators, with a clear relationship to the replacement and a visible current acceptance state. A user reading the current passport should not be directed towards a withdrawn claim merely because the original link still works. The system should distinguish retained history from current permission to rely on that history. This design recommendation applies to a database with an audit history as well as to a shared ledger.

For a procurement trial, GFT would ask every candidate to complete the same sequence: ingest an assertion, verify it independently, withdraw it, publish a correction, export the complete evidence set and restore the acceptance history in a separate environment. Record dependency failures and operator intervention. Success should mean that another authorised reviewer can explain the current claim and reconstruct the earlier decision. The build-or-buy comparison should use these observed outcomes, alongside measured operating effort, rather than treating a cryptography label as a performance result.

GFT would also require an exit rehearsal before relying on a shared service. The proposed test should export records in an agreed readable format, identify missing attachments and demonstrate verification without the departing provider's privileged account. The receiving operator should show how current status, superseded claims and access restrictions survive the move. A successful file download alone would not

satisfy this requirement. If the exported record cannot explain which assertion a buyer accepted, the migration has preserved storage without preserving the decision evidence.

The proposed storage boundary should keep personal and commercially sensitive records in governed repositories with purpose-specific access. Public references should expose only what the claim requires. A hash or identifier should not be assumed harmless merely because its original attachment is private. GFT would review whether repeated references reveal counterparties or allow records about individuals to be linked. This is a design precaution; the appropriate retention and disclosure duties require separate legal assessment. This chapter provides no investment, legal or tax advice and does not establish regulatory conformity.

10.6

Trust survives incidents through assigned responsibilities

NIST's zero-trust overview separates authentication and authorisation and rejects implicit trust based solely on network location or asset ownership. [S1006] GFT applies that principle to a proposed issuance workflow: being inside a factory network should not grant permission to approve an origin claim. The data preparer, signing service administrator and claim release owner need distinct permissions wherever the operating structure permits. Exceptions should identify the combined responsibilities and compensating review rather than pretending that a small team has separation it cannot actually sustain.

The incident procedure should begin with a clear decision tree. Is there credible evidence of key or issuer-account compromise? If so, GFT recommends pausing the affected issuance route, preserving logs, invoking the approved status mechanism and opening a historical review. If the key remains controlled but a physical label has been copied, isolate the object-to-record problem and avoid withdrawing unrelated credentials without evidence. If the resolver or domain is unavailable, restrict dependent release decisions and activate the tested continuity route. Several branches may apply together; the incident owner should record that overlap explicitly.

For an illustrative compromised-key incident, the security owner would contain the signing route and protect recovery access. The evidence owner would identify assertions within the suspect interval and gather preserved dossiers. The claim owner would decide which statements require temporary withdrawal, narrower wording or reissue after review. The buyer communication owner would send the approved account through an established channel, distinguishing confirmed facts from open questions. An operational team should practise these handovers before a live dispute so that uncertainty about authority does not delay containment.

For an illustrative copied-label incident, the warehouse or dispatch owner would identify the affected physical units and preserve the observed label and transaction context. The verifier owner would determine whether the credential itself remains authentic. The claim owner would investigate the association between object and record before authorising further use of the label. A valid record attached to an

unverified object should remain insufficient for release. The communication should explain the object-binding uncertainty, rather than inaccurately describing the event as a failed signature or alleging misconduct without an investigation.

An abandoned domain or departing service provider creates a different continuity problem. NIST's supply-chain risk guidance addresses identifying, assessing and mitigating cybersecurity risks across acquired products and services. [S1007] GFT proposes named ownership of domain renewal, provider exit, evidence export and restoration testing. The continuity owner should hold a readable issuer-register export, the relevant historical key information, status records and the claim decision history. A replacement service must preserve the ability to explain prior assertions; simply loading current product descriptions would leave historical acceptance unreviewable.

The proposed buyer notice should identify the affected claim, the material or product scope, the reason for the restriction and the next decision owner. It should distinguish an investigated finding from a precaution taken because information is missing. The notice should avoid unnecessary producer or worker details and should not expose private signing material. GFT recommends keeping an approved notice with the incident record and recording the channel used for each affected counterparty. Delivery evidence is separate from drafting the message or making a public status change.

After containment, the incident owner should commission a retrospective that tests the control rather than merely closing the ticket. Did the team identify the complete suspect set? Could the reviewer reconstruct the earlier acceptance? Did recovery restore the appropriate permissions without extending them? GFT proposes using the answers to revise the issuer policy, checker requirements and rehearsal cases. A resumed service proves availability; the separate claim review must establish what can again be stated about the cotton.

The pilot should test the decision tree with deliberately incomplete evidence, not merely a successful demonstration credential. GFT proposes asking an independent reviewer to assess a supported assertion, a correctly signed unsupported assertion, a wrong-purpose proof, stale status, a lost issuer key and a copied label. The reviewer should see which branch was taken and why, without receiving unrestricted personal records. A useful failure report states the action withheld, the evidence needed and the responsible owner. It does not convert an unknown result into either acceptance or an accusation.

Handover to wider governance and infrastructure work should preserve these requirements as acceptance criteria. Identity resolution must have an owner and a tested recovery route. Credential checking must expose pending and failed states. The evidence dossier must remain reconstructible after correction or supplier exit. Claim release must identify its authority and boundary. GFT would recommend scaling

only after the pilot demonstrates these behaviours and an independent reviewer can reconstruct adverse cases. Until then, the material here remains a proposed trust system, not a qualified operating result.

A signature preserves who asserted the claim; governance decides whether the evidence can carry it.

CHAPTER SOURCE NOTES

S1001 World Wide Web Consortium. 2025-05-15.

S29 UNECE / UN Transparency Protocol. 2026-10-30.

S1002 World Wide Web Consortium. 2025-05-15.

S1003 World Wide Web Consortium. 2025-05-15.

S1004 World Wide Web Consortium. 2022-07-19.

S1008 Ismael Illán García et al. / arXiv. 2024-10-21.

S1005 National Institute of Standards and Technology. 2018-10.

S1007 National Institute of Standards and Technology. 2024-11-01.

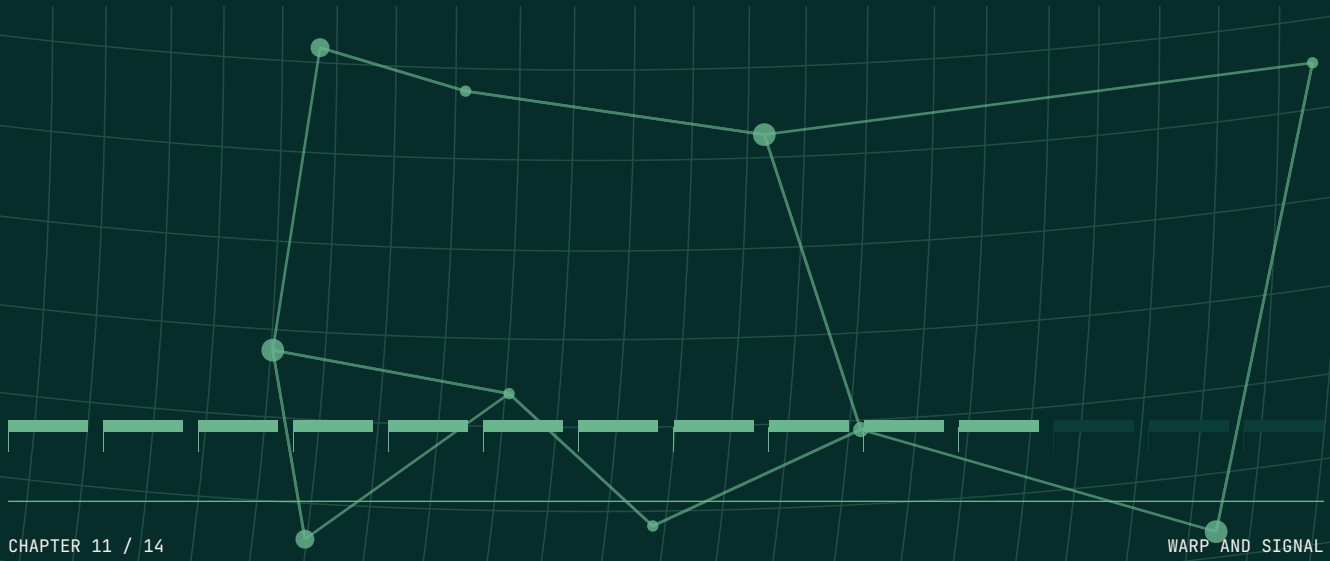
S1006 National Institute of Standards and Technology. 2020-08.

11

PART III: PASSPORTS MUST PRESERVE EVIDENCE / OPERATING DISCIPLINE

Traceability must fit real work and protect the people recorded

A system survives only if responsibilities, exceptions, privacy and constrained connectivity are part of ordinary work.



CHAPTER 11
DECISION TEST

A system survives only if responsibilities, exceptions, privacy and constrained connectivity are part of ordinary work.

A digital product passport fails on the factory floor long before it fails in a browser if the people who weigh bales, join fabric rolls, approve rework and inspect incoming certificates lack authority or time to record what happened. [S03] Traceability governance works only when every material observation has an accountable role, capture occurs at the point of work, outages place claims into a visible pending state, personal data collection stays restricted to a lawful purpose, and workers or producers have safe routes to challenge errors and report harm. [S10] [S19] [S1101] Green Future Tech Limited (GFT), Hong Kong SAR, specifies this operating discipline as a proposed extension to its three-part Cameroon textile programme, prepared on 31 January 2024 with source refreshes retained in 2026 (feasibility study, performance-management system design and digital strategy). [R06] None of the roles, exception workflows, privacy registers or training drills here is presented as a running factory deployment or audited compliance result; each is an engineering design to test in a bounded pilot before releasing any commercial origin claim. [S01] [S02]

11.1

Every material observation needs an accountable role

Chain-of-custody standards require documented responsibilities across receiving, storage, processing, subcontracting, volume reconciliation and claim release. [S03] [S06] Many traceability projects configure software as if one administrator enters and approves every transaction. On a real spinning, weaving, dyeing or garment floor, custody moves across teams whose incentives diverge when a delivery arrives without paperwork, a roll split loses its ticket or a shipment faces a dispatch deadline. [S06] [S10] If the person measured on shift throughput also holds unrestricted authority to override a missing input link or release a product claim, records will bend toward shipping targets rather than evidential accuracy. [S02] [S03]

11.2 SEPARATION OF DUTIES PREVENTS SILENT CLAIM OVERRIDES

To prevent unverified material from entering an eligible pool by default, GFT separates operational observation from exception resolution and claim release. [S03] [S06] Under the Content Claim Standard (CCS) published by Textile Exchange and Version 1.0 of the Aid by Trade Foundation (AbTF) Transparency Standard dated June 2025, a site must verify transport and transaction documents at receipt, maintain physical or temporal separation where required, reconcile volumes, and prevent double claiming. [S03] [S06] Translating those rules into daily work requires six functional roles, even where a smaller facility combines several operational duties under shared supervision during early ramp-up. [S06] [S17]

- **Receiving and warehouse custody officer:** inspects bale or roll identifiers against delivery notes, records gross and tare weight on an identified scale, assigns a quarantine bay when paperwork is incomplete, and logs the receipt. [S03] [S06]
- **Production line team leader:** records batch transformations at bale laydown, spinning, knitting or weaving, dyeing, cutting lays and sewing bundles, linking consumed inputs to output lots and logging rework or waste. [S06] [S10]

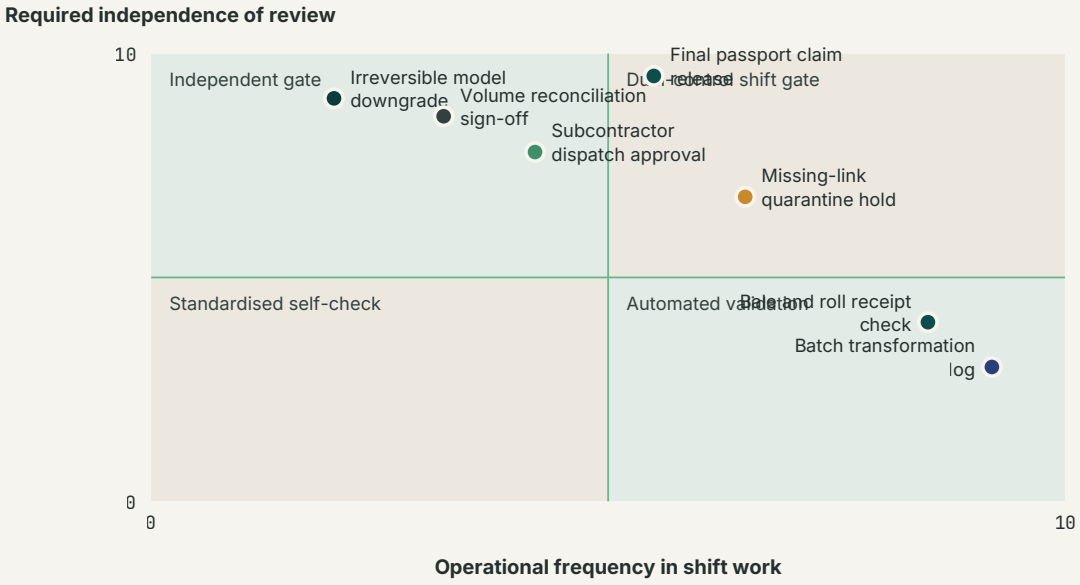
- **Quality and assurance reviewer:** checks scope certificates, transaction certificates, laboratory reports and subcontractor eligibility before lifting a hold or approving a downgrade from physical segregation to mass balance. [S03] [S06]
- **Purchasing and counterparty coordinator:** maintains supplier scope registers, issues procurement schedules carrying custody terms, and confirms counterparty transactions in external scheme portals. [S06] [S09]
- **Data steward and system custodian:** manages identifier namespaces, offline queue synchronisation, schema validation, access permissions and backup exports without altering shop-floor observations. [S10] [S26] [S27]
- **Authorised claim-release officer:** verifies before shipment that genealogy links are unbroken, volume reconciliation residuals sit within declared limits, and the passport statement matches the narrowest admissible input status. [S02] [S03]

Where pilot staffing does not allow six individuals on every shift, GFT sets a minimum two-person rule for high-risk custody decisions: the person recording a receipt or transformation cannot approve an exception override, execute an irreversible downgrade under Section 7.2 of the June 2025 AbTF standard, or authorise claim release. [S06] Role assignments follow zero-trust access principles: subject and device authentication are checked before any session writes or approves a custody event, regardless of network location. [S26]

Exhibit 46, p. 169 places these illustrative custody tasks across two dimensions: operational frequency during shift work and the independence of review required before supporting an external claim. [S03] [S06] [S17]

EXHIBIT 46 / ILLUSTRATIVE GOVERNANCE INDEX (0 TO 10)

Responsibility should follow each custody decision



ILLUSTRATIVE [S03] [S06] [S17] Illustrative GFT role design derived from custody and due-diligence responsibilities in S03, S06 and S17. Coordinates are categorical design placements to separate routine capture from independent release review, not empirical measurements.

As **Exhibit 46**, p. 169 shows, high-frequency events such as batch transformation logging and receipt checks sit in the lower-right region where standardised operator capture and format validation keep work moving. [S03] [S10] Actions that alter claim admissibility, including subcontractor dispatch approvals, volume reconciliation sign-offs, irreversible downgrades from Hard Identity Preserved (HIP) or Segregation to mass balance, and final passport release, sit in the upper quadrants where independent review or dual control is mandatory. [S06] This chart is a governance design rather than a measured scorecard; it cannot establish that a facility has enough staff for each gate without pilot verification. [S03]

11.3 EXCEPTION REVIEW JOINS THE EXISTING SHIFT AND WEEKLY CADENCE

A traceability system fails when exceptions wait for a quarterly audit, because physical lots have already been blended, cut, sewn and shipped before a discrepancy is noticed. [S03] [S10] In GFT's Cameroon textile programme, the performance-management design sets a tiered review rhythm across shift handovers, daily production reviews, weekly plant reconciliations and monthly governance (covered in wp02 and the `kpi-cascade` tool). [R06] GFT proposes embedding custody exception review into that cadence rather than creating parallel meetings. [S03] [S06]

At shift handover, the line leader and receiving officer review unclosed batches, quarantined receipts and damaged bale labels from the shift. [S06] [S10] At the daily operational meeting, the quality reviewer and purchasing coordinator inspect shipments or cutting lays held for missing counterparty confirmation or subcontractor scope, assigning an owner to obtain the document or downgrade the batch claim. [S06] [S09] At the weekly plant review, the data steward and claim-release officer reconcile physical stock against the eligible claims ledger before approving outbound passport disclosures. [S03] [S06] Connecting traceability to the management cadence is a proposed extension; GFT has not operated this cadence in a live Cameroon mill. [R06]

> **GFT NOTE**
>
> Never reward a shift supervisor or warehouse clerk on the percentage of batches released with a provenance claim. If incentives penalise staff for placing an unverified bale or unlinked roll into quarantine, operators will copy old identifiers to clear the screen. Measure teams instead on how quickly and accurately they surface exceptions, preserve physical separation of quarantined lots, and close error declarations with source documents. [S03] [S06] [S10]

11.4

Capture should happen at the point of work

Retrospective reconstruction, where clerks type Monday's paper tally sheets into a spreadsheet on Friday afternoon, introduces transcription errors, loses the sequence of roll splits and encourages silent averaging of waste. [S03] [S10] Consistent with the data-first discipline of GFT's Cameroon textile programme, custody evidence should be captured at the physical boundary where material changes hands or form, using compact forms with pre-validated identifiers. [R06] [S10]

11.5 COUNTERPARTY TRACKING DIFFERS FROM PURCHASE-ORDER ADMINISTRATION

A common error in factory digitalisation is assuming that an enterprise resource planning (ERP) purchase order or invoice suffices as a custody record. [S09] [S10] Commercial documents record financial obligations and pricing tiers, which often aggregate deliveries, omit bale or roll identifiers, or pass title through a trader who never takes physical possession. [S01] [S10] The Sustainable Cotton Tracker (SCOT) operated for Cotton made in Africa shows why custody tracking and commercial ordering remain distinct: the SCOT FAQ states that the platform is not an order system, and instead requires registered counterparties to record and confirm certified material transactions by supply-chain role. [S09]

For shop-floor capture in an African cotton-to-garment chain, GFT separates commercial purchasing from custody confirmation through three interface rules. [S09] [S10]

1. **Task-bounded input screens:** a receiving terminal displays only fields observable at the dock (carrier reference, supplier identifier, bale or roll code, gross weight, tare code, moisture reading and seal status), without exposing unit prices or margins. [S06] [S10] [S19]
2. **Controlled identifier selection:** operators scan a barcode or select from pre-issued active batch identifiers rather than typing free-text lot names, preventing typographical breaks in the genealogy graph. [S10] [S12]
3. **Explicit unknown and hold states:** if a delivery arrives with an illegible tag or a frame draws from an unlabelled bin, the operator has a non-punitive button to log an `unknown-input` exception and print a quarantine ticket, rather than inventing a code to pass a mandatory field. [S01] [S10]

11.6 OPERATOR CAPTURE TIME MUST BE BUDGETED AND MEASURED IN A PILOT

Barcode scans, scale confirmations, roll-split tickets and exception holds take physical time on the floor. [S03] [S06] If engineers assume operators absorb extra capture steps at zero cost, workers under throughput pressure will batch scans at shift end, bypassing validation. [S10] In Cameroon, where WageIndicator records a standard 40-hour week, a 48-hour legal maximum with overtime at 1.2 times base pay, and a statutory monthly minimum wage (SMIG) raised to XAF 43,969 from 23 February 2024 (about US$76, up 5 percent from XAF 41,875 in 2023), administrative tasks must be budgeted within lawful shift hours. [R14] [R16]

WORKED EXAMPLE: SHIFT-LEVEL CAPTURE AND EXCEPTION-RECONCILIATION TIME BUDGET

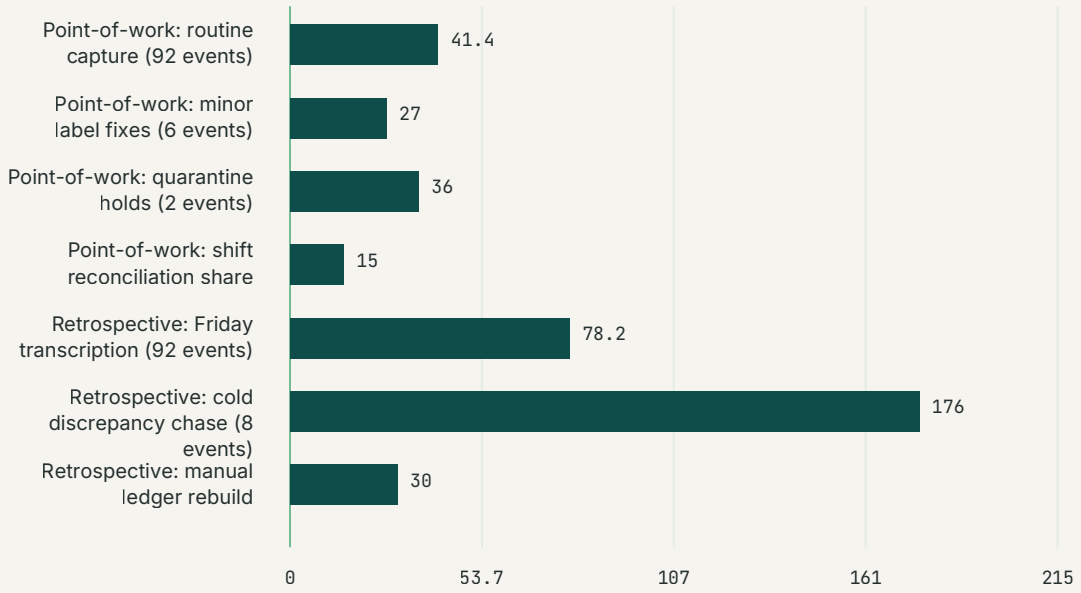
To show how GFT models point-of-work capture workload before a pilot, consider an illustrative single-shift cell handling 100 custody events across an 8-hour shift (480 minutes). All timings and frequencies are illustrative assumptions demonstrating the method, not observed GFT factory measurements. [R14] [R16]

- **Illustrative event mix per 100 custody events:** 92 routine events (receipts, cutting-lay starts, bundle transfers and carton aggregations where codes scan cleanly) and 8 exceptions (6 minor label replacements or weight re-checks, plus 2 missing-link quarantine holds requiring supervisor and quality review). [S03] [S10]
- **Assumed unit durations (illustrative):** a routine scan takes 0.45 minutes (27 seconds). A minor label replacement takes 4.5 minutes. A missing-link quarantine hold takes 18.0 minutes across containment, cage move and quality review. Weekly reconciliation across 6 shifts (600 events) takes 90 minutes, or 15.0 minutes per 100 events. [S03] [S10]
- **Illustrative calculated point-of-work time per 100 events:** routine capture takes `92 x 0.45 = 41.4` minutes; minor exceptions take `6 x 4.5 = 27.0` minutes; quarantine holds take `2 x 18.0 = 36.0` minutes; and reconciliation takes `15.0` minutes, totalling `119.4` minutes (1.99 hours) per 100 events. [S03] [S10]
- **Comparison with retrospective Friday reconstruction (illustrative):** if the 100 events wait on paper until Friday, transcribing 92 routine rows at 0.85 minutes each takes `78.2` minutes, chasing 8 discrepancies across cold lines at 22.0 minutes each takes `176.0` minutes, and ledger rebuild takes `30.0` minutes, totalling `284.2` minutes (4.74 hours) with higher origin-gap risk. [S03] [S10]
- **Illustrative wage-floor reference:** using the SMIG floor of XAF 43,969 across a 173.3-hour month (`40 hours x 52 weeks / 12 months`), the statutory floor is about XAF 253.7 per hour (while cross-sector average pay in Cameroon is about US$359 a month in R15). At an illustrative blended operator and supervisor rate of XAF 1,200 per hour, `1.99` hours of point-of-work capture costs XAF 2,388 per 100 events, against XAF 5,688 for `4.74` hours of late reconstruction. [R14] [R15] [R16]

Exhibit 47, `p. 173` compares the illustrative minute breakdown per 100 custody events between point-of-work capture and end-of-week clerical reconstruction from the worked example. [S03] [S10]

EXHIBIT 47 / ILLUSTRATIVE MINUTES PER 100 CUSTODY EVENTS

Point-of-work capture takes less time than late clerical reconstruction



ILLUSTRATIVE [S03] [S10] [R16] Illustrative GFT workload model from the chapter case study: 92 routine events and 8 exceptions per 100 shift events. Values are assumed planning inputs to be replaced by timed pilot observations; they are not measured GFT operating results.

The lesson of **Exhibit 47**, p. 173 is structural: even under point-of-work capture, the 8 illustrative exception events require `63.0` minutes (`27.0 + 36.0`), exceeding the `41.4` minutes spent on all 92 routine scans. [S03] [S10] Under retrospective reconstruction, chasing those 8 exceptions after physical lots have moved consumes `176.0` minutes and often ends in a batch downgrade. [S10] Because these durations are illustrative assumptions, GFT requires the Chapter 13 pilot to time live scan, relabelling and hold durations before fixing staffing ratios or unit-cost denominators in Chapter 12. [S03]

11.7

An outage must not erase the custody sequence

Industrial zones and rural ginning corridors in Central and West Africa face intermittent telecommunications and grid power interruptions (whose electrical and edge-computing engineering is addressed in wp07 and `edge-architecture`). [S10] [S27] When a cloud-only portal drops offline while trucks unload seed cotton or a dye house batches fabric rolls, operators must halt production, skip the digital record, or scribble notes on paper for later entry. [S10] A governance model assuming continuous connectivity will stall the factory or corrupt custody during its first outage. [S10] [S27]

11.8 LOCAL QUEUES AND PRE-ISSUED IDENTIFIERS KEEP PHYSICAL WORK MOVING

GFT specifies an offline-first custody capture discipline to test during the pilot. [S10] [S27] Every receiving dock, ginning press, spinning group, dye kitchen and cutting terminal operates against a local edge queue on non-volatile storage with battery

backup. [S26] [S27] Before a shift starts, the local node caches the supplier scope register, active production order identifiers and a block of pre-issued batch and event identifiers. [S10] [S26]

When connectivity drops, operators continue scanning bales, logging transformations and printing local batch tickets from the pre-issued pool. [S10] Each observation is signed by the authenticated local device and operator session and appended to an append-only local log. [S23] [S26] While disconnected from the central ledger, the local system enforces a strict boundary: it confirms internal observations and moves work-in-progress between workstations, but cannot verify external counterparty status lists, confirm an inbound electronic transaction certificate, or release an outbound passport claim. [S06] [S24]

11.9 EVENT TIME AND RECORDING TIME PRESERVE THE PHYSICAL SEQUENCE

When connectivity returns and queued records upload, naive databases overwrite the physical operation timestamp with server ingestion time. [S10] If a spinning laydown occurred at 09:15 on Tuesday during an outage, and the yarn shipment was logged from a connected dispatch office at 14:00 before the spinning terminal reconnected at 16:30, server receipt time makes the yarn appear shipped two hours before it was spun. [S10] Automated genealogy checks then reject the shipment or attach it to an unrelated lot. [S10]

GS1 EPCIS Release 2.0 resolves this by separating `eventTime` (when the physical event occurred, with local time-zone offset) from `recordTime` (when the event was recorded by the repository). [S10] Combined with GS1 Core Business Vocabulary (CBV) Release 2.0 dispositions and business steps, preserving both timestamps lets the central ledger reconstruct the physical sequence after delayed upload while flagging clock-drift anomalies for steward review. [S10] [S11]

OUTAGE QUEUE AND TEMPORAL RECONCILIATION PROTOCOL

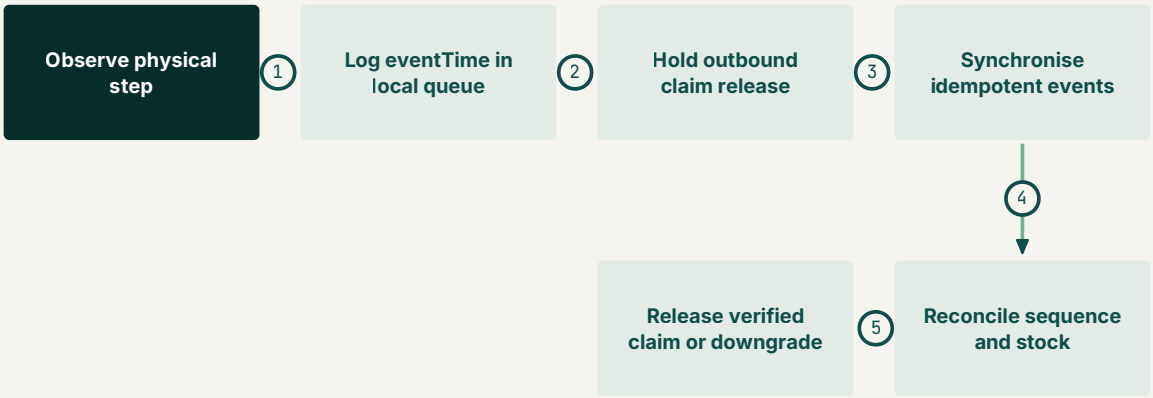
To keep offline capture auditable without inventing certainty during a link failure, GFT specifies a five-step protocol grounded in GS1 EPCIS Release 2.0 semantics and NIST SP 800-161 Rev. 1 resilience controls: [S10] [S27]

1. **Pre-allocation of namespace blocks:** each workstation holds a reserved prefix of event and batch identifiers (`site-node-shift-sequence`) so offline stations never generate colliding lot numbers. [S10]
2. **Dual-timestamp capture:** every queued event records `eventTime` from a local hardware clock (with UTC offset and sync status), `operatorRoleId`, `deviceId`, and `offlineCapture: true`. [S10] [S26]
3. **Outbound claim freeze during partition:** any shipment prepared while the central ledger or status list is unreachable receives a `pending-reconciliation` disposition; goods may move to bonded storage under a provisional bill of lading that withholds public provenance claims. [S10] [S11] [S24]
4. **Idempotent replay and sequence sorting:** upon reconnection, the edge queue transmits stored events using idempotent hashes; the repository orders genealogy by `eventTime` while retaining `recordTime` as the upload audit trail. [S10]
5. **Post-outage reconciliation check:** before lifting `pending-reconciliation`, the data steward and claim-release officer verify that no eligible input volume was double-allocated across disconnected terminals and that counterparty certificates were valid at `eventTime`. [S06] [S10] [S24]

Exhibit 48, p. 176 diagrams this sequence from local observation during an outage through queue synchronisation, reconciliation and conditional claim release. [S10] [S27]

EXHIBIT 48 /

An outage creates pending records rather than invented certainty



1. link down
2. provisional status
3. link restored
4. order by eventTime
5. balances match

ILLUSTRATIVE [S06] [S10] [S24] [S27] Illustrative GFT offline-to-online control flow based on S10 event-time semantics, S06 double-claim prohibitions, S24 status verification and S27 resilience practices. No outage duration or network uptime percentage is assumed.

As **Exhibit 48**, p. 176 shows, a power or network outage never forces an operator to choose between halting a spinning frame and fabricating a timestamp. [S10] Production continues against local identifiers, while external claim release pauses until eventTime ordering, volume balances and certificate status checks are reconciled. [S06] [S10] [S24] What **Exhibit 48**, p. 176 cannot guarantee is hardware survival during prolonged power loss without the backup power and surge protection specified in wp07. [S27]

11.10

Privacy starts with deciding which data are necessary

Traceability programmes often over-collect personal information under the false belief that publishing a farmer's name, national identity number, household GPS polygon or a sewing operator's payroll record makes a product passport more credible. [S19] [S28] Indiscriminate collection exposes smallholders and workers to privacy breaches and commercial poaching while creating legal liabilities for every entity storing or transferring the data. [S19] [S1102]

11.11 DATA MINIMISATION SEPARATES PRODUCT EVIDENCE FROM PERSONAL IDENTITY

The European Data Protection Board (EDPB) guide for small businesses states the rule of data minimisation: an organisation can process only personal data that are necessary and proportionate for the specific purpose envisaged. [S19] When a brand or buyer verifies whether cotton shirts meet an origin or certified-content claim, it needs admissible evidence of custody, ginning campaign linkage, certification scope and volume reconciliation. [S03] [S06] [S28] Neither a consumer scanning a QR code nor a sourcing team inspecting a shipment pack needs the personal names, phone numbers, biometrics or home coordinates of farmers or sewing workers. [S19] [S28]

In northern Cameroon, where inherited evidence record R03 notes that SODECOTON supports more than 220,000 cotton producers across nine ginning plants and two oil mills, production involves hundreds of thousands of households in producer groups. [R03] Recording deliveries at the ginnery requires a link to a producer group or pseudonymous member code so payment, agronomy support and scheme eligibility can be audited by certification bodies. [S06] [S19] Publishing those personal records in a downstream feed or public passport violates purpose limitation and creates an irreversible privacy exposure. [S19] [S28]

11.12 APPLICABLE DATA-PROTECTION LAW REQUIRES LOCAL AND CROSS-BORDER LEGAL REVIEW

Traceability systems spanning Cameroon production, Hong Kong SAR engineering and global export markets cross multiple legal regimes. [S19] [S1102] Under the EU General Data Protection Regulation (GDPR), territorial scope is conditional on establishment or targeting/monitoring in the Union. [S19] Simultaneously, domestic African laws govern processing at the source. [S1102] In Cameroon, practitioner commentary published by LEX Africa on 31 October 2025 highlights Law No. 2024/017 of 23 December 2024 on personal data protection, covering collection, recording, storage, retrieval, transmission, alignment, erasure or transfer of personal data, and requiring consent, compliance protocols and prior authorisation from the Data Protection Authority where applicable (noting an alignment window to 23 June 2026). [S1102]

Because GFT does not provide legal advice and statutes require review by local counsel (see wp17), GFT designs the data model around data minimisation and segregated storage. [S19] [S1102] Personal identifiers of producers and workers stay in restricted local cooperative or HR registries in Cameroon; the custody ledger and product passport receive only pseudonymous group, shift or workstation codes, role titles and institutional certificate references. [S19] [S26] [S28]

Exhibit 49, p. 178 sets out GFT's illustrative privacy-by-purpose register across five data categories in a cotton-to-garment chain. [S19] [S28] [S1102]

EXHIBIT 49 / QUALITATIVE GOVERNANCE REGISTER

Data purpose determines access and retention

Data category	Lawful operational purpose	Custody ledger representation	Public passport disclosure	Access and retention rule
Smallholder producer identity	Cooperative payment, input credit and scheme audit	Pseudonymous producer-group and delivery-lot code only	Country or region of origin and scheme status only	Local cooperative registry only; delete or archive per local law
Farm plot location	Agronomy support and deforestation or scheme verification	Ginning catchment zone and bounded regional code	Country or sub-national region name; no household coordinates	Restricted to accredited auditors; no cross-border export by default
Factory operator and clerk logs	Shift accountability, separation of duties and error review	Pseudonymous role-holder token and workstation identifier	Never disclosed; facility name and process step only	Internal plant quality and HR access; purge token link after audit window
Quality and release approvers	Verify authority for custody holds, downgrades and release	Role title, institutional certificate ref and key identifier	Issuing organisation name and conformity scope only	Retain institutional sign-off for product-claim validity period
Worker grievance and remedy filings	Investigate and remediate adverse labour or safety impacts	Excluded from product custody ledger; separate case ref	Never disclosed on product records; aggregate reporting only	Strictly confidential; managed by designated remediation channel

ILLUSTRATIVE [S19] [S26] [S28] [S1102] Illustrative GFT privacy-by-purpose schedule grounded in S19 data-minimisation principles, S26 role-based access, S28 passport tiers and S1102 Cameroon data-protection scope. Retention rules are conditional on legal counsel review; no universal statutory period is asserted.

The rule in **Exhibit 49**, p. 178 is that the custody ledger never acts as a personnel file. [S19] [S28] When a buyer or auditor inspects a garment batch, they see that receiving check `RCV-2026-0412` was logged by `Role: Receiving-Dock-A` and released by `Role: QA-Reviewer-02` under an active scope certificate. [S03] [S26] If an accredited auditor on site needs to verify that `QA-Reviewer-02` completed required AbTF training, the plant's internal register resolves that token locally without exporting employee files into cloud passports. [S06] [S19] [S1102]

11.13

Due diligence must include routes for challenge and remedy

A digital map of supplier tiers and bale lot numbers is an input to supply-chain management, not proof that people growing cotton or sewing garments work under fair, safe and voluntary conditions. [S17] [S20] Conflating traceability with labour assurance creates two hazards: buyers may treat an EPCIS event graph as a substitute for work-

place due diligence, or designers may attach unverified labour-risk scores to supplier nodes without giving workers or producers a safe route to contest errors or obtain remedy. [S17] [S20] [S1101]

11.14 SUPPLIER MAPPING CANNOT PROVE DECENT WORK OR ABSENCE OF COERCION

The International Labour Organization (ILO) defines forced labour as work or service exacted from any person under the threat of a penalty and for which the person has not offered themselves voluntarily, covering all work in any activity, industry or sector, including the informal economy. [S20] In Cameroon, where inherited record R16 notes an informal employment share of about 90 percent, labour due diligence requires ongoing attention to recruitment, wages, working hours, overtime consent and sub-contracting. [R16] [S20] A barcode scan confirming that a bale moved to a spinning mill, or that panels were sewn on Line 3, records where material moved and when; it provides zero observation of whether wages were paid, overtime was voluntary, or freedom of association was respected. [S10] [S20]

Similarly, the OECD Due Diligence Guidance for Responsible Supply Chains in the Garment and Footwear Sector emphasises practical, collaborative approaches to identifying, preventing, mitigating and accounting for how enterprises address adverse impacts. [S17] Traceability records identify which facilities, subcontractors and ginning corridors participate in a chain so risk assessments can be targeted. [S17] Once mapped, due diligence requires workplace assessment, corrective action plans, purchasing practices that do not induce unauthorised subcontracting or excessive overtime, and verified remediation. [S17] [S1101]

> **SUPPLIER MAPPING IS NOT LABOUR ASSURANCE OR REMEDIATION**
>
> Never publish a digital product passport claim stating or implying that a garment is "free of forced labour" or "socially verified" solely because its material genealogy is 100 percent traced from bale to carton. Location and custody records establish material provenance within a stated boundary; they cannot observe coercion, withholdings or workplace safety, and no allegation or clearance regarding any named Cameroon actor can be inferred from a custody log. [S17] [S20]

11.15 OPERATIONAL GRIEVANCE CHANNELS MUST BE ACCESSIBLE, SAFE AND DISTINCT FROM CUSTODY TICKETS

Under Principle 29 of the United Nations Guiding Principles on Business and Human Rights (UNGPs) published by the Office of the United Nations High Commissioner for Human Rights (OHCHR), enterprises should establish or join operational-level grievance mechanisms for adversely impacted individuals and communities so grievances are addressed early and remediated directly. [S1101] Principle 29 and Principle 31 explain that these channels support due diligence by surfacing concerns before harms compound, and must meet effectiveness criteria (legitimacy, accessibility, predictability, equitability, transparency, rights-compatibility, learning and dialogue) without undermining trade unions or judicial recourse. [S1101]

In an operable governance system, GFT separates three complaint pathways so each reaches a competent owner with confidentiality safeguards. [S03] [S17] [S1101]

- **Pathway 1: Commercial and evidential custody dispute.** A supplier, ginnery, warehouse or buyer contests a weight discrepancy, rejected transaction certificate, batch downgrade or error declaration. Owner: **Quality reviewer with the data steward**. Resolution follows EPCIS error-declaration and reconciliation rules (Chapters 4, 6 and 8), retaining original and corrected records. [S03] [S10]
- **Pathway 2: Product quality or composition nonconformity.** A cell, laboratory or customer identifies off-specification yarn, shade variation, fabric defects or wrong composition labels. Owner: **Quality engineering and production management**. Resolution follows quarantine, rework and corrective-action rules (linked to wp02 and R29, where manual inspection is 60 to 70 percent accurate and misses 20 to 30 percent of defects against above 90 percent for computer vision). [R29] [S34]
- **Pathway 3: Worker, producer or community grievance.** A worker, subcontracted operator, farmer or community member reports unpaid wages, coerced overtime, unsafe conditions, retaliation, or improper data disclosure. Owner: **Human-rights and labour grievance committee with worker or union representation and external recourse**. Records sit in a confidential register excluded from the traceability database, with non-retaliation rules and local-language intake (spoken, paper drop-box and assisted intake). [S17] [S19] [S1101]

Where a grievance reveals an operational cause threatening custody integrity, such as late order changes forcing unrecorded night-shift subcontracting, the committee issues an anonymised corrective requirement to purchasing and operations without exposing the complainant. [S06] [S17] [S1101]

11.16

Training is complete only when people handle exceptions

Chain-of-custody standards require organisations to train staff on traceability procedures and retain training records. [S06] Most implementation budgets spend training hours on the "happy path" in a classroom: scanning a clean barcode on an intact bale with fast Wi-Fi and a matching delivery note. [S06] [S10] Within forty-eight hours of launch, an operator faces a rain-smudged tag, a split roll lacking a child ticket, a subcontractor return with a 15 kg weight difference, or a disconnected terminal. [S06] [S10] Without exception rehearsals, operators improvise workarounds that corrupt the genealogy graph. [S03] [S10]

11.17 INSTRUCTIONS AND INTERFACES MUST MEET TESTABLE ACCESSIBILITY AND LANGUAGE RULES

A shop-floor interface or standard operating procedure (SOP) works only if operators on every shift can perceive, understand and act on it under warehouse lighting, noise and time pressure. [S31] GFT applies World Wide Web Consortium (W3C) Web Content Accessibility Guidelines (WCAG) 2.2 principles to shop-floor capture tools and public passport views, paired with plain-language job aids. [S31]

1. **Perceivable and non-colour-dependent states:** holds, pending-sync warnings and released states never rely on red, amber or green colour alone; every status pairs high-contrast text (`HOLD`, `PENDING SYNC`, `RELEASED`) with distinct icons (`[!]`, `[~]`, `[OK]`) legible on monochrome labels and terminals. [S31]
2. **Keyboard, scanner and large-target operability:** workers wearing gloves or using a weighbridge keypad can complete every capture and exception step via physical keys or a barcode trigger without fine touch gestures. [S31]
3. **Plain language and bilingual job aids:** technical terms from GS1 EPCIS (`TransformationEvent`, `correctiveEventIds`) or scheme rulebooks (`irreversible conversion`) are translated into concrete actions in French, English and local working languages used in northern and littoral Cameroon sites, backed by laminated cards at each station. [S06] [S10] [S31]

11.18 PILOT COMPETENCY MUST BE VERIFIED THROUGH FAULT-INJECTION DRILLS

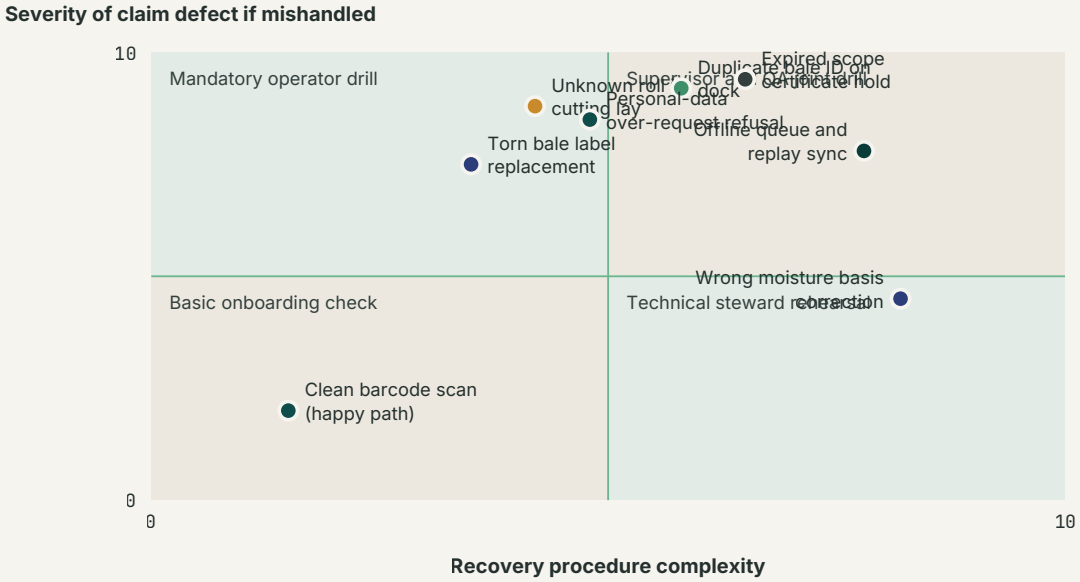
Rather than measuring training readiness by attendance signatures, GFT defines a competency gate to pass before the Chapter 13 pilot starts (with the wider vocational training pipeline covered in wp09). [S06] Every receiving clerk, line leader, quality reviewer and data steward must complete fault-injection drills using synthetic training lots and leave a verifiable record trail. [S03] [S06] [S10]

- **Drill 1: Damaged or duplicate bale label at receipt.** The trainee receives two bales with identical lot numbers or a torn barcode. Pass condition: quarantine both bales, log a `disputed-receipt` exception referencing the transport document, and refuse a duplicate stock receipt. [S06] [S10]
- **Drill 2: Unidentified reserve roll added to a cutting lay.** A cutting trainee completes a 10-roll lay where one roll lacks a batch link. Pass condition: log the missing link on the cutting-lay transformation event, restricting the bundle batch from carrying a provenance claim until quality review reconstructs the link or downgrades the batch. [S02] [S06] [S10]
- **Drill 3: Network outage and delayed replay.** A terminal is disconnected while the trainee logs three events (receipt, storage move and spinning laydown), then reconnected alongside a duplicate message. Pass condition: use the local queue without halting work, hold outbound claims, and verify after sync that idempotent ingestion kept one record per event ordered by `eventTime`. [S10] [S27]
- **Drill 4: Expired scope certificate or privacy over-request.** A quality trainee receives a simulated shipment whose supplier scope certificate expired two days before dispatch, plus a buyer request for farmer names and phone numbers. Pass condition: block certified-claim allocation for the expired shipment and refuse the personal-data request using the privacy register. [S03] [S19]

Exhibit 50, p. 182 maps these illustrative drills across two dimensions: severity of the claim defect if mishandled and complexity of the shop-floor recovery procedure. [S06] [S10] [S31]

EXHIBIT 50 / ILLUSTRATIVE SCENARIO INDEX (0 TO 10)

Training must test the difficult cases



ILLUSTRATIVE [S06] [S10] [S19] [S31] Illustrative GFT competency-testing matrix based on S06 training and record-keeping duties, S10 error declarations, S19 data minimisation and S31 accessibility guidelines. Coordinates are instructional design categories, not measured test scores.

As **Exhibit 50**, p. 182 shows, the "happy path" scan in the lower-left quadrant carries low recovery complexity and low defect risk because software validates it automatically. [S10] High-severity cases in the upper quadrants, including unknown rolls in a cutting lay, duplicate bale codes, expired scope certificates and offline queue sync, require practiced judgment across operator, quality and steward roles. [S06] [S10] **Exhibit 50**, p. 182 sets the curriculum for pilot readiness; it does not claim any Cameroon workforce has yet been tested against these scenarios, and pass rates must be recorded during the Chapter 13 pilot. [S06]

11.19 STANDARD WORK CONNECTS OPERATING DISCIPLINE TO THE COMMERCIAL COST TEST

Delivering an operable governance system yields three artefacts for the rest of this paper: the six-role responsibility matrix (**Exhibit 46**, p. 169), the offline and exception standard-work protocols (**Exhibit 48**, p. 176 and **Exhibit 50**, p. 182), and the privacy-by-purpose register (**Exhibit 49**, p. 178). [S03] [S10] [S19] Every control requires

operator minutes, labels, edge storage, drills and independent review. [S06] Chapter 12 prices that recurring work against bounded counterfactual benefits before any platform vendor is chosen. [S03] [S27]

A record is only as reliable as the working conditions of the person asked to keep it.

CHAPTER SOURCE NOTES

S03 Textile Exchange. 2026-10-30.

S10 GS1. 2022.

S19 European Data Protection Board. 2026-10-30.

S1101 Office of the United Nations High Commissioner for Human Rights. 2011.

R06 Cameroon Trade Hub. Publication date unrecorded; inherited source-text check.

S01 International Organization for Standardization. 2020.

S02 ISEAL Alliance. 2025.

S06 Aid by Trade Foundation. 2025.

S17 OECD. 2018-03-07.

S09 Cotton made in Africa / Sustainable Cotton Tracker. 2026-10-30.

S26 National Institute of Standards and Technology. 2020.

S27 National Institute of Standards and Technology. 2024-11-01.

S12 GS1. 2026.

R14 WageIndicator. Publication date unrecorded; inherited source-text check.

R16 WageIndicator. Publication date unrecorded; inherited source-text check.

R15 wage.is. Publication date unrecorded; inherited source-text check.

S23 World Wide Web Consortium. 2025-05-15.

S24 World Wide Web Consortium. 2025-05-15.

S11 GS1. 2022.

S28 UNECE / UN Transparency Protocol. 2026-10-30.

S1102 LEX Africa. 2025-10-31.

R03 SODECOTON. Publication date unrecorded; inherited source-text check.

S20 International Labour Organization. 2026-10-30.

R29 MDPI; industry inspection literature. Publication date unrecorded; inherited source-text check.

S34 European Commission, DG GROW. 2026-10-30.

S31 World Wide Web Consortium. 2024-12-12.

12

PART IV: SCALE FOLLOWS DEMONSTRATED CONTROL / COMMERCIAL TEST

Traceability economics depend on the work needed to sustain it

Compare the cost of producing admissible evidence with bounded benefits rather than an assumed premium.

CHAPTER 12
DECISION TEST

Compare the cost of producing admissible evidence with bounded benefits rather than an assumed premium.

Traceability in an African cotton-to-garment supply chain is an operating control commitment before it is a software purchase, and its commercial viability depends on whether the recurring work of capturing, reconciling and verifying admissible evidence can be sustained by bounded operational savings rather than an uncontracted price premium. [S03] [S1201] Sponsors evaluating provenance systems often compare subscription fees for cloud dashboards while overlooking the daily shop-floor labour required to label bales and rolls, record custody handovers, investigate weight discrepancies, maintain physical segregation and pay for third-party transaction assurance. [S03] [S06] When those recurring human and procedural tasks are omitted from the budget, a programme can buy a platform that generates digital identifiers while failing to fund the evidence discipline that makes a product claim defensible. [S01] [S02]

Within the Warp and Signal framework developed by Green Future Tech Limited (GFT), Hong Kong SAR, production is the warp and measurement is the weft: the economic test of a traceability system must price the measurement weft across every physical boundary where material changes form or custody. [S01] [S10] Cameroon's inherited sector baseline indicates that about 95 percent of cotton fibre is exported raw and about 5 percent is processed locally, while national industrial policy targets 50 percent local processing by 2030 (as recorded in the inherited source-text register, where the original publication date of the baseline split is unrecorded). [R06] [R07] Moving fibre through domestic spinning, weaving, wet processing and garment assembly multiplies the custody transfers and transformation events that must be documented. [S02] [S03] GFT's three-part Cameroon textile programme, covering a feasibility study, performance-management system design and digital strategy prepared on 31 January 2024 with source refreshes retained in 2026, provides the design context for this chapter without claiming an operating factory or realised financial returns. [R06] [S1201]

This chapter delivers three practical instruments for industrial sponsors, supply-chain managers and assurance leads: a bottom-up cost model specification that separates setup expenditure, recurring operating work and upstream partner onboarding; a counterfactual baseline measurement plan that defines unit cost over eligible released garments and sets any uncontracted price premium to zero; and a vendor evidence request that tests interoperability, key custody and exit portability before contract signature. [S10] [S27] [S1201] Together, these specifications define the inputs required for GFT's `unit-economics` and `build-or-buy` evaluation tools while respecting the scope boundaries of companion papers on capital structure (`wp13`) and production capacity utilisation (`wp15`). [S1201]

12.1

Cost starts with capture and reconciliation work

A credible traceability budget begins by inventorying the physical and administrative control duties required by the chosen custody standard, rather than starting from a software vendor's licence tier. [S03] [S06] Under chain-of-custody frameworks such as ISO 22095:2020 and the ISEAL Alliance guidance, preserving an attribute across a supply chain requires defined identification, segregation or controlled mixing, documentation at each transfer and periodic volume reconciliation. [S01] [S02] Operational

standards including the Textile Exchange Content Claim Standard (CCS), the Global Organic Textile Standard (GOTS) and the Aid by Trade Foundation Transparency Standard translate those principles into concrete workplace tasks: inspecting incoming shipping documents, tagging segregated lots, logging input-to-output conversion batches, confirming counterparty receipts, training staff on exception handling and submitting records for conformity assessment. [S03] [S05] [S06] Every one of those obligations consumes consumables, operator minutes, supervisor review time and external audit fees regardless of which database stores the resulting events. [S03] [S06]

12.2 IMPLEMENTATION EXPENDITURE, RECURRING OPERATING WORK AND PARTNER ONBOARDING BELONG IN SEPARATE ACCOUNTS

Financial appraisals frequently distort traceability economics by blending one-off setup expenditure with ongoing operational costs or by omitting upstream supplier onboarding altogether. [S27] [S1201] To prevent understatement of the steady-state burden, GFT separates the cost specification into three distinct accounts, each governed by its own cost drivers and verification rules. [S03] [S27]

Initial implementation expenditure (capital and setup account) covers the one-off engineering work required to define claim boundaries, configure identifier namespaces, build standard operating procedures, install industrial barcode or quick-response (QR) printers and handheld readers at receiving and dispatch bays, configure local offline queues, and execute conformance and recovery testing before live release. [S10] [S12] [S27] In an illustrative financial model, these setup items are amortised over a stated planning horizon (for example, an illustrative three-year equipment life) rather than treated as sunk and forgotten. [S1201]

Recurring internal operating and control cost (annual operating account) covers the continuous cost of consumables (durable bale tags, roll labels, carton labels and thermal transfer ribbons), point-of-work data capture time by receiving clerks and machine operators, supervisory exception investigation and monthly mass-balance or batch reconciliation, annual refresher training including adverse-case drills, third-party scope and transaction certification fees, and software hosting, resolver operation and technical support. [S03] [S06] [S13]

Partner and supplier onboarding and maintenance cost (value-chain account) covers the work required to bring upstream ginneries, traders, spinners, commission dyers and subcontractors into conformance with the required evidence format, including assisted data-entry tools, local-language instructions, paper-to-digital synchronisation routines and counterparty reconciliation support. [S06] [S09] [S17] Even when an upstream supplier such as SODECOTON operates an organised producer network supporting more than 220,000 cotton farmers across nine ginning plants and two oil mills in northern Cameroon according to its inherited profile, integrating lot-level shipping and ginning-campaign references into a downstream garment maker's event ledger requires explicit interface testing and administrative coordination. [R03] [S06]

12.3 A BOTTOM-UP COST SCHEDULE PRICES EVERY CUSTODY OBLIGATION BEFORE VENDOR SELECTION

To make the cost structure inspectable before formal vendor quotations or pilot stopwatch observations are collected, GFT defines a parametric bottom-up cost equation in which every line item is expressed as an observable physical quantity multiplied by

an explicit unit rate. [S03] [S1201] For one operating year, total annualised traceability cost (C_total) is specified as an illustrative sum of annualised setup cost (K_setup / T_amort), recurring internal control cost and allocated partner maintenance cost: [S1201]

```
C_total = (K_setup / T_amort) + C_media + C_capture + C_reconcile + C_train + C_assure + C_platform + C_partner
```

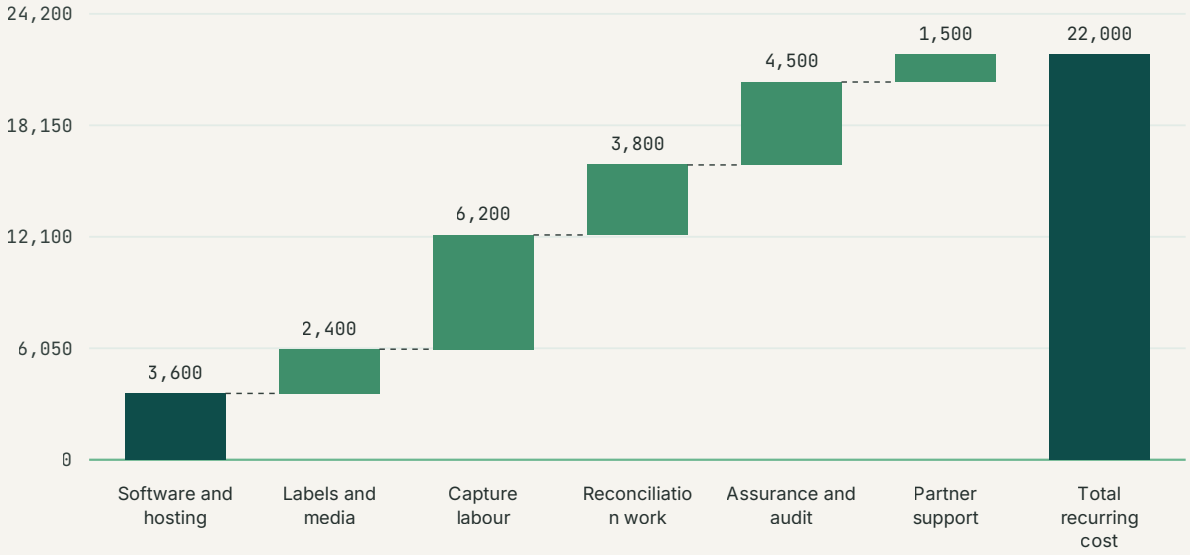
In this illustrative formulation, K_setup is initial setup expenditure amortised over T_amort years; C_media is annual label and tag count multiplied by unit consumable cost; C_capture is annual custody and transformation event count multiplied by capture hours per event and loaded operator wage rate; C_reconcile is annual supervisory and accounting hours for volume reconciliation and exception resolution multiplied by loaded supervisory rate; C_train is annual training and competency testing cost; C_assure combines annual certification scope audits and per-shipment transaction certificate fees; C_platform is annual software, resolver and backup cost; and C_partner is annual supplier onboarding and file-validation support. [S03] [S05] [S13]

Cost category	Control duty	Physical driver	Live appraisal source	Illustrative baseline (thousand XAF/year)
Software and hosting	Event store, resolver and status list [S10] [S13] [S24]	Active sites and event volume [S10] [S27]	Vendor quote plus exit fee schedule [S27] [S1201]	3,600 (illustrative)
Labels and media	Bale, yarn, roll, bundle and carton tags [S03] [S06]	Batch count plus replacement rate [S06] [S12]	Consumables quote and durability test [S06]	2,400 (illustrative)
Capture labour	Scanning receipts and logging transformations [S09] [S10]	Event count times seconds per entry [S03] [S10]	Pilot time study and payroll schedule [S1201]	6,200 (illustrative)
Reconciliation work	Monthly balance close and error resolution [S03] [S06] [S10]	Lots, subcontractors and mismatches [S03] [S06]	Quality and accounting pilot logs [S03] [S1201]	3,800 (illustrative)
Assurance and audit	Scope audit and transaction certificates [S04] [S05] [S29]	Certified sites and claimed shipments [S03] [S05]	Certification body fee schedule [S04] [S05]	4,500 (illustrative)
Partner support	Supplier file checks and restore drills [S06] [S10] [S27]	Upstream partners and continuity tests [S06] [S27]	Support log and continuity plan [S27] [S1201]	1,500 (illustrative)

As shown in **Exhibit 51**, p. 188, the human and assurance components of a functioning custody system typically outweigh the software subscription itself when modelled across a complete annual cycle. [S03] [S06] [S1201]

EXHIBIT 51 / ILLUSTRATIVE ANNUAL COST (THOUSAND XAF)

Recurring cost includes the human control work



ILLUSTRATIVE [S03] [S06] [S27] Illustrative bottom-up annual operating model for a single bounded pilot chain: software subscription and hosting (3,600), physical labels and consumables (2,400), point-of-work capture labour (6,200), monthly reconciliation and exception review (3,800), scheme and transaction assurance (4,500) and partner support and recovery tests (1,500), summing to 22,000 thousand XAF per year. All quantities are hypothetical teaching inputs, not vendor quotes or GFT operating costs.

In **Exhibit 51**, p. 188, software and hosting represent 3,600 thousand XAF out of an illustrative 22,000 thousand XAF annual recurring budget (about 16.4 percent), whereas point-of-work capture labour (6,200 thousand XAF), reconciliation and exception handling (3,800 thousand XAF) and external assurance (4,500 thousand XAF) together account for 14,500 thousand XAF (about 65.9 percent of the illustrative total). [S03] [S06] While these figures are explicitly illustrative teaching inputs rather than empirical measurements from a Cameroon factory, they establish that a cost appraisal pricing only software licences and barcode stickers cannot prove that a factory can afford to sustain the control system. [S03] [S1201]

12.4

Per-garment cost needs a defensible denominator

Dividing an annual traceability budget by a factory's theoretical nameplate capacity produces a misleadingly low unit cost because traceability expenses are incurred across the entire operating system while only a subset of output ultimately qualifies for a verified claim. [S02] [S03] To evaluate unit economics honestly, the denominator must be restricted to the volume of garments that actually complete manufacturing with an intact, reconciled and admissible evidence trail. [S03] [S06]

12.5 NAMEPLATE CAPACITY, PHYSICAL OUTPUT, CUSTODY-ELIGIBLE OUTPUT AND RELEASED VOLUME ARE DISTINCT DENOMINATORS

In industrial operations, four different volume measures exist along the path from engineering design to commercial dispatch, and confusing them invalidates unit-cost comparisons. [S02] [S03]

Nameplate capacity (`Q_nameplate`**)** is the theoretical maximum annual garment output of a facility running all installed lines at standard efficiency across all scheduled shifts. [R12] As documented in companion paper `wp15` and illustrated by the inherited sector record for CICAM (where a July 2023 report recorded capacity utilisation of 33.7 percent at Garoua, 48.9 percent at CICAM 1 and 10.83 percent at CICAM 2, with underutilisation costing about CFAF 2 billion in 2020), installed textile capacity in Cameroon has historically diverged sharply from realised production. [R12] Similarly, third-party announcements such as the Camtext SA project (reported on 12 November 2025 at US$300 million or 180 billion XAF for 12,000 tonnes a year processed and optimal capacity around 2033) represent planned third-party targets rather than current operating denominators. [R09] [R10]

Physically produced volume (`Q_produced`**)** is the actual count of first-quality garments completed and packed by the factory during the accounting period, after accounting for machine downtime, line-balancing losses, power interruptions and quality rejects. [R12] **Custody-eligible volume (**`Q_eligible`**)** is the subset of physically produced garments manufactured from cotton and intermediate fabrics that entered the facility with valid upstream scope and transaction evidence and maintained required physical segregation or controlled blending rules throughout spinning, weaving, dyeing and cutting. [S02] [S03] [S06] Under Version 1.0 of the Aid by Trade Foundation Transparency Standard (dated June 2025), if Hard Identity Preserved (HIP) cotton (termed Segregation on the foundation's current traceability webpage) is mixed with conventional cotton or downgraded to mass balance, that conversion is irreversible and final; those garments permanently leave the physically segregated denominator. [S06] [S07]

Evidence-supported released volume (`Q_released`**)** is the final subset of custody-eligible garments for which all dispatch and receipt confirmations match, volume reconciliation closes within declared tolerances, no unresolved certificate suspension or data contradiction exists, and the designated evidence approver authorises claim release. [S03] [S06] [S24] Across every operating period, these four quantities satisfy the strict ordering $Q_{nameplate} \geqslant Q_{produced} \geqslant Q_{eligible} \geqslant Q_{released}$. Because fixed software fees, annual scope audits, baseline training and core reconciliation overhead must be paid regardless of how many lots pass final review, unit traceability cost ($c_{released}$) must be defined strictly as $C_{total} / Q_{released}$. [S03] [S1201]

UNIT TRACEABILITY COST AND DENOMINATOR RECONCILIATION

System boundary: From raw-cotton bale receipt (or yarn and fabric receipt for a non-integrated plant) through internal batch transformations, physical storage, subcontracted processing and final garment claim release. [S03] [S10]

Calculation inputs and verification rules: Annualised setup expenditure (`K_setup / T_amort` in XAF per year, with asset life stated explicitly) is added to annual recurring control cost (`C_rec`) and partner maintenance cost (`C_partner`) to obtain `C_total`. [S03] [S1201] Physical production ledger counts (`Q_nameplate`, `Q_produced`, `Q_eligible` and `Q_released` in garments per year) are reconciled against the material balance equation from Chapter 6. [S03] [S06] Before computing unit cost, the analyst verifies that `Q_released ⩽ Q_eligible ⩽ Q_produced`; any lot quarantined for missing upstream transaction certificates or unresolved mass residuals is excluded from `Q_released` even if sold commercially as conventional product. [S03] [S05] Both the apparent cost per produced garment (`C_total / Q_produced`) and the true cost per eligible released garment (`C_total / Q_released`) are reported so the cost penalty of custody attrition remains visible. [S02] [S06]

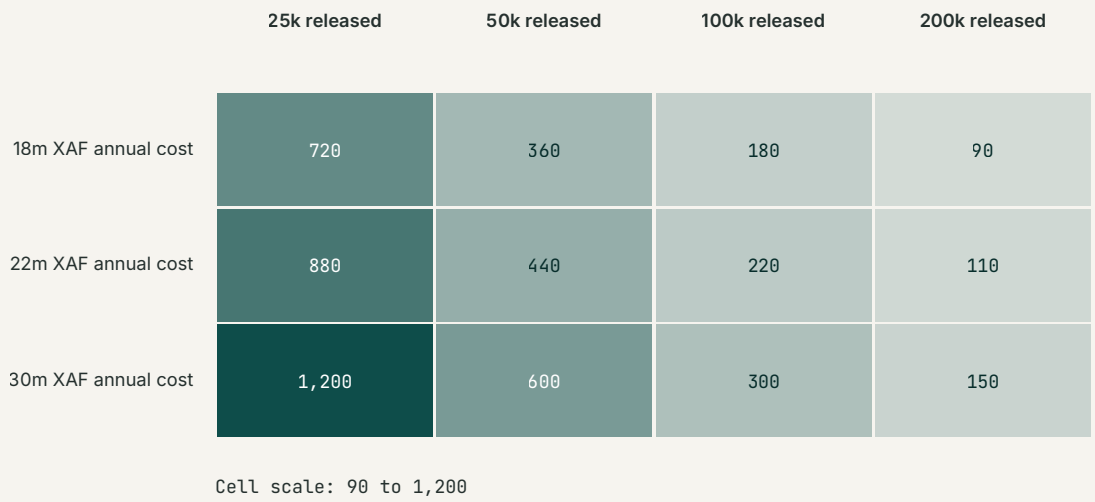
12.6 UNRECONCILED HANDOVERS AND DOWNGRADES COMPRESS THE DENOMINATOR AND RAISE UNIT COST

When a factory experiences high exception rates, such as unrecorded roll substitutions in the cutting room, missing subcontractor return tallies or delayed transaction certificates from an upstream spinner, two financial effects occur simultaneously. [S03] [S05] [S06] First, the numerator `C_total` rises because quality and data-stewardship staff spend additional hours investigating discrepancies and issuing EPCIS error declarations. [S10] Second, the denominator `Q_released` shrinks because affected garment batches must be stripped of their provenance claim or downgraded to a weaker custody model before shipment. [S02] [S06]

Exhibit 52, p. 191 illustrates how variations in total annual control cost and eligible released volume interact to determine the traceability cost per supported garment. [S02] [S03] [S06]

EXHIBIT 52 / ILLUSTRATIVE XAF PER ELIGIBLE RELEASED GARMENT

Low released volume raises the cost of every supported claim



ILLUSTRATIVE [S02] [S03] [S06] Illustrative arithmetic sensitivity of unit control cost (C_total / Q_released) across three hypothetical annual cost levels (18,000, 22,000 and 30,000 thousand XAF, including annualised setup and recurring control work) and four hypothetical eligible released garment volumes (25,000, 50,000, 100,000 and 200,000 garments per year). Every cell equals annual cost divided by eligible released volume. Values are illustrative teaching calculations, not observed factory costs.

As **Exhibit 52**, p. 191 demonstrates, at an illustrative annual cost of 22,000 thousand XAF (22 million XAF), achieving 200,000 eligible released garments yields an illustrative unit cost of 110 XAF per garment (below US$0.20 at the inherited reference band of 563 to 610 XAF per US dollar in the GFT study's method note). [R32] [S03] If custody failures, low factory utilisation or missing upstream certificates reduce eligible released volume to 25,000 garments while annual control overhead rises to 30,000 thousand XAF due to manual rework, the illustrative unit cost reaches 1,200 XAF per released garment (around US$2.00 to US$2.13 per garment on the same illustrative exchange-rate basis). [R32] [S06] What **Exhibit 52**, p. 191 cannot establish is the actual release yield or cost curve of a specific Cameroon plant; those parameters must be measured during a bounded operational pilot and combined with the capacity-utilisation methods in wp15. [S1201]

12.7

Benefits must be measured by a counterfactual

Just as costs must be built from observable tasks, commercial benefits must be measured against an explicit operational counterfactual rather than assumed from generic industry marketing. [S1201] Although global fashion surveys report broad executive enthusiasm for digital and artificial-intelligence initiatives (for example, McKinsey's 2025 fashion study cites sector-wide inventory and forecasting ranges for AI at scale), a provenance ledger does not automatically generate inventory reductions, higher retail prices or preferential tariff treatment. [R27] [S18] In GFT's appraisal method, every proposed benefit is treated as a testable operational hypothesis tied to a specific baseline workflow. [S03] [S1201]

12.8 OPERATIONAL HYPOTHESES REPLACE ASSUMED RETAIL PRICE PREMIUMS IN THE BASE CASE

In an illustrative base-case appraisal, GFT sets the unit price premium from traceability to zero (`0 XAF`) unless an enforceable buyer offtake contract or observed historical transaction record specifies a defined monetary supplement for documented provenance. [S02] [S1201] Traceability is frequently a condition of market entry, tender eligibility or buyer retention rather than a trigger for higher unit pricing, and treating a speculative price uplift as guaranteed revenue conceals whether the factory can sustain the control burden from ordinary operating margins. [S03] [S1201]

Instead of relying on an uncontracted price premium, GFT evaluates three internal operational benefit channels grounded in chain-of-custody control requirements. [S03] [S06] **Evidence-request and audit-preparation labour saved** arises because, in a baseline operation using scattered paper delivery notes, spreadsheets and email attachments, responding to a buyer due-diligence query or assembling a transaction-certificate application pack requires clerks and quality managers to reconstruct batch links manually. [S03] [S05] [S17] When receiving, transformation and shipping events are captured at the point of work using structured identifiers, assembling an evidence pack shifts from manual archive searches to a bounded query, reducing administrative minutes per buyer request or audit cycle. [S10] [S1201]

Narrower exception containment and quarantine scope arises when an upstream certificate is suspended, a moisture or weight discrepancy surfaces, or a subcontractor mixing error is discovered. [S03] [S06] [S24] In an unindexed factory, conservative compliance requires quarantining or downgrading an entire production campaign or warehouse zone because the exact affected rolls cannot be isolated; a granular batch genealogy graph (using GS1 EPCIS transformation semantics) bounds the blast radius of a defect to the specific yarn lots, fabric rolls and garment bundles linked to the compromised input, preserving the eligibility of unaffected lots. [S02] [S10] **Avoided shipment and claim-release delay** arises where counterparty confirmations and volume reconciliations are performed continuously at each handover rather than reconstructed weeks after garment packing, so fewer outbound shipments stall awaiting missing origin documentation, reducing working-capital holding time and administrative expediting fees. [S03] [S09]

12.9 A BASELINE MEASUREMENT PLAN PREVENTS DOUBLE-COUNTING OF LABOUR AND LEAD-TIME GAINS

A recurring analytical error in business-case templates is counting the same operational improvement twice: once as clerical labour saved during audit preparation, again as faster inventory turnover, and a third time as reduced compliance risk. [S1201] To prevent double-counting, GFT requires a pre-pilot baseline measurement plan that pairs every benefit hypothesis with a single mutually exclusive accounting metric, a measured baseline denominator and an independent verification source. [S03] [S1201]

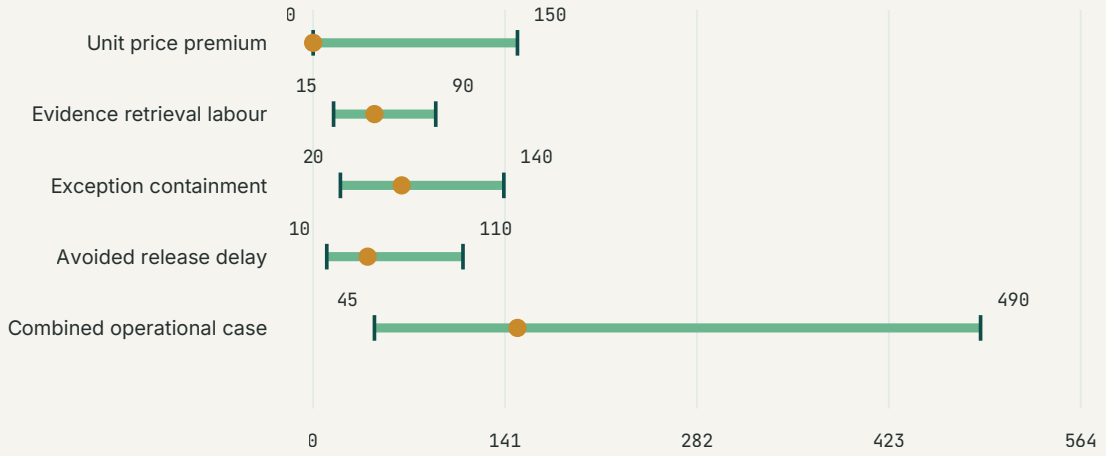
Benefit hypothesis	Baseline measurement	Pilot measurement	Double-counting exclusion	Base-case treatment
Evidence retrieval labour saved	Stopwatch minutes to assemble a 10-lot paper and spreadsheet evidence pack (illustrative) [S03] [S1201]	Stopwatch minutes to export and verify the 10-lot pack from the pilot store [S10] [S1201]	Count direct clerical hours only; do not double-count under audit fee reductions [S1201]	Disclosed hypothetical minutes only; zero until timed [S1201]
Narrower exception quarantine	Share of monthly batch downgraded when one input lot fails under coarse tracking [S03] [S06]	Share downgraded when the same fault is injected during Chapter 13 testing [S06] [S10]	Value preserved margin on isolated volume only; exclude if no replacement cost applies [S02] [S06]	Conditional bound; excluded from guaranteed cash flow [S1201]
Avoided claim-release delay	Days from garment packing to complete transaction-evidence sign-off at baseline [S03] [S05]	Days from packing to evidence sign-off under point-of-work capture [S09] [S10]	Value working-capital hold cost only (wp13); never add full shipment revenue [S1201]	Conservative bound pending multi-shipment observation [S1201]
Contracted buyer price premium	Observed unit price for equivalent conventional garments without provenance [S02] [S1201]	Contracted unit price differential tied to verified claim release [S03] [S1201]	Exclude unless backed by signed contract; do not combine with market-access credit [S1201]	Set to 0 XAF per garment in base and low cases [S1201]

When converting saved administrative or operational minutes into monetary terms in Cameroon, analysts must distinguish statutory minimum wages, sector averages and actual site payroll costs. [R14] [R15] In the inherited evidence register, Cameroon's statutory minimum wage (SMIG) was raised from XAF 41,875 a month in 2023 to XAF 43,969 a month from 23 February 2024 (about US$76, a 5 percent increase), while an across-sector average salary benchmark is recorded at about US$359 a month, alongside a standard 40-hour week, 48-hour maximum and overtime at 1.2 times in a labour market where informal employment is about 90 percent. [R14] [R15] [R16] Because quality controllers, inventory accountants and compliance officers typically earn between the statutory floor and formal industrial supervisory rates, a live business case must use the facility's actual loaded payroll schedule rather than an unverified single wage figure. [R14] [R15] [S1201]

Exhibit 53, p. 194 presents an illustrative comparison of low, base (mid) and high unit benefit bounds per eligible released garment across the four candidate channels, keeping the base-case price premium at zero. [S03] [S06] [S17]

EXHIBIT 53 / ILLUSTRATIVE XAF PER ELIGIBLE RELEASED GARMENT

Benefits remain conditional until measured



ILLUSTRATIVE [S03] [S06] [S17] Illustrative operational benefit bounds per eligible released garment (at a hypothetical 100,000-garment released volume) across four candidate benefit channels. Base-case unit price premium is set to 0 XAF (low 0, mid 0, high 150 XAF conditional on contracted buyer incentive). Evidence-pack retrieval labour saved (low 15, mid 45, high 90 XAF), narrower exception quarantine (low 20, mid 65, high 140 XAF) and avoided shipment release delay (low 10, mid 40, high 110 XAF) derive from disclosed hypothetical minute, inventory-holding and lot-isolation assumptions. Not an observed GFT result.

In **Exhibit 53**, p. 194, the illustrative low-case operational savings sum to 45 XAF per eligible released garment (15 XAF from retrieval labour, 20 XAF from exception containment and 10 XAF from avoided release delay, with 0 XAF price premium), while the illustrative base (mid) case reaches 150 XAF per garment (45 XAF plus 65 XAF plus 40 XAF, with 0 XAF premium). [S03] [S06] Only in the illustrative high case, which assumes both high baseline friction and a contracted 150 XAF buyer premium alongside upper-bound operational savings (90 XAF plus 140 XAF plus 110 XAF), does the combined benefit reach 490 XAF per released garment. [S03] [S1201] Comparing **Exhibit 53**, p. 194 with **Exhibit 52**, p. 191 reveals the central commercial tension of traceability: at 100,000 released garments and an illustrative 22,000 thousand XAF annual cost (220 XAF per garment), the illustrative mid-case internal operational savings of 150 XAF per garment cover roughly two-thirds of the control cost, leaving a net 70 XAF per garment that must be justified by market-access retention, higher released volume or buyer co-funding. [S03] [S1201]

12.10

Choose scope before choosing a vendor

Selecting a software vendor or ledger architecture before defining the claim boundary, identification granularity and partner exchange method reverses the engineering sequence and locks the factory into unnecessary recurring costs. [S10] [S12] [S27] A traceability platform is an infrastructure layer for storing and exchanging custody observations; it cannot determine whether batch or serial tracking is physically observable on the spinning floor, nor can it substitute for missing upstream certificates. [S01] [S10] [S25]

12.11 GRANULARITY, EXCHANGE MODE AND HOSTING ARCHITECTURE FOLLOW THE CLAIM BOUNDARY

Before issuing a request for proposals, GFT's `build-or-buy` methodology requires the sponsor to fix three architectural scope choices derived from Chapters 5, 8, 9 and 10. [S10] [S12] [S27]

Identification granularity (product model, production batch or serialised item): Under GS1 Digital Link URI syntax (Release 1.7.0, ratified August 2026) and the working UNECE / UN Transparency Protocol (UNTP) Digital Product Passport specification, identifiers can resolve at the product class level, the batch or lot level, or the unique serialised item level. [S12] [S28] Because cotton bales are blended in spinning laydowns and fabric rolls are grouped in cutting lays, upstream provenance is physically bounded at the batch or campaign level; applying unit-level radio-frequency identification (RFID) or serialised QR tags to individual garments cannot create farm-level precision upstream, and EPCIS 2.0 explicitly does not require RFID. [S02] [S10] [S12] Choosing batch-level tracking for pilot evaluation avoids the recurring consumable and scanning cost of item-level serialisation unless a buyer contract specifically funds item-level anti-counterfeiting controls. [S10] [S12]

Partner data exchange mode (controlled file templates versus automated APIs): While GS1 EPCIS 2.0 and Core Business Vocabulary (CBV) 2.0 support real-time capture and query interfaces, many ginneries, cooperatives, warehouses and commission finishers in West and Central Africa operate periodic accounting systems or face intermittent connectivity. [S10] [S11] A practical system must therefore accept validated flat-file or spreadsheet uploads that map cleanly to EPCIS event fields and preserve cryptographic hashes of attached PDFs (such as weighbridge tickets and transaction certificates), rather than requiring every upstream partner to purchase an enterprise API connector. [S03] [S10]

Hosting and ledger model (managed database, self-hosted repository or permissioned shared ledger): NIST IR 8202 explains how blockchain technology provides tamper-evident distributed ledgers, while NIST SP 800-161 Rev. 1 (updated November 2024) emphasises assessing cybersecurity and continuity risks across software and service supply chains. [S25] [S27] As shown in Chapter 10, ledger immutability prevents silent retroactive alteration of a stored record, but it cannot verify that a physical bale weighed at a ginnery matched the number typed into the terminal, and an immutable ledger still requires an explicit EPCIS error-declaration workflow when human entry mistakes occur. [S10] [S25] Similarly, whether verifiable credentials follow the W3C Verifiable Credentials Data Model v2.0, W3C Decentralized Identifiers (DIDs) v1.0, W3C Bitstring Status List v1.0 and the March 2026 W3C Verifiable Credentials Use Cases Note, or whether records are held in a conventional relational database with signed exports, depends on whether multiple untrusting parties need decentralised verification, rather than on marketing claims that a blockchain reduces audit costs. [S21] [S22] [S24] [S1202]

12.12 INTEROPERABILITY, BULK EXPORT, KEY RECOVERY AND EXIT RIGHTS MUST BE TESTED BEFORE CONTRACT SIGNATURE

When a garment manufacturer places its custody records and product passport URLs inside a proprietary software-as-a-service (SaaS) platform, vendor lock-in becomes a direct threat to commercial continuity. [S13] [S27] Under the European Commission's Ecodesign for Sustainable Products Regulation (ESPR) implementation process,

textile-specific Digital Product Passport fields remain to be defined through future delegated acts (with adoption of the textile delegated act indicatively planned for Q4 2027 as of the research cutoff), meaning that data schemas and disclosure rules will evolve over coming years. [S14] If a vendor controls the domain name printed on garment labels, stores events in an undocumented format, holds the private cryptographic signing keys without customer recovery rights, or charges punitive fees to export historical evidence, switching providers can invalidate years of issued product identifiers and audit trails. [S12] [S13] [S27]

To prevent lock-in, GFT evaluates candidate platforms and internal build options against the qualitative acceptance criteria in **Exhibit 54**, p. 196, requiring executable proof during procurement rather than sales assurances. [S10] [S13] [S27]

EXHIBIT 54 / QUALITATIVE PROCUREMENT CRITERIA

A vendor decision must include exit and evidence portability

Control domain	Required vendor evidence	Pilot verification test	Disqualifying defect
Event semantics	EPCIS 2.0 and CBV 2.0 import and export schemas	Round-trip batch genealogy reconstruction	Proprietary fields that drop input links
Identifier syntax	GS1 Digital Link URI syntax under buyer domain	Resolve batch URI across service change	Vendor-owned domain locks product codes
Resolver governance	Resolver description file and link-type routing	Inspect machine-readable resolver response	Hard-coded redirects without export table
Evidence export	Complete bulk export of events, hashes and files	Restore archive to independent staging node	Paid exit fee or incomplete audit history
Key and status custody	Customer-controlled signing keys and status list	Rotate key and verify historical revocation	Vendor holds sole private key without escrow
Offline queue sync	Idempotent ingestion with retained event times	Replay queued events after simulated outage	Server receipt time overwrites observation

ILLUSTRATIVE [S10] [S12] [S13] [S27] Illustrative GFT procurement evaluation matrix grounded in GS1 EPCIS 2.0 (S10), GS1 Digital Link (S12), GS1 Resolver 1.2.1 (S13) and NIST SP 800-161 Rev. 1 (S27). Qualitative acceptance tests replace numerical vendor scoring.

Every row in **Exhibit 54**, p. 196 translates a technical standard into a contractual and operational gate. [S10] [S13] [S27] Under GS1-Conformant Resolver Standard Release 1.2.1 (ratified August 2026), a conformant resolver publishes a machine-readable description file and routes requests across link types; by keeping the top-level domain or subdomain under the manufacturer's or brand's own DNS control and requiring a full export of the resolver routing table, the enterprise can redirect existing garment QR codes to a new host if a software contract ends. [S12] [S13] Similarly, requiring bulk export of all EPCIS 2.0 events, UNTP Digital Traceability Events (DTEs) or Conformity Credentials, and linked PDF evidence files, and testing that export by restoring it onto an independent staging environment under NIST SP 800-161 Rev. 1 supply-chain continuity principles, ensures that historical custody records survive

vendor insolvency or price increases. [S10] [S27] [S29] [S30] Notice that **Exhibit 54**, p. 196 assigns no synthetic points or market-share rankings to named software vendors; GFT has not benchmarked commercial providers in Cameroon, and procurement acceptance depends solely on passing these functional verification tests. [S27] [S1201]

12.13

The parties carrying the burden need a fair allocation

A traceability system that appears profitable on a brand's or garment exporter's income statement can still fail operationally if it shifts uncompensated capture, segregation and administrative work onto upstream farmers, producer groups, ginneries and domestic subcontractors. [S06] [S17] In multi-tier cotton chains, the actors nearest the raw material often face the tightest working-capital constraints and the highest transaction count per tonne of fibre, while the commercial reward for a verified origin claim accrues at the final brand or export invoice. [R03] [S17]

12.14 UPSTREAM CAPTURE, SEGREGATION AND BUYER-SPECIFIC FORMATTING IMPOSE ASYMMETRIC BURDENS

Tracing cotton from northern Cameroon's production zone through ginning, spinning, fabric processing and garment assembly distributes distinct operational burdens across four tiers of participants. [R03] [S06]

Smallholder producers and producer groups: Collecting delivery receipts, verifying group membership, maintaining clean harvest bags to prevent contamination, and consenting to personal-data processing impose time and coordination costs at the village collection point. [S06] [S19] While inherited evidence notes that SODECOTON supports more than 220,000 cotton producers and injects roughly US$100 million a year into rural communities, individual smallholders cannot be assumed to own smartphones, maintain continuous data connectivity or absorb unpaid administrative form-filling without risking exclusion of smaller farms. [R03] [R04] [S17] Furthermore, as the European Data Protection Board (EDPB) small-business guidance states, an organisation may process only personal data that is necessary and proportionate for the envisaged purpose; demanding excessive farm-level personal identifiers raises both compliance costs and privacy risks without improving batch-level cotton provenance. [S19]

Ginneries and lint warehouses: Under the Aid by Trade Foundation Transparency Standard, keeping eligible seed cotton and ginned lint bales physically or temporally separated from conventional material, cleaning gin stands between campaigns, tagging every bale and registering shipments in tracking portals such as the Sustainable Cotton Tracker (SCOT) require dedicated warehouse space, campaign scheduling and clerical verification. [S06] [S09] Notice that SCOT's operational FAQ explicitly states that SCOT is not an order system; counterparties must therefore maintain tracking confirmations alongside their ordinary commercial invoicing. [S09]

Spinners, weavers, dyers and toll subcontractors: Maintaining batch genealogy across bale laydowns, yarn lots, greige fabric rolls and dye batches requires smaller lot runs, more frequent line changeovers and explicit subcontractor tally sheets. [S03] [S06] [S10] When a garment maker serves three different international buyers who

each demand a different spreadsheet template or proprietary portal login for the same physical custody events, clerical entry time multiplies without adding a single new physical observation. [S10] [S1201]

Garment manufacturer and brand claimant: The downstream claimant bears the cost of final cutting-lay allocation, passport publication, customer-facing resolver maintenance and legal accountability for the public claim, while holding the direct commercial relationship with the institutional buyer or retail market. [S13] [S14] [S28] The OECD Due Diligence Guidance for Responsible Supply Chains in the Garment and Footwear Sector emphasises collaborative, constructive approaches across supply chains rather than shifting compliance burdens unilaterally onto upstream suppliers. [S17] Equally, as the International Labour Organization (ILO) definition of forced labour underscores, labour due diligence concerns coercion and voluntariness across formal and informal work arrangements; paying for a fibre-tracking software licence neither compensates upstream workers nor substitutes for independent labour risk assessment and remediation. [S17] [S20]

12.15 A SHARED-DATA CONTRACT REDUCES DUPLICATE ENTRY WHILE PRESERVING EACH BUYER'S CLAIM BOUNDARY

To prevent supplier fatigue and smallholder exclusion, GFT proposes an operational cost-allocation schedule and a shared-data contract architecture across the supply chain. [S06] [S10] [S17] At the producer group and first-collection tier, pseudonymous delivery receipt capture, bag marking and privacy-compliant group roster maintenance are funded by the downstream programme or managing entity through field-agent capture support and direct service fees, with zero software fees charged to farmers. [S06] [S17] [S19] At the ginnery and lint storage tier, campaign segregation, bale tagging, moisture and tare logging, and dispatch confirmation are compensated through an explicit per-bale handling and documentation supplement in the lint procurement schedule, audited against matched receipt packs. [S03] [S06] [S09] At spinning, fabric and wet-processing mills, transformation event logging, roll-splitting records, subcontractor tracking and volume reconciliation are governed by a capture-once shared-data clause so the supplier records one canonical EPCIS 2.0 and CBV 2.0 event stream and exports buyer-specific views without duplicate manual entry. [S03] [S10] [S11] At the garment exporter and brand tier, claim-card definition, final batch release review, third-party assurance fees and passport hosting are borne by the commercial claimant, with transaction certificate and assay costs shared according to contracted order volume. [S05] [S14] [S1201]

GFT NOTE

Price upstream capture explicitly and standardise the core event record. GFT recommends two non-negotiable commercial rules before launching a cotton traceability pilot in Cameroon. First, never assume that farmers, producer groups or domestic tolling mills will absorb extra labelling, segregation and data-entry work for free; include an explicit line item for upstream capture support and handling in the procurement contract so the party requesting the evidence funds its collection. [S06] [S17] Second, protect domestic mills from multi-portal exhaustion by adopting a capture-once shared-data clause grounded in GS1 EPCIS 2.0 and CBV 2.0: the factory records each physical receipt, transformation and shipment once in an open canonical schema, and software adapters generate scheme-specific or buyer-specific views while keeping each buyer's commercial pricing, customer identity and claim boundary strictly segregated. [S10] [S11] [S26]

12.16

A pilot determines whether the investment case survives

Because neither unit control costs nor operational savings can be known with certainty before operators test the procedures on real production lots, the investment case for traceability must be framed as a conditional break-even surface to be resolved by the Chapter 13 pilot. [S1201] Rather than presenting a single point estimate of net present value or return on investment, GFT defines the exact break-even threshold per eligible released garment and sweeps the operational parameters that govern whether the threshold is met. [S03] [S1201]

12.17 BREAK-EVEN BENEFIT PER RELEASED GARMENT SWEEPS CAPTURE TIME, ADOPTION AND RELEASE YIELD

For a traceability system to break even on purely operational and contracted commercial terms within an annual period, the realised unit benefit per eligible released garment (`b_realised`, comprising measured clerical retrieval savings, measured exception-containment savings, measured delay-avoidance savings and any contracted buyer price supplement) must equal or exceed the unit traceability cost over eligible released garments (`c_released`): [S03] [S1201]

```
b_break_even = c_released = ((K_setup / T_amort) + C_rec + C_partner) /
(Q_produced * y_eligible * y_release)
```

Here `Q_released` is factored into physically produced garments `Q_produced`, the custody-eligibility ratio `y_eligible = Q_eligible / Q_produced` (the share of output using Segregated or eligible input lots) and the evidence-release yield `y_release = Q_released / Q_eligible` (the share of eligible lots that pass reconciliation and assurance review without disqualifying defects). [S02] [S03] [S06]

This decomposition exposes why pilot measurement is indispensable across three operational variables. [S03] [S10] [S1201] First, regarding **point-of-work capture and correction time**, if scanning and form validation at the receiving bay or cutting table take an illustrative 45 seconds per event with a 2 percent mismatch rate, a single clerk can handle the shift flow within normal duties; if poorly designed interfaces, damaged barcode labels or offline synchronisation conflicts push capture and rework to an

illustrative 6 minutes per event with a 15 percent exception rate, capture and reconciliation labour costs double while shipments stall. [S06] [S10] Second, regarding **upstream partner adoption and timely evidence delivery (`y_eligible`)**, if upstream ginneries or yarn suppliers fail to transmit transaction references or mix segregated and conventional bales during storage, `y_eligible` drops, shrinking the denominator that carries the fixed software and scope-audit overhead. [S03] [S06] Third, regarding **reconciliation and assurance release yield (`y_release`)**, even when physical cotton is eligible, unconfirmed handovers, unexplained moisture or waste residuals beyond tolerance, or revoked conformity credentials reduce `y_release`, forcing the factory to sell traced production as ordinary untraceable garments while still paying the full cost of the control system. [S03] [S24] [S29]

WORKED EXAMPLE

Unit cost and break-even arithmetic across denominator attrition. Consider an illustrative garment manufacturing line in Cameroon configured for a bounded pilot with a theoretical nameplate capacity of `Q_nameplate = 100,000` garments per year. [S1201] Suppose initial setup expenditure for industrial printers, ruggedised scanners, local edge queuing and workflow configuration is `K_setup = 12,000,000 XAF`, amortised on a straight-line basis over an illustrative `T_amort = 3 years` to give `4,000,000 XAF` per year. [S10] [S27] Suppose annual recurring internal control and assurance costs (from **Exhibit 51**, p. 188, excluding partner onboarding) are `16,500,000 XAF` and annual partner onboarding and support costs are `1,500,000 XAF`, so total recurring and partner cost is `18,000,000 XAF` per year and total annualised traceability cost is `C_total = 4,000,000 + 18,000,000 = 22,000,000 XAF` per year. [S03] [S06]

Now trace how denominator attrition alters the unit economics across four stages of operational reality, all using explicitly illustrative teaching quantities. [S02] [S03] In Stage 1 (naive nameplate calculation), dividing `22,000,000 XAF` by `Q_nameplate = 100,000` garments yields an apparent cost of `220 XAF` per garment. [S1201] In Stage 2 (physical utilisation reality), suppose line-balancing losses and power interruptions limit physical output to `Q_produced = 80,000` garments per year (80 percent utilisation), raising the cost per physically produced garment to `22,000,000 / 80,000 = 275 XAF` per garment. [R12] [S1201] In Stage 3 (custody-eligibility filtering), suppose `y_eligible = 0.75` because one quarter of fabric rolls used conventional yarn during a supply gap or suffered an irreversible HIP-to-mass-balance downgrade under the Aid by Trade Foundation rules, leaving `Q_eligible = 80,000 * 0.75 = 60,000` garments and raising cost per custody-eligible garment to `22,000,000 / 60,000 = 366.67 XAF` per garment. [S06] [S07] In Stage 4 (final evidence-release gate), suppose `y_release = 0.8333` (5/6) because 10,000 eligible garments are held back from provenance claims due to an unconfirmed subcontractor tally and an unresolved cutting-room roll link, leaving `Q_released = 50,000` eligible released garments; the true unit traceability cost is `c_released = 22,000,000 / 50,000 = 440 XAF` per eligible released garment, which is exactly double the naive nameplate estimate of `220 XAF`. [S03] [S10] [S1201]

Break-even test: Against `c_released = 440 XAF` per released garment, the illustrative mid-case internal operational benefit of `150 XAF` per garment (from **Exhibit 53**, p. 194, with zero price premium) leaves an uncovered gap of `440 - 150 = 290 XAF` per released garment (or `14,500,000 XAF` per year across 50,000 garments). [S03] [S1201] To close that gap without assuming an uncontracted retail premium, the pilot must demonstrate either (a) higher custody and release yields (for example, raising `Q_released` to 150,000 garments across expanded lines, which lowers `c_released` to `146.67 XAF` per garment, below the `150 XAF` operational saving), (b) lower capture and reconciliation labour through simpler batch boundaries, or (c) a binding buyer co-funding or preferred-supplier volume commitment worth at least `290 XAF` per released garment. [S03] [S10] [S1201] These figures are illustrative arithmetic to demonstrate the decision method, not a forecast or observed GFT factory result. [S1201]

12.18 COMMERCIAL, FINANCING AND LEGAL BOUNDARIES GOVERN THE SCALE GATE

In GFT's governance sequence, the cost model, baseline measurement plan and vendor portability checklist developed in this chapter feed directly into the pilot challenge protocol in Chapter 13 and the gated expansion roadmap in Chapter 14. [S03]

[S27] Before any capital is committed to factory-wide roll-out, multi-site software licences or long-term assurance contracts, three institutional handoffs apply. [S14] [S27] [S1201]

First, regarding the **interactive modelling handoff (`unit-economics` and `build-or-buy`)**, the parametric cost equation, denominator hierarchy (`Q_nameplate` to `Q_released`) and vendor portability matrix specify the required input fields for GFT's educational `unit-economics` and `build-or-buy` web tools, where sponsors can substitute their own verified payroll rates, consumable quotes, audit fee schedules and pilot release yields. [S10] [S27] [S1201] Second, regarding **companion-paper handoffs (`wp02`, `wp07`, `wp09`, `wp12`, `wp13`, `wp14`, `wp15`, `wp17` and `wp18`)**, capital structure, discount rates, debt service and blended development-finance instruments belong to `wp13`; factory capacity utilisation and line efficiency belong to `wp15`; inventory buffer sizing belongs to `wp12`; operator training systems belong to `wp09`; power and offline edge resilience belong to `wp07` and `wp18`; enterprise data governance belongs to `wp14`; shop-floor KPI cadence belongs to `wp02`; and legal interpretation of EU ESPR delegated acts, green-claims rules and cross-border contracts belongs to `wp17`. [S14] [S17] [S27] Third, regarding the **pilot go/no-go gate**, if the bounded pilot in Chapter 13 shows that point-of-work capture delays production, that reconciliation residuals cannot be closed without excessive clerical overtime, or that upstream evidence access lowers `Q_released` below the commercial break-even threshold, the programme must redesign the claim boundary or simplify the custody model before purchasing enterprise software. [S02] [S03] [S1201]

> **EDUCATIONAL MODEL BOUNDARY AND PROFESSIONAL-ADVICE NOTICE**
>
> The cost equations, sensitivity matrices, benefit bounds and procurement checklists in this chapter are analytical and educational engineering specifications. They do not constitute investment, financial, legal, accounting or tax advice, and they do not report operating costs, realised savings or commercial quotes from an active GFT facility. [S1201] All monetary figures in XAF and US dollars, time-study minutes, lot sizes and release yields are illustrative teaching inputs unless explicitly attributed to a graded entry in the evidence register, where inherited source-text limitations remain in force. [R06] [R14] [R32] Industrial sponsors and investors must obtain binding supplier quotations, accredited certification-body fee schedules, site-specific pilot measurements and independent financial and legal advice before committing capital or entering commercial supply contracts. [S04] [S14] [S27]

Price the daily work of keeping a claim true before buying the screen that displays it.

CHAPTER SOURCE NOTES

S03 Textile Exchange. 2026-10-30.

S1201 UNECE / UN Transparency Protocol. 2026-10-30.

S06 Aid by Trade Foundation. 2025.

S01 International Organization for Standardization. 2020.

S02 ISEAL Alliance. 2025.

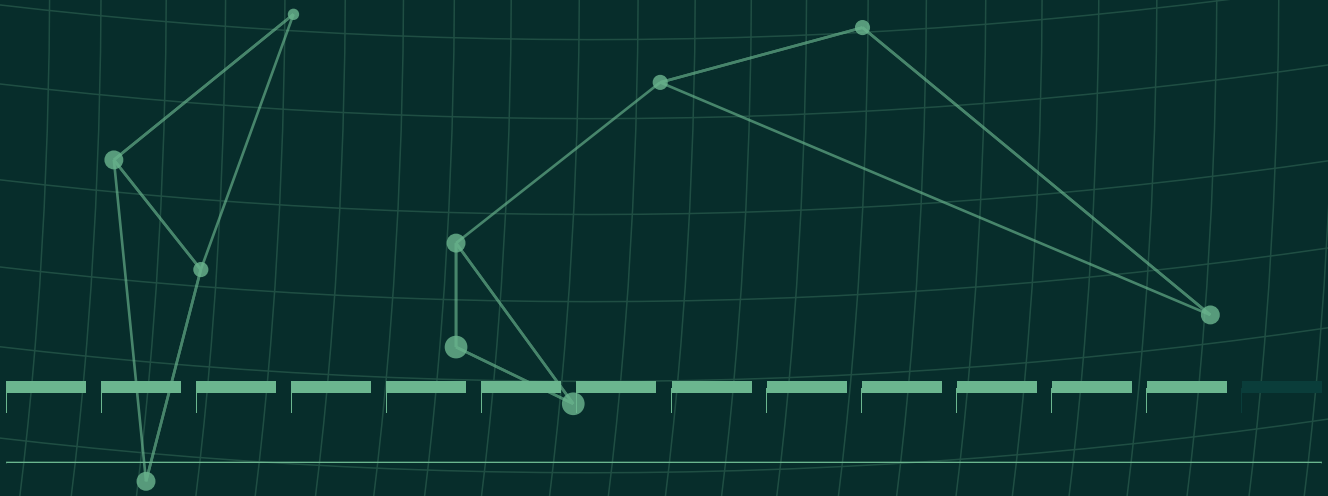
S10 GS1. 2022.
R06 Cameroon Trade Hub. Publication date unrecorded; inherited source-text check.
R07 Ecofin Agency. Publication date unrecorded; inherited source-text check.
S27 National Institute of Standards and Technology. 2024-11-01.
S05 Global Standards gGmbH. 2026-10-30.
S12 GS1. 2026.
S13 GS1. 2026.
S09 Cotton made in Africa / Sustainable Cotton Tracker. 2026-10-30.
S17 OECD. 2018-03-07.
R03 SODECOTON. Publication date unrecorded; inherited source-text check.
S24 World Wide Web Consortium. 2025-05-15.
S04 Textile Exchange. 2026-10-30.
S29 UNECE / UN Transparency Protocol. 2026-10-30.
R12 Business in Cameroon. Publication date unrecorded; inherited source-text check.
R09 Ecofin Agency. Publication date unrecorded; inherited source-text check.
R10 Ecofin Agency. Publication date unrecorded; inherited source-text check.
S07 Aid by Trade Foundation / Cotton made in Africa. 2026-10-30.
R32 Wise; XE. Publication date unrecorded; inherited source-text check.
R27 McKinsey, The State of Fashion 2025. Publication date unrecorded; inherited source-text check.
S18 World Trade Organization. 2026-10-30.
R14 WageIndicator. Publication date unrecorded; inherited source-text check.
R15 wage.is. Publication date unrecorded; inherited source-text check.
R16 WageIndicator. Publication date unrecorded; inherited source-text check.
S25 National Institute of Standards and Technology. 2018.
S28 UNECE / UN Transparency Protocol. 2026-10-30.
S11 GS1. 2022.
S21 World Wide Web Consortium. 2025-05-15.
S22 World Wide Web Consortium. 2022-07-19.
S1202 World Wide Web Consortium. 2026-03-18.
S14 European Commission, DG GROW. 2026-10-30.
S30 UNECE / UN Transparency Protocol. 2026-10-30.
S19 European Data Protection Board. 2026-10-30.
R04 Financial Fortune Media. Publication date unrecorded; inherited source-text check.
S20 International Labour Organization. 2026-10-30.
S26 National Institute of Standards and Technology. 2020.

13

PART IV: SCALE FOLLOWS DEMONSTRATED CONTROL / PROOF BEFORE SCALE

A pilot should fail on the same defects as a real shipment

Pilot success requires adverse cases, reproducible evidence and independently reviewed release decisions.



CHAPTER 13
DECISION TEST

Pilot success requires adverse cases, reproducible evidence and independently reviewed release decisions.

A traceability pilot should be judged by the claims it refuses, not by the speed of its dashboard. GFT proposes a bounded cotton-chain pilot that rehearses ordinary custody, injects the defects that could corrupt a real shipment and requires an independent reviewer to reconstruct affected claims from original evidence. A working interface is only one test object. The other objects are the genealogy, quantity ledger, evidence permissions, recovery procedure and release decision. Synthetic records can establish whether the design behaves as specified. They cannot establish the origin of actual cotton. No completed pilot, willing supplier group or operating GFT deployment is asserted here.

13.1

Select a chain whose claim can actually be tested

The pilot begins with a buyer question and a claim card, not a software shortlist. ISO describes chain of custody as applicable across materials and products, while ISEAL explains that custody models transfer materials and associated attributes through certified supply chains. [S01] [S02] GFT would therefore state the material, claimed attribute, geographic and temporal boundary, product unit, custody model, claimant and evidence owner before selecting identifiers or infrastructure. The question might be whether a defined garment batch can carry a bounded statement about the country in which its cotton was grown. That question does not automatically include customs origin, certified content, labour conditions or environmental performance.

A suitable first chain is narrow enough to reconstruct and real enough to contain consequential handovers. The proposed scope would name one product family, the participating receiving and processing boundaries, the relevant transformations and the final dispatch unit. It would include at least one conversion and one custody transfer, because a pilot confined to a single stock ledger cannot test genealogy across organisational boundaries. It would also state which activities remain outside the claim. Thread, trims, packaging and non-cotton components should not disappear into an ambiguous whole-product statement. The claim card must make those exclusions visible to the reviewer.

Participation is an entry condition rather than an assumption. Each proposed evidence holder would need to agree which original records can be inspected, which personal or commercially sensitive fields require restriction and who can explain an exception. GFT would not treat a verbal expression of interest as evidence access. The pilot charter should identify the accountable operating role, evidence approver, data steward and independent reviewer for every boundary. If a necessary upstream holder cannot provide admissible evidence, the team should narrow the claim or stop at that boundary rather than fill the gap with a default value.

The custody model must match the intended wording. A physically segregated chain and a quantity-allocation chain can produce different defensible statements even when they use the same event fields. The pilot charter should name the selected model, its scheme or contract version, permitted mixtures and the treatment of unknown inputs. It should also specify whether the observation unit is a bale group,

production lot, fabric roll, cutting batch or garment batch. A serialised garment can serve as a query key without implying that every earlier operation was observed at item level.

Initial volumes, durations and performance thresholds remain illustrative planning assumptions until the sites agree them. They should appear in a scope register with an owner and a reason, never as silent promises in a demonstration. The register should distinguish rehearsal fixtures from live evidence, and proposed release wording from wording approved for actual sale. During rehearsal, public-facing examples should carry a visible synthetic status. A real origin claim requires actual supply evidence and the ordinary release process, regardless of how convincing the rehearsal appears.

Scope control is itself a test. Adding another supplier, product family or claim during the exercise changes the expected genealogy and may invalidate earlier comparisons. GFT recommends a versioned scope baseline and a change record stating the reason, affected fixtures and required regression tests. The reviewer should be able to determine exactly which chain was evaluated. Expansion before the initial chain closes its adverse cases would conceal rather than resolve uncertainty.

13.2

Normal transactions establish the reference history

Ordinary transactions provide the control against which injected faults become meaningful. GS1 EPCIS provides visibility-event semantics, including transformations and aggregations, while the Core Business Vocabulary supplies shared business meanings used within those events. [S10] [S11] GFT would translate those concepts into a proposed fixture set covering receipt, storage, conversion, split, shipment, return and balance close. The mapping is a design choice to be tested. It is not a claim that every partner already uses EPCIS or that a particular scheme requires this implementation.

Each fixture needs an independently prepared expectation. Before the software processes a transaction, the test owner should record the expected input identifiers, output identifiers, custody state, quantity effect, evidence references and admissible claim. Another person should be able to prepare that expectation from the fixture narrative without seeing the system's answer. This separation prevents a demonstration from becoming circular, where the same event interpretation both produces and validates the result. The expected genealogy and expected quantity ledger are acceptance artefacts in their own right.

A receiving fixture should distinguish the physical observation from its later entry. The proposed record identifies the supplier, receiving site, material unit, observed quantity and basis, event time, recording time, actor, transport reference and source evidence. A storage fixture preserves the material identity while changing its location or custody status. A conversion fixture consumes declared inputs and creates declared outputs. A split changes the division of units without pretending that a new production process occurred. These distinctions give the reviewer a physical explanation for every digital transition.

The shipment fixture should pair dispatch and receipt rather than treat an invoice as proof of both. The return fixture should identify the original movement and the condition of the returned material, then apply the appropriate claim and quantity treatment. A balance-close fixture should reconcile opening quantity, receipts, consumption, outputs, returns, recorded losses and closing quantity on a compatible basis. Where a correction is required, the expected history retains the original observation and its authorised correction. Deleting the inconvenient event would remove the very evidence the pilot is meant to preserve.

Normal does not mean idealised beyond recognition. The reference set should include ordinary variations such as a document arriving after the material, a permitted roll split and an authorised return. Each variation needs a stated expectation so that the team can distinguish a supported exception from an uncontrolled defect. The pilot should not inject every fault at once. A stable reference history establishes that the basic chain works before a challenge case shows which control fails under pressure.

Synthetic fixtures are useful at this stage because their complete truth is known by construction. They allow the test owner to specify exactly which inputs were consumed, which quantities should remain and which claim should survive. That certainty belongs only to the exercise. When live capture begins, the reviewer must replace assumed truth with inspected evidence. A successful synthetic genealogy is not an origin certificate, and a balanced synthetic ledger is not proof of physical stock.

> **GFT NOTE**
>
> Freeze the expected genealogy, quantity ledger and claim outcome before demonstrating each fixture. Give the independent reviewer the source narrative and expected result in a separate pack. If the implementation and expectation disagree, preserve both and investigate. Never edit the expectation merely to make the demonstrated output pass.

The reference history also establishes the query cases used later. A reviewer should be able to ask which inputs support a garment batch, which outputs consumed a bale group, which evidence justified a release and which corrections changed the record. The expected answers should include absent and restricted information, not only successful paths. By defining these queries before fault injection, the pilot can test whether the system preserves a useful history when the answer becomes uncomfortable.

13.3

Adverse cases expose unsupported certainty

A pilot becomes useful when it deliberately creates a conflict between an attractive claim and the evidence available to support it. Textile Exchange describes verified tracking as a basis for credible, substantiated content claims, and the opened CmiA standard provides a scheme-specific example of controls for segregation, subcontracting, reconciliation and repeated claiming. [S03] [S06] GFT would use those control

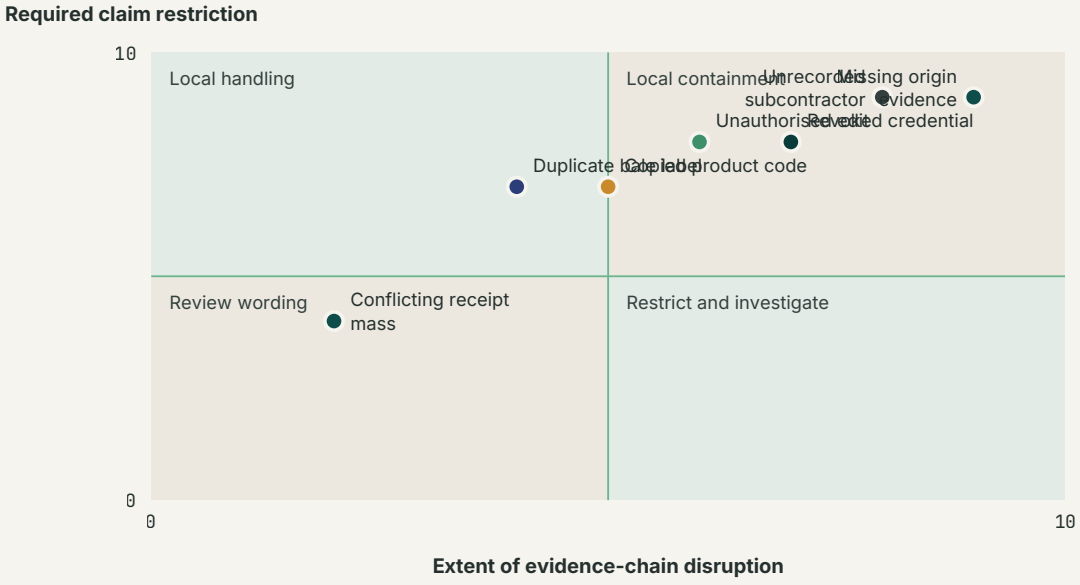
objectives to design adverse fixtures, without presenting the fixtures as evidence of a scheme audit. Each case needs a starting fixture, an injected fault, an expected detection, a required claim outcome, retained evidence and an accountable reviewer.

The central pass condition is behavioural: insufficient evidence must produce a restricted, rejected or explicitly inconclusive outcome. A service that remains available while releasing an unsupported origin statement has failed the important test. Conversely, a temporary processing delay is not necessarily a custody failure if the material remains controlled, the uncertainty stays visible and final release waits for the required evidence. The expected result must therefore address both system behaviour and claim wording.

Exhibit 55, p. 208 positions the proposed challenges according to the kind of disruption they create and the restriction the release owner should expect. The positions are categorical teaching aids, not risk scores. The executable detail sits in the fixture record and its expected evidence trail.

EXHIBIT 55 / ILLUSTRATIVE CATEGORICAL POSITIONS

Deliberate faults should force a visible claim decision



ILLUSTRATIVE [S03] [S06] [S10] [S12] [S23] [S24] [S26] Illustrative test-design map. Horizontal positions distinguish local record conflicts from broader evidence-chain disruption. Vertical positions distinguish ordinary exception handling from mandatory claim restriction. Coordinates are arbitrary placements, not probabilities, severity ratings or measured pilot results.

For a missing-origin fixture, the test owner removes or withholds the upstream evidence that the reference history used to justify its geographic statement. The expected system response is an unknown or unsupported origin state for the affected outputs. The test fails if a supplier default, previous shipment or country printed on a commercial document silently fills the gap. The retained record should identify exactly which proposition lacks support, when the gap was detected and which downstream claims were placed on hold.

For a duplicate-bale fixture, the same physical identifier is introduced against a second receipt or allocation. The expected control preserves both submissions, quarantines the identity conflict and prevents an additional eligible quantity from entering the claims ledger. Resolving the case requires original receiving evidence and an authorised linkage or correction. Assigning a fresh identifier without retaining the duplicate relationship would hide the defect. Deleting the later observation would also destroy information needed to establish what happened.

For an unrecorded-subcontractor fixture, material leaves the visible chain, undergoes a transformation and returns without the required processing-site and input-output records. The expected outcome is not a generic warning attached to an otherwise clean claim. The gap must propagate to the affected output genealogy and restrict its release. Subsequent documents can explain the operation only if the reviewer accepts them as evidence for the original event. A newly created record dated as though it had been captured at the time is not an acceptable substitute.

For a conflicting-mass fixture, dispatch and receipt report different quantities on a stated compatible basis, or their bases cannot yet be compared. The expected record retains both observations and their units, scales, packaging treatment and moisture context where relevant. The reviewer should investigate the difference rather than overwrite the smaller or larger value. The claim outcome depends on the selected custody and quantity rules, but an unexplained residual cannot be presented as reconciled. The fixture must also test that a later agreed correction preserves the initial mismatch.

The digital challenges require equally physical expectations. GS1 Digital Link defines URI syntax for identification keys. [S12] In a copied-code fixture, a valid address resolves to a genuine product record while the code is attached to a different test object. The expected control checks the object, batch and supporting custody evidence rather than treating successful resolution as authentication. A copied label should not inherit the original object's claim merely because both queries return the same page.

A revoked-credential fixture separates document integrity from current acceptability. W3C provides a mechanism for publishing credential status, while its Data Integrity work requires checks on proof purpose and the relevant verification relationship. [S23] [S24] The pilot should preserve the credential, record the authenticated status observation and apply the declared policy. Revocation should trigger the specified hold or rejection, not an assertion that the physical cotton has been proved falsely described. An unavailable status service should produce an inconclusive result where fresh status is a release requirement.

An unauthorised-edit fixture tests whether role and device permissions prevent a user from changing evidence outside that user's authority. NIST describes authentication and authorisation as discrete functions performed before access to an enterprise resource. [S26] The expected system preserves the attempted change, denies the operation and leaves the accepted evidence unchanged. If an edit is technically possible through an administrative route, the test should expose the missing governance control rather than celebrate the ability to repair data quickly. The release owner needs to know whether the displayed record is still the record that was reviewed.

13.4

Outage and recovery tests must preserve evidence

Connectivity loss should create pending digital work, not a new physical history. EPCIS distinguishes the time at which an event occurred from the context in which it was captured and exchanged. [S10] GFT's proposed outage fixture therefore begins with pre-issued identifiers and a controlled local queue. Operators record the physical observations through the approved fallback procedure, retain the source documents and restrict claim release where a required check cannot be completed. The exercise should show which work may continue and which decision must wait.

The first recovery case replays the queued records in their original event order. The reviewer compares the reconstructed genealogy with the expected history and checks that recording delays did not overwrite event times. A late upload should remain visibly late. Replacing an uncertain local timestamp with the server receipt time would make the history tidier while destroying relevant context. Where clocks disagree, the record should retain the offset or uncertainty and flag the ordering question for review.

The second recovery case submits the same queued event again. Repeated delivery must not create another transformation, dispatch or eligible allocation. The expected ingestion record links the duplicate to the original event identifier and explains why no additional business event was created. This is a test of idempotent processing and of the quantity ledger, not merely a check that the network accepted the message. The reviewer should compare physical history, claim balance and exception log after the replay.

A third case introduces events that arrive out of order. A transformation message may reach the service before an earlier receiving message, or a correction may arrive before the record it corrects. The pilot specification should state whether the system holds the incomplete sequence, accepts it with an explicit pending dependency or rejects it. Silent reordering without a retained receipt history would conceal the conflict. The expected final state must be justified by the physical evidence, not by whichever message happened to arrive last.

Recovery also means operating without the original service environment. NIST's supply-chain risk guidance addresses the identification, assessment and mitigation of risks surrounding suppliers and their services. [S27] GFT would require an export containing event history, evidence references, allocation records, corrections, access rules and relevant policy versions. The test team would restore that export into a separate controlled environment and ask a reviewer who did not perform the restore to reconstruct selected claims. A file download that no independent reader can use does not satisfy the objective.

The restore comparison should cover both content and meaning. Event identifiers, input-output links, quantities, claim states and correction relationships must match the approved source snapshot. Evidence links must resolve to the intended retained versions or produce a visible exception. Access rules must continue to protect

restricted records, and a public view must not become more informative merely because the restoration tool ignored its permissions. Any transformation required by the receiving environment should be documented and reversible for inspection.

A restore manifest should make that comparison executable. Before the exercise, the evidence owner lists every required collection, record class, policy version and restricted evidence item, including the expected relationships between them. The recovery operator signs over what was actually exported, while the independent reviewer signs over what could be retrieved and interpreted after restoration. Missing items remain explicit rather than disappearing from a revised manifest. The reviewer should also test a claim that depends on a correction and a restricted attachment, because restoring the main event stream alone would not prove that the release decision can still be defended. This procedure separates technical availability of a database from operational availability of the evidence needed to challenge or support a shipment.

Recovery time needs an operational definition before measurement. The proposed timer starts at the declared recovery exercise boundary and stops only when the agreed evidence set is available for independent querying, not when a login page appears. Verification time is measured separately from restoration. The pilot should record incomplete restores, unreadable evidence and manual work as results rather than exclude them from the narrative. No service-level result is available in this chapter; the purpose is to specify what a future pilot must time and disclose.

13.5

Acceptance criteria need denominators and accountable reviewers

An acceptance measure should tell the reviewer what was attempted, what was required and what happened to the exceptions. A percentage without its denominator can make a narrow demonstration look like chain-wide control. GFT proposes a metric dictionary prepared before live capture, with each numerator, denominator, source record, owner and review cadence stated in advance. The measures should cover evidence, quantities, queries and recovery rather than reward message volume or screen availability.

Exhibit 56, p. 212 specifies the proposed measures without populating results. Apart from the hard gate against unsupported release, numerical targets require agreement with the participating sites and a defensible baseline. A threshold chosen after seeing the results would not provide an independent test.

EXHIBIT 56 / ILLUSTRATIVE METRIC SPECIFICATION

Every acceptance measure needs a denominator and a decision use

Measure	Definition and denominator	Decision use
Custody-event completeness	Required events with admissible evidence divided by all required events	Expose missing history
Admissible-origin coverage	Supported output units divided by units for which origin release is requested	Bound the saleable claim
Unmatched handovers	Unresolved dispatch-receipt pairs divided by all required pairs	Contain transfer gaps
Reconciliation residual	Observed closing quantity minus modelled closing quantity on one basis	Investigate, not average away
Claim-query handling	Correct release, restriction and inconclusive outcomes divided by all attempted queries	Test decision behaviour
Restore fidelity	Matching required elements divided by all elements in the restore manifest	Accept or reject recovery
Independent reconstruction	Sampled claims reproduced from originals divided by all sampled claims	Confirm the evidence itself

ILLUSTRATIVE [S03] [S10] [S27] Illustrative acceptance dictionary, not observed results or universal thresholds. Required events come from the independently prepared scope and genealogy. The hard gate is no unsupported released origin claim. Other targets and warning bands remain to be agreed before live capture.

Completeness should be calculated against the required history, including events that the system never received. Using captured events as the denominator would make missing capture invisible. Origin coverage needs a product and quantity boundary that matches the requested claim. Reconciliation residuals need a sign convention and compatible mass basis, with measurement uncertainty discussed separately from administrative mismatches. Query handling should retain correct restrictions and inconclusive outcomes as successful control behaviour where the fixture requires them.

The hard gate is different from a performance average. No unsupported origin claim may be released in the accepted pilot evidence set. A high proportion of correct queries cannot compensate for one release that the evidence cannot support. Other measures may need thresholds, but those thresholds should reflect actual process variation, claim criticality and agreed operating capacity. They are not imported industry standards.

WORKED EXAMPLE: A HIGH AVERAGE CANNOT CANCEL AN UNSUPPORTED RELEASE

This illustrative acceptance exercise assumes 120 required custody events, of which 114 have admissible evidence and six remain incomplete. Event completeness is 114 divided by 120, or 95 percent. The denominator comes from the independent expected genealogy, not from the events that happened to reach the system. All counts are chosen solely to demonstrate the calculation.

The same illustrative fixture assumes opening stock of 200 kg plus receipts of 800 kg, good output of 760 kg, recoverable waste of 160 kg and recorded losses of 40 kg. Modelled closing stock is 200 + 800 - 760 - 160 - 40 = 40 kg. If observed closing stock is 36 kg on the same basis, the residual is 36 - 40 = -4 kg. This is an unexplained difference to investigate, not an accepted tolerance.

Finally, assume 40 attempted claim queries in this illustrative case. The system handles 39 correctly but releases one origin claim without sufficient evidence. Query handling is 39 divided by 40, or 97.5 percent, yet the pilot fails the proposed hard gate. The percentage remains useful for diagnosing behaviour, but it cannot dilute the unsupported release. None of these values is an observed pilot result.

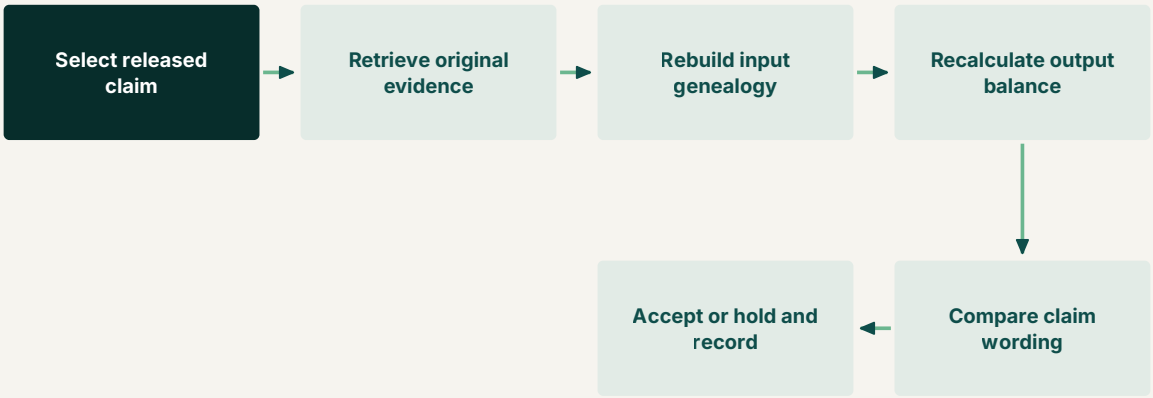
The reviewer should also examine whether the denominator changed during the test. Adding a supplier after a fault appeared, removing an incomplete fixture or reclassifying a failed query as out of scope can improve an average without improving control. Any justified scope change requires a versioned reason and a recalculation that preserves the earlier result. The acceptance pack should show both the original and revised populations so that the decision remains auditable.

Independent reconstruction tests the claim rather than the dashboard. GFT proposes a reviewer who did not build the fixture, enter the events or approve the original release. That reviewer receives the claim sample, scope version and access to original evidence, then prepares a fresh genealogy and quantity calculation. The sample selection and reasons should be retained, including risk-directed cases and cases drawn without relying on the release team's preferences. Independence here describes a pilot role, not an accreditation or external certification.

Exhibit 57, p. 214 shows the proposed review path. The reviewer works backwards from the released product unit to its admissible inputs, forwards through the relevant quantities and outputs, and finally compares the supported proposition with the disclosed wording.

EXHIBIT 57 / ILLUSTRATIVE REVIEW SEQUENCE

Independent reconstruction tests the claim itself



ILLUSTRATIVE [S03] [S10] Illustrative GFT review procedure based on custody evidence and event genealogy. The reviewer uses original records rather than dashboard status. A mismatch returns the claim to hold and creates a defect record. This is not an audit opinion or a completed pilot result.

A mismatch should identify the stage at which reconstruction diverged. Missing original evidence is not the same defect as an arithmetic error or an overbroad public sentence. The reviewer should record the evidence inspected, calculations repeated, inaccessible material and resulting decision. Reconstruction can show that the documented chain supports a bounded statement. It cannot establish facts outside the evidence boundary or turn a synthetic rehearsal into a live assurance engagement.

13.6

Failure should change the design before expanding scope

A defect register should explain which part of the control system failed. GFT proposes six categories: observation, identifier, quantity, semantic, assurance and disclosure. An observation failure concerns what was seen or documented at the physical boundary. An identifier failure breaks the link to a material unit. A quantity failure distorts a balance or allocation. A semantic failure gives a valid-looking event the wrong business meaning. An assurance failure concerns issuer, evidence or status. A disclosure failure publishes more than the accepted record supports.

Each defect needs a reproducible fixture, affected scope, containment decision, accountable owner and evidence of closure. The register should preserve the original result and the expected result before remediation begins. Root-cause analysis should ask why the control allowed the outcome, not merely which operator touched the record last. A missing upstream document may require a revised evidence agreement. A duplicate allocation may require a release-time constraint. An overbroad label may require a narrower claim rather than a software change.

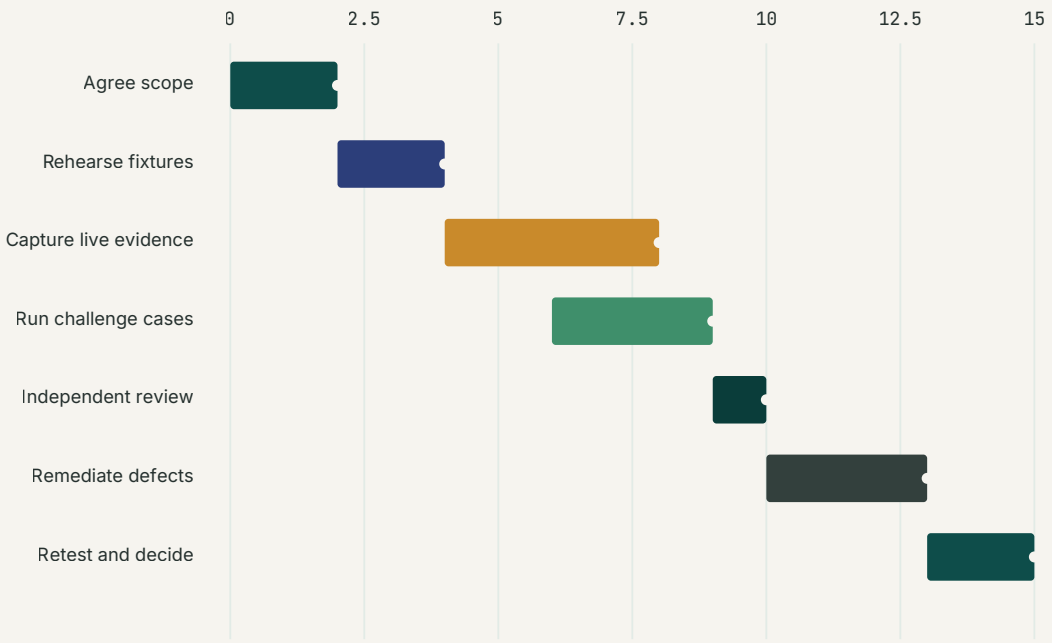
Containment comes before cosmetic repair. Where an unsupported claim may already have been disclosed, the proposed response is to hold further release, preserve the affected evidence, identify recipients and prepare a correction that states the remaining support. The incident owner should not quietly rewrite the genealogy to produce a clean demonstration. If the expected fixture was wrong, the reviewer should approve a reasoned change that cites the physical or contractual basis. The earlier expectation and result remain available for comparison.

Closure requires repetition, not attendance at a review meeting. The team should rerun the failed adverse case, the normal fixtures touching the same control and any related recovery case. The independent reviewer should repeat the affected reconstruction using the retained evidence. A defect can close only when the expected claim outcome, quantity effect and evidence trail all agree with the reviewed expectation. If the remedy is to narrow the claim, every affected view and export must carry that narrower boundary.

Exhibit 58, p. 215 places remediation and retest before any conditional expansion. Its relative positions make the sequence inspectable, but they are not a calendar commitment. Actual durations depend on site access, evidence availability and the time required to correct and repeat the failed cases.

EXHIBIT 58 / ILLUSTRATIVE RELATIVE WEEK FROM SCOPE APPROVAL

Scale waits for adverse-case closure



ILLUSTRATIVE [S03] [S10] [S27] Illustrative planning sequence only. Durations and overlaps are assumed for layout and method, not commitments or achieved milestones. Expansion is conditional on evidence access, independent review, defect remediation and successful repetition of affected cases.

The final decision memorandum should state the scope version, evidence cut-off, claims tested, hard-gate result, open defects, restore outcome and independent review conclusion. It should record a decision of go, hold or no-go, with named conditions and an accountable owner. Go means only that the agreed next scope may

proceed. It does not certify every product or supplier. Hold means evidence or remediation is incomplete. No-go means the proposed claim or control design should not proceed in its current form.

Unresolved limitations belong in that memorandum rather than in a footnote detached from the decision. Missing evidence access, untested partner exchange, residual manual work and unresolved claim wording can all restrict expansion. A simulated pass demonstrates the behaviour of a rehearsal. A source register documents the basis of a design. Neither establishes a deployed GFT capability, a certified supply chain or acceptance by a buyer. Scale remains conditional on the next chain meeting the same evidence standard.

A pilot earns expansion by refusing the claims that its evidence cannot carry.

CHAPTER SOURCE NOTES

S01 International Organization for Standardization. 2020.

S02 ISEAL Alliance. 2025.

S10 GS1. 2022.

S11 GS1. 2022.

S03 Textile Exchange. 2026-10-30.

S06 Aid by Trade Foundation. 2025.

S12 GS1. 2026.

S23 World Wide Web Consortium. 2025-05-15.

S24 World Wide Web Consortium. 2025-05-15.

S26 National Institute of Standards and Technology. 2020.

S27 National Institute of Standards and Technology. 2024-11-01.

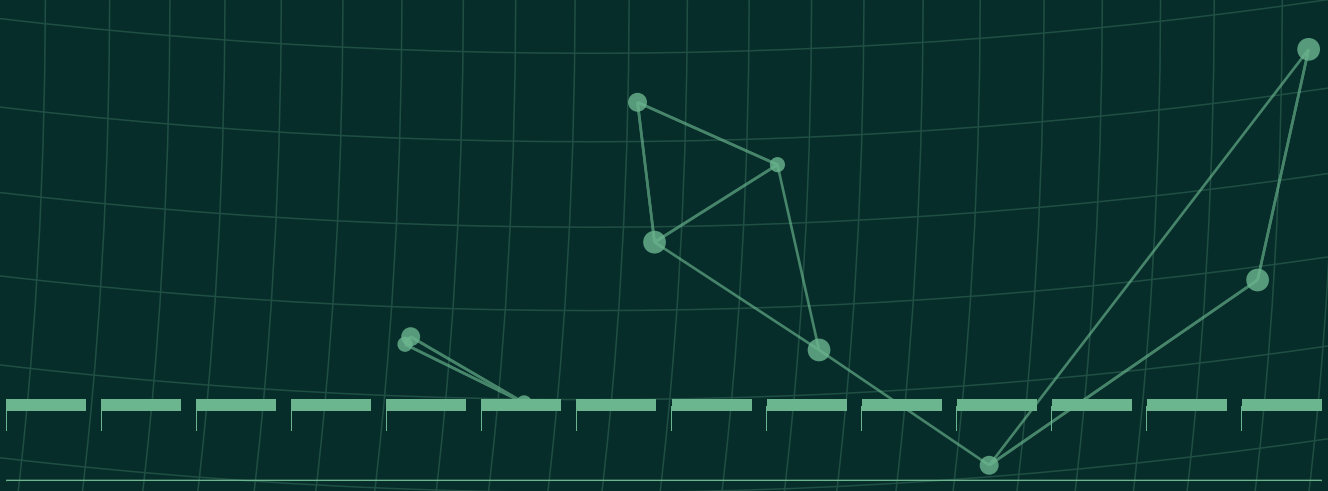
GREEN FUTURE TECH
LIMITED / HONG KONG SAR

14

PART IV: SCALE FOLLOWS DEMONSTRATED CONTROL / RECOMMENDATIONS

Scale only after the claim survives independent reconstruction

GFT recommends a staged programme in which every expansion follows demonstrated control of evidence, quantities and disclosure.



CHAPTER 14
DECISION TEST

GFT recommends a staged programme in which every expansion follows demonstrated control of evidence, quantities and disclosure.

GFT recommends scaling a claim, not scaling a promise. The saleable proposition, its custody model and its admissible evidence should be settled before labels or software are commissioned. A bounded implementation should then prove that another reviewer can reconstruct the claim from original records, repeat the quantity calculations and reach the same disclosure decision. Expansion becomes justified only after that review accepts the relevant normal and adverse cases. The recommended unit of growth is therefore a defined combination of claim, supplier boundary, process and product family. More traffic, more identifiers and more public pages are not evidence of control. This chapter sets out a proposed programme and decision framework. It does not report a completed pilot, an operating passport or a certified GFT supply chain.

14.1

Agree the saleable claim and the evidence boundary first

The first investment should be a claim card signed by the commercial owner and the evidence approver. ISO's public abstract places its chain-of-custody terminology across materials and products, while ISEAL explains that custody models transfer materials and their associated attributes. [S01] [S02] The practical consequence is that the attribute must be named before the model is chosen. The card should state the material, claimed characteristic, geographic boundary, production period, product unit, custody model, claimant, evidence owner and intended audience. It should also record what the statement deliberately excludes. A precise exclusion prevents a correct fibre statement from becoming an incorrect whole-product impression.

The buyer's question needs the same discipline. Country in which the cotton was grown, certified content, customs origin and fibre composition are different propositions. WTO describes rules of origin as criteria for determining a product's national source, while the Commission identifies fibre-composition labelling as a distinct textile requirement. [S18] [S34] Neither proposition is interchangeable with a documented growing location. The commercial owner should therefore record which buyer decision each statement must inform. If the buyer needs several answers, the programme should maintain several claim records with separate evidence mappings rather than broaden one convenient label.

A suitable claim card also distinguishes observation from allocation. A record can show that material passed through specified hands without proving every production characteristic that a marketing statement might assert. Textile Exchange links verified tracking to credible, substantiated content claims, but that still requires the relevant material, scope and transaction evidence. [S03] GFT would ask which proposition each document can carry, which proposition it cannot carry and who has authority to accept the difference. The answer belongs at claim level, not in a generic evidence folder.

14.2 THE CUSTODY MODEL AND SCHEME VERSION BELONG IN THE SALES DECISION

Custody selection is not an administrative detail left to the data team. The model determines which mixtures are permitted, which attributes can travel and when a stronger statement must be withdrawn. ISEAL's guidance provides the general model

vocabulary, while the opened CmiA documents show why edition control matters: the archived standard uses HIP language and the current webpage explains its move to Segregation terminology. [S02] [S06] [S07] The programme should freeze the applicable scheme, edition, contractual rule set and terminology for each proposed claim. A discrepancy between versions goes into the open-evidence register rather than being silently harmonised.

The evidence approver should test the proposed wording against failure cases before commercial approval. What happens when an input has no admissible origin record, when a processor changes, or when eligible quantity is allocated twice? The opened CmiA standard supplies scheme-specific controls for segregation, subcontracting, reconciliation and double claiming, including an irreversible downgrade from HIP to mass balance under that edition. [S06] Those rules should not be generalised to every scheme. They demonstrate why the claim card needs an explicit downgrade path and a rule for removing the stronger statement from every affected view.

Commercial and evidence approval should be separate even where one person temporarily holds both roles. The commercial owner confirms that the bounded statement answers a real buyer question. The evidence approver confirms that the stated records could support it. Operations confirms that the proposed custody model can be executed at the actual boundaries. A label designer or software supplier should receive only the agreed output of those decisions. Reversing this order would make the interface the de facto claim policy.

Before signature, the evidence approver should attempt a desk reconstruction with representative documents. The purpose is to discover whether the proposed wording can be linked to an issuer, material unit, period and process boundary without relying on verbal context. If the available sample supports only a broader geography or a weaker content statement, the team should rewrite the claim before commissioning capture. If no representative documents are available, the card remains proposed and the missing access becomes an explicit upstream validation task.

The signed claim card becomes the first acceptance artefact. Any later change to geography, product scope, scheme, custody model or public wording requires a versioned revision and a review of affected evidence. A commercial team may choose a narrower claim to make progress, but it may not describe that narrowing as proof of the original ambition. This discipline gives the programme a useful starting point: a statement whose value and evidential cost can both be assessed.

14.3

Build custody and quantity controls before public disclosure

The first working system should be a modest evidence pack, not a public passport with an elaborate front end. Textile Exchange describes tracking through the supply chain as the basis for substantiated content claims, and EPCIS provides a standard event model for recording transformations and other visibility events. [S03] [S10] GFT would begin with the receiving record, input-output genealogy, dispatch-receipt pair,

physical or temporal segregation record where required, quantity ledger, allocation ledger and release decision. Each record needs an accountable issuer, an observation time and a link to retained source evidence.

This minimum set follows the material rather than the organisation chart. A receiving clerk observes arrival and quantity. A production role records which inputs were consumed and which outputs appeared. A warehouse role preserves location and custody status. A quality or evidence role reviews exceptions. A release owner decides whether the exact proposed statement may leave the organisation. The records must meet at the same material identifiers and measurement bases. A complete database in each department cannot compensate for a broken link between them.

Quantity control should precede persuasive disclosure. The physical ledger must distinguish opening stock, receipts, consumption, good output, by-products, recorded losses and closing stock. The claims ledger must separately record eligible input, allocation, cancellation and remaining eligible balance under the selected rules. The CmiA standard's reconciliation and no-double-claim provisions offer a scheme-specific reason to keep these duties visible. [S06] A positive eligible balance is not proof that a particular garment contains fibre from a stated place. Conversely, a physically present lot is not automatically available for every certified-content statement.

The first implementation should also make correction ordinary. EPCIS includes error-declaration concepts, allowing a correction to be distinguished from a new physical event. [S10] GFT's proposed records would retain the original observation, the correction, its reason, its authoriser and the effect on genealogy, quantities and claim status. Unknown remains a distinct state. It must not be converted to zero, a default supplier country or a pass. Where the evidence needed for release is unavailable, the correct operational output is a hold or an explicitly inconclusive decision.

> **GFT NOTE**
>
> Approve the first release pack before approving a public page. Ask a reviewer who did not enter the records to take one proposed claim, retrieve the original evidence, rebuild the input-output history and repeat the quantity and allocation calculations. If the reviewer needs the dashboard to explain what the source records mean, keep the claim on hold and repair the evidence chain first.

Public disclosure should consume the approved state rather than maintain a separate editorial version of reality. The page, data export and buyer pack should draw on the same claim identifier and scope version. A later correction must propagate to each surface while preserving the earlier release history. If a public sentence needs qualification that the operating record cannot express, the field model is incomplete. If the operating record contains uncertainty that the public sentence hides, the disclosure control has failed.

A controlled evidence pack is also a better test of supplier participation than a demonstration portal. Proposed partners can show whether original records are accessible, whether roles can confirm a handover and whether exceptions have an owner before any consumer-facing design is commissioned. Their inability or unwill-

ingness to supply a necessary item is a scope result, not a data-entry inconvenience. GFT should respond by narrowing the claim, changing the evidence arrangement or stopping the affected pathway. It should not fill the gap with an attractive default.

14.4

Publish a prototype while keeping legal status explicit

A prototype can be useful now provided its legal and evidential status travels with it. As of 30 October 2026, the Commission says exact textile passport information requirements will be set through relevant delegated acts and supporting technical specifications, with adoption of the textile delegated act shown on an indicative timeline for Q4 2027. [S14] That planned adoption is not an application date or a settled field list. The Commission's implementation overview also describes the framework, consultation and technical preparation through which product rules develop. [S15] The programme should therefore maintain an as-of legal status register rather than print a future deadline on a present design.

The register should identify the instrument or working document, its publication or access date, the proposition it supports, the responsible reviewer and the next refresh trigger. It should separate current authoritative text, official explanation, indicative planning, working specification and GFT proposal. A procurement decision, buyer commitment or market-entry date can each require a fresh review. Where current consolidated legal texts or specialist interpretation are unavailable, the register should record that limitation beside the affected claim. This chapter provides a design method, not legal, investment or tax advice.

UNTP's passport specification is explicitly marked suitable for pre-production pilot implementations. [S28] GFT can use its working vocabulary to compare product properties, claims, evidence and upstream links, while freezing the exact version used in a prototype. That comparison does not establish EU conformity or legal recognition. The prototype's field dictionary should mark every entry as source-backed concept, proposed GFT field, restricted operational value or future requirement to confirm. An absent value, an unknown value and a deliberately withheld value need different representations.

The public prototype should show the claim boundary in plain language. A reader should be able to distinguish who makes the statement, to which product unit it applies, what evidence class supports it and which limitations remain. Restricted evidence can support a controlled buyer review without becoming public. The public page must not imply that hidden documents were independently inspected when they were not. Nor should a product identifier be presented as physical authentication: the object, its attached carrier and the custody record still need to correspond.

Credentials deserve the same restraint. W3C's Verifiable Credentials model separates issuer, holder and verifier roles, while Data Integrity requires attention to proof purpose and verification relationship. [S21] [S23] GFT would introduce signed credentials only where a real verifier needs portable issuer assertions, status handling and key governance. A signature can preserve an assertion and reveal alteration. It cannot repair an unsupported origin observation or turn an informal declaration into inde-

pendent assurance. If a controlled evidence pack answers the buyer's question, adding credential infrastructure would be a separate investment requiring its own gate.

Legal watch items should connect to operational decisions rather than sit in a policy annex. A change to composition terminology can affect the label owner. A change to passport requirements can affect the field dictionary and access model. A question about customs origin belongs with the applicable rule and specialist review, not with a generic provenance badge. [S18] [S34] The release checklist should require the responsible owner to confirm that no open legal item invalidates the proposed use. Where such an item remains, the prototype may continue as an explicitly labelled design exercise while actual claim release stays within the supported boundary.

14.5

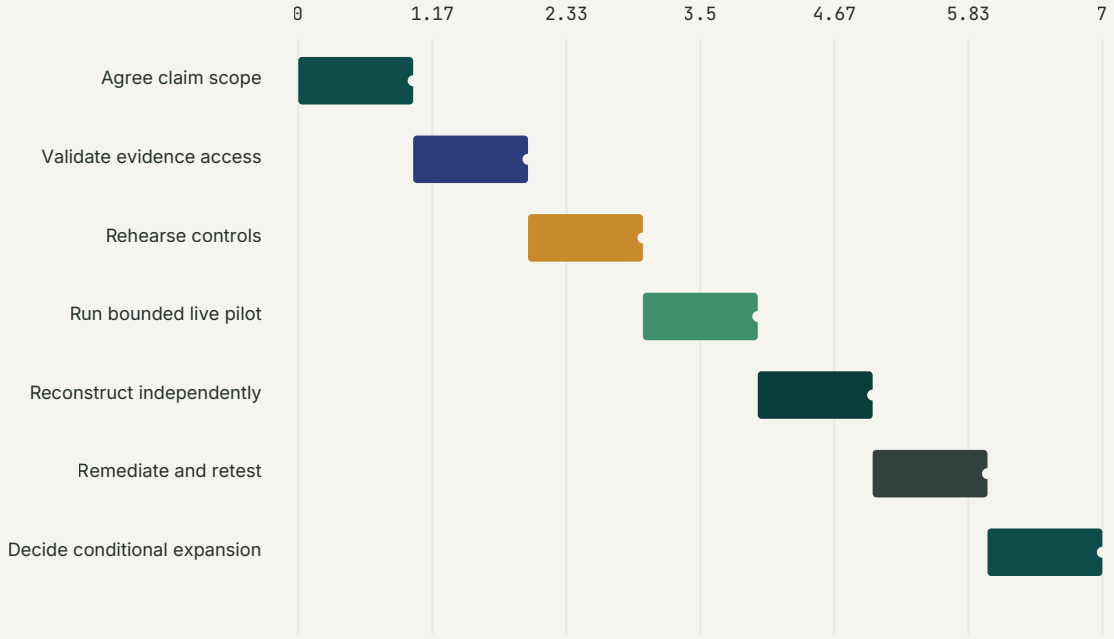
Advance through gates rather than an invented launch calendar

The programme should advance when evidence changes, not when a calendar page turns. GFT proposes a sequence of scope agreement, upstream evidence validation, control rehearsal, bounded live capture, independent review, remediation and conditional expansion. Each stage produces an artefact that the next stage must accept. Elapsed time can reveal operating workload and delay, but it is not a pass criterion. A supplier that cannot provide admissible records after months of discussion has not nearly passed. It has established a constraint that the scope decision must address.

Exhibit 59, p. 223 shows the ordering without assigning weeks, calendar dates or a launch commitment. Equal intervals are sequence positions only. The live pilot begins after evidence holders and expected controls are identifiable, while expansion begins only after the review and any required retest have closed. Actual durations remain to be agreed with participating organisations.

EXHIBIT 59 / ILLUSTRATIVE RELATIVE GATE POSITION

Evidence gates determine the implementation sequence



ILLUSTRATIVE [S03] [S06] [S10] [S27] Illustrative programme sequence. Each interval is one ordering position, not a week, month, elapsed-time estimate or commitment. Expansion is conditional on evidence access, independent reconstruction, adverse-case closure and an accepted decision memorandum.

Scope agreement ends with the signed claim card, custody-model decision, scheme version and named operating roles. Upstream evidence validation ends with an inventory of actual records, access permissions, known gaps and the person able to explain each boundary. Control rehearsal ends with an independently prepared expected genealogy, expected quantity ledger and expected claim outcomes for normal and adverse fixtures. None of these artefacts requires a public interface. Together they show whether the proposed live test has a meaningful expectation against which to judge it.

The bounded live stage should use real operating evidence within the agreed claim scope. Its output is not simply a populated database. It is a release pack containing source references, exception records, reconciliations, corrections and the decisions made by accountable roles. The independent reviewer then reconstructs selected claims without relying on the release team's dashboard state. NIST's supply-chain risk guidance also supports reviewing supplier and service dependencies, which makes evidence export and recovery part of the same review rather than a later technical exercise. [S27]

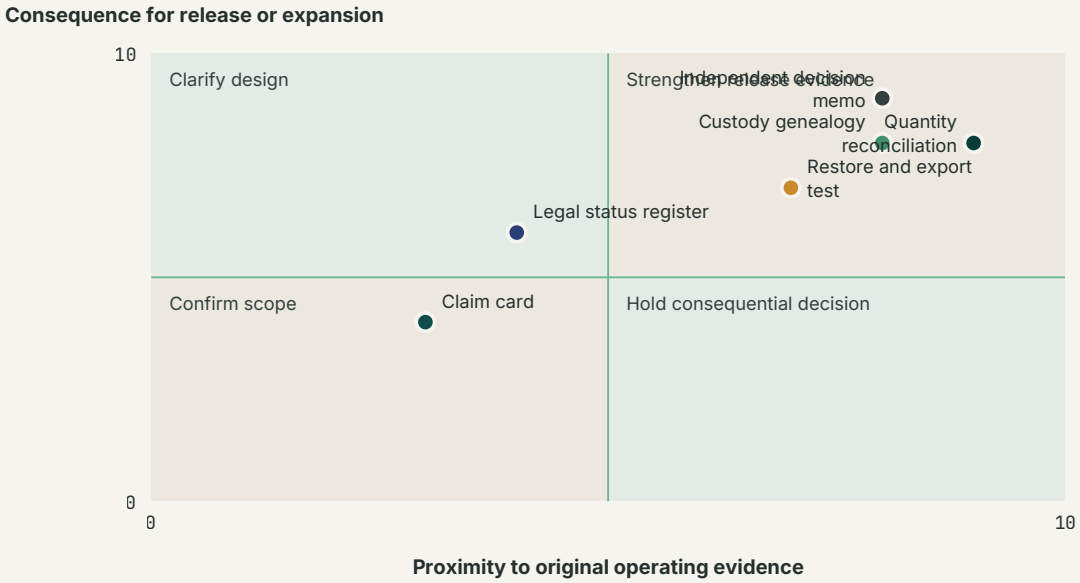
Remediation can change the claim, procedure, record model or technology. It must not merely change the expected result. A failed case is repeated together with the normal cases touching the same control, and the reviewer repeats the affected reconstruction. Expansion is considered only when the relevant adverse outcomes are

accepted and no unsupported claim remains released within the reviewed scope. A remedy that narrows the claim can be valid, but every affected buyer pack, export and public statement must adopt that narrower boundary.

Exhibit 60, p. 224 links the principal decisions to inspectable artefacts. The coordinates express categorical differences in evidence proximity and decision consequence. They are not maturity scores, probabilities or supplier ratings.

EXHIBIT 60 / ILLUSTRATIVE CATEGORICAL POSITIONS

Each scale decision requires a reviewable artefact



ILLUSTRATIVE [S03] [S06] [S10] [S14] [S27] Illustrative gate map. Horizontal positions run from derived presentation towards original operating evidence. Vertical positions run from design effect towards release or expansion effect. Coordinates are arbitrary placements, not measured readiness or assurance scores.

Artefact acceptance needs a named recipient as well as a named producer. Operations should not mark its own procedure accepted merely because the form exists. The evidence approver receives the genealogy and release pack, the quality owner receives the reconciliation, the service owner receives the restore manifest and the commercial owner receives the final claim wording. The independent reviewer records whether these artefacts agree with one another. Conflicting versions remain open until a controlled revision explains which record governs and why.

The decision memorandum is the final artefact at each expansion gate. It should state the approved claim and scope version, evidence cut-off, participating boundaries, claims sampled, calculations repeated, adverse cases tested, restore result, open defects and unresolved legal or commercial questions. The reviewer should record which original evidence was accessible and which was restricted or unavailable. The decision must be limited to the next stated scope. It must not certify every product from a supplier or every future claim made by the same system.

A go decision authorises only the specified expansion. A hold decision keeps the present scope while named evidence or remediation is completed. A no-go decision rejects the current claim or control design and requires reconsideration before further

operating expenditure. Each decision needs an accountable executive owner, an evidence approver and a review date or trigger. The memorandum should also record dissent where operations, commercial and evidence roles do not reach the same conclusion. A tidy unanimous summary would conceal the uncertainty that the gate exists to expose.

14.6

GFT would measure evidence quality and the cost of keeping it

The scale scorecard should measure whether evidence remains usable under ordinary work. Textile Exchange's tracking and reconciliation objectives, GS1's event model and NIST's supplier-risk guidance point towards different parts of that question: admissible records, shared event meaning and recoverable service dependencies. [S03] [S10] [S27] GFT would combine them in one operating dictionary. Every metric needs a unit, numerator, denominator, source record, owner and review cadence before results are collected. The dictionary must also state which decisions a metric can influence and which hard gate it cannot override.

Exhibit 61, p. 226 provides the proposed starting template. Its initial value is unmeasured, not zero. Zero would assert that a defined population was observed and no exception existed. Unmeasured means that the required observation has not yet been made. This distinction is especially important for duplicate allocations and contradictions, where an empty dashboard may simply mean that no reliable detection or review has occurred.

EXHIBIT 61 / ILLUSTRATIVE METRIC SPECIFICATION

The scorecard distinguishes missing evidence from zero failures

Measure	Unit, calculation and denominator	Source and accountable role	Proposed review
Event completeness	Percent, evidenced required events divided by all required events	Expected genealogy, data steward	Each release cycle
Origin coverage	Percent, supported units divided by units requesting origin release	Claim register, evidence approver	Each release cycle
Unmatched handovers	Count and percent of all required dispatch-receipt pairs	Transfer log, receiving owner	Weekly and at close
Allocation exceptions	Count of duplicate attempts and unresolved contradictions	Allocation log, evidence approver	Each release cycle
Quantity residual	Mass by compatible basis, observed less modelled closing quantity	Quantity ledger, quality owner	Each balance close
Retrieval and correction	Elapsed time per sampled request and per open correction	Review log, data steward	Monthly
Capture effort	Work time per required event and per corrected event	Time study, operations owner	Each pilot review
Control cost	XAF per evidence-supported released garment, using stated cost allocation	Cost workbook, commercial owner	Each investment gate
Restore fidelity	Percent, readable required elements divided by all manifest elements	Restore manifest, service owner	Each recovery exercise

ILLUSTRATIVE [S03] [S10] [S27] Illustrative operating scorecard. Populations and cadences are proposals to be agreed before live capture. No performance result, tolerance or industry benchmark is supplied. Unknown remains distinct from zero.

The denominator must come from the required history rather than the records that happen to be present. Event completeness uses the independently expected genealogy. Origin coverage uses all units for which the statement was requested, including units later held back. Unmatched handovers retain both sides of the transfer and their discrepancy state. Quantity residuals retain the sign convention, mass basis and measurement uncertainty. Removing difficult units from these denominators would improve the reported result without improving the evidence.

Operational measures show whether control can survive expansion. Evidence retrieval time starts with a defined reviewer request and ends when the required readable evidence is available, not when a search screen returns. Capture effort includes original entry and later correction, separated so that a fast but error-prone process does not appear cheap. Correction delay remains visible alongside the number of correc-

tions. Control cost uses evidence-supported released garments as its denominator and includes the recurring human work specified in the commercial chapter, rather than dividing software expenditure by nameplate production.

Recovery needs a similarly strict outcome. A restore exercise succeeds only when the required event history, evidence references, allocations, corrections, policies and access rules can be read and interpreted in the receiving environment. The manifest supplies the denominator. A service being online is not equivalent to a claim being reconstructable. Where a restore is partial, the missing elements stay on the scorecard and the affected release or expansion decision remains held.

WORKED EXAMPLE: SCALE THE SUPPORTED ENVELOPE, NOT THE REQUESTED VOLUME

This illustrative decision case assumes that a buyer requests a country-of-cotton-growing statement for 1,200 garments spanning two product families. Review finds complete required custody and origin evidence for 1,080 garments in Family A. The remaining 120 garments in Family B pass through an unconfirmed subcontracting boundary. The illustrative admissible-origin coverage is 1,080 divided by 1,200, or 90 percent of requested units. These values are chosen only to demonstrate the release calculation.

The illustrative decision is not to describe the whole request as 90 percent traceable and release every garment. Family B's 120 units remain held, and their uncertainty is not averaged across Family A. Family A can enter the independent release review only for its stated country claim and only if quantity reconciliation, adverse-case results and disclosure review also pass. The supported release envelope is therefore smaller than the requested commercial envelope. No observed pilot result is implied.

The illustrative expansion decision is equally bounded. A reviewer may accept the defined Family A pathway while refusing to add Family B or another supplier until its missing evidence is resolved. The scorecard retains 1,200 requested units as the coverage denominator until a versioned scope change is approved. If the buyer later accepts a narrower claim for Family B, that new wording needs its own claim card and evidence decision. Arithmetic clarifies the boundary; it cannot create the missing subcontractor record.

A hard gate sits above these averages. One unsupported origin release cannot be offset by fast retrieval elsewhere or a high completeness percentage. Other thresholds should be agreed from actual process variation, claim criticality and operating capacity before live capture. The programme should retain the raw counts and exception log beside every percentage so that reviewers can inspect whether reclassification, exclusion or late arrival changed the result. A metric that cannot change a decision is reporting overhead and should be removed or redesigned.

14.7

The next investment depends on what the pilot proves

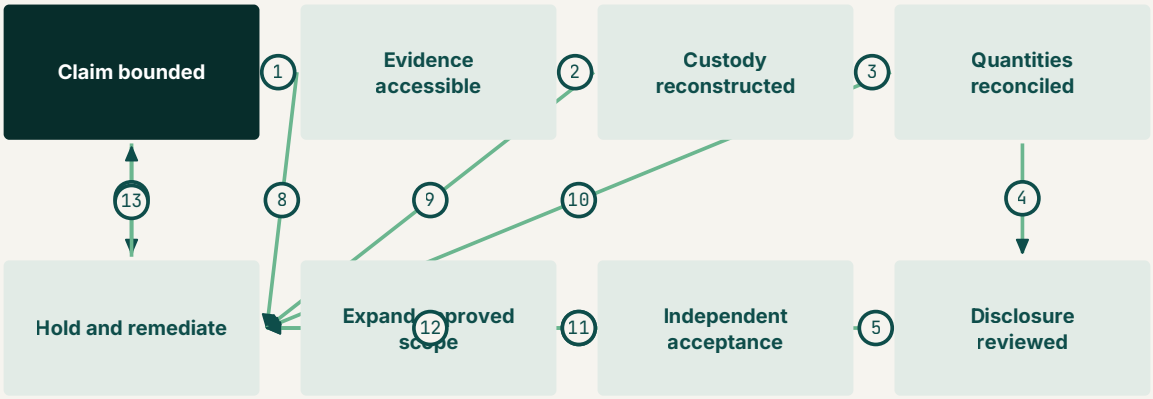
The next investment should follow a demonstrated control boundary, not confidence accumulated through presentation. Independent reconstruction must support the exact claims proposed for expansion, and the adverse cases relevant to the new

scope must produce the required release, restriction or inconclusive outcome. Financial benefit remains conditional until actual capture effort, correction work, evidence retrieval, operating cost and buyer response have been measured. A technically successful rehearsal can justify a live pilot. It cannot by itself justify a multi-supplier roll-out or a price assumption.

Exhibit 62, p. 228 makes the expansion logic explicit. Failure at any gate leads to containment and remediation rather than a weaker version of the same public statement. The approved expansion inherits the reviewed claim boundary. It does not inherit permission to add a new origin, certification or customs proposition without another evidence review.

EXHIBIT 62 / ILLUSTRATIVE DECISION SEQUENCE

The programme expands only after demonstrated control



1. Yes
2. Yes
3. Yes
4. Yes
5. Yes
6. Yes
7. No
8. No
9. No
10. No
11. No
12. No
13. Retest revised scope

ILLUSTRATIVE [S03] [S06] [S10] [S14] [S27] Illustrative GFT decision rule. A No at any gate holds the affected claim and creates a remediation record. Independent acceptance covers only the reviewed scope and evidence cut-off. This is not a completed implementation or certification decision.

An expansion proposal should name what will change and what will remain fixed. Adding volume within an accepted supplier, process, product and claim pathway is different from adding a supplier, transformation, country assertion or custody model.

Each change can alter the required evidence and the failure modes. The decision memorandum should identify the new acceptance artefacts and regression cases before expenditure is authorised. Where the proposal depends on a new service provider, export, restoration and exit evidence belong in that same gate. [S27]

The open-evidence register prevents unanswered questions from disappearing behind a conditional approval. It records the evidence needed, the decision blocked and the accountable role. The register below is a proposed starting point, not a statement that any supplier, buyer, laboratory or authority has agreed to participate.

Exhibit 63, p. 229 carries forward the principal unknowns. Closing an item requires inspected evidence and a recorded decision, not merely a newer webpage or a verbal assurance. Some closures may narrow the commercial opportunity. That is a useful result because it prevents investment in a claim that cannot be defended.

EXHIBIT 63 / ILLUSTRATIVE DECISION REGISTER

Open evidence determines which investment remains blocked

Open question	Evidence required to close it	Decision blocked	Accountable role
Will evidence holders participate?	Signed scope, record access and exception contacts	Live pilot boundary	Programme owner
What does each certificate cover?	Current issuer, site, activity, material, validity and transaction evidence	Certified-content claim	Evidence approver
Can testing corroborate origin?	Qualified method, relevant references and blinded results	Any assay-supported statement	Quality owner
What will control cost?	Observed effort, corrections, quotations and released-volume denominator	Recurring operating investment	Commercial owner
What does the buyer require?	Claim-specific acceptance criteria and evidence review	Saleable wording and benefit case	Commercial owner
Which legal rules apply?	Current authoritative texts and specialist interpretation	Conformity or customs assertion	Legal reviewer
Can records survive service change?	Readable export, restore test, access rules and exit terms	Provider or platform expansion	Service owner

ILLUSTRATIVE [S03] [S05] [S14] [S15] [S18] [S27] [S33] Illustrative open-evidence register for a proposed programme. No supplier participation, certificate scope, assay performance, buyer acceptance, actual cost or final legal requirement is asserted. Owners are roles, not named people.

Origin testing illustrates why an open item must remain bounded. The opened isotope review abstract describes a potential route for geographic-origin corroboration, but it does not establish a Cameroon-specific classifier or accuracy for this proposed chain. [S33] Investment in testing would therefore begin with a qualification design and

suitable reference material, not a claim of country exclusion. An inconclusive result must remain an allowed outcome. Laboratory evidence would join, rather than replace, custody and quantity records.

Certificate review requires the same specificity. Textile Exchange and Global Standards distinguish organisational or processing certification from transaction evidence in their published overviews. [S03] [S05] A current certificate must be checked for the actual site, activity, material and claim scope before it influences a release decision. No GFT or proposed supplier certification follows from the existence of a scheme or from participation in a design exercise.

The final investment memorandum should make the remaining uncertainty legible to a decision-maker. It should state what the independent reviewer reconstructed, which claims remained held, what the operating work cost, which supplier or service dependencies were tested and which open items could still reverse the case. Professional legal, financial and tax advice remains necessary where those matters affect an actual commitment. The programme should prefer a smaller defensible claim with known operating work to a broader claim whose evidence and recurring cost are still speculative.

This is the Warp and Signal discipline applied to growth. Production creates the material history, and measurement preserves the part of that history needed to defend a product statement. The first expansion is earned when both survive independent reconstruction. Wider production economics, infrastructure, circularity, trade and legal questions remain with their companion papers. Within this paper's boundary, GFT's recommendation is deliberately conservative: publish only the supported proposition, retain every limitation and make the next investment reproduce the control at its new boundary.

Scale the evidence that survives reconstruction, never the claim that merely attracts it.

CHAPTER SOURCE NOTES

S01 International Organization for Standardization. 2020.

S02 ISEAL Alliance. 2025.

S18 World Trade Organization. 2026-10-30.

S34 European Commission, DG GROW. 2026-10-30.

S03 Textile Exchange. 2026-10-30.

S06 Aid by Trade Foundation. 2025.

S07 Aid by Trade Foundation / Cotton made in Africa. 2026-10-30.

S10 GS1. 2022.

S14 European Commission, DG GROW. 2026-10-30.

S15 European Commission. 2026-10-30.

S28 UNECE / UN Transparency Protocol. 2026-10-30.

S21 World Wide Web Consortium. 2025-05-15.

S23 World Wide Web Consortium. 2025-05-15.

S27 National Institute of Standards and Technology. 2024-11-01.

S05 Global Standards gGmbH. 2026-10-30.

S33 Jin, Shi and Wang / Taylor & Francis, hosted by Hong Kong Polytechnic University. 2026.

Provenance travels with the claim.

Available inherited records and all chapter-local source records are graded below. Identical source identities are consolidated without losing citation aliases. Missing annex references are excluded. Unrecorded dates are disclosed rather than invented.

R01 Inherited evidence R01 GRADE C

Business in Cameroon. Publication date unrecorded. businessincameroon.com

Cameroon seed-cotton production 2022-2024: 330,000 t (2022), 314,455 t (2023), about 340,000 t (2024).

Inherited source-text check; original source not independently re-opened for this edition.

R02 Inherited evidence R02 GRADE C

Fibre2Fashion; Business in Cameroon. Publication date unrecorded. fibre2fashion.com; businessincameroon.com

2025 seed-cotton projection above 350,000 t.

Inherited source-text check; original source not independently re-opened for this edition.

R03 Inherited evidence R03 GRADE C

SODECOTON. Publication date unrecorded. sodecoton.cm

Company profile: more than 220,000 cotton producers supported in northern Cameroon; nine ginning plants; two oil mills.

Inherited source-text check; original source not independently re-opened for this edition.

R04 Inherited evidence R04 GRADE C

Financial Fortune Media. Publication date unrecorded. financialfortunemedia.com

SODECOTON injects roughly US$100 million a year into rural communities.

Inherited source-text check; original source not independently re-opened for this edition.

R05 Inherited evidence R05 GRADE C

Ecofin Agency. Publication date unrecorded. ecofinagency.com

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R06 Inherited evidence R06 GRADE C

Cameroon Trade Hub. Publication date unrecorded. cameroontradehub.cm

About 95 percent of cotton fibre exported raw against 5 percent processed locally; industrialisation target of 50 percent local processing.

Inherited source-text check; original source not independently re-opened for this edition.

R07 Inherited evidence R07 GRADE C

Ecofin Agency. Publication date unrecorded. ecofinagency.com

SND30 restates the 50 percent local-processing target by 2030.

Inherited source-text check; original source not independently re-opened for this edition.

R08 Inherited evidence R08 GRADE C

Business in Cameroon. Publication date unrecorded. businessincameroon.com

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R09 Inherited evidence R09 GRADE C

Ecofin Agency. Publication date unrecorded. ecofinagency.com

Camtext SA integrated cotton-to-textile project, US$300 million (180 billion XAF); Panafritex and Arise with SODECOTON, CNPS and Marlo; 12 November 2025.

Inherited source-text check; original source not independently re-opened for this edition.

R10 Inherited evidence R10 GRADE C

Ecofin Agency. Publication date unrecorded. ecofinagency.com

Camtext SA: 12,000 t a year processed; about 12,000 jobs at the Dibamba hub and 3,000 at Garoua; return on investment near 11 years; optimal capacity around 2033.

Inherited source-text check; original source not independently re-opened for this edition.

R11 Inherited evidence R11 GRADE C

Business in Cameroon; MMI News. Publication date unrecorded. businessincameroon.com; mimimefoinfos.com

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R12 Inherited evidence R12 GRADE C

Business in Cameroon. Publication date unrecorded. businessincameroon.com

CICAM capacity utilisation, July 2023 report: Garoua 33.7 percent, CICAM 1 48.9 percent, CICAM 2 10.83 percent; underutilisation cost about CFAF 2 billion in 2020.

Inherited source-text check; original source not independently re-opened for this edition.

R13 Inherited evidence R13 GRADE C

Business in Cameroon; MMI News. Publication date unrecorded. businessincameroon.com; mimimefoinfos.com

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R14 Inherited evidence R14 GRADE C

WageIndicator. Publication date unrecorded. wageindicator.org

Cameroon minimum wage (SMIG) XAF 41,875 a month in 2023, raised to XAF 43,969 a month from 23 February 2024, about US$76, a rise of 5 percent.

Inherited source-text check; original source not independently re-opened for this edition.

R15 Inherited evidence R15 GRADE C

wage.is. Publication date unrecorded. wage.is/cameroon

Average salary across sectors in Cameroon about US$359 a month.

Inherited source-text check; original source not independently re-opened for this edition.

R16 Inherited evidence R16 GRADE C

WageIndicator. Publication date unrecorded. wageindicator.org

Informal share of employment about 90 percent; standard 40-hour week, 48-hour maximum, overtime at 1.2 times.

Inherited source-text check; original source not independently re-opened for this edition.

R17 Inherited evidence R17 GRADE C

just-style. Publication date unrecorded. just-style.com

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R18 Inherited evidence R18 GRADE B

Congressional Research Service IF10149; AGOA (Wikipedia). Publication date unrecorded. congress.gov; en.wikipedia.org

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R23 Inherited evidence R23 GRADE C

MacMap; AfCFTA. Publication date unrecorded. macmap.org

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R24 Inherited evidence R24 GRADE C

Mordor Intelligence. Publication date unrecorded. mordorintelligence.com

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R25 Inherited evidence R25 GRADE C

Market.us. Publication date unrecorded. market.us

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R26 Inherited evidence R26 GRADE C

Statista. Publication date unrecorded. statista.com

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R27 Inherited evidence R27 GRADE B

McKinsey, The State of Fashion 2025. Publication date unrecorded. mckinsey.com

AI at scale in fashion: inventory cost down 35 to 40 percent; forecast accuracy up 20 to 30 percent; revenue per customer up 15 to 25 percent; forecast errors cut 20 to 50 percent; lost sales down up to 65 percent; 75 percent of executives prioritising; sector operating-profit potential US$150 to 275 billion over three to five years.

Inherited source-text check; original source not independently re-opened for this edition.

R28 Inherited evidence R28 GRADE C

DataIntelo. Publication date unrecorded. dataintelo.com

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R29 Inherited evidence R29 GRADE C

MDPI; industry inspection literature. Publication date unrecorded. mdpi.com

Manual defect inspection 60 to 70 percent accurate, missing 20 to 30 percent of defects; computer vision above 90 percent across more than 40 defect types; line-scan inspection up to 60 metres a minute.

Inherited source-text check; original source not independently re-opened for this edition.

R30 Inherited evidence R30 GRADE C

Design Journal (Taylor and Francis). Publication date unrecorded. tandfonline.com

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R31 Inherited evidence R31 GRADE C

arXiv 2509.04705. Publication date unrecorded. arxiv.org/abs/2509.04705

Source metadata retained for traceability. This entry is not cited in the chapter text.

Inherited source-text check; original source not independently re-opened for this edition.

R32 Inherited evidence R32 GRADE C

Wise; XE. Publication date unrecorded. wise.com; xe.com

CFA franc to US dollar reference rates; franc pegged to the euro at 655.957. The GFT study's method note places the franc near 590 to 610 per US dollar across the 2023 study window and near 563 to 577 more recently, and treats currency conversions as estimates.

Inherited source-text check; original source not independently re-opened for this edition.

c01-S01 ISO 22095:2020: Chain of custody, General terminology and models GRADE A

International Organization for Standardization. 2020. https://www.iso.org/standard/72532.html

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S02 Chain of Custody Models and Definitions Guidance GRADE B

ISEAL Alliance. 2025. https://isealalliance.org/what-we-do/systems-effectiveness/traceability/chain-custody-models-and-definitions-guidance

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S03 The Content Claim Standard GRADE B

Textile Exchange. 2026-10-30. https://textileexchange.org/content-claim-standard/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S04 The Organic Content Standard GRADE B

Textile Exchange. 2026-10-30. https://textileexchange.org/organic-content-standard/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S05 GOTS: Key features GRADE B

Global Standards gGmbH. 2026-10-30. https://global-standards.org/our-standards/gots/key-features

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S06 Transparency Standard, Version 1.0 GRADE B

Aid by Trade Foundation. 2025. https://cottonmadeinafrica.org/wp-content/uploads/AbTF_TransparencyStandard_Version1_6.2025.pdf

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S07 How Do We Track Every Fibre? GRADE B

Aid by Trade Foundation / Cotton made in Africa. 2026-10-30. https://cottonmadeinafrica.org/traceability/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S10 EPCIS Standard, Release 2.0 GRADE A

GS1. 2022. https://ref.gs1.org/standards/epcis/2.0.0/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S11 Core Business Vocabulary Standard, Release 2.0 GRADE A

GS1. 2022. https://ref.gs1.org/standards/cbv/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S12 GS1 Digital Link Standard: URI Syntax, Release 1.7.0 GRADE A

GS1. 2026. https://ref.gs1.org/standards/digital-link/uri-syntax/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S14 Textile Apparel and the Digital Product Passport (DPP) GRADE A

European Commission, DG GROW. 2026-10-30. https://single-market-economy.ec.europa.eu/single-market/digital-product-passport/textile-apparel_en

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S15 **Implementing the Ecodesign for Sustainable Products Regulation** GRADE A

European Commission. 2026-10-30. https://green-forum.ec.europa.eu/implementing-ecodesign-sustainable-products-regulation_en

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S17 **OECD Due Diligence Guidance for Responsible Supply Chains in the Garment and Footwear Sector** GRADE A

OECD. 2018-03-07. https://www.oecd.org/en/publications/oecd-due-diligence-guidance-for-responsible-supply-chains-in-the-garment-and-footwear-sector_9789264290587-en.html

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S18 **Technical Information on Rules of Origin** GRADE A

World Trade Organization. 2026-10-30. https://www.wto.org/english/tratop_e/roi_e/roi_info_e.htm

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S21 **Verifiable Credentials Data Model v2.0** GRADE A

World Wide Web Consortium. 2025-05-15. https://www.w3.org/TR/vc-data-model-2.0/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S28 **Digital Product Passport** GRADE B

UNECE / UN Transparency Protocol. 2026-10-30. https://untp.unece.org/docs/specification/product-passport/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S29 **Conformity Credential** GRADE B

UNECE / UN Transparency Protocol. 2026-10-30. https://untp.unece.org/docs/specification/conformity-credential/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S33 **Progress in stable isotope analysis for natural fiber traceability** GRADE B

Jin, Shi and Wang / Taylor & Francis, hosted by Hong Kong Polytechnic University. 2026. https://ira.lib.polyu.edu.hk/handle/10397/121712

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c01-S34 **Textiles, clothing, leather and footwear industries** GRADE A

European Commission, DG GROW. 2026-10-30. https://single-market-economy.ec.europa.eu/sectors/textiles-ecosystem_en

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c02-S01 Same source record as c01-S01.

c02-S02 Same source record as c01-S02.

c02-S03 Same source record as c01-S03.

c02-S04 Same source record as c01-S04.

c02-S05 Same source record as c01-S05.

c02-S06 Same source record as c01-S06.

c02-S07 Same source record as c01-S07.

c02-S08 FAQ GRADE B

Aid by Trade Foundation / Cotton made in Africa. 2026-10-30. https://cottonmadeinafrica.org/faq/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c02-S0201 Benefits of GOTS GRADE A

Global Standards gGmbH. 2026-06-14. https://global-standards.org/our-standards/gots/benefits

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c02-S0202 Choosing the right chain of custody model for supply chain impact GRADE B

ISEAL Alliance. 2025-10-30. https://isealalliance.org/sustainability-news/choosing-right-chain-custody-model-supply-chain-impact

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c03-S01 Same source record as c01-S01.

c03-S02 Same source record as c01-S02.

c03-S03 Same source record as c01-S03.

c03-S06 Same source record as c01-S06.

c03-S07 Same source record as c01-S07.

c03-S09 SCOT FAQ GRADE B

Cotton made in Africa / Sustainable Cotton Tracker. 2026-10-30. https://scot.cottonmadeinafrica.org/faqs/view

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c03-S10 Same source record as c01-S10.

c03-S11 Same source record as c01-S11.

c03-S17 Same source record as c01-S17.

c03-S19 Data protection basics: Data protection guide for small business GRADE A

European Data Protection Board. 2026-10-30. https://www.edpb.europa.eu/sme/learn-the-basics/data-protection-basics_en

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c03-S20 What is forced labour? GRADE A

International Labour Organization. 2026-10-30. https://www.ilo.org/topics-and-sectors/forced-labour-modern-slavery-and-trafficking-persons/what-forced-labour

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c03-S28 Same source record as c01-S28.

c03-S29 Same source record as c01-S29.

c03-S30 Digital Traceability Events GRADE A

UNECE / UN Transparency Protocol. 2026-10-30. https://untp.unece.org/docs/specification/traceability-event/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c03-S33 Same source record as c01-S33.

c03-S0301 The classification of cotton GRADE A

USDA Agricultural Research Service. 2020-12-15. https://www.ars.usda.gov/research/publications/publication/?seqNo115=377189

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c03-S0302 Packaging lint cotton GRADE A

USDA Agricultural Research Service. 2024-11-03. https://www.ars.usda.gov/research/publications/publication/?seqNo115=407325

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c04-S01 Same source record as c01-S01.

c04-S02 Same source record as c01-S02.

c04-S03 Same source record as c01-S03.

c04-S06 Same source record as c01-S06.

c04-S09 Same source record as c03-S09.

c04-S10 Same source record as c01-S10.

c04-S11 Same source record as c01-S11.

c04-S18 Same source record as c01-S18.

c05-S01 Same source record as c01-S01.

c05-S02 Same source record as c01-S02.

c05-S03 Same source record as c01-S03.

c05-S05 Same source record as c01-S05.

c05-S06 Same source record as c01-S06.

c05-S07 Same source record as c01-S07.

c05-S10 Same source record as c01-S10.

c05-S11 Same source record as c01-S11.

c05-S14 Same source record as c01-S14.

c05-S18 Same source record as c01-S18.

c05-S28 Same source record as c01-S28.

c05-S30 Same source record as c03-S30.

c05-S34 Same source record as c01-S34.

c05-S0501 **PROV-DM: The PROV Data Model** GRADE A

World Wide Web Consortium. 2013-04-30. https://www.w3.org/TR/prov-dm/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c05-S0502 **Constraints of the PROV Data Model** GRADE A

World Wide Web Consortium. 2013-04-30. https://www.w3.org/TR/prov-constraints/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c05-S0503 **Chain of Custody and Mass Balance** GRADE B

UNECE / UN Transparency Protocol. 2026-10-30. https://untp.unece.org/docs/design-patterns/ChainOfCustody

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c06-S01 **ISO 22095:2020: Chain of custody, General terminology and models** GRADE A

International Organization for Standardization. 2020-10. https://www.iso.org/standard/72532.html

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c06-S02 Same source record as c01-S02.

---

c06-S03 Same source record as c01-S03.

---

c06-S06 **Transparency Standard, Version 1.0** GRADE B

Aid by Trade Foundation. 2025-06. https://cottonmadeinafrica.org/wp-content/uploads/AbTF_TransparencyStandard_Version1_6.2025.pdf

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c06-S07 Same source record as c01-S07.

---

c06-S10 **EPCIS Standard, Release 2.0** GRADE A

GS1. 2022-06. https://ref.gs1.org/standards/epcis/2.0.0/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c06-S11 **Core Business Vocabulary Standard, Release 2.0** GRADE A

GS1. 2022-06. https://ref.gs1.org/standards/cbv/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c07-S03 Same source record as c01-S03.

---

c07-S05 Same source record as c01-S05.

c07-S17 OECD Due Diligence Guidance for Responsible Supply Chains in the Garment and Footwear Sector GRADE A

OECD. 2018. https://www.oecd.org/content/dam/oecd/en/publications/reports/2018/03/oecd-due-diligence-guidance-for-responsible-supply-chains-in-the-garment-and-footwear-sector_g1g89b0b/9789264290587-en.pdf

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c07-S20 Same source record as c03-S20.

---

c07-S24 Bitstring Status List v1.0 GRADE A

World Wide Web Consortium. 2025-05-15. https://www.w3.org/TR/vc-bitstring-status-list/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c07-S29 Same source record as c01-S29.

---

c07-S33 Same source record as c01-S33.

---

c07-S0701 ISO/IEC 17025:2017: General requirements for the competence of testing and calibration laboratories GRADE A

International Organization for Standardization. 2017-11. https://www.iso.org/standard/66912.html

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c07-S0702 Integrity measures by Global Standards GRADE B

Global Standards gGmbH. 2026-10-30. https://global-standards.org/about/how-we-work/integrity

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c08-S01 Same source record as c01-S01.

---

c08-S02 Same source record as c01-S02.

---

c08-S03 Same source record as c01-S03.

---

c08-S05 Same source record as c01-S05.

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c08-S06 Same source record as c06-S06.

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c08-S07 Same source record as c01-S07.

---

c08-S09 Same source record as c03-S09.

---

c08-S10 Same source record as c06-S10.

c08-S11 Same source record as c06-S11.

c08-S12 GS1 Digital Link Standard: URI Syntax, Release 1.7.0 GRADE A

GS1. 2026-08. https://ref.gs1.org/standards/digital-link/uri-syntax/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c08-S13 GS1-Conformant Resolver Standard, Release 1.2.1 GRADE A

GS1. 2026-08. https://ref.gs1.org/standards/resolver/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c08-S14 Same source record as c01-S14.

c08-S15 Same source record as c01-S15.

c08-S16 Textiles Strategy GRADE A

European Commission, DG Environment. 2022. https://environment.ec.europa.eu/strategy/textiles-strategy_en

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c08-S17 Same source record as c01-S17.

c08-S19 Same source record as c03-S19.

c08-S21 Same source record as c01-S21.

c08-S22 Decentralized Identifiers (DIDs) v1.0 GRADE A

World Wide Web Consortium. 2022-07-19. https://www.w3.org/TR/did/

Source metadata retained for traceability. This entry is not cited in the chapter text.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c08-S23 Verifiable Credential Data Integrity 1.0 GRADE A

World Wide Web Consortium. 2025-05-15. https://www.w3.org/TR/vc-data-integrity/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c08-S24 Same source record as c07-S24.

c08-S26 **NIST SP 800-207: Zero Trust Architecture** GRADE A

National Institute of Standards and Technology. 2020-08. https://csrc.nist.gov/pubs/sp/800/207/final

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c08-S27 **NIST SP 800-161 Rev. 1: Cybersecurity Supply Chain Risk Management Practices for Systems and Organizations** GRADE A

National Institute of Standards and Technology. 2024-11-01. https://csrc.nist.gov/pubs/sp/800/161/r1/upd1/final

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c08-S28 Same source record as c01-S28.

---

c08-S29 Same source record as c01-S29.

---

c08-S30 Same source record as c03-S30.

---

c08-S34 Same source record as c01-S34.

---

c08-S0801 **RFC 3339: Date and Time on the Internet: Timestamps** GRADE A

Internet Engineering Task Force. 2002-07. https://www.rfc-editor.org/rfc/rfc3339.txt

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c08-S0802 **RFC 9562: Universally Unique IDentifiers (UUIDs)** GRADE A

Internet Engineering Task Force. 2024-05. https://www.rfc-editor.org/rfc/rfc9562.txt

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c08-S0803 **JSON-LD 1.1: A JSON-based Serialization for Linked Data** GRADE A

World Wide Web Consortium. 2020-07-16. https://www.w3.org/TR/json-ld11/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c09-S12 Same source record as c01-S12.

---

c09-S13 **GS1-Conformant Resolver Standard, Release 1.2.1** GRADE A

GS1. 2026. https://ref.gs1.org/standards/resolver/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

---

c09-S14 Same source record as c01-S14.

c09-S15 Same source record as c01-S15.

c09-S16 Same source record as c08-S16.

c09-S19 Same source record as c03-S19.

c09-S21 Verifiable Credentials Data Model v2.0 GRADE A

World Wide Web Consortium. 2025-05-15. https://www.w3.org/TR/2025/REC-vc-data-model-2.0-20250515/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c09-S26 NIST SP 800-207: Zero Trust Architecture GRADE A

National Institute of Standards and Technology. 2020. https://csrc.nist.gov/pubs/sp/800/207/final

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c09-S27 Same source record as c08-S27.

c09-S28 Same source record as c01-S28.

c09-S29 Same source record as c01-S29.

c09-S31 Web Content Accessibility Guidelines (WCAG) 2.2 GRADE A

World Wide Web Consortium. 2024-12-12. https://www.w3.org/TR/WCAG22/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c09-S34 Same source record as c01-S34.

c10-S1001 Same source record as c09-S21.

c10-S1002 Verifiable Credential Data Integrity 1.0 GRADE A

World Wide Web Consortium. 2025-05-15. https://www.w3.org/TR/2025/REC-vc-data-integrity-20250515/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c10-S1003 Bitstring Status List v1.0 GRADE A

World Wide Web Consortium. 2025-05-15. https://www.w3.org/TR/2025/REC-vc-bitstring-status-list-20250515/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c10-S1004 Decentralized Identifiers (DIDs) v1.0 GRADE A

World Wide Web Consortium. 2022-07-19. https://www.w3.org/TR/2022/REC-did-core-20220719/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c10-S1005 NIST IR 8202: Blockchain Technology Overview GRADE A

National Institute of Standards and Technology. 2018-10. https://csrc.nist.gov/pubs/ir/8202/final

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c10-S1006 Same source record as c08-S26.

c10-S1007 NIST SP 800-161 Rev. 1: Cybersecurity Supply Chain Risk Management Practices for Systems and Organizations GRADE A

National Institute of Standards and Technology. 2024-11-01. https://doi.org/10.6028/NIST.SP.800-161r1-upd1

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c10-S1008 Digital Product Passport Management with Decentralised Identifiers and Verifiable Credentials GRADE B

Ismael Illán García et al. / arXiv. 2024-10-21. https://arxiv.org/abs/2410.15758

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c10-S29 Same source record as c01-S29.

c11-S01 Same source record as c01-S01.

c11-S02 Same source record as c01-S02.

c11-S03 Same source record as c01-S03.

c11-S06 Same source record as c01-S06.

c11-S09 Same source record as c03-S09.

c11-S10 Same source record as c01-S10.

c11-S11 Same source record as c01-S11.

c11-S12 Same source record as c01-S12.

c11-S17 Same source record as c01-S17.

c11-S19 Same source record as c03-S19.

c11-S20 Same source record as c03-S20.

c11-S23 Same source record as c08-S23.

c11-S24 Same source record as c07-S24.

c11-S26 Same source record as c09-S26.

c11-S27 Same source record as c08-S27.

c11-S28 Same source record as c01-S28.

c11-S31 Same source record as c09-S31.

c11-S34 Same source record as c01-S34.

c11-S1101 Guiding Principles on Business and Human Rights: Implementing the United Nations 'Protect, Respect and Remedy' Framework GRADE A

Office of the United Nations High Commissioner for Human Rights. 2011. https://www.ohchr.org/sites/default/files/documents/publications/guidingprinciplesbusinesshr_en.pdf

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c11-S1102 Data Protection Law in Cameroon: Key Compliance Rules GRADE C

LEX Africa. 2025-10-31. https://lexafrica.com/2025/10/cameroon-data-protection-law-compliance/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c12-S01 Same source record as c01-S01.

c12-S02 Same source record as c01-S02.

c12-S03 Same source record as c01-S03.

c12-S04 Same source record as c01-S04.

c12-S05 Same source record as c01-S05.

c12-S06 Same source record as c01-S06.

c12-S07 Same source record as c01-S07.

c12-S09 Same source record as c03-S09.

c12-S10 Same source record as c01-S10.

c12-S11 Same source record as c01-S11.

c12-S12 Same source record as c01-S12.

c12-S13 Same source record as c09-S13.

c12-S14 Same source record as c01-S14.

c12-S17 Same source record as c01-S17.

c12-S18 Same source record as c01-S18.

c12-S19 Same source record as c03-S19.

c12-S20 Same source record as c03-S20.

c12-S21 Same source record as c01-S21.

c12-S22 Same source record as c08-S22.

c12-S24 Same source record as c07-S24.

c12-S25 NIST IR 8202: Blockchain Technology Overview GRADE A

National Institute of Standards and Technology. 2018. https://csrc.nist.gov/pubs/ir/8202/final

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c12-S26 Same source record as c09-S26.

c12-S27 Same source record as c08-S27.

c12-S28 Same source record as c01-S28.

c12-S29 Same source record as c01-S29.

c12-S30 Same source record as c03-S30.

c12-S1201 Business Case for Industry GRADE A

UNECE / UN Transparency Protocol. 2026-10-30. https://untp.unece.org/docs/business-case/BusinessCaseIndustry

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c12-S1202 Verifiable Credentials Use Cases GRADE A

World Wide Web Consortium. 2026-03-18. https://www.w3.org/TR/vc-use-cases/

Opened source record.

Accessed 2026-10-30. Quote retained in the machine-readable source record.

c13-S01 Same source record as c01-S01.

c13-S02 Same source record as c01-S02.

c13-S03 Same source record as c01-S03.

c13-S06 Same source record as c01-S06.

c13-S10 Same source record as c01-S10.

c13-S11 Same source record as c01-S11.

c13-S12 Same source record as c01-S12.

c13-S23 Same source record as c08-S23.

c13-S24 Same source record as c07-S24.

c13-S26 Same source record as c09-S26.

c13-S27 Same source record as c08-S27.

c14-S01 Same source record as c01-S01.

c14-S02 Same source record as c01-S02.

c14-S03 Same source record as c01-S03.

c14-S05 Same source record as c01-S05.

c14-S06 Same source record as c01-S06.

c14-S07 Same source record as c01-S07.

c14-S10 Same source record as c01-S10.

c14-S14 Same source record as c01-S14.

c14-S15 Same source record as c01-S15.

c14-S18 Same source record as c01-S18.

c14-S21 Same source record as c01-S21.

c14-S23 Same source record as c08-S23.

c14-S27 Same source record as c08-S27.

c14-S28 Same source record as c01-S28.

c14-S33 Same source record as c01-S33.

c14-S34 Same source record as c01-S34.

Stable definitions make comparisons useful.

Provenance

The documented history and origin of material or a product within a stated boundary.

Traceability

The ability to follow identified material or products through specified processes and custody events.

Chain of custody

The documented sequence of custody or control transfers and processing needed to preserve a claimed attribute.

Claim boundary

The material, attribute, geography, period and product granularity to which an assertion applies.

Identity preservation

A custody approach intended to retain an identified source's distinct material identity, subject to scheme rules.

Segregation

Keeping eligible material apart from ineligible material while preserving the specified claimed class.

Controlled blending

Mixing specified inputs in controlled proportions under a defined custody model and claim rule.

Mass balance

A model that accounts for eligible input and output quantities under specified rules; it does not by itself identify each product's physical fibre origin.

Book-and-claim

A model in which attribute certificates or credits can be transferred separately from physical material, under defined rules.

Hard Identity Preserved

The legacy HIP term in the opened CmiA standard; the current webpage uses Segregation with a terminology explanation.

Seed cotton

Harvested cotton containing fibre and seed before ginning; its mass must not be substituted for lint mass.

Lint

Cotton fibre separated from seed during ginning.

Bale

An identified compressed unit of cotton fibre used in handling and trade.

Lot

A defined quantity treated as a common unit for custody and record keeping.

Bale laydown

The set of bales selected as inputs for a spinning production run.

Transformation event

A record linking inputs consumed by a process to its outputs.

Aggregation event

A record of a grouping whose child objects retain their identities, such as cartons on a pallet.

Association event

A record of a lasting or semi-permanent relationship, distinguished from consumption and temporary grouping.

Genealogy graph

A linked representation of material inputs, transformations and outputs.

Volume reconciliation

Checking eligible material flows, processing and balances within a specified boundary and period.

Measurement basis

The units and conditions, including moisture or packaging treatment, that give a quantity its meaning.

Reconciliation residual

The difference between observed and modelled closing quantity under a stated sign convention.

Eligible balance

Quantity still available for a specified claim after applying the relevant scheme's allocation and cancellation rules.

Double claiming

Assigning the same eligible quantity to incompatible or repeated claims contrary to the relevant scheme rules.

Scope certificate

Evidence that an organisation, site or activity falls within a certification scope during a stated period.

Transaction certificate

Evidence concerning specified certified-material transactions, distinct from an organisation's general certification scope.

Conformity assessment

An assessment of whether specified requirements for a product, process or organisation have been met.

Independent assurance

Assessment by a party with a stated degree of independence and authority, limited to its actual scope.

Stable isotope analysis

Measurement of isotope ratios that may corroborate geographic origin using suitable reference data and qualification.

EPCIS

GS1's standard for capturing and exchanging visibility-event data within and across organisations.

Core Business Vocabulary

GS1 vocabulary defining shared business-step, disposition and related values used with EPCIS.

Digital Link URI

A web identifier expressing GS1 identification keys according to the specified syntax.

Resolver

A service that directs an identifier request to related information or services under defined rules.

Digital product passport

A structured product information record; regulatory scope and required fields depend on applicable rules.

Data carrier

A physical or electronic representation, such as a code, used to access an identifier or data.

Granularity

The level of identification, such as product model, batch or serial item.

Verifiable credential

A machine-readable set of issuer claims that can be secured against tampering under a defined verification model.

Decentralised identifier

An identifier whose control and resolution follow a specified DID method.

Proof purpose

The declared intended use of a cryptographic proof, checked to prevent misuse in another context.

Revocation

A status change withdrawing acceptance of a credential under its governing policy.

Idempotent ingestion

Processing a repeated event submission without creating an additional business event or allocation.

Event time

The recorded time of a physical or business event, distinct from later entry or receipt time.

Evidence admissibility

Acceptance of an evidence item for a particular claim under declared criteria; not a legal admissibility opinion.

Customs origin

A product's national origin as determined by the applicable trade rules, distinct from cotton growing location.

Data minimisation

Limiting personal data to what is necessary and proportionate for a specified purpose.

Due diligence

A risk-based process to identify, prevent, mitigate and address adverse impacts, extending beyond supplier mapping.

Unknown state

An explicit indication that a required fact has not been established; it is not equivalent to zero or a negative finding.

Claim release

An authorised decision that a specific product claim has sufficient evidence for its proposed use.

Follow the terms back to their context.

Page references point to occurrences in chapter prose. When a term does not occur in a chapter, its glossary definition is indexed.

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