

A Three-Layer Metadata Model for the Digital Inventory of Kasab Aceh

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ARTICLE INFO

Article history:

Published
December 17, 2025

Keywords:

Kasab Aceh
Metadata
Dublin Core
CIDOC CRM
Digital Inventory

ABSTRACT

Kasab Aceh raised gold-thread embroidery worked on velvet—embodies aesthetic, symbolic, and social meaning across Aceh’s regions. Yet its diverse forms and motifs remain unevenly documented in digital repositories, limiting preservation and scholarly reuse. This article presents a concise yet comprehensive, three-layer metadata model descriptive, administrative, and structural—for the digital inventory of Kasab Aceh. The design adapts Dublin Core for interoperable description and aligns with CIDOC CRM to support event-centric semantics and future publication as Linked Open Data. We delineate core entities (Product, Motif, Artisan, Photo, Session, Region, Registration), cardinalities (e.g., Product–Motif M:N; Photo–Product N:1), normalization policies (centimeters/grams for measurements; free-text materials and colors), and session-based provenance. Results include an Entity–Relationship schema, illustrated instances from South Aceh fieldwork, and a validation regimen using SHACL constraints. We discuss practical trade-offs between field flexibility and data consistency, demonstrate how structural links to image-derivative files (mask/overlay/SVG/JSON) enable reproducible visual analytics, and outline pathways for semantic migration and public access. The model offers a durable foundation for culturally faithful curation and cross-disciplinary research.

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I. Introduction

Kasab Aceh occupies a distinctive position in Acehnese material culture, where regional repertoires such as *taloe ie*, *bungong meutaloe*, *buleun*, *peudeung*, and *pucuk rebung* encode locally situated aesthetics and values. In ceremonial contexts weddings, *peusijek* (blessing rites), and domestic adornment—Kasab textiles operate simultaneously as artistic objects, social signals, and moral texts. As with many traditional cultural expressions, much of this meaning is tacit, carried in practice rather than stored explicitly in records [1]–[7].

Despite recognition that inventories are essential for safeguarding intangible cultural heritage, comprehensive digital documentation of Kasab remains fragmented, difficult to interlink, and vulnerable to loss or misappropriation. Photographs and narratives exist across personal archives, social media, and small institutional collections, but without shared semantics they are not easily discoverable or reusable. Metadata designed with explicit semantics and strong provenance can bridge the gap between physical artifacts, digital surrogates, and knowledge organization systems, thereby improving findability, stewardship, and analytical reuse [8]–[9].

To ensure interoperability beyond local systems, contemporary cultural heritage practice advocates alignment with community standards—Dublin Core (DC) for descriptive exchange and CIDOC Conceptual Reference Model (CRM) for event-centric integration and Linked Open Data publication [10]–[14]. In this spirit, we propose a three-layer metadata model tailored to Kasab Aceh. The model integrates cultural semantics (motif identity, meanings, regional affiliation), governance (rights, ownership, registration), and file-level structure (relations among photographs and derivatives), while preserving field authenticity through free-text materials and colors.



II. Method

A. Domain Analysis and Data Sources

Primary data were collected in South Aceh Regency (Samadua, Kluet Selatan) through semi-structured interviews with artisans, observation of embroidery workflows, and photographic documentation of finished products. Each capture was registered to a Session (date, place, participants, evidentiary notes) to secure provenance. Physical measurements were recorded in centimeters/grams to support aggregation, cross-entry comparison, and validation.

Secondary literature regional motif typologies, cultural symbolism, and inventory governance was synthesized to delimit the entity set and justify relational constraints. This triangulation anchored the model in practice while ensuring conceptual reach beyond the initial field sites.

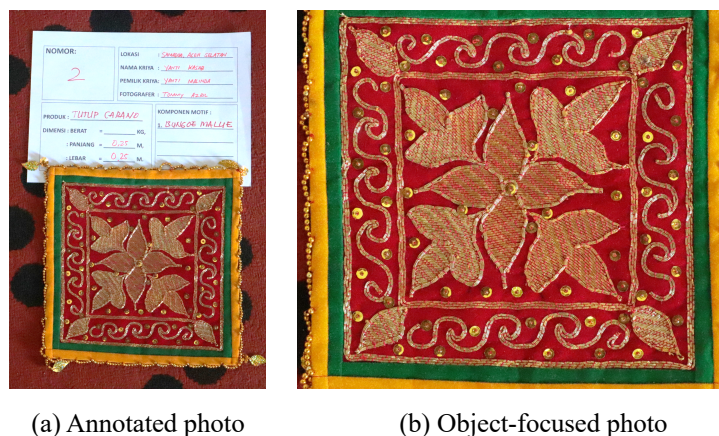


Fig. 1. Representative Kasab textile showcasing traditional Acehnese embroidery motifs, photographed on-site at Yanti Kasab's production house, Samadua, South Aceh.

B. Entities and Cardinalities

The domain is expressed through core entities: Artisan, Product, Motif, Photo, Session, Region, Registration, with optional Ethnic Group, Motif Group, and Participant. This selection reflects cataloging realities and supports cultural exploration across places and communities.

Cardinalities align with documentation practices: Product–Artisan = M:N (collaborative work), Photo–Product = N:1 (each photo depicts exactly one object), Product–Motif = M:N (≥ 1 motif per product), Motif–Region = M:N (cross-regional diffusion), Product–Region = N:1 (mandatory), and Session–Photo = 1:N (event-based provenance). These decisions balance curatorial precision with cultural variability and prepare the dataset for semantic projection to CIDOC CRM.

The Motif–Region relation is particularly important. Motifs circulate across districts via kinship, trade, and apprenticeship networks. Modeling diffusion as M:N avoids over-fitting local labels and keeps the inventory open to emergent alignment as more data arrive.

C. Three-Layer Metadata Design

The descriptive layer records identity and cultural–physical characteristics for discovery and interpretation. It includes motif name and category (DC: Title, Subject), cultural description and symbolic meanings (Description), product forms and materials (Type; details in Description or extensions), dominant colors (free text), and standardized physical measurements (centimeters/grams). To respect local terminology, materials and colors are captured as free text but normalized via editorial guidelines (case/diacritic handling, preferred spellings). This light-weight policy preserves field authenticity while supporting basic aggregation (e.g., counts by color term) and later reconciliation if a controlled vocabulary is introduced.

The administrative layer governs rights, ownership, registration, and provenance. Rights (DC: Rights) encode copyright, licensing, and usage conditions e.g., CC BY for digital surrogates—consistent with frameworks for Traditional Cultural Expressions. Registration is represented in two

tiers: a summary status on Product (registered/unregistered) for fast filtering and a detailed history in Registration (type, agency, number, date) for archival integrity. Session-based provenance anchors each record in an acquisition context (date, place, participants, evidentiary notes). This approach supports auditability across the documentation pipeline and anticipates event-centric mapping to CIDOC CRM.

The structural layer binds digital surrogates to their acquisition context. One Photo may reference source images (RAW/TIFF/JPG), segmentation masks, overlays, SVG contours, and JSON process parameters [15]-[20]. Stable, human-readable identifiers connect Product–Motif–Photo and support synchronization to JSON-LD/RDF; version tags record changes without breaking references [21]. Designing structural links at the metadata level allows curators to audit derivative provenance and analysts to reconstruct processing contexts. In practice, this improves error recovery (e.g., revisiting segmentation parameters) and ensures that derivative reuse is properly attributed to the underlying session and artifact.

D. Normalization and Data Governance

Strict relational normalization removes redundancy and clarifies semantics. Many-to-many associations are expressed via junction tables (artisan_product, product_motif, motif_region). Measurements are non-negative decimals (length_cm, width_cm, weight_gram). Per-product uniqueness constraints suppress duplicate spellings in materials/colors while avoiding a central authority list. Registration governance adopts dual representation: a binary status on Product for operational queries (e.g., filter for registered artifacts) and an append-only audit trail in Registration linked via product_registration for legal and historical fidelity. This pattern supports efficient querying with minimal schema friction while preserving provenance depth.

We recommend lightweight cataloging rules—how to write color names, how to describe materials, how to reference sessions—to reduce ambiguity without imposing heavy editorial overhead. These rules can evolve with community input as the corpus grows.

E. Standards Adaptation and Semantic Readiness

We adopt Dublin Core as a pragmatic descriptive spine and formalize a lightweight application profile tailored to Kasab Aceh. Core elements—Title, Creator, Subject, Description, Date, Type, Format, Identifier, Source, Language, Coverage, Rights—are accompanied by guidance (required vs. recommended, datatype hints). Persistent, human-readable identifiers are minted per object and propagated to derivatives; a bilingual labeling policy (id/en) can be applied via language tags.

Table 1. Adaptation of Dublin Core Metadata Elements for the Documentation of Acehese Kasab

Elements of Metadata	Description	Example Values
Title	Name of the motif or Kasab product	<i>Pucuk Rebung</i>
Creator	Name of the artisan or producing group	<i>Yanti Kasab</i>
Subject	Theme or category of the motif	<i>Motif Flora</i>
Description	Detailed explanation of the motif and its symbolic meaning	<i>Melambangkan pertumbuhan dan harapan</i>
Date	Date of creation or digitization	<i>2025-08-10</i>
Type	Type of object	<i>Tekstil Kasab</i>
Format	Digital file format	<i>TIFF, PNG JPEG.</i>
Identifier	Unique identification number	<i>KASAB-ACEH-0001</i>
Source	Origin of the physical object	<i>Aceh Selatan, Indonesia</i>
Language	Language of the description	<i>id</i>
Coverage	Cultural or geographic region associated with the object	<i>Aceh, Indonesia</i>
Rights	Copyright and usage rights information	<i>Hak milik pengrajin, lisensi CC-BY</i>

For semantic integration, we align the model with CIDOC CRM by projecting objects, actors, and events into event-centric classes and properties (e.g., Product ↔ cultural object, Photo ↔ visual item, Session ↔ documentation/acquisition activity). Serializations in RDF/Turtle and JSON-LD follow a

stable namespace and URI policy (patterned identifiers, version tags, change logs) [22]. Integrity rules (domain–range, cardinality, datatypes) are encoded as SHACL shapes to safeguard semantic quality [23].

F. Validation and Quality Assurance

We implement a library of SHACL shapes that enforce core constraints: (i) each Photo depicts exactly one Product; (ii) each Product has at least one Motif; (iii) each Product is located in exactly one Region; (iv) each Motif may be present in ≥ 0 Regions. Shapes use minCount/maxCount, qualified value shapes, and datatype/range checks (non-negative measurements, valid dates).

Validation runs at ingestion and scheduled audits. Reports include severity levels (Violation, Warning) to guide remediation. Authority control for materials/colors is intentionally relaxed to preserve field authenticity, mitigated by normalization rules and editorial guidelines.

III. Results and Discussion

A. ER Schema and Instance Illustration

The ER design places Product at the center and connects it to Motif (M:N), Region (N:1), Artisan (M:N), Photo (N:1), Session (1:N), and Registration (historical records). Structural metadata link each Photo to derivative files—mask, overlay, SVG contours, and JSON process parameters—ensuring precise references to cultural and visual artifacts. A sample instance, “Kipeh – Pucuk Rebung,” maps cleanly to Dublin Core: Title (product/motif), Creator (artisan group), Subject (Floral Motif), Description (growth/hope symbolism), Date (digitization), Type (“Kasab textile”), Format (TIFF for photo; PNG for mask), Identifier (stable code), Source/Coverage (Aceh Selatan/Aceh), and Rights (artisan ownership/license).

The schema is engineered to reflect cultural practice and technical traceability in digital curation. Product serves as the primary anchor because physical artifacts (e.g., kipeh, tilam pandak) are stable units of collection in field cataloging [6]. Domain-appropriate cardinalities—Product–Motif (M:N), Motif–Region (M:N), Product–Artisan (M:N), Photo–Product (N:1), Session–Photo (1:N), and Product–Registration via a junction table—align with inventory governance and enable downstream semantic alignment with event–actor models in CIDOC CRM once projected beyond relational constraints.

From the structural perspective, explicit links between Photo and derivatives support methodological transparency and reproducibility in computer-vision workflows (contrast enhancement, color/texture segmentation, morphological refinement). JSON parameters let auditors reconstruct processing contexts and verify consistency across sessions—key for quality assurance and comparative analysis. Declaring Format (DC:Format) for each surrogate and minting persistent Identifiers prepare records for Linked Open Data export and maintain a provenance chain consistent with heritage standards.

Design choices reinforce integrity and interpretability: enforcing Photo→Product = N:1 prevents ambiguous depiction for both segmentation evaluation and rights attribution; allowing Product→Motif = M:N and Motif→Region = M:N captures the plurality and diffusion of motif traditions; and Session→Photo = 1:N formalizes acquisition context (date, place, actors, evidence) so all derivatives trace back to the field workflow. Together with format-aware structural links and standards-based encoding, the ER schema provides a future-proof inventory backbone that supports local cataloging (flexible text for materials/colors), enforces minimal integrity (≥ 1 motif per product; exactly one product per photo), and positions the dataset for DC exchange, CIDOC CRM alignment, and SHACL validation.

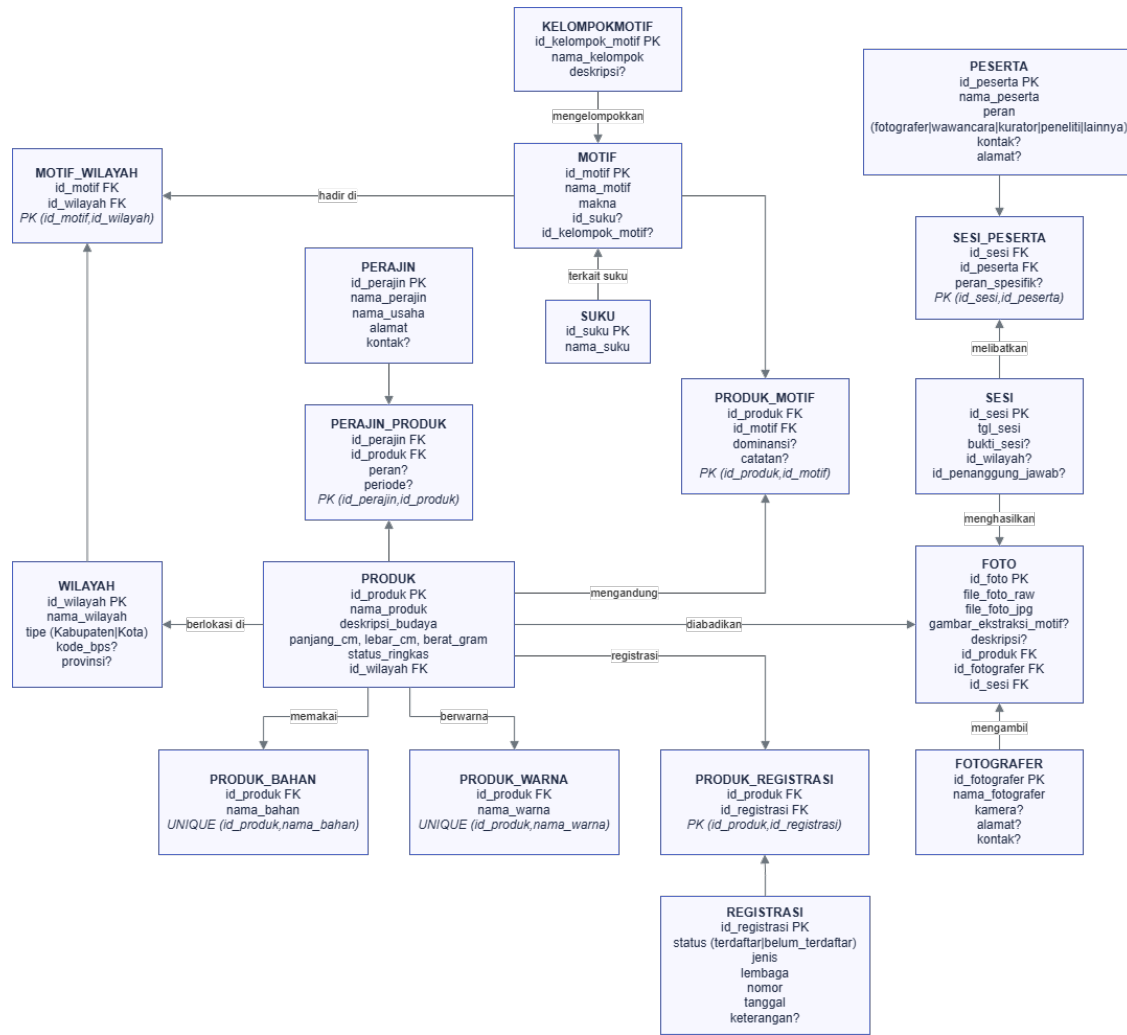


Fig. 2. Entity–relationship (ER) diagram of the Kasab Aceh metadata model

The design reconciles flexibility and consistency. Photo→Product = N:1 prevents ambiguous depiction; M:N relations for Product–Motif and Motif–Region capture cultural plurality without artificial constraints. Session-based provenance formalizes acquisition context and ensures derivative files remain traceable.

By declaring format, identifiers, and linkages for all surrogates, the schema operationalizes computer-vision deliverables within a cultural metadata frame, enabling reproducible analytics and positioning the corpus for semantic publication. This integration reduces friction between curators and technical analysts, allowing each to operate within a shared, audit-ready backbone.

A key trade-off is the decision to avoid a controlled vocabulary for materials/colors at the outset. The benefit is field agility and cultural fidelity; the cost is increased variation. Our mitigation—per-product uniqueness constraints, editorial style guides, and optional post-hoc reconciliation—has proven sufficient for early-stage cataloging. If downstream consumers require stricter semantics, the corpus can host parallel authority lists without rewriting records

B. Limitations and Future Work

Coverage remains limited to initial districts in South Aceh. As the inventory expands to additional districts, we anticipate new motif variants and product forms that may challenge current labels. The schema is designed to absorb this growth without structural changes; however, cataloging guidelines will require iterative refinement.

We plan to publish RDF/JSON-LD endpoints with documented SHACL profiles for federated reuse and to develop a minimal API for programmatic access. Future work will integrate computer-vision derivatives more deeply—e.g., linking mask provenance to training datasets for classification tasks—and explore bilingual labeling (Indonesian/English) for broader educational reach.

C. Semantic Readiness and Interoperability

A lightweight DC application profile governs required/recommended elements and datatypes; a stable namespace and URI policy mints human-readable identifiers; CIDOC CRM projections provide event-centric semantics; SHACL shapes safeguard integrity. Together, these features position the corpus for cross-repository discovery and Linked Open Data publication while maintaining local curatorial practice.

D. Visual Analytics Integration

Structural links enable visual analytics: overlays support rapid inspection; masks feed segmentation metrics (Intersection-over-Union, F1-score); SVG contours allow vector visualization and geometry queries; JSON parameters document algorithm settings for reproducibility. Because each Photo depicts exactly one Product, segmentation outputs and administrative attribution remain unambiguous.

IV. Conclusion

We deliver a three-layer metadata model that unifies descriptive semantics, administrative governance, and structural file relations for Kasab Aceh. The design adapts Dublin Core for interoperable description and aligns with CIDOC CRM to enable event-centric semantics and Linked Open Data publication. Preliminary SHACL validation confirms core integrity (≥ 1 motif per product; exactly one product per photo; standardized cm/gram measurements).

Future work will expand regional coverage, formalize cataloging guidelines for free-text materials/colors, publish RDF/JSON-LD endpoints with documented SHACL profiles, and integrate computer-vision derivatives to support visual analytics and motif classification. The model is practical for local cataloging yet robust for semantic migration, placing Kasab Aceh on a durable path toward discoverability, respectful reuse, and research impact.

Acknowledgment

This research was supported by the Directorate of Research and Community Service, Ministry of Higher Education, Science, and Technology, Indonesia (2025).

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