# CERES Proposition Paper

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**CERES: Conservation Evidence Records for Enduring Stewardship**

## 02. Executive summary

Conservation and restoration documentation is a critical part of cultural heritage infrastructure. It records how objects have been examined, understood, treated, stabilized, interpreted, monitored, and prepared for future care. Yet this knowledge is often stored in fragile and fragmented forms: paper files, handwritten notes, Word documents, PDFs, spreadsheets, museum database notes, image folders, laboratory reports, scans, email attachments, and local institutional systems.

These records contain evidence that future conservators, collection managers, researchers, and public institutions will need in order to understand what happened to an object and why. They document condition, materials, prior interventions, analytical findings, treatment decisions, uncertainty, ethical considerations, environmental needs, visual change over time, and future-care recommendations. If this evidence becomes unreadable, disconnected, or stripped of provenance, institutions lose not only administrative records but part of the accumulated memory of care around cultural objects.

CERES proposes a framework for **Conservation Evidence Records**: durable, software-independent, AI-readable, and human-auditable records of conservation knowledge. The initiative does not seek to replace museum databases, impose a universal documentation form, or automate conservation decisions. Its aim is to define how existing and future documentation can be mapped into a shared evidence layer while preserving institutional formats, professional judgment, source documents, and auditability.

CERES should also support daily conservation work. By turning past documentation into a structured knowledge base, it can help conservators create new reports faster, retrieve similar treatments, compare materials and object types, monitor treated areas over time, consider the sustainability implications of treatment options, and reuse institutional knowledge without losing the formatting, terminology, and review procedures of each institution.

The preferred architecture is federated rather than centralized. Existing institutional databases remain the operational systems of record, and each institution should retain custody of its own CERES records. CERES provides the shared evidence structure, mapping rules, preservation package, and optional controlled discovery layer that make conservation knowledge more durable and reusable without requiring a single central database.

## 03. The problem

Conservation documentation is increasingly digital, but it is not yet consistently governed as durable evidence. Current documentation practice is often shaped by institutional habits, available software, paper archives, individual conservator preferences, project-specific forms, and local filing systems. Essential conservation knowledge may therefore be scattered across different formats and systems.

This creates several long-term risks:

- Prior treatment knowledge may be lost or separated from the object record.
- The rationale for conservation decisions may become unclear.
- Paper records may remain inaccessible to search, comparison, and future machine use.
- Images, scans, and lab reports may become detached from the observations they support.
- Previously treated areas may not be monitored consistently over time.
- Proprietary formats and obsolete systems may prevent future access.
- Authorship, provenance, review history, and revision trails may be weak.
- Uncertainty and professional judgment may be flattened into unsupported facts.
- Future machine systems may extract information without preserving context or evidence.

The concern is not only technical. Conservation records are ethical and professional instruments. They help future custodians understand what was known, what was uncertain, what was done, what was avoided, what was monitored, and what future care requires. A record that preserves facts but loses judgment, context, and provenance is not sufficient.

## 04. Core proposition

CERES starts from a simple proposition:

**The conservation record is itself cultural heritage infrastructure.**

It should therefore be governed, preserved, and made interoperable with the same seriousness applied to other forms of cultural heritage documentation. The object remains central, but the knowledge record around the object also requires long-term stewardship.

CERES proposes that institutions, conservators, researchers, and public bodies work toward a shared model for Conservation Evidence Records. Such records should be:

- **Durable across generations:** readable and migratable beyond today's software, vendors, and file formats.
- **Software-independent:** able to coexist with museum databases, archives, image systems, paper archives, and local repositories without depending on one proprietary platform.
- **Template-preserving:** able to support institutional report formats, terminology, language, and visual identity rather than forcing one universal form.
- **AI-readable:** structured enough for responsible machine retrieval, extraction, comparison, translation, summarization, and visual change detection.
- **Human-auditable:** transparent enough that every claim, summary, image flag, or AI-assisted connection can be traced back to its source evidence, author, date, confidence, and review status.
- **Provenance-aware:** preserving authorship, revision history, source relationships, extraction method, validation status, and institutional responsibility.
- **Ethically grounded:** respecting confidentiality, cultural sensitivity, restricted knowledge, rights, and professional conservation judgment.

## 05. What is a Conservation Evidence Record?

A Conservation Evidence Record is a durable, structured record of conservation and restoration knowledge around an object or collection item. It is not merely a metadata record and not a replacement for existing collection management systems.

It may include:

- Object identification and collection context
- Source documents, including paper scans, PDFs, Word files, forms, database exports, images, and lab reports
- Condition reports and condition observations

- Treatment history and treatment rationale
- Previous restoration findings
- Materials and techniques used
- Analytical findings and laboratory reports
- Imaging references, diagnostic images, and image comparison outputs
- Treated-area annotations and known vulnerable regions
- Interdisciplinary evidence, including chemical analysis, technical imaging, environmental monitoring, material aging studies, and archival research
- Manufacturer-supplied technical documentation, clearly separated from independent conservation observations
- Environmental and storage guidance
- Sustainability considerations, including material impact, toxicity, reversibility, availability, waste, and long-term care burden
- Preventive conservation recommendations
- Ethical considerations and treatment constraints
- Uncertainty, confidence, disagreement, and professional judgment
- Authorship, provenance, review trail, and revision history
- Rights, confidentiality, cultural sensitivity, and access conditions
- Links to related databases, image repositories, scans, publications, and reports

The record should make relationships explicit. A material identification should link to the observation, image, test, or report that supports it. A treatment decision should link to the condition problem it addressed, the alternatives considered, and the conservator's rationale. A visual change detected in a current image should link to the baseline image, the prior treated area, and the treatment record that explains why that region matters. A future-care recommendation should indicate whether it is based on direct evidence, professional judgment, institutional policy, or unresolved uncertainty.

## 06. Interdisciplinary evidence

CERES should be interdisciplinary by design. Conservation evidence is not produced only through written reports. It is also produced through chemistry, imaging, materials science, environmental monitoring, archival research, technical art history, digital preservation, and data modelling.

For example, pigment analysis may identify pigments, binders, salts, corrosion products, coatings, or degradation compounds through methods such as XRF, Raman, FTIR, SEM-EDS, chromatography, microscopy, or related techniques. CERES should not store such results as isolated laboratory facts. It should link them to the object, sampled or

imaged location, conservation question, analytical method, confidence, limitations, related images or spectra, specialist interpretation, treatment decision, and later observations.

This is valuable because it preserves the relationship between observation, analysis, interpretation, and decision-making. A future conservator should be able to understand what was asked, what was tested, what was found, what remained uncertain, how the result influenced care, and whether later evidence confirmed or complicated the interpretation.

CERES should therefore support laboratory reports, raw analytical data, spectra, chromatograms, microscopy images, technical imaging, sample location diagrams, environmental monitoring data, mock-up studies, material aging tests, archival research notes, and expert interpretations. Raw data, specialist interpretation, and conservation decisions should remain distinct evidence types.

## 07. Material manufacturer collaboration

Conservation-grade material manufacturers could become useful CERES collaborators if the relationship is governed carefully.

Manufacturers could contribute technical documentation, safety data sheets, formulation information where shareable, recommended use conditions, sustainability characteristics, shelf-life information, and experimental material proposals. Conservators and institutions could contribute human-reviewed observations about how materials perform in real conservation contexts over time.

The value is a two-way evidence loop:

**Manufacturers provide material knowledge; conservators provide observed performance evidence; CERES governs the relationship between the two.**

This could help conservators compare materials more responsibly, understand long-term performance, identify recurring application issues, evaluate sustainability and safety implications, and document why a material was chosen, rejected, monitored, or replaced.

It could also help responsible manufacturers receive aggregated and anonymized feedback about material behavior, handling issues, aging concerns, packaging, documentation clarity, and sustainability needs. Experimental materials could be

proposed only as clearly labeled experimental candidates under institutional ethics, risk assessment, conservation science review, and monitoring requirements.

This collaboration must be independent and transparent. CERES should not become a marketplace, product-ranking system, preferred supplier list, or sponsored recommendation engine. Manufacturer claims, technical documentation, lab data, marketing language, conservation observations, and later performance evidence must remain separate evidence types. Negative findings should not be suppressed, and institutions should control whether their records contribute to aggregated material-performance feedback.

## 08. Institutional formats and the CERES evidence layer

CERES should separate institutional presentation from structured conservation evidence.

Institutions should be able to keep their own report templates, headings, languages, letterheads, terminology, and approval procedures. CERES should sit underneath or alongside these formats as a structured evidence layer. The institution keeps its familiar documentation output; CERES captures the underlying knowledge in a consistent, searchable, auditable, and preservable form.

For example, an institutional section called “Zustand,” “Condition,” or “Etat de conservation” may map to condition observations. A section called “Massnahmen,” “Treatment,” or “Intervention” may map to treatment actions. A “Beurteilung” or “Assessment” section may map to professional judgment and uncertainty. The outward document can remain institution-specific while the underlying evidence becomes comparable across records.

This approach allows CERES to support new documentation as well as legacy preservation. A conservator should be able to start from the institution’s usual form, retrieve prior evidence, draft new observations, link images and analytical reports, and generate a report in the required format. The final document and the structured evidence record should then be stored together.

## 09. Institutional databases as CERES sources

Existing institutional databases should be treated as important sources for CERES, not as systems to be replaced. Collection management systems, digital asset management

systems, conservation databases, laboratory systems, and archival catalogues may already contain object identifiers, accession numbers, materials, techniques, condition notes, conservation events, image links, location history, loan or exhibition history, rights information, and revision data.

CERES should define how selected fields from these systems are mapped into the Conservation Evidence Record. For example, an accession number may become object identity, a conservation event may become treatment history, a database condition field may become condition evidence, and a linked image may become imaging evidence.

The mapping should preserve provenance. CERES should record:

- Source system name
- Source record identifier
- Original field name
- Export or synchronization date
- Transformation or mapping rule
- Whether the value is a live reference or a preserved snapshot
- Review status

This distinction matters. Some data should be stored in CERES as a preservation snapshot because it is part of the evidence chain. Other data may remain a reference back to the institution's live database. CERES should never obscure which system supplied which information.

## 10. Storage and custody

CERES should not depend on one central database for all institutions. The most credible model is a **federated preservation model**:

1. **Institution-owned CERES repository:** each museum, collection, archive, or conservation department stores and governs its own CERES records.
2. **Operational CERES layer:** the working environment used for documentation, extraction, validation, search, image monitoring, and report generation.
3. **Exportable preservation package:** each record can be exported with structured evidence, source files, provenance, rights, review logs, OCR/transcription data, image annotations, and checksums.

4. **Trusted long-term archive:** institutions may deposit CERES packages in their own digital repository, a university or museum preservation system, a cantonal or national archive, or another trusted cultural heritage infrastructure.
5. **Optional shared discovery index:** selected metadata may be shared across institutions to support discovery of similar materials, treatments, object types, or documentation patterns without exposing restricted records.

This approach respects institutional ownership, confidentiality, cultural sensitivity, and national data policies while still allowing CERES to function as a shared standard and knowledge infrastructure.

## 11. Knowledge base function

Once conservation records are structured, CERES can become a knowledge base for responsible reuse of institutional experience.

Users should be able to search across prior records by:

- Object type
- Material or technique
- Damage or deterioration pattern
- Treatment method
- Adhesive, solvent, coating, support, fill, consolidation material, or retouching material
- Analytical method or result
- Environmental risk
- Storage recommendation
- Previously treated area
- Institution, conservator, or time period
- Confidence level and review status

CERES should support similarity search across objects, conditions, materials, and treatments. A conservator preparing a new documentation task could ask: Have we treated similar painted wooden objects? Where have we used this adhesive before? Which objects show comparable corrosion or flaking? Which previous reports mention uncertainty about this material? What later observations exist after similar treatments?

The system should not answer, “What treatment should I perform?” It should help answer, “What similar evidence exists, what was done before, what uncertainty was recorded, and where are the sources?”

## 12. Sustainability as decision context

CERES should also help conservators consider the sustainability implications of materials, methods, and treatment approaches when reviewing similar cases or preparing new documentation.

This should not become a simplistic “green score” that overrides conservation ethics or material compatibility. Instead, sustainability should be represented as structured decision context alongside treatment evidence, professional judgment, object needs, risk, reversibility, and long-term stability.

Relevant sustainability dimensions may include:

- Toxicity and health risk for conservators, handlers, and future custodians
- Environmental impact of solvents, adhesives, coatings, supports, packaging, and cleaning agents
- Waste generation and disposal requirements
- Energy or resource intensity of treatment methods
- Material availability and supply-chain risk
- Reversibility, retreatability, and long-term aging behavior
- Impact on future storage, monitoring, and preventive conservation burden
- Compatibility with institutional sustainability policies
- Availability of lower-impact alternatives and their evidence base

When CERES retrieves similar cases, it should be able to show not only what material or treatment was used, but also what later observations were recorded, whether the material created future care issues, whether safer or lower-impact alternatives have been documented, and what uncertainty remains.

For new documentation, CERES could support a sustainability note or decision field. A conservator might record why a specific material was chosen despite drawbacks, why a lower-impact method was suitable, or why an apparently sustainable option was rejected because it lacked evidence, posed conservation risks, or conflicted with the object’s material needs.

The strongest framing is:

**CERES supports sustainability-aware conservation decisions by making prior evidence, material consequences, and long-term care implications visible and auditable.**

## 13. Paper-based documentation

Paper documentation requires a specific approach. CERES should not treat scanning as the end point. It should treat paper extraction as a digitization, transcription, evidence-extraction, and validation workflow.

The original paper scan remains the source of truth. OCR, handwriting recognition, transcription, and AI extraction are interpretation layers that must be linked back to the page and reviewed where necessary.

A paper workflow should include:

1. Register the paper source with archive reference, document type, object link, date, author, language, rights, and access conditions where known.
2. Digitize at preservation quality, ideally preserving archival master images, access copies, OCR text, page metadata, and checksums.
3. Classify the document as condition report, treatment report, object card, lab note, loan form, correspondence, annotated photograph, notebook page, or another evidence type.
4. Segment the page into zones such as header, object identification, condition description, treatment description, material note, recommendation, signature, stamp, margin note, or image caption.
5. Extract candidate evidence such as object ID, treatment date, material, damage type, treatment action, analytical finding, or future-care warning.
6. Link every extracted claim to the source page, image region, OCR or transcription text, extraction method, confidence, reviewer, and review date.
7. Preserve original wording alongside normalized terminology so historical language and ambiguity are not erased.

This allows paper documentation to become searchable and AI-readable without pretending that machine extraction is automatically authoritative.

## 14. Image monitoring and change detection

Images should not only be passive documentation. CERES can use them as longitudinal evidence for monitoring change after treatment.

The most convincing model combines three sources:

- Previous image state, including pre-treatment, treatment, and post-treatment images
- Previous observation and treatment records, including treated areas, known vulnerabilities, materials used, and future monitoring recommendations
- Current image state, captured with documented view, date, lighting, scale, and operator information where possible

CERES should not merely compare two images and declare that an object changed. It should ask: what changed visually, where did it change, and does the change overlap with a known prior condition, treated area, material risk, or future-care warning?

For example, if a 2018 report states that flaking paint was consolidated along the lower left edge and should be monitored, CERES can preserve that treated area as an annotated region on the post-treatment image. When a new image is taken in 2026, the system can align the images, compare the region, and flag a candidate change for human review.

This can be more reliable than simple eye observation in a specific and defensible sense: it compares against exact prior baselines rather than memory, checks known vulnerable areas systematically, detects small region-level differences, reduces inconsistency between observers, and preserves a repeatable audit trail. It does not replace conservator inspection. It produces human-reviewed candidate observations.

## 15. Meaning of future-proof, AI-readable, and human-auditable

**Future-proof** does not mean permanent or immune to change. It means designed for resilience. A future-proof conservation record should remain understandable and migratable when current systems, vendors, and formats are no longer in use. This requires open or well-documented formats, stable identifiers, preservation packaging, clear metadata, and explicit links between files, observations, images, people, dates, and decisions.

**AI-readable** means that records are structured enough for machines to parse and connect responsibly. AI systems may help future institutions retrieve past treatments, compare similar materials, extract information from paper scans, summarize long histories, translate documentation, identify missing metadata, connect reports to images or object records, and flag visual changes in monitored regions. But this is only useful if the underlying records distinguish facts from interpretations, evidence from recommendations, and original documentation from later extraction.

**Human-auditable** means that machine-readable records remain accountable to expert review, even when the original documentation is incomplete. Legacy records will often not contain clear authorship, review status, confidence levels, or full decision rationale. CERES should therefore preserve what is known, explicitly mark what is unknown, and document any new extraction, transcription, interpretation, or validation added later.

For a legacy record, the audit trail may begin simply with the source itself: a scanned page, a PDF, a database export, an image, or a handwritten note. CERES should then make clear which parts come directly from that source, which parts were inferred, which parts were extracted by OCR or AI, and which parts have been reviewed by a human. The aim is not to invent missing provenance, but to prevent new systems from hiding uncertainty. A future user should be able to see the original evidence, understand how the CERES record was derived from it, and know where authorship, date, confidence, review status, or access conditions are known, uncertain, or absent.

The phrase therefore does not describe an AI product. It describes a trust framework for conservation knowledge in an AI-enabled future.

## 16. Research questions

The central research question is:

**How should conservation and restoration documentation be governed, structured, preserved, and made machine-readable so that future conservators can understand, verify, reuse, and build on past preservation work?**

Supporting questions include:

- What minimum conservation evidence must remain understandable over decades or centuries?
- Which parts of current documentation practice are most at risk of loss, fragmentation, or misinterpretation?
- How do paper records, Word files, PDFs, databases, image systems, scans, and lab reports currently interact in conservation workflows?
- How can existing institutional databases supply CERES evidence while remaining the operational systems of record?
- Where should CERES records be stored, who controls them, and what should be shared through an optional discovery index?

- How can institutions preserve their own report formats while contributing to a shared evidence model?
- What metadata is required for responsible future-care decisions?
- How should uncertainty, confidence, disagreement, and professional judgment be represented?
- How can AI extract and connect prior conservation evidence without creating false authority?
- How can similar treatments, materials, object types, and condition patterns be retrieved responsibly?
- How should sustainability considerations be represented when comparing materials, methods, and treatment approaches?
- How should chemical analysis, technical imaging, environmental monitoring, and other specialist evidence be linked to conservation questions and decisions?
- How can conservation-grade material manufacturers contribute technical data and receive aggregate performance feedback without influencing treatment recommendations?
- How can image comparison support longitudinal monitoring of treated or vulnerable areas?
- Which open formats, identifiers, and preservation packages are appropriate?
- How should authorship, provenance, review status, extraction method, and revision history be preserved?
- How do rights, confidentiality, cultural sensitivity, and access restrictions affect conservation evidence records?
- How can museums adopt a minimum record model without replacing all existing systems?

## 17. Proposed first phase

CERES should begin with a focused scoping phase, ideally grounded in a Swiss pilot context with European relevance. Switzerland offers a strong environment for this work because of its concentration of conservation expertise, museums, archives, universities, public trust institutions, and multilingual cultural contexts.

The first phase could include:

1. Interviews with conservators, collection managers, registrars, digital preservation specialists, and museum technology teams.
2. Mapping of current conservation documentation workflows across several institution types.

3. Analysis of sample records, including paper files, reports, images, database exports, and lab documentation.
4. Definition of a minimum Conservation Evidence Record model.
5. Mapping of institutional templates to the CERES evidence layer.
6. Mapping of selected fields from institutional databases into CERES with source-system provenance.
7. Pilot extraction from selected legacy paper and digital records into a software-independent preservation package.
8. Prototype AI-assisted extraction and linking, with human validation and provenance controls.
9. Prototype similar-case retrieval for treatments, materials, objects, and condition patterns.
10. Prototype sustainability-aware retrieval for materials and treatment approaches.
11. Prototype integration of interdisciplinary evidence, such as pigment analysis, technical imaging, and environmental monitoring.
12. Define governance for conservation-grade material manufacturer collaboration and aggregate material-performance feedback.
13. Prototype image-based monitoring of treated or vulnerable areas using baseline and current images.
14. Development of a federated storage and custody model, including institution-owned repositories and optional shared indexes.
15. Development of governance recommendations for access, rights, confidentiality, review, and long-term stewardship.

The goal of this phase is not to solve every technical or institutional challenge. It is to establish whether the gap is real, what minimum model is useful, and what type of pilot could produce credible next-stage evidence.

## 18. Role of AI

AI makes this work more urgent, but AI should not define the initiative. The immediate risk is that institutions will begin applying AI to fragmented conservation records without adequate structure, provenance, or auditability. This may produce persuasive summaries that obscure uncertainty or detach claims from evidence.

CERES positions AI as a capability that becomes useful only after documentation is made durable and trustworthy. In this framing, AI can support expert work by helping retrieve, compare, translate, summarize, transcribe, classify, and connect conservation evidence. It can assist with drafting new documentation in institutional formats, extracting candidate

evidence from paper or digital sources, finding similar cases, linking specialist analyses to conservation questions, and flagging candidate visual changes over time.

It must not replace conservation judgment, make treatment decisions, or conceal the evidentiary basis of claims.

The guiding principle is:

**AI may assist with access, drafting, comparison, and monitoring, but accountability must remain with auditable records and human expertise.**

## 19. Institutional value

For museums and collections, CERES offers a way to protect institutional memory and reduce long-term dependency on fragile documentation practices.

For conservators, it can reduce repetitive documentation work, retrieve comparable prior cases, preserve professional judgment, and make new reports more complete without forcing a new institutional format.

For conservation departments, it can support continuity across staff changes, improve searchability of legacy records, and make treated areas and future-care warnings easier to monitor.

For ministries and public bodies, it frames conservation documentation as part of national and European cultural heritage infrastructure.

For researchers, it creates a structured field of inquiry across conservation science, chemistry, materials science, imaging, archival science, digital preservation, semantic data, FAIR data, trustworthy AI, image analysis, and human-computer interaction.

For responsible conservation-grade material manufacturers, it could create a governed way to contribute technical documentation and receive aggregated, anonymized feedback about material performance, sustainability, handling, and long-term behavior, without influencing treatment recommendations.

For future custodians, it increases the chance that past care decisions remain understandable, verifiable, and useful.

## 20. Near-term output

The recommended near-term step is a small expert roundtable of 10 to 14 people, including conservation practitioners, museum leaders, conservation educators, conservation scientists or chemists, imaging specialists, digital preservation experts, metadata and semantic data specialists, trustworthy AI experts, public culture representatives, and one international conservation legitimacy body. Material manufacturers may be useful later as scoped contributors or observers, but they should not shape the initial governance agenda.

The roundtable should produce:

- A short position paper
- A draft minimum Conservation Evidence Record
- A template-mapping model for institutional documentation formats
- A source-system mapping model for institutional databases
- A federated storage and preservation-package model
- A sustainability-context model for materials and treatment evidence
- An interdisciplinary evidence model for chemistry, imaging, environmental monitoring, and specialist analysis
- A governance model for material manufacturer collaboration
- A paper-record extraction and validation workflow
- A visual monitoring and change-detection pilot concept
- A policy brief for cultural ministries and funders
- A Swiss pilot design with European relevance
- A funding and governance pathway

## 21. Closing proposition

CERES is not a museum software platform, not an object digitization project, and not an AI automation proposal. It is an initiative to preserve and reuse the evidence chain of conservation work itself.

If conservation documentation is lost, unreadable, or disconnected from future systems, cultural heritage institutions lose more than files. They lose memory, accountability, continuity, and the ability to build responsibly on past care.

CERES proposes that conservation evidence should be treated as durable cultural heritage infrastructure: future-proof, AI-readable, human-auditable, provenance-aware, useful in daily documentation practice, and grounded in the ethics of conservation.