AURORA ANCHISE ENIGMA

Policy Recommendations

COUNTERING TRAFFICKING AND LOOTING OF CULTURAL GOODS

The experience of the Cluster Projects Horizon Europe

November 2025

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INTRODUCTION

The fight against trafficking and looting of cultural property is a crime that affects the memory of collectivities and communities, both inside and outside the Union.
Now is the time to act, based on experience in the field.

The war in Ukraine and the destruction in Gaza exposed the vulnerability of heritage to armed conflicts, while post-Brexit tensions have fragmented long-established cooperation networks. Simultaneously, the evolution of security threats, from terrorism to transnational organised crime, places cultural heritage protection at the heart of European internal security concerns. In recent years, the fight against trafficking and looting of cultural goods has seen an increase in political attention, especially at the European Union level: the greatest example is the current "EU Action Plan against trafficking in cultural goods" under the umbrella of the EU Security Union Strategy 2020-2025. What has been achieved through this political coordination is unparalleled in this field and demonstrates the need to perpetuate these policy objectives.

The experience gained from the Horizon Cluster projects AURORA, ANCHISE and ENIGMA has enabled the 3 consortia with different geographical coverage and complementary expertise to analyse the needs for strengthening the fight against trafficking and looting. The aim of these policy recommendations is to ensure that the legacy of these cooperation projects lives on beyond the duration of European funding. The points raised are testimony to a network of actors committed to ensuring that these crimes, so damaging to collective memory, can be curbed with ever greater success through innovative, technological and research-based solutions.

The Horizon project cluster presenting these recommendations is a concrete example of how collaboration between different sectors can enable progress in strengthening the fight against trafficking and looting that would otherwise not be possible. The recommendations are based on experience in the field and are intended to be pragmatic and, above all, achievable.

The main target of these recommendations are the three main European institutions, the Commission, the Parliament and the Council, each according to their capacity to act on what is proposed. For each recommendation, after an explanation of the problems identified and the proposed course of action, it identifies which policy makers are actually called upon to intervene and the communities to be involved in implementing them.

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SHORT PRESENTATION OF PROJECTS

ANCHISE (Applying New solutions for Cultural Heritage protection by Innovative, Scientific, social and economic Engagement) is a research and innovation project funded by the Horizon Europe programme (2023-2026, €4 million budget) that aims to build a comprehensive and sustainable response to the challenges of protecting cultural heritage against looting and illicit trafficking.

Bringing together 15 partners from 7 European countries – universities, research centres, technology companies and professional organizations – ANCHISE relies on an interdisciplinary approach combining social sciences and humanities (SSH) research, law enforcement expertise and technological innovations. The consortium includes the French School at Athens (coordinator), CNRS, the French National Police College, the European University Institute in Florence, the International Council of Museums (ICOM) and several European technological institutions.

The project is structured around four main objectives: Understand, Prevent, Act and Repair. ANCHISE's research component focuses on the political economy and sociology of trafficking networks, examining the socio-economic factors that enable looting, the connections between cultural goods trafficking and organized crime, the sociology of detectorism across Europe, and the operational chains linking source countries to European markets. Through international symposia and comparative studies across multiple European contexts, the project generates fundamental knowledge essential for informing both technological solutions and policy frameworks.

On the technological front, ANCHISE develops operational tools combining 3D photogrammetry for site monitoring, artificial intelligence for object identification at borders, and spectral signatures for authentication. Nine demonstrations involving more than 150 practitioners test these solutions in real-world contexts: museums, border controls and archaeological sites.

Website: www.anchise.eu
Social media: @AnchiseProject

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SHORT PRESENTATION OF PROJECTS

AURORA - Artwork Unique RecognitiOn and tRacking is a groundbreaking Horizon Europe project (2023-2025) addressing the critical challenge of illicit trafficking in cultural goods through innovative technological solutions. Led by AVVALE (formerly known as Techedge), the €3.2 million initiative brings together 9 partners from 6 countries, including the Balkan Museum Network, Lviv Polytechnic National University, University College Cork, Hungarian National Museum, Antonio Mirabile conservator, OTID specialized in digital ID creation, .

The project tackles the €6 billion annual illegal art market by developing a comprehensive digital identity system for artworks using advanced chemical analysis, miniaturized tracking devices, and blockchain technology. AURORA's innovative approach combines non-invasive deep-layer chemical composition analysis with permanent, unalterable digital storage to create stable physical-to-digital identity connections for cultural objects.

Key technological innovations include the implementation of the blockchain technology in order to create a robust, and immutable way to record the artwork sensitive information regarding the authenticity verification process proposed by AURORA; In detail, this was created by exploiting the Ethereum-based blockchain infrastructure with Polygon Layer 2 scaling, ERC-721 NFT standards for unique artwork identities, and encrypted IPFS storage for sensitive data. The system could achieve 12-15 Transaction Per Seconds (TPS) speeds while maintaining environmental sustainability and cost-effectiveness. Specific solutions, such as Account Abstraction protocols, were employed to eliminate technical barriers for cultural institutions, and provide a smooth user experience through background polling systems.

The project has successfully tested its solutions through chemical markers using carbon dots and transparent codes enabling the artwork authentication verification process using low-cost devices (e.g., smartphone and UV-lamp). AURORA was able to perform a Real-world application of the proposed technology in Ukraine; in fact, during the current complex situation, a number of Ukrainian artworks located in different regions were accurately tagged with the AURORA chemical marker, allowing to enhance their protection. Further validation occurs through partnerships with museums, conservation laboratories, and cultural institutions across Europe.

AURORA's impact extends beyond technology, fostering "technological democratization" among cultural institutions by bridging the latest technical competencies with heritage professionals. The project collaborates with EU initiatives including ANCHISE and ENIGMA, contributing to the broader European strategy against cultural property trafficking.

Website: https://www.aurora-euproject.eu
Social media: LinkedIn - @aurora-project-eu

AURORA

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SHORT PRESENTATION OF PROJECTS

ENIGMA - Endorsing Safeguarding, Protection & Provenance management of cultural heritage is an EU funded project under GA. No. 101094237 which started its implementation in January 2023. ENIGMA brings together 12 partners from 7 countries including The Aristotle University of Thessaloniki, Kiklo, The eratosthenes centre of excellence, Cellock, The University of Turku, The royal museums of art and history, the center for security studies, the Hellenic police, Heritage Malta, Neuraltech, Anysolution, and MIRAlab SARL. The main aim of ENIGMA is to achieve excellence in the protection of cultural goods and artefacts from man made threats by contributing to identification, traceability, and provenance research of cultural goods as well as by safeguarding and monitoring heritage sites. The main objectives of ENIGMA are to co-design the novel concept of the Unique Authenticity identifier (UAI), to mitigate anthropogenic threats of heritage sites by integrating earth observation techniques and GIS to create remote sensing tools and to develop an advanced decision support and communication platform. In addition, ENIGMA aims to co-create, develop and test and validate the UAI tools, to create advanced machine learning algorithms for cultural heritage objects clustering and stratification and to develop novel approaches for advanced metadata analysis for interlinking existing disparate data sources. ENIGMA achieved these objectives through the development of a holistic platform that integrates novel and innovative technological solutions and applications in a single access point. The tools were developed by an interdisciplinary team of experts including technology developers, cultural heritage experts and law enforcement agencies. The ENIGMA platform aims to offer to the cultural heritage protection community a system that can help them in the fight against the illicit trafficking of cultural goods. At ENIGMA's core is the UAI a multi composite identifier that acts as a DNA strand to describe a cultural good, using information contained at the ENIGMA main database. The ENIGMA database has been developed by integrating the Europeana data model with CIDOC-CRM and Dublin core classes in a hybrid schema and Getty Thesaurus to provide a standardized terminology. The Platform integrates a web crawler for data acquisition, ML/AI tools for data standardization, the Earth Observation toolkit that provides alerts at monitoring sites, the provenance research tool that aids the study and documentation of cultural goods' provenance particularly under conditions of looting, trafficking and illegal circulation, the scenario building engine that is used in a higher level to build and run workflows by incorporating metrics and insights for decision making, the public engagement infrastructure that leverages crowdsourced information by providing user friendly tools to report potential illegal excavation sites or looted building, based on location, time and images, and the training infrastructure that can accommodate the diverse needs of stakeholders and end users.

Website: https://eu-enigma.eu/
Social media: LinkedIn - @enigma-eu-project

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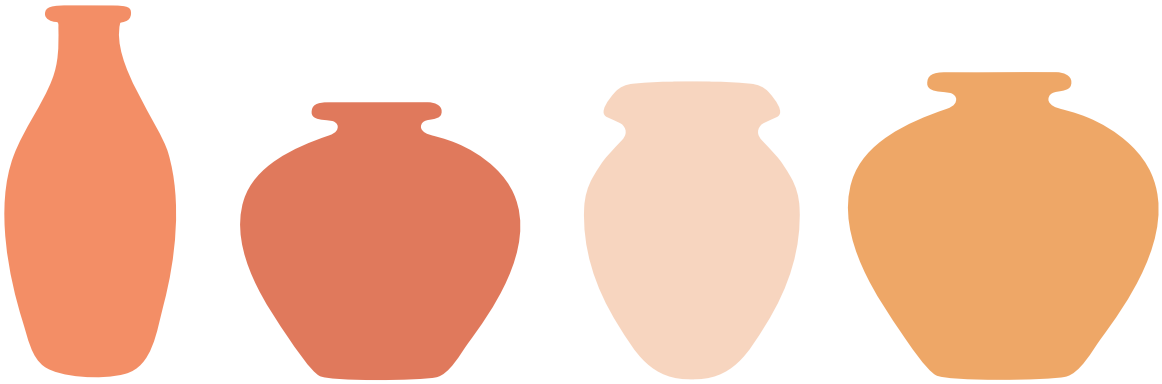

POLICY RECOMMENDATIONS

1

INITIATE THE EUROPEAN INTERDISCIPLINARY COMPETENCE CENTRE FOR THE FIGHT AGAINST ILLICIT TRAFFICKING OF CULTURAL GOODS

Identified problem	The European Union's response is currently constrained by structural shortcomings for dealing with trafficking and looting of cultural heritage. *The immediate context is a* **fragmented ecosystem**. The EU, acting as a source, transit, and destination for cultural goods, features highly uneven national capacities, creating gaps criminal networks exploit. Existing cooperation efforts are hampered by dependency on personal and informal networks, geographic coverage imbalances, and the temporal limits of project-based funding, preventing the accumulation of sustainable expertise. *These issues are symptomatic of* **three interconnected structural shortcomings**: 1. **Institutional Fragmentation:** This includes major capacity inequalities among Law Enforcement Agencies (LEAs), varying implementation of EU regulations across Member States, and persistent data silos. There is currently no centralized EU database integrating national inventories, customs, and police data on trafficked objects, limiting interoperability. 2. **Deficit in Interdisciplinary Coordination:** Effective action requires linking multiple communities. Interdisciplinarity is currently hindered because access to essential expertise, such as provenance studies from Cultural Heritage Institutions (CHIs) and researchers, is often based on informal networks. Social Sciences and Humanities (SSH) research, crucial for understanding root causes, and museum activities are marginalized and often lack access to operational data. Furthermore, technological solutions developed in silos are insufficiently informed by SSH research and lack interoperability. 3. **Discontinuity and Limitations of Current Initiatives:** Significant investment in pilot projects risks being lost due to their time-bound nature, failing to create long-term institutional arrangements.

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Policy recommendation	The European Union should **establish a European Interdisciplinary Competence Centre (ECC) to combat the illicit trafficking and looting of cultural goods**. The European Commission and Member States should initiate this operational structure through a **Coordination and Support Action (CSA) under the Horizon Europe programme, launching in 2026**. This pragmatic approach utilizes existing funding mechanisms to act swiftly, bypassing the lengthy political process required for a traditional EU agency, while simultaneously establishing the ECC as an **incubator for a future dedicated European Agency**. This ECC must address the current structural fragmentation by implementing the following core operational actions: 1. **Institutionalise interdisciplinary cooperation:** Establish the ECC as a permanent platform connecting the six essential communities: Law Enforcement Agencies (LEAs), Cultural Heritage Institutions, SSH Researchers, Technology Developers, Civil Society Organizations, and Educational Communities. This network should **formalize relationships** that currently rely on informal or personal contacts. 1. **Harmonize national capacity:** Serve as a **capacity-building catalyst** to elevate and standardize the capabilities of national LEAs across Europe, especially in Member States lacking specialized art crime units. 1. **Solve data silos:** Drive methodological innovation by developing and disseminating **data standards and interoperability protocols**. The ECC's Observatory mission must maintain a toolkit of vetted technological solutions and act as a **European reference hub** to transform fragmented research outcomes into sustained strategies. **Ensure sustainable funding:** Use the window of opportunity presented by the upcoming **Multiannual Financial Framework (MFF) 2028-2034** negotiations to embed the ECC within long-term European budgetary priorities, guaranteeing continuity beyond temporary project cycles.

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Objective	The structural and systemic goal behind the proposal is the **European institutionalization** of the fight against illicit trafficking, aiming to transform fragmented excellence into **systematic effectiveness**. The ECC addresses the fundamental paradox that the EU's response is constrained by **structural shortcomings** and the **temporal limitations of project-based funding**. It seeks to provide a permanent, sustainable coordination platform, acting as a **capacity-building catalyst** to standardize uneven national capabilities. Ultimately, the ECC is an **incubator for a future dedicated European Agency**. This **evolutionary strategy** prepares the foundation for long-term institutional development, ensuring a coherent and sustained European strategy to counter transnational crime
Connection to existing EU policies and legislation	*The proposal for a European Interdisciplinary Competence Centre (ECC) is strategically linked to key EU instruments and political priorities.* *The ECC is proposed to be initiated through a* **Coordination and Support Action (CSA)** under the **Horizon Europe** programme. This approach leverages existing mechanisms for a rapid pilot phase. The ECC aims for synergy with emerging digital heritage initiatives under programmes like **Digital Europe**, specifically the Common European Data Space for Cultural Heritage, the European Collaborative Cloud for Cultural Heritage (ECCCH), and the European Open Science Cloud (EOSC). ***Regulations and Strategies:*** The ECC supports the operationalisation of core regulations, including **Regulation (EU) 2019/880** on the **import of cultural goods** (fully applicable from 28 June 2025) and Regulation (EC) 116/2009 on export controls. Politically, it aligns with the **EU Action Plan against illicit trafficking of cultural goods** within the framework of the **European Security Strategy 2020-2025**. Crucially, the Centre aims to secure **long-term funding** by embedding cultural heritage protection within the upcoming **Multiannual Financial Framework (MFF) 2028-2034** negotiations

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Proposed level(s) of intervention	For the first phase (CSA action): • European Commission • EU Agencies (Europol, REA) For the second phase (sustainability through EU Regulation) • European Parliament • Council of the EU • Member States (Defence Ministries, Culture Ministries)
Key stakeholders involved	The proposal requires mobilizing **six interconnected pillars**: **Law Enforcement Agencies (LEAs)**, **Cultural Heritage Institutions and Professionals**, **Social Sciences and Humanities Researchers**, **Technology Developers**, **Civil Society Organizations (CSOs)**, and **Educational Communities**. These communities must engage in constant dialogue with EU and national policymakers
Supporting evidence or results from the project	*Policy Research -* ***Towards a European Interdisciplinary Competence Centre to Combat Illicit Trafficking of Cultural Heritage*** https://www.anchise.eu/_files/ugd/694c76_96f41b60656e49f29ef4d50c94cfc780.pdf Short Version: https://www.anchise.eu/_files/ugd/694c76_0ebf0f9b247c444db97ca21dbb769300.pdf

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2

AURORA

IMPLEMENT A EUROPEAN STANDARDIZED BLOCKCHAIN INFRASTRUCTURE FOR CULTURAL GOODS AUTHENTICITY CERTIFICATION AND TRACEABILITY

Identified problem	Illicit trafficking of cultural goods represents a growing threat to European heritage, amplified by fragmented authentication systems and lack of secure digital traceability. The AURORA project experience has demonstrated that the current absence of a unified digital identification system prevents rapid provenance verification of artworks, facilitating illegal trade. Fragmented digitization and lack of interoperable standards among Member States create vulnerabilities that traffickers systematically exploit to commercialize stolen or counterfeit goods.
Policy recommendation	The European Commission should develop and implement a standardized pan-European blockchain platform for cultural goods certification and traceability, building on AURORA project results and integrating it into the European Blockchain Services Infrastructure (EBSI). This platform should: • Adopt unified technical standards based on Ethereum/Polygon to ensure interoperability, contained costs, and environmental sustainability, using ERC-721 protocols to create unique digital identities for artworks. Implement a decentralized storage system (IPFS) with advanced encryption to protect sensitive artwork data while maintaining transparency necessary for verifications. • Establish a regulatory framework requiring mandatory blockchain registration for artworks valued over €50,000 and for all cultural goods in cross-border transit. Integrate the system with existing customs platforms and the ICG system to automate import/export controls. • Develop standardized APIs for integration with existing museum collection management systems and art e-commerce platforms, ensuring GDPR compliance and other privacy regulations. • Establish certification protocols for chemical analysis laboratories and cultural institutions authorized to register new works in the blockchain

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Objective	The objective is to create a unified and secure European system for digital identification of cultural goods that eliminates vulnerabilities exploited by illicit trafficking. Blockchain will guarantee immutability of provenance records, facilitating due diligence for art market operators and enabling rapid identification of stolen goods by law enforcement. This system will strengthen cross-border cooperation, reduce authenticity verification costs, and protect European cultural heritage through an innovative and standardized technological approach
Connection to existing EU policies and legislation	This recommendation directly aligns with the EU Action Plan against trafficking in cultural goods (2022), EU Regulation 2019/880 on cultural goods imports, and the EU Blockchain Strategy. It integrates with the Digital Single Market Directive for cultural heritage digitization, the European Blockchain Services Infrastructure (EBSI), and the Common European Data Space for Cultural Heritage. It also supports objectives of the New European Agenda for Culture and the European Framework for Action on Cultural Heritage.
Proposed level(s) of intervention	• European Commission (DG CONNECT, DG HOME, DG EAC) • European Parliament • Council of the EU • Member States (Ministers of Culture, Interior, Customs) • EU Agencies (Europol, EACEA, eu-LISA for technical integration)
Key stakeholders involved	Museums, archaeological sites, conservation laboratories, auction houses, art dealers, customs authorities, specialized law enforcement units (like Italy's Carabinieri Cultural Heritage Protection), blockchain technology providers, chemical analysis laboratories, cultural heritage lawyers, UNESCO national commissions, Interpol's Database of Stolen Art

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Supporting evidence or results from the project	AURORA has successfully developed and tested a blockchain-based artwork authentication system using Ethereum with Polygon Layer 2, achieving optimal balance between performance (12-15 TPS base, 3,000-65,000 TPS on Layer 2) and sustainability. The project validated ERC-721 NFT standards for unique digital identities and implemented encrypted IPFS storage addressing privacy concerns. Chemical marker testing on diverse materials (paper, sandstone, marble, wood) demonstrated universal applicability with 30cm localization accuracy. User experience improvements through Account Abstraction and background polling systems eliminated technical barriers for cultural institutions. The modular smart contract architecture proved scalable for various cultural heritage use cases, while integration with existing museum systems validated commercial viability. As a consequence, the AURORA blockchain solution designed together with Museums and Cultural Heritage professionals resulted to be rapidly and easily integrated (also in terms of technical understanding) on currently existing Cultural institution processes. It is important to mention that AURORA was able to successfully apply the chemical marker developed during the project on artwork part of the Ukrainian Cultural Heritage. In detail, a number of artworks located in different parts of Ukraine were tagged under the supervision of Cultural Heritage professionals and following the regulations framework, practically enhancing the protection of the Ukrainian Cultural Identity in such a critical situation. The invisible marking will be identifiable only by the specific personnel. This activity also allowed us to understand the most effective directions towards which align future researches, to further improve AURORA proposition adaptability to various types of objects and situations, making it easier to be adopted by cultural institutions without requiring specific knowledge or resources. AURORA surveyed more than 60 cultural entities spanning over 12 European countries. Participants ranged from micro-institutions with 1-10 employees (40% of sample) managing under 1,000 objects on under 500 m^2, to large national museums with substantial staffing operating collections exceeding 1 million items across 10,000+ m^2 and attracting over 1 million annual visitors. In the following are the most relevant derived insights with respect to the Blockchain technology: **1. Blockchain Addresses Critical Data Security and Provenance Tracking Needs Despite Minimal Current Adoption** Survey results demonstrate significant institutional recognition of blockchain's value for cultural heritage despite virtually no practical implementation.

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Supporting evidence or results from the project	While fewer than 20% of respondents reported any direct experience with blockchain technology, over 55% acknowledged its utility for tracking provenance and ownership history of artworks and museum objects. More compellingly, the majority of participants believed blockchain could enhance the security of their organization's data and records, a critical concern given that multiple institutions confirmed actual theft incidents and approximately 40% experienced difficulties locating objects within their collections. This disconnect between awareness and adoption reflects not institutional resistance but rather the absence of accessible, heritage-specific blockchain implementations. AURORA's Ethereum-based system with Polygon Layer 2 directly responds to this validated need by providing tamper-resistant, immutable records for object authentication and provenance documentation capabilities that institutions recognize as valuable but currently lack the infrastructure to deploy. **2. Blockchain's Interoperability Capabilities Address Systemic Institutional Fragmentation** The survey revealed a significant infrastructure challenge that blockchain is uniquely positioned to resolve: institutional digital isolation. Over 70% of institutions reported that their digital systems were not integrated with national or international platforms, creating significant barriers to collaborative collection management and inter-institutional artifact loans. Simultaneously, a substantial number of respondents expressed optimism that blockchain could help streamline the loaning and borrowing of artifacts between institutions addressing the administrative complexity and trust deficits inherent in cross-institutional transactions. Given that more than 50% of institutions still rely on basic Excel spreadsheets for collection management while sound 20% have no digital cataloguing system whatsoever, AURORA's blockchain-based architecture offers a standardized, decentralized framework for secure data sharing that circumvents the need for centralized infrastructure. The ERC-721 NFT standard for unique digital identities provides a technically accessible, internationally recognized protocol that enables smaller, under-resourced institutions to participate in collaborative networks without requiring expensive proprietary systems or extensive technical expertise

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Supporting evidence or results from the project	**3. Regulatory Gaps and Ethical Concerns Validate AURORA's Privacy-First Blockchain Architecture** Survey responses identified substantial regulatory and ethical barriers that AURORA's blockchain design could help to address through technical architecture choices. Over 60% of respondents indicated that national policies inadequately support digital transformation, with concerns centered on unclear legal frameworks, data privacy protection, and lack of regulatory guidance for emerging technologies. Additionally, over 80% acknowledged ethical implications regarding sensitive cultural objects, particularly those with religious or contested heritage significance. These dual concerns regulatory uncertainty and ethical sensitivity explain why blockchain adoption remains theoretical despite conceptual interest. AURORA's implementation of encrypted IPFS storage for off-chain data combined with on-chain authentication directly responds to these privacy and sovereignty concerns, ensuring that sensitive collection information remains under institutional control while leveraging blockchain's transparency and immutability for authentication purposes. This architecture demonstrates that blockchain can be deployed in culturally sensitive contexts without compromising ethical principles or data protection requirements addressing the sector's most significant adoption barriers through technical design rather than requiring institutions to compromise their values or regulatory compliance	
References for AURORA contribution	• *Link 1* • *Link 2* • *Link 3* • *Link 4* • *Link 5* • *Link 6* • *Link 7* • *Link 8* • *Link 9* • *Link 10* • *Link 11* • *Link 12* • *Link 13*	• *Link 14* • *Link 15* • *Link 16* • *Link 17* • *Link 18* • *Link 19* • *Link 20* • *Link 21* • *Link 22* • *Link 23* • *Link 24*

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3

ENIGMA

IMPLEMENT STANDARDIZATION ON CULTURAL HERITAGE DATA DOCUMENTATION AND OPEN ACCESS TO EXISTING DATA

Identified problem	Currently the problem with the identification of undocumented cultural goods lies in the fact that existing data of documented CGs that can be found in cultural heritage organizations like museums, ministries of culture or national cultural heritage management organizations are not standardized and not in the public domain even for data existing in public websites. The majority of illegally trafficked cultural goods are unknown and undocumented, which significantly limits the existing technological solutions. Authenticating and tracing cultural goods depends on the quality and availability of documentation data. Currently the identification of an object is usually performed using the minimum amount of information (Object-ID), which limits the traceability. There is a need to extend the evidence base, by using a holistic documentation as well as spatial/location associations. The quality, relevance, and format of the different data sources are very heterogenous affecting their ability to become reliable and actionable tools. Furthermore, there is a dilemma of intellectual property rights vs open access. This means that various issues of data privacy, confidentiality of commercial interests exist and need to be addressed at a European level. This fact has as a result that there are no incentives for business actors to engage in co-development, co-creation, and co-production of tools with multi-disciplinary actors including academia and end users. Currently the interlinking and accessibility of the existing databases is limited by institutional, regulatory, security and governance barriers, e.g. limited access to LEA databases due to legal and security regulations. Interoperability of existing databases is also limited by technical / technological barriers. Another part of the existing barriers is the methodological legitimacy and the ethical and legal and ethical aspects. With respect to the methodological legitimacy tech logical and knowledge gaps appear in the end users such as AI literacy among LEAs, or lack of awareness of modern solutions by the end-users. Unwillingness to adopt new technologies or skepticism about novel solutions are part of the social/uptake barriers.

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	Another barrier is the budget limitation for a great number of stakeholders and end user like small museums that prevents them digitizing their documentation procedures and using the proposed solutions. Finally, organizations responsible for standard creation may decline to include results in rules based on the lack of a legal framework and security limitations on the communication and dissemination of results. The Ethical legal aspects include among others institutional, regulatory and governance barriers, uncertainty on the responsibility for ownership and maintenance of databases e.g. intermediate tracking data databases, legal considerations and regulation compliance of AI tool, and legal aspects relating to the accessibility/ storage of data, and GDPR and IPR issues of cultural goods documentation data.
Policy recommendation	Policy support needs and recommendations target organizational (ORL), societal (SRL), legal (LRL), and technology (TRL) readiness levels. The existing evidence base (CG documentation) currently contains only the minimum amount of information (Object-ID), which limits the traceability and identification of undocumented CGs. • Extend the object-Id to include a holistic documentation of CGs as well as additional associations by using an approach like ENIGMA's Unique Authenticity Identifier. (increasing TRL, LRL, and ORL) • Create international standards for a: the holistic documentation of cultural heritage goods, b) database content, structure, data models/ontologies for intolerable cultural goods authentication and tracking, and c) common security, operational, and organizational protocols to be followed by Law Enforcement agencies during the tracking of a cultural good. These should be in the form of an internationally acclaimed quality assurance scheme. (Increasing TRL, LRL, and ORL). • Create an enabling governance framework and a establish a security and legal framework for existing database interlinking and exchange. (LRL, TRL) • Promote the dialog and cross cluster complementarities between the CH and Security projects. (TRL, SRL) • Invite and require conceptualization of upscale demonstrators in future HE calls to generate operational cases, narratives and best practices to be diffused between LEAs and CH institutions to help mature the market.

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Objective	Protecting, authenticating, and tracing illegally trafficked cultural goods is based on the availability of documentation data both for known and unknown / undocumented objects. The standardization of documentation of CH objects will provide an easy way for exchanging and sharing data between the cultural heritage ecosystems. The goal of enhancing interoperability is to improve data exchange between the relevant stakeholders, and thus improve coordination, help the identification and tracing of illegally trafficked cultural goods resulting in better cultural heritage protections. In addition, data interoperability will help cultural heritage experts on a global level to enhance their research when documenting unknown cultural goods. Furthermore, the training of AI algorithms that can provide similarity metrics between unknown / undocumented cultural goods and known registered cultural goods need vast amounts of data. Open access to the online public websites of cultural heritage institutions and the license to use that data, including images for training the algorithms and use them in a central database project database with the proper references when showing them to the users will vastly improve the identification of unknown objects and will be valuable tool not only in the fight against illicit trafficking of cultural goods but also in the documentation of cultural goods performed by cultural heritage experts.
Connection to existing EU policies and legislation	This recommendation directly aligns with the broader European framework for data governance and digital transformation. It integrates the objectives of the **Open Data Directive (Directive (EU) 2019/1024) and its predecessor, Directive 2013/37/EU**. Furthermore, it supports the vision set out in the European Data Strategy. In addition, it reinforces the implementation of the Data Governance Act and the Data Act. Closely linked to these principles, it also contributes to the development of **Common European Data Space for Cultural Heritage**. Finally, this recommendation supports the **Interoperable Europe Act**, and complements the regulatory framework established by the **AI Act.**
Proposed level(s) of intervention	• European Commission (DG CONNECT, DG HOME, DG EAC) • EU Agencies (Europol, EACEA, EIT) • European Initiatives (Europeana Initiative, European Cloud for Cultural Heritage)

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Key Stakeholders involved	ENIGMA's policy recommendations is addressed to the following stakeholder groups: • Policy makers at EU and national level involved in decision making • Cultural heritage networks on European, national, and regional level • Cultural heritage institutions • Law Enforcement agencies • collaborating professionals.
Supporting evidence or results from the project	ENIGMA performed a survey in online databases and sites that provide information about stolen cultural goods or documented cultural goods in order to assess the type of information included in the databases and their standardization on how these parameters are being documented. The survey investigated the existence of 22 parameters that can be used to document a cultural good. The parameters were title, subject, short description, type of object, date or period, maker/author/editor, material and techniques, dimensions, object photos, owner of object, provenance, country, origin, inscriptions & markings, distinguishing features, signature, keywords, additional information, items attached, place of publication, type of export, and contact. The initial survey included 15 online databases and sites such as FBI's national stolen art File, ID-art, Lost art database, Proveana, ICOM red list, ITPc, etc. During the course of the project other online databases were examined including mostly museum online catalogs. During the investigation it became evident that each database was using different parameters and different ways to describe them. Each organization used their own database structure and standardization, which in some cases was different for objects of the same civilization and origin when documented by different curators. For example, in the period or date field of Egyptian cultural goods, some records provided a temporal description while for other ones the dating was provided by using the Pharoh dynasty. This plethora of approaches, database structures, and parameter description lead ENIGMA to design and develop a structured and standardized database for the documentation of cultural goods. The ENIGMA main database is based on Europeanea data model enriched with CIDOC-CRM and Dublin core classes transformed in a hybrid schema. The developed schema is a flexible framework designed to facilitate the aggregation, integration, and sharing of cultural heritage metadata across Europeana's digital platform and all the cultural management systems that incorporate similar standardization. This model facilitates the interoperability of diverse data sources, enabling museums, archives, and libraries to contribute their digital collections in a structured and consistent manner.

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Supporting evidence or results from the project	In order to standardize the terminology used since the vocabularies used across museums, archives and libraries is not unified the ENIGMA dataset exploited the Getty Thesaurus to provide a unified approach on the vocabularies for cultural heritage information facilitating better interoperability, data sharing, and retrieval. Finally, the ENIGMA database was designed with an open architecture in order to facilitate the transition to the European Collaborative Cloud for cultural heritage standardization and structure quick and with the minimal effort. The ENIGMA project has developed all the infrastructure needed to allow the integration of its database with the ECCCH infrastructure when operational. **Data access and sharing** Cultural goods documentation data are an essential source of information for the ENIGMA platform and for the identification of unknown / undocumented cultural heritage artifacts. Data is used for the training of machine learning and artificial intelligence algorithms and provides a base for any system that can search to find similarities between known and well documented artefacts and unknown cultural heritage goods. During the course of its implementation ENIGMA identified a large number of online CGs databases documenting stolen or lost cultural goods and known ones. The majority of the public databases concerning known cultural goods are websites of museums or national cultural heritage management organizations, with online catalogs. Even though the sites are public and the data can be accessed by everyone downloading the documentation data or using them for other purposes requires additional permissions described in the terms of use of each website. ENIGMA examined the terms and conditions of a large number of online databases publicly available through the websites of cultural heritage organizations. The majority of the terms and services of these websites stated that reproduction, editing dissemination of their data requires the prior express and written consent of the data owners. In some of them there was a term allowing the use of data for private or non-commercial purposes. ENIGMA contacted the owners of databases from several websites querying if it can use their data for research purposes and only during the course of the project in order to train machine learning and artificial intelligence algorithms and use the data in the ENIGMA database. The majority of the sites either did not respond or responded negatively.

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CONCLUSION

The fight against illicit trafficking and looting of cultural goods demands a coordinated European response, leveraging technological innovation and interdisciplinary collaboration to safeguard our shared heritage. ANCHISE, AURORA, and ENIGMA highlight the urgent need for a coordinated EU response to combat illicit trafficking and looting of cultural goods, integrating technological innovation and policy coherence.

The **Interdisciplinary Competence Centre** centralizing expertise across law enforcement, cultural institutions, and researchers on the collaboration model brought by ANCHISE will bridge fragmentation, standardize national capacities, and ensure sustained collaboration. By institutionalizing knowledge-sharing, the Centre closes gaps traffickers exploit and enhances operational responses through unified strategies. A **standardized blockchain system**, building on AURORA's success, will secure provenance records and automate customs checks. Immutable digital identities prevent forgery, simplify due diligence, and disrupt black-market trade by enabling real-time verification of legal ownership. ENIGMA's **Unique Authenticity Identifier (UAI)** framework harmonizes documentation, enabling interoperability between databases. Open access to structured, AI-friendly data strengthens identification of undocumented looted goods and accelerates cross-border investigations. Furthermore the ENIGMA platform integrates all the developed tools in a holistic way allowing Law Enforcement agency officers and cultural heritage experts to interact, examine, research and investigate potential illegally trafficked cultural goods focusing on unknown / undocumented artefacts.
Embedding these measures within EU frameworks like the **Security Union Strategy, Digital Europe and the funding for Horizon** ensures sustainability beyond project cycles. By prioritizing technological advancement, fostering SSH-informed solutions, and centralizing expertise, the EU can combat transnational crime, uphold cultural heritage as a security priority, and lead globally in heritage protection. Immediate action by EU institutions could ensure an alignment with the **2028-2034 MFF, securing long-term impact.**

The EU can and must secure heritage as a strategic priority, leveraging innovation to dismantle trafficking networks and safeguard collective memory.

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