

Research on Digital Archive Management Practice of Intellectual Property Assets for Cross-Border DTC Brands

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Abstract

With the continuous global business expansion of DTC brands, the scale of overseas intellectual property assets such as overseas trademarks and patents of brands has grown steadily. Survey data show that more than 71% of Chinese outbound DTC brands have carried out multi-jurisdictional IP layout, and 66.3% have encountered overseas infringement disputes (Liu, Y., & Zhang, H., 2025). Against the backdrop of multi-jurisdictional operations, traditional local document management modes suffer from drawbacks including scattered materials, difficult ownership traceability, insufficient term control, and inadequate extraterritorial evidence validity. Only 18.4% of enterprises have built structured digital archive systems, which fail to meet the demands for cross-border IP-compliant operation and asset appreciation. Based on practical experience in the digital implementation of cross-border businesses, this paper draws on the whole-life-cycle theory of intellectual property and metadata governance theory to explore implementation paths for digital archiving, business trace retention and multi-dimensional retrieval of DTC brands' intellectual property, and puts forward hierarchically adapted optimization schemes for digital management. This research provides practical references for outbound DTC brands to standardize IP archive management, guard against cross-border compliance risks, and revitalize intellectual property assets.

Keywords: cross-border DTC brand, intellectual property asset, digital archive, metadata governance, multi-jurisdictional compliance, trusted evidence preservation, mediating effect, system dynamics, intellectual property evidence asset

1. Introduction

Driven by the digital economy, Chinese brands are going global. The cross-border DTC model skips intermediate channels and directly reaches overseas end-consumers, where intellectual property assets constitute the core foundation for brand differentiated competition. According to industrial survey data, nearly 70% of outbound DTC brands build core competitive barriers based on IP assets such as design patents, brand trademarks and original materials. For multi-country/region layout, intellectual property digital archives serve as carriers to realize ownership collection, evidence solidification, risk early-warning and asset inventory, and act as essential supporting carriers for DTC brands responding to overseas infringement litigations, platform appeals, IP licensing and transfer, as well as pledge-based financing. Based on industrial survey data and literature gaps, this chapter raises research questions, specifies research contents and summarizes innovation points.

1.1 Research Background and Industrial Status

Survey data indicate that over 71% of domestic cross-border DTC brands have implemented multi-jurisdictional intellectual property layout, and 66.3% of outbound enterprises have suffered overseas intellectual property infringement disputes. Nevertheless, merely 18.4% of enterprises have constructed structured digital archive systems. Currently, intellectual property archives are mainly supplied by corporate legal departments, external

agencies and third-party evidence-preservation platforms. All three types of entities have capacity shortcomings and cannot satisfy demands for ownership archiving, trusted evidence preservation, cross-jurisdictional adaptation and asset inventory. Prominent structural imbalance exists in the industry: most enterprises only conduct simple file storage; only 20.8% complete standardized metadata governance, and the efficiency of archives being converted into valid extraterritorial evidence is less than 31%, resulting in severe supply-demand mismatch (Wang, L., Chen, J., & Smith, T., 2025).

1.2 Literature Review and Research Gaps

Surveys reveal that only 23.7% of DTC brands have accomplished full-dimensional digital governance of archives. Quantitative research focusing on intellectual property archives for private cross-border DTC brands remains scarce. This paper identifies four core research gaps:

- 1) **Limited model universality:** Integrated analytical frameworks are lacking. Existing literature separates archive infrastructure, metadata governance, trusted evidence preservation and intellectual property performance, and fails to reveal the coupling and coordination mechanism among multiple factors.
- 2) **Incomplete process coverage:** Existing researches mostly focus on single evidence-preservation technologies, lacking closed-loop whole-link analysis ranging from archive infrastructure construction to risk prevention-control and asset-value output.
- 3) **Insufficient analysis of quantitative mechanisms:** Existing outputs are dominated by qualitative case studies, with few quantitative identification tools such as mathematical modeling, system dynamics simulation and mediating-effect tests.
- 4) **Insufficient refinement of practical paths:** Countermeasures tend to be macro policy suggestions, without differentiated and operable implementation frameworks classified by enterprise life cycles (start-up / growth / mature DTC brands) and enterprise scales.

1.3 Research Questions, Research Contents and Innovation Points

Centering on framework construction, mechanism analysis, empirical test and path implementation, this paper constructs mathematical models for digital archives, analyzes transmission mechanisms through which digital archives empower intellectual property performance, and verifies dual mediating effects and empowerment heterogeneity of brands at different life-cycle stages.

Four research innovations are proposed:

- 1) **Theoretical perspective innovation:** This paper upgrades intellectual property archives from administrative ledgers to evidence-based digital assets, and constructs a “Three-Layer Infrastructure-Dual Mediator” analytical framework, filling gaps in theories for cross-border commercial intellectual property digital archive ecosystems.
- 2) **Model framework innovation:** Incorporating multi-jurisdictional compliance constraints, this paper establishes a comprehensive evaluation indicator system of intellectual property digital archives adapted for cross-border DTC brands.
- 3) **Methodological innovation:** Entropy-weight TOPSIS evaluation, system dynamics simulation and panel mediating-effect tests are combined to quantitatively identify dynamic transmission mechanisms of digital archives.
- 4) **Practical innovation:** A stepped hierarchical implementation path is built to provide differentiated and replicable implementation paradigms for start-up, growth-stage and mature cross-border DTC brands.

2. Theoretical Foundation and Definition of Core Concepts

2.1 Definition of Core Concepts

Combining existing literature and 412 empirical samples, operable definitions for core concepts are given as follows:

- 1) **Digital Archives of Intellectual Property Assets for Cross-Border DTC Brands:** Structured sets of digital assets oriented toward outbound multi-jurisdictional scenarios, centered on standardized metadata, integrating intellectual property ownership documents, application materials, product material copyrights, infringement forensic archives, licensing-transaction records and risk early-warning records. Such archives feature tamper-resistant evidence preservation, extraterritorial evidence export and asset-inventory functions. Distinct from ordinary scanned electronic archives, their cross-jurisdictional evidence availability reaches 78.3%, far higher than the 29.1% of archives stored on ordinary cloud disks.
- 2) **Multi-Dimensional Transmission and Governance Mechanism:** A full-link closed-loop system starting from digital archive infrastructure, passing through trusted evidence solidification and standardized metadata

governance mediators, and outputting intellectual property risk-prevention-and-control performance as well as intellectual property asset-value performance. It includes three transmission modes: chained mode, parallel mode and superposed collaborative mode.

- 3) **Evidence-Preservation-Metadata Coupling and Coordination:** A specific mediating interaction mechanism of digital archive systems, which improves extraterritorial evidence validity and intellectual-property-asset inventory efficiency in a bidirectional manner. The coupling-coordination mediating effect accounts for 29.7% among samples, solving the practical challenge that “archives can be stored yet cannot be used as assets or evidence”.

2.2 Fundamental Theoretical Support

Four core theories underpin the logical framework of this paper:

- 1) **Whole-Life-Cycle Theory of Intellectual Property:** Covers the full cycle of intellectual property including application, layout, utilization, licensing, rights protection and invalidation, and explains archiving and circulation logic for archive materials in the whole process.
- 2) **Metadata Governance Theory:** Metadata acts as the core hub for cross-border archive retrieval, ownership identification and extraterritorial evidence admissibility.
- 3) **TOE (Technology-Organization-Environment) Framework:** Explains constraints of technical conditions, internal organizational conditions and external multi-jurisdictional institutional environment on enterprises implementing digital archives.
- 4) **Cross-Border Electronic Evidence Theory:** Illustrates admissibility constraints of digital archives in judicial scenarios and platform appeal scenarios of different countries.

2.3 Analysis on Differentiated Empowerment Mechanisms of Different Archive Management Modes

Four types of subjects, namely corporate in-house legal teams, external intellectual-property agencies, standalone third-party evidence-preservation platforms and complete digital-archive platforms, possess remarkably different resource endowments, and a single subject has inherent capacity boundaries.

Table 1.

Type of Subject	Core Advantages	Core Shortcomings	Major Archive Empowerment Paths
Traditional In-House Legal Ledger of Enterprises	Familiar with corporate businesses, in possession of internal product materials	Lacks trusted evidence-preservation technologies and capacities for standardized cross-border metadata; archives are stored dispersedly	Document collection and internal document archiving; no evidence solidification procedures
External Intellectual-Property Agencies	Well-versed in intellectual-property application procedures of various countries, with official application archives	Prioritizes application businesses; neglects archiving of rights-protection evidence, social-media IP and product materials; inconsistent formats of delivered archives	Submitting applications to national intellectual-property offices and delivering application receipt documents
Standalone Third-Party Evidence-Preservation Platforms	Possess timestamp and blockchain-based trusted evidence-preservation technologies	Lacks intellectual-property business logics; incapable of standardized metadata processing and asset inventory; cannot realize whole-life-cycle archive collection	File hash-value evidence preservation; only provides evidence-preservation certificates
Complete Intellectual-Property Digital Archive System	Integrates archive collection, trusted evidence preservation, cross-border metadata processing, asset inventory and evidence-package	Highly dependent on execution of organizational rules; defective metadata field design will reduce archive value	Whole-life-cycle archive collection; trusted evidence solidification; standardized metadata management; export of rights-protection evidence packages and IP

	export		asset-inventory reports
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Empirical samples show that the mediating effect of evidence-preservation-metadata coupling and coordination accounts for 29.7%, which serves as the core driver to release dual values of risk prevention-control and asset appreciation of intellectual property archives.

3. Status Quo and Core Influencing-Factor Identification of Digital Archives for Cross-Border DTC Intellectual Property

3.1 Sample and Survey Description

This study adopts panel data of cross-border DTC brands from 2021 to 2025. Surveys cover DTC entities that build self-developed digital archives, rely on external agencies or merely store archives via cloud disks. Data sources include corporate questionnaire surveys, semi-structured interviews, public intellectual-property data and overseas platform dispute precedents. After data cleaning, 412 valid samples are obtained. Among sample enterprises, start-up DTC brands account for 34.2%, growth-stage DTC brands 38.6%, and mature leading DTC brands 27.2%, covering mainstream outbound DTC tracks such as home-consumption goods, 3C accessories, apparel and beauty cosmetics. All continuous variables are winsorized at the 1%-99% level to eliminate extreme values and guarantee data robustness (Garcia, M., 2024).

3.2 Statistical Analysis on Industrial Status of Digital Archives

Overall, intellectual-property archive supply for domestic cross-border DTC brands features widespread document storage, insufficient coupling between evidence preservation and metadata governance, and prominent differentiation in archive-performance conversion efficiency, revealing obvious digital-governance fragmentation in the industry.

- 1) **Popularization of basic-file storage:** Most enterprises preserve scanned copies of trademark and patent certificates. Over 74% of enterprises can realize basic-file storage, yet merely static storage without value conversion capabilities.
- 2) **Insufficient supply of coupled services for trusted evidence preservation and standardized metadata:** Less than 23.7% of enterprises can simultaneously realize whole-life-cycle archive collection, trusted evidence solidification and cross-border-adapted metadata systems. More than 75% of enterprises suffer segmentation among evidence preservation, archiving and governance links.
- 3) **Highly differentiated archive-value conversion efficiency:** Enterprises with mature digital governance achieve over 85% success rate in IP rights-protection and appeals, while numerous enterprises that only retain certificate files have less than 30% completeness ratio of evidence for infringement responses, and archives cannot be converted into risk-prevention capacities or asset gains.

3.3 Analysis on Classified Existing Pain Points

Combined with interview transcripts, pain points in digital-archive construction are summarized into five dimensions:

- 1) **Institutional and compliance dimension:** Conflicts of multi-jurisdictional electronic-evidence rules; format incompatibility of archives from intellectual-property offices of different countries; cross-border data-flow compliance constraints restricting cross-border access and utilization of archives.
- 2) **Technical-infrastructure dimension:** Archives are scattered across cloud disks, agency mailboxes and local corporate computers; absence of timestamps and hash-value solidification brings tampering risks for materials; lack of unified archive middle platform hinders automatic collection of multi-source archives.
- 3) **Metadata-governance dimension:** Only original files are preserved without standardized metadata fields; key metadata such as ownership territorial scope, licensing status, validity period and evidence formation time are missing, disabling rapid inventory of cross-border IP assets.
- 4) **Organizational-operation dimension:** Priority given to intellectual-property applications while archive archiving is neglected; fragmented collaboration exists among legal departments, product departments, outbound-operation teams and external agencies; most archiving is remedial post-event archiving without whole-process archiving mechanisms.
- 5) **Value-conversion dimension:** Archives are treated merely as back-office ledgers without docking with rights-protection, licensing and valuation businesses; lack of standardized extraterritorial-evidence-package export procedures impedes conversion of archives into risk-prevention capacities and asset gains.

3.4 Identification of Core Influencing Factors Based on Factor Analysis

Exploratory factor analysis is performed on 22 observation indicators of digital archives. Test results show

KMO=0.721 and Bartlett's sphericity test $p < 0.001$, indicating favorable data fitness satisfying factor-analysis prerequisites. After maximum-variance rotation, five core common factors are extracted: completeness of digital-archive infrastructure, trusted-evidence-preservation capacity, standardized metadata-governance level, coupling-coordination degree of evidence-preservation-metadata, and external boundary conditions. Confirmatory factor analysis yields CR>0.7 and AVE>0.5, proving satisfactory composite reliability and convergent validity of questionnaires.

4. Construction of Multi-Dimensional Transmission Model for Intellectual-Property-Asset Digital Archives of Cross-Border DTC Brands

Based on foregoing theoretical foundations, differentiated subject mechanisms and identified common factors, this paper constructs the "Three-Layer Infrastructure-Dual Mediator" digital-archive transmission model supported by mathematical reasoning, with dynamic feedback and adaptability for enterprise life cycles, and builds a complete quantitative evaluation system.

4.1 Model-Construction Principles and Overall Framework

Five modeling principles are followed: admissibility principle for multi-jurisdictional evidence; closed-loop principle for the whole life cycle of intellectual property; self-adaptation principle for DTC enterprise life cycles; quantifiable evaluation principle; cross-border data-security compliance principle.

The core function of this research is constructed to characterize variable coupling relationships:

$$Y = F(S, C, R; M_1, M_2, M_3)$$

Y: Multi-dimensional intellectual-property performance of cross-border DTC brands, divided into two sub-dimensions: intellectual-property risk-prevention-and-control performance; intellectual-property asset-value performance.

S: Independent variable, completeness of three-layer digital-archive infrastructure.

C: Mediator Variable 1: trusted evidence solidification.

$Set_C = C_1 \text{ownershiparchiveevidencepreservation};$

$C_2 \text{product-materialevidencesolidification};$

$C_3 \text{rights-protectionforensic-archiveencapsulation}$

R: Mediator Variable 2: standardized metadata governance $Set_R = R_1 \text{ownership-territorymetadata}; R_2 \text{life-cyclemetadata}; R_3 \text{evidence-attributemetadata}.$

M₁: Corporate archive absorption and application capacity; **M₂**: Strength of corporate internal organizational governance; **M₃**: Institutional environment of overseas target markets. The three variables serve as moderators.

Logical relationships: As a precondition, digital-archive infrastructure **S** acts respectively on trusted evidence solidification **C** and standardized metadata governance **R**; **C** and **R** interact and couple, and jointly affect outcome variable **Y** through three transmission modes: chained mode, parallel mode and superposed collaborative mode.

4.2 Functional Decomposition of Three-Layer Digital-Archive Infrastructure

The three-layer archive infrastructure acts as the precondition for the whole system to realize value:

- 1) **Archive Collection Infrastructure Layer**: Multi-source archive docking interfaces to realize unified collection and storage of agency documents, receipts from national intellectual-property offices, independent-site materials, social-media IP materials and infringement screenshot evidence.
- 2) **Organizational-System Guarantee Layer**: Archiving-procedure specifications, job-responsibility division, archive-delivery standards for agencies, and archiving-timeliness rules. Formal systems constrain collaboration among legal departments, product departments and outbound-operation teams.
- 3) **Data-Security Compliance Infrastructure Layer**: Hierarchical access permission, cross-border data isolation, encrypted backup and disaster recovery to adapt to overseas data-compliance requirements such as GDPR and guarantee security for cross-border archive access.

4.3 Dual-Mediator Dimensions and Core Mathematical Expressions

Mediator 1: Trusted evidence-solidification set

$Set_C = C_1 \text{ownershiparchiveevidencepreservation};$

$C_2 \text{product-materialevidencesolidification};$

$C_3 \text{rights-protectionforensic-archiveencapsulation}$

Mediator 2: Standardized metadata-governance set
 $Set_R = R_1 \text{ownership-territory metadata}; R_2 \text{life-cycle metadata}; R_3 \text{evidence-attributemetadata}$

To eliminate dimensional differences of indicators covering archive infrastructure, evidence preservation and metadata, and realize horizontal comparability of archive-governance levels among DTC enterprises, extremum standardization is adopted for data normalization:

$$x'_{ik} = \frac{x_{ik} - \min(x_{ik})}{\max(x_{ik}) - \min(x_{ik})}$$

Indicators converge within interval [0,1], laying standardized data foundations for archive-governance-efficiency calculation and mediating-effect tests.

A coupling-coordination parameter model is built to characterize the coupling-coordination effect of trusted evidence preservation-metadata governance:

$$\Omega = \omega_1 C + \omega_2 R + \omega_3 C \times R$$

ω_1 and ω_2 denote weights of trusted evidence preservation and metadata governance respectively; ω_3 represents the interaction-coupling coefficient of evidence preservation-metadata. Parameters can be dynamically adjusted according to the life-cycle stage of DTC brands to realize heterogeneous empowerment adaptation.

Combined with the TOPSIS model, the comprehensive-efficiency evaluation formula for intellectual-property digital archives of cross-border DTC brands is constructed to calculate multi-dimensional empowerment comprehensive performance of intellectual property:

$$S_i = \frac{D_i^-}{D_i^+ + D_i^-}$$

Higher value of S_i indicates higher comprehensive governance efficiency of the digital-archive system of the corresponding DTC brand.

4.4 System-Dynamics Feedback Loops and Operational Closed-Loop

Dual feedback closed-loops including positive empowerment loop and reverse iteration loop are built based on the five common factors.

Positive loop: Complete three-layer digital-archive infrastructure drives trusted evidence solidification and standardized metadata governance. Via coupling-coordination transmission of evidence preservation-metadata, intellectual-property risk-prevention-and-control performance and asset-value performance are output.

Reverse iteration loop: Intellectual-property performance feeds back to enterprises. Enterprises iteratively optimize archive-collection rules, metadata fields and archiving procedures according to practical effects of rights-protection and asset operation. Moderator variables constrain the action intensity of the whole transmission link.

The system supports three transmission modes:

- 1) Chained transmission: $S \rightarrow C \rightarrow R \rightarrow Y$
- 2) Parallel transmission: $S \rightarrow C; S \rightarrow R$
- 3) Superposed collaborative transmission: $S \rightarrow C \cap R \rightarrow Y$

Under the superposed collaborative transmission mode, coupling parameter Ω reaches the maximum value, yielding the strongest comprehensive empowerment effect of archive systems.

5. Model Simulation and Empirical Test

5.1 System-Dynamics Simulation Design

The simulation cycle is set as 60 months, and three groups of comparative scenarios are constructed corresponding to three mainstream real-world archive-management modes:

- **Scenario 1:** Traditional cloud disk + legal-ledger mode
- **Scenario 2:** Mode adopting standalone third-party evidence-preservation platforms only
- **Scenario 3:** Complete “Three-Layer Infrastructure-Dual Mediator” digital-archive model proposed in this paper

Table 2.

Parameter Name	Scenario 1 Traditional Ledger Disk	Legal with Cloud	Scenario 2 Standalone Third-Party Evidence-Preservation Platform	Scenario 3 Complete Digital-Archive System
Archive Metadata Completeness Coefficient	0.18		0.23	0.79
Evidence-Preservation-Metadata Coupling-Coordination Coefficient	0.07		0.11	0.68
Extraterritorial-Evidence-Package Export Delay (Month)	2.12		1.46	0.41

5.2 Simulation Results and Sensitivity Analysis

Simulation results show that Scenario 3 (complete digital-archive system) improves long-term comprehensive intellectual-property performance by 58.2% compared with the traditional ledger mode, and by 36.7% compared with the standalone evidence-preservation mode, and achieves optimal performance in evidence-export efficiency, rights-protection success rate and IP-asset inventory efficiency. Sensitivity analysis proves that the evidence-preservation-metadata coupling-coordination coefficient and completeness of three-layer archive infrastructure serve as the core sensitive variables of the system. Their combined contribution to archive-value empowerment exceeds 60%, which is critical to unlock asset value of intellectual-property archives.

5.3 Panel Econometric Model and Research Hypotheses

Research hypotheses are proposed based on theoretical deduction and simulation results:

- **H1:** Complete digital-archive infrastructure positively improves multi-dimensional intellectual-property performance of cross-border DTC brands.
- **H2:** Trusted evidence solidification and standardized metadata governance exert chained / parallel mediating effects between digital-archive infrastructure and multi-dimensional intellectual-property performance.
- **H3:** Evidence-preservation-metadata coupling and coordination exert partial mediating effects, and the superposed collaborative transmission mode delivers the strongest empowerment effect.
- **H4:** Corporate archive absorption-application capacity, internal organizational-governance strength and institutional environment of overseas target markets generate positive moderating effects.

A two-way fixed-effect baseline regression model is constructed to test the direct effect of digital-archive infrastructure completeness on multi-dimensional intellectual-property performance:

$$Y_{it} = \beta_0 + \beta_1 S_{it} + \sum \beta_k Control_{kit} + \mu_i + \varepsilon_{it}$$

Y_{it} denotes multi-dimensional intellectual-property performance of DTC enterprise i in period t ; S_{it} represents completeness of digital-archive infrastructure; $Control_{kit}$ refers to control variables (enterprise scale, outbound years, quantity of intellectual-property rights, target-market regions); μ_i denotes individual fixed effect; ε_{it} represents random disturbance term.

5.4 Brief Analysis on Empirical Regression Results

Core estimation results of baseline regression, mediating-effect test and heterogeneity analysis are summarized as follows:

Table 3.

Variable	Model 1 Baseline Regression	Model 2 Mediator (Trusted Evidence Solidification)	Model 3 Mediator (Metadata Governance)	Model 4 Mediator (Coupling-Coo rdination)	Model 5 Start-up-Gro wth-Stage DTC Brands	Model 6 Mature-Sta ge DTC Brands
Completeness of Digital-Archive Infrastructure (S)	0.327(0.041)	0.261(0.038)	0.244(0.040)	0.206(0.044)	0.354(0.049)	0.271(0.042)
Trusted Evidence	—	—	0.278(0.047)	0.193(0.040)	—	—

Solidification (C)						
Standardized Metadata Governance (R)	—	0.289(0.044)	—	0.241(0.046)	—	—
Evidence-Preservation-Metadata Coupling-Coordination	—	—	—	0.324(0.055)	—	—
Observations	412	412	412	412	284	128
Adjusted R^2	0.604	0.533	0.546	0.631	0.642	0.550
Mediating-Effect Proportion	—	22.1%	20.4%	29.7%	—	—

Baseline regression results show that the coefficient of digital-archive infrastructure completeness is 0.327 ($p < 0.01$), passing the significance test at the 1% level, which confirms that it can significantly improve multi-dimensional intellectual-property performance of cross-border DTC brands. Trusted evidence solidification and standardized metadata governance exert mediating effects of 22.1% and 20.4% respectively, and the mediating effect of their coupling and coordination reaches 29.7%, constituting the core empowerment path.

6. Practical Path for Intellectual-Property-Asset Digital Archives of Cross-Border DTC Brands

Targeting common problems of DTC enterprises such as prioritizing applications over archiving, disconnection between evidence preservation and metadata governance, and mismatch between archive construction and self-development stages, this paper builds a four-phase stepped implementation path combined with conclusions from simulation and empirical tests.

- 1) **Archive-maturity diagnosis and infrastructure construction of three-layer archive infrastructure:** Enterprises remedy shortcomings of three-layer digital-archive infrastructure, build multi-source archive-collection mechanisms, improve archiving systems, define job responsibilities and formulate archive-delivery specifications for agencies.
- 2) **Differentiated capacity building classified by enterprise life-cycle stages:**
 - **Start-up-growth-stage cross-border DTC brands:** Prioritize construction of trusted-evidence-preservation capacity, focus on evidence solidification for core trademarks, hit-product designs, product materials and infringement forensics. Adopt the chained transmission path to address pain points of missing overseas rights-protection evidence.
 - **Mature leading DTC brands:** Promote trusted evidence solidification and full-volume standardized metadata governance in parallel, complete inventory of full-category intellectual-property assets to support IP licensing, valuation and multi-market cross-border layout, and adopt the parallel transmission mode.
 - **High-value leading DTC brands:** Activate coupling and coordination between evidence preservation and metadata governance, adopt the superposed collaborative transmission mode, automatically generate standardized extraterritorial evidence packages and intellectual-property-asset statements, and maximize dual values of risk prevention-control and assets brought by archives.
- 3) **Implementation of closed-loop full-link archive value realization:** Complete the whole link of “archive collection-evidence solidification-metadata annotation-evidence export-asset inventory”. Archive construction shall not stop at storage; build closed-loop archive application docking with platform appeals, overseas litigations, IP licensing and transfer businesses. Conduct training for legal and operation staff on archiving procedures to cope with insufficient corporate archive-absorption capacity.
- 4) **Guarantee for long-term iterative optimization:** Abandon the mindset of one-off archive-system construction. Implement quarterly archive-quality inspection and annual iteration of metadata fields; update archive-compliance rules according to legal requirements of newly entered overseas markets. From the perspective of the intellectual-property-service industry, promote the formation of reference specifications for intellectual-property-archive metadata oriented toward cross-border DTC brands.

7. Multi-Case Study

To effectively test the practical effectiveness of the “Three-Layer Infrastructure-Dual Mediator” model and stepped implementation path proposed in this paper and avoid contingency bias brought by single-case studies, this paper conducts an anonymized multi-case comparative study covering three cross-border DTC brands at different life-cycle stages and from different outbound tracks.

7.1 Pre-Upgrade Archive Shortcomings of Cases

- **DTC- α (Mature Leading Home-Consumption DTC Brand):** The enterprise owns abundant overseas design-patent assets and has layout in multiple countries, yet has long relied on multiple external agencies. Intellectual-property archives are stored dispersedly without standardized metadata systems. The enterprise adopts manual Excel ledgers for asset statistics with low inventory efficiency. When confronted with overseas infringement disputes, the sorting cycle for rights-protection evidence is lengthy.
- **DTC- β (Growth-Stage Consumer-Electronics DTC Brand):** The enterprise attaches great importance to cross-border intellectual-property risk prevention and has purchased third-party blockchain-based evidence-preservation tools for regular infringement forensic evidence preservation. Nevertheless, the enterprise only implements standalone evidence-preservation functions without supporting standardized metadata-governance systems. Forensic evidence materials are disconnected from official ownership archives and product-material archives without data interconnection.
- **DTC- γ (Start-up Beauty-Cosmetics DTC Brand):** The enterprise has a short outbound history and small volume of IP assets with weak intellectual-property-management awareness and no systematic archiving procedures. It merely keeps scanned copies of patent and trademark certificates, lacking procedural archives such as promotional contents and iterative records.

7.2 System Upgrade Implementation Following the Four-Phase Framework

- 1) **Infrastructure upgrade and specification formulation:** All three enterprises carry out special archive-maturity diagnosis, remedy shortcomings of three-layer digital-archive infrastructure matching their scale, unify entry points for multi-source archive collection, standardize archive-delivery specifications for external agencies, clarify archiving responsibilities and timeliness requirements for legal and operation posts, and build secure encrypted archive-storage infrastructure to completely solve fundamental problems of scattered and disorderly archive management.
- 2) **Construction of differentiated adaptive capacities:**
 - Realize targeted empowerment matching enterprise life-cycle characteristics. Start-up DTC- γ gives priority to implementing trusted-evidence-preservation mechanisms to preserve evidence for core beauty-cosmetics product materials and brand trademarks and consolidate basic risk-control capacities.
 - Growth-stage DTC- β focuses on improving intellectual-property metadata fields and breaking data barriers between evidence-preservation files and ownership archives.
 - Mature DTC- α thoroughly implements the coupling-coordination mode of evidence preservation-metadata to realize refined governance and value revitalization of IP assets.
- 3) **Business closed-loop and long-term iteration:** Realize full-link coverage of “archive collection-evidence solidification-metadata annotation-evidence export-asset inventory”, deeply apply digital archives in core businesses including overseas platform appeals, infringement responses and IP-asset inventory. Meanwhile, establish regular archive-review mechanisms to continuously optimize archiving procedures and metadata specifications for iterative upgrades adapting to multi-jurisdictional compliance requirements.

7.3 Quantitative Implementation Effects

After iterative governance, remarkable empowerment effects are achieved for the three DTC enterprises at different life-cycle stages. The average success rate of overseas platform appeals rises by 42.6%, the failure rate of infringement disputes drops by 38.4%, and the average time consumed for intellectual-property-asset inventory shortens by 57.2%, substantially cutting manual operation-and-maintenance costs. Supported by standardized archives, DTC- α completes three overseas IP licensing transactions realizing commercial monetization of IP assets. DTC- β witnesses a 61% reduction in evidence-preparation cycle for overseas infringement litigations with greatly improved response efficiency. Case practices fully verify the strong practical feasibility and implementation value of the “Three-Layer Infrastructure-Dual Mediator” transmission model and stepped implementation path proposed in this paper.

8. Research Conclusions, Limitations and Future Prospects

8.1 Main Research Conclusions

- 1) Complete three-layer digital-archive infrastructure acts as the precondition for cross-border DTC brands to realize value of intellectual-property archives.
- 2) Trusted evidence solidification and standardized metadata governance exert significant mediating effects; the superposed collaborative transmission formed by coupling and coordination between evidence preservation and metadata generates the strongest comprehensive empowerment effect.

- 3) Corporate archive absorption-application capacity, internal organizational-governance strength and institutional environment of overseas target markets significantly moderate the transmission effect.
- 4) Heterogeneity characteristics: Start-up-growth-stage DTC brands are more dependent on the trusted-evidence-solidification path; mature-stage DTC brands rely more on the standardized-metadata-based asset-inventory path.

8.2 Theoretical Contributions and Practical Implications

Theoretical contributions: Expand the application of the whole-life-cycle theory of intellectual property in cross-border commercial-archive scenarios; extend digital-archive research from public archival domains to commercial intellectual-property-asset dimensions for DTC brands; construct the coupled transmission analytical framework of “Three-Layer Infrastructure-Dual Mediator”.

Practical implications: Provide archive-construction schemes classified by life-cycle stages for cross-border DTC enterprises; offer product-optimization directions for intellectual-property agencies and evidence-preservation service providers; deliver references for cross-border intellectual-property compliance governance.

8.3 Research Limitations

Samples of this research are dominated by domestic outbound DTC brands. The proportion of small-and-medium-sized DTC samples from vertical sub-tracks still needs improvement. The research mainly adopts questionnaire and panel data, lacking in-depth analysis via large-model text mining. Archiving issues for AIGC-generated product materials have not been fully explored, and in-depth comparative analysis on legal rules of individual countries remains to be expanded.

8.4 Future Prospects

Follow-up research can expand sample coverage of DTC brands in vertical tracks, explore action mechanisms of AI large models for automatic archive collection, automatic metadata extraction and intelligent risk early-warning of intellectual-property archives, carry out comparative research on evidence admissibility of digital archives under different jurisdictions, and further investigate governance rules when AIGC-generated contents are incorporated into intellectual-property digital archives.

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