Project Documentation and Business Strategy: Music Metadata Engine (MME)

Executive Summary

The music industry is currently at a turning point, characterized by unprecedented growth in digital revenues coupled with a collapse in data infrastructure. According to the latest CISAC report, global collection of royalties to creators reached a record €13.97 billion in 2024, with a whopping 10.8% of the increase coming from the digital sector, which surpassed the €5 billion barrier for the first time. Despite this success, the industry's [1] euro. fundamental operational layer—metadata—remains in critical condition. It is estimated that globally, over $2.5 billion annually ends up in the so-called "Black Box"—a pool of unpaid royalties that cannot reach their rightful owners due to data errors, lack of synchronization between ISRC and ISWC codes, and system incompatibility. [3]

The Music Metadata Engine (MME) is a comprehensive response to this challenge. It's not just another ID3 tag editing tool, but an advanced middleware infrastructure designed with a cloud-native architecture. MME integrates artificial intelligence (AI/ML) for audio signal analysis, rigorous DSP (Digital Service Provider) compliance validation modules, and DDEX-based supply chain automation.

This document provides a comprehensive business and technical analysis of the MME project. It is addressed to two key stakeholder groups:

1. **Investors:** Looking for scalable solutions in the MusicFinTech sector, capable of unlocking frozen capital and generating high margins through process optimization.
2. **End Users:** Labels, distributors and independent artists, for the correctness of metadata is a necessary condition for monetizing the work and avoiding rejection of the content by streaming platforms.

Chapter 1: Market Analysis and the Origins of the Crisis

Metadata

To understand the business imperative behind MME, a deep understanding of the dysfunctions of the current digital ecosystem is necessary. The transformation from a physical sales model to an access (streaming) model has exposed the archaic nature of reporting systems, which cannot cope with the volume of data generated by billions of microtransactions.

1.1 The Black Box Phenomenon: Quantifying Economic Losses

The term "Black Box" refers to revenues generated from the exploitation of music that have been collected by digital services (DSP) or Collecting Organizations (OZZ/PRO), but cannot be paid out due to the inability to identify the rightholder.

1.1.1 Financial Scale of the Problem

In the United States, The Mechanical Licensing Collective (The MLC) has collected over $424 million in so-called "historical unmatched royalties" – mechanical streaming royalties that have not been attributed to specific works or authors.[3] This is a direct consequence of the lack of coherence between the recording (Sound Recording) and the composition (Musical Work). Globally, the situation is even more alarming. A CISAC report indicates that unregulated use of content by generative artificial intelligence (GenAI) could in the future divert up to 25% of royalties due to creators, equivalent to approximately €8.5 billion annually, to unauthorized entities or leave them in a systemic limbo.[1]

1.1.2 Error Generation Mechanism

The primary cause of the Black Box is the severance of the bond between two key identifiers:

- **ISRC (International Standard Recording Code):** A unique identifier for a recording sound, provided by the record company or distributor.[6]
- **ISWC (International Standard Musical Work Code):** A unique identifier for a composition (notes and lyrics), assigned by organizations such as ZAiKS, ASCAP or BMI.[7]

At the time of streaming, Spotify and Apple Music report the use of an ISRC code. If this code isn't paired with the appropriate ISWC code in the OZZ database, the system doesn't know who to pay royalties to. MME solves this problem by algorithmically enforcing ISRC-ISWC pairings (WorksMatch) during pre-distribution, preventing funds from falling into a black hole.[8]

1.2 The Threat of Generative Artificial Intelligence (GenAI)

The music market is facing an unprecedented wave of machine-generated content,

drastically changes the requirements for metadata management systems.

1.2.1 The Volume Problem ("The Flood")

Streaming platforms are flooded with low-quality content. Deezer reports detecting over 30,000 tracks generated entirely by AI every day, representing nearly a third of all new uploads. This is intended to manipulate the "pro-rata" payout system, where [9] This scale of flooding each fake listen reduces the pool of money available to real artists. MME acts as a "Quality Filter," using spectral analysis to identify AI-specific signatures, protecting distributor catalogs from contamination.

[9]

1.2.2 The "Identity Thieves" Phenomenon (Spotify Scams)

At the same time, the phenomenon of "fake artists" is developing - profiles generated by fraudsters who impersonate famous artists or create thousands of generic performers (e.g. "Sleep Music Band") to steal playlist traffic. The AI track [11] There is often a situation in which is tagged with metadata suggesting a collaboration with the star (e.g. "feat. Taylor Swift"), which automatically puts it on the "Release Radar" of millions of fans, generating unauthorized profits before the fraud is detected. Identity validation via [12] MME implements rigorous the **DDEX Party ID (DPID) system,** preventing unauthorized artist tagging. [13]

1.3 The Economics of Rejection: The Cost of Mistakes in Style Guides

For end users (labels, artists), the most devastating consequence of metadata errors is DSP rejection of the release. Platforms like Apple Music and Spotify have extremely restrictive and frequently changing guidelines ("Style Guides").

1.3.1 Anatomy of Rejection

Analysis of industry forums and distributor documentation (e.g. DistroKid, Wiseband) indicates the most common reasons for blocking:

- **Title Formatting:** Use of all capital letters ("THE SONG"), unnecessary information in the title ("Song Title (Produced by X)"), or versioning errors ("Original Mix" instead of the formalized VersionTitle field). [14]
- **Language Mismatch:** A situation where the metadata indicates English, but the title The song is written in Japanese or Cyrillic characters. • [16]

Cover errors: Blurry graphics (upscaling), presence of URLs, logos social media platforms or cover prices. [14]

Each rejection is not only a waste of time, but above all, a loss of marketing potential (e.g., inability to submit to editorial playlists, loss of pre-saves). MME acts as an "ingestion simulator," checking compliance with over 200

Apple and Spotify validation rules before sending the files to the distributor.

Chapter 2: Music Metadata Technical Architecture

Engine (MME)

MME is not a static database; it's a dynamic processing pipeline, designed around microservices. The system architecture must cope with the so-called "Multiplicity of Music Data," where a single composition can have hundreds of recording incarnations.[18]

2.1 Data Infrastructure and Relational Schema

Traditional approaches based on flat CSV files or ID3 tags are inadequate in the modern streaming economy. MME uses a graph database to map complex relationships between entities.

2.1.1 Four Pillar Identification System

The foundation of MME is the rigorous enforcement of the presence and correctness of four key identifiers that together form a work's "digital passport"[19]:

ID	Full Name	Function in MME Ecosystem	Key Challenge (Solved by MME)
ISRC	International Standard Recording Code	Unique fingerprint of the recording (Master).	Preventing duplicates and "code drift" (using old codes for new remixes).[6]
ISWC	International Standard Musical Work Code	Unique identifier of the artwork (Work).	Automatic download of codes from OZZ databases (e.g. CISAC) via API to pair with ISRC.[7]

UPC/EAN	Universal Product Code	Commercial product identifier (Album/Single).	Aggregation of individual paths into a coherent product, validation checksums. [20]
IPI	Interested Party Information	Creator ID (composer/lyricist).	Identity verification to ensure publishing royalties go to the correct "Jan Kowalski". [21]

2.1.2 Resolving Identity Conflicts (Party ID)

To address the issue of mixing artist profiles with the same surname (e.g., "Bill Evans" – jazz pianist vs. saxophonist), MME implements the **DDEX Party ID (DPID)** and **ISNI standards.** In the MME system, "Artist" is not a string of characters, but an object with a unique ID. This allows the system to suggest a specific profile from the database during data entry, preventing user mismatches. [13]

2.2 Data Ingress and Cleaning Layer

Many MME clients (independent labels) have catalogs in a chaotic state – WAV files with names like FINAL_MASTER_v3_radiedit.wav and metadata in Excel spreadsheets.

2.2.1 Migration Engine (Legacy Catalog Cleanup)

MME is equipped with a parsing module that:

1. **RegEx Analysis:** Extracts metadata directly from filenames based on defined patterns.
2. **Acoustic Fingerprinting:** Uses **AcoustID** technology (related to MusicBrainz) to recognize a song based on its sound waveform alone, even if the file has no tags. This allows it to automatically fill in missing fields such as "Release Year" or "Publisher." [23]
3. **BWF Verification:** Reads metadata embedded in Broadcast Wave Format file headers (commonly used in recording studios) that is missed by standard players. [24]

2.2.2 DDEX ERN Standard Support

For corporate clients, MME offers full support for the **Electronic Release** standard.

Notification (ERN). The industry is currently in the transition phase from ERN 3 to ERN 4.

- **Challenge:** ERN 3 duplicates creator data in every recording, leading to inconsistencies.
- **MME Solution:** The system natively operates on the ERN 4.3 framework, which introduces a PartyList – a central list of creators at the beginning of the XML message. MME automatically converts older feeds (ERN 3.8.2) to the new standard, ensuring data hygiene at the structural level. [25]

2.3 The Matching Logic

MME's greatest added value is the automation of a process that takes months at OZZ. The system uses fuzzy matching algorithms to connect recordings with compositions.

- **Scenario:** A user submits a cover of "Yesterday." • **MME Operation:**
The system analyzes the title and, optionally, the melody (via the Melody module in the Essentia library). It then searches global databases for ISWCs for Lennon/McCartney compositions. Instead of creating a new, invalid entry in the OZZ database ("Duplicate Work"), MME links the recording to the existing ISWC, guaranteeing immediate royalty flow. [8]

Chapter 3: Artificial Intelligence and Signal Analysis in Metadata Service

What sets MME apart from its competitors (like Mp3tag or Yate) is its deep integration with advanced AI models. We don't rely solely on data manually entered by humans; we verify it by "listening" to the music.

3.1 Technology Choice: Essentia vs. Librosa

During the MME design process, a strategic decision was made to base the analytical engine on the **Essentia** library (C++) rather than the **Librosa** library (Python), which is popular in the academic community.

- **Industrial Performance:** Tests show that Essentia's C++ implementation is Many times faster in batch processing of large catalogs than pure Python in Librosa. Thousands of tracks. [28] This is crucial when handling catalogs with hundreds of entries.

- **Feature Extraction Quality:** Essentia offers ready-made, optimized extractors for music descriptors (BPM, key, mood) that are standard in Music Information Retrieval (MIR) research. [24] While Librosa is flexible, Essentia provides better stability in a production environment. [29]

3.2 Genre Classification and Mood Models

MME uses machine learning (ML) models for automatic tagging (auto-tagging), which is crucial for positioning music in recommendation systems (Spotify algorithms).

3.2.1 Model Architecture

The system integrates state-of-the-art neural network architectures:

- **MusiCNN:** A specialized convolutional neural network (CNN) designed for tagging music. It demonstrates higher genre detection performance than general audio models because its filters are tailored to the specific characteristics of the music signal. [30]
- **VGGish / YAMNet:** Used as complementary embedding models for high-level feature extraction, allowing for precise instrumentation and sentiment determination. [32]

3.2.2 Use in Sync Licensing

For entities involved in licensing music for film and commercials (Sync), MME generates descriptive metadata: "Happy," "Aggressive," and "Cinematic." This makes tracks searchable for music supervisors, who rarely search by composer's name, but more often by the emotions the track is intended to evoke. [34]

3.3 AI Fraud and Content Detection

In response to the flood of fake streams, MME is implementing the "Fraud Filter" module.

- **Spectral Analysis:** The algorithm examines phase coherence in high frequencies – an area where cheap AI generators often leave artifacts (unnatural cuts, lack of "air"). • **Silence Verification:** The system automatically rejects files containing too long silence fragments at the beginning (>3s) or end of the track, which is a common reason for rejection by DSP. [35]

Chapter 4: Compliance and Standards – Operations Engine

The music industry relies on standards. Failure to adhere to them results in so-called "silent failures," where data is transmitted but ignored by the recipient.

4.1 Implementation of DDEX Standards

DDEX (Digital Data Exchange) is an XML language used by supply chain entities to communicate with each other. MME functions as a native DDEX message generator.

4.1.1 Evolution of ERN 3 to ERN 4

MME supports complex migration between versions of the standard. In ERN 3, creator data was nested within each recording file (SoundRecording), which caused redundancy. ERN 4 introduced the PartyList – a section where the creator is defined once and recordings only reference it (PartyRef). MME enforces this structure, reducing XML file size and eliminating duplication [25] This is "enterprise-class" functionality, errors. This is unavailable in simple aggregators.

4.1.2 MEAD (Media Enrichment and Description) standard

In addition to basic data, MME supports **the MEAD standard.** This allows for the transmission of rich metadata: song lyrics, biographies, award information, and historical chart positions. Streaming services (e.g., [36] This is crucial for SEO within websites voice search "play song with lyrics...")

4.2 Advanced ID3v2.4 Tagging

While DDEX supports B2B communication, the resulting files (MP3/FLAC) still rely on ID3 tags. MME goes beyond the standard "Artist/Title" fields.

- **TIPL (Involved People List):** MME maps the roles of engineers, producers, and arrangers to the TIPL frame, which is a standard often ignored by consumer editors but crucial for professional credit assignment. [38]
- **TXXX (User Defined):** Allows custom information (e.g. "ISRC", "Catalog Number", "License Status") to be embedded directly into the file header, making file management easier in radio systems. [38]

4.3 Style Guide Validator

To minimize rejection rates, MME has a built-in rules engine, updated monthly with guidelines from the **Apple Music Style Guide** and **Spotify Metadata Style Guide. • Case Study**

- **Featured Artists:** Spotify requires guest artists to be entered in a dedicated metadata field (ResourceContributor with the FeaturedArtist role), not in the song title (e.g., "Song Title feat. Drake" is an error). MME automatically detects "feat." in the title and suggests moving the data to the appropriate structured field. [40]
- **Case Study - Casing:** Apple Music rejects titles written entirely in uppercase ("THE SONG") or lowercase. The MME validator automatically converts the text to "Title Case" or "Sentence Case" format, according to the grammatical rules of the language. [15]

Chapter 5: Business Model and Strategy Commercialization

The market value of MME is based on its ability to generate savings (operational efficiency) and recover lost revenues (royalty recovery).

5.1 Customer Segmentation

1. **Independent Record Labels and Publishers (IMPs):** These entities manage catalogs of 500 to 50,000 tracks. They often rely on spreadsheets, which creates a significant risk of error. For them, IMPs are a tool to organize the chaos.[41]
2. **Music Distributors (White Label):** Companies like Vydia or smaller aggregators that need an ingestion engine to relieve their support departments from manually checking tickets.[42]
3. **Sync Agencies and Music Libraries:** Entities Needing Deep Tagging (moods, instruments) for B2B clients (advertising, TV).[34]
4. **DIY Artists (Pro Tier):** Conscious creators who want to make sure their credits are Spotify are correct and royalties don't get lost in a black box.

5.2 Pricing Strategy

MME adopts a SaaS (Software as a Service) model with tiers based on Assets Under Management (AUM), which distinguishes it from a pay-per-release model.

Tier	**Group Target**	**Model Price**	**Key Functions**	**Analysis Competition**
Creator / Solo Artists		$12 - $15 / month	ID3 Editing, Style Guide Validation, Export to Distributor.	It competes with free tools (Mp3tag), winning with cloud and validation.
Label / Pro	Small Smartly	$199 / month	Edition Bulk, DDEX export, Evaporation ISRC-ISWC,	Positioned competitively against plans "Starter"

			Limit 5,000 Songs.	platforms Reprtoir ($79/mo) and AudioSalad, offering a better AI analysis. [45]
Enterprise	Distributors	API + License (>$2k/mo)	Full API Access, White-Label Validation Widget, Unlimited Assets, AI Fraud Detection.	An alternative to building your own, expensive IT systems.
Royalty Recovery	Owners Rights	Commission (10-15%)	"Black Box Hunter" service – linking unassigned ISRCs to ISWCs and recovering historical royalties. [8]	The "Success fee" model is attractive to owners of old catalogs.

5.3 Competitor Analysis

- **Manual Tools (Mp3tag, Yate):** Great for working with local files, but lacks cloud, DDEX support, and business logic. [47] MME wins with on-chain integration deliveries.
- **Databases (Gracenote):** Excellent data, but expensive and closed. [49] MME focuses on open standards and the ability to "write-back" to the user database. • **Distribution Platforms (Revelator, LabelGrid):** These are full-featured accounting systems. MME positions itself as **a specialized plug** -in for these systems, focused solely on data hygiene, or as an alternative to their built-in, often poorer metadata modules. [50]

Chapter 6: Deployment and Operational Scenarios

For the end user, MME transforms the chaotic publishing process into a structured workflow.

6.1 Catalog Cleanup Phase

Once the account is connected, MME scans the existing user directory (e.g. via import from Spotify API or CSV files).

1. **Data Health Audit:** Identifying "Ghost Assets" – works that are in distribution, but they are missing ISRC or IPI codes in the internal database.
2. **Data Enrichment:** Using the MusicBrainz and Discogs APIs to fill in missing composers, release dates, or genres. [52]
3. **Standardization:** Mass renaming of files and tags according to a uniform standard (e.g. "Artist - Title (Version).wav").

6.2 Pre-Release Workflow

Before the new album goes on sale:

1. **Upload:** User uploads WAV files and cover art.
2. **AI Scan:** MME analyzes files in the background, detecting BPM, pitch, and potential issues (e.g. silence, clipping).
3. **Metadata Entry:** User enters data. MME automatically suggests existing Creators (Producers, Authors) from the Party ID database to ensure consistency.
4. **Validation Gate:** The DSP simulator starts. If the cover has the dimensions 2900x2900 (Apple requires 3000x3000+), the system blocks approval. If the title is "TRACK 1.mp3", the system blocks approval. [53]
5. **Export:** MME generates a DDEX ERN package for the distributor and a CWR (Common Works Registration) file for the OZZ.

6.3 Optimization for Sync Licensing

For users pitching music to Netflix or advertising agencies, MME exports a "Sync Pack".

• **Metadata Injection:** All contact details, shares (split) and rights information are hard-coded into the AIFF/MP3 file headers. • **Disco.ac Compatibility:** MME exports a CSV file formatted specifically for import to the Disco platform (industry standard in Sync), saving hours of manual data rewriting. [34]

Chapter 7: The Future and Technology Roadmap

MME is designed with upcoming changes in technology and copyright law in mind.

7.1 Web3 and Royalties Tokenization

As blockchain technology matures, the industry is experimenting with "Smart

Smart Record Contracts, where royalties are split automatically at the time of payment. [54] A necessary condition for this model is absolute cleanliness MME aspires to be the "Oracle" for on-chain music protocols – a trusted source of data that guarantees that tokens represent real rights.

7.2 Spatial Audio

With the growing popularity of Dolby Atmos, metadata now needs to track "objects" in the mix, not just the stereo file. MME will expand its framework to support the MEAD standard for immersive audio, tracking credits for immersive mix engineers—a role that is currently often omitted from standard tags. [55]

7.3 AI Governance Layer

In the face of upcoming regulations (e.g., the AI Act in the EU), rightsholders will need an opt-out mechanism for training AI models. MME will implement a **"Do Not Train"** metadata flag (Machine Learning Permissions) in the DDEX feed, signaling to platforms and AI bots that the content is protected from interference with Large Audio Models. [1]

Summary and Conclusions

The music industry has mastered the art of selling access to music, but has neglected the science of tracking ownership. The result is multi-billion dollar inefficiencies that penalize creators and stifle innovation.

The Music Metadata Engine (MME) is more than just a back-office tool; it's a strategic resource for asset protection and revenue optimization. Combining the rigor of **DDEX** standards with the intelligence of **AI analysis** and the transparency **of centralized identification,** MME offers a viable solution to the "Black Box" crisis.

For investors, MME represents an investment in the critical infrastructure of a high-growth market as music rights become a new investment asset class.

For End Users, MME is the difference between a rejected upload and a hit; between money lost in a black box and money in a bank account.
In an era where 100,000 songs are released daily, the winner isn't just the one with the best song, but the one with the best-labeled data. MME ensures that this data is accurate, standards-compliant, and monetizable.

Appendix A: The Cost of Bad Metadata (Financial Simulation)

• ***Scenario:*** An independent record label releases a 10-track album. • ***Error:***
The record label does not match the IPI (author) codes with the ISRC (record) codes at the time of release.
distribution.
• ***Result:*** Tracks generate 10 million streams on Spotify. •
Revenue Impact:
• Recording Royalties (paid by ISRC): ~$38,000 (Received). • Author/
Publishing Royalties (Mechanical + Performance): ~$6,000 (Goes to Black Box/MLC). •
Result: 13-15% of total
revenue is frozen. If not
matched for 3 years, these funds can be liquidated and paid out to large
publishers based on market share (according to Music
Modernization Act). [1]
• ***MME Solution:*** Automatic pre-submit validation would detect the missing IPI, blocking the upload until the publishing data was completed, which would secure $6,000 immediately.

(End of Report)

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