Case Study – Prompt 5 v2 (finale) SUNO 4.5

Manual Annotation → Automatic Pipeline → QA → Final Metadata

(Goals: A = QA Validation, B = Integration of Manual + Automatic Metadata)

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1. Overview & Purpose

This case study demonstrates the complete workflow I apply to validate, correct, and merge automatic + manual metadata for AI-generated music.

The track **"Prompt 5 v2 (finale) SUNO 4.5"** was chosen because it contains:

- **A tempo profile with flexible phrasing and a final rallentando**
- **Harmonic shift** from **Gb major → Eb minor (relative)**
- **A soft, non-percussive texture**, which makes automatic BPM detection unreliable
- **Layered instrumentation** (felt piano, pads, cello)

This allows me to show both **music-theoretical reasoning** and **audio-analysis QA**.

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2. Step 1 — Manual Annotation (Ground Truth)

Field	Value
BPM_manual	~40 BPM (with light tempo flexibility + final rallentando)
Key_manual	**Gb major** (A section) → **Eb minor** (B–C), relative modulation
Instruments_manual	Felt piano, ambient pads, soft cello solo
Notes_manual	Soft texture; no percussion; piano gives the only beat reference; expressive shaping; clear shift toward relative minor in later sections.

Why this matters

The absence of percussion and the smooth pad layers reduce the clarity of the beat, making BPM estimation inherently unstable.

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3. Step 2 — Automatic Pipeline Output

Extracted via VS Code + Python:

```
python src/extract_bpm.py > csv/auto_bpm.csv
python src/extract_key.py > csv/auto_key.csv
python src/extract_mfcc.py > csv/ai_mfcc.csv
```

Field	Automatic Output	Notes
BPM_est	**120.2**	not double-time — this is *pulse misalignment caused by weak rhythmic cues*
Key_est	**Eb minor**	coherent with B–C sections, less with the opening in Gb major
Confidence	~0.96	stable harmonic spectrum → high confidence
Instruments_auto	MFCC-based embedding only	
MFCC_1..13	extracted	timbre fingerprint

3.1 Why the BPM Estimator Failed

This track has:

- No percussive onsets
- Sustained pads masking transients
- Piano figuration that is not metrically strong
- A final rallentando

→ The algorithm **locks onto a faster internal subdivision**, not the musical tactus.

This is **not** double-time, but rather:

"tempo-level misinterpretation under weak beat salience."

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4. Step 3 — QA Review (Manual vs Automatic)

BPM (Incorrect)

- Auto: **120.2 BPM**
- Manual: **~40 BPM**
- Error category: **pulse-level misalignment** (not double-time)

Key (Partially correct)

- Auto: **Eb minor** → correct only for B–C
- Manual: **Gb major → Eb minor** → acknowledges global tonal plan

Instruments

- Manual: felt piano, pads, cello
- Auto: MFCC vector only (no symbolic inference for WAV)
- Merge strategy: keep manual instrumentation; use MFCC only as timbral descriptor.

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5. Step 4 — Final Corrected Metadata (Merged Record)

Field	Value
title	Prompt 5 v2 (finale) SUNO 4.5
source	AI_generated
source/model	SUNO 4.5
duration	00:04:03
audio_link	https://suno.com/s/By6ZULssPoPRwITC
BPM_manual	40
BPM_est	120.2
Key_manual	Gb major → Eb minor (relative modulation)
Key_est	Eb minor
Instruments_manual	Felt piano, ambient pads, soft cello solo
instruments_merged	Manual instrumentation preserved (felt piano, ambient pads, soft cello solo) + MFCC timbre embedding
Genre	Cinematic ambient
Mood	Calm, melancholic, meditative
Usage_context	Underwater documentary soundtrack
Confidence	~0.96
mfcc_1 … mfcc_13	Automatically extracted MFCC timbre features
Notes	Only piano gives rhythmic reference; no percussion. Rubato + final rallentando (40 vs 120.2) → BPM misalignment; Intro in Gb major; sections B–C shift to Eb minor (relative modulation); auto key Eb minor coherent.

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6. What This Case Demonstrates

A) QA Skills

- Identifying BPM estimation errors beyond simple double-time
- Detecting tonal plans and relative modulation
- Validating or overriding automatic outputs when needed

B) Metadata Integration

- Merging manual and automatic fields
- Using MFCCs as timbre descriptors
- Maintaining consistent schema across AI and real-world datasets

C) Musicological Insight

- Understanding tonal hierarchy (relative minor shift)
- Describing expressive tempo shaping
- Correctly interpreting instrumentation from audio