Music360

A 360 DEGREES PERSPECTIVE ON THE VALUE OF MUSIC

D3.1 Reusable dashboard to present and analyze the value of music - version 1

Disclaimer

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1. Introduction

1.1. Purpose of the Deliverable

The Music360 dashboard is a pivotal software tool developed within *Work Package 3 – Stakeholder-level reporting and analysis of the value of music*. This deliverable, titled "D3.1 – Reusable dashboard to present and analyze the value of music – version 1," serves as the initial documentation and presentation of the tool. The primary purpose of this deliverable is threefold:

1. **Documentation of progress**: To formally document the design, development, and initial capabilities of the reusable dashboard as a key output of Work Package 3 (WP3). This establishes a baseline for the project's advancement and facilitates future iterations.
2. **Communication with stakeholders**: To effectively communicate the dashboard's functionality, features, and potential benefits to all relevant Music360 stakeholders. This includes Collective Management Organizations (CMOs), venues, music creators, policymakers, and researchers, providing them with a clear understanding of the tool's value proposition.
3. **Foundation for feedback and iteration**: To solicit feedback from stakeholders on the dashboard's Version 1, enabling iterative improvements based on their insights and needs. This feedback loop is essential for ensuring that the final dashboard aligns with the diverse requirements of the music ecosystem.

The initial delivery date for this document was set for May 31, 2024. However, to ensure that the latest status of the dashboard's developments, including integrated components from WP2 and newly incorporated requirements for the current demo version, could be reported, the date has been revised to September 2, 2024.

In essence, this deliverable represents a significant milestone in the Music360 project. It not only showcases the tangible progress achieved but also sets the stage for continued collaboration and refinement, ultimately leading to a comprehensive and impactful tool for understanding and enhancing the value of music.

1.2. Scope of the Music360 Dashboard (Version 1)

The dashboard is referred to as "reusable dashboard" in the title and some parts of the present deliverable to emphasize that its modular design allows for the components to be reused across different contexts within the Music360 ecosystem, customizable across different Music360 living labs and stakeholder groups.

Version 1 of the dashboard represents the initial phase of development, focusing on the core functionalities essential for exploring and analysing music usage data within the Music360 project. This version aims to provide a solid foundation for future enhancements and customization based on evolving stakeholder needs.

Core Functionalities

The dashboard's primary features include:

- **Data Visualization**: Two main tabs offer diverse visualisations. One tab presents various graphs (pie charts, bar charts, heatmaps) depicting plays or revenues by multiple criteria (artist, performer, genre, tempo, language, etc.) or combinations of criteria. Time-based histograms and territory-based heatmaps further enhance analysis. The second tab displays a detailed track playlist table with comprehensive music usage information and associated metadata.
- **Filtering and Sorting**: Both tabs feature robust filtering capabilities, allowing users to refine data by parameters such as date, title, ISRC, artist, venue, or venue type, providing flexibility in exploration.
- **Key Statistics**: A prominent header displays essential summary statistics for the data currently in view, including total revenue, total plays, total genres, total languages among others.

Data Scope

The current version has been built to integrate music usage data from venues participating in the Music360 living labs. This encompasses data from Vericast, BMAT's music monitoring services (Finland, Portugal, Ireland) as well as playlists from background music providers (The Netherlands, Spain). The raw data obtained from the music monitoring service or the background music providers is processed and enriched with metadata from audio analysis (e.g., BPM, type of voice), editorial and music business sources (e.g., ISWC, composers, performers, revenue). The amount and type of data available will depend on the particular deployment of the dashboard instance, ranging from mock data to the full integration of real data according to the development stage of the project.

Stakeholder Views

Version 1 takes into account the needs of specific stakeholder groups identified through user stories. These include a variety of stakeholders: authors' and neighbouring rights CMOs, songwriters, performers, publishers, record labels, background music providers, retail shops, hospitality, music venues, researchers, and trade associations. The dashboard caters to their information needs through the track playlist table and the revenue & plays analytics tab. The tool shows the user only the data the user is allowed to according to their role, and it currently supports views for authors' and neighbouring rights CMOs, songwriters and performers (e.g., the plays of their recordings to a user performer, the plays of their members' repertoire to a CMO admin user…). However this first version does not yet include specific custom views per other stakeholders.

Roadmap Version Aspects

While Version 1 establishes a strong foundation, it also outlines key areas for future development and enhancement:

- **Core Functionalities**: Views for Cultural and Social Value analysis are planned for future versions. Their requirements are being defined in parallel with the natural evolution of the project, and they will be included in major Version 2 of the dashboard.
- **Data Scope**: Data containing economic information and non-music data from living labs are on the roadmap. Currently, revenue data from CMOs for certain music assets

is shown, but Version 2 will include the currently missing information as the heterogeneous data gathered through the living labs is processed and integrated through the data pipeline according to the project's data model.
- **Stakeholder Views**: Further development is underway to support access restrictions and customisation options to fully address the security and data access requirements for all envisaged user types (e.g., venues, researchers, policymakers).

These aspects are planned to be addressed in subsequent iterations, evolving in tandem with the project's overall development to ensure the dashboard comprehensively meets the needs of all Music360 stakeholders.

1.3. Target Audience (Stakeholders)

The Music360 reusable dashboard is designed to cater to a diverse range of stakeholders within the music ecosystem, each with distinct roles, needs, and levels of interaction with the platform.

Primary Stakeholders

- **Rights Societies (CMOs)**: Authors' and neighbouring rights societies are key users, leveraging the dashboard to gain insights for improving royalty distribution processes, understanding the value music generates, and establishing data-informed licensing practices.
- **Creative Entities**: Songwriters, publishers, performers, and record labels directly benefit from the dashboard's transparency. It provides them with detailed information about the impact and value their music creates, empowering them to make informed decisions about their careers and businesses.
- **Policy and Research Stakeholders**: Policymakers, music industry researchers, and trade associations utilise aggregated data within the dashboard to understand the value of music across various criteria. This informs data-driven policy decisions and supports research initiatives that contribute to a deeper understanding of the music industry's dynamics.

Secondary Stakeholders

- **Music Users**: Music venues, retail shops, hospitality establishments, and health institutions can access the dashboard to explore the correlation between music usage and its impact on their businesses or activities, potentially informing their music choices and strategies.
- **Commercial Entities**: Background music providers and music data companies play a crucial role in supplying data to the platform, ensuring its accuracy and comprehensiveness. They also have a vested interest in the insights derived from the dashboard to refine their services and offerings.

Data Access and Stakeholder-Specific Views

The dashboard recognises the varying needs and sensitivities of different stakeholder groups by implementing tiered data access.

- **CMOs** and their members (**Creative Entities**) have access to data relevant to their repertoire and rights, ensuring confidentiality and data protection.
- **Policy and Research Stakeholders** primarily access aggregated and anonymised data to derive broader industry insights.
- **Music Users** can view data related to their specific music usage patterns and the resulting impact on their businesses or activities.

Feedback and Collaboration

The development of the dashboard is a collaborative effort, involving active engagement with all project partners representing the diverse stakeholder groups, as part of their participation in related project work packages such as “WP6 – A field validated Music360 solution”. This iterative process ensures that the dashboard evolves to meet the needs and expectations of all stakeholders through continuous feedback and refinement. The first version of the dashboard is the fruit of a development process driven by several initial iterations and provides a tangible tool that users can begin to interact with to provide feedback so we can iterate development towards improved subsequent versions.

1.4. Overview of WP3 Objectives

Work Package 3 (WP3) – "Stakeholder-level reporting and analysis of the value of music" – plays a crucial role in achieving Music360's overarching goal of creating a digital platform to understand and quantify the value of music played in various venues. WP3 specifically focuses on empowering stakeholders with the tools and insights they need to make informed decisions based on comprehensive data analysis.

Key Objectives of WP3

1. **Develop Optimised Dashboards**: WP3 aims to design and implement user-friendly dashboards tailored to the specific needs of different stakeholders. These dashboards will enable the visualisation and analysis of music usage data collected from living labs across multiple countries, providing a multi-faceted view of music's value.
2. **Address Data Privacy and Security**: Recognising the sensitive nature of music usage data, WP3 prioritises the development of robust security mechanisms. This includes the integration of access control, homomorphic encryption, and token-based solutions developed within WP2 to ensure that data is only accessible to authorised individuals and entities, protecting the privacy of all stakeholders.
3. **Answer Key Research Questions**: WP3 seeks to answer critical research questions, such as how to best support the presentation and analysis of music value data through software tools and how to effectively restrict information based on stakeholder roles and permissions.

The Reusable Dashboard's Role

The development of the dashboard (documented in the present deliverable, D3.1, and in its second version, D3.2, expected for month M31 of the project) is a central component of WP3. It serves as the primary tool for achieving the work package's objectives by:

- **Supporting Data Presentation and Analysis**: The dashboard provides an intuitive interface for visualising complex music usage data, enabling stakeholders to explore trends, patterns, and correlations relevant to their interests.
- **Enabling Stakeholder-Specific Views**: The dashboard's design allows for customization and filtering, ensuring that each stakeholder group can access the data and insights most pertinent to their roles and responsibilities.
- **Contributing to Project Outcomes**: By facilitating data-driven decision-making, the dashboard directly contributes to Music360's project outcomes, including more accurate royalty distribution, improved licensing agreements, insights into the value of music, and evidence-based policymaking.

Interdependencies with Other Work Packages

WP3's success is intrinsically linked to other work packages within the Music360 project. Notably, WP2 – "Standardized, trusted and unified collection of music metadata" – provides the foundational ontology and data collection infrastructure upon which WP3 builds its analysis tools. WP6 – "A field validated Music360 solution" – plays a crucial role in testing and validating the dashboard within real-world living lab scenarios, ensuring its practical applicability and effectiveness.

This interdependency underscores the collaborative nature of the Music360 project, where each work package contributes to a unified goal: to revolutionise the understanding and utilisation of music's value across the entire ecosystem.

1.5. Document Structure

The remainder of this document is structured as follows:

- **Section 2: Dashboard Design and Development Process** details the user-centred approach taken, stakeholder requirements gathering, technology choices, and the iterative development methodology employed.
- **Section 3: Dashboard Architecture** outlines the overall system architecture, data flow, sources, and the security measures implemented to protect sensitive information.
- **Section 4: Dashboard Features (Version 1)** provides a comprehensive overview of the core functionalities, visualisation types, filtering options, and initial stakeholder-specific views available in this version.
- **Section 5: User Interface and Experience** explores the fundamental principles of UI design and the systematic process employed to arrive at the optimal UX/UI, with the help of a comprehensive definition of scenarios to cover using Version 1. It also offers the link to an interactive prototype and screenshots of the frontend UI.
- **Section 6: Preliminary Results and Analysis** showcases sample data demonstrations, highlights early insights or trends discovered, outlines areas for future development based on the learnings from Version 1.
- **Section 7: Next Steps and Roadmap** outlines the planned enhancements for immediate releases and future versions and the timeline for full implementation and testing.

- **Section 8: Conclusion** summarises the achievements of Version 1, emphasises the dashboard's value proposition for Music360, and discusses its potential impact on the music industry.
- **Section 9: Appendices** include detailed technical specifications used for the dashboard design and backend development.

2. Dashboard Design and Development Process

This chapter outlines the systematic approach undertaken to design and develop the reusable dashboard, emphasising a user-centred philosophy throughout the process. By actively involving stakeholders and incorporating their feedback at each stage, we aimed to create a tool that truly aligns with their needs and expectations. This chapter will delve into the specific methods used for requirements gathering, design iterations, and technology choices, demonstrating our commitment to delivering a user-friendly and effective solution for analysing the value of music.

2.1. User-Centred Design Approach

The development of the Music360 dashboard was firmly rooted in a user-centered design philosophy, prioritizing the needs and expectations of stakeholders throughout the entire process. Recognizing the diverse perspectives within the music ecosystem, we actively engaged key partners, including Collective Management Organizations (CMOs), record labels, music venues, and music technology experts.

A dedicated workshop served as a crucial forum for collaboration. We presented the dashboard's purpose and facilitated the capture of user stories, employing a structured template to document the specific needs and desired functionalities of different stakeholder user roles. This direct engagement yielded invaluable insights that shaped the dashboard's design and features. For instance, CMOs expressed a strong interest in visualizing royalty payouts by region. In response, we incorporated an interactive map into the dashboard, enabling CMOs to gain a clear understanding of the geographical distribution of royalties. Such feedback directly translated into acceptance criteria, ensuring that the final product effectively addressed the core needs of stakeholders and fostered a deeper understanding of the value of music.

This user-centered approach fostered a sense of ownership and collaboration among stakeholders, resulting in a dashboard that not only fulfills its functional requirements but also resonates with the diverse needs of the music industry.

Requirement Gathering Techniques

To comprehensively capture user needs, we employed a variety of requirement gathering techniques:

- **User Story Workshops:** We conducted workshops dedicated to user story creation, fostering collaboration among industry partners to define functionalities and data needs. A user story template ensured consistency and facilitated clear communication of stakeholder requirements. The template contained 2 different tabs. In the first we defined the different user roles to be represented in the dashboard for the project stakeholders (e.g., *songwriter*, *music venue*, …), a total of 15 different user roles categorized into five distinct groups (*Creative*, *Rights society*, *Music user*, *Commercial entity*, *Policy stakeholder*). Then, a second tab was prepared to gather

the elicited user stories, using the user roles described as a reference. The common structure for the user stories was the usual "*As a* [user role] *I want to* [requirement] *so that* [reason]", accompanied by a space for comments and other contextual information (see *Figure 1*).

- **Shared Documentation:** A collaborative Google spreadsheet served as a central repository for documenting the user stories, user roles, and other relevant information. This eased the process, promoted transparency and allowed stakeholders to track the evolution of the dashboard's design. Initially, the document accounted for a total of 57 user stories collected.
- **Requirements Analysis:** We carefully studied existing project documentation and deliverables to identify additional requirements and align the dashboard with the broader goals of the Music360 project.

	Description					
As a...	I want to...	so that...	Comments	Proposed by	Code	Module
music venue	List the my most popular songs played	I can evaluate which songs are more appealing to grow my attendance		BMAT	DAS-VEN-2	Dashboard
record label	Filter by label	I can visualize where my catalog is being played		BMAT	DAS-REC-1	Dashboard
background music...	Filter my own catalog (we could do this with tags, or if not filtering by composers)	I can ensure that my catalog is being used where it was licensed, and not being used without license		BMAT	DAS-BAC-1	Dashboard
retail shop	List the songs played in my venue per date with timestamp	I can relate the music played to sales data to get any kind of insight that help me grow my revenue		BMAT	DAS-RET-1	Dashboard
hospitality	List the songs played in my venue per date with timestamp	I can relate the music played to sales data to get any kind of insight that help me grow my revenue		BMAT	DAS-HOS-2	Dashboard
trade association	List the my most popular songs played	I can evaluate which songs are more appealing to share with my associates		BMAT	DAS-TRA-3	Dashboard
performer	List of my songs played including amount / airplay	I can determine which repertoire is more popular in the given dates		Sena	DAS-PER-2	Dashboard
performer	Filter / Group by country	I can filter / group "list of my songs played .... " using multiple filters and visualize the different per country	if Filter / Grouping not feasible " ..by Country" is addition to Query .. "List of my songs played..... by country"	Sena	DAS-PER-3	Dashboard
performer	Filter / Group by venue type (e.g. shops, restaurants...)	I can filter / group "list of my songs played .... " using multiple filters and visualize the different per venue type	..	Sena	DAS-PER-4	Dashboard
performer	Sort aplhabetically or amount/.airplay	I can sort the selection based on alphabet (main artist / title) or airplay / value		Sena	DAS-PER-12	Dashboard
music venue	List of value indicators (e.g. revenue, customer satisfaction, employe satisfaction)	I can evaluate the effect of the music selection on the indicators which measure value withing my venue		Sena	DAS-VEN-3	Dashboard
music venue	Filter / Group by song charasteristics (e.g. % genre, tempo, language..) based on % of total playlist	I can filter / group "list of value indicators .... " using multiple filters and visualize the effect based on different chasteristics of playlists		Sena	DAS-VEN-4	Dashboard
music venue	Filter / Group by Venue	I can filter / group "list of value indicators .... " using multiple filters and visualize the effect and difference per venue		Sena	DAS-VEN-5	Dashboard
researcher	Revenues per type of venue/location	I can compare the revenues depending on the different types of venue and/or by different locations	Indoor/outdoor/Backgrou nd/Foreground	UPV	DAS-RES-1	Dashboard
researcher	Genre of music per location	I can compare which genre of music is played depending on the location	Pop/Rock/Jazz/Classical. ..	UPV	DAS-RES-2	Dashboard
researcher	Revenues per genre of music/location	I can compare the revenues depending on the genre of music and/or by different locations		UPV	DAS-RES-3	Dashboard
researcher	Social value (linked to 31, 36)	I can link revenues and number of partipants per type of venue and social value		UPV	DAS-RES-4	Dashboard
researcher	Cultural value (linked to 32, 37)	I can link revenues per genre and cultural value		UPV	DAS-RES-5	Dashboard
researcher	Number of participants per type of venue/location	I can check how many people has participated venu/location		UPV	DAS-RES-6	Dashboard

***Figure 1**: A detail of the gathered user stories. Complete list in section 9.1.4.*

Prioritization of User Needs

We systematically prioritized user needs to ensure the dashboard addressed the most critical pain points and use cases. We made that by starting the design of the tool by an analysis of the requirements that emerged from the analysis of the user stories and discussing them in subsequent workshops, as it will be further developed in *section 2.2*:

- **User Story Analysis:** The initial user stories spreadsheet was analyzed to identify recurring themes, group user types with common needs, and define allowed operations and tool modules. List in *section 9.1.4*.
- **Technical Analysis:** A second spreadsheet facilitated a more technical analysis of user stories, mapping them to dashboard sections, UI elements, and data model requirements. List in *section 9.1.5*.
- **Field Permissions:** We defined field permissions based on user roles, balancing data access needs with security and privacy considerations. The initial setting of field permissions is based on the requirements gathered through the user stories, and the

project plans for periodic revisions involving the data providers to make sure it complies with their data policies, which will regulate the granular access control. List in *section 9.1.6*.

Iterative Feedback Loop

We placed user needs at the centre of the design process through an iterative feedback loop.

After meticulously analysing the user stories collected, we have kept several feedback online sessions to discuss and present the selection of grouped and categorized user stories to make sure they were complete and understood correctly, ensuring the functionalities addressed the specific needs of each user role (e.g., CMOs, record labels, music venue representatives…).

Next, we created wireframes of the UI elements mapped to the digested user stories using Balsamiq[2], a user-friendly wireframing tool (see *Figure 2*). These wireframes were first reviewed and iterated upon internally within the UX/UI team. Subsequently, we presented them to all project partners during a dedicated interactive workshop in order to validate the translation of the user stories to the design of the tool. We offered access to the project in Balsamiq, allowing partners to directly interact with the wireframes and provide valuable feedback through inline comments and conversations directly on the UI elements of the wireframes. Through this collaborative process, where they could directly interact with the designers and developers and follow the evolution and changes of the tool, we were able to refine the design with the user in the loop and ensure a first version of the Music360 dashboard which effectively addressed the needs of its users ready for implementation.

With that information into account and process in place, an interactive alpha version containing the essential elements and functionalities of the future tool was implemented, deployed and presented with mock data. This alpha version was very valuable to gather early feedback from a fully working prototype, although not yet connected to the dashboard's back end.

Finally, a second round of user requirements was then set in order to define meaningful demo scenarios for a selection of stakeholders for the release of the beta version connected to a working platform back end, the Music360 Dashboard Version 1, including the most relevant features of the platform for the data available at the moment. This was organised in periodic online workshops involving the technical partners (UPV, VU, TVE and BMAT) and the use case experts, in this case the project CMOs (SENA and GDA in particular) where specific demo scenarios where defined, and all relevant technical requirements thoroughly discussed in order to develop the technical solution.

This iterative feedback process will continue throughout the design, implementation and validation phases of the dashboard in its several versions to ensure that it responds effectively to the users and project needs.

[2] https://balsamiq.cloud

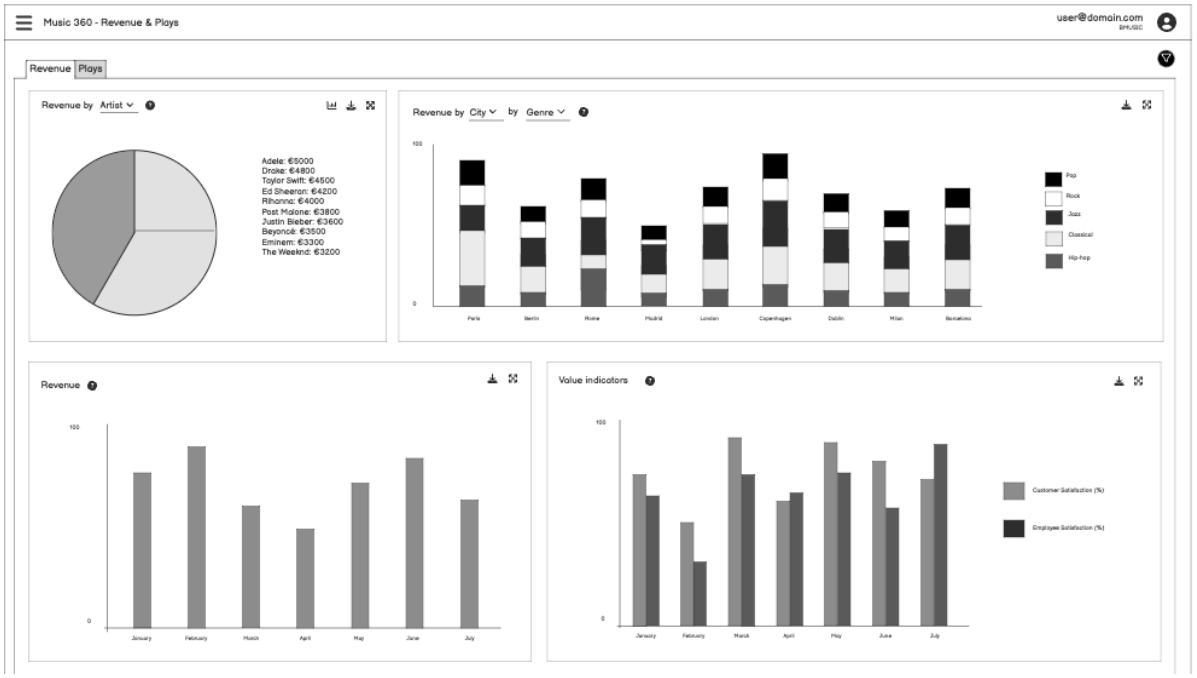


***Figure 2**: The wireframes of the dashboard in Balsamiq. More about it in section 2.4.*

Accessibility Considerations

The Music360 dashboard prioritizes accessibility for users with diverse abilities:

- **Google Material Design:** We leveraged Google Material Design principles, which incorporate accessibility best practices.
- **WCAG Compliance:** The dashboard adheres to WCAG compliance guidelines, ensuring features like keyboard navigation and proper colour contrast for optimal usability.
- **Alternative Text:** All visual elements include alternative text descriptions for users with visual impairments.

By integrating these principles, we've strived to create a dashboard that is not only functional and informative but also inclusive and accessible to all stakeholders within the music ecosystem.

2.2. Stakeholder Requirements Gathering & Analysis

To ensure the Music360 dashboard effectively addressed the diverse needs of its target audience, we engaged in a rigorous process of stakeholder requirements gathering and analysis. This process involved:

Key Requirements Identified

Through workshops and collaborative documentation, we gathered a wide range of stakeholder needs. The list of elicited user stories was analyzed one by one and on the whole to find patterns and commonalities. Some common themes emerged, including:

- The desire to view key performance indicators (KPIs) for various metrics (e.g., total revenue, venue count) at a glance, filtered by specific criteria.
- The ability to list and filter detailed information about played songs (e.g., title, artist, genre, date, location).
- The need to generate charts and graphs showcasing revenue or play data, aggregated and filtered by multiple criteria (e.g., composer, language, venue type) and displayed over time or by territory.
- The critical requirement for data access restrictions, ensuring that each stakeholder group (e.g., creators, CMOs, venues) could only view data relevant to their role and permissions.

The initial analysis of the initial user stories spreadsheet also allowed us to create a list of user types with common user needs (see table in *section 9.1.3*), describing their allowed operations, and a list of the different separate modules of the tool: the Dashboard itself and a User Management System (see table in *section 9.1.1*). From that raw list of user stories, we created a second document containing a more technical analysis of the initial inputs. The user stories were classified and sorted, grouping them under module sections (Track Playlist, Revenue Analytics, Play Analytics, Social and Cultural Value, User Management System), and defining a UI element to cater for that requirement. This analysis also took into account the definition of the field permissions depending on the user role at a UI level and their relation with the data model of the back end and API requirements, although this will be further discussed in other sections of this document.

Despite the varied user stories proposed by different stakeholders, several requirements could be met by the same type of tool. For instance, a bar chart tool could cater to both the needs of a venue to filter and group songs by characteristics like genre, tempo, and language based on playlist percentages, and a researcher's need to comprehend revenues by venue type or location by simply modifying the aggregation variables. Ultimately, all requirements can be synthesized into the following UI elements:

1. KPIs
2. Filters
3. Chart: Revenue by x
4. Chart: Revenue by x by y
5. Chart: Revenue by month
6. Chart: Revenue by territory
7. Chart: Plays by x
8. Chart: Plays by x by y
9. Chart: Plays by month
10. Chart: Plays by territory
11. Chart: Value Indicators
12. Table: Track playlist
13. Chart: Cultural Value per genre
14. Chart: Social value per venue type

15. Chart: Participants by venue type (Indoor/Outdoor)
16. Chart: Participants by venue type (Background/Foreground)

Challenges and Conflicts

The primary challenge was mapping the diverse range of user stories to a limited set of UI elements while ensuring comprehensive coverage of stakeholder needs. We addressed this through in-depth analysis and the design of flexible tools capable of adapting to various scenarios through customizable parameters, like aggregation criteria.

Additionally, we faced the challenge of balancing the number of user stories per stakeholder group, as some groups were more vocal than others. To ensure inclusivity, we adopted an approach of offering flexible UI tools that empower users to tailor the dashboard to their specific needs. Additionally, we will be more vigilant when evaluating the platform's suitability for stakeholders who have provided limited information during the development of user stories.

Requirement Prioritization

We prioritized requirements through a multi-faceted approach:

- **Common Pattern Analysis:** We identified recurring themes and patterns in the user stories, prioritizing the UI elements that addressed the most widespread needs.
- **Demo Scenarios:** Feedback from initial design iterations led to the definition of demo scenarios for specific user roles (performer, songwriter, neighbouring rights' CMO). Data was already available for these, driving the prioritization of features for the Version 1 release.
- **Project Evolution:** Requirements related to topics requiring further discussion within the project (e.g., cultural and social value) were deferred to Version 2.

Traceability

We maintained traceability between requirements and implemented features using a structured approach:

- **User Story Codification:** To facilitate easy future referencing, user stories were subjected to analysis, classification, and coding. The coding system incorporated three key elements: module (Dashboard [DAS] or User Management System [UMS]), user role (refer to the table in *section 9.1.2* in the Appendix), and a sequential number. As an illustration, the second user story created by a Performer for the Dashboard would be assigned the code "DAS-PER-2".
- **Technical Mapping:** A dedicated spreadsheet mapped user stories to specific UI elements, data model requirements, and field permissions, to connect user requirements with the technical elements for development.
- **Shared Documentation:** This documentation in collaborative documents serves as a record of the requirement gathering and analysis process, ensuring transparency and facilitating future development and refinement (see *Figure 3)*.

Through this comprehensive process, we ensured that the Music360 dashboard's design and functionality are firmly grounded in the real-world needs and expectations of its diverse stakeholders.

User story code	As a...	I want to...	so that...	Comments	UI
DAS-PUB-7	publisher	Usage data by revenue	I can analyse the use of my recording by revenues		Table: Track playlist
DAS-SON-6	songwriter	Usage data by performer	I can analyse the use of my works by performer		Table: Track playlist
DAS-PUB-8	publisher	Usage data by performer	I can analyse the use of my recording by performer		Table: Track playlist
DAS-ACM-3	authors' CMO	Usage data on works/repertoire of CMO	How works in a given author CMOs repertoire have been played		Table: Track playlist
DAS-ACM-4	authors' CMO	Usage data on individual works/authror/publisher level, with (forecasted) revenue and playcount	How works in a given author CMOs repertoire have been played		Table: Track playlist
Revenue analytics					
DAS-VEN-3	music venue	List of value indicators (e.g. revenue, customer satisfaction, employe satisfaction)	I can evaluate the effect of the music selection on the indicators which measure value withing my venue		Bar chart: Value indicators
DAS-VEN-4	music venue	Filter / Group by song charasteristics (e.g. % genre, tempo, language..) based on % of total playlist	I can filter / group "list of value indicators .... " using multiple filters and visualize the effect based on different chasteristics of playlists		Bar chart: Value indicators
DAS-VEN-5	music venue	Filter / Group by Venue	I can filter / group "list of value indicators .... " using multiple filters and visualize the effect and difference per venue		Bar chart: Value indicators
DAS-VEN-6	music venue	Filter / Group by Date	....		Bar chart: Value indicators
DAS-VEN-7	music venue	Filter / Group by Music Selection Criteria in Venue (e.g. Employee Choice)	....		Bar chart: Value indicators
DAS-RES-1	researcher	Revenues per type of venue/location	I can compare the revenues depending on the different types of venue and/or by different locations	Indoor/outdoor/Background/Foreground	Table: Track playlist Pie/Bar chart: Revenue by ... Map: Revenue by territory
DAS-RES-3	researcher	Revenues per genre of music/location	I can compare the revenues depending on the genre of music and/or by different locations		Table: Track playlist Pie/Bar chart: Revenue by ...
DAS-RES-12	researcher	Economic value (linked to DAS-RES-1, DAS-RES-3)	I can check the revenues in both cases		Table: Track playlist Pie/Bar chart: Revenue by ...
Play analytics					
DAS-PER-5	performer	Filter / Group by region / province / city area within a specific country (based on location of venue)	..	... / a heat map would could be a nice way to display information. Interesting for performers with mostly local airplay.	Table: Track playlist Map: Plays by territory
DAS-RES-2	researcher	Genre of music per location	I can compare which genre of music is played depending on the location	Pop/Rock/Jazz/Classical...	Table: Track playlist Bar chart: Plays per genre
Social&Cultural value					
DAS-RES-4	researcher	Social value (linked to DAS-RES-1, DAS-RES-6)	I can link revenues and number of partipants per type of venue and social value		Bar Chart: Revenue & Participants & Social value per venue type
DAS-RES-5	researcher	Cultural value (linked to DAS-RES-2, DAS-RES-7)	I can link revenues per genre and cultural value		Pie/Bar chart: Revenue by ... Bar Chart: Revenue & Cultural Value per genre
DAS-RES-6	researcher	Number of participants per type of venue/location	I can check how many people has participated venu/location		Pie chart: Participants by venue type (Indoor/Outdoor) Pie chart: Participants by venue type (Background/Foreground)

***Figure 3**: A detail of the user stories once analysed, sorted and grouped. Complete list in section 9.1.5.*

2.3. Technology Selection and Rationale (Frontend/Backend)

The selection of appropriate technologies for both the frontend and backend development of the Music360 dashboard was a critical decision, directly impacting the platform's performance, scalability, maintainability, and overall user experience. This section outlines the specific technologies chosen for each layer of the application and provides a detailed rationale for their selection.

Frontend

For the frontend development of the Music360 dashboard, we opted for a technology stack that leveraged our team's existing skill set and fostered code reusability. Additionally, the chosen technologies aimed to deliver a performant and scalable user experience while prioritising maintainability and security.

- **Frontend Framework: Vue.js and Nuxt.js**
  - Vue.js, a popular JavaScript framework known for its lightweight core and reactivity system, was the foundation of our frontend development. Nuxt.js, a framework built on top of Vue.js, provided additional benefits like server-side rendering (SSR) and static site generation (SSG). This combination allowed us to:

    - **Expedite Development:** Nuxt.js' features streamlined the development process, enabling us to focus on core functionalities.
    - **Promote Reusability:** Both Vue.js and Nuxt.js promote a component-based architecture, which aligns with our use of pre-built, battle-tested modules. This approach facilitates code maintainability and faster development cycles.
    - **Benefit from a Rich Ecosystem:** The vast Vue.js community and ecosystem provided access to numerous libraries and plugins that addressed our project's specific requirements.
- **Testing and Linting:** We prioritised code quality and maintainability through a rigorous testing and linting strategy. This included:
    - **End-to-End Testing:** Cypress, a popular end-to-end testing framework, was instrumental in ensuring the dashboard functioned as intended across various user interactions.
    - **Code Reviews:** Pull request (PR) reviews fostered collaboration and ensured code quality by allowing team members to review each other's code contributions. The code of the project is versioned using Git, managed through an account in Bitbucket.
    - **Linting Tools:** We employed ESLint, a popular linting tool, to enforce coding conventions and identify potential errors or stylistic inconsistencies. This proactive approach helped us maintain a clean and consistent codebase.
- **Deployment Strategy: Static Site Generation (SSG):** The Music360 dashboard was deployed as an SSG site. This approach offered several advantages:
    - **Enhanced Performance:** SSG pre-renders content at build time, resulting in significantly faster loading times for users compared to fully server-rendered applications. This is particularly crucial for a data-rich dashboard like Music360.
    - **Scalability:** SSG sites excel in handling high traffic volumes. By adding more servers horizontally, we can easily scale the application to accommodate increasing user demands.
    - **Reduced Hosting Costs:** Since SSG sites primarily serve pre-rendered content, the server workload is reduced, leading to lower hosting costs.
- **UI Component Library: Vuetify:** We leveraged Vuetify, a comprehensive Material Design UI component library for Vue.js. Vuetify offered a set of pre-built components that adhered to Google's Material Design guidelines. This not only accelerated the UI development process but also ensured a consistent and visually appealing user experience aligned with modern web design standards.
- **Data Visualization Libraries:** The inclusion of Chart.js, a popular JavaScript charting library, and Vue Chart.js Exporter, a plugin enabling chart export functionalities, empowers users to explore and interact with data through various charts and graphs. This visual representation of music-related data facilitates deeper insights and data-driven decision making.

Prioritising Maintainability and Security:

- **Limiting External Packages:** We adopted a principle of minimising our reliance on external packages. This approach reduces potential security vulnerabilities and

simplifies the maintenance process. By carefully evaluating our needs, we were able to achieve the desired functionalities with a core set of well-established libraries.

- **Regular Package Updates:** We prioritise keeping all our dependencies updated to their latest versions on a weekly basis. This ensures we benefit from the latest features, bug fixes, and security patches offered by the maintainers of these packages.

Backend

As we will see in *section 3*, the Music360 dashboard relies on the data managed by the Music360 platform, which consists of a decentralized cluster of resource servers implemented following the developments of WP2 of this project and thoroughly described in their respective deliverables.

The frontend component of the dashboard application receives data from the Music360 platform through an application backend component. This backend component extracts and aggregates the necessary data in the format required by the user interface (UI). As a result, we refer to the backend module of the dashboard as "the aggregator."

- **Framework/Language: Python with FastAPI**
  - Python, our team's language of expertise, was the natural choice.
  - FastAPI, known for its high performance and ease of use, was selected to build a robust and efficient backend.
  - Poetry was used for library dependency management and packaging.
  - Docker enabled easy deployment and portability across different environments.
- **Database: PostgreSQL**
  - PostgreSQL, a powerful and reliable relational database, was chosen for data storage and management as part of the developments in WP2.
  - The client backend (aggregator) interacts with the database transparently through the Music360 platforms' DB REST API, using Pydantic models for data handling.
- **API Framework: RESTful APIs with FastAPI**
  - FastAPI facilitated the creation of a RESTful API, enabling seamless communication between the frontend and backend.
  - Pydantic models ensured clear definitions of API endpoints' inputs and outputs.
- **Data Processing and Analysis: Pandas and Polars**
  - Pandas and Polars, powerful data manipulation and analysis libraries, were employed for efficient data processing and transformation on the backend.
- **Rationale for Backend Choices**
  - The primary considerations for the backend were performance, compatibility with the existing Music360 platform, and security.
  - FastAPI's and Polars' speed and efficiency were crucial for handling heavy aggregations and data processing.

- The use of APIs ensured seamless integration with both the frontend and the Music360 platform, while also enabling robust authentication and authorization mechanisms.
- Docker provided the flexibility to deploy and scale the backend across various environments.

To ensure the Music360 dashboard's performance, scalability, and user-friendliness, we meticulously selected technologies and weighed their trade-offs. We prioritized maintainability and security through thoughtful package management practices. This approach allowed us to build a robust frontend that meets current user needs while providing a solid foundation for future improvements. By carefully assessing these factors, we have developed a technology stack that not only supports the Music360 dashboard's existing functionalities but also creates a framework for future enhancements and scalability.

2.4. Wireframes and Mockups (Visual Representations)

Wireframes and mockups played a pivotal role in the iterative design process of the Music360 dashboard. They provided a tangible representation of the dashboard's layout, functionalities, and user interactions, facilitating early feedback and collaboration among stakeholders in the development cycle.

Balsamiq for Collaborative Design

As mentioned in *section 2.1*, we leveraged Balsamiq, an online wireframing tool, to create interactive prototypes of the dashboard, going beyond static images. This collaborative environment allowed us to:

- **Version Control & Iteration:** Easily create and manage multiple versions of wireframes, tracking design changes and ensuring everyone was working with the latest version.
- **Stakeholder Engagement:** Invite partners to explore the wireframes, simulate the user experience, providing a deeper understanding of the dashboard's functionality. The platform allows users to leave comments directly on specific UI elements and engage in discussions within the tool or via email notifications.
- **Streamlined Feedback Integration:** Quickly implement changes based on feedback, replicate them across multiple pages, and generate new versions for further review and iteration.
- **Email Notifications:** Keep stakeholders informed of updates and new comments through automated email digests, ensuring active participation throughout the design process.

Mock Data for an Alpha Version

To provide a realistic user experience even before integrating with the backend, we generated mock data using ChatGPT. This data included information on music usages, territories, and artists, populating the dashboard's visualizations and tables. The alpha version, powered by this mock data, allowed for early testing and identification of potential

design or functionality gaps. For instance, during filtering interactions, we uncovered opportunities for improvement, leading to refinements in the final design.

Wireframe/Mockup Examples

The following screenshots of key wireframes illustrate the development process and highlight main components of the dashboard like navigation, data visualization areas, and filter panels.

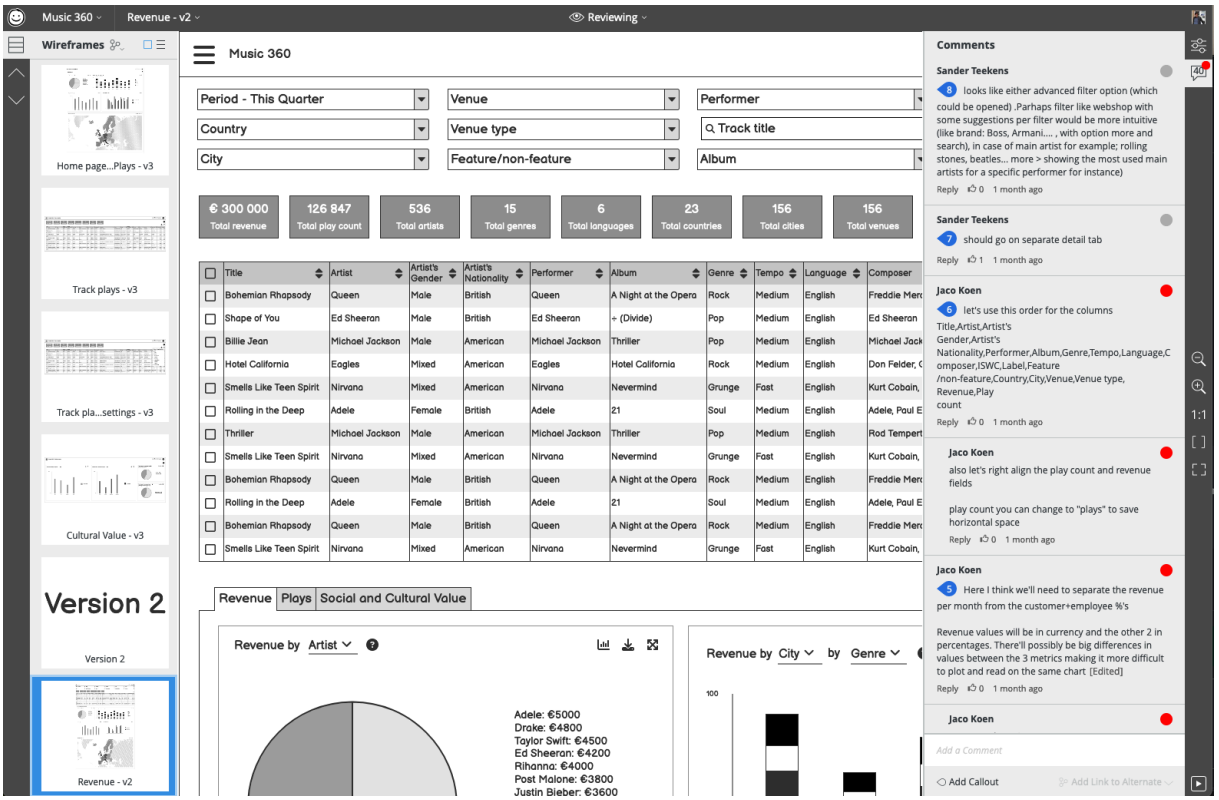


Figure 4: *General view of the Balsamiq environment in Review mode, showcasing an early version of the dashboard design, with the navigator of the wireframes at the left side and the comments section at the right side. Version 2 had the filter panel and the track table at the top of the web page.*

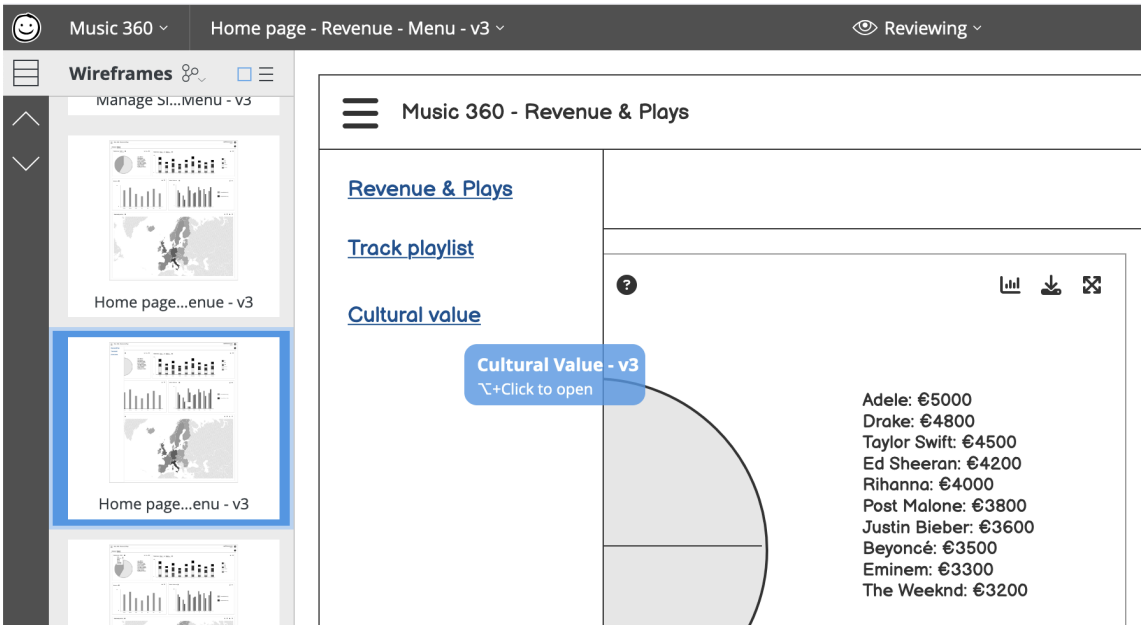


Figure 5: *Detailed view of the navigation section, showcasing how users can seamlessly move between different sections of the dashboard.*

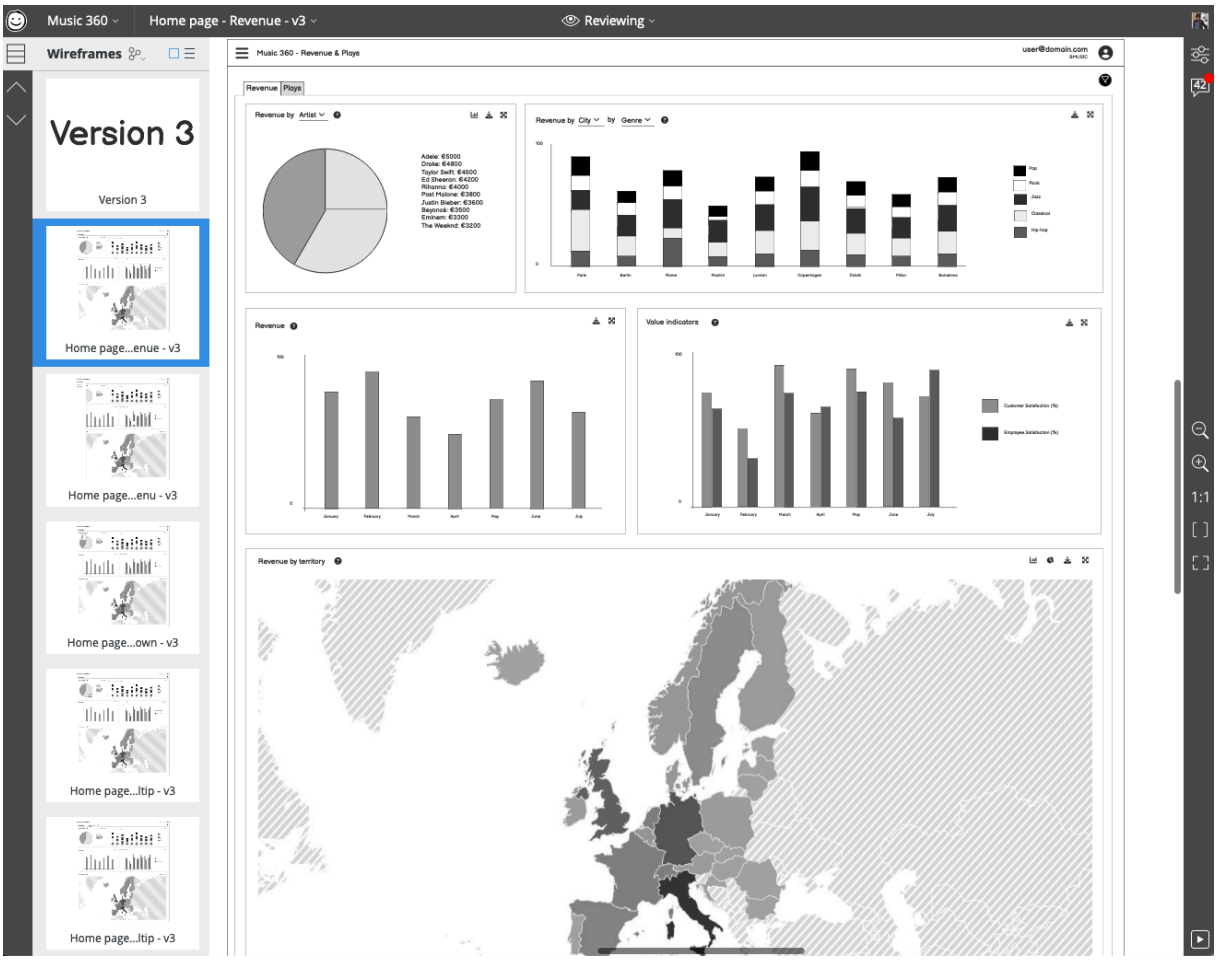
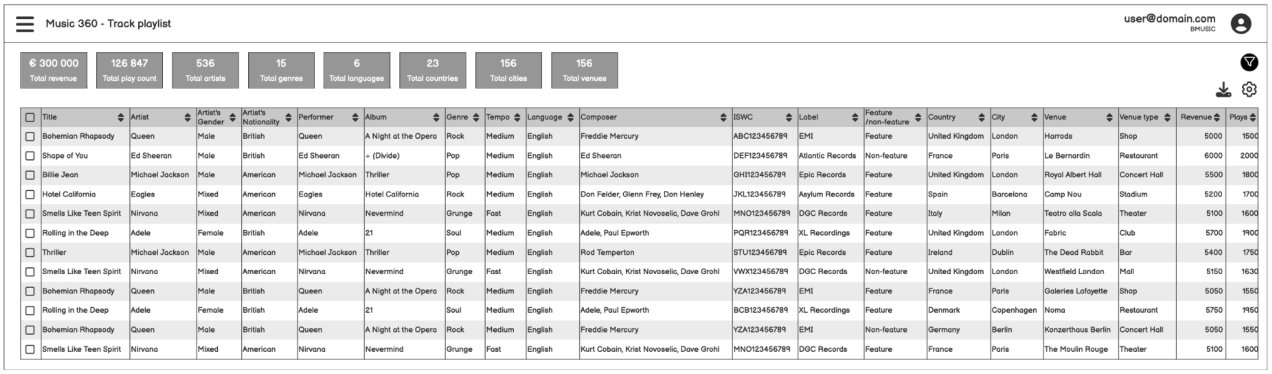


Figure 6: *A view of a wireframe in Balsamiq of the 3rd iteration of the Music360 dashboard, including different data visualization elements like pie charts, bar charts, or interactive heat maps.*



Title	Artist	Artist's Gender	Artist's Nationality	Performer	Album	Genre	Tempo	Language	Composer	ISWC	Label	Feature /non-feature	Country	City	Venue	Venue type	Revenue	Plays
Bohemian Rhapsody	Queen	Male	British	Queen	A Night at the Opera	Rock	Medium	English	Freddie Mercury	ABC123456789	EMI	Feature	United Kingdom	London	Harrods	Shop	5000	1500
Shape of You	Ed Sheeran	Male	British	Ed Sheeran	÷ (Divide)	Pop	Medium	English	Ed Sheeran	DEF123456789	Atlantic Records	Non-feature	France	Paris	Le Bernardin	Restaurant	6000	2000
Billie Jean	Michael Jackson	Male	American	Michael Jackson	Thriller	Pop	Medium	English	Michael Jackson	GHI123456789	Epic Records	Feature	United Kingdom	London	Royal Albert Hall	Concert Hall	5500	1800
Hotel California	Eagles	Mixed	American	Eagles	Hotel California	Rock	Medium	English	Don Felder, Glenn Frey, Don Henley	JKL123456789	Asylum Records	Feature	Spain	Barcelona	Camp Nou	Stadium	5200	1700
Smells Like Teen Spirit	Nirvana	Mixed	American	Nirvana	Nevermind	Grunge	Fast	English	Kurt Cobain, Krist Novoselic, Dave Grohl	MNO123456789	DGC Records	Feature	Italy	Milan	Teatro alla Scala	Theater	5100	1600
Rolling in the Deep	Adele	Female	British	Adele	21	Soul	Medium	English	Adele, Paul Epworth	PQR123456789	XL Recordings	Feature	United Kingdom	London	Fabric	Club	5700	1900
Thriller	Michael Jackson	Male	American	Michael Jackson	Thriller	Pop	Medium	English	Rod Temperton	STU123456789	Epic Records	Feature	Ireland	Dublin	The Dead Rabbit	Bar	5400	1750
Smells Like Teen Spirit	Nirvana	Mixed	American	Nirvana	Nevermind	Grunge	Fast	English	Kurt Cobain, Krist Novoselic, Dave Grohl	VWX123456789	DGC Records	Non-feature	United Kingdom	London	Westfield London	Mall	5150	1630
Bohemian Rhapsody	Queen	Male	British	Queen	A Night at the Opera	Rock	Medium	English	Freddie Mercury	YZA123456789	EMI	Feature	France	Paris	Galeries Lafayette	Shop	5050	1550
Rolling in the Deep	Adele	Female	British	Adele	21	Soul	Medium	English	Adele, Paul Epworth	BCB123456789	XL Recordings	Feature	Denmark	Copenhagen	Noma	Restaurant	5750	1950
Bohemian Rhapsody	Queen	Male	British	Queen	A Night at the Opera	Rock	Medium	English	Freddie Mercury	YZA123456789	EMI	Non-feature	Germany	Berlin	Konzerthaus Berlin	Concert Hall	5050	1550
Smells Like Teen Spirit	Nirvana	Mixed	American	Nirvana	Nevermind	Grunge	Fast	English	Kurt Cobain, Krist Novoselic, Dave Grohl	MNO123456789	DGC Records	Feature	France	Paris	The Moulin Rouge	Theater	5100	1600

Figure 7: *Detailed view of the wireframe of a data table with music usages with mock data.*

By utilizing wireframes and mockups, we ensured that the dashboard's design evolved in response to stakeholder feedback, resulting in a user-friendly and intuitive interface that effectively communicates the value of music.

2.5. Agile Development Methodology

To ensure efficient development, flexibility, and responsiveness to evolving needs, we adopted an Agile methodology, specifically utilizing a bi-weekly sprint structure.

- **Sprint Goals and Planning:** Sprint goals were established based on the prioritization of user stories and any dependencies between frontend and backend development. We conducted sprint planning meetings to estimate the effort required for each task and allocate them accordingly, considering the team's velocity.
- **JIRA and Bitbucket for Tracking and Collaboration:** We used JIRA to plan and track issues using a Kanban board, visualizing the progress of tasks through "to do," "in progress," "in review," and "done" columns. JIRA issues were linked to epic issues for major dashboard versions and segregated between frontend and backend tasks. Bitbucket was used for code management with Git, creating new branches for each feature before merging them into the main branch after the approval of the peer review of a pull request.

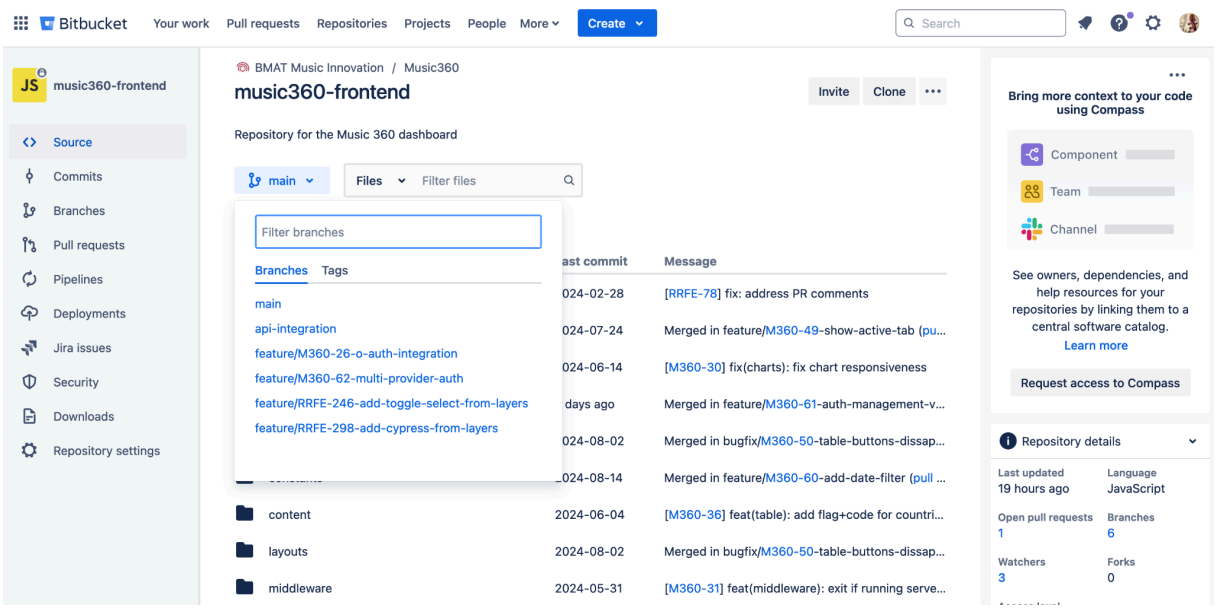


Figure 8: *The frontend code repository in Bitbucket, with feature branches connected to the JIRA issues.*

- **Communication and Synchronization:** Daily stand-up meetings ensured everyone was aligned on progress and any blockers. Additionally, a weekly sync meeting with the technical teams from VU, TVE, and UPV fostered coordination and collaboration across the project. A dedicated Slack channel enabled asynchronous communication.
- **Adaptability and Flexibility:** The Agile approach proved crucial in navigating unexpected challenges and evolving requirements. For instance, coordinating the integration with the Music360 platform or aligning frontend and backend development required adjustments and replanning within sprints. Agile allowed us to respond effectively, minimizing blockers and ensuring continuous progress.

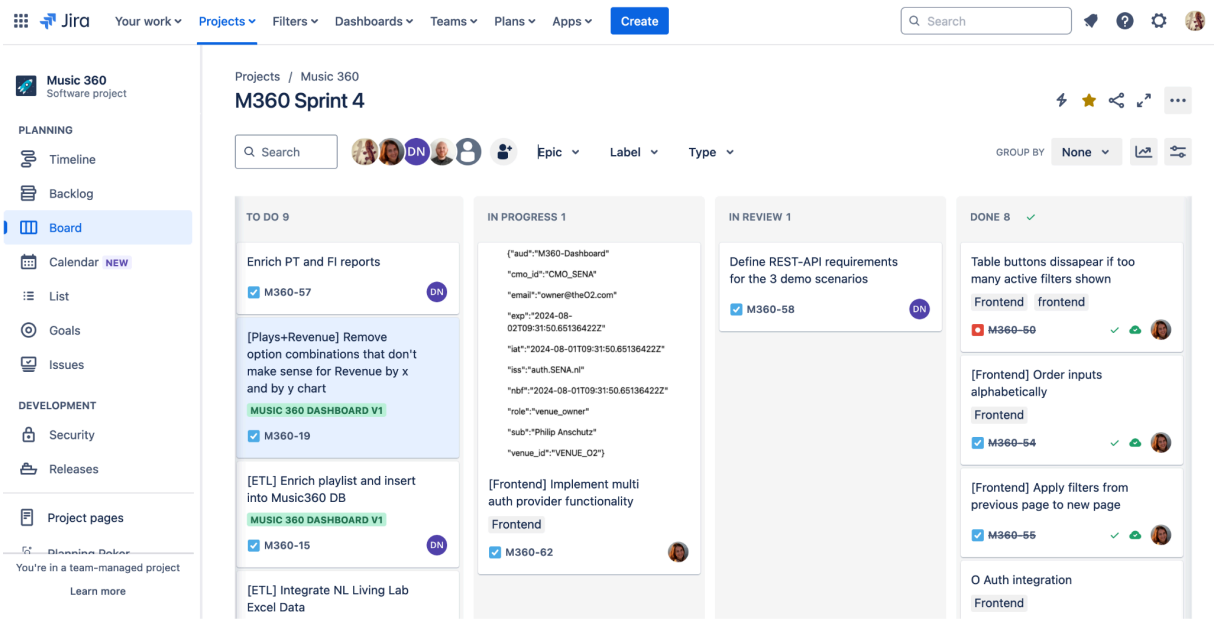


Figure 9: *The Kanban board in the Music360 project in JIRA.*

Benefits of Agile

The adoption of Agile methodology yielded several key benefits:

- **Clear Framework for Collaboration:** Agile provided a structured yet flexible framework for teamwork, promoting transparency and shared ownership of the development process.
- **Predictable Delivery:** The sprint structure ensured regular delivery of value, with tangible features completed at the end of each sprint.
- **Progress Visibility:** The Kanban board and regular meetings provided clear visibility into project progress, enabling stakeholders to stay informed and engaged.
- **Adaptability to Change:** Agile empowered us to adapt swiftly to changes in requirements or unforeseen challenges, ensuring the dashboard remained aligned with evolving needs.

Overall, the Agile methodology proved instrumental in successfully delivering the Music360 dashboard's Version 1, fostering collaboration, flexibility, and a user-centric approach throughout the development process.

3. Dashboard Architecture

This section provides a comprehensive overview of the Music360 dashboard's underlying architecture. Understanding the system's design is crucial for comprehending its data flow, integration with the Music360 platform, and the security measures implemented to safeguard sensitive information. This architectural foundation ensures that the dashboard is not only functional and efficient but also scalable and secure, capable of supporting the diverse needs of its stakeholders within the music ecosystem.

3.1. Overall System Architecture Diagram

The dashboard is a crucial component of the Music360 ecosystem, providing an interface for users to interact with data according to their roles. The system architecture of the whole platform has been thoroughly described and discussed in the deliverable "D2.2 – A distributed architecture for music data collection, representation, and distribution – version 1." Here, we contextualize the dashboard architecture within the general framework.

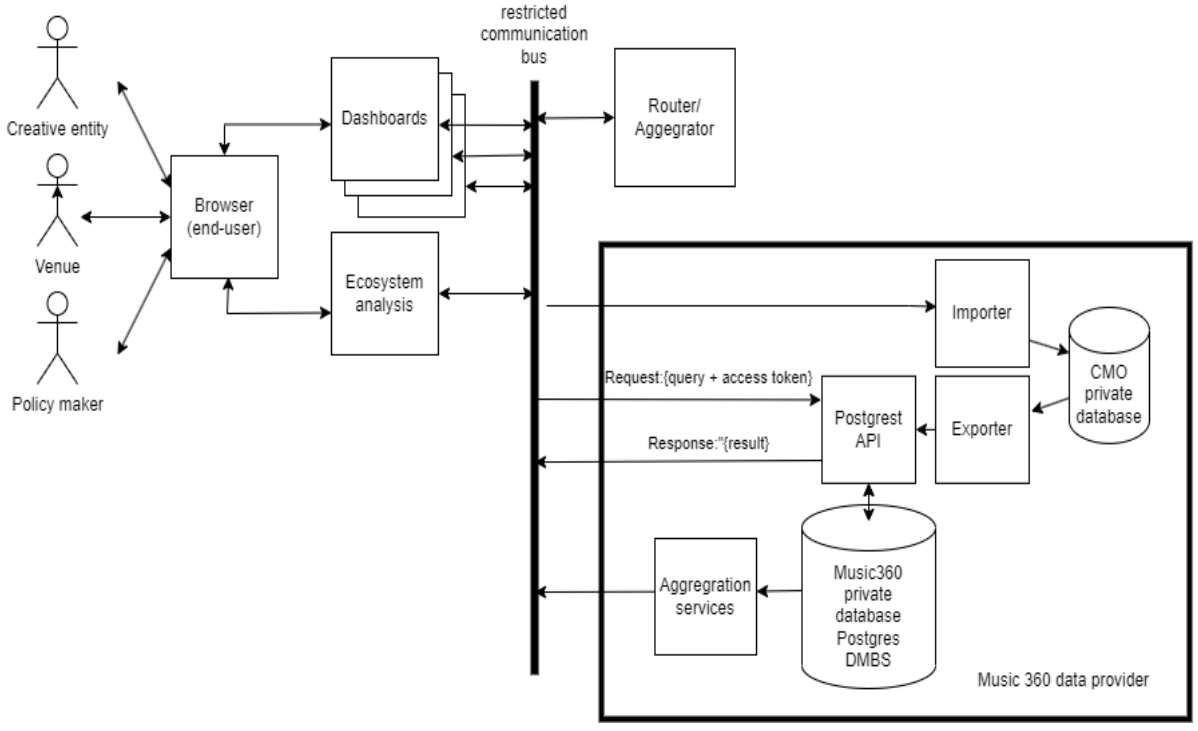


Figure 10: *An initial view of the dashboard integrated into the Music360 platform*

The dashboard comprises two main architectural elements: the frontend module (referred to in *Figure 10* as *Dashboards*) and the backend module (referred to in *Figure 10* as *Router/Aggregator*). The internal architecture of the dashboard and its interaction with the rest of the system have evolved during development. Initially, the Router/Aggregator was

planned as part of WP2's Music360 backend platform, but it has now been integrated into the dashboard application. The data processed by the frontend is provided by the aggregator service, as explained in *section 3.3*.

3.2. Data Sources and Types

The data displayed in the Music360 dashboard resides in various resource servers connected to the platform. These resource servers utilize their own database instances, adhering to the shared DB schema derived from the Music360 ontology, which is detailed in the deliverable "D2.1 – MUSIC360 Ontology for the Value of Music."

The data can be broadly classified into three types:

- **Music usage data:** Provided by music monitoring providers and background music services, this data includes lists of music played in different venues, collected automatically through audio fingerprinting or from background music playlists.
- **Economic and music industry data:** Supplied by CMOs, this data encompasses international codes for music recordings and underlying works, right holder information, and corresponding revenues, enabling the assessment of music's monetary value.
- **Field data:** Generated by the Living Labs, this data captures social or cultural impact information through surveys, interviews, and other techniques, contributing to the assessment of music's non-monetary value.

3.2.1. Data Acquisition, Preparation, and Loading into the Music360 DB

The process of obtaining, preparing and loading the data into the Music360 DB is as follows:

Music Usage Data

The music usage data can be obtained either through audio fingerprinting analysis of the music played in the venue, or from the venue's background music provider. In the former case, BMAT installs a micro-computer in the venue to capture the audio signal, which is sent to the analyzer servers, fingerprinted and compared against a database with millions of reference fingerprinted audios.

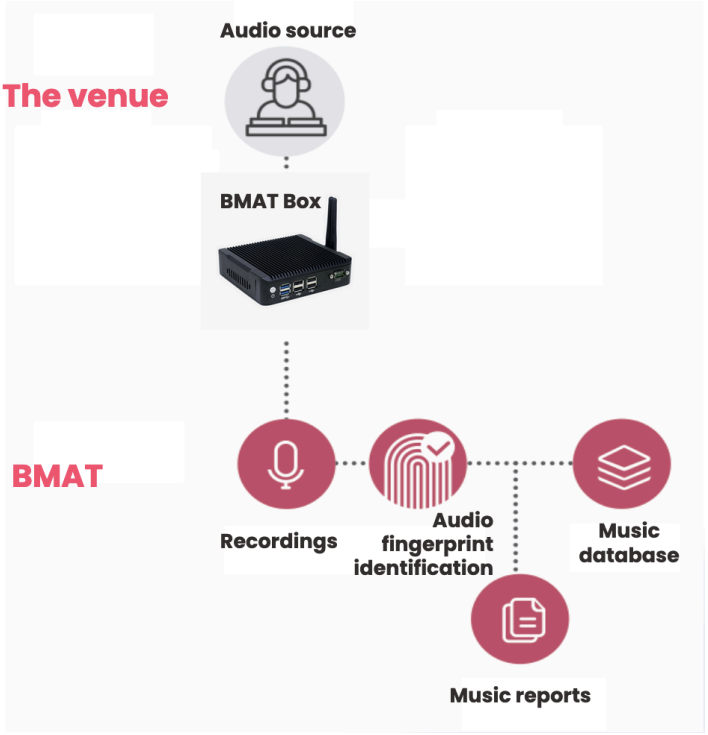


Figure 11: *A schematic representation of the music monitoring service based on audio fingerprinting*

This generates a list of music used with basic information like the name of the title and artist, associated metadata, a timestamp and venue information (see *section 5.4.2* for more details).

date	time	duration	channel	track	artist	label	isrc	bmatid	Album
30/4/24	22:44:13	00:00:47	Flamingo	Never Gonna Not Dance Again	P!Nk	Sony Music Entertainment	USRC12203282	11ad201e-77cd-4c1a-a75b-104f2b83a5ee	NEVER GONNA NOT DANCE AGAIN
30/4/24	22:41:01	00:03:12	Flamingo	Flowers	Miley Cyrus	Sony Music Entertainment	USSM12209777	c2b70c77-9860-4e8b-9d5c-c7db218be40d	Flowers
30/4/24	22:37:35	00:03:28	Flamingo	Selfish (Alan Walker Remix).	Madison Beer	Epic/Sing It Loud	USSM12003646	c57ab2fe-f7e9-49f1-b3b1-7fae61297117	Selfish (Alan Walker Remix)
30/4/24	22:34:36	00:03:00	Flamingo	Easy	Great Good Fine Ok	Sony Music Entertainment	USUS11800286	c6c89b5d-e468-44ac-82d5-87a382a83a96	Easy
30/4/24	22:32:04	00:02:34	Flamingo	Party In My Mind	Dolores Forever	Sweat Entertainment	QM24S2106712	f0f68dfb-1e67-4875-8707-0c184023faf5	Party In My Mind
30/4/24	22:28:32	00:03:34	Flamingo	Stranger In The Night	Ben L'Oncle Soul	Universal Music Group	FRUM71702038	bf34a77e-2a13-4974-82f9-70df377b442d	Stranger In The Night
30/4/24	22:25:07	00:03:24	Flamingo	Bite	Fickle Friends	Universal Music Group	GBUM71706128	958f6918-b810-489e-9418-d33d8f0303dd	You Are Someone Else
30/4/24	22:22:36	00:02:31	Flamingo	The Feeling	Lost Frequencies	Epic Amsterdam	BEHP42300013	34c1374f-30ec-4266-b11c-ecbcc7c8f600	The Feeling
30/4/24	22:19:54	00:02:42	Flamingo	Softest Touch	Khalid	Right Hand Music Group, Llc/Rca Records	USRC12300188	3f2d2ae0-65d2-474f-ad2f-718dda70bda2	Softest Touch
30/4/24	22:16:31	00:03:22	Flamingo	Nothing Else! Feat. Jamie Lidell	Mura Masa	Universal Music Group	GBUM71702433	1dd2ce91-3789-41ca-bb6c-435b8971474b	Mura Masa
30/4/24	22:13:25	00:03:07	Flamingo	Lighthouse	Calum Scott	Capitol Records	USUM72318379	c8feb722-f7db-4fa1-939a-b5461202f354	lighthouse
30/4/24	22:07:36	00:05:48	Flamingo	Lose Yourself To Dance	Daft Punk, Pharrell Williams	Sony Music Entertainment	USQX91300106	02ae8685-8d8b-42cd-af77-d27c21618ac0	Random Access Memories
30/4/24	22:03:07	00:04:30	Flamingo	In Case Of Fire	Mark Ronson, Jeff Bhasker	Sony Music Entertainment	GBARL1401631	cc520cee-c33e-4bfc-af13-74a183f30a8d	Uptown Special
30/4/24	21:59:53	00:03:14	Flamingo	How Long	Charlie Puth	Artist Partner	USAT21702278	2e58d260-e2c3-47c0-a0ec-a9765d7b8232	How Long
30/4/24	21:54:58	00:04:58	Flamingo	Extra Mile	Deluxe	Chinese Man Records	FRP7S1300031	48d5563d-dca2-4ec5-8c38-4eb4d8ede946	The Deluxe Family Show
30/4/24	21:51:56	00:03:03	Flamingo	Vowels	Capital Cities	Capital Cities	USUG11600807	a9e9434c-258d-45c3-a66f-6ee312fc36ef	Vowels
30/4/24	21:48:55	00:03:02	Flamingo	Shout, Baby	Chris Holsten	Warner Music Group	NOAGW2000112	bdb2078a-0ab3-4169-a4dd-db15855555c3	Shout, baby
30/4/24	21:45:15	00:03:40	Flamingo	You'Re The First, The Last, My Everything	Micheal Buble	Warner Music Group	USRE12100771	1dd84120-d5b4-4a51-87ad-07135cda7391	Higher
30/4/24	21:42:19	00:02:56	Flamingo	Can'T Stay Away	Darin	Dex Music	GBKPL2151580	45842861-2782-4fbc-825f-bb867e6692da	Can't stay away
30/4/24	21:41:48	00:02:19	Jumbo	Lonely	Diplo & Jonas Brothers	Sony Music Entertainment	USSM11903345	fd4f0b4a-61cc-4b97-a307-25a40f86689f	Lonely
30/4/24	21:39:16	00:03:04	Flamingo	Deeper	Morello Twins	Knightvision	NLS3R1800175	4a8957a0-af09-4d98-b2dd-f9682f6cae80	Deeper
30/4/24	21:36:29	00:02:44	Jumbo	Enough	Jess Glynne	Emi	GBUM72311208	3f2a84a4-e333-463a-8829-4d64f48a66b4	Enough
30/4/24	21:36:02	00:03:14	Flamingo	Behave	Benjamin Ingrosso	Record Company Ten	SEWEE1801501	90528083-45e2-4442-9622-856d4911dbdd	Identification
30/4/24	21:33:14	00:02:48	Flamingo	Oblivious	Nonono	Warner Music Group	SEPQA1800288	71da2932-5d68-4bd3-a6f7-e86d067350c4	Undertones
30/4/24	21:32:35	00:02:12	Jumbo	Wildflower	5 Seconds Of Summer	Universal Music Group	USUG12000296	dad7c1de-4a5e-4938-b532-174db34fded8	Wildflower
30/4/24	21:28:52	00:04:22	Flamingo	Secrets	The Weeknd	Universal Music Group	USUG11600984	f6e4b377-296c-4541-8704-e77c674131dd	Starboy
30/4/24	21:26:11	00:03:23	Jumbo	Alive And Kicking	Simple Minds	Universal Music Group	GBAAA1300123	d2072d4b-25dd-4555-b0b7-f9f7e2900b45	Celebrate (Greatest Hits)
30/4/24	21:23:43	00:02:27	Jumbo	Loyal	Sara Bee	Wm Finland	FIWMA2400046	8cd803e0-7f2a-470d-988f-e93426f6f0aa	Loyal
30/4/24	21:22:13	00:03:16	Flamingo	Auntie'S Basement	Anthony Ramos	Universal Music Group	USUG11903283	4741291b-0237-40dd-861d-d12430750234	The Good & The Bad
30/4/24	21:18:30	00:03:45	Flamingo	Heartbreaker	Nabiha, Tabi Bonney	Disco:Wax	DK4YA1301707	00182f2b-98f7-4f2e-92f7-98d4837faecb	Mind the Gap
30/4/24	21:17:23	00:02:59	Jumbo	Sunday Morning (Album Version).	Maroon 5	Universal Music Group	USJAY0300086	52b55269-40ec-4862-8830-72a22d8f32f7	Red Hot Hits
30/4/24	21:15:42	00:02:48	Flamingo	How Many Tears	Kygo X Sam Feldt X Emily Warren	Smi/ Columbia/B1	USRC12203955	930fdf29-3f1a-41c3-a3f9-a43158c3eefd	Thrill Of The Chase
30/4/24	21:13:31	00:03:47	Jumbo	The Power Of Love	Huey Lewis And The News	Helta	DEUE21615463	a45e0304-0f6c-4f26-b1a6-34fee8070d57	Rock Line, Vol. 3
30/4/24	21:12:15	00:03:28	Flamingo	Say Something	Kylie Minogue	Bmg Rights	GBSKW2001668	d499a664-ffeb-4e0d-b02e-085efe9d8e52	Say Something

Figure 12: *An example of music monitoring report*

In the latter case, CMOs get the playlists of the music played during a given period of time, with diverse quality, but usually with poorer metadata and time precision.

Data Enrichment & ETL

The inputs form background music playlists are harmonized by BMAT to give it a compatible

format with the music usage data as a first step of the data processing pipeline, which from that point follows the same workflow. This data processing pipeline is commonly known as ETL (Extract, Transform, Load). The music monitoring service used is BMAT's Vericast. The data from this music monitoring service can be extracted manually from a UI in the form of a CSV or Excel file, but it also offers an API to facilitate programmatic access. Once extracted, the raw data is matched against different metadata dabatases to add missing information (codes, contributors…) that will help with the matching of the plays with the documentation databases of CMOs in a later step.

The reference audios of the music reports are analyzed with audio processing techniques using the open-source Essentia library[3] which uses machine learning algorithms to extract high-level and low-level audio descriptors. For Music360 we are mainly interested in the high-level descriptors like BPM, genre or danceability metric. Version 1 will use BPM to determine the tempo and genre to enrich the music reports to help classify and filter the music usages collected in the Living Labs.

The ETL pipeline is built in a cloud computing environment, namely in Amazon's AWS, as it offers out-of-the-shelf services that allow for a scalable and flexible processing infrastructure.

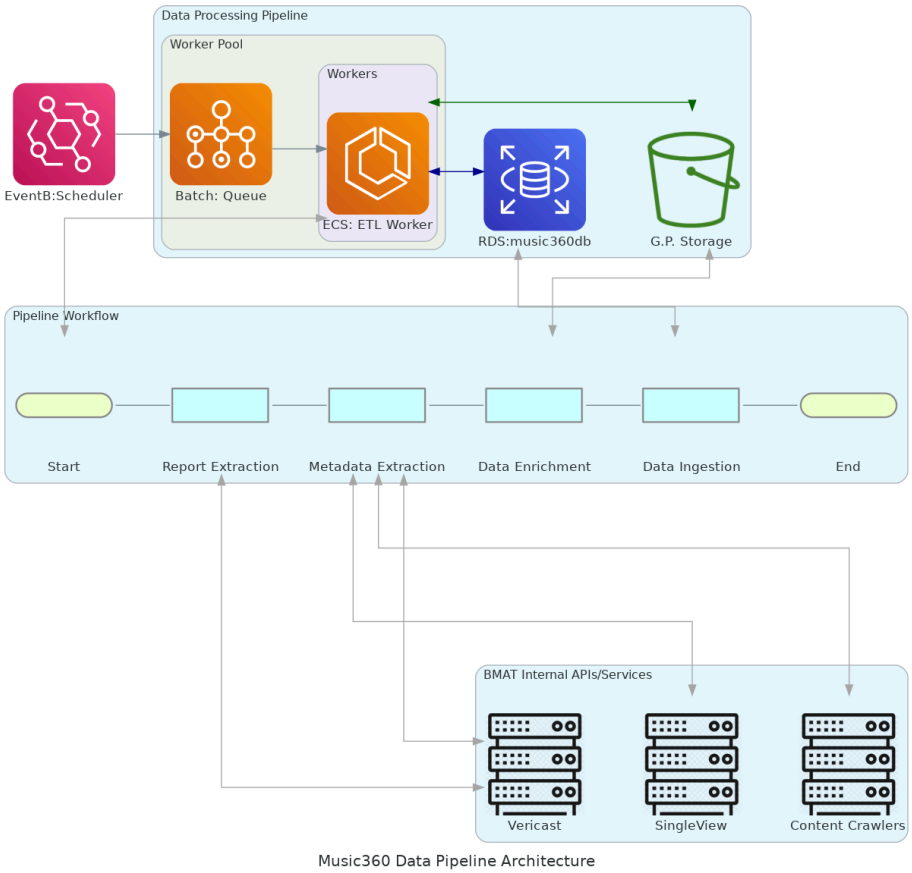


Figure 13: *A diagram of the ETL workflow to prepare the music usage data for ingestion into the Music360 DB, using a cloud computing environment in Amazon's AWS*

[3] https://essentia.upf.edu/

```
highlevel:
    danceability:
        all:
            danceable: 0.268335461617
            not_danceable: 0.731664538383
        probability: 0.731664538383
        value: "not_danceable"
    gender:
        all:
            female: 1.370175141356-05
            male: 0.999986290932
        probability: 0.999986290932
        value: "male"
    genre_dortmund:
        all:
            alternative: 0.350509405136
            blues: 0.179271131754
            electronic: 0.0423830449581
            folkcountry: 0.0800917372108
            funksoulrnb: 0.0144755709916
            jazz: 0.0326254554093
            pop: 0.0446969754994
            raphiphop: 0.00915636774153
            rock: 0.24679030478
        probability: 0.350509405136
        value: "alternative"
    genre_electronic:
        all:
            ambient: 0.547067761421
            dnb: 0.0682357251644
            house: 0.265040457249
            techno: 0.044291164726
            trance: 0.0753649026155
        probability: 0.547067761421
        value: "ambient"
```


Figure 14: *A sample of the generated audio descriptors with the Essentia library*

Economic and Music Industry Data

To get the economic and music industry data, the enriched reports are sent to the CMOs for further processing, matching and enrichment with their internal data. Initially, the reports for the tool were extracted and received manually. However, the plan is to establish automated processes for CMOs to obtain the necessary information from the Music360 API. This will enable programmatic processes within a production environment. The details of the data covered in Version 1 can be checked in *section 5.4.2* too. They include international codes for music recordings and works, right holder information and corresponding revenues. Once done, these enriched reports are loaded into a Music360 DB instance of a resource server, which will offer its data to the dashboard's aggregator through the DB REST-API applying the security and access rules according to the dashboard user. Finally, the aggregator will process and prepare the data for the dashboard's UI.

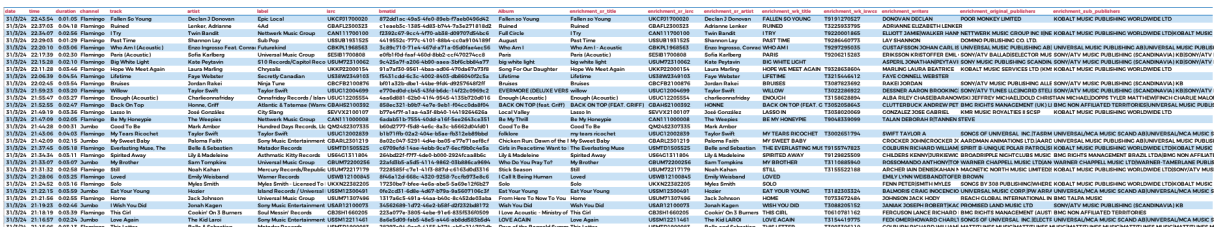


Figure 15: *The raw music usage reports are enriched following the ETL pipeline*

Field Data

The field data, coming from the Living Labs, follow a separate workflow. The raw information obtained in surveys and interviews is analyzed and mapped to a common framework in

tabular data, and a series of scripts are being developed to load the information in DB following the data models derived from the Music360 ontology. Version 1 does not yet include this type of data, as it requires further analysis and standardization.

3.3. The Aggregator Service: Data Flow and Integration with the Music360 Platform

In this section, we will delve into the backend service of the dashboard, known as the aggregator service, by describing its client API endpoints and exploring the interactions that occur between this service, the frontend, and the platforms' REST-APIs that allow the data to flow end to end from the resource servers to the client application.

3.3.1. Definition

The aggregator service provides a layer of abstraction in the communication pipeline to provide data aggregation to the dashboard across multiple instances of databases which are wrapped by a REST-API, one for each resource server of the platform's decentralized architecture.

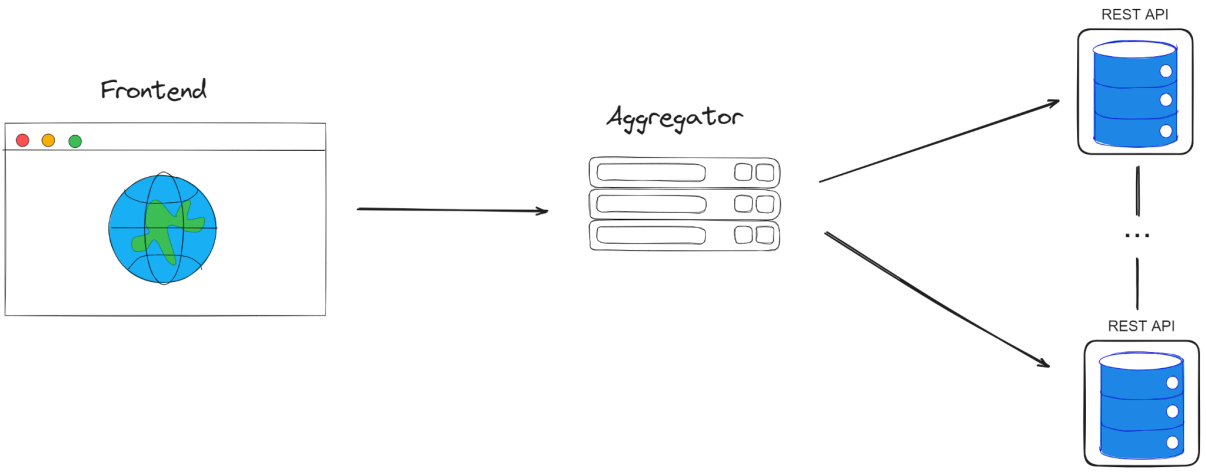


Figure 16: *The interaction between the dashboard frontend, the dashboard backend or aggregator and the resource servers of the platform*

The service must connect to the different resource servers using their REST-API, extract all the relevant data, compute any aggregation, and serve the data to the frontend through the client API in an efficient way to load it and render it in the client's UI. The data must be aggregated according to the requirements of the logged user in the application. In the future, the client API will also be available to external applications for programmatic interaction with Music360 platform data.

3.3.2. Preliminary Design

The aggregator provides an API with endpoints that can be reused for different items in the dashboard. The interaction flow between services is as follows:

1. The dashboard UI sends a request with user-selected filters as query parameters and additional aggregation parameters based on the graph/element type.

2. The aggregator checks its cache; if available it returns the cached response. Otherwise, it forwards the request to the REST-API, including the user's JWT token and the query parameters that describe filtering criteria.

3. The aggregator caches the REST-API response and proceeds to aggregate the data as per the aggregation parameters or endpoint type.

4. The aggregator sends a JSON response with aggregated data in a predefined format back to the dashboard.

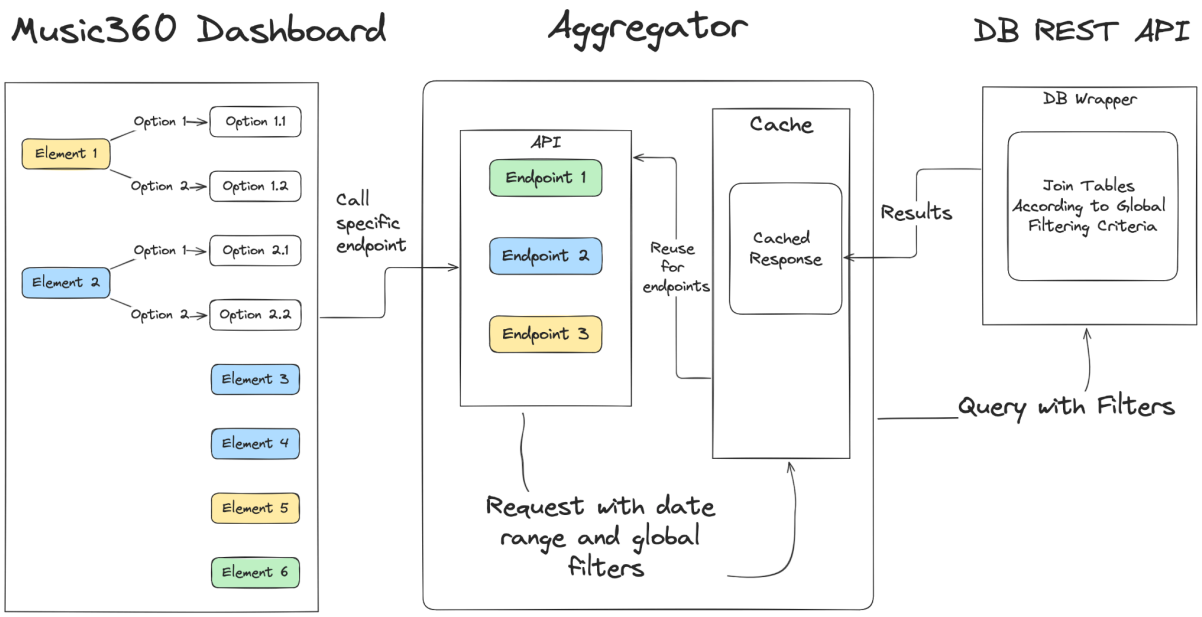


Figure 17: *A workflow diagram of the interaction between services*

3.3.3. Endpoints

The client API provides the following endpoints, grouped by dashboard elements:

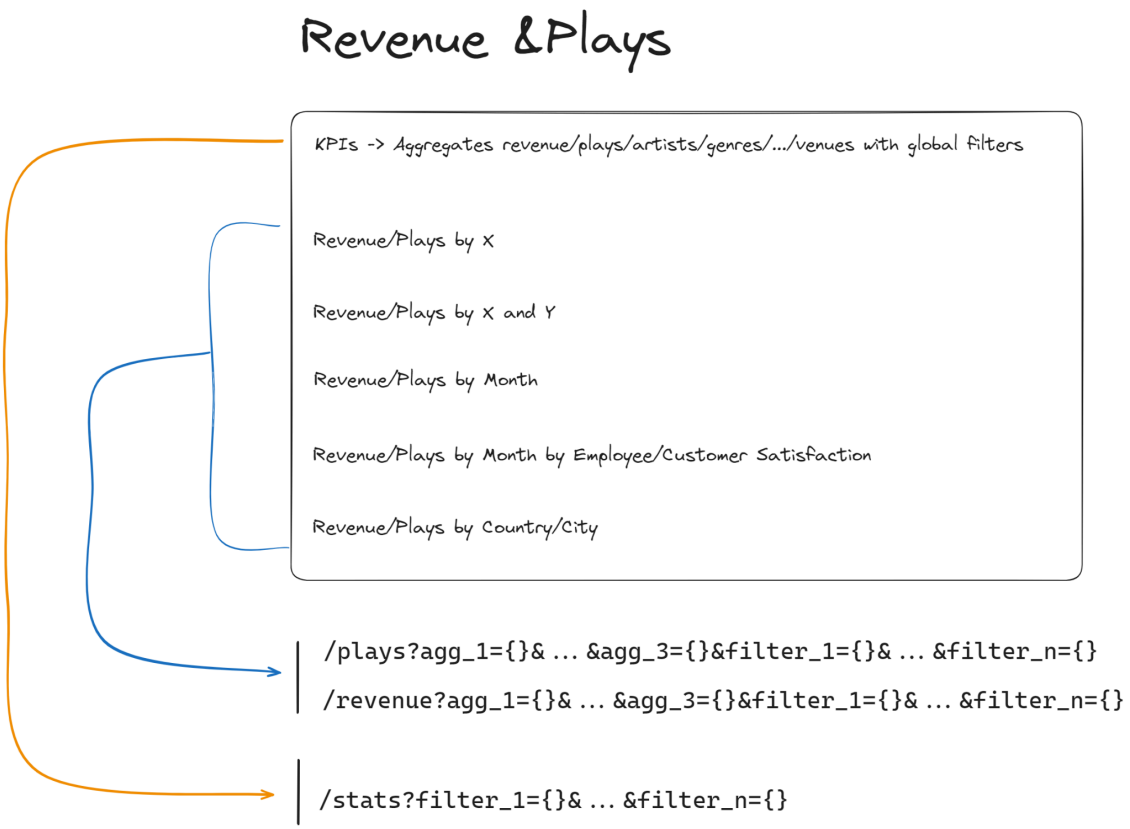


Figure 18: *Relationship between UI elements and client API for the Revenue & Plays section*

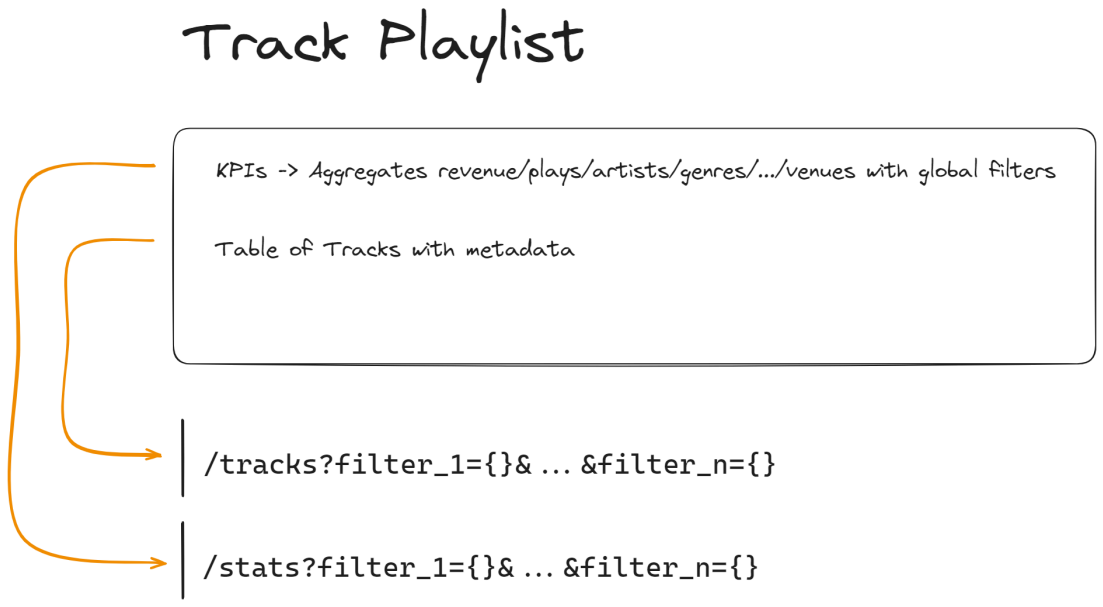


Figure 19: *Relationship between UI elements and client API for the Track Playlist section*

- `/plays` **and** `/revenue` **endpoints:**

  In this pair of endpoints the aggregation criteria depends on the user's active tab (REVENUE or PLAYS), and the data is aggregated by revenue or number of plays respectively. In the first two graphs the user can choose levels of aggregation (e.g., Revenue/Plays by Artist). These levels of aggregation are passed as query parameters to the aggregator along with the filters selected by the user (date range, country, type of venue, etc.).

Figure 20: *Detail of UI elements of the Revenue & Plays section with different types of charts*

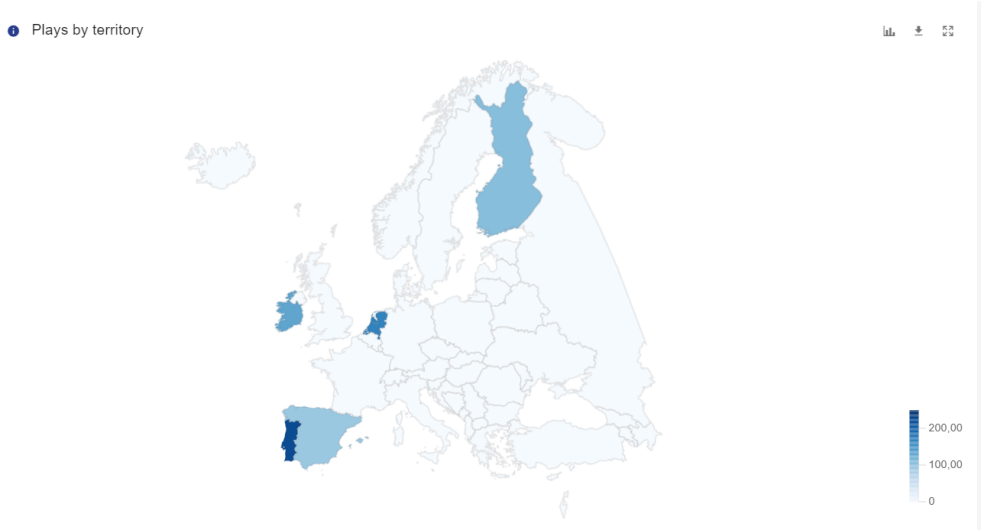


Figure 21: *Detail of the UI element of a map of plays by territory in the Revenue & Plays section*

Query examples for graphs above:

```
Unset
/plays?agg_1=Artist&start_date={start}&end_date={end}

/plays?agg_1=City&agg_2=Genre&start_date={start}&end_date={end}

/plays?agg_1=Country&start_date={start}&end_date={end}
```

- `/stats` **endpoint:**

  The endpoint aggregates data for each field based on filter query parameters, for the KPIs section of the UI.

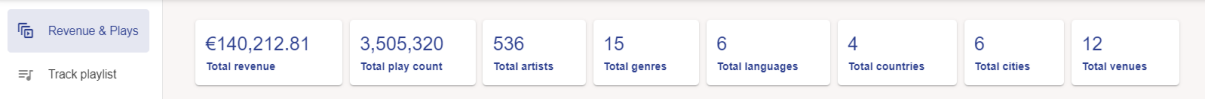


Figure 22: *Detail of the KPIs UI element of the dashboard*

Query example:

```
Unset
/stats?start_date={start}&end_date={end}
```

- `/tracks` **endpoint:**

  This endpoint aggregates the revenue and plays per recording, returning metadata based on filters selected by the user.

Figure 23: *The track playlist table of the dashboard*

Query example:

```
Unset
/tracks?start_date={start}&end_date={end}&filter_venue={venue_name}
```

Additionally, this endpoint provides the following capabilities:

- **Sorting:** Sorts the response based on a given column name and order criteria (ascending or descending).

```
Unset
/tracks?start_date={start}&end_date={end}&sort={col_name}&order={asc|desc}
```

- **Pagination:** Breaks the response into pages according to the specified page size and returns the tracks for the specified page.

```
Unset
/tracks?start_date={start}&end_date={end}&page_size=20&page=1
```

- **Export tracks (all/selected):** Exports the response to a CSV file, either for the selected track IDs or for the entire filtered response.

```
Unset
/tracks?start_date={start}&end_date={end}&export=True&track_ids=[1,...,n]
```

3.3.4. Ecosystem data flow

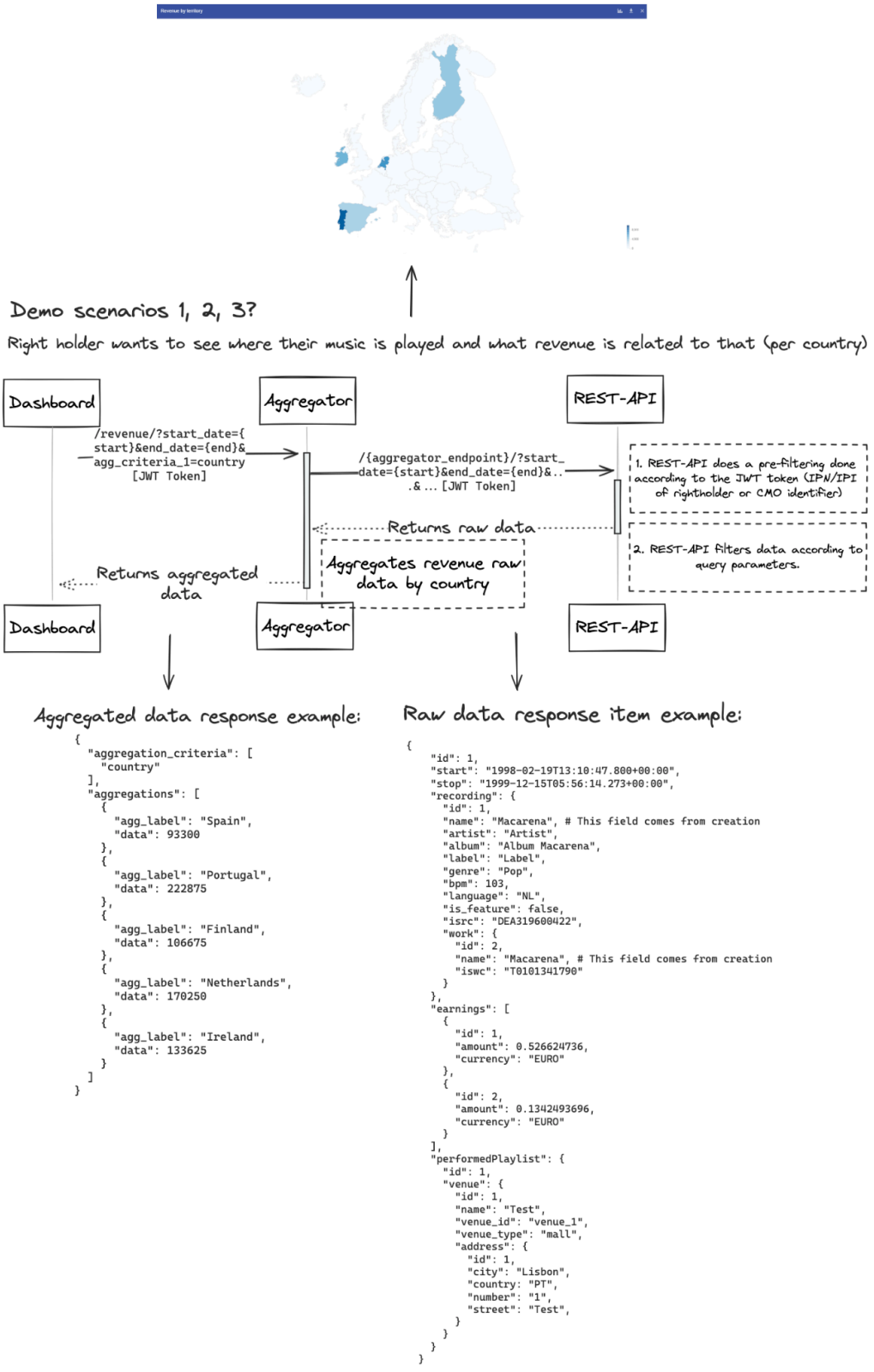


Figure 24: *Data flow in the Music360 ecosystem to render data in the dashboard*

The data flow illustrated in *Figure 24* is modelled after the three demo scenarios defined for Version 1, which will be further described in section 5.4.1. The three scenarios involve different user types requesting the same kind of data. However, the dataflow handled by the aggregator remains consistent across scenarios, as the process of filtering data according to user type is handled by the REST-API at the database level, making this filtering process transparent to the aggregator.

The dataflow process shown in the diagram is described as follows:

1. The user signs in and selects a date range filter (start and end date).

2. The “Revenue by Territory“ and “Plays by Territory“ dashboard elements make the following their respective requests with the user JWT token and filters:

```
Unset
/revenue?agg_1=Country&start_date={start}&end_date={end}[JWT Token]
/plays?agg_1=Country&start_date={start}&end_date={end}[JWT Token]
```

3. The aggregator makes a request to the REST-API for each request received from the dashboard with the filters selected by the user and its JWT token.

```
Unset
/{aggregator_endpoint}/?start_date={start}&end_date={end}&...&...[JWT Token]
```

4. The REST-API performs a pre-filtering according to the JWT token of the right holder (IPN/IPI/CMO ID).

5. The REST-API filters the data according to the query parameters received by each request and returns the data.

6. The aggregator aggregates the received data by plays or revenue (according to the endpoint) and by country (aggregation criteria selected at the beginning). Returns the aggregated data.

7. The “Revenue by Territory“ and “Plays by Territory“ dashboard elements display the data received by the aggregator.

It is worth noting that this data flow does not include the caching step or interaction with multiple databases as described in the definition of the service and its preliminary design, as these aspects are beyond the scope of the demo. The caching step, which also relies on measuring the performance of the REST-API, is considered a performance improvement feature and has not yet been analysed.

3.4. Security and Privacy Considerations (Encryption, Access Control)

The Music360 dashboard places a high priority on the security and privacy of its users. Here's how we achieve this:

- **Secure Communication:** The dashboard utilises HTTPS (Hypertext Transfer Protocol Secure) to ensure all communication between the user's web browser and the server is encrypted. This safeguards sensitive data, such as login credentials, from interception during transmission.
- **Robust Authentication:** To ensure secure user authentication, the Music360 dashboard utilises OAuth 2.0 with Proof Key for Code Exchange (PKCE) flow. This industry-standard protocol protects against authorisation code injection attacks, enhancing the security of user credentials.
- **Granular Access Control:** The dashboard leverages a robust access control mechanism to safeguard sensitive data developed as part of WP2 of the project. This system ensures that only authorised users can access specific resources based on their roles and permissions. This multi-layered approach protects data from unauthorised access and maintains data integrity. The granular access rules are based on the established list of UI field permissions (see *section 9.1.6*), which will be reviewed regularly and updated according to its last version.
- **Resource Server Authentication:** The use of multiple resource servers necessitates user authentication for each server. This granular approach ensures that users only grant access to the specific data sets required by each resource, minimising data exposure and upholding user privacy.

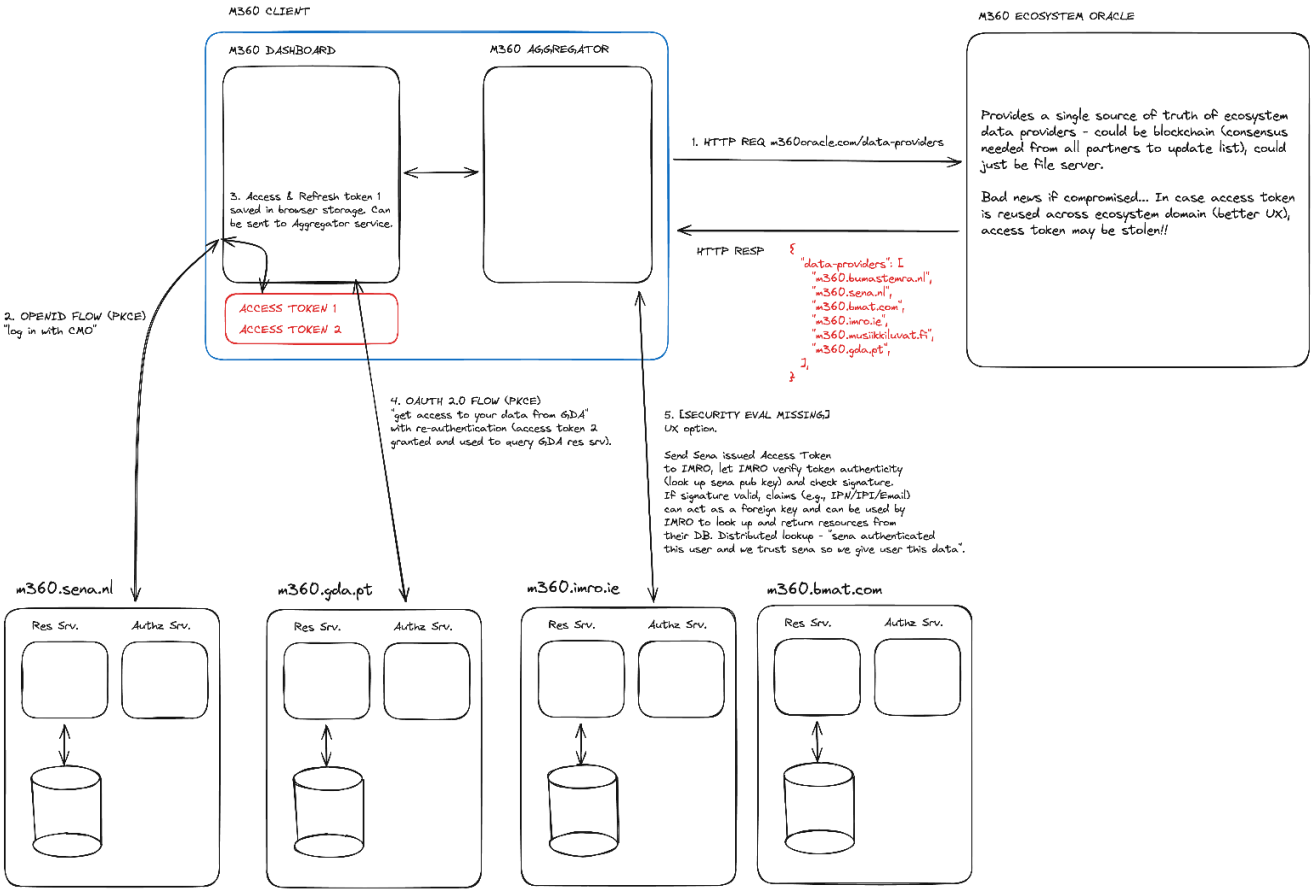


Figure 25: *Authentication and authorization flow in the Music360 dashboard. The development of the authentication and authorization workflows are deeply described in deliverable "D2.3 – Secure and trusted sharing of music data – version 1."*

By implementing these security and privacy measures, the Music360 dashboard fosters a trusted environment for users to access and analyse data related to the value of music.

4. Dashboard Features (Version 1)

This section provides a comprehensive overview of the core functionalities and features implemented in Version 1 of the Music360 dashboard. It explores the various data visualization options, filtering and sorting capabilities, and the initial steps taken to provide stakeholder-specific views. By understanding the dashboard's current feature set, stakeholders can gain insights into its potential for addressing their specific needs and contributing to a deeper understanding of music's value within the Music360 ecosystem. Additionally, we briefly outline potential future features, showcasing the dashboard's roadmap for continuous enhancement and expansion.

4.1. Core Functionality

This subsection describes the essential features and functionalities that form the foundation of the Music360 dashboard's Version 1. It explores the core capabilities that empower users to visualize, filter, and interact with music-related data, providing the initial building blocks for comprehensive analysis and insight generation.

4.1.1. Data Visualisation

The Music360 dashboard empowers users to explore music-related data through a variety of interactive visualisations.

Key Metrics at a Glance

The dashboard features a prominent header displaying essential KPIs (Key Performance Indicators) and data aggregations, providing a quick overview of critical information, such as total revenue, play count, number of artists, genres, languages, countries, cities, and venues. These metrics dynamically update based on applied filters, enabling users to gain immediate insights into the filtered dataset.

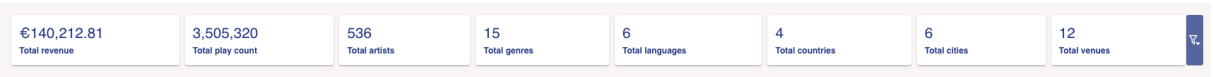


Figure 26: *The KPI header of the dashboard*

Customizable Charts

A range of chart types are available for deeper exploration, including pie charts, doughnut charts, territory maps, timelines, and bar charts:

- **Pie Chart/Doughnut Chart/Bar Chart:** Visualizes revenue or plays by a single, user-selectable aggregation parameter (e.g., Artist, City, Composer, Country).
- **Bar Chart with Two Aggregation Parameters:** Displays revenue or plays aggregated by two criteria (e.g., Plays by City by Genre), offering deeper insights into data relationships.

- **Time-Based Bar Chart:** Shows revenue or plays over time (months), enabling trend analysis.
- **Value Indicators Bar Chart:** Presents customer and employee satisfaction metrics over time (months), allowing for correlation analysis with music usage when this data will be available.
- **Heatmap (Choropleth):** Visualizes plays or revenue by territory on a map, providing geographical insights into music's social and economic impact.

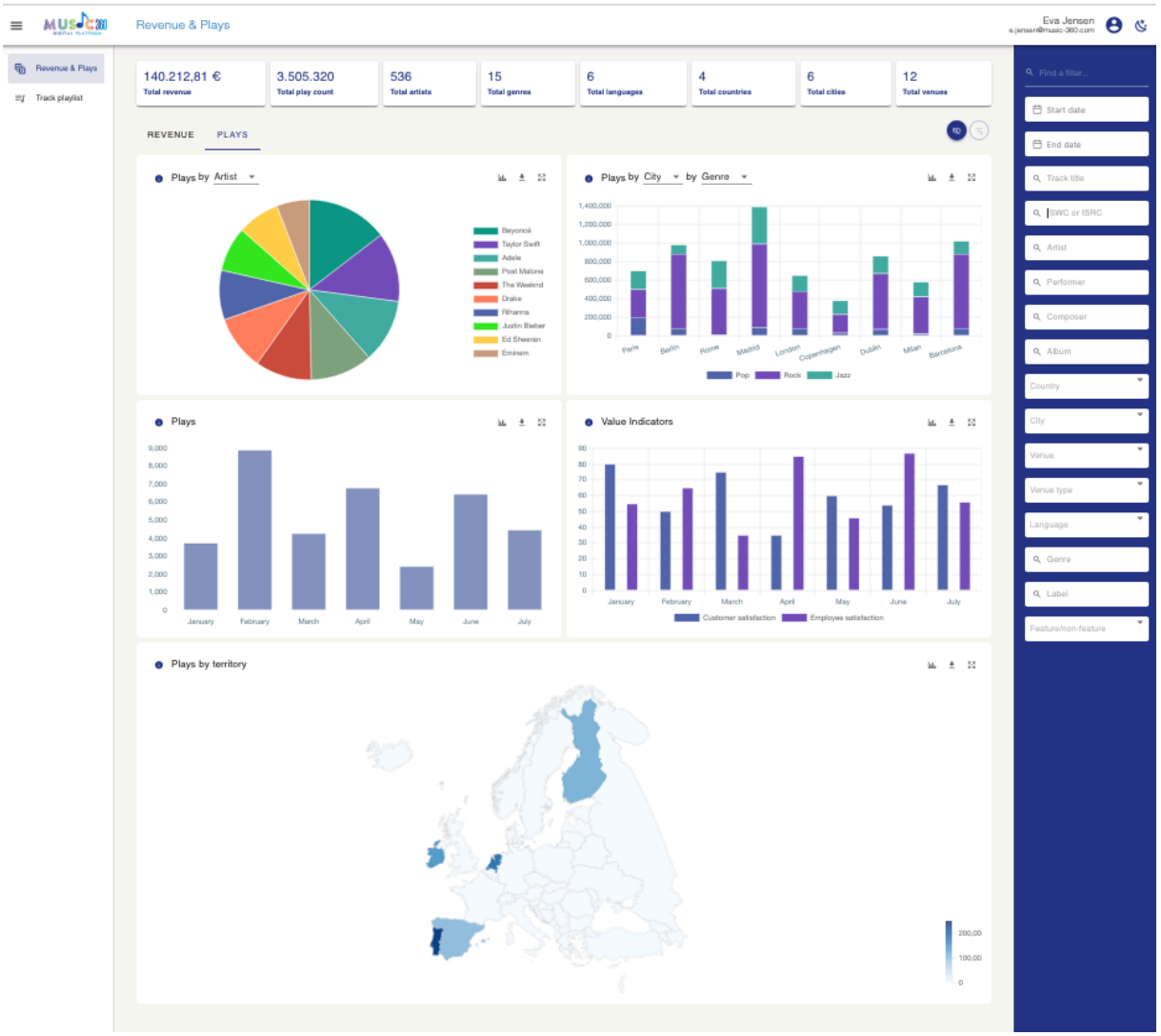


Figure 27: *General view of the Revenue & Plays tab showcasing the different types of charts*

Chart Customization and Export

Users can personalise their experience thanks to the following features:

- Users can dynamically change aggregation criteria and chart types (where applicable)

to explore data from different perspectives.
- Data series displayed in the charts are determined by filter selections.
- Charts can be exported as CSV files for further analysis or sharing.
- A full-screen mode is available for immersive data exploration.

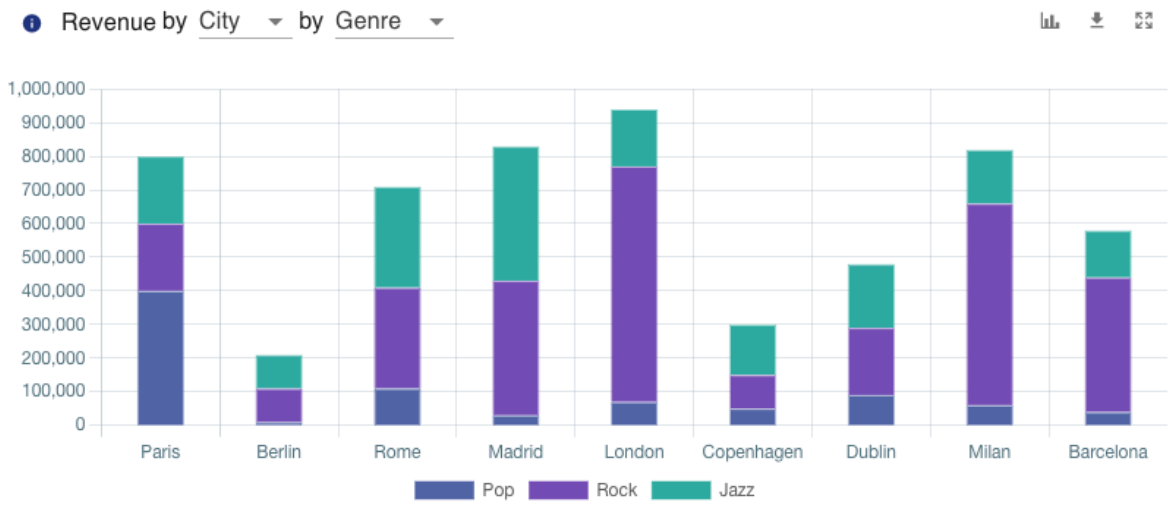


Figure 28: *A bar chart with two aggregation parameters selectable by the user*

Track Playlist Table

A table lists tracks played in venues accessible to the user, providing detailed information about each track, with the following features:

- Users can filter and sort the table by various criteria, show/hide and move columns, and click on data points to apply additional filters dynamically.
- The table data can be exported as a CSV file, either in full or for selected records.
- Individual cell content can be easily copied, and clicking on a record applies filters to the entire dashboard, including the other visualization elements, facilitating focused analysis.
- Pagination settings allow users to control the number of items displayed per page.

4.1.2. Filtering and Sorting

The Music360 dashboard offers robust and powerful filtering and sorting capabilities to refine data exploration and identify specific trends:

Granular Filtering: All data sets can be filtered by a wide range of criteria, including:

- Date range
- Track title, ISWC, or ISRC

- Artist, Performer, Composer, Feature/non-feature
- Country, City
- Venue, Venue Type
- Album, Genre, Label, Language

Filter the Filters: To manage the potentially extensive list of filters, a search function within the filter panel allows users to quickly find and apply the desired filters, streamlining the navigation and simplifying the process of finding the desired filter options.

Contextual Filter Options: Filter options are dynamically adjusted based on the user's role and permissions (e.g., CMO, record label representative). This ensures that users only see filters relevant to their specific role and data needs.

Space-Saving Filter Design: The filter panel is designed to save screen space. Filters are displayed vertically and can be hidden when not in use, allowing users to focus on the primary data visualisations.

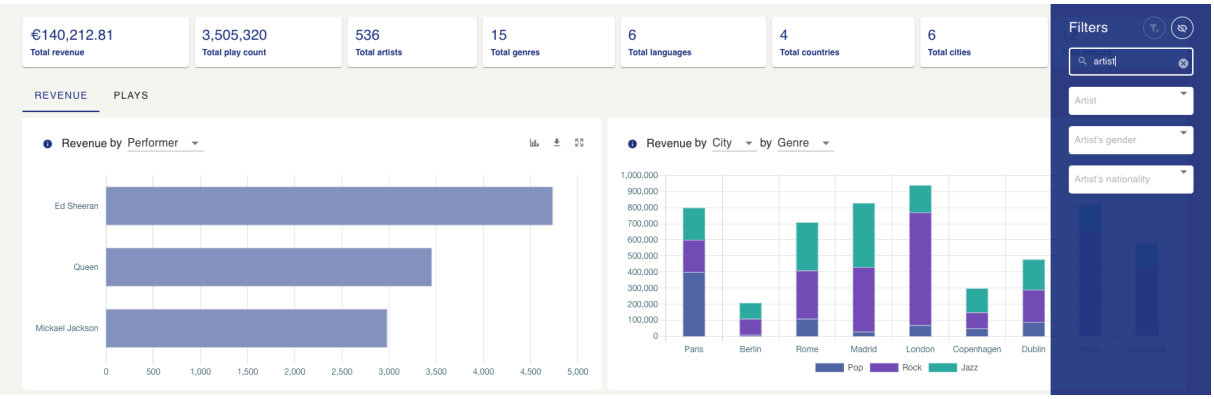


Figure 29: *A screenshot of the dashboard showing the filter search feature for "artist" in the right column*

4.1.3. Stakeholder-Specific Views

The dashboard caters to diverse user needs by adapting visualizations and data access based on user roles.

Data Filtering: Data displayed in charts and tables is filtered on the backend according to the logged-in user's type and permissions, ensuring that only relevant and authorized information is presented.

Visualization Customization: Certain visualizations may be hidden or modified based on user type. For example, venue representatives might not see the heatmap of plays or revenue by territory, and revenue data might be restricted in the track playlist view.

Filter Contextualization: Filter options are tailored to the user's context. For instance, venue representatives won't see filters for venue or venue type, as their view is already scoped to their specific venue.

As an example, a dedicated view showcases tracks played within all the venues a user has access to. This view allows users to filter and sort data based on their preferences, hide or show specific data columns, and click on data points to create additional filters. This empowers users to gain valuable insights into music performance within their venues.

This approach ensures that each stakeholder group receives the most pertinent insights while maintaining data security and privacy.

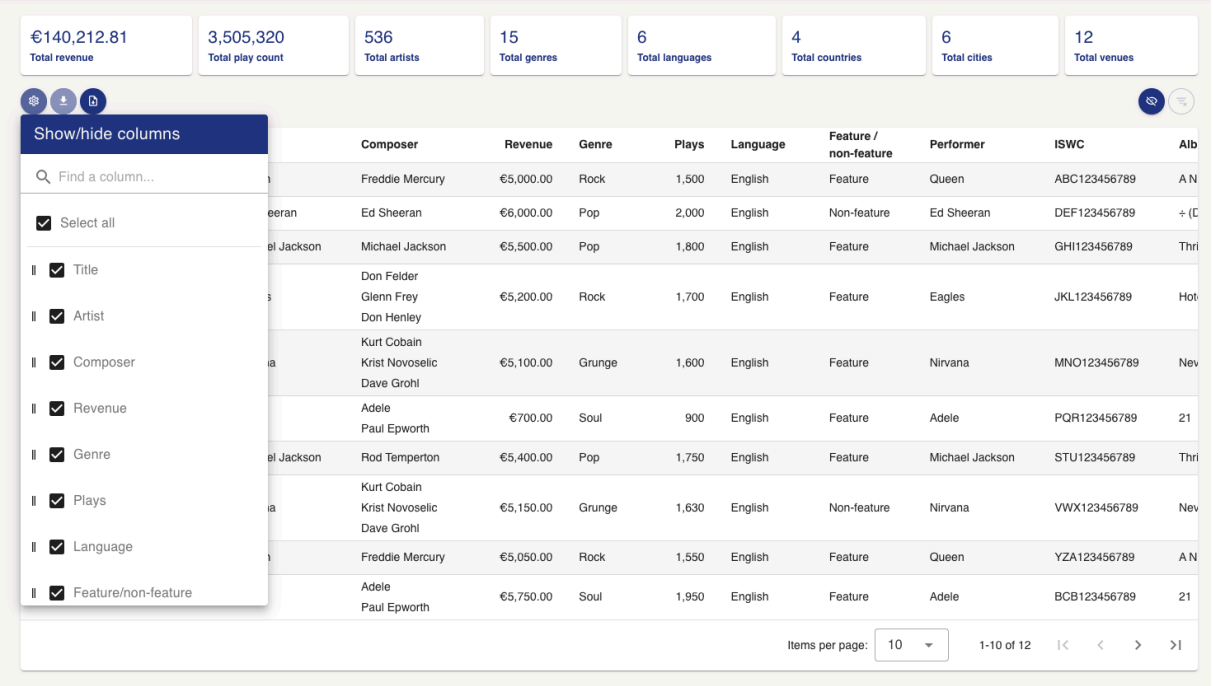


Figure 30: *The Track Playlist view with customizable columns*

4.2. Potential Future Features

The Music360 dashboard is envisioned as an evolving platform, with plans to incorporate additional features in future versions. Some potential enhancements include:

- **Societal and Cultural Impact:** A dedicated section could explore the non-monetary value of music, incorporating metrics such as customer/employee satisfaction, regional music trends, sentiment analysis, music engagement, and the impact of music in various settings (e.g., healthcare, festivities). These metrics would be visualized through interactive charts and graphs, enabling comparisons and correlation analysis with existing economic data.
- **Background vs. Foreground Music:** The dashboard could differentiate between background and foreground music scenarios, providing insights into how music usage

context influences its impact.

- **Indoor vs. Outdoor Venues:** Similarly, analysis could be extended to compare music usage and its effects in indoor versus outdoor settings.

New dedicated visualization charts will enable the possibility to answer questions like, Can specific music genres influence customer or employee satisfaction? Or analyze regional differences and similarities in music consumption patterns to understand how music preferences vary across geographical locations.

Innovative visualization charts will empower users to address new intriguing inquiries. For instance, they will be able to explore whether specific music genres impact customer or employee satisfaction or examine regional variations and similarities in music consumption patterns to gain insights into how musical preferences differ across geographical locations.

These potential future features will further enrich the dashboard's capabilities, providing stakeholders with a holistic understanding of music's multifaceted value, empowering users to not only understand the economic impact of music, but also explore its profound influence on society and culture.

5. User Interface and Experience

This section explores the design philosophy and implementation details that shaped the user interface (UI) and user experience (UX) of the Music360 dashboard. It outlines the guiding principles, wireframing and prototyping process, and the visual design system employed to create an intuitive, accessible, and engaging platform for stakeholders to interact with music value data. Furthermore, this section presents specific demo scenarios that have shaped the design of the user experience for Version 1, highlighting how the dashboard's features cater to different user needs and use cases within the Music360 ecosystem.

5.1. UI Design Principles and Guidelines

The Music360 dashboard prioritises a user-friendly and intuitive interface. To achieve this, we adhered to the following design principles:

- **Nielsen Norman's 10 Heuristics[4]:** We grounded our design decisions in the well-established Nielsen Norman's 10 heuristics for user interface design. These principles emphasise clarity, consistency, user control, and accessibility, ensuring a positive user experience for a diverse range of users. Some examples of the principles applied to our dashboard include:
    - **User Control and Freedom:** Providing clear ways for users to undo actions (e.g., easily clearing filter settings) and return to default views.
    - **Consistency and Standards:** Using industry-standard codes like ISRC, ISWC, IPI, and IPN for external consistency, and maintaining internal consistency through reusable UI elements and a cohesive color scheme.
    - **Recognition Rather Than Recall:** Offering tooltips with descriptions, intuitive menus, and readily visible options to minimize the user's memory load.
    - **Flexibility and Efficiency of Use:** Empowering users with customization features like column selection and chart type changes to tailor the dashboard to their needs.
    - **Aesthetic and Minimalist Design:** Prioritizing content and functionality while maintaining a clean, uncluttered interface that avoids distractions.
- **Google Material Design:** The visual language leverages Google's Material Design system. Material Design offers a comprehensive set of UI components and best practices that promote a clean, modern aesthetic and intuitive interactions. For example, this is evident in the use of:
    - **Recognizable Icons:** Employing clear and universally understood icons to enhance navigation and comprehension.
    - **Consistent Color Palette:** Utilizing a harmonious color scheme that adheres to accessibility guidelines while reflecting the Music360 brand identity.

By combining these principles, we aimed to create a Music360 dashboard that is not only visually pleasing but also easy to use, efficient, and accessible for a diverse range of

[4] https://www.nngroup.com/articles/ten-usability-heuristics/

stakeholders.

5.2. Wireframing and Prototyping

Wireframing and prototyping played a pivotal role in shaping the user interface and experience of the Music360 dashboard. The UI design process began with low-fidelity wireframes created using Balsamiq. These initial wireframes served as a foundation for iteratively developing and refining the layout and functionality of the dashboard. We went through multiple versions of the wireframes to ensure they effectively addressed user needs. These early-stage design tools allowed us to:

- **Rapidly Translate Requirements:** Quickly translate stakeholder requirements and user stories into visual representations, facilitating a shared understanding of the dashboard's structure and functionality.
- **Iterate Efficiently:** Explore and test different design options and layouts in a low-fidelity format, saving time and resources compared to making changes directly in code.
- **Gather Early Feedback:** Solicit feedback from stakeholders on the proposed design and interactions, enabling us to address potential usability issues and refine the user experience before development.

For detailed information on how we leveraged Balsamiq for collaboration, version control, and feedback integration during the wireframing and prototyping phase, please refer to section 2.4.

Specific examples of design improvements resulting from this iterative process include:

- **Tab-Based Navigation:** Initially, the track playlist was on the same page as the revenue and plays visualizations. Feedback indicated a preference for clear separation, leading to the implementation of tab-based navigation.
- **Space Optimization:** The filter banner was originally horizontal and occupied valuable screen real estate. Through wireframing iterations, we refined its placement and adopted a vertical layout, maximizing the space available for data visualization.

These examples demonstrate how wireframing and prototyping served as a bridge between user needs and the final design, ensuring that the Music360 dashboard is both functional and user-friendly.

5.3. Visual Design System

The Music360 dashboard's visual design system prioritizes consistency, efficiency, and accessibility. It leverages a component-based architecture, ensuring a unified look and feel throughout the platform.

- **Component-Based Design:** Reusable UI components that adhere to Google's Material Design principles were built using Vuetify, a Material Design UI library for Vue.js, and formed the backbone of the dashboard's visual structure. These components, such as buttons, cards, and navigation elements, were designed to be easily incorporated and customized across different sections of the dashboard. As an example, a versatile and reusable chart component was created, enabling users to dynamically change chart types, view charts in full-screen mode, access tooltips for additional information, and more. This component is utilized throughout the dashboard, ensuring a consistent data visualization experience while minimizing development effort.
- **Accessibility-Centric Design:** In addition to careful color selection for optimal contrast, the dashboard prioritizes accessibility through:
    - **Clear Labeling:** All UI elements are clearly labeled, making it easy for users to understand their purpose and functionality.
    - **Keyboard Navigation:** The dashboard supports keyboard navigation, allowing users to interact with all elements without relying on a mouse.
    - **Screen Reader Compatibility:** Semantic HTML and ARIA attributes are employed to ensure that the dashboard's content is accurately interpreted by screen readers, making it accessible to users with visual impairments.
    - **Colour Scheme:** The colour scheme for the dashboard was meticulously chosen. We considered the existing brand colours from the logo while prioritising accessibility best practices to ensure optimal contrast and readability for users with visual impairments.

By adhering to these design principles, we've created a visually cohesive and accessible dashboard that caters to a diverse range of users, promoting inclusivity and ease of use.

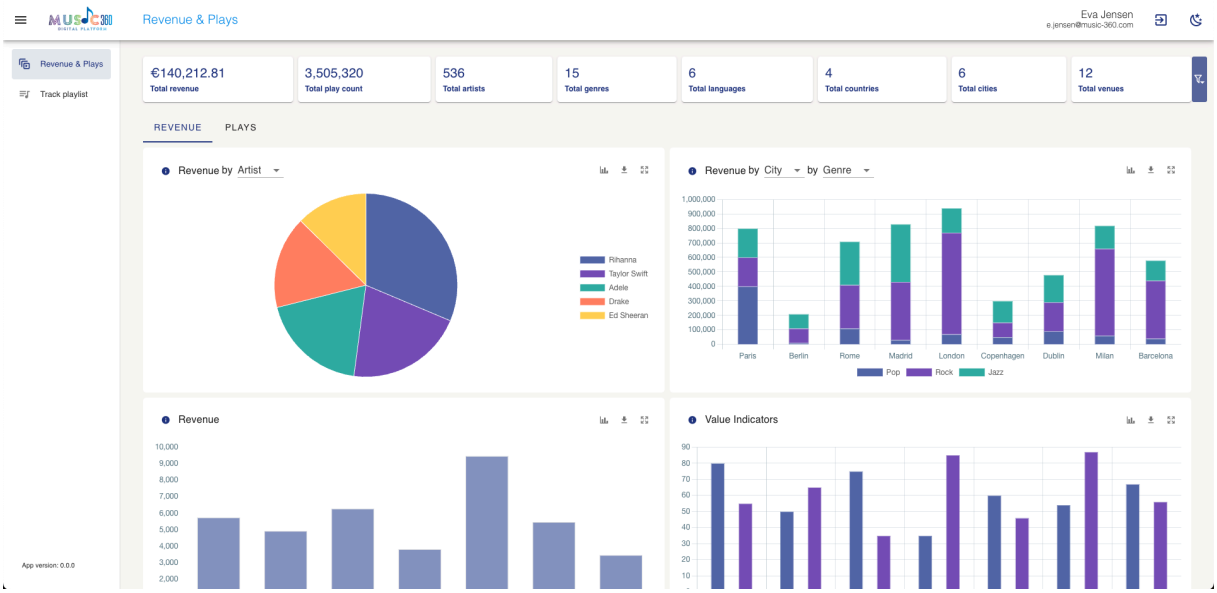


Figure 31: *A view of the UI implemented following the design principles described in this section*

5.4. Demo Scenarios for Version 1

In the early stages of development, we established three practical scenarios to guide our UI/UX design decisions. These scenarios were also designed to gather valuable feedback from real-world external stakeholders and ensure the dashboard's usefulness and relevance for specific user roles. The selection of these roles was based on the availability of relevant display information during the project's initial phases.

5.4.1. Definition of Demo Scenarios

- **Scenario 1: Performer Perspective**
  A performer, identified by their unique IPN (International Performer Number), wants to see where their music has been played and the associated royalties earned per country. The system leverages the performer's IPN and their neighboring rights CMO's granted access to identify and display relevant music usage and revenue data.

- **Scenario 2: Dual Role - Performer and Composer**
  Building on Scenario 1, the same user now also acts as a composer, identified by their IPI (Interested Party Information) code. Their author's rights CMO has granted them access to view data related to their compositions. The dashboard seamlessly integrates both roles, allowing the user to see combined or segregated plays and revenues as both a performer and composer.

- **Scenario 3: CMO Perspective**
  A CMO representative wants to analyze the plays and revenues generated by their members across different territories. The dashboard provides aggregated and segregated data and visualizations, enabling the CMO to gain insights into the performance of their repertoire and identify potential trends or opportunities.

5.4.2. Data Scope

Data Requirements per Scenario

The required type of data for the defined scenarios are:

- **Scenario 1 (Performer):**
  - Playlist linked to venue/country
  - Recording information linked to the play/playlist
  - Right holders having a claim on the recording
  - Revenue for the right holder associated with the play
- **Scenario 2 (Performer & Composer):**
  - All data from Scenario 1
  - Recording linked to work
  - Work information (linked to recording)
  - Right holders having a claim on the work

    - Link between IPI (composer) and IPN (performer)
- **Scenario 3 (CMO):**
    - Playlist linked to venue/country
    - Recording information linked to the play/playlist
    - Work information (linked to recording)
    - Right holders having a claim on recording and/or work
    - Revenue for right holders associated with the play
    - Link between (IPI and/or IPN) and the CMO's mandate

Data Types Utilized in Version 1

The data required for the defined demo scenarios, and consequently included in Version 1 of the dashboard, encompasses the following types:

- **Playlist Information:** This data, sourced from music monitoring services, details the music played in venues, including timestamps, venue information, and basic track metadata (title, artist, label, ISRC, etc.).

- **Recording Information:** Provided by neighboring rights CMOs, this data includes detailed information about sound recordings, such as the main artist, track title, version, ISRC, and VRDBID.

- **Work Information:** Sourced from authors' rights CMOs, this data focuses on musical works, including the title and ISWC.

- **Right Holder Information:** This data, sourced from CMOs and linked to recordings or works, identifies the right holders (performers or authors) by their international identifiers (IPN or IPI), names, the mandate of their CMOs, type of right holder (performer or author), and the revenue generated from each play.

For more details on data sources and their acquisition, please refer to *section 3.2*.

Data Structure and Examples

The specific data fields and their formats, essential for feeding the Music360 platform and supporting the demo scenarios, are defined below:

Playlist Information:

- `date`: day in which the music was used (e.g., *09/07/2024*)
- `time`: moment in which the music recording started being played (e.g., *00:58:36*)
- `duration`: amount of time a music recording has been detected in use (e.g., *00:02:14*)
- `channel`: venue being monitored (e.g., *SHELTER BAR - Club Lisboa 038*)
- `city`: city of the venue (e.g., *Lisboa*)
- `country`: country of the venue (e.g., *Portugal*)
- `track`: track title according to the metadata of the music monitoring provider (e.g., *Drifting*)

- `artist`: artist name according to the metadata of the music monitoring provider (e.g., *Tiësto*)
- `label`: record label according to the metadata of the music monitoring provider (e.g., *Musical Freedom*)
- `isrc`: ISRC (international sound recording code) according to the metadata of the music monitoring provider (e.g., *NLZ542300863*)
- `bmatid`: code of the recording within BMAT's monitoring service (e.g., *bcc65c0e-e6db-4db0-ab60-f5f53b037781*)
- `iswc`: ISWC (international work code) according to the metadata of the music monitoring provider (e.g., *T3185471976*)
- `album`: album title according to the metadata of the music monitoring provider (e.g., *Drifting*)
- `language`: language of the lyrics according to the metadata of the music monitoring provider (e.g., *en*)
- `genre`: genre of the song according to the metadata of the music monitoring provider (e.g., *Dance*)
- `bpm`: BPM of the song according to the metadata of the music monitoring provider (e.g., *130*)

Recording information:

- `Main Artist`: main artist name according to the neighbouring rights' CMO (e.g., *Tiësto*)
- `Title Track`: track name according to the neighbouring rights' CMO (e.g., *Drifting*)
- `Version`: version name of the recording according to the neighbouring rights' CMO (e.g., *Single*)
- `ISRC`: ISRC (international sound recording code) according to the neighbouring rights' CMO (e.g., *NLZ542300863*)
- `VRDBID`: code of the recording within SCAPR's VRDB system[5] according to the neighbouring rights' CMO

Work information:

- `Title`: work name according to the author rights' CMO (e.g., *DRIFTING*)
- `ISWC`: ISWC (international work code) according to the author rights' CMO (e.g., *T3185471976*)

Right Holder Information:

- `International Identifier of RH`: IPN for RH of type performer, IPI for RH of type author, as provided by the corresponding CMO (e.g., *00249141472*)
- `Right Holder Name`: name of a RH associated with the recording or work played, as provided by the corresponding CMO (e.g., *VERWEST TIJS M*)

[5] https://www.scapr.org/tools-projects/

- `Visibility to CMO`: CMO that can access to the information of that RH for that song, as provided by the corresponding CMO (e.g., *BUMA*)
- `Type of RH`: type of RH associated with the recording or work played, as provided by the corresponding CMO (e.g., *author*)
- `Value`: revenue (in EUR) associated with the play of the music corresponding to a given RH, as provided by the corresponding CMO (e.g., *4.31*)

5.4.3. Authentication / Authorization Flow

The authentication and authorization flow ensures secure access to the dashboard and data based on user roles and permissions.

- **Scenario 1 & 2:** Users authenticate through their respective CMOs, granting the dashboard access to their IPN or IPI data. The system then filters and displays information relevant to their creative works. See *Figure 32 and Figure 33*, describing in detail the authentication/authorization flow for the user.

- **Scenario 3:** CMO representatives authenticate as CMO staff, gaining broader access to data related to their mandate, including aggregated information about their right holders' performances.

For a detailed explanation of the authentication and authorization workflows, please refer to the deliverable "D2.3 – Secure and trusted sharing of music data – version 1."

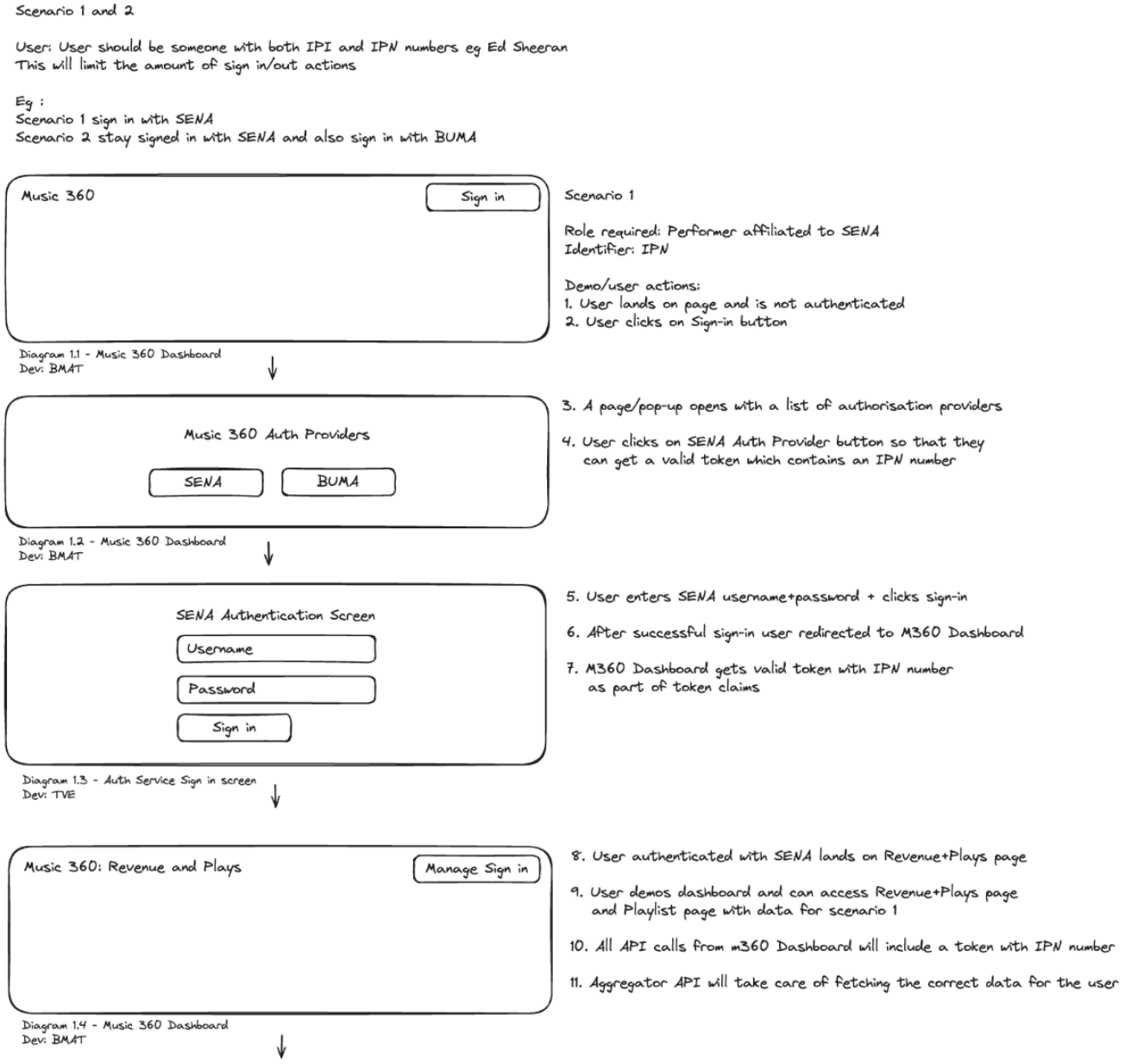


Figure 32: *The auth flow of a user for Scenario 1*

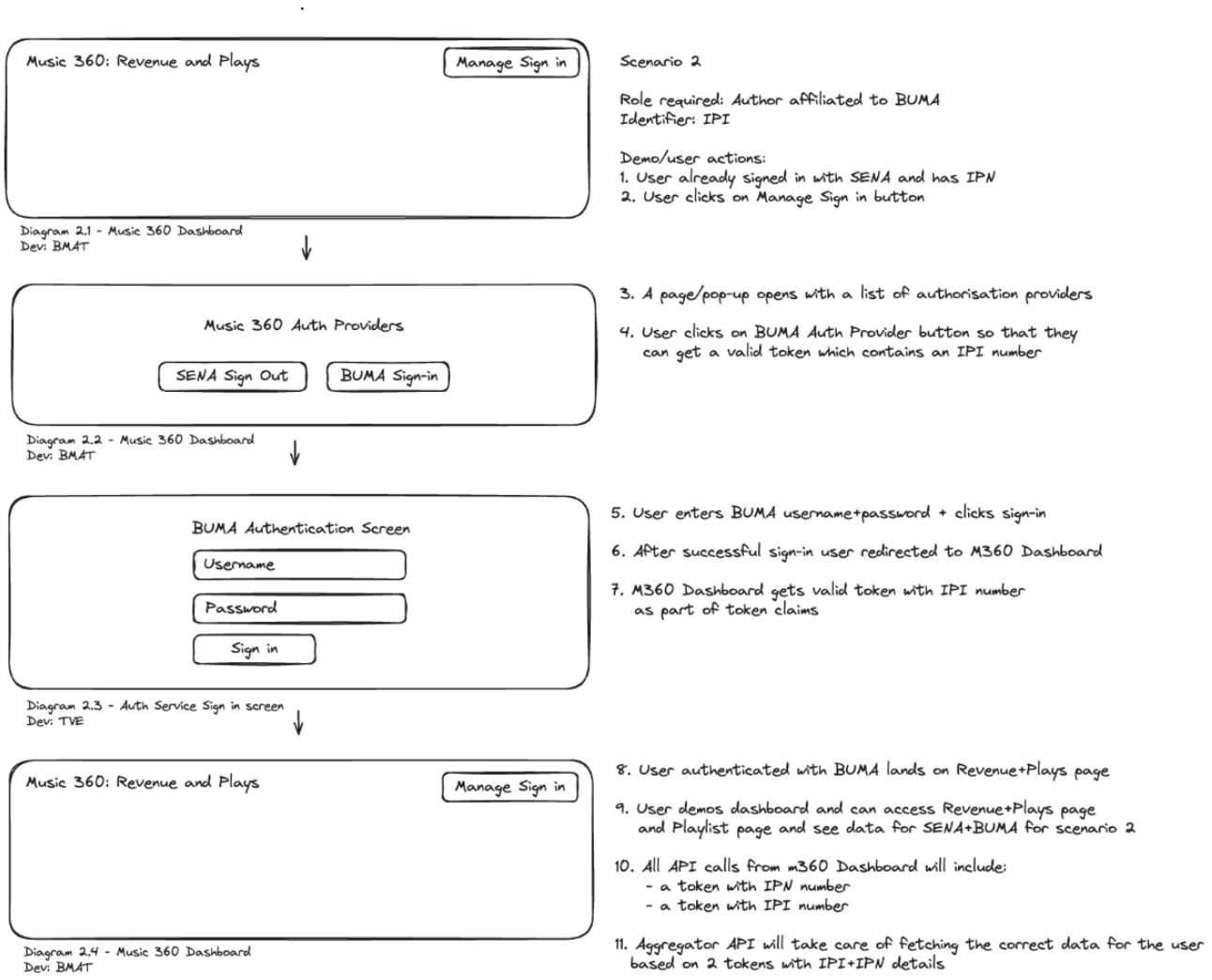


Figure 33: *The auth flow of a user for Scenario 2, coming from Scenario 1*

These demo scenarios, combined with the diverse data scope and robust and intuitive authentication/authorization flow, highlight the Music360 dashboard's potential to empower stakeholders with actionable insights and contribute to a more transparent and equitable music ecosystem.

5.5 Screenshots and Interactive Prototype

An interactive version of the dashboard with its latest features (currently using mock data due to the public nature of the site and the absence of user access control) is available at:

https://frontend.music360.bmat.com

This URL points to the dashboard's front end's staging version. As development progresses, its content will change. The client web application currently provides Version 1 features,

addressing the demo scenarios outlined in this document. Several screenshots capture the tool's primary functions and sections:

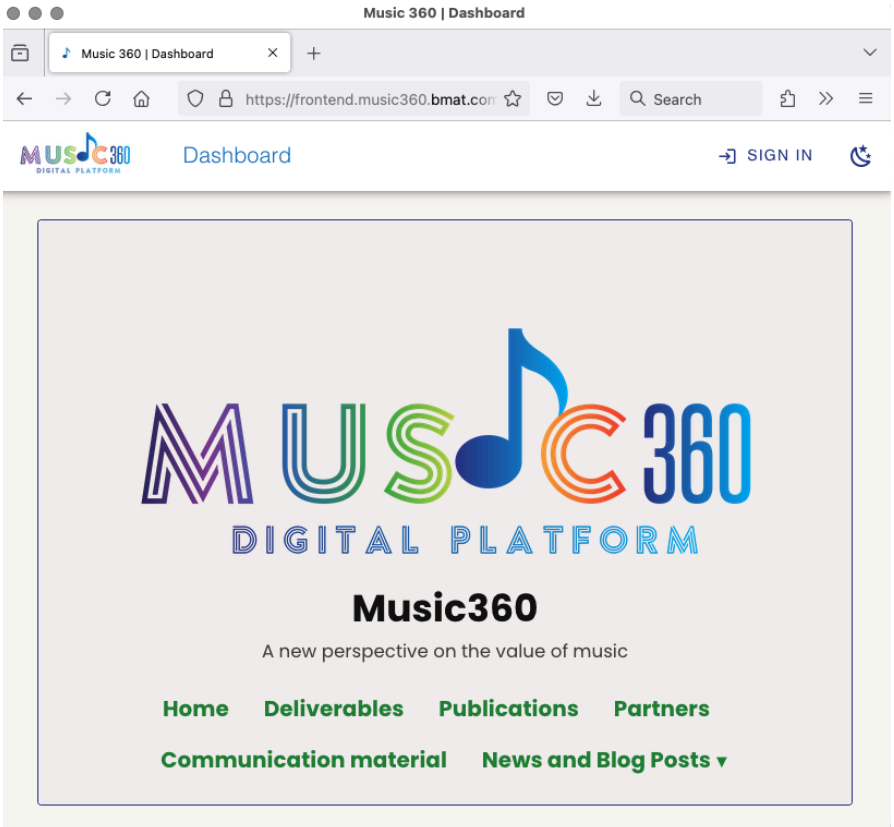


Figure 34: *Landing page of the staging version of the [Music360 dashboard]*

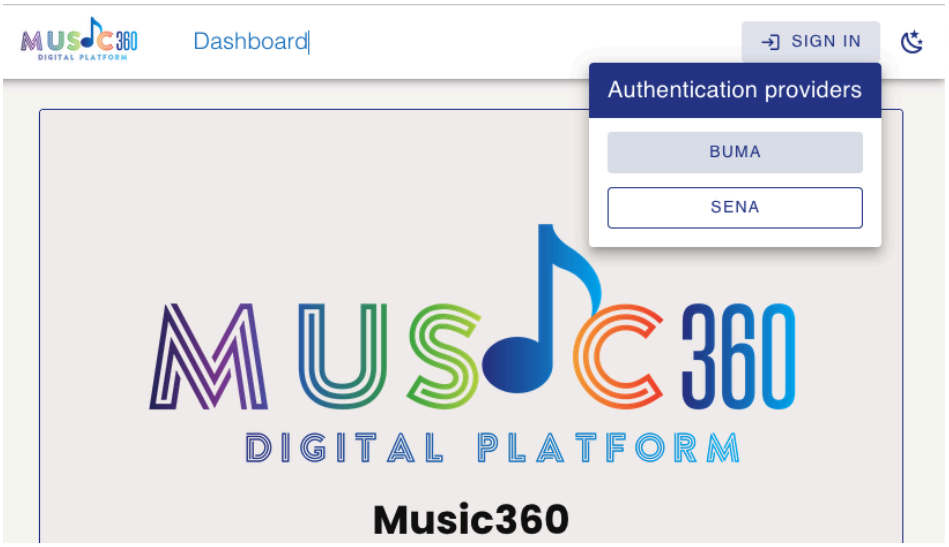


Figure 35: *The sign in menu with the available authentication providers*

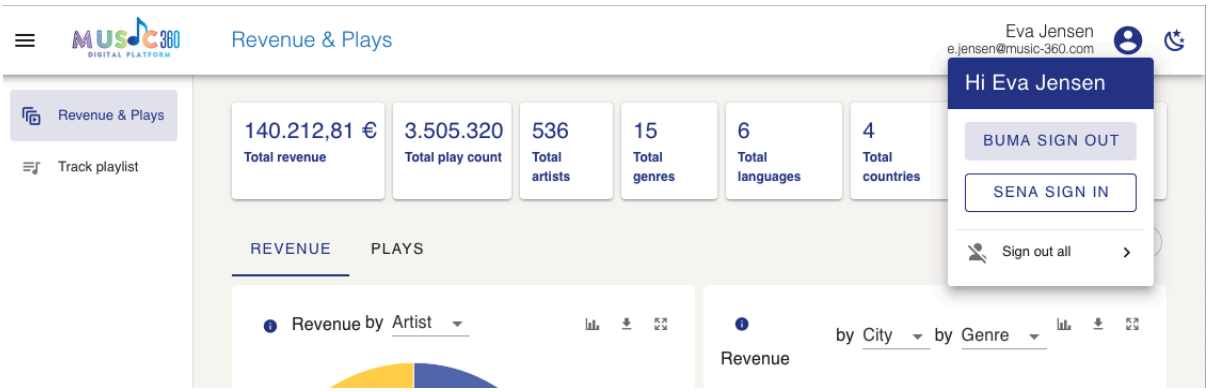


Figure 36: *The user signs in through the CMO "BUMA" authentication service and accesses to the dashboard*

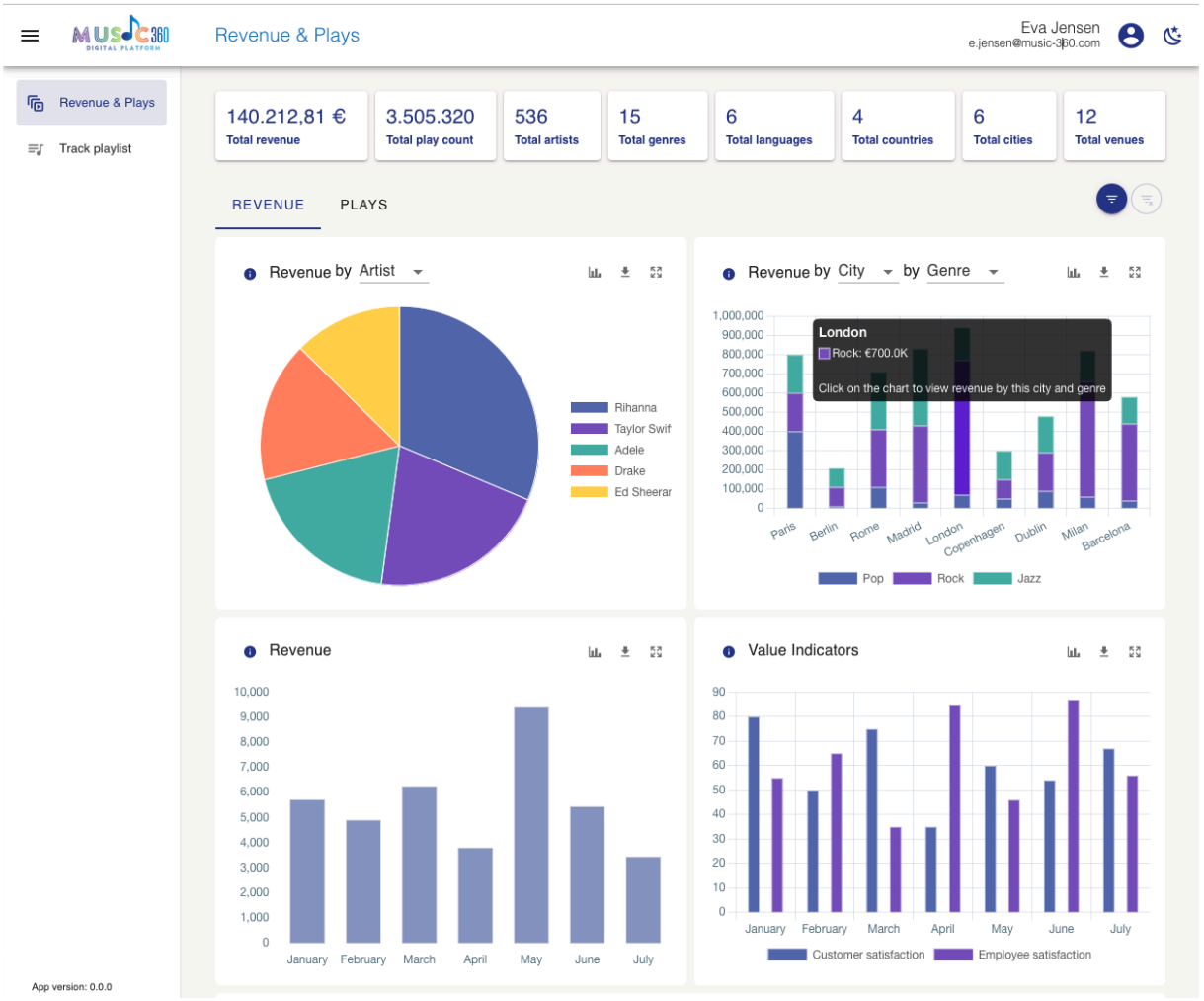


Figure 37: *The default view is the Revenue & Plays tab without any filters applied*

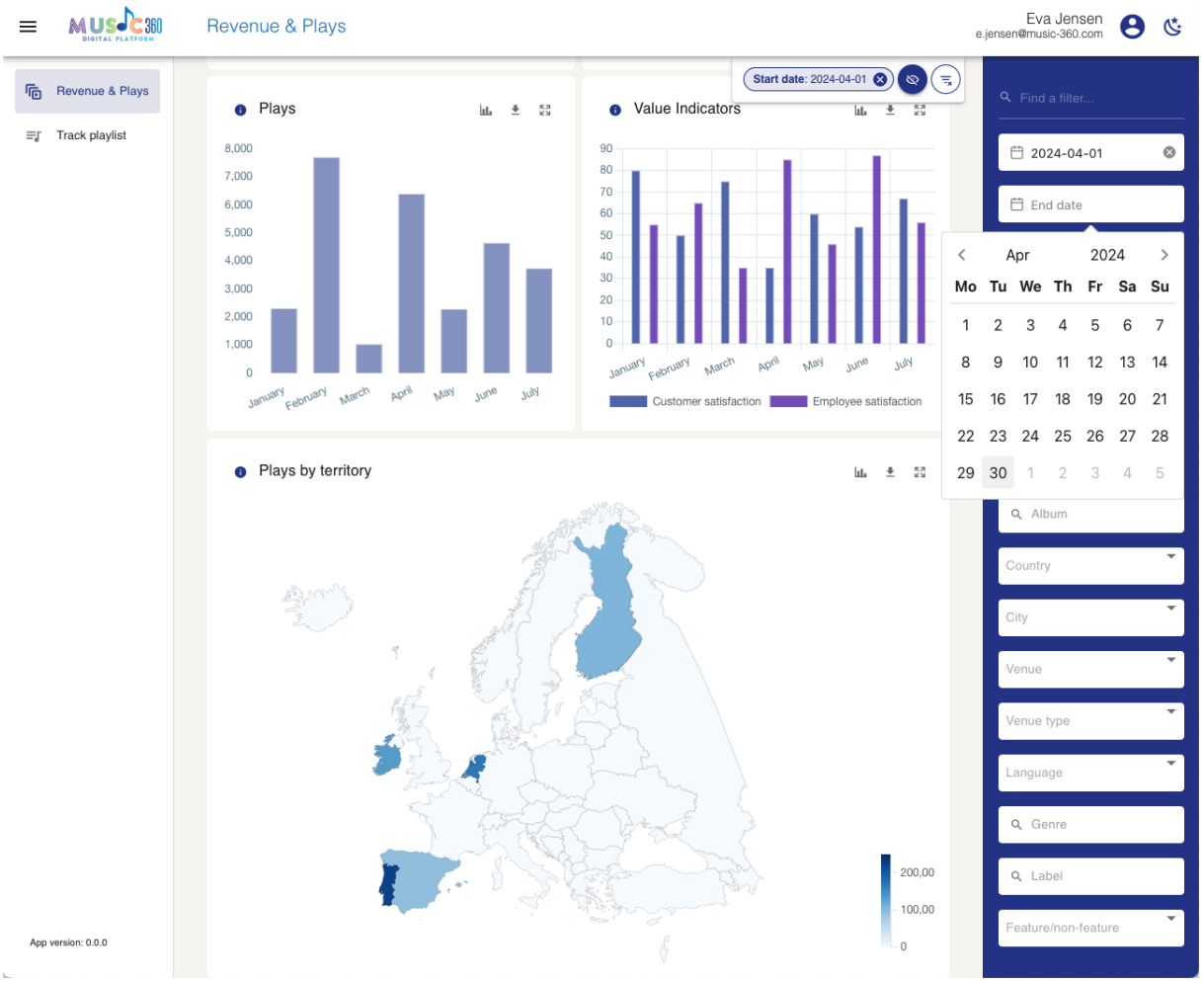


Figure 38: *The user can scroll through the different charts, apply different filters and switch between Revenue or Plays data within the same tab*

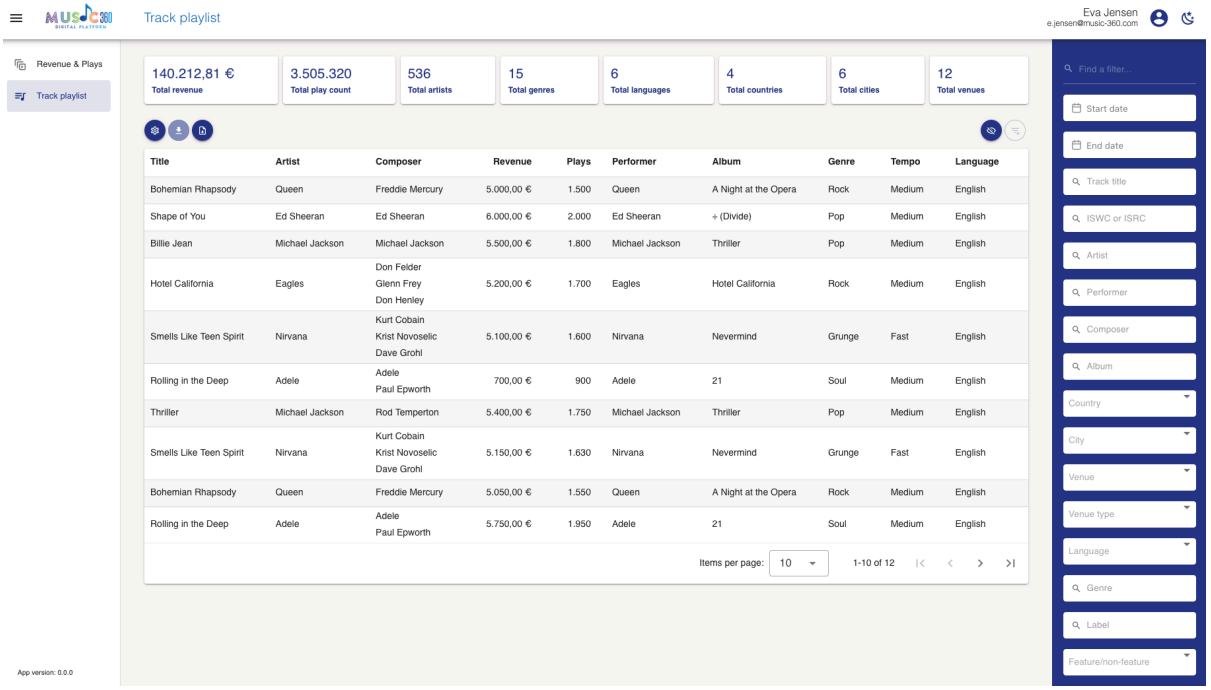


Figure 39: *On a separate tab, the user can find the track playlist, which displays the detailed music usages that can be filtered and sorted, presented in a customizable table*

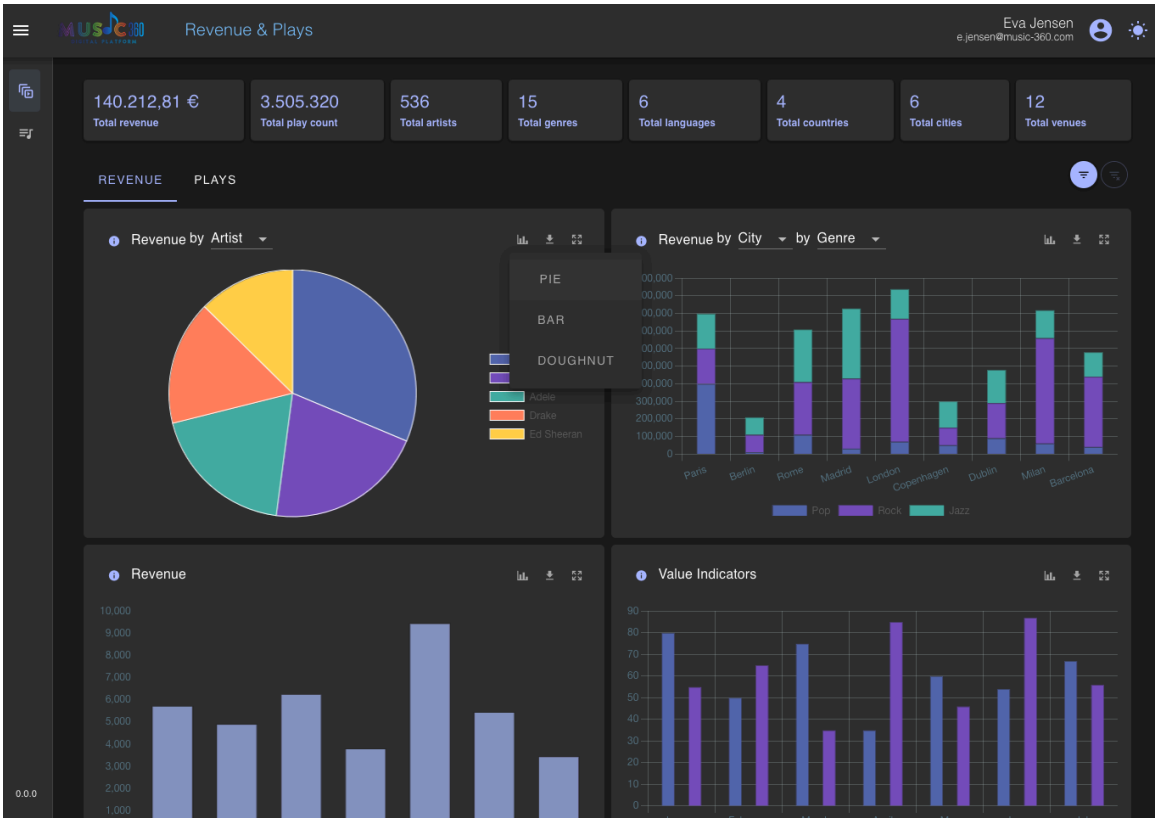


Figure 40: *Among its various visualization options, the dashboard offers a dark mode, custom chart type views, and collapsible menus.*

6. Preliminary Results and Analysis

The development of the Music360 dashboard has progressed from a functional alpha version with mock data to a beta version (Version 1) supporting three defined demo scenarios as detailed in *section 5.4* of the accompanying documentation. This beta version incorporates a subset of real data and connects to a fully functional backend, although it's not yet deployed in a production environment.

These scenarios are scheduled for presentation to SCAPR[6] (the international association for performers' collective management organizations) in a demo aimed at gathering direct feedback from key music industry stakeholders, namely performers and CMOs.

6.1 Sample Data Demonstrations

This subsection presents the datasets used for both the alpha and beta versions of the dashboard, showcasing their main characteristics and capabilities.

- **Alpha Version Data:** Mock data was generated primarily using ChatGPT (versions GPT-3.5 and GPT-4o). A manually designed JSON file structure ensured proper parsing, with prompts tailored to generate data in the provided structure and restrictions based on specific graph types, supported aggregations, and filtering criteria. Manual adjustments were made where necessary to enhance the data's relevance and insightfulness.

- **SCAPR Demo Data:** This demo utilizes real music monitoring data from February 9th to April 30th, 2024, spanning approximately three months. The data includes music monitoring reports provided by BMAT's audio fingerprinting service:

    - **Portugal:** 10 music clubs, 77,389 plays detected
    - **Finland:** 10 stores, 112,792 plays detected
    - GDA (a neighboring rights CMO) enriched the playlists with right holder and revenue data for prominent international artists.

  The top 10 most played artists in both territories are:

Artist	Portugal play count	Finland play count	Total play count
Dua Lipa	779	426	1205
Taylor Swift	282	678	960
Ed Sheeran	450	397	847
Billie Holiday	88	770	858
Ella Fitzgerald	120	701	821
The Weeknd	416	255	671

[6] https://www.scapr.org

Ava Max	360	239	599
Nat King Cole	43	642	685
Jessie Ware	135	500	635
Charlie Puth	261	315	576

Figure 41: *The 10 most played artists in the sample data for the SCAPR demo*

6.2 Early Insights or Trends

The alpha version of the dashboard was well received by partner CMOs, who gave positive feedback on its design, usability, and the successful translation of user requirements into the visual language. Among them, IMRO requested a dedicated demo for their board. The design also evolved based on valuable feedback from industry experts (SENA, GDA) during initial development, culminating in a refined version ready for the SCAPR demo with relevant industry scenarios. We eagerly await feedback from SCAPR (demo scheduled for late September 2024) to conduct a deeper analysis, gain further insights, and refine the design and backlog prioritization for Version 2.

6.2.1. Data Analysis

To gain insights into patterns, behaviors, and ensure accuracy, the music data collected from the Living Labs that will be included in the SCAPR Demo has been analysed. When examining the play count categorized by monitored locations, a notable finding was the asymmetry in the quantity of music utilized across various outlets in Finland (see *Figures 42 and 43*).

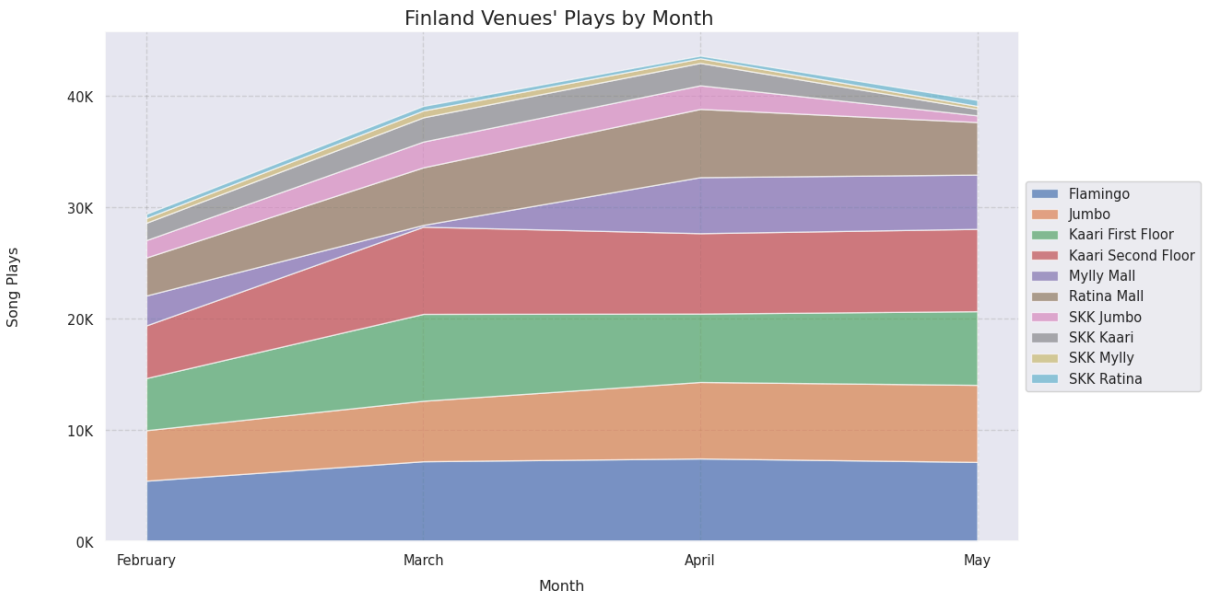


Figure 42: *Stacked play count by month in the Finnish Living Lab*

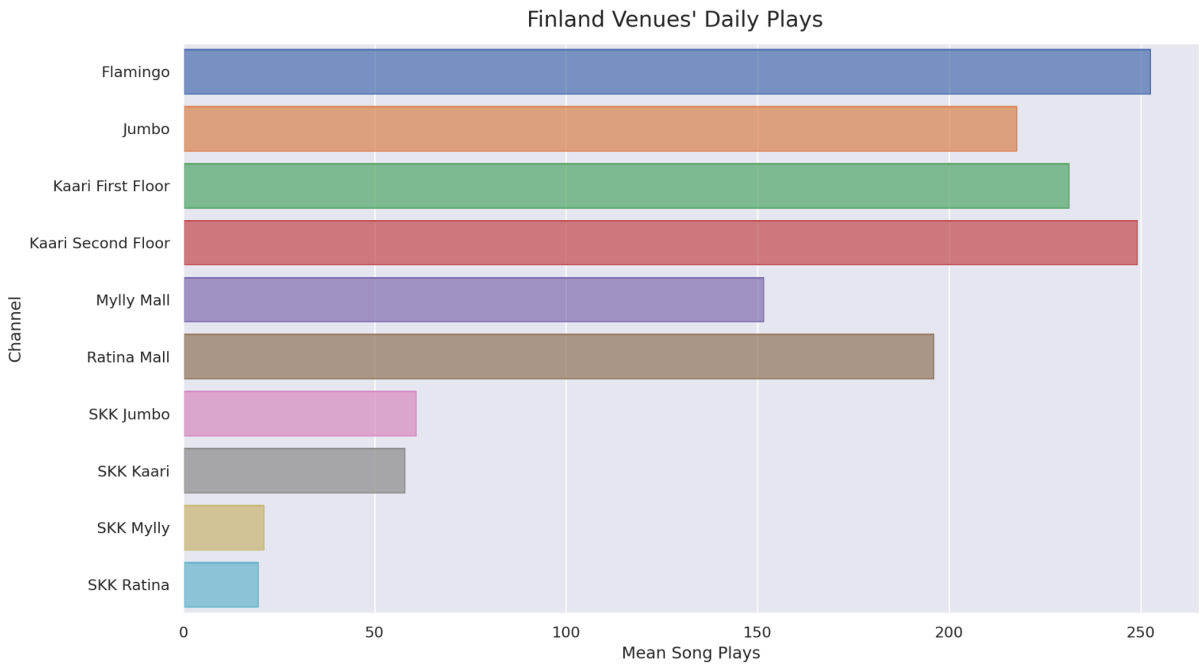


Figure 43: *Mean of daily play counts per store in the Finnish Living Lab*

The previous visualizations were inadequate for detecting the trend, but a deeper analysis and a plot of the weekly play counts per venue (see *Figure 44*) revealed some interesting patterns which let us understand the behavior and detect a flaw in the music monitoring service. In some locations, despite music playing in the venue, almost no music was detected throughout the Finnish Living Lab setup. Other locations exhibited abrupt changes in detected music from one week to another, resembling a wave-like pattern in the plot.

Upon further investigation, it was discovered that during periods of low music detection, venues were utilizing production music catalogs that were not being tracked by the audio fingerprinting system. To ensure accurate fingerprint matching, these catalogs needed to be incorporated into the reference indices.

Figure 44: *Weekly play counts per store in the Finnish Living Lab*

6.2.2. Recent Improvements

In addition to data analysis, several enhancements have been made to the UI based on feedback and iterative development of the current dashboard version within managed agile development cycles. Some examples of these improvements include:

Frontend:

- UX enhancements:
  - Manage table columns (order, show/hide)
  - Ascending order for input options
  - Active filters display with show/hide functionality and state preservation
  - Filters persist across pages
  - Chart segment click leads to filtered playlist view
  - Country flags added to territory input
  - All possible API endpoints available in the backend integrated
  - Auth UI built for CMO selection (sign-in/sign-out)
  - SENA and BUMA auth providers integrated

- **Backend:**
  - Aggregator endpoints now provide dynamic responses.
  - Filtering is available for all endpoints.
  - Plays/Revenue endpoints aggregate data as per Swagger UI criteria
  - Tracks endpoint provides paginated response and supports sorting
  - New endpoints:
    - POST `/tracks/to_csv/`: Exports tracks table to CSV, with filtering and optional selected row export
    - GET `/filters/`: Returns available values for low-variance filters after applying filtering criteria sent in the request

6.3 Areas for Future Development

Version 1, while promising, has room for growth:

- **Music Catalogue:** Include missing music catalogues to the monitoring services, specially specific production music catalogues, to capture the full spectrum of music used in the venues.
- **Data Scope:** Currently includes limited real monitoring data (3 months, 2 living labs: Portugal and Finland) and mock revenue data. Integration of other living labs (Ireland, Spain, The Netherlands) and background music provider data (Spain and The Netherlands) is pending.
- **Deployment:** The backend is integrated but not yet deployed in a production environment.
- **User Roles:** Only three user types (performer, songwriter, CMO) are currently supported, with a lack of diverse views tailored to each.

These areas for future development will be addressed in subsequent iterations, ensuring the dashboard evolves alongside the project to comprehensively meet the needs of all Music360 stakeholders.

7. Next Steps and Roadmap

This chapter outlines the planned trajectory for the Music360 dashboard, encompassing immediate next steps, future enhancements, and the timeline for full implementation and testing.

7.1. Immediate Next Steps

With the completion of Version 1, our focus now shifts to gathering valuable feedback and refining the dashboard based on real-world usage and stakeholder insights.

SCAPR Demo and Feedback Collection

A pivotal milestone is the upcoming demo to SCAPR, where we will showcase the dashboard's capabilities to key stakeholders representing performers and CMOs. This demo will serve as a crucial opportunity to gather firsthand feedback and understand how the dashboard aligns with their needs and expectations.

We will employ a combination of structured interviews and collaborative analysis sessions to capture in-depth insights. Key stakeholders will be invited to share their impressions, identify areas for improvement, and suggest potential new features or functionalities. Additionally, project partners will actively utilize the dashboard to analyze living labs data, providing valuable feedback from a technical and user experience perspective.

This comprehensive feedback collection process will culminate in a dedicated workshop where we will collaborate with stakeholders to identify common pain points, prioritize areas for enhancement, and refine the roadmap for Version 2.

Fine-tuning Version 1

In parallel with feedback collection, we will continue to refine and polish Version 1 of the dashboard. This will involve addressing any identified bugs or issues, implementing minor improvements to enhance usability, and ensuring a seamless and robust user experience.

Furthermore, we will expand the dataset integrated into the dashboard, incorporating music usage feeds from additional living labs, such as playlists from background music providers in the Dutch Living Lab. This will enrich the data available for analysis and provide a more comprehensive picture of music usage patterns across different contexts.

These immediate next steps represent a crucial phase in the dashboard's evolution. By actively engaging stakeholders and incorporating their feedback, we will ensure that Version 2 builds upon the solid foundation of Version 1, delivering an even more powerful and user-centric tool for understanding the value of music.

7.2. Planned Enhancements for Future Versions

Version 1 serves as a foundation for future iterations, with the following enhancements planned for Version 2:

- **Iterative Design Refinement:** Continuous improvement of existing views (Revenue & Plays, Track Playlists) based on user feedback and evolving needs.
- **Stakeholder-Specific Views:** Development of additional customized views and functionalities tailored to the unique requirements of different stakeholder groups.
- **Cultural and Social Value Analysis:** Incorporation of views and metrics to explore the non-monetary value of music, drawing on data from Living Labs and other sources.
- **Expanded Data Integration:** Integration of economic data from CMOs and non-music data from living labs to enrich the dashboard's analytical capabilities.
- **Enhanced Access Control:** Full implementation of robust access restrictions and customization options to ensure data security and privacy for all user types.

A discovery workshop will be conducted with key stakeholders to identify additional missing functionalities and prioritize them for future development.

7.3. Timeline for Full Implementation and Testing

The dashboard's development is a core part of WP3, which involves two major iterations. Following the delivery of Version 1, we will conduct extensive testing and demos, incorporating stakeholder feedback.

The implementation phase for Version 2 is scheduled to begin in April 2025, contingent upon the completion of WP2's second iteration of the Music360 platform's backend software. Development of Version 2 is expected to conclude in September 2025, incorporating all planned features and data from all project Living Labs.

Final testing and validation will be conducted within “WP6 – A field validated Music360 solution”, involving tasks such as:

- T6.10: Defining international field validator
- T6.11: Unifying national data feeds
- T6.12: Designing and implementing International Dashboard
- T6.13: Validating in the field

This testing phase will include further user testing and engagement with additional organizations, potentially including CISAC[7], to ensure the dashboard's effectiveness and usability across the music ecosystem.

[7] https://www.cisac.org/

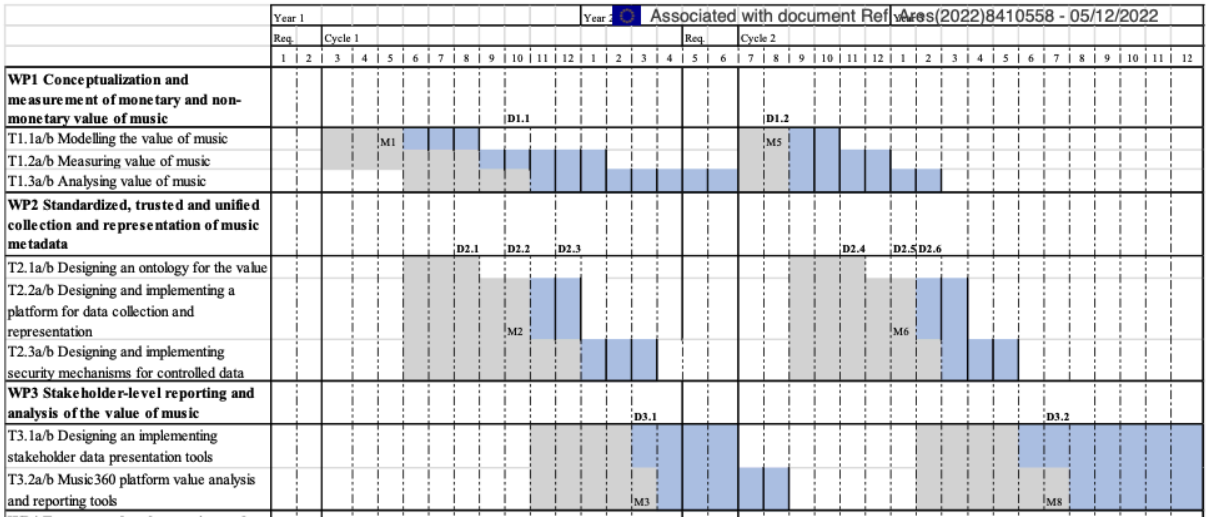


Figure 45: *A view of the project's Gantt chart including WP2 and WP3, closely connected*

Key Milestones

- **Version 1 Demo to SCAPR:** September 2024
- **Version 1 Refinement & Extended Dataset:** October - December 2024
- **Version 2 Development Start:** April 2025
- **Version 2 Development Completion:** September 2025
- **Final Testing & Validation:** October 2025 - Project End

This roadmap reflects our commitment to continuous improvement, stakeholder collaboration, and the delivery of a comprehensive, user-friendly dashboard that empowers the music industry to understand and leverage the true value of music.

8. Conclusion

This chapter concludes the deliverable by summarizing the key achievements of the Music360 dashboard's Version 1 development, highlighting its value proposition within the project, and outlining its potential impact on the broader music industry. It also reflects on lessons learned during the development process and provides a glimpse into the future roadmap for the dashboard's continued evolution.

8.1 Summary of Achievements

Version 1 of the Music360 dashboard represents a significant milestone in the project's journey towards providing stakeholders with a powerful tool for understanding and analyzing the value of music.

- **User-Centric Design:** Through extensive stakeholder engagement and a rigorous user-centered design approach, we have created a dashboard that prioritizes usability, accessibility, and alignment with real-world needs.
- **Core Functionalities:** The dashboard offers a range of core features, including interactive data visualizations, granular filtering and sorting options, and initial stakeholder-specific views, empowering users to explore and analyze music usage data in meaningful ways.
- **Robust Architecture:** The underlying architecture, with its integrated aggregator service, ensures efficient data flow, seamless integration with the Music360 platform, and robust security measures to protect sensitive information.

8.2 Value Proposition of the Dashboard for Music360

The dashboard directly addresses the objectives of WP3, contributing to the broader goals of the Music360 project. By providing a user-friendly and customizable interface for data exploration, it empowers stakeholders to:

- **Gain Actionable Insights:** Identify trends, patterns, and correlations in music usage data, informing decision-making across various domains (e.g., royalty distribution, licensing, policymaking).
- **Foster Transparency:** Enhance transparency within the music ecosystem by providing creators, CMOs, and other stakeholders with access to relevant and reliable data.
- **Support Evidence-Based Decision Making:** Enable data-driven decision-making at all levels of the music industry, from individual creators to policymakers, fostering a more equitable and sustainable ecosystem.

8.3 Potential Impact on the Music Industry

The Music360 dashboard has the potential to revolutionize how the music industry understands and leverages the value of music. By providing a centralized platform for data visualization and analysis, it can:

- **Improve Royalty Distribution:** Enable CMOs to refine their royalty distribution processes, ensuring fairer and more accurate compensation for creators.
- **Facilitate Better Licensing Agreements:** Equip stakeholders with data-driven insights to negotiate more equitable and transparent licensing agreements.
- **Inform Policy Development:** Support evidence-based policymaking, leading to more effective and targeted initiatives that benefit the entire music ecosystem.
- **Empower Creators:** Provide creators with a deeper understanding of their music's impact, enabling them to make informed decisions about their careers and creative output.

While Version 1 marks an important first step, the dashboard's planned enhancements and future iterations promise to further unlock its full potential, transforming the way the music industry operates and creating a more sustainable and vibrant future for music creators and stakeholders alike.

Lessons Learned & Future Outlook

The development of Version 1 has underscored the importance of iterative design and continuous stakeholder engagement. Their feedback has been instrumental in shaping the dashboard's current features and will continue to guide its future evolution.

We are excited about the potential of the Music360 dashboard to transform the music industry. We invite all stakeholders to explore the interactive demo and share their feedback, contributing to the development of a tool that empowers the entire music ecosystem.

The journey towards a more transparent, equitable, and data-driven music industry has begun. With the Music360 dashboard as a catalyst, we are confident that the future of music holds immense possibilities.

Acknowledgments

We thank all project partners and stakeholders for their contributions, expertise, and dedication to the development of the Music360 dashboard. This collaborative effort reflects our shared commitment to comprehend and enhance the significance of music.

9. Appendices

9.1. Technical Specifications of the Dashboard Design

9.1.1. Table of Frontend Modules

Code	Module	Comments
DAS	Dashboard	
UMS	User Management System	for admin users

9.1.2. Table of User Roles

Code	Role	Category	Comments	Identifier type	User type
SON	songwriter	Creative	composer/lyricist/arranger/translator, affiliated to an author's CMO	IPI	U-ME
PUB	publisher	Creative	music publisher affiliated to an authors' CMO	IPI	U-ME
PER	performer	Creative	singer/session musician... affiliated to a neighbouring rights' CMO	IPN	U-ME
REC	record label	Creative	record label... affiliated to a neighbouring rights' CMO		U-ME
ACM	authors' CMO	Rights society			U-CA
NCM	neighbouring rights' CMO	Rights society			U-CA
VEN	music venue	Music user	disco, music club, music pub, ...		U-MU
RET	retail shop	Music user	shopping mall, library		U-MU
HOS	hospitality	Music user	hotel, restaurant, bar...		U-MU
HEA	health	Music user	hospital, day centre...		U-MU
BAC	background music provider	Music usage provider			U-MP
MON	music monitoring provider	Music usage provider	fingerprinting company, metadata company...		U-MP
POL	policy maker	Policy stakeholder	public body like the European Commission		U-SH
RES	researcher	Policy stakeholder	university, research centre		U-SH
TRA	trade association	Policy stakeholder	music association, venues association...		U-SH

9.1.3. Table of User Types

Code	User types	Operations
U-GA	General admin	creates CMOs admins
		creates policy stakeholders users
U-CA	CMO admin user	creates "member" users
		creates "music user" users
		they see the data of their members / music users
U-SH	Policy stakeholder	just aggregated data (global? per region?)
U-ME	CMO "member" user	detailed data about their assets
U-MU	CMO "music user" user	general data about the assets used
U-MP	Technical provider	restricted data about the music usages provided

9.1.4. Table of Raw User Stories

As a...	I want to...	so that...	Code	Module
music venue	List the my most popular songs played	I can evaluate which songs are more appealing to grow my attendance	DAS-VEN-2	Dashboard
record label	Filter by label	I can visualize where my catalog is being played	DAS-REC-1	Dashboard
background music provider	Filter my own catalog (we could do this with tags, or if not filtering by composers)	I can ensure that my catalog is being used where it was licensed, and not being used without license	DAS-BAC-1	Dashboard
retail shop	List the songs played in my venue per date with timestamp	I can relate the music played to sales data to get any kind of insight that help me grow my revenue	DAS-RET-1	Dashboard
hospitality	List the songs played in my venue per date with timestamp	I can relate the music played to sales data to get any kind of insight that help me grow my revenue	DAS-HOS-2	Dashboard
trade association	List the my most popular songs played	I can evaluate which songs are more appealing to share with my associates	DAS-TRA-3	Dashboard
performer	List of my songs played including amount / airplay	I can determine which repertoire is more popular in the given dates	DAS-PER-2	Dashboard
performer	Filter / Group by country	I can filter / group "list of my songs played .... " using multiple filters and visualize the different per country	DAS-PER-3	Dashboard
performer	Filter / Group by venue type (e.g. shops, restaurants...)	I can filter / group "list of my songs played .... " using multiple filters and visualize	DAS-PER-4	Dashboard

As a...	I want to...	so that...	Code	Module
		the different per venue type		
performer	Filter / Group by region / province / city area within a specific country (based on location of venue)	..	DAS-PER-5	Dashboard
performer	Filter / Group by Date	..	DAS-PER-6	Dashboard
performer	Filter / Group by Song Charasteristics (e.g. genre, tempo, language)	..	DAS-PER-7	Dashboard
performer	Filter / Group by Composer	..	DAS-PER-8	Dashboard
performer	Filter / Group by Main Artist	..	DAS-PER-9	Dashboard
performer	Filter / Group by Musical Work (ISWC)	..	DAS-PER-10	Dashboard
performer	Filter / Group by Album	..	DAS-PER-11	Dashboard
record label	Filter / Group by Label	..	DAS-REC-2	Dashboard
performer	Sort aplhabetically or amount/.airplay	I can sort the selection based on alphabet (main artist / title) or airplay / value	DAS-PER-12	Dashboard
music venue	List of value indicators (e.g. revenue, customer satisfaction, employe satisfaction)	I can evaluate the effect of the music selection on the indicators which measure value withing my venue	DAS-VEN-3	Dashboard
music venue	Filter / Group by song charasteristics (e.g. % genre, tempo, language..) based on % of total playlist	I can filter / group "list of value indicators .... " using multiple filters and visualize the effect based on different chasteristics of playlists	DAS-VEN-4	Dashboard
music venue	Filter / Group by Venue	I can filter / group "list of value indicators .... " using multiple filters and visualize the effect and difference per venue	DAS-VEN-5	Dashboard
music venue	Filter / Group by Date	....	DAS-VEN-6	Dashboard
music venue	Filter / Group by Music Selection Criteria in Venue (e.g. Employee Choice)	....	DAS-VEN-7	Dashboard
researcher	Revenues per type of venue/location	I can compare the revenues depending on the different types of venue and/or by different locations	DAS-RES-1	Dashboard

As a...	I want to...	so that...	Code	Module
researcher	Genre of music per location	I can compare which genre of music is played depending on the location	DAS-RES-2	Dashboard
researcher	Revenues per genre of music/location	I can compare the revenues depending on the genre of music and/or by different locations	DAS-RES-3	Dashboard
researcher	Social value (linked to 31, 36)	I can link revenues and number of partipants per type of venue and social value	DAS-RES-4	Dashboard
researcher	Cultural value (linked to 32, 37)	I can link revenues per genre and cultural value	DAS-RES-5	Dashboard
researcher	Number of participants per type of venue/location	I can check how many people has participated venu/location	DAS-RES-6	Dashboard
researcher	Main artists Metadata (Gender, Nationality)	I can check if music is national or not	DAS-RES-7	Dashboard
researcher	Lyrics Language		DAS-RES-8	
researcher	Date of the venue/performance	I can check the date when is performed	DAS-RES-9	Dashboard
researcher	Audience profile (Classifed under different criteria) (target) per venue	I can check the target per venue	DAS-RES-10	Dashboard
researcher	Filter by year	I can estimate the trend along a period	DAS-RES-11	Dashboard
researcher	Economic value (linked to 31, 33)	I can check the revenues in both cases	DAS-RES-12	Dashboard
performer	Access the list of venues where my music was used	I can view it by time, region, main artist, track and feature/non-feature type of participation	DAS-PER-13	Dashboard
performer	Know the most used sound recordings	I can see the usage statistics by country	DAS-PER-14	Dashboard
performer	Know the money generated by the usage in venues of my sound recordings	I can view the revenue generated by sound recording, by country and by main artist	DAS-PER-15	Dashboard
performer	Know the attributes of my top 10 used sound recordings	I can view it by country	DAS-PER-16	Dashboard
performer	Delegate to my manager the ability to see my results		UMS-PER-1	User Management System
authors' CMO	View the sound recorings used	I can analyze usage data by country, by location/area and by date	DAS-ACM-1	Dashboard

As a...	I want to...	so that...	Code	Module
authors' CMO	Access revenues generated	I can analyze revenue trends by country, by performer, by sound recording, by date, and by main artist	DAS-ACM-2	Dashboard
authors' CMO	Access self user information/data		UMS-ACM-1	User Management System
songwriter	Usage data: list of my works that have been played, including playcounts and (forecasted) amounts of royalties	I can analyse the use of my works/repertoire and see or forecast revenue	DAS-SON-2	Dashboard
songwriter	Usage data on work level by country	I can analyse the use of my works by country	DAS-SON-3	Dashboard
songwriter	Usage data on work level by date (range) - year, month, week, day	I can analyse the use of my works by year/date	DAS-SON-4	Dashboard
songwriter	Usage data by type of venue (list of venues where works were used)	I can analyse the use of my works by type of venue (if such data on venues is available)	DAS-SON-5	Dashboard
publisher	Usage data: list of works and catalog/repertoire (all works in a publisher's catalog) that has been used	I can track how my works/repertoire has been played	DAS-PUB-3	Dashboard
publisher	Usage data on individual works and author level	I can track how my recording/works has been played	DAS-PUB-4	Dashboard
publisher	Usage data by country	I can analyse the use of my recordings by country	DAS-PUB-5	Dashboard
publisher	Usage data by year /date (range)	I can analyse the use of my recordings by year/date	DAS-PUB-6	Dashboard
publisher	Usage data by revenue	I can analyse the use of my recording by revenues	DAS-PUB-7	Dashboard
songwriter	Usage data by performer	I can analyse the use of my works by performer	DAS-SON-6	Dashboard
publisher	Usage data by performer	I can analyse the use of my recording by performer	DAS-PUB-8	Dashboard
authors' CMO	Usage data on works/repertoire of CMO	How works in a given author CMOs repertoire have been played	DAS-ACM-3	Dashboard
authors' CMO	Usage data on individual works/autrhor/publisher level, with (forecasted) revenue and playcount	How works in a given author CMOs repertoire have been played	DAS-ACM-4	Dashboard

9.1.5. Table of Sorted User Stories

Code	As a...	I want to...	so that...	UI
Track playlist				
DAS-VEN-2	music venue	List the my most popular songs played	I can evaluate which songs are more appealing to grow my attendance	KPIs Table: Track playlist
DAS-TRA-3	trade association	List the my most popular songs played	I can evaluate which songs are more appealing to share with my associates	KPIs Table: Track playlist
DAS-PER-2	performer	List of my songs played including amount / airplay	I can determine which repertoire is more popular in the given dates	Table: Track playlist
DAS-PER-3	performer	Filter / Group by country	I can filter / group "list of my songs played .... " using multiple filters and visualize the different per country	Table: Track playlist
DAS-PER-4	performer	Filter / Group by venue type (e.g. shops, restaurants...)	I can filter / group "list of my songs played .... " using multiple filters and visualize the different per venue type	Table: Track playlist
DAS-PER-6	performer	Filter / Group by Date	..	Table: Track playlist
DAS-RET-1	retail shop	List the songs played in my venue per date with timestamp	I can relate the music played to sales data to get any kind of insight that help me grow my revenue	Table: Track playlist
DAS-HOS-2	hospitality	List the songs played in my venue per date with timestamp	I can relate the music played to sales data to get any kind of insight that help me grow my revenue	Table: Track playlist
DAS-PER-7	performer	Filter / Group by Song Charasteristics (e.g. genre, tempo, language)	..	Table: Track playlist
DAS-PER-8	performer	Filter / Group by Composer	..	Table: Track playlist
DAS-BAC-1	background music provider	Filter my own catalog (we could do this with tags, or if not filtering by composers)	I can ensure that my catalog is being used where it was licensed, and not being used without license	Table: Track playlist
DAS-PER-9	performer	Filter / Group by Main Artist	..	Table: Track playlist
DAS-PER-10	performer	Filter / Group by Musical Work (ISWC)	..	Table: Track playlist
DAS-PER-11	performer	Filter / Group by Album	..	Table: Track playlist

Code	As a...	I want to...	so that...	UI
DAS-REC-2	record label	Filter / Group by Label	..	Table: Track playlist
DAS-REC-1	record label	Filter by label	I can visualize where my catalog is being played	Table: Track playlist
DAS-PER-12	performer	Sort aplhabetically or amount/.airplay	I can sort the selection based on alphabet (main artist / title) or airplay / value	Table: Track playlist
DAS-PER-13	performer	Access the list of venues where my music was used	I can view it by time, region, main artist, track and feature/non-feature type of participation	Table: Track playlist
DAS-PER-14	performer	Know the most used sound recordings	I can see the usage statistics by country	Table: Track playlist Map: Plays by territory
DAS-PER-15	performer	Know the money generated by the usage in venues of my sound recordings	I can view the revenue generated by sound recording, by country and by main artist	Table: Track playlist
DAS-PER-16	performer	Know the attributes of my top 10 used sound recordings	I can view it by country	Table: Track playlist
DAS-ACM-1	authors' CMO	View the sound recorings used	I can analyze usage data by country, by location/area and by date	Table: Track playlist Map: Plays by territory
DAS-ACM-2	authors' CMO	Access revenues generated	I can analyze revenue trends by country, by performer, by sound recording, by date, and by main artist	Table: Track playlist Pie/Bar chart: Revenue by ...
DAS-SON-2	songwriter	Usage data: list of my works that have been played, including playcounts and (forecasted) amounts of royalties	I can analyse the use of my works/repertoire and see or forecast revenue	Table: Track playlist
DAS-SON-3	songwriter	Usage data on work level by country	I can analyse the use of my works by country	Table: Track playlist Map: Plays by territory
DAS-SON-4	songwriter	Usage data on work level by date (range) - year, month, week, day	I can analyse the use of my works by year/date	Table: Track playlist
DAS-SON-5	songwriter	Usage data by type of venue (list of venues where works were used)	I can analyse the use of my works by type of venue (if such data on venues is available)	Table: Track playlist
DAS-PUB-3	publisher	Usage data: list of works and catalog/repertoire (all works in a	I can track how my works/repertoire has been played	Table: Track playlist

Code	As a...	I want to...	so that...	UI
		publisher's catalog) that has been used		
DAS-PUB-4	publisher	Usage data on individual works and author level	I can track how my recording/works has been played	Table: Track playlist
DAS-PUB-5	publisher	Usage data by country	I can analyse the use of my recordings by country	Table: Track playlist Pie/Bar chart: Plays by ...
DAS-PUB-6	publisher	Usage data by year /date (range)	I can analyse the use of my recordings by year/date	Table: Track playlist
DAS-PUB-7	publisher	Usage data by revenue	I can analyse the use of my recording by revenues	Table: Track playlist
DAS-SON-6	songwriter	Usage data by performer	I can analyse the use of my works by performer	Table: Track playlist
DAS-PUB-8	publisher	Usage data by performer	I can analyse the use of my recording by performer	Table: Track playlist
DAS-ACM-3	authors' CMO	Usage data on works/repertoire of CMO	How works in a given author CMOs repertoire have been played	Table: Track playlist
DAS-ACM-4	authors' CMO	Usage data on individual works/autrhor/publisher level, with (forecasted) revenue and playcount	How works in a given author CMOs repertoire have been played	Table: Track playlist
Revenue analytics				
DAS-VEN-3	music venue	List of value indicators (e.g. revenue, customer satisfaction, employe satisfaction)	I can evaluate the effect of the music selection on the indicators which measure value withing my venue	Bar chart: Value indicators
DAS-VEN-4	music venue	Filter / Group by song charasteristics (e.g. % genre, tempo, language..) based on % of total playlist	I can filter / group "list of value indicators .... " using multiple filters and visualize the effect based on different chasteristics of playlists	Bar chart: Value indicators
DAS-VEN-5	music venue	Filter / Group by Venue	I can filter / group "list of value indicators .... " using multiple filters and visualize the effect and difference per venue	Bar chart: Value indicators
DAS-VEN-6	music venue	Filter / Group by Date	....	Bar chart: Value indicators
DAS-VEN-7	music venue	Filter / Group by Music Selection Criteria in Venue (e.g. Employee Choice)	....	Bar chart: Value indicators

Code	As a...	I want to...	so that...	UI
DAS-RES-1	researcher	Revenues per type of venue/location	I can compare the revenues depending on the different types of venue and/or by different locations	Table: Track playlist Pie/Bar chart: Revenue by ... Map: Revenue by territory
DAS-RES-3	researcher	Revenues per genre of music/location	I can compare the revenues depending on the genre of music and/or by different locations	Table: Track playlist Pie/Bar chart: Revenue by ...
DAS-RES-12	researcher	Economic value (linked to DAS-RES-1, DAS-RES-3)	I can check the revenues in both cases	Table: Track playlist Pie/Bar chart: Revenue by ...
Play analytics				
DAS-PER-5	performer	Filter / Group by region / province / city area within a specific country (based on location of venue)	..	Table: Track playlist Map: Plays by territory
DAS-RES-2	researcher	Genre of music per location	I can compare which genre of music is played depending on the location	Table: Track playlist Bar chart: Plays per genre
Social&Cultural value				
DAS-RES-4	researcher	Social value (linked to DAS-RES-1, DAS-RES-6)	I can link revenues and number of partipants per type of venue and social value	Bar Chart: Revenue & Participants & Social value per venue type
DAS-RES-5	researcher	Cultural value (linked to DAS-RES-2, DAS-RES-7)	I can link revenues per genre and cultural value	Pie/Bar chart: Revenue by ... Bar Chart: Revenue & Cultural Value per genre
DAS-RES-6	researcher	Number of participants per type of venue/location	I can check how many people has participated venu/location	Pie chart: Participants by venue type (Indoor/Outdoor) Pie chart: Participants by venue type (Background/Foreground)
DAS-RES-7	researcher	Main artists Metadata (Gender, Nationality)	I can check if music is national or not	Table: Track playlist
DAS-RES-8	researcher	Lyrics Language		Table: Track playlist
DAS-RES-9	researcher	Date of the venue/performance	I can check the date when is performed	Table: Track playlist
DAS-RES-10	researcher	Audience profile (Classifed under different criteria) (target) per venue	I can check the target per venue	

Code	As a...	I want to...	so that...	UI
DAS-RES-11	researcher	Filter by year	I can estimate the trend along a period	Table: Track playlist
User Management System				
UMS-PER-1	performer	Delegate to my manager the ability to see my results		
UMS-ACM-1	authors' CMO	Access self user information/data		

9.1.6. Table of UI Field Permissions

UI Field	Code	song writer	publisher	performer	record label	authors' CMO	neighbouring rights' CMO	music venue	retail shop	hospitality	health	background music provider	music data company	policy maker	researcher	trade association
KPIs																
revenue	DAS-PER-15, DAS-ACM-2, DAS-ACM-3, DAS-SON-2, DAS-PUB-7, DAS-ACM-4	☑	☑	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
play count	DAS-PER-2, DAS-PER-12, DAS-PER-14, DAS-PER-16, DAS-SON-2, DAS-VEN-2, DAS-TRA-3	☑	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☑
artist	DAS-PER-9	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
genre	DAS-PER-7	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
language	DAS-PER-7	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
country	DAS-PER-3	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
city	DAS-PER-5	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
venue	DAS-PER-13	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Filters																
title	DAS-PER-12, DAS-VEN-2, DAS-TRA-3	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☑
musical work (ISWC)	DAS-PER-10, DAS-PER-15, DAS-ACM-2, DAS-ACM-3, DAS-ACM-4, DAS-PUB-3, DAS-PUB-4	☐	☑	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
artist	DAS-PER-9, DAS-PER-12, DAS-PER-13, DAS-PER-15, DAS-ACM-2	☐	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
performer	DAS-ACM-2, DAS-SON-6, DAS-PUB-8	☑	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
composer	DAS-PER-8, DAS-BAC-1	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
album	DAS-PER-11	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
country	DAS-PER-3, DAS-PER-14, DAS-PER-15, DAS-PER-16, DAS-ACM-1, DAS-ACM-2, DAS-SON-3, DAS-PUB-5, DAS-PER-5, DAS-RES-1, DAS-RES-2	☑	☑	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
city	DAS-PER-13, DAS-ACM-1, DAS-RES-1, DAS-RES-2, DAS-RES-6, DAS-RES-4	☐	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
venue	DAS-PER-13, DAS-RET-1, DAS-HOS-2, DAS-VEN-5, DAS-RES-1, DAS-RES-3, DAS-RES-9	☐	☐	☑	☐	☐	☐	☑	☑	☑	☐	☐	☐	☐	☑	☐
venue type	DAS-PER-4, DAS-SON-5, DAS-RES-1	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
language	DAS-PER-7, DAS-VEN-4, DAS-RES-8	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☐

tempo	DAS-PER-7, DAS-VEN-4	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐
genre	DAS-PER-7, DAS-VEN-4, DAS-RES-2, DAS-RES-4	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☐
label	DAS-REC-2, DAS-REC-1	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
feature/non-feature type of participation	DAS-PER-13	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
artist's gender	DAS-RES-7	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
artist's nationality	DAS-RES-7	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
period	DAS-PER-2, DAS-PER-6, DAS-PER-13, DAS-ACM-1, DAS-ACM-2, DAS-SON-4, DAS-PUB-6, DAS-RET-1, DAS-HOS-2, DAS-VEN-6, DAS-RES-1, DAS-RES-3, DAS-RES-9, DAS-RES-11, DAS-PER-5, DAS-PER-14, DAS-RES-2, DAS-RES-4, DAS-PUB-3, DAS-PUB-4	☑	☑	☑	☐	☑	☐	☑	☑	☑	☐	☐	☐	☐	☑	☐
Revenue & Plays																
Chart: Revenue by x																
revenue	DAS-PER-15, DAS-SON-2, DAS-PUB-7, DAS-RET-1, DAS-HOS-2, DAS-RES-1, DAS-RES-3	☑	☑	☑	☐	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☐
artist	DAS-ACM-2	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
performer	DAS-ACM-2	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
album	DAS-PER-11	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
genre	DAS-RES-5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
tempo	DAS-PER-7, DAS-VEN-4	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐

language	DAS-PER-7, DAS-VEN-4, DAS-RES-8	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☐
composer	DAS-PER-8, DAS-BAC-1	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
country	DAS-ACM-2	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
city	DAS-RES-5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
venue	DAS-VEN-5	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐
venue type	DAS-RES-1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
musical work (ISWC)	DAS-ACM-2	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
label		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
feature/non-feature type of participation		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Chart: Revenue by x by y																
revenue	DAS-PER-15, DAS-SON-2, DAS-PUB-7, DAS-RET-1, DAS-HOS-2, DAS-RES-1, DAS-RES-3	☑	☑	☑	☐	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☐
artist	DAS-ACM-2	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
performer	DAS-ACM-2	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
album		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
genre	DAS-RES-5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
tempo	DAS-VEN-4	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐
language	DAS-VEN-4	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐
composer		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
country	DAS-ACM-2	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
city	DAS-RES-5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
venue	DAS-VEN-5	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐
venue type	DAS-RES-1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
musical work (ISWC)	DAS-ACM-2	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
label		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
feature/non-feature type of		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

participation																
Chart: Revenue by month																
revenue	DAS-PER-15, DAS-SON-2, DAS-PUB-7, DAS-RET-1, DAS-HOS-2, DAS-RES-1, DAS-RES-3	☑	☑	☑	☐	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☐
Chart: Revenue by territory																
revenue	DAS-RES-1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
country	DAS-RES-1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
Chart: Plays by x																
play count		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
artist		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
performer	DAS-SON-6, DAS-PUB-8	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
album		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
genre	DAS-RES-2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
tempo		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
language		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
composer		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
country	DAS-PUB-5, DAS-PER-5	☐	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
city	DAS-PER-5	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
venue		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
venue type		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
musical work (ISWC)	DAS-ACM-3, DAS-ACM-4	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
label		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
feature/non-feature type of participation		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Chart: Plays by x by y																
play count		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
artist		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
performer	DAS-SON-6, DAS-PUB-8	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
album		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

genre	DAS-RES-2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	✓	☐
tempo		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
language		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
composer		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
country	DAS-PUB-5	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
city	DAS-PER-5	☐	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
venue		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
venue type		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
musical work (ISWC)	DAS-ACM-3, DAS-ACM-4	☐	☐	☐	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
label		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
feature/non-feature type of participation		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Chart: Plays by month																
play count	DAS-ACM-1, DAS-SON-4, DAS-PUB-6	✓	✓	☐	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Chart: Plays by territory																
play count	DAS-PER-5, DAS-PER-14, DAS-ACM-1	✓	☐	✓	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
country	DAS-SON-3	✓	☐	✓	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Chart: Value Indicators																
customer satisfaction	DAS-VEN-3, DAS-VEN-4, DAS-VEN-5, DAS-VEN-6, DAS-VEN-7	☐	☐	☐	☐	☐	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐
employe satisfaction	DAS-VEN-3, DAS-VEN-4, DAS-VEN-5, DAS-VEN-6, DAS-VEN-7	☐	☐	☐	☐	☐	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐
Track playlist																
Table: Track playlist																
title	DAS-PER-12	☐	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
artist	DAS-PER-9, DAS-PER-12, DAS-PER-13, DAS-PER-15, DAS-ACM-2	☐	☐	✓	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

composer	DAS-PER-8	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
revenue	DAS-PER-15, DAS-SON-2, DAS-PUB-7, DAS-RET-1, DAS-HOS-2, DAS-RES-1, DAS-RES-3	☑	☑	☑	☐	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☐
play count	DAS-PER-2, DAS-PER-12, DAS-PER-14, DAS-PER-16, DAS-SON-2, DAS-ACM-3, DAS-ACM-4, DAS-VEN-2, DAS-TRA-3, DAS-PUB-3, DAS-PUB-4	☑	☑	☑	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☑
artist's gender	DAS-RES-7	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
artist's nationality	DAS-RES-7	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
performer	DAS-ACM-2, DAS-SON-6, DAS-PUB-8	☑	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
album	DAS-PER-11	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
genre	DAS-PER-7, DAS-RES-3, DAS-RES-2	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
tempo	DAS-PER-7	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
language	DAS-PER-7, DAS-RES-8	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
musical work (ISWC)	DAS-PER-10, DAS-PER-15, DAS-ACM-2, DAS-ACM-3, DAS-ACM-4, DAS-PUB-3, DAS-PUB-4	☐	☑	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
label	DAS-REC-2, DAS-REC-1	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
feature/non-feature type of participation	DAS-PER-13	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

country	DAS-PER-3, DAS-PER-14, DAS-PER-15, DAS-PER-16, DAS-ACM-1, DAS-ACM-2, DAS-SON-3, DAS-PUB-5, DAS-RES-2	☑	☑	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
city	DAS-PER-5, DAS-PER-13, DAS-ACM-1, DAS-RES-3, DAS-RES-2	☐	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
venue	DAS-PER-13, DAS-RET-1, DAS-HOS-2, DAS-RES-9	☐	☐	☑	☐	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☐
venue type	DAS-PER-4, DAS-SON-5	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Cultural value																
Chart: Cultural Value per genre																
cultural value	DAS-RES-5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
genre	DAS-RES-5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
Chart: Social value per venue type																
social value	DAS-RES-4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
venue type (indoor/outdoor/background/foreground)	DAS-RES-4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
Chart: Participants by venue type (Indoor/Outdoor)																
number of participants	DAS-RES-6	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
venue type (indoor/outdoor/background/foreground)	DAS-RES-6	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
Chart: Participants by venue type (Background/Foreground)																
number of participants	DAS-RES-6	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
venue type (indoor/outdoor/background/foreground)	DAS-RES-6	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐

9.2. REST-API Requirements

The following requirements are needed in the Music360 DB REST-API for the aggregator to serve data to the frontend:

1. Authentication and Authorization
2. Data Retrieval Endpoints

9.2.1. Authentication and Authorization

The REST-API should be able to serve data according to the business logic defined by the database schema. This involves the ability to perform a correct pre-filtering of the data following the nature of the stakeholder, user and role. For this, the aggregator will deliver a **JWT token** provided by the frontend on the user's login that should be correctly **validated**. The highlighted terms are further explained below to avoid any confusions on their role.

- **JWT (JSON Web Token)**: The service requires clients to pass a JWT token with each request. This token is used to authenticate the client and determine their access level and permissions.
- **Token Validation**: The service validates the JWT to ensure it is issued by a trusted authority, not expired, and contains the necessary claims.

Example of JWT token to make requests to the REST-API:

```javascript
{
  "sub": "mickjagger@trs.com",
  "jti": "12345",
  "ipi": "IPI-1234-5678-9012",
  "ipn": "IPN-1234-5678-9012",
  "scope": "read:reports",
  "X-USER-ID": "10fc1485-7cc2-42ac-a896-1ac370f5401e",
  "nbf": 1715900360,
  "exp": 1747436360,
  "iat": 1715900360,
  "iss": "data-provider1.music360.com",
  "aud": "dashboard.music360.com"
}
```

9.2.2. Data Retrieval Endpoints

The RESTful API should offer endpoints capable of performing the following functions:

1. Retrieving all necessary data from the database in accordance with the agreed-upon database schema.

2. Providing data in a format suitable for aggregation by the aggregator, enabling accurate display of data in the frontend.
3. Adding data to the database when required.

This document focuses on the endpoints for retrieving data for the aggregator. For clarity, other endpoints, such as those used to add data, will be excluded from this discussion since they are not required for the Version 1 of the dashboard.

To retrieve data from the Music360 platform, the aggregator will deliver to the REST-API:

- **JWT token:** For correct authentication and pre-filtering purposes done by the REST-API.
- **Global filtering criteria**: These are query parameters such as: Date range (start and stop date), Genre, Country, Venue, etc. Passed by the user, as described in the user stories gathered for the dashboard and reflected in *section 9.1.5*.
  The aggregator needs to have the flexibility of the REST-API to pass the selected filters from the Dashboard to the REST-API in order to get filtered results from the DB. Otherwise, the aggregator would need to fetch all the data from the DB and filter it in memory, which would not be a good practice, and can be problematic as the amount of data grows.
  Moreover, the aggregator needs flexibility to activate and deactivate pagination in every endpoint. In aggregation operations, a single SQL query on the REST-API side can avoid a huge amount of HTTP requests to the REST-API.

The expected response should be in JSON format, where each item is a nested object with data regarding a specific play retrieved from the database. The nested information should include all the data necessary for the aggregator to perform aggregations regarding:

- Monetary values
- Social values
- Recording metadata
- Venue information

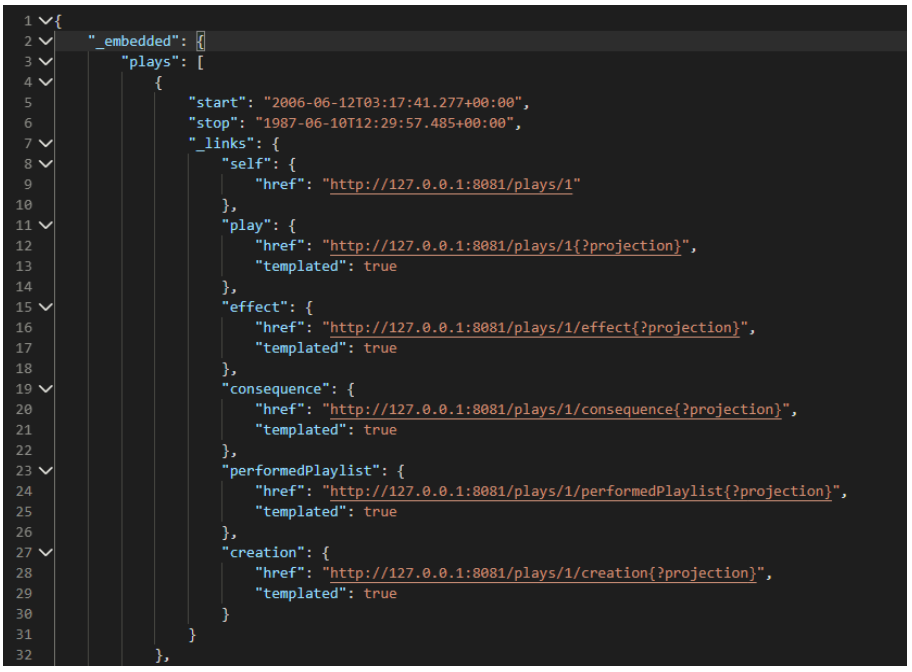
Gathering this information would prompt the REST-API to join the necessary tables and perform the filtering according to the parameters passed by the aggregator. We provide a non-exhaustive example of an item expected in the response of the REST-API:

*Example of the suggested format for the response of the **/plays** endpoint:*

```javascript
{
    "id": 1,
    "start": "1998-02-19T13:10:47.800+00:00",
    "stop": "1999-12-15T05:56:14.273+00:00",
    "recording": {
      “id”: 1,
```

```
      "name": "Macarena",
      "genre": "Pop",
      "bpm": 103,
      "language": "NL",
      "isrc": "DEA319600422"
    },
    "work": {
      “id”: 2,
      "iswc": "T0101341790"
    },
    "earnings": [
      {
        "amount": 0.526624736,
        "currency": "EURO"
      },
      {
        "amount": 0.1342493696,
        "currency": "EURO"
      }
    ]
  }
```


The aggregator works mainly with play data so a query with a date range is performed on the **plays/** endpoint, yielding the following response which contains play objects within the given date range:



```
{
    "_embedded": {
        "plays": [
            {
                "start": "2006-06-12T03:17:41.277+00:00",
                "stop": "1987-06-10T12:29:57.485+00:00",
                "_links": {
                    "self": {
                        "href": "http://127.0.0.1:8081/plays/1"
                    },
                    "play": {
                        "href": "http://127.0.0.1:8081/plays/1{?projection}",
                        "templated": true
                    },
                    "effect": {
                        "href": "http://127.0.0.1:8081/plays/1/effect{?projection}",
                        "templated": true
                    },
                    "consequence": {
                        "href": "http://127.0.0.1:8081/plays/1/consequence{?projection}",
                        "templated": true
                    },
                    "performedPlaylist": {
                        "href": "http://127.0.0.1:8081/plays/1/performedPlaylist{?projection}",
                        "templated": true
                    },
                    "creation": {
                        "href": "http://127.0.0.1:8081/plays/1/creation{?projection}",
                        "templated": true
                    }
                }
            },
```

Adding **projection=playDetail** to the previous request as follows:

```
Unset
/plays/search/findByStartAndStop?start={start_date}&stop={stop_date}&
projection=playDetail
```

the API should add the nested information of a given play (for example, offering the recording information as nested objects of plays), by joining data from tables holding data regarding Venues, Recordings, Works, Creation, and other tables that describe monetary and social values.

9.2.3. REST-API minimum requirements for Version 1

For the aggregator to seamlessly extract essential data from the Music360 platform to process it and present it efficiently in a structured format to the dashboard's frontend, the REST-API must adhere to a set of minimum requirements to cover the needs for Version 1. These minimum requirements affect the endpoints and filters for queries.

Endpoint response:

The aggregator needs for Version 1 an endpoint that returns plays with the characteristics presented in the following example.

*Proposed response of the REST-API /**plays** endpoint with example data:*

```
Unset
GET
{
  "id": 1,
  "start": "1998-02-19T13:10:47.800+00:00",
  "stop": "1999-12-15T05:56:14.273+00:00",
  "recording": {
    "id": 1,
    "name": "Macarena", // This field comes from creation
    "artist": "Artist",
    "album": "Album Macarena",
    "label": "Label",
    "genre": "Pop",
    "bpm": 103,
    "language": "NL",
    "is_feature": false,
    "isrc": "DEA319600422",
```

```
"work": {
  "id": 2,
  "name": "Macarena", // This field comes from creation
  "iswc": "T0101341790",
  "claims": [
    {
      "id": 1,
      "rightholder": { // author_rightholder
        "id": 2,
        "ipi": "00045620792",
        "name": "Author"  // claimant
      },
      "earnings": [
        {
          "id": 2,
          "amount": 0.1342493696,
          "currency": "EURO"
        },
        {
          "id": 3,
          "amount": 0.2665876523,
          "currency": "EURO"
        }
      ]
    }
  ]
},
"claims": [
  {
    "id": 1,
    "rightholder": { // neighbouring_rightholder
      "id": 1,
      "ipn": "12345678996",
      "name": "Performer" // claimant
    },
    "earnings": [
      {
        "id": 1,
        "amount": 0.526624736,
        "currency": "EURO"
      }
    ]
```

```
        }
      ]
    },
    "performedPlaylist": {
      "id": 1,
      "venue": {
        "id": 1,
        "name": "Test",
        "venue_id": "venue_1",
        "venue_type": "mall",
        "address": {
          "id": 1,
          "city": "Lisbon",
          "country": "PT",
          "number": "1",
          "street": "Test"
        }
      }
    }
  }
```


Filters:

Here we propose the necessary filters of the REST-API endpoints based on the features of the Dashboard Version 1, which are related to their corresponding DB fields.

Main filters:

- Date range: start date and stop date timestamps (fields in metamodel_play) → play.start/play.stop

Dashboard filter - Required REST-API Filter:
Query parameter names are just suggestions

- Track Name → recording.name **(LIKE query)**
  - *E.g.: ?recording_name=stairway to*
- ISWC → work.iswc **(exact query)**
  - *E.g.: ?work_iswc=T0101341790*
- ISRC → recording.isrc **(exact query)**
  - *E.g.: ?recording_isrc=DEA319600422*
- Artist → recording.artist **(LIKE query)**
  - *E.g.: ?recording_artist=led zepp*
- Performer → recording.claim.rightholder.neighbouring_rightholder.ipn **(exact query)**

    - **Already filtered by JWT Token that we pass to the REST-API request (TBC)**
    - **We'd need it anyway to be able to accomplish Scenario 2 & 3**
    - *E.g.: ?rightholder_ipn=00045620792*
- Composer → work.claim.rightholder.author_rightholder.ipi **(exact query)**
    - **Already filtered by JWT Token that we pass to the REST-API request (TBC)**
    - **We'd need it anyway to be able to accomplish Scenario 2 & 3**
    - *E.g.: ?rightholder_ipi=12345678996*
- Album → recording.album **(LIKE query)**
    - *E.g.: ?recording_album=IV*
- Country → address.country **(exact query)**
    - *E.g.: ?address_country=UK*
- City → address.city **(exact query)**
    - *E.g.: ?address_city=Manchester*
- Venue → venue.name **(exact query)**
    - *E.g.: ?venue_name=SKK Jumbo*
- Venue type → venue.venue_type **(exact query)**
    - *E.g.: ?venue_type=UK*
- Language → recording.language **(exact query)**
    - *E.g.: ?recording_language=EN*
- Genre → recording.genre **(LIKE query)**
    - *E.g.: ?recording_genre=Pop*
- Label → recording.label **(LIKE query)**
    - *E.g.: ?recording_label=Sony Music Entertainment*
- Feature/non-feature → recording.is_feature **(exact query)**
    - *E.g.: ?recording_is_feature=true*

Example of request to a REST-API endpoint using filters:

```
Unset
GET
{endpoint}/?start=2000-02-26T00:00:00&stop=2009-02-26T00:00:00&record
ing_isrc=DEA319600422&address_city=Manchester
```