

ORIGINAL RESEARCH

Planning Concerts With AI: An Integrated Decision-Support Framework For Demand, Sustainability, And Economic Feasibility

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Abstract

Concert organizers must balance financial success, operational efficiency, and environmental sustainability, yet these factors are often evaluated separately. Artificial intelligence and workflow automation offer opportunities for integration, but integrated decision-support systems remain limited in concert planning. This study develops an AI-assisted concert-planning decision-support system implemented in n8n. It combines user-defined event parameters with external artist-popularity metrics and currency exchange services to estimate audience demand, environmental indicators, and financial feasibility, and generate structured planning recommendations within one workflow. A case study based on Coldplay's Music of the Spheres World Tour concert at Olympiastadion Berlin demonstrates the framework's functionality. The system predicted attendance of 72,306 spectators, approximately 97% of stated venue capacity, and generated planning estimates for energy consumption, carbon emissions, waste, transportation, ticket revenue, costs, and profitability. Because complete verified concert-specific data were unavailable, these outputs demonstrate system functionality and plausibility rather than validate predictive accuracy or reconstruct actual concert performance. The framework illustrates how integrated AI and workflow automation can support efficiency, transparency, and consistency in pre-event decision-making. It also shows how environmental sustainability and economic viability can be assessed together rather than as independent objectives. Intended to support early-stage feasibility assessment, the system does not replace detailed operational analyses or comprehensive life-cycle assessments. It provides a practical approach to more sustainable, transparent, and data-driven planning in the live event industry.

Keywords: Artificial Intelligence; Sustainable Event Management; Concert Planning; Decision Support Systems; Workflow Automation; Demand Forecasting; Economic Evaluation; Environmental Sustainability

1. Introduction

1.1 Background of the Study

The global event industry has grown substantially, contributing to tourism, entertainment, and the creative sectors while generating economic and social benefits. This expansion has also increased attention to the

environmental and operational challenges of organizing large-scale events.

Changing social values have made ecological sustainability increasingly relevant (Bär et al. 2022). Every phase of an event, from planning and transportation to venue operation, energy use, catering, and waste management, contributes to its environmental impact. Audience travel, electricity consumption, temporary infrastructure, and single-use materials are major sources of emissions and waste. Goldman et al. (2026), for example, estimated 109.1 kilotonnes of CO₂-equivalent emissions for a modelled 32-concert Coldplay stadium-tour scenario without emissions-reduction measures. Audience travel accounted for approximately 97% of this estimate, with air travel alone contributing 74% of the total. Sustainability should therefore be incorporated throughout the event planning process as an integral component of responsible management.

Academic research reflects this growing importance. Cavallin Toscani et al. (2024) reviewed 247 publications and identified environmental sustainability in the event industry as a rapidly growing, interdisciplinary field. Its four main research themes—environmental impacts, green event management, environmental policy and guidelines, and stakeholder environmental psychology—demonstrate that sustainability encompasses management practices, policy, and stakeholder behavior alongside impact assessment.

Despite increased awareness, implementation remains challenging. Organizers must balance financial performance, operational efficiency, audience satisfaction, safety, and environmental responsibility. Interconnected decisions about venues, staffing, transportation, energy, and resource allocation make simultaneous optimization difficult. Concert promoters also bear responsibility for event costing, venue booking, and financial risk management (Brennan & Webster 2011). A survey by Vision for Sustainable Events (2022) illustrates these constraints: 76% of outdoor event organizers identified cost as a barrier to sustainable solutions, while 52% cited limited time or organizational capacity. Major expenditures, including artist fees, venue rental, staffing, logistics, and energy, further underline the need to assess environmental impacts alongside financial feasibility.

Advances in artificial intelligence, predictive analytics, and data-driven decision-support systems offer opportunities to integrate operational data and support attendance estimation, cost assessment, and sustainability analysis before events take place (Matias et al. 2026). Motivated by these developments, this study develops an AI-assisted concert-planning decision-support system that combines demand and resource estimation, sustainability assessment, and economic evaluation within a unified workflow to support structured pre-event planning decisions.

1.2 Problem Statement

Large-scale concert planning requires simultaneous consideration of operational, financial, and environmental factors, including venue capacity, staffing, transportation, energy consumption, waste generation, artist costs, and budgets (Di Gerio et al. 2020). Frameworks such as ISO 20121 and growing expectations to reduce live events' environmental impacts further emphasize sustainability in planning (Zanella et al., 2026; Goldman et al. 2026).

However, attendance forecasting, budgeting, staffing, environmental assessment, and transportation planning may rely on separate tools, data sources, and managerial experience. This fragmentation limits organizers' ability to assess how changes in one component affect overall event performance and sustainability. For example, selecting a larger venue based on estimated attendance without updating staffing, energy, and cost estimates could overstate financial feasibility. Such disconnected decisions may lead to unnecessary costs, inefficient resource allocation, and avoidable environmental impacts (Zanella et al. 2026).

Sustainability assessment is also insufficiently integrated into pre-event decision-support. Post-event reports and carbon accounting provide retrospective information but cannot directly inform decisions already made for that event. Earlier assessment can help identify opportunities to reduce emissions, improve transportation and energy efficiency, and minimize waste (Goldman et al. 2026). Although AI-based and data-driven approaches support resource estimation and sustainability-oriented decisions,

many applications reviewed in this study address individual analytical tasks, leaving opportunities for greater integration (Megheirkouni et al. 2026).

These gaps matter because predicted attendance influences staffing, transportation demand, energy consumption, waste generation, and ticket revenue, which subsequently affect sustainability indicators and economic feasibility. Connecting these stages can therefore clarify the relationships between operational, environmental, and financial decisions.

To address these gaps, this study develops an AI-assisted concert-planning decision-support system that integrates demand and resource estimation, sustainability assessment, and economic analysis within a unified workflow to support more structured pre-event planning decisions.

1.3 Research Objectives

This study aims to develop an AI-assisted concert-planning decision-support system that integrates sustainability, operational efficiency, and economic performance within a unified planning and evaluation framework. Its specific objectives are:

1. To develop a rule-based model for estimating concert attendance from event-related and artist-related inputs.
2. To estimate staffing, transportation, energy, and waste requirements using predicted attendance and event characteristics.
3. To assess selected environmental indicators, including carbon emissions, energy consumption, transportation, and waste generation.
4. To evaluate potential economic feasibility by estimating operational costs, ticket revenue, artist fees, profit, and profit margin.
5. To generate an objective-weighted evaluation score combining attendance, cost, carbon emissions, energy consumption, and waste indicators.
6. To generate AI-assisted recommendations by interpreting pre-calculated outputs and identifying potential improvements in sustainability, resource allocation, and cost management.
7. To demonstrate the framework's practical applicability through a real-world concert case study and assess the plausibility of its outputs.

2. Literature Review

2.1 The Live Music and Concert Industry

The live music industry is an economically significant part of global entertainment, generating value through ticket sales, sponsorship, merchandising, tourism, and local expenditure. Live events also provide broader social, cultural, and tourism benefits, including destination promotion (Getz & Page, 2016; Bowdin et al. 2023).

Concert delivery requires coordination among artists, promoters, venue operators, ticketing companies, technical teams, security providers, and local authorities, contributing to operational and financial complexity (Allen, 2024). Industry growth has also been accompanied by rising ticket prices, production and artist costs, workforce constraints, and increasing environmental and audience expectations.

Digital ticketing, streaming, social media, and data analytics increasingly influence concert promotion and planning. Streaming activity and online engagement provide indicators of audience interest, supporting data-driven approaches that complement managerial experience.

The following sections examine the operational, demand, sustainability, economic, and technological dimensions relevant to integrated concert planning.

2.2 Concert Planning and Operational Challenges

Concert planning coordinates artistic, technical, commercial, logistical, and safety-related activities within a limited timeframe. Its temporary, interdependent structure creates uncertainty because decisions or disruptions in one area can affect others. It therefore constitutes a system of connected decisions rather

than independent tasks (Ellert et al. 2015). Timely information and resource flows among stakeholders are essential; poor coordination can cause scheduling conflicts, staffing problems, delays, and inefficient resource allocation.

Venue selection involves operational and financial trade-offs. Larger venues offer greater revenue potential but increase rental costs, staffing, energy use, security requirements, and financial exposure to low attendance. Insufficient capacity can restrict revenue and create crowding or service-quality problems. Capacity must therefore be assessed alongside expected demand, ticket pricing, production requirements, and available resources.

Demand uncertainty further complicates planning. Attendance depends on factors such as artist popularity, ticket price, location, event date, marketing, and seasonality, influencing capacity, staffing, transportation, waste planning, and revenue. Overestimation can produce unnecessary costs and underused capacity, while underestimation can create operational and service problems. Demand estimation is examined further in Section 2.3.

Crowd management and public safety require risk assessment, communication, resource planning, and coordinated emergency preparedness, particularly under challenging attendance and venue conditions (Alhajri et al., 2023; Haghani et al., 2023; Koski et al. 2021). Workforce planning similarly depends partly on expected attendance: inaccurate estimates can increase labour costs or leave insufficient operational capacity and service quality.

These challenges are interconnected. Attendance affects staffing and transportation, venue choice shapes energy and production requirements, and pricing influences demand and revenue. Disconnected tools can hinder consistent evaluation of these relationships (Matias et al., 2026), supporting the need for a common decision-support framework integrating demand, operational, environmental, and economic variables.

2.3 Demand Forecasting in Live Events

Demand forecasting estimates likely ticket purchases or attendance. It is important in live entertainment because venue capacity is fixed and operational commitments often precede final attendance figures (Kamakura & Schimmel 2013). Estimates therefore inform capacity, staffing, transportation, waste management, and financial planning.

Concert demand is difficult to forecast because events differ in artist, venue, location, date, pricing, and market conditions. Historical sales may become less relevant as these conditions or artist popularity change, while purchasing behaviour varies across events and audience groups (Price 2019).

Traditional approaches include managerial judgement, historical averages, regression, and time-series models. Judgement incorporates context but can involve inconsistent assumptions (Lawrence et al. 2006). Quantitative methods offer systematic analysis of observable variables, and combining them with structured judgement can be useful when historical data are limited (Goodwin 2004). Regression can examine relationships between demand, ticket price, and artist popularity, while time-series methods analyse sales patterns when sufficient relevant observations exist (Hyndman et al. 2021).

Machine learning can capture nonlinear relationships among demand indicators. Event-attendance research suggests that behavioural, temporal, geographic, and popularity-related variables can supplement ticket prices and historical sales (Du et al. 2022). However, complex models do not necessarily outperform simpler methods, particularly with limited datasets. Selection should therefore reflect data availability, interpretability, and practical purpose (Vollmer et al. 2021).

The literature identifies historical, contextual, behavioural, and digital indicators as potential sources of demand information. However, concert-specific datasets may be limited or commercially restricted, making transparent, practical methods useful for early-stage planning. This study uses a rule-based demand estimation model as a planning tool rather than a statistically trained forecasting model. Its outputs inform subsequent staffing, transportation, sustainability, and economic calculations.

2.4 Artist Popularity and Attendance Prediction

Artist popularity can influence potential audience size, geographical reach, and willingness to purchase concert tickets. Research links artist fame to attendance intention while showing that experiential factors also shape audience decisions (Heredia-Carroza et al. 2025). Popularity is therefore an important but not independent determinant of demand.

Traditional indicators include record sales, chart performance, media exposure, and previous concert results. Digital platforms provide additional, more current measures of visibility, including streaming activity, monthly listeners, searches, and social-media engagement. Christensen (2022) found a relationship between streaming exposure and concert outcomes, supporting the potential usefulness of streaming indicators in demand estimation.

However, monthly listeners do not directly measure ticket-purchasing intentions. Streaming volume can reflect playlists, collaborations, or temporary attention rather than concert demand. Social-media indicators provide complementary information, but follower totals similarly should not be equated with ticket demand or financial success (Watson, Watson, & Tompkins 2023).

Popularity is also geographically sensitive and time-dependent. Global visibility may not translate into equivalent demand across cities, making regional streaming, local ticket history, and geographic audience data potentially more informative. Releases, collaborations, media exposure, and social-media trends can rapidly change popularity, so recent indicators may differ from lifetime measures.

Combining streaming, follower counts, engagement, chart performance, and regional audience information into a popularity score requires transparent construction and interpretation because platforms capture different audience behaviours. Overall, popularity measures should be considered alongside ticket price, venue capacity, and event timing. This study therefore uses an artist popularity score as one input in its rule-based demand estimation model rather than as an isolated determinant of attendance.

2.5 Ticket Pricing and Consumer Demand

Ticket pricing affects concert demand and financial performance. Higher prices may discourage attendance, but pricing decisions must also account for revenue, venue capacity, and market demand. Price sensitivity varies with artist popularity, consumer characteristics, and perceived value (Courty 2019). Highly popular performers may face less price-sensitive demand because of market power and audience loyalty, so price should be assessed alongside artist popularity (Connolly & Krueger 2006).

Data-driven pricing approaches can combine demand information with historical attendance and digital engagement, although their usefulness depends on data quality and relevance (Talluri & Van Ryzin 2004). Pricing also affects operational planning: changes in attendance influence staffing, transportation, and other resource requirements. It should therefore be considered within an integrated framework rather than solely as a financial variable (Shone & Parry 2019).

This study uses ticket price alongside artist popularity and event characteristics as an input to the rule-based demand estimation model and to calculate ticket revenue. Through estimated attendance, price also influences subsequent operational, environmental, and economic calculations within the workflow.

2.6 Sustainable Event Management

Sustainable event management integrates environmental, economic, and social considerations into event planning and implementation rather than treating sustainability as isolated environmental actions. The Triple Bottom Line framework provides a conceptual basis for this approach, extending performance assessment beyond attendance and financial outcomes to environmental and social impacts (Elkington 1997).

The field has increasingly shifted from reactive mitigation toward proactive planning. Cavallin Toscani et al. (2024) identified growing emphasis on integrated management approaches, supporting earlier incorporation of sustainability into planning. Similarly, ISO 20121 provides a management-system framework encompassing event planning, stakeholder engagement, monitoring, and continuous improvement, treating sustainability as an organizational process rather than prescribing individual environmental

actions.

Implementation remains challenging because environmental objectives may conflict with financial constraints, impacts can be difficult to quantify, and responsibilities are distributed across stakeholders. Sustainability therefore involves managerial decisions and trade-offs alongside environmental objectives.

Digital technologies and decision-support systems can inform these decisions through pre-event estimates of attendance, transportation, energy use, and waste. However, approaches integrating environmental, operational, and financial considerations remain comparatively limited in live music. This integrated planning perspective supports the present study's combination of demand estimation, operational planning, selected environmental indicators, and economic evaluation within an AI-assisted concert-planning framework.

2.7 Environmental Impacts of Concerts

Concerts generate environmental impacts through venue operations, transportation, energy consumption, waste generation, and other resource use. These impacts depend partly on planning decisions, allowing environmental considerations to be addressed before implementation rather than only retrospectively.

Transportation is frequently a major contributor to event impacts. Collins and Cooper (2017) found that visitor travel accounted for approximately 61% of the environmental footprint in their Hay Festival case study, highlighting the importance of transport mode in sustainability planning.

Concerts also require electricity for lighting, sound, displays, climate control, and production infrastructure. Energy requirements vary with production scale and event duration. Waste volumes similarly depend on audience size and event operations. Although waste management encompasses prevention, separation, recycling, and material recovery, early estimates of total waste can inform resource planning.

Life Cycle Assessment (LCA) evaluates environmental impacts across multiple stages of an event lifecycle (Toniolo et al. 2017). This study instead uses selected indicators for early-stage decision-making without performing a full LCA.

Attendance can influence energy use and waste generation, while venue and transportation conditions shape travel-related impacts. These relationships support integrated assessment of environmental and operational variables. Studies focused on individual indicators or retrospective assessment may have limited direct usefulness for pre-event decisions, creating opportunities to connect attendance and operational estimates with environmental indicators before implementation.

Accordingly, this study integrates selected transportation, energy, and waste indicators with attendance and operational estimates within an AI-assisted decision-support framework. Its outputs are planning estimates rather than a complete assessment of a concert's environmental footprint.

2.8 Economic Feasibility of Concerts

Economic feasibility assesses whether a proposed concert's expected revenue is sufficient relative to its costs. Promoters often commit resources before final demand is known, with financial exposure increasing alongside venue capacity and production scale (Tschmuck 2023).

Ticket sales generally constitute the principal revenue source, particularly for independently promoted concerts. Expected ticket revenue is calculated as:

$$\text{Expected Ticket Revenue} = \text{Predicted Attendance} \times \text{Average Ticket Price} \quad (1)$$

Actual attendance and realized prices may differ from planning assumptions, while taxes, fees, and contractual deductions can reduce the revenue retained by organizers.

Costs include fixed, variable, and attendance-related components such as artist fees, venue rental, staffing, energy, production, and other operational expenses. Artist compensation can be substantial and uncertain, varying with career stage and market position rather than following a reliable industry-wide estimate (Everts et al. 2024). Demand estimates therefore influence both revenue and selected costs.

Larger venues increase revenue potential but also operational expenses and exposure to weak attendance, making alignment between demand and venue scale essential (Tschmuck 2023). Breakeven

attendance should be compared with capacity and forecast demand: a concert requiring nearly full occupancy carries greater risk than one remaining viable at moderate attendance.

Profit and profit margin provide additional indicators:

$$\text{Total Economic Cost} = \text{Operational Cost} + \text{Estimated Artist Fee} \quad (2)$$

$$\text{Estimated Profit} = \text{Estimated Ticket Revenue} - \text{Total Economic Cost} \quad (3)$$

$$\text{Profit Margin} = \frac{\text{Estimated Profit}}{\text{Estimated Ticket Revenue}} \times 100 \quad (4)$$

These indicators depend on uncertain attendance, pricing, artist-fee, and cost assumptions and represent early-stage estimates rather than guaranteed outcomes. Environmental measures may also affect costs, while resource efficiency can generate savings, supporting integrated economic and environmental assessment (Mair & Smith 2021).

This study combines estimated attendance, ticket price, operational costs, an AI-assisted artist-fee estimate, ticket revenue, total economic cost, profit, and profit margin to assess potential feasibility. These outputs are planning estimates rather than audited or contract-based financial projections.

2.9 Artificial Intelligence and Decision-Support Systems

Artificial Intelligence (AI) can support managerial decision-making by processing information, identifying patterns, and generating interpretations or recommendations. Decision Support Systems (DSSs) combine data, analytical models, and decision rules to address semi-structured managerial problems. Incorporating AI can extend these capabilities while complementing managerial judgement and preserving human oversight.

Transparency enables users to assess the basis and reasonableness of recommendations. Explainability can strengthen accountability and user confidence in managerial applications (Kostopoulos et al. 2024). System reliability also depends on input quality and representativeness, with final responsibility remaining with human decision-makers.

DSSs can combine multiple criteria to represent trade-offs among operational, economic, and environmental objectives. This study uses an objective-weighted scoring framework to combine indicators rather than formal mathematical optimization.

Event-management applications of AI include demand analysis, audience segmentation, pricing, recommendations, and operational scheduling. These functions are often addressed separately, leaving opportunities to integrate operational, environmental, and financial considerations. Music analytics, venue information, transportation data, and financial inputs can provide structured information within a pre-event decision-support workflow.

The present study's contribution lies in integrating rule-based demand estimation, selected sustainability indicators, operational cost components, economic evaluation, and AI-assisted interpretation within an automated concert-planning workflow. It does not develop a new AI model. The AI recommendation component interprets pre-calculated analytical outputs rather than performing the underlying numerical calculations.

2.10 Existing Event Planning Technologies

Digital technologies support ticketing, scheduling, communication, budgeting, and logistics. However, many platforms focus on specific administrative or operational functions rather than integrating operational, environmental, and economic analysis within a single decision-support framework.

Event Management Systems commonly provide registration, ticketing, scheduling, budgeting, communication, and reporting, while broader analytical and sustainability functions may require additional tools. Digital ticketing platforms manage distribution, sales monitoring, payments, and customer information, supplying valuable demand data but requiring complementary sources and tools for wider planning analysis.

Music-industry analytics services provide artist-popularity, streaming, social-media, and audience information. Chartmetric, used in this study, supplies music-market intelligence but does not independently perform the broader analyses required for concert planning. Sustainability tools support environmental measurement and reporting on transportation, energy, and waste; some require detailed data and are better suited to measurement or retrospective assessment than simplified early-stage estimates.

When information is distributed across specialized systems, manually combining artist analytics, operational plans, sustainability assessments, and financial outputs can complicate integrated decision-making.

Existing technologies therefore support individual functions while leaving opportunities for integration. This study combines Chartmetric popularity data, rule-based demand estimation, transportation indicators, selected environmental calculations, operational costs, economic feasibility indicators, workflow automation, and AI-assisted interpretation within a unified concert-planning process.

2.11 Research Gap

The reviewed literature demonstrates progress in demand analysis, sustainable event management, environmental assessment, economic evaluation, and artificial intelligence. However, these areas are frequently addressed separately, leaving opportunities for more integrated concert-planning decision support.

Three main gaps emerge. First, operational, environmental, and economic perspectives are insufficiently integrated within a common framework. Demand research focuses on attendance, sustainability research examines transportation, energy, emissions, and waste, and economic studies address pricing, costs, and profitability. Concert planning requires these outputs to be considered together.

Second, specialized sources and tools—including artist analytics, event-management systems, sustainability tools, and financial analyses—serve different purposes and may require manual reconciliation. Automated workflows could connect their data and outputs across planning domains.

Third, many environmental approaches reviewed rely on retrospective data, limiting their direct usefulness during early planning. Incorporating selected environmental indicators alongside demand, operational, and economic estimates could inform decisions before major commitments are finalized.

These gaps matter because attendance influences operational and environmental calculations, while resource requirements and costs affect economic feasibility. Representing these interdependencies within one workflow can support integrated pre-event analysis.

This study addresses these opportunities through an AI-assisted framework combining artist-popularity data, rule-based demand estimation, transportation indicators, selected energy, carbon, and waste calculations, operational costs, and economic feasibility indicators. External inputs, predefined rules, automation, and selective AI assistance generate structured outputs for managerial evaluation, while final decisions remain with users.

The study's primary contribution is the integration and orchestration of these components rather than a new forecasting, environmental-assessment, optimization, or AI methodology. The prototype demonstrates how planning variables, external data, calculations, and AI-assisted interpretation can form a transparent automated decision-support process.

3. Methodology and System Development

3.1 Research and Development Approach

This study uses a modelling-based, AI-assisted approach to develop and evaluate an integrated decision-support prototype for sustainable concert planning. It combines selected operational, economic, and environmental variables, including attendance, costs, energy consumption, carbon emissions, and waste generation. Rather than developing or training a new AI model, it integrates existing AI services, rule-based calculations, external data, and workflow automation. AI selectively supports input estimation, output interpretation, and planning recommendations.

The methodology follows a Design Science Research process comprising problem identification, literature review, framework design, system development, implementation, and case-study evaluation. The prototype is implemented in n8n using external Application Programming Interfaces (APIs), JavaScript processing nodes, predefined calculations, and AI services. A concert case study examines operational functionality and output plausibility.

The framework combines complementary computational components. A rule-based demand module estimates attendance from artist popularity and event characteristics. Sustainability modules use predefined prototype calculations to estimate transportation-related indicators, energy consumption, waste generation, and a selected carbon-emission indicator. The economic module estimates ticket revenue, operational costs, an AI-assisted artist fee, total economic cost, profit, and profit margin. Finally, an AI-assisted interpretation module converts pre-calculated numerical outputs into structured planning recommendations for managerial decision-making.

Integrating these components within a single automated workflow is the framework's central design feature.

3.2 Overall System Architecture

The concert-planning tool operates as an automated n8n workflow, combining user-defined event information with selected external data. Predefined rules, calculation nodes, and AI-assisted estimation generate demand, sustainability-related, operational, and economic outputs. An AI model then interprets the pre-calculated results and generates recommendations before they are compiled into an automated report.

The framework comprises four interconnected layers: Input, Data Acquisition, Analytical Processing, and Output. Information flows sequentially, with each layer supplying inputs to the next. This modular structure supports organization, maintainability, and the addition or modification of analytical modules and external services.

The Input Layer collects and structures event information through an online interface, as detailed in Section 3.4. The Data Acquisition Layer combines these inputs with integrated external services and predefined workflow parameters; its data sources and APIs are described in Section 3.5.

3.3 Workflow Development in n8n

The system was implemented in n8n for its ability to integrate external services, automate sequential processing, and coordinate data exchange between modular computational components. As shown in Figure 1, event inputs are structured and automatically transferred between processing nodes without routine manual data transfer.

Dedicated OpenAI nodes communicate with external AI models and return structured outputs for subsequent workflow processing. They do not execute the underlying rule-based calculations, keeping AI-assisted functions distinct from deterministic computational components.

3.4 System Inputs

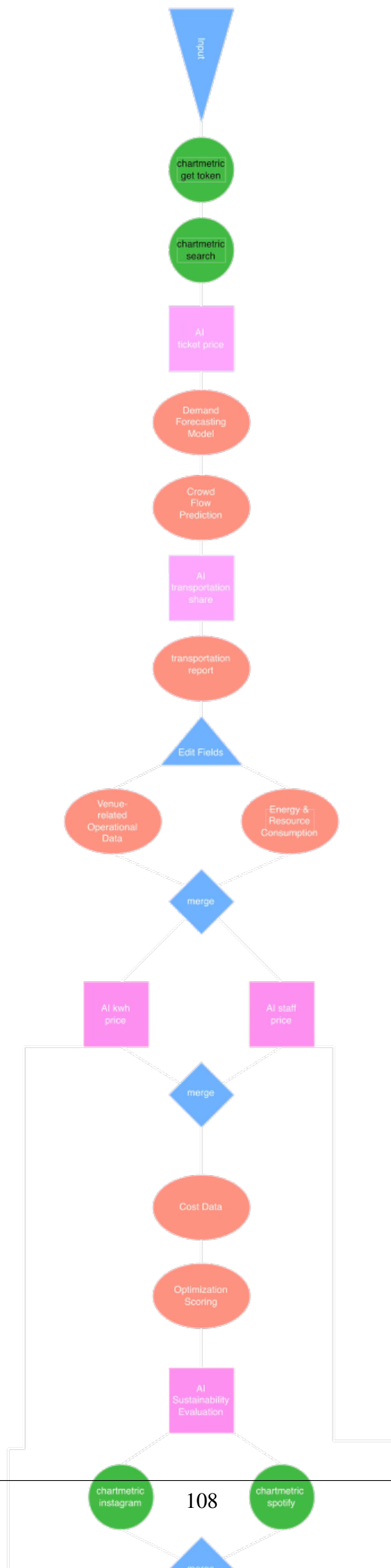
A structured Tally interface collects standardized venue, operational, equipment, financial, artist, timing, evaluation-objective, and report-delivery information before the workflow begins.

Venue inputs specify location and capacity, establishing context and the capacity constraint for subsequent analyses. Concert duration, setup time, and teardown time define the timeline for resource calculations. Equipment inputs indicate whether existing venue equipment will be used and, where relevant, specify external rental costs or transportation distances.

Users select a currency, with monetary values standardized during financial processing using external exchange-rate data. The artist name identifies the performer for retrieval of publicly available popularity indicators.

Users also select one of four evaluation objectives:

1. Balanced



2. Lowest Cost
3. Maximum Attendance
4. Lowest Carbon Emissions

The selected objective determines the weighting profile for objective-weighted scoring, reflecting planning priorities without changing the underlying demand, sustainability, or economic calculations. An email address enables automatic delivery of the final report.

3.5 Data Sources and APIs

The prototype supplements user inputs through four external services: the Chartmetric, ExchangeRate, OpenAI, and Gmail APIs. These support data acquisition, selected AI-assisted tasks, financial processing, and report delivery.

The Chartmetric API supplies the artist score and platform indicators, including Spotify monthly listeners and Instagram followers. The artist score serves directly as the popularity input in the rule-based demand model, reducing manual assignment. Additional indicators support other workflow stages, including AI-assisted artist-fee estimation.

The ExchangeRate API standardizes relevant monetary values before economic calculations.

The OpenAI API supports ticket-price, transportation-mode, and artist-fee estimation, alongside interpretation of sustainability and financial outputs. At the recommendation stage, it converts pre-calculated structured results into planning explanations and recommendations without performing the underlying rule-based calculations.

The Gmail API automatically delivers the generated report to the user-provided email address.

3.6 Rule-Based Demand Estimation Model

The prototype estimates attendance using a rule-based model combining the Chartmetric artist score, ticket price, concert date, and venue capacity. Spotify monthly listeners and Instagram followers support other workflow functions but are not direct inputs to this calculation.

The initial fill rate is calculated as:

$$\text{Fill Rate} = 0.30 + \left(\frac{\text{Popularity}}{100} \times 0.65 \right) - \left(\frac{\text{Ticket Price}}{500} \times 0.12 \right) + \text{Weekend Adjustment} + \text{Seasonality Adjustment} \quad (5)$$

The weekend adjustment is 0.08 for Saturday or Sunday and 0 otherwise. The seasonality adjustment is 0.06 for May through September and 0 otherwise.

A capacity difficulty factor reflects the assumption that larger venues are harder to fill:

Table 1. Capacity difficulty factors by venue size.

Venue Capacity	Capacity Difficulty Factor
$\leq 5,000$	1.00
5,001–15,000	0.90
15,001–30,000	0.78
30,001–50,000	0.65
50,001–70,000	0.52
$> 70,000$	0.45

For popularity scores of 95 or above, the factor is set to 1.00. After multiplication by the applicable factor, the fill rate is constrained to 0.12–1.00. Attendance is then calculated as:

$$\text{Estimated Attendance} = \text{round}[\min(\text{Venue Capacity} \times \text{Adjusted Fill Rate}, \text{Venue Capacity})] \quad (6)$$

The coefficients and thresholds are prototype assumptions rather than parameters estimated from historical concert data. The model provides transparent, reproducible, scenario-specific planning estimates rather than statistically validated attendance predictions. Future work could calibrate it using historical ticket-sales and attendance data.

3.7 Sustainability Assessment Module

The Sustainability Assessment Module uses estimated attendance and event inputs to generate energy, simplified carbon, waste, and AI-assisted audience transportation indicators. These support early-stage planning rather than a complete Life Cycle Assessment or measurement of the concert's total environmental footprint.

Energy consumption is calculated using simplified power-demand assumptions:

$$\text{Total Energy (kWh)} = (\text{Lighting kW} + \text{Sound kW} + \text{HVAC kW} + \text{LED kW} + \text{Transportation-related kW}) \times \text{Total Operational Duration} \quad (7)$$

Total operational duration combines concert, setup, and teardown time. Component assumptions are:

$$\text{Lighting kW} = \text{Attendance} \times 0.02 \quad (8)$$

$$\text{Sound kW} = \text{Attendance} \times 0.01 \quad (9)$$

$$\text{HVAC kW} = \text{Attendance} \times 0.025 \quad (10)$$

$$\text{LED kW} = \text{Attendance} \times 0.008 \quad (11)$$

The equipment-transportation-related component uses the relevant distance input. These coefficients are planning assumptions rather than empirically calibrated engineering values.

Waste generation is calculated as:

$$\text{Estimated Waste} = \text{Predicted Attendance} \times \text{Waste Factor} \quad (12)$$

The factor is 0.5 kg/person below 5,000 attendees, 0.8 for 5,000–49,999, and 1.1 for 50,000 or more. These are internal assumptions, not universal industry standards.

The electricity-related carbon indicator multiplies estimated energy consumption by a regional emission factor: 0.25 kg CO₂/kWh for Europe, 0.40 for North America, 0.42 for Turkey, 0.45 for Asia, and 0.40 by default. Where applicable, a simplified transportation-related term is added. The result is a planning indicator rather than a complete concert carbon footprint.

A separate AI-assisted step uses location and event information to estimate shares for private car, metro/rail, bus, and walking/bicycle/other modes. These represent planning estimates rather than observed or independently calibrated travel behaviour.

Selected outputs are compared with internal, region-specific thresholds for carbon emissions per attendee, waste per attendee, and private-car share. These serve as heuristic evaluation criteria rather than regulatory requirements or industry standards.

3.8 Economic Feasibility Module

The Economic Feasibility Module provides early-stage estimates of ticket revenue, operational costs, an AI-assisted artist performance fee, total economic cost, profit, and profit margin. It uses estimated attendance alongside ticket price, staffing, energy, equipment, currency, and other operational inputs.

Ticket revenue combines predicted attendance with the ticket-price estimate generated during demand forecasting, enabling financial assessment before prices are finalized or tickets go on sale.

Operational expenditure comprises four components:

$$\text{Operational Cost} = \text{Staff Cost} + \text{Energy Cost} + \text{Equipment Cost} + \text{Transportation-Related Cost} \quad (13)$$

Staff cost uses estimated staffing requirements and hourly wages. Energy cost combines estimated consumption with electricity-price information obtained during the workflow, while equipment cost is user-provided. Transportation-related cost is a simplified approximation derived from transportation and energy-price variables rather than a detailed cost model.

An AI-assisted module estimates the artist performance fee from the artist's popularity and market profile rather than using a fixed fee assumption. This estimate is incorporated into the economic evaluation.

The module then calculates total economic cost, estimated profit, and profit margin, allowing users to compare ticket revenue with the costs represented in the prototype. These financial indicators provide the basis for the subsequent AI-assisted evaluation.

3.9 AI Recommendation Module

The AI Recommendation Module interprets structured, pre-calculated outputs from preceding analytical modules to generate planning explanations and recommendations. Inputs include predicted attendance, transportation-related carbon emissions, electricity consumption, waste, operational costs, revenue, artist performance fee, profit, and profit margin. These are assembled into a structured dataset for an OpenAI language model to consider together.

The module performs two complementary evaluations. The AI Sustainability Evaluation interprets carbon, energy, waste, and transportation indicators against predefined prototype sustainability criteria. It summarizes results, identifies strengths and improvement opportunities, and suggests measures concerning public transportation, resource consumption, or waste management where supported by the outputs.

The AI Financial Evaluation interprets estimated ticket revenue, operational costs, artist fees, total economic cost, profit, and profit margin. It explains their planning implications and identifies areas for consideration supported by the calculated results.

Recommendations complement quantitative analysis. All numerical calculations are completed before AI evaluation; the model translates their outputs into understandable recommendations. Separating computation from interpretation supports transparency by distinguishing calculated indicators from AI-generated advice. Final decision-making remains with the user.

3.10 Automated Report Generation

After analysis and AI-assisted interpretation, n8n compiles selected event information, estimated attendance, sustainability indicators, economic outputs, and planning recommendations into a structured report. The Gmail API automatically delivers it to the user-provided email address. This final communication module consolidates and communicates preceding outputs without performing additional analysis.

3.11 Assumptions and Decision Thresholds

Because complete operational, environmental, and financial information is generally unavailable during early-stage planning, the prototype uses predefined assumptions, rule-based calculations, external data, and selected AI-assisted estimates. User inputs are assumed to accurately represent the scenario, making output reliability dependent on input quality.

The Chartmetric artist score serves as a popularity proxy, while AI-assisted ticket prices are planning assumptions rather than observed market prices. These support demand estimation when event-specific historical sales data are unavailable.

Sustainability outputs derive from prototype coefficients, regional parameters, attendance estimates, operational inputs, and AI-assisted or rule-based procedures rather than direct measurements. They represent selected planning indicators, not exact measurements or a complete environmental footprint.

Similarly, financial outputs rely on estimated costs and AI-assisted inputs rather than finalized contracts and are neither audited nor historically verified outcomes.

An objective-weighted score combines attendance, cost, carbon, energy, and waste indicators. The selected objective changes scoring weights without altering the underlying analytical calculations:

Table 2. Objective-weighted scoring profiles (%).

Evaluation Objective	Attendance	Cost	Carbon	Energy	Waste
Lowest Cost	20	50	15	10	5
Maximum Attendance	50	20	15	10	5
Lowest Carbon	10	10	40	25	15
Balanced	25	25	20	15	15

Attendance is evaluated relative to venue capacity; lower-is-better indicators are assessed against predefined prototype limits. Scores are classified as Highly Recommended at 75 or above, Feasible but Needs Optimization from 50 to below 75, and Not Recommended below 50.

These weights, limits, and classifications are internal prototype rules rather than externally validated industry standards. The resulting decision-support estimates remain dependent on assumptions and input quality.

3.12 System Limitations

The framework has limitations concerning data availability, estimation methods, prototype assumptions, and evaluation scope. Attendance, ticket prices, transportation behaviour, energy use, waste, and operational costs may be unavailable during early planning, requiring heuristic parameters, external data, and AI-assisted estimates. Outputs therefore represent planning estimates rather than predictions of actual concert outcomes.

Reliance on third-party services creates additional dependencies: changes in API availability, data quality, or external outputs can affect workflow results. AI-assisted ticket prices, transportation-mode shares, artist fees, and recommendations are not independently validated within the prototype and require human judgement.

The system was developed for concert planning. Adaptation to other event types would require revised estimation rules, assumptions, and evaluation criteria. Its single-concert case study demonstrates functionality and selected output plausibility but does not establish predictive accuracy or generalisability. Broader evaluation across artists, venues, locations, and event scales is needed to assess robustness.

The sustainability module uses simplified coefficients to estimate selected indicators rather than conducting a complete Life Cycle Assessment. Its carbon output is not a total concert footprint, and transportation-mode shares are estimates rather than observed travel behaviour.

The economic module estimates ticket revenue from attendance and price, while costs and artist fees rely partly on assumptions or external estimates. It does not capture all revenue streams, contractual arrangements, taxes, fees, or financial risks and provides an early-stage feasibility indication rather than a complete forecast.

Sustainability thresholds and objective-weighting profiles are internal rules without empirical calibration or validation as industry standards. Alternative settings could change evaluation outcomes.

Despite these limitations, the prototype demonstrates the integration of rule-based calculations, external data, automation, and selective AI assistance. Future work should prioritize empirical calibration, multi-scenario evaluation, improved data integration, sensitivity analysis, and refinement of assumptions and decision rules.

4. Case Study and Results

4.1 Case Study Selection

Coldplay's Music of the Spheres World Tour concert at Olympiastadion Berlin on 13 July 2022 was selected to examine framework functionality and the plausibility of selected demand, sustainability, and economic outputs. The tour's sustainability reporting and academic coverage provide contextual reference points for assessment.

With a reported venue capacity of approximately 74,475 spectators, the concert represents the large-scale stadium context for which the prototype was designed. Public sources provided the artist, venue, date, capacity, and concert duration. Undocumented setup and teardown durations and equipment configuration were defined as prototype assumptions and explicitly identified in the case-study dataset.

Outputs are interpreted alongside published and publicly available evidence, including Goldman et al. (2026) and Coldplay's sustainability information. The aim is to examine plausible, internally coherent planning outputs for a documented scenario rather than reproduce actual concert results.

4.2 Case Study Inputs

The dataset combines publicly documented event characteristics with explicitly identified prototype assumptions (Table 3). Setup and teardown durations were unavailable in the consulted sources and were assigned illustrative values of 10 and 6 hours. Equipment was categorized as "Large Stadium Concert" based on the venue's 74,475-spectator capacity and the international tour's scale.

These adjustable parameters demonstrate duration- and equipment-dependent calculations rather than reconstruct the concert's actual operational schedule. Because they were not empirically validated, related outputs represent modelled scenarios rather than documented event characteristics.

Table 3. Case study input parameters.

Input Parameter	Value	Unit	Source
Artist	Coldplay	—	Goldman et al. (2026); Coldplay Official Tour
Tour	Music of the Spheres World Tour	—	Coldplay Official
Venue	Olympiastadion Berlin	—	Olympiastadion Berlin Official
City	Berlin, Germany	—	Official Venue
Concert Date	13 July 2022	—	Setlist.fm
Venue Capacity	74,475	spectators	Olympiastadion Berlin Official
Concert Duration	125	minutes	Setlist.fm
Currency	EUR	—	Event Location
Setup Duration*	10	hours	Prototype Assumption
Teardown Duration*	6	hours	Prototype Assumption
Equipment Type*	Large Stadium Concert	—	Prototype Assumption

*Prototype assumptions rather than documented operational characteristics.

During execution, inputs are supplemented by Chartmetric popularity data, exchange rates, ticket-price estimates, electricity-price and staffing-cost information, and an estimated artist fee. The dataset therefore combines documented characteristics, prototype assumptions, external information, and AI-assisted estimates.

Although the concert has already occurred, its characteristics are processed as planning inputs. Modifying parameters and rerunning the workflow enables comparison of alternative scenarios and operational choices.

4.3 Demand Estimation Results

The model estimated 72,306 spectators for the Coldplay case study, approximately 97% of the stated venue capacity of 74,475 (Table 4). This high attendance is directionally consistent with the stadium

context and artist-popularity input but represents a planning estimate rather than reconstructed actual attendance.

Table 4. Demand estimation results.

Parameter	Value
Venue Capacity	74,475 spectators
Predicted Attendance	72,306 spectators
Estimated Fill Rate	97%

Attendance is constrained by venue capacity and informs subsequent sustainability and economic calculations. Uncertainty in this estimate can therefore propagate to energy, waste, transportation, staffing, and financial outputs.

Publicly reported box-office data combine the Berlin performances on 10, 12, and 13 July 2022, recording 216,535 spectators, or approximately 72,178 per show. The prototype's estimate for the 13 July scenario exceeds this average by 128 spectators, approximately 0.18%. The average observed fill rate was approximately 96.9%, compared with the modelled 97%.

This comparison provides preliminary evidence of contextual plausibility but does not validate the prediction against the individual attendance of the 13 July concert.

4.4 Sustainability Results

The Sustainability Assessment Module generated energy, carbon, waste, and audience transportation indicators using estimated attendance, operational inputs, prototype coefficients, regional factors, and AI-assisted estimates. These represent early-stage planning outputs rather than a complete concert environmental footprint.

Estimated energy consumption was 84,272.64 kWh, with an associated cost of €5,668.08. The carbon indicator of 21,068.16 kg CO₂ equals estimated energy consumption multiplied by the European prototype electricity-emission factor of 0.25 kg CO₂/kWh. It therefore represents a limited electricity-related indicator, not total concert emissions.

Estimated waste was 79,536.60 kg, calculated using the predefined per-attendee factor. The AI-assisted transportation component estimated 25,307 private-car users, 32,538 metro users, and 10,846 bus users. These waste and transportation outputs are planning estimates rather than observed Berlin concert data.

The evaluated indicators met the internal thresholds described in Section 3.11, producing an overall prototype sustainability status of Passed (Table 5).

Table 5. Sustainability results.

Indicator	Value
Estimated Energy Consumption	84,272.64 kWh
Estimated Energy Cost	€5,668.08
Carbon-Emission Indicator	21,068.16 kg CO ₂
Estimated Waste Generation	79,536.60 kg
Estimated Private-Car Users	25,307
Estimated Metro Users	32,538
Estimated Bus Users	10,846
CO ₂ Prototype Limit	Passed
Waste Prototype Limit	Passed
Transportation Prototype Limit	Passed
Overall Prototype Sustainability Status	Passed

These categories reflect sustainability issues discussed in the live-music literature. However, the numerical outputs should not be directly compared with comprehensive Life Cycle Assessments, as they cover selected operational indicators rather than the complete life-cycle impacts of a concert or tour.

4.5 Economic Results

The Economic Feasibility Module combined estimated attendance, ticket-price information, operational costs, and an AI-assisted artist-fee estimate to generate an early-stage financial assessment.

The estimated artist fee was €2,500,000. No verified contractual fee was identified in the consulted public sources, preventing comparison with the actual payment. Ticket revenue and tour gross were not used as substitutes because they also cover production, venue, promotion, taxation, and other expenses rather than representing the artist's contractual fee. This figure therefore remains an unvalidated planning estimate.

Using predicted attendance of 72,306 and the workflow's ticket-price estimate, ticket revenue was calculated as €8,152,502. Total economic cost, comprising the represented operational costs and estimated artist fee, was €2,645,043.38. The resulting estimated profit was €5,507,458.62, with a margin of 67.56% (Table 6).

Table 6. Economic results.

Indicator	Value
Estimated Artist Fee	€2,500,000
Estimated Ticket Revenue	€8,152,502
Total Economic Cost	€2,645,043.38
Estimated Profit	€5,507,458.62
Profit Margin	67.56%
Financial Status	Profitable

The positive financial outcome depends on high estimated attendance, the ticket-price estimate, prototype operational-cost assumptions, and the AI-assisted artist fee. It represents the modelled scenario rather than verified concert profitability.

4.6 AI-Generated Recommendations

The AI Recommendation Module interpreted selected pre-calculated demand, sustainability, and economic outputs, translating them into readable planning considerations and recommendations without performing or modifying numerical calculations.

For the case-study run, the AI classified the scenario as "Recommended with Improvements," providing a positive overall interpretation while identifying selected environmental indicators as potential areas for improvement.

5. Discussion

5.1 Interpretation of Economic Results

Under the prototype's inputs and assumptions, the Coldplay scenario generated estimated ticket revenue of €8,152,502, total economic cost of €2,645,043.38, profit of €5,507,458.62, and a margin of 67.56%. These demonstrate the economic module's operation rather than the Berlin concert's actual financial performance.

Attendance influences revenue and downstream operational and sustainability calculations, allowing demand uncertainty to propagate into financial outputs. The module's value therefore includes presenting financial indicators alongside demand and sustainability information within a unified workflow.

The high estimated margin requires caution because ticket price, artist fee, and operational costs are estimated or simplified. Changes to these assumptions could materially alter the outcome, which represents a planning scenario rather than verified profitability.

5.2 Strengths of the Developed System

The tool's main strength is integrating demand estimation, sustainability assessment, economic evaluation, and AI-assisted interpretation within an automated n8n workflow. External data, rule-based calculations, predefined evaluation procedures, and selected AI functions generate planning indicators and structured recommendations. This reduces manual information transfer between analytical stages and enables demand, economic, and sustainability indicators to be considered together.

5.3 Comparison with Existing Approaches

The framework differs from the reviewed approaches primarily by connecting planning analyses within one automated workflow. Kamakura and Schimmel (2013) used single-ticket sales and concert-program characteristics to estimate audience preferences and support performing arts planning. Here, rule-based attendance estimates feed subsequent energy, waste, transportation, ticket-revenue, and other planning calculations rather than constitute a standalone forecasting methodology.

Bottrill et al. (2010) quantified UK music-industry greenhouse gas emissions from venue energy, festival generators, equipment transportation, tour buses, and audience travel. The present model has a narrower scope, generating selected energy, carbon, waste, and audience transportation indicators within the planning workflow rather than reproducing a comprehensive carbon assessment.

Matias et al. (2026) found that AI was perceived as particularly valuable for pre-event planning and scheduling, with system integration important to successful implementation. This study provides a practical example by connecting event inputs, external data, rule-based calculations, selected AI functions, and automated reporting through n8n.

Its main distinction is therefore the practical integration and orchestration of these components, rather than a new forecasting, environmental-assessment, or AI methodology.

5.4 Practical Applications

The tool supports early-stage concert planning through integrated attendance, financial, energy, carbon, waste, and audience transportation estimates. These help users assess venue capacity, staffing, resources, financial assumptions, and selected sustainability factors before an event.

Users can modify inputs and rerun the workflow to compare manually specified scenarios. The prototype evaluates these scenarios but does not automatically identify an optimal configuration.

Its modular structure could be adapted to other live events by modifying inputs, calculations, assumptions, and data sources. Broader application would require calibration, testing against observed event data, and evaluation across multiple scenarios.

5.5 Limitations

Evaluation using a single Coldplay scenario demonstrates workflow functionality and contextual plausibility but does not establish predictive accuracy or generalisability across artists, venues, locations, or event scales.

The framework's strength lies in integrating demand, operational, environmental, and economic variables within an adjustable workflow. However, artist fees, ticket prices, operational parameters, and environmental coefficients rely on external estimates, AI assistance, or prototype assumptions rather than empirically calibrated event data. Numerical precision should therefore not be equated with predictive certainty. Agreement with average attendance across three Berlin concerts provides preliminary support for demand plausibility but does not validate environmental or economic outputs, for which comparable concert-specific data remain unavailable.

The sustainability module estimates selected indicators rather than conducting a complete Life Cycle Assessment. It does not comprehensively cover artist and crew travel, freight, accommodation, procurement, supply chains, infrastructure, or end-of-life impacts. Its carbon indicator therefore does not represent the concert's complete footprint.

External-service availability and data quality can affect outputs, while AI-generated estimates and interpretations introduce further uncertainty. The prototype should support decision-making rather than replace verified operational data, specialist analysis, or professional judgement.

5.6 Future Improvements

Future development could strengthen the prototype through empirical calibration, broader environmental and economic modelling, richer data integration, and formal optimization.

The sustainability module could move toward a more comprehensive Life Cycle Assessment by incorporating freight, artist and crew travel, accommodation, infrastructure, procurement, and supply-chain impacts. Updated or real-time ticket sales, transportation conditions, and audience-mobility data could also allow estimates to be revised as information becomes available.

Economic modelling could include additional revenue streams, taxes, ticketing deductions, insurance, financing costs, and contractual arrangements. Their omission may underestimate costs or overestimate returns. Sensitivity and break-even analyses could examine how attendance, ticket price, artist fees, and major cost assumptions affect financial outcomes.

AI-assisted components could provide more structured explanations, scenario-specific suggestions, and improved interaction while retaining human oversight. Adapted versions could be evaluated across concert formats and other event categories.

Formal optimization algorithms could automatically compare configurations and identify preferred combinations of venue, pricing, staffing, and sustainability measures according to defined objectives, extending objective-weighted evaluation into an optimization system.

Finally, larger historical datasets and multiple observed concert outcomes could support calibration of the demand model, thresholds, and assumptions, providing stronger evidence of robustness and practical usefulness.

6. Conclusion

6.1 Summary of the Project

This study developed an AI-assisted concert-planning decision-support framework integrating demand estimation, selected sustainability indicators, and economic evaluation for early-stage planning. Implemented in n8n, it combines user inputs, external data, rule-based calculations, selected AI-assisted estimates and interpretation, objective-weighted scoring, and automated reporting.

A case study based on Coldplay's Music of the Spheres World Tour concert at Olympiastadion Berlin generated estimated attendance of 72,306 spectators, energy consumption of 84,272.64 kWh, an electricity-related carbon indicator of 21,068.16 kg CO₂, and waste generation of 79,536.60 kg. Under the prototype's financial assumptions, estimated ticket revenue was €8,152,502, total economic cost €2,645,043.38, and profit margin 67.56%.

These are model-generated planning outputs, not verified attendance, environmental performance, or financial results for the concert. The single case study demonstrates functionality and contextual plausibility rather than predictive accuracy or generalisability.

Users can adjust assumptions and compare manually defined scenarios, but the prototype does not automatically identify an optimal configuration. Future work could include historical-data calibration, broader environmental and economic modelling, multi-case evaluation, sensitivity analysis, and formal optimization.

The study's primary contribution is the integration and orchestration of analytical components, AI-assisted interpretation, and automated reporting rather than a new forecasting, environmental-assessment,

optimization, or AI methodology. It provides a transparent foundation for further research into integrated, data-informed concert planning.

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Conflicts of Interest

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