The architecture of triangulation

A technical framework for unified marketing measurement

Introduction

Modern marketing measurement faces two systemic challenges. The first is data fragmentation across hundreds of platforms, each with distinct formats, attribution rules and availability constraints. The second is methodological fragmentation, where single-method approaches such as marketing mix modeling (MMM) or multi-touch attribution (MTA) attempt to explain marketing impact from only one point of view. This leaves organizations with conflicting numbers and a biased foundation for budget or performance decisions.

Funnel Measure solves these challenges through triangulation, a unified framework that integrates MMM, MTA and incrementality testing into one coordinated system. Triangulation creates a calibrated, scalable and scientifically grounded approach to measurement that aligns channel-level and campaign-level insights with real incremental performance.

This white paper provides a technical overview of Funnel's modeling methodology, the optimization system that unifies the models and the architectural advantages of Funnel's data hub that make scalable measurement possible.

Why marketing measurement is broken today

Marketing data has become increasingly scattered, inconsistent and incomplete. Browser restrictions, privacy regulations and the decline of third-party identifiers reduce the visibility of user-level interactions.

Platform attribution models tend to over-credit their own conversions. MMM alone cannot resolve campaign-level effects, while MTA alone cannot overcome missing journey data. Incrementality testing produces strong causal signals but cannot be run everywhere or continuously.

These forces create persistent reporting gaps that make it difficult for analysts and data engineers to reconcile data sources and allocate budgets with confidence. A new approach is required, one that integrates multiple models and resolves contradictions between them.

Introducing triangulation

Triangulation is Funnel's unified measurement framework. It integrates three complementary methodologies that each capture different aspects of marketing influence.

- **Marketing mix modeling (MMM)** provides long-term causal estimation of channel-level effects.
- **Multi-touch attribution (MTA)** assigns granular influence across campaigns and touchpoints.
- **Incrementality testing** adds direct causal evidence that corrects or validates modeled assumptions.

By operating these models within one coordinated system and aligning them through multi-objective optimization, Funnel ensures that each method strengthens the others. MMM establishes the structural anchor. MTA distributes channel-level impact across campaigns. Incrementality testing calibrates and corrects both models.

Together, they create a single, coherent measurement layer suitable for planning, optimization and reporting.

The case for integrated measurement

MMM, MTA and incrementality testing each offer valuable but incomplete perspectives on marketing effectiveness. MMM provides a structured, long-term view of channel impact and captures external forces such as seasonality and pricing, yet it cannot resolve campaign-level performance or rapid short-term changes. MTA adds the ability to understand user journeys at a granular level and reveal how individual touchpoints contribute to conversions, but it remains limited by platform bias, missing journey data and its dependence on observable interactions. Incrementality testing offers the highest standard of causal evidence and is uniquely capable of validating or correcting modeled assumptions, but it is not feasible to run continuously across all channels or markets.

Individually, each method solves part of the measurement problem while leaving important gaps. Integrated measurement resolves these limitations by combining the structural strengths of MMM, the tactical resolution of MTA and the causal grounding provided by incrementality tests. Together, they create a measurement foundation that is more complete, more reliable and more adaptable than any single method.

The table below summarizes how these methods compare across key requirements and shows why triangulation is the only approach that provides full coverage.

Strengths and gaps across methods

Legend:

✅ = **Strong capability**

❌ = **Not capable**

➖ = **Partially capable or dependent on data conditions**

CAPABILITY / LIMITATION	MMM	MTA	INCREMENTALITY TESTING	TRIANGULATION
Measures incremental contribution at channel level	✅	❌	✅	✅
Provides campaign-level granularity	❌	✅	✅	✅
Accounts for seasonality and external factors	✅	❌	❌	✅
Supports scenario analysis and long-term planning	✅	❌	❌	✅
Captures offline and non-trackable influences	✅	❌	✅	✅
Responds to short-term changes	➖	✅	❌	✅
Corrects attribution bias	✅	❌	✅	✅
Provides independent causal evidence	❌	❌	✅	✅
Scales across all channels, including offline	✅	❌	✅	✅
Cost-efficient and feasible to run continuously	✅	✅	❌	✅

Architecture of Funnel Measure

Funnel Measure is built on top of Funnel's data hub, which provides the foundation required for consistent, reliable and scalable marketing modeling.

Categories of input data

Funnel's data hub connects to over 600 marketing data sources and addresses several challenges that frequently derail measurement projects:

- Consistent, governed ingestion across all major advertising, analytics and offline systems
- Automatic normalization of disparate metric names, formats and definitions
- Structuring of all marketing data as continuous time series, which is required for MMM
- Central, secure credential management for all integrations
- Persistent storage of all historical data, preventing gaps caused by platform outages
- Connector technology designed to operate within strict API rate limits and volume constraints

This eliminates the most common cause of MMM and attribution failure: inconsistent or incomplete time series data.

Preprocessing steps

Before modeling, Funnel's data hub automatically:

- Categorizes metrics and date fields
- Structures all inputs as clean, unified time series
- Standardizes historical data into consistent schemas
- Ensures dimensional alignment for MTA training
- Provides multi-year historical continuity for MMM projects without manual effort

This preprocessing layer significantly reduces the operational overhead normally required for modeling.

Model refresh frequency

Funnel's connectors refresh data every few hours, depending on platform rules. Because historical data is permanently stored, Funnel avoids common issues where platforms temporarily withdraw or purge historical reporting. This stability enables reliable updates across MMM, MTA and optimization layers.

Output schemas and destinations

Funnel Measure provides a dual-pathway for acting on insights. Results are available through interactive planning & optimization widgets and as structured data exports for external analysis.

- Interactive planning & optimization: Users can explore past performance and run "what-if" simulations within Funnel. The system allows for budget optimization and scenario planning, helping teams determine the ideal allocation across channels to maximize future returns.
- Structured schemas: Data is output in formats designed specifically for MMM, MTA and incrementality testing workflows, eliminating the need for manual data wrangling.

These outputs can be delivered seamlessly to:

- Funnel Dashboards for real-time performance tracking
- BI tools (e.g., Looker, Tableau, Power BI)
- Data warehouses (e.g., BigQuery, Snowflake, Redshift)
- Spreadsheets and external modeling systems

By combining interactive exploration with flexible data delivery, Funnel ensures that insights are immediately actionable for marketing, analytics and finance teams alike.

Marketing mix modeling (MMM)

MMM estimates the incremental contribution from marketing of each channel by analyzing historical relationships between media spend and outcomes over time.

Key technical features:

- Regression-based modeling
- Baseline estimation
- Accommodates dynamically changing media effectiveness and macro environments
- Ad stock modeling for carryover effects
- Saturation modeling for diminishing returns
- Integration of external variables such as seasonality, weather and pricing

Figure 1 illustrates the hierarchical structure of factors influencing channel performance and their relationship to conversions. This hierarchy allows the model to explicitly model interactions between upper- and lower-funnel media and avoid selection bias that often occurs when channels are analyzed in isolation.

Validation uses holdout periods, root mean squared error (RMSE) and mean absolute percentage error (MAPE) thresholds. Models are recalibrated when performance deviates from acceptable ranges. Validating attribution systems such as MMM is fundamentally challenging due to the absence of true attribution ground truth and objective benchmarks.

At Funnel, we validate our MMM modeling approach by using a synthetic ground-truth framework that overcomes the lack of real attribution benchmarks. We generate synthetic marketing data with known channel-level attribution, then run our full MMM process on this data and compare the estimated results against the predefined ground truth.

This allows us to directly measure attribution accuracy using metrics such as channel-level MAPE and the correctness of ROI rankings across channels. The same process is applied to open-source MMM solutions, enabling an objective and apples-to-apples benchmark of Funnel's modeling performance against external alternatives.

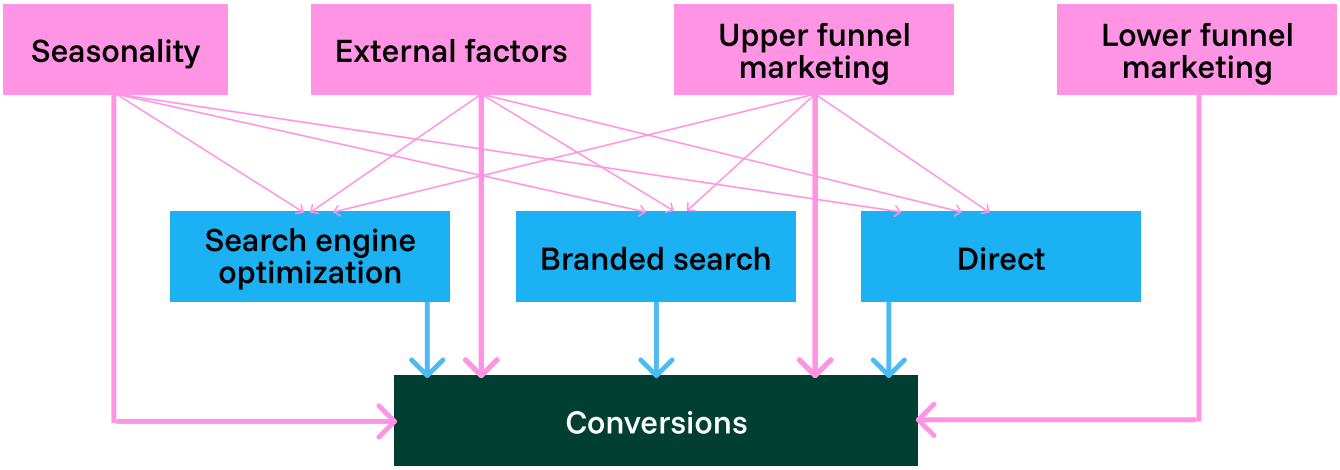


Figure 1. Hierarchy of models

Multi-touch attribution (MTA)

MTA quantifies the influence of individual touchpoints across user journeys. Funnel's MTA uses machine learning-based data-driven attribution that accounts for the sequence of and time between events and touchpoints. By analyzing both converting and non-converting journeys, the model identifies the true drivers of performance. Validation is performed through training and holdout splits and evaluated using metrics such as area under the curve (AUC).

Deep learning and LSTM architecture

As customer journeys grow in complexity, the underlying model must evolve beyond a simple network. While a simple network relies on a single hidden layer, Funnel utilizes a deep learning neural network structure as illustrated in Figure 3. This multi-layered approach allows for the use of Long Short-Term Memory (LSTM) networks, which are uniquely suited for user journey analysis because they implicitly handle the vast combinatorics and complexity of modern customer paths, leading to higher attribution accuracy.

This architecture provides a significant technical advantage by automating the processing of high-dimensional data, which saves substantial time otherwise spent on manual feature engineering. For example, a journey involving 40 campaigns, 5 time dimensions and 5 touchpoint positions quickly scales to 1,000 dimensions, creating a level of complexity that LSTMs navigate efficiently to uncover the true value of every interaction.

Once trained, the model assigns incremental conversion probabilities at each step of a journey. These increments are then used to determine each touchpoint's contribution to the final conversion probability. This prevents over-crediting late-stage interactions such as retargeting and captures the role of earlier signals that shape user intent.

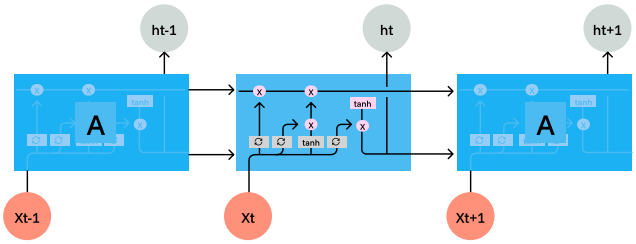


Figure 2. LSTM sequence modeling

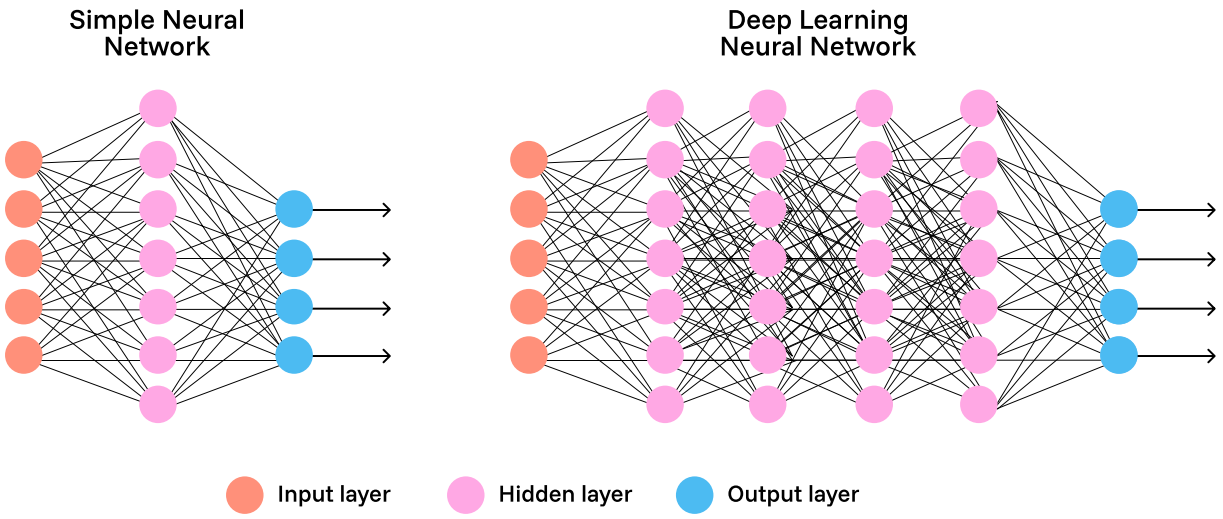


Figure 3. Neural networks

Incrementality testing

Incrementality testing provides direct causal evidence by measuring how outcomes change when specific marketing actions are introduced or withheld. Funnel Measure works with geo lift testing based on synthetic controls:

Key technical features:

- Geo lift testing based on synthetic controls: Includes treated and untreated regions to define test and synthetic controls in order to estimate lift.
- Flexible testing cadence: Tests are designed and then executed by clients. Funnel provides guidance on statistical validity, region selection and contamination avoidance.
- Calibration role: Results refine MMM through priors or calibration losses and can constrain optimization outputs in planning tools.
- Weighting: Incrementality evidence acts as the highest-quality signal and can override modeled outputs when robust.

Best practices include selecting comparable control regions, avoiding overlapping media activity and running tests for four to eight weeks depending on channel and purchase cycle.

Multi-objective model optimization

Funnel Measure uses a multi-objective optimization framework to unify MMM, MTA and incrementality into one coherent modeling system.

As shown in Figure 4, Funnel evaluates thousands of model configurations, each representing different:

- Media response curve specifications
- Priors and constraints
- Hyperparameters
- Ad stock and saturation shapes

Each configuration is evaluated against both statistical accuracy and attributional consistency criteria. Only models satisfying both are retained and deployed to production, creating a Pareto-optimal set of models that form the backbone of Funnel Measure.

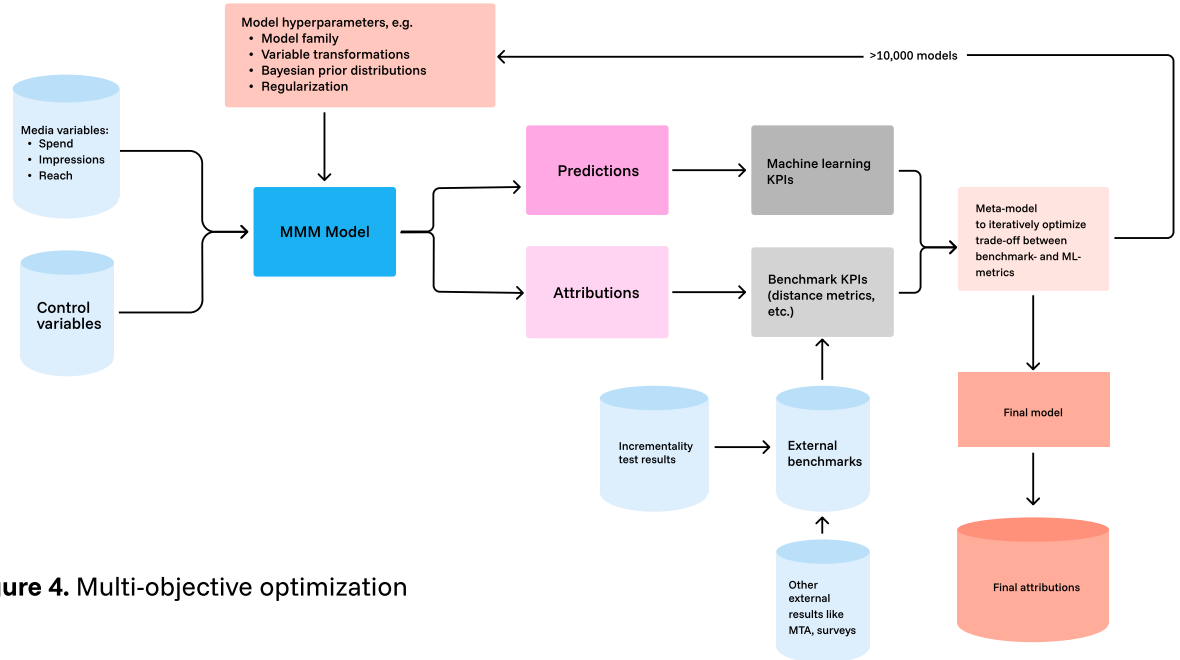


Figure 4. Multi-objective optimization

Governance, monitoring and stability

Funnel Measure incorporates monitoring, data governance and model management processes to ensure stability and transparency.

Key operational safeguards:

- Model monitoring: Automated alerts identify sudden shifts in learned effects or model performance. Internal tools track MMM and MTA behavior over time to detect drift.
- Data quality assurance: All data enters through governed connectors. Schema validation and consistency checks occur during onboarding and prior to MTA training.
- Noise and outlier handling: Time-varying coefficients, Bayesian priors and media response functions reduce sensitivity to short-lived anomalies. Campaigns with insufficient signal may be excluded.
- Model versioning: Daily refreshes incorporate new data without re-running hyperparameter search. Full re-runs occur when new channels are added, data conditions shift or new test results become available.

Transparency and auditability: Clients have access to KPIs such as RMSE, MAPE, R^2 and AUC. Attribution outputs can be exported for reconciliation. Key model assumptions and configurations are documented and reviewable.

Summary

Funnel Measure brings together the three pillars of modern marketing analysis in one unified framework. By combining the structural strengths of MMM, the granularity of MTA and the causal grounding of incrementality testing, triangulation produces a measurement system that is both comprehensive and reliable. Funnel's data hub ensures that this modeling foundation is built on consistent, high-quality and continuously refreshed data, while the optimization layer aligns all signals into a coherent understanding of performance.

This approach replaces fragmented reporting with a single calibrated view of marketing impact that adapts to new data, new channels and new insights. It provides analysts, data engineers and marketing leaders with the clarity they need to plan budgets, evaluate performance and make confident decisions in a complex and rapidly evolving environment. With Funnel Measure, organizations can move beyond isolated metrics and adopt a scientifically grounded framework that supports both long-term strategy and day-to-day optimization.