Agent-Based Modeling: A Breakthrough Approach to Marketing Mix Optimization
**Executive Summary**

Marketing will not survive long as the “last bastion of unaccountable corporate spend,” as described by then Google CEO Eric Schmidt. It is paramount that the marketing organization adopt more robust methods to not only measure the impact of marketing but also to forecast future potential sales based on varying marketing plans to keep pace and react to the constant change in the marketplace.

Fundamental shifts in the consumer marketing landscape have created a demand for better ways to understand both consumers and the marketing used to influence them. Historically, firms have used a variety of statistical techniques to build mathematical representations of the relationship between marketing spend and the resulting outcomes, typically some measure of sales. And in the past when there were fewer options on how to spend marketing dollars, these techniques fit the requirement well. Today, the number of options available to connect with consumers has exploded – each with unique measurements, resulting in a general lack of confidence in the effectiveness of traditional statistical modeling tools.

Further exacerbating the challenges of past techniques is the explosion of data in terms of volume, variety, and velocity, originating primarily from digital marketing channels. The era of “big data” has created amazing opportunities but also a number of significant challenges for both the marketing scientist and the marketer.

ThinkVine has developed a methodology using an agent-based modeling approach for Marketing Mix Optimization that can scale in terms of the granularity within marketing vehicles; the breadth of marketing and media that can be measured; and the need for a persistent, on-going planning and analytics cycle in today’s fast-paced, dynamic marketplace.

This whitepaper will describe the way Agent-Based Modeling works and how it is used; and lastly, how it delivers superior insights for today’s marketing challenges.
Overview of Agent-Based Modeling

Widely-accepted by the science community, agent-based modeling (ABM) has been around for decades. The hard and social sciences have considered ABM a standard framework for understanding complex systems such as how diseases spread globally, migratory patterns of animals, and supply chain systems. Today, ABM is commonly used across industries including academic, government, military, and think tank environments.

Described as non-deterministic, agent-based modeling has no obvious, direct path from the inputs to the outputs of the system. Conversely, regression analysis, a form of traditional statistical modeling, uses a mathematical equation where the results are pre-determined by the inputs; the same input will always produce the same result. Because of the dynamic and stochastic nature of typical agent-based models, the results will vary, even with the same inputs, because they are produced as an emergent property of the dynamic process.

ABM is also characterized as probability-based. This means that the outcomes are the result of probabilities that are determined by rules. The rules may be directly derived from data sources or based on direct data inputs. Also contrary to deterministic models, ABM is not expressed in terms of a mathematical equation, so there are no correlation matrices and coefficients. An agent-based model is a living, breathing simulation of the real-world system being studied. The way you learn from the system is thru changing the inputs and tracking the subsequent changes in the end state.

**Agent-Based Modeling** /ˈæjənt-ˌbāsəd ˈmædl-ɪŋ/ (ABM) *n.*

*1* An agent-based model is a class of computational models for simulating the actions and interactions of autonomous agents with a view to assessing their effects on the system as a whole.
**A Brief History**

The origin of agent-based modeling as a scientific approach dates back to the 1950s. A mathematician named John von Neumann, who was critical to the development of game theory as well as several other fields of mathematics and physics, developed lattice theory, which provided the initial steps toward cellular automata. Agent-based modeling primarily derived from von Neumann's original work has since been infused with several other disciplines like behavior economics and sociology.

In the late 1990s, scientists from the Santa Fe Institute partnered with management consulting companies like Ernst & Young (now Cap Gemini Ernst and Young) to apply ABM to improving dynamic business processes like supply chain, distribution, and organizational behavior. Case studies from leading brands like Proctor & Gamble, Southwest Airlines, and Boeing emerged proving the successful application of ABM for business improvements. This was just the beginning of ABM transforming foundational belief systems and processes within Fortune 500 companies.

Meanwhile, the government was quietly employing ABM solutions in a number of areas, including the Defense Advanced Research Projects Agency (DARPA) and the Departments of Defense, Energy, and Transportation. In 2007, Dr. Michael North, now Deputy Director for the Center for Complex Adaptive Agent Systems Simulation at Argonne National Laboratory, published *Managing Business Complexity: Discovering Strategic Solutions with Agent-Based Modeling and Simulation*. His work significantly accelerated the discussion of expanding the use of ABM solutions to marketing departments.

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**Figure 1: Advances in Agent-Based Modeling**

| JOHN VON NEUMANN: Advanced game theory concept and lattice theory paving the way for a whole new branch of analytical sciences. |
| SANTA FE INSTITUTE/MILLER: One of the first Fellows at the Santa Fe Institute working to advance the complexity sciences and utilization of agent-based models. |
| AXELROD/COMPLEXITY OF COOPERATION: Leading academic proponent of agent-based systems for use in the political sciences. |
| GOLDENBERG ON NEW PRODUCT DIFFUSION: Dr. Goldenberg conducted innovative research on new product diffusion utilizing agent-based modeling. |
| ICOSYSTEMS: Dr. Eric Bonabeau opens up Icosystems expressly for the utilization of the agent-based modeling framework to solve complex business and non-business problems. |
| THOMAS SCHELLING: A Nobel prize winning economist who developed an early example of an agent-based model showing how populations can segregate. |
| BIOSGROUP/KAUFMAN: Nobel prize winning and lead scientist at the Santa Fe Institute who pioneered the use of agent-based models for business application through Biosgroup, a consulting company he founded. |
| ARGONNE NATL LABS/NORTH: Pioneered work in the simulation of the complex energy creation and distribution systems using agent-base models. North and Macal authored one of the first books on agent-based models for business applications. |
| REPASt/UOCHICAGO: Development of one of the first multipurpose computer languages for the creation of multi-agent based simulation systems. |

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ThinkVine launches its Marketing Mix Optimization Software that utilizes agent-based modeling as a new approach to marketing mix modeling.
ABM Makes Its Marketing Debut

This whitepaper has shown that ABM can be used across industries to model real-world systems. ThinkVine’s agent-based modeling engine is built to understand and simulate a marketing system. In the marketing analytic space, there are many types of market models. The most common approach used today falls under the umbrella of marketing or media mix modeling (MMM). Traditionally, MMM analytics are conducted using variants of regression methods. The generalized goal of these approaches is to develop an understanding of how marketing activities and non-marketing influencers impact sales. There are several fundamental use cases for MMM analytics:

- Quantify the impact of marketing activities and non-marketing factors on sales
- Quantify the sales impact at different time periods
- Calculate the return on investment for dollars spent against marketing activities
- Determine the likely points of saturation of marketing (where increases in spend produce proportionally lower increases in sales)
- Forecast the likely impact of marketing activity and non-marketing factors on future sales

Regression models analyze all independent variables like media type, marketing variables, or exogenous effects like macro-economics or weather. The ultimate goal is to minimize the unexplained variance of a dependent performance measure like unit sales or revenue/profit. As sales increase or decrease over time, the goal of these algorithms, generally, is to reduce the amount of fluctuations that cannot be directly “explained”* through the variability of the independent variables. For example, if promotions are increased, but there is not also an increase in sales during the same time, a regression model would use promotion data to explain some of the sales variance. Like many statistical modeling techniques, there are a multitude of varieties; the most notable of all is the Ordinary Least Squares method or OLS Regression. There also is a number of other regression-based approaches that are used for MMM like Bayesian Regression and Vector Autoregression (VAR) techniques.

Another key distinction between methodologies can be summarized by the classification or nature of the methodology. There are several ways to classify mathematical models: linear vs. non-linear, deterministic vs. stochastic, or discrete vs. continuous. Agent-based models are non-linear, stochastic, and continuous models. The types of regression techniques used by most MMM providers are linear or non-linear, deterministic, and discrete representations of the data being modeled.

* It’s important to make a distinction between association vs. causation. When we say “explained” variance, we are not talking about cause and effect. When a model determines that buying a certain amount of GRPs of TV advertising explains the variance in sales during a particular period, it doesn’t mean the TV advertising caused sales to change but that there was enough evidence to show a relationship between TV advertising and sales.
ABM models the aggregate phenomena rather than modeling the underlying data relationships. Model fidelity, the degree to which a model represents the actual process being modeled, is extremely important for accurate results. ThinkVine’s methodology is purposefully designed to close the gap between the behavior of the real-world system and the method used to understand and predict that behavior.

Regression analysis is broadly defined as a parametric method and there are a number of fundamental assumptions that are made regarding the characteristics of the data being used. First, the independent variables must be uncorrelated or truly independent of each other, and second, the standard deviations of the error terms between independent variables are constant, essentially establishing homoscedasticity of error terms.

Lastly, and on a much more practical basis, the marketing mix optimization problem is inherently a human behavior problem. And, one of the most relevant aspects of the human behavior problem is that people are different in terms of who they are and how they behave. If people didn’t behave differently, then everyone would watch the same TV program, click on the same banner ads, and “like” the same Facebook pages. They also would buy the same product at the same frequency. The heterogeneity in the population is a significant component to understanding how marketing influences people.

This is the biggest and most significant challenge for traditional marketing mix models because people – and their infinite differences – are not part of the formula. Typical marketing mix models are aggregated to some level and are very inefficient at looking at the differences between people in a dynamic and interactive system. ABM embraces the notion of the individual. ThinkVine’s agent-based modeling engine realistically represents the heterogeneity that exists in the population both in terms of people’s characteristics and the relationship between those characteristics and their behaviors.

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ThinkVine’s Implementation of ABM

In essence, an agent-based model is a direct representation of the actual system under examination, and agents represent the “actors” that create change and are measured within that system. ThinkVine has pioneered marketing software that uses an underlying agent-based modeling engine called ThinkAhead Technology™ to replicate the real-world consumer marketplace. Within the ThinkVine model, the simulated agents are people who respond to marketing activities and make purchases – just like real consumers do.

With ThinkVine’s model, marketing organizations can analyze and measure what has and hasn’t worked in the past as well as forecast the potential future performance of marketing plans. In today’s highly targeted and highly fragmented media world, it is critical that any assessment of historical and future performance is capable of delivering actionable insight in four critical and dependent dimensions:

Marketing mix modeling needs to answer the questions these four dimensions raise: how much to spend; where to spend it; when to spend it; and who to spend it on. The first step to answering these questions within the model is building the context for how people will behave in the future as well as what the impact will be on the brand if you can reach them.

Using innovative consumer behavior modeling technology, ThinkVine provides a never-before-seen glimpse into the way marketing influences purchase behavior to model the collective influence of a marketing plan on how people buy. ThinkVine’s ThinkAhead Technology combines the most accurate and up-to-date data available including a brand’s sales and marketing info, market and category data, consumer behavior data and advanced marketing science to create the most realistic marketplace where people consume media, engage with marketing, and purchase products the way real people do.

Figure 3: Key Marketing Questions

Spend
- How much should we invest in marketing?
- What is the impact of increased or reduced investments?
- How can we redeploy funds to support emerging markets?

Tactics
- How do we measure and manage return by brand, channel, geography, sales channels, etc.?
- How do we test and learn into new media channels?

Targets
- What are the impacts to customer acquisition and retention?
- How do we align my marketing to specific high value segments?

Timing
- How do we forecast long-term, brand-building effects?
- How can we leverage seasonality and timing of tactics to our advantage?
This gives marketers an unparalleled, in-depth understanding of how marketing has impacted business outcomes historically as well as short- and long-term forecasts of how well it will achieve business objectives in the future.

For each customer, ThinkVine experts configure and calibrate a unique, customer-specific market model. Once the system is ready, marketers use the ThinkVine Marketing Mix Optimization software to manage marketing plans, test various “what if” scenarios and strategies as well as view, store, and share results and forecasts across internal and external teams.

The software is unique in that it provides marketers with direct access to the agent population. Because the results from the software are a direct expression of the model that represents the dynamic process that occurs in the real-world consumer marketplace, marketers gain more accurate, forward-looking forecasts of marketing effectiveness.

Figure 4: ThinkVine’s ThinkAhead Technology Platform

In a complicated world, the various elements that make up the system maintain a degree of independence from one another. Thus, removing one element (which reduces the level of complication) does not fundamentally alter the system’s behavior apart from what directly resulted when that piece was removed. Complexity arises when the dependencies among the elements become important. In such a system, changing one such element destroys system behavior to an extent that goes beyond what is embodied by the particular element that is removed.

Complex Adaptive Systems: An Introduction to Computational Models of Social Life
John H. Miller & Scott E. Page © 2007, by Princeton University Press
The ThinkAhead Technology

ThinkVine’s ThinkAhead Technology contains two simultaneous, but intertwined systems – a response process and buying process – built into one dynamic model.

The response system simulates people’s media consumption habits and the probability of reaching people with marketing during those activities. It is configured for a wide range of marketing and media activities to integrate traditional as well as emerging marketing channels. Simultaneously, the buying system incorporates the probability that an agent will buy a brand and within the category. These two processes are intertwined in the model in order to accurately represent the real-world dynamic marketplace.

The Real-World Marketplace

Every day, people have a probability that they will carry out certain activities such as listening to the radio, driving to work, doing research online, connecting with friends via social networks, and watching TV. Consumer media consumption is important for marketers to understand, but the list of media activities continues to grow, making it more difficult than ever to keep up.

The probability that a person will perform one of these activities is based on the frequency and duration of the same activity they and others like them have done in the past. But, past behavior does not guarantee or pre-determine a future behavior, adding to the marketing complexity. Similarly, people purchase products and services to meet a need. Their likelihood to buy in any given category and purchase a particular brand at a specific time can be informed by previous purchases. Generally, needs arise with a frequency pattern that can be observed through historical data. Again, history doesn’t guarantee a future purchase but can help inform the probability. The success of marketing is based on being able to align marketing spends with a person’s buying cycle.

65% of marketers said that comparing the effectiveness of marketing across different digital media is “a major challenge” for their business.

— 2012 BRITE-NYAMA Marketing in Transition Study
The ThinkAhead Technology engine is designed to accurately replicate this buying process. The understanding of how this process works requires customer-supplied and market data. If you think of rules as the brains of the ThinkAhead Technology engine then data is the lifeblood. Because the engine utilizes rules, it does not require a formal single source data structure. Information can come in a variety of forms, including formal databases, unstructured data, and individual statistics. For instance, data inputs can vary from an Excel spreadsheet with weekly sales data to a single statistic like average unaided brand awareness.
Customer Data

One of the main types of input data into the ThinkAhead Technology engine is customer-supplied data. Within customer data, there is required data and additional data.

1 Adding Customer Data

A. Required Data

Sales or Performance Data

ThinkVine’s ThinkAhead Technology has the flexibility to measure against any business metric. The most common business metric is sales. However, there are situations depending on the nature of the business where another business metric is more relevant. The key is to use the business metric that marketing is measured against. At a minimum, two years of historical sales data (at a weekly or monthly level) is preferred for a successful and robust implementation. With brands that have a significantly longer sales cycle, additional years of data can be helpful. For faster moving categories, two to three years of historical data is ideal.

Example 1:
For one customer in the software industry, the key objective of their marketing activity is to drive trials of the product, so the customer used weekly trial data for the past three years.

Example 2:
For several customers in the consumer packaged goods space, the key objective of their marketing is to drive purchases of the product. In this situation, weekly unit sales or gross margin (unit sales x gross margin per unit) was used.

Example 3:
For a customer in the financial services industry, the purpose of their marketing was to drive new accounts opened. This customer used weekly new accounts activity as the performance data.
Historical Marketing Data

The ThinkAhead Technology engine requires historical marketing data that aligns to the sales/performance data during the same timeline. For example, if two years of sales data is used then two years of historical marketing data for the same period is required.

Marketing data can come in a variety of forms depending on the marketing activity being described. The goal is to create an exhaustive list of all marketing used and to obtain data that describes them. The standard descriptors for most marketing activities are: spend amount ($), time of spend (calendar), and size of audience (estimates of reach). In today’s marketing landscape, there are many ways to measure an expanding set of digital and emerging media activities like impressions, clicks, and likes.

B. Additional Data

The ThinkAhead Technology can take advantage of many additional types of data, which fall into four main buckets:

1. **Consumer:** Consumer data is any type of tracked, syndicated, or primary market research data that describes consumers and their behavior relative to the category, brands, and marketing activities in more detail. Often, this comes from custom or purchased segmentation data, marketing contact audits (MCA), brand health trackers, and awareness & usage surveys.

2. **Price and Promotion:** Price and promotion data is any type of deeper analysis into consumer responsiveness to price and promotion. This can include price and promotional elasticity of demand analysis through econometric models or conjoint/discrete choice research.

3. **Sales Channel:** Sales channel data is syndicated or primary shopper research that describes how consumers utilize different sales channels to make purchases in the category. This can include physical stores, call centers, and e-commerce sites.

4. **Product:** Product data is any research into the value consumers place on different elements of the product relative to competition, pricing/promotion, and how the elements are communicated.
Any data sources within these four categories can add value to the customer-specific market model by inputting more information that describes how the marketplace for a particular category works across consumers, products, and media.

**Multi-tenant Market Data**

The other main category of data is Multi-tenant Market Data, which ThinkVine obtains and manages. It’s referred to as multi-tenant because the data is used to inform how agents are generated for every custom vs. customer data that is uniquely used for an individual customer.

Market data describes the characteristics of people within a population; how those people use different types of media; and how they carry out activities. The sources of market data include Census data, Nielsen or IRI data, comScore, Arbitron, Google, GfK MRI MediaDay, MBI USA TouchPoints, and much more. Within the market, there is a tremendous amount of captured and researched data available to marketers about how people engage with marketing. Because of the flexibility of the engine, ThinkVine can incorporate all forms of market data. There also is no requirement to merge these sources into a single database as the data is synthesized when agents are generated, which enables the seamless integration of emerging marketing channel data streams. The engine is frequently updated with market data to form the most realistic and up-to-date marketplace simulation available to marketers.
Configuring & Calibrating Models

Once the customer-supplied sales and marketing data along with market research data is in the system, the configuration and calibration process begins. During configuration, parameters are set for generating agents and setting up each marketing activity. There are a series of steps taken to generate agents, configure their behavioral settings, and calibrate the results to known inputs and outputs.

2 Building an Agent Population

A. Demographics
We mathematically recreate a representative population of the country.

B. Media Consumption
We layer in media consumption by tapping a variety of well-known, widely-accepted sources of consumer behavior data.

C. Consumer Agents
Targeting is brought to life by having the right marketing hit the right person at the right time. The software now contains a simulated panel based on individual distributions that is representative of consumers in the market.

D. Purchasing Behavior
Agents are configured in terms of how consumers actually purchase within a specific product or service category.

E. Agent Brand Preference
Ehrenburg’s findings on brand purchase are used to assign brand preferences to agents.
Agent-Based Modeling
A Breakthrough Approach to Marketing Mix Optimization

Agent Generation
In the ThinkAhead Technology engine, an agent represents a consumer. Because agents are defined by specific demographic characteristics and behaviors that represent individuals within a population. A typical implementation of the ThinkAhead Technology has upwards of 50,000 agents, which establishes a marketplace that is highly representative of the real-world population in the aggregate and by consumer segment.

A. Agent Demographics
Using characteristics from the population (demographics, socio-economics, etc.) and from a behavior perspective (media usage, activities, etc.), agents are designed to behave like real-world people by making “weighted” decisions. Similar to how people develop certain patterns of behaviors that describe how they are likely to behave in the future so do agents.

For example, a person may enjoy watching a television program every Wednesday night, but sometimes something happens that prohibits that person from watching the program. This creates a chance that they will miss the show each week. Agents are designed to work in the same way. By evaluating the distribution of past TV Viewership in total and by different sub-groups of the population, ThinkVine is able to sample from these distributions to mathematically generate a realistic simulation of how people in a population watch TV.

This may seem simple for a single distribution of one behavior like TV Viewership. However, sampling multiple distributions is much more complex because it has to allow for bias based on correlations to characteristics like demographics while assuring a uniform distribution in the outcome. ThinkVine has patent-pending algorithms for facilitating this sampling procedure where agents “wake up” every day and make decisions about what they will do. These decisions are weighted based on draws from a list of distributions that describe a variety of activities. Each agent makes a set of decisions, and every day the process repeats itself. Because the draws are randomized, the outcome for each activity may vary from day to day just like real-world people make different decisions every day.

This is the first in a series of steps that guarantee that the model, when applied to marketing mix optimization, will maintain the heterogeneity inherent in the population. The validation of this step is evident when comparing the agent characteristics to the appropriate population.

B. Agent Media Consumption
Contrary to a regression model, the ThinkAhead Technology engine handles behaviorally targeted media. Using renowned sources of media consumption data like MRI & USA TouchPoints, each agent is assigned rules to simulate activities and media habits that represent real-world behaviors.

C. Consumer Agents
Targeting is brought to life by having the right marketing hit the right person at the right time. Using the same sampling procedure described in Agent Demographics, the media usage distributions and the relationships between agents’ media usage characteristics and their demographics accurately reflect the consumer marketplace. In today’s consumer-driven world, it’s more important than ever for marketers to understand how marketing influences targeted consumer segments.
D. Agent Purchase Behavior

The rules that define agents’ category purchase behaviors are based on the frequencies with which they experience various needs or wants. Customer and research-based data and insights is used to determine how demographic differences factor into category needs. Purchase motivations and frequency distributions are then assigned to the agents to align with widely-accepted purchase theory. This ensures that the model doesn’t just provide aggregate outcomes but that the outcomes over time reflect actual purchase patterns, which a heterogeneous model provides naturally.

E. Agent Brand Preference

At the beginning of configuration, agents are assigned a preference spread for the brand. ThinkVine leverages Ehrenberg’s findings on brand purchase (i.e. that repeat purchase conforms to a negative binomial distribution) and applies it to sampling capabilities to assign brand preferences. This is achieved while maintaining all correlations to segment membership or demographic group. At this point, customer-supplied data is introduced into the model to create a unique, customer-specific market model.

All of these steps combine to create the environment in which the agents interact. Factors like macro-economic variables, competitive media, sales, and seasonality information are also incorporated to provide marketers with all the information that is pertinent to real-world market scenarios.

System Calibration & Validation

Finally, the agents are released into their virtual world and the outcomes are observed. The results are compared to actual historical sales and penetration build if available, and then the behavior rules are adapted to “train” the model to match reality. This becomes an iterative process with a ThinkVine analyst closely evaluating the results for validity. Once the model has been calibrated and validated, it is ready to accurately forecast future sales and provide rich decision-making information for each marketing plan and “what if” scenario.

Creating the Market Model

A. Training the system

Analysts develop and calibrate a custom model that recreates the past two years of sales.

B. Proving the system

The most recent 6-months of actual sales is compared to a simulation of that same 6-month period.

C. Using the system

Once the model is calibrated and validated, it’s ready for use.


Regression-based models treat this step as a “line-fitting exercise.” ThinkVine approaches this step as a behavior-fitting exercise.
Running “What If” Marketing Plan Scenarios

ThinkVine’s Marketing Mix Optimization software enables marketers to manage very simple to very complex marketing and media plans. Access to the plan information is through an easy-to-use interface where the planner or analyst can make detailed changes across several dimensions:

- Overall budget
- Estimated reach by tactic
- Allocation mix by tactic
- Timing of spend by tactic

Marketers also have the ability to quickly and easily run unlimited marketing plan scenarios in the frequently updated virtual marketplace. Scenarios are “what-if” tests against an existing plan or the creation of a new plan. In every scenario, ThinkVine’s cross-channel attribution analyzes activities in both offline and online channels, giving marketers unprecedented insight on optimal short- and long-term resource allocation. After a scenario is run, it generates an analysis and set of insights for how that scenario is likely to perform, so marketers can get answers to questions like:

- What marketing plan will give us the best results?
- What would happen if we vary our strategy?
- What marketing tactic is likely to deliver the highest ROI by consumer segment?
- If we cut the marketing budget now, how will that affect next year?
- What is the optimal spending level?
- Which marketing types will yield the highest ROI?
Creating, managing, analyzing, and sharing plans across in-house and agency teams is quick and easy with advanced security and collaboration capabilities within the software. With user-level security features, an administrator can define which users gain access to different plans and scenarios. It also enables the administrator to grant sharing privileges based on user roles, which is important when collaborating with multiple teams during the planning process. These features provide a more streamlined process for sharing insights across key stakeholders.

There are a variety of forward-looking, actionable insights that are generated with every plan and scenario that is tested, which include:

- Volume Attribution/Due-To Chart
- Short Term/Long Term ROI
- Long Term Media Impact
- Media Effectiveness
- Media Efficiency
- Media & Marketing Summary Charts (Historical & Future Plans)
- Drilldown based on Target/Segment
Sample Outputs

Quantify Marketing Effectiveness

To quantify marketing effectiveness using dollar and volume measures appropriate for higher education across media and inquiry channels and segments.

- Historical diagnostics and predictive ROI on media tactics by custom-defined consumer segments.
- All tactics are analyzed in the context of each other, and each ROI reported by ThinkVine also captures the synergistic effects generated by that specific tactic.

Figure 8: Better understand the ROI and volume trade-offs of varying marketing activities.

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<tr>
<th>Marketing Activities</th>
<th>Volume (MM)</th>
<th>Spend (MM)</th>
<th>Short Term ROI</th>
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Identify Optimal Spend Level

To identify the optimal level of total marketing spend.

- Optimal level of total marketing spend by simulating the projected revenue results under different spend scenarios.
- ThinkVine is able to accurately forecast business results even when inputs are outside of historical norms, e.g. 200-300%, whereas traditional methods are constrained to +/- 30%.

Figure 9: Easily compare proposed marketing budgets changes on revenue.
**Identify Optimal Marketing Mix**

To identify the optimal marketing mix while accounting for as many institutional and external factors as possible, including aggregator-based vs. organic and national media vs. local media.

- Insights to make better strategic decisions across timing, tactics and spending levels across segments, products, channels, and geographies.
- ThinkVine’s software incorporates many levers across different dimensions, including but not limited to: macro factors (economy/unemployment/competition), all types of marketing tactics (aggregator/organic, national/local, online/offline, traditional/digital), timing, spending, and targets.

Figure 10: Quickly compare “what if” marketing scenarios to identify the best mix of tactics, timing, segments, and spend levels.
Tie Admission Behaviors to Brand Health Metrics

To tie admission behaviors (web visitation, inquiry, application, enrollment) to brand health metrics such as but not limited to awareness, familiarity, consideration, and preference.

- Better understand key brand metrics like awareness tracking by segment.
- ThinkVine preserves the heterogeneity of consumers to more closely match reality and improve accuracy.

Figure 11: Better understand marketing impact on long-term brand metrics.
Measure the Impact of Consumption

To measure the impact of consumption of branded content (such as videos, articles, and infographics).

- Easily see the contribution of each tactic to total volume — in every scenario.

Figure 12: Quickly identify the best plan to achieve your volume objectives.
Measure the Impact of External Factors

To measure the impact of external factors (macro-economic, industry-specific, competitive, earned media).

- Quickly identify which tactics have the greatest impact in the face of increasing competition.
- ThinkVine can incorporate the impact of a variety of factors, including macro-economic (i.e. unemployment rate), competition, seasonality, etc.

Figure 13: Easily incorporate and account for the impact of external factors on financial performance.
Conclusion

No one doubts that there is more diversity among consumers, more fragmentation in media consumption behavior, more marketing choices and more ways to buy. And, no one doubts that the pace of change is accelerating. Given the pressure for accountability and revenue impact, tying critical success metrics to performance and being able to constantly optimize the way marketing dollars are spent is a necessity to achieving a competitive advantage.

Marketing departments need to shift from simple Excel-math to embrace analytics and simulation in order to keep pace with the constant change and increasing number of marketing choices. ThinkVine’s Marketing Mix Optimization software and underlying ThinkAhead Technology engine were designed to enable robust analysis of past spending, accurate forecasting of future performance, and reliable attribution of marketing spend to business results within one system. This enables an agile and objective view of alternative scenarios to maximize marketing effectiveness, as well as the ability for brand stakeholders to plan in a collaborative and informed way.

Our agent-based modeling framework is built to extend well beyond traditional marketing mix models to put the consumer at the center of your planning. ABM also provides a more granular view of all marketing tactics as well as the targets you spend against, including people, segments, geographies, and sales channels.

With ThinkVine, it is possible now to employ an agile, objective, cross-channel marketing planning process that uses the readily available data and new types of advanced analytics to provide the forward-looking information marketers need to develop an effective and efficient annual marketing plan that spans all consumer groups, all types of marketing, and all channels, and to adjust that plan throughout the year as the market changes. Because the market has changed and continues to change, and because data is the new currency of the realm, the marketing organization must embrace data and technology not only to improve tactical efficiency but also to inform marketing strategy.
About the Author

Damon Ragusa, Founder & Chief Strategy Officer, ThinkVine

As Chairman and Chief Strategy Officer, Damon Ragusa shapes the company’s strategy and product direction. An accomplished entrepreneur and marketing technologist, Damon has successfully transitioned ThinkVine from a custom solutions consultancy into a software-as-a-service enterprise in the marketing mix optimization space. In early 2009, under Damon’s leadership, ThinkVine launched its Marketing Mix Optimization software, described as a “leading” product in the marketing mix space by independent research firm Forrester Research. A popular speaker known for his domain expertise and thought leadership, Damon is frequently asked to present at such conferences as ad:tech, American Marketing Association (AMA), Advertising Research Foundation and the Institute for International Research. Damon has held partner and senior level positions at management consulting, marketing science and software development firms and holds degrees in Statistics and Psychology from Bowling Green State University and has conducted advanced studies in both Business Administration and Computer Science.
Who ThinkVine Is

ThinkVine’s Marketing Mix Optimization software provides B2C marketers with the forward-looking information they need to get the maximum return across all their marketing investments. With ThinkVine, marketers make better strategic decisions about spending levels, tactics and timing across consumer groups, products, channels and geographies to positively impact financial performance. Using innovative consumer behavior modeling, our breakthrough ThinkAhead Technology creates a custom, virtual marketplace that simulates how targeted consumers will respond to different marketing plans. Our software provides marketers with rich historical insights and better short- and long-term forecasts of ROI and sales, as well as support for an agile, objective ongoing planning process.

Recently named an industry leader by an independent research firm, ThinkVine boasts the highest-rated marketing mix optimization solution on the market today. ThinkVine’s customers include market leaders in consumer goods, food & beverage, financial services, insurance, pharmaceutical, travel and hospitality, consumer services, and other industries.
Contact Us

General Contact Info
Phone: +1 513 842 5900
ThinkVine.com
Twitter.com/ThinkVine
info@thinkvine.com

Chicago Office
566 W. Lake Street, Suite 200
Chicago, IL 60661

Cincinnati Office
10816 Millington Ct
Cincinnati, Ohio 45242

Phoenix Office
2218 E. Williams Field Rd, Suite 245
Gilbert, AZ 85295
Notes & Resources

Books

North & Macal “Managing Business Complexity: Discovering Strategic Solutions with Agent-Based Modeling and Simulation”

John Miller “Complex Adaptive Systems”

Papers

Goldenberg, Tubia, Garcia “A New Approach to Modeling the Adoption of New Products: Aggregated Diffusion Models”

North, Macal et al., Argonne National Laboratory “Multiscale Agent-Based Consumer Market Modeling”

Procter & Gamble and Others “Using Agent-Based Modeling for Supply Chain Management”

Rand & Rust, U. of Maryland “Agent-Based Modeling in Marketing: Guidelines for Rigor”