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DEVELOPING DISRUPTIVE BUSINESS STRATEGIES WITH SIMULATION

WHITE PAPER

CONTENTS

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INTRODUCTION

Innovation in products, markets, and business models fuels business growth, and disruptive strategies radically change the business ecosystem. When managing innovation, firms must decide whether to invest in new products for markets that do not yet exist, with business models that have not yet been tried. Leaders consistently miss big opportunities when faced with disruption because traditional analysis methods are inadequate when faced with innovation. Working with disruptive strategies is different than predicting the future based on our view of the past. It is important not to just predict the future but to think about how to create the future with our decisions.

In this paper, we will cover different approaches for modeling and analyzing business strategies, determine how to develop an optimal business strategy, and explain why simulation modeling is the best approach to address these kinds of challenges.

The white paper is based on the presentation of Lyle Wallis, director at PwC, at the AnyLogic Conference.

TRADITIONAL METHODS FOR ANALYZING BUSINESS STRATEGIES

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TRADITIONAL METHODS FOR ANALYZING BUSINESS STRATEGIES

Really, how can we predict the future? To give a substantive answer, we must create a representative model. This is inherently a creative process, and we must consider the tools that can support this. Most importantly, which tool is right for a particular project?

Anyone can perform a simple analysis. However, the more complex the analysis becomes, the more powerful tools are needed. If we look at the tool sets that have historically been available, we find three:

QUALITATIVE SCENARIO ANALYSIS

These approaches are very subjective and general. They usually provide a narrative and contextual description of how the present will evolve into the future. Qualitative scenario analysis can be seen as a process of understanding, analyzing, and describing the behavior of complex systems consistently and completely using non-numerical data. Qualitative scenario analysis does not give organizations any insight into investments they should make, to what degree they need to make investments, or over what timeframe. It may be contextually useful, but it does not take us far enough.

DATA-DRIVEN TECHNIQUES

These are, for instance, correlational, statistical, and machine learning techniques, as well as other methods that look for patterns in the historical data. They try and project those patterns forward to say something useful about the near future. Consequently, when planning fundamental changes and market disruption, information about the past can have limited relevance. Overall, it is a highly useful technique because it helps us understand where we are and what might happen if everything remains stable. Its main problem is that when seeking to disrupt a market, its predictions about the future are only of limited value.

SPREADSHEET MODELING

This is the most popular approach. Although commonly used, spreadsheet models are inadequate for describing innovative business systems. All business systems have feedback, nonlinearity, and delays, and spreadsheet-based models cannot describe these features adequately. The quality of the model that is used for decision-making is crucial for the quality of thinking around important strategic questions and, consequently, for the success of the business. Spreadsheet models cannot provide us with high-quality strategic insight. Let us illustrate this statement with an example.

TWO JUDGMENTS ABOUT UBER'S POTENTIAL MARKET SIZE

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A professor of finance at New York University's Stern School of Business, Aswath Damodaran, once published a post in his blog about the value of Uber.[1] Using market data and financial analysis, Professor Damodaran came to the conclusion that, with his best estimation, the value of Uber was $5.895 billion. This number was far below the $17 billion valuation set by investors at that time. Damodaran summed up that Uber is highly overpriced. It is worth mentioning that, as of 2025, Uber's valuation has reached $204 billion.

Damodaran's estimate of value was tied to two assumptions: the total available market (TAM) and Uber's market share within that TAM. The TAM was based on the historical size of the taxi and limousine market, which was estimated at $100 billion. The financial analysis results depended entirely on these two assumptions.

The model of the Uber's opportunity looked like this:

Market opportunity = TAM * % Share

The opposite opinion on the same topic was given by professional investor Bill Gurley.[2] In his blog, he declared there was a critical error in both core assumptions. In choosing to use the historical size of the taxi and limousine market, Damodaran assumed that the future would look very much like the past. This meant that the arrival of a new service, like Uber, would make no difference in the size of the car-for-hire transportation market–a dangerous presumption. If you significantly improve the quality of service, create new features, and, in addition, extend the sphere of application, you can materially expand the market. With these things in mind, what were Uber's strong points?

[1] Aswath Damodaran, "A Disruptive Cab Ride to Riches: The Uber Payoff", Blogspot, June 9, 2014, http://aswathdamodaran.blogspot.com/2014/06/a-disruptive-cab-ride-to-riches-uber.html

[2] Bill Gurley, "How to Miss By a Mile: An Alternative Look at Uber's Potential Market Size", Above the Crowd, July 11, 2014, http://abovethecrowd.com/2014/07/11/how-to-miss-by-a-mile-an-alternative-look-at-ubers-potential-market-size/

Waiting time
Uber had reduced the average waiting time to less than five minutes, significantly helping improve the *quality of service*.

Coverage
Uber became popular even in geographic regions where consumers rarely order taxis. So, *the market size expanded*.

Payment method
With Uber you don't need to pay with cash. This makes it *much easier to use* than an ordinary taxi.

Civility
Uber's customers and taxi drivers can rate each other. This leads to politer interactions. If your ride was pleasant, you are *more likely to use their service again*.

Safety
With Uber, there is a record of every ride, every customer, and every taxi driver. This makes it safer and *more trustworthy for customers,* especially women.

Lower price
Uber was becoming more and more popular, so it was able to lower prices without any damage to taxi drivers' income. *A fall in prices led to an increase in demand*.

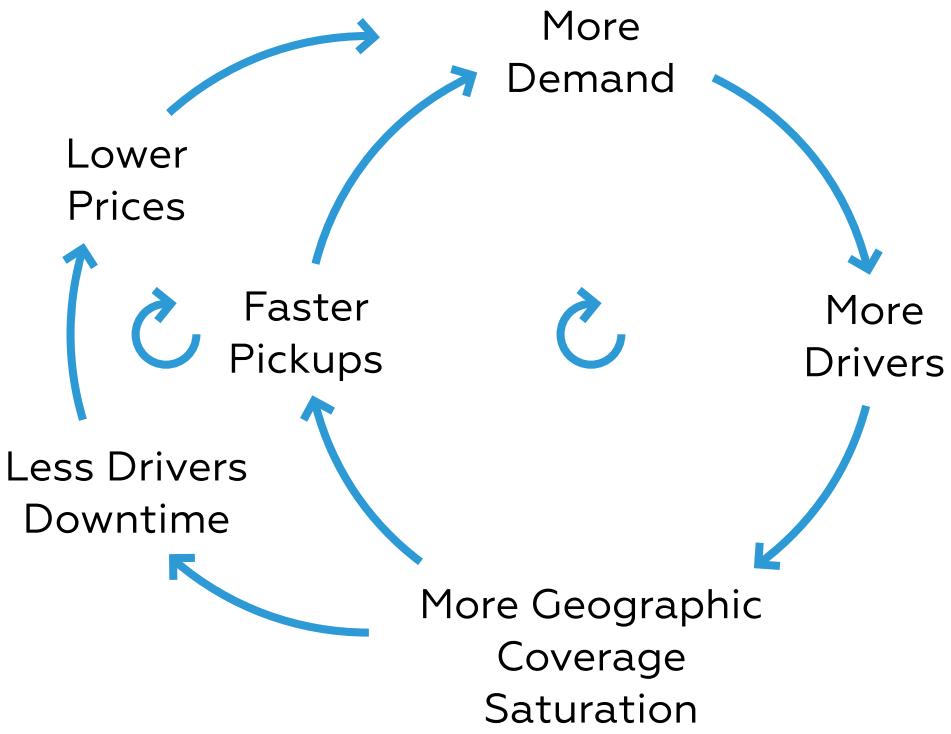
Bill Gurley's model demonstrates the dynamics of the taxi market when introducing change, which are far more complex than the fixed market of Damodaran. To analyze the system, it is necessary to understand its structure, inside interdependencies, and feedback. So, he captured this idea in a stock and flow diagram (see right), a tool commonly used in system dynamics.

The small positive feedback loop generates a larger market and a competitive cost advantage. **The large positive feedback loop** is an engine of rapid growth. Still, this is a simplified model that leaves out important growth limiting negative feedbacks, such as competition for customers and drivers. Beyond that, deeper analysis, and perhaps market research, is needed to quantify these effects and the company's potential growth. As a result of his own analysis, Bill Gurley identified a market opportunity that was much larger than the spreadsheet version (~$250B).

It's difficult to say which is better, as both provide worthwhile viewpoints, and for any stakeholder it is preferable to analyze the situation from multiple perspectives.

Nevertheless, this example confirms that formulas are useful for expressing static dependencies between variables, but they fall short when describing systems with dynamic behavior. The positive loops in Bill Gurley's model generate a change in the addressable market–change that could never be represented in a spreadsheet. Bill Gurley's model clearly highlights the weakness of the spreadsheet approach.

In recognition of the dynamic nature of the systems that Damodaran and Gurley tried to represent, it is necessary to explore a modeling approach designed specifically for analyzing dynamic–simulation modeling.



HOW SIMULATION CAN HELP CREATE BUSINESS STRATEGY

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Simulation modeling means creating a digital prototype of a real-world system. Simulation enables experimentation on a valid digital representation of a system to analyze, optimize, and predict processes inside.

The main advantages of using simulation modeling as a problem-solving tool, compared to spreadsheet-based modeling, are:

INCREASED ACCURACY

Simulation models enable you to analyze systems and find solutions where traditional methods fail. This is largely because a simulation model can take into account more complex interdependencies and the behavior of the system over time.

EASE OF USE

Once you have selected the appropriate level of abstraction, the development of a simulation model is a more straightforward process than analytical modeling. It typically requires less intellectual effort, is scalable, and is modular.

COOPERATION

The structure of a simulation model naturally reflects the structure of the real system. As simulation models are developed using mostly visual languages, it is easy to communicate the model internals to other people.

MEASURABILITY

In a simulation model, you can measure any value and track any entity that is not below the level of abstraction. Measurements and statistical analysis can be added at any time.

VISUALIZATION

The ability to play and animate system behavior over time is one of the greatest advantages of simulation. Animation is used not only for demo purposes but also for verification and debugging.

PERSUASIVENESS

Simulation models are a lot more convincing than spreadsheets (not to mention slides or reports with numbers). If you bring and run a simulation to support your proposal, you will have an advantage over those who bring just numbers.

HANDLE UNCERTAINTY

Simulation considers the randomness and interdependencies that characterize real-life business.

Consequently, we can say that the power to "look into the future" and understand the impact on multiple key metrics, instead of making assumptions and using averages, is what simulation provides.

Analyzing innovation is a tricky and complicated process, and building the simulation model is only the first step. In general, we can divide this process into four basic steps:

1. MODEL DEVELOPMENT

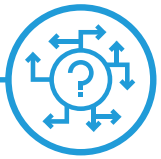
The most important step is to identify and formulate the problem correctly. The phase of building the model is a necessarily creative process. Mapping the real world to the world of models, choosing the abstraction level and the modeling language, is the least formalized element in the whole process of using models to solve problems. A model should capture the dynamics of a business system (for example, customer adoption, competitor response, and asset utilization). Only the components essential for solving the problem should be represented in the model.

2. PERFORMANCE METRICS

Data on system specifications, input variables, and the performance of the existing system is required. Statistics should measure an organization's behavior, activities, and performance. Many metrics are finance-based, but they may also focus on other things. Performance metrics are traditionally used by stakeholders to evaluate strategic decisions. So, you must decide what performance measures will be analyzed in your simulation model.

3. VISUALIZATIONS

Even if you are not creating an exact digital twin of your organization in 3D, visualization should be done for verification of your model. Verification is the process of ensuring that the model behaves as intended. To verify your model, you can input real data and compare the results with historical data. Good data representation will also help you choose between strategic alternatives. Moreover, simulation software enables users to visualize vehicles, staff, equipment, buildings, and other items and processes within their models.



4. SCENARIO ANALYSIS

A model can be used to test thousands of strategy variations and scenarios that capture uncertainty. For this purpose, you can use Monte Carlo, Sensitivity Analysis, and Parameter Variation experiments. They help you discover how randomness and parameter change can affect your model's behavior.

When developing a strategy, each alternative must be evaluated and compared against each other using a whole range of conditions. Many factors should be considered, including:

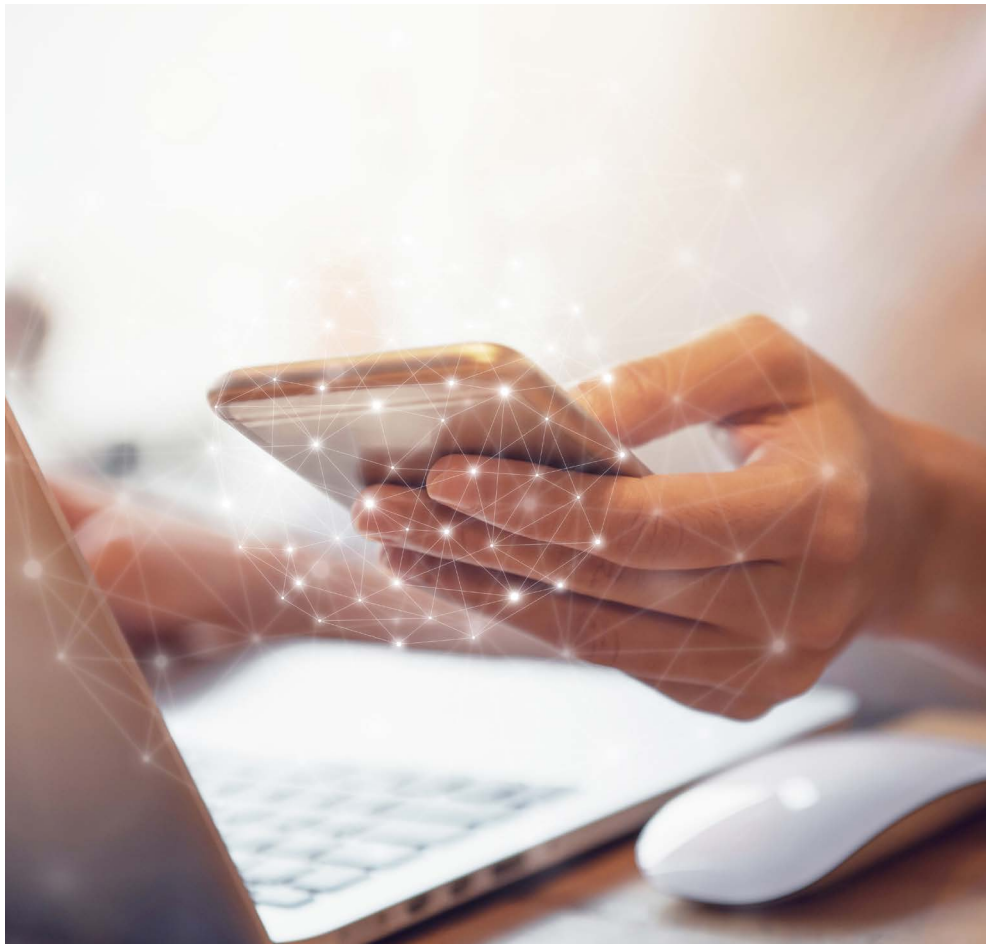
- **Policy alternatives.** Examples of different strategies include increasing marketing spending, competitive pricing, and maximizing service levels.
- **Environmental assumptions.** Outside control factors that can impact strategy effectiveness (for example, customer acceptance, competitor response, and economic trends).
- **Randomness.** Stochastic factors that can impact effectiveness include customer choice, word-of-mouth messaging, and marketing reach.

In some of their projects, PwC conducted strategy analysis that utilized ~500K simulation runs of a single model with different scenarios and varying parameters.

Many simulation runs can pose a problem because it is hard to evaluate thousands of them without access to a lot of computing power.

To make this practical, PwC built a cloud-based analysis workflow for their projects that allows them to iteratively generate new strategies and explore results. This provides a valuable example of how business analysts can organize data flows when using simulation for strategy analysis. See the figure on the next page.

PwC built an AnyLogic simulation model and hosted it on their own cloud infrastructure. AnyLogic Cloud simplifies this process and provides a platform for analysts to integrate models into their data flows.



Scenarios are distributed for execution to one or more cloud servers. (Google Compute or MS Azure)

Scenario analysis is used to identify new strategies and formulate experiments for future iterations

New Scenarios

Cloud Compute Infrastructure

Strategy Table

Strategies are codified as model scenarios. (Python or Excel)

Utility to manage the creation and distribution of model experiments to cloud infrastructure (Python or Java)

Exported model that can be executed as Java-application or model in AnyLogic Cloud executed via Java API working over HTTPS

Results

Model experiment outputs are consolidated to a single data set (1 to 20 GB per analysis)

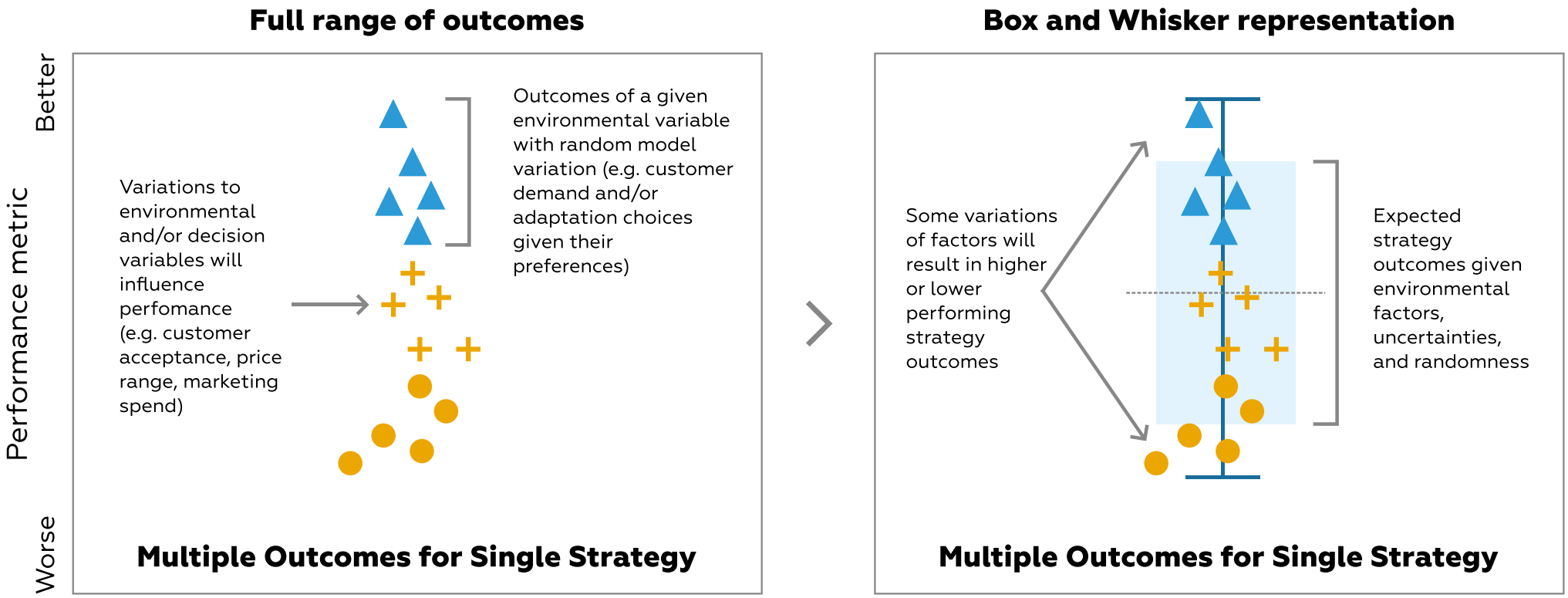
Analysis Engine

Scenario outputs are processed and transformed into evaluation metrics (Alteryx, R, Spark, Python)

Dashboards

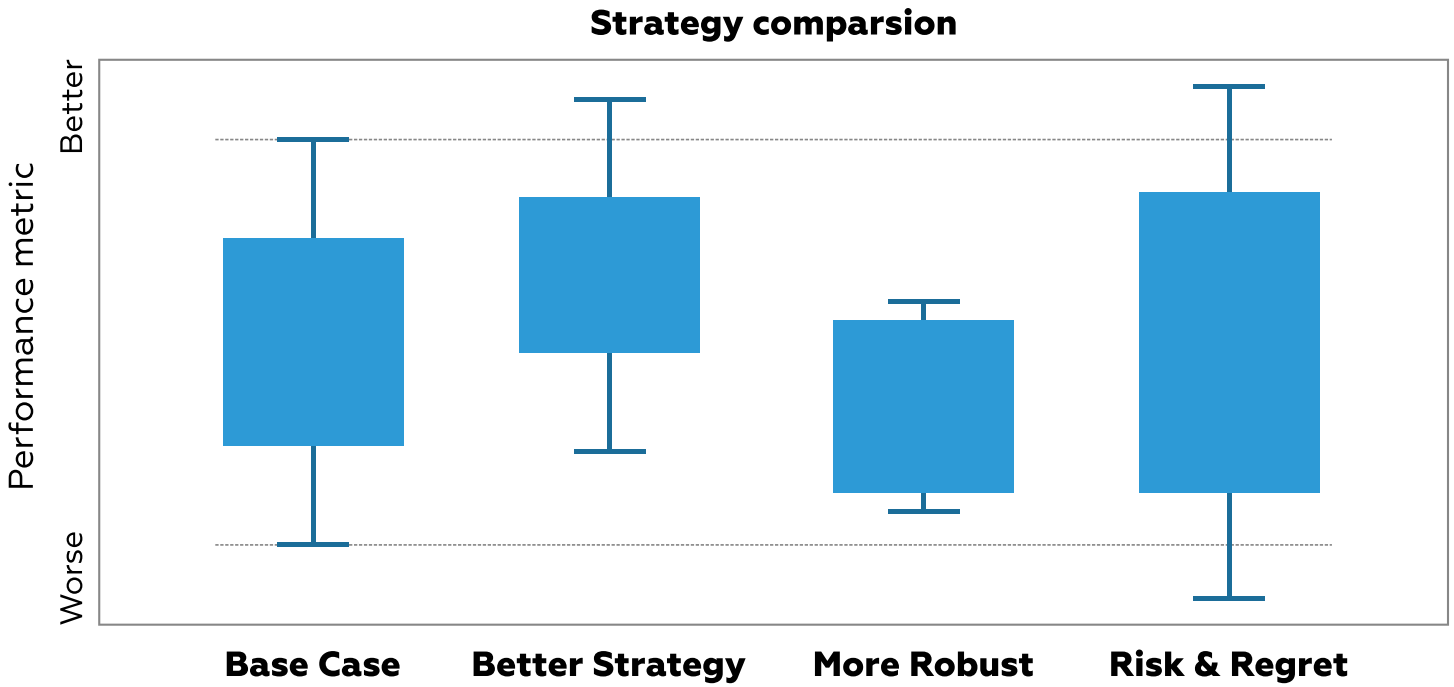
Dashboards and visualizations incorporate to evaluate strategy performance and tradeoffs (Tableau)

Because of deep uncertainties in the environment and random variation, each strategy alternative can produce a range of outcomes. One way to summarize these for easy comparison is a Box and Whisker plot.



The distribution of outcomes for each strategy can be compared to determine the performance, robustness, and risk associated with each decision. Some strategies will have greater upside and lower risk compared to the base case. Better strategies will also have higher average expected returns within their range of possible outcomes.

Robust strategies are those that perform consistently under uncertainty. There may be a cost associated with predictable strategies. An example of a more robust strategy could involve policies that seek to increase asset utilization through active management. Good strategies have disproportionate upside potential. Large upsides are driven by strong positive feedback loops and nonlinearity.



Real data for Box & Whisker plots can only be obtained through simulation modeling, as it is the only analytical method that accounts for randomness inside a model.

To illustrate these ideas, let us consider an example from the PwC's practice. This case study is based on the presentation of Mark Paich from PwC at the AnyLogic Conference.

CASE STUDY: MAJOR US AIRLINE DECIDES NOT TO CHARGE ADDITIONAL FEES

04

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The U.S. commercial airline industry is one of the most diverse, dynamic, and perplexing in the world. It is fast-evolving, labor-intensive, capital-intensive, hyper-competitive, and very vulnerable to the ebb and flow of business cycles, as well as being among the most regulated of businesses.

Airline management is required to make long-term decisions regarding fleet sizes, market fluctuations, and fuel prices, while seeking ways to increase profit in a competitive environment.

PROBLEM

A major U.S. airline was facing a situation where opportunities to extend its existing strategy were limited, along with an increasing cost structure due to competition, commodity prices, and acquisition integration activities. The airline began to explore several options to generate new profits through ancillary products or changes to existing policies and while under intense pressure from board members, Wall Street, and various analysts.

Although the revenue generation through charging additional fees was apparent in the short term, the airline chose to evaluate the long-term perceived impact on brand equity, market share, and customer loyalty before implementing a policy change.

SOLUTION

PwC was employed by the airline to model the predicted impact of the client's ticket market share and company brand sentiment after introducing new products or policy changes.

PwC found traditional marketing mix models to be limited and unable to analyze the airline's challenges. First, because they are aggregate, all customers are represented in a single regression equation, which disregards the fact that not all consumers behave the same.

Secondly, these types of models do not show interaction between consumers, when, on the contrary, customers share stories, attitudes, and memories, which is known as emergent behavior. Emergence is used to describe the behavior a group exhibits because individuals make different choices than they would if they were not part of a group.

A third limitation, when using typical market models, is the lack of explicit representation of consumer decision-making. Analysts are then unable to see consumers gathering information, making informed decisions, and forming consideration sets as they do in the real world. Lastly, in traditional regression models, nonlinear relationships are not accounted for, data is limited to time series data, and there is a relatively short time horizon. In the end, this type of model is inappropriate for most consumer behavior analytics.

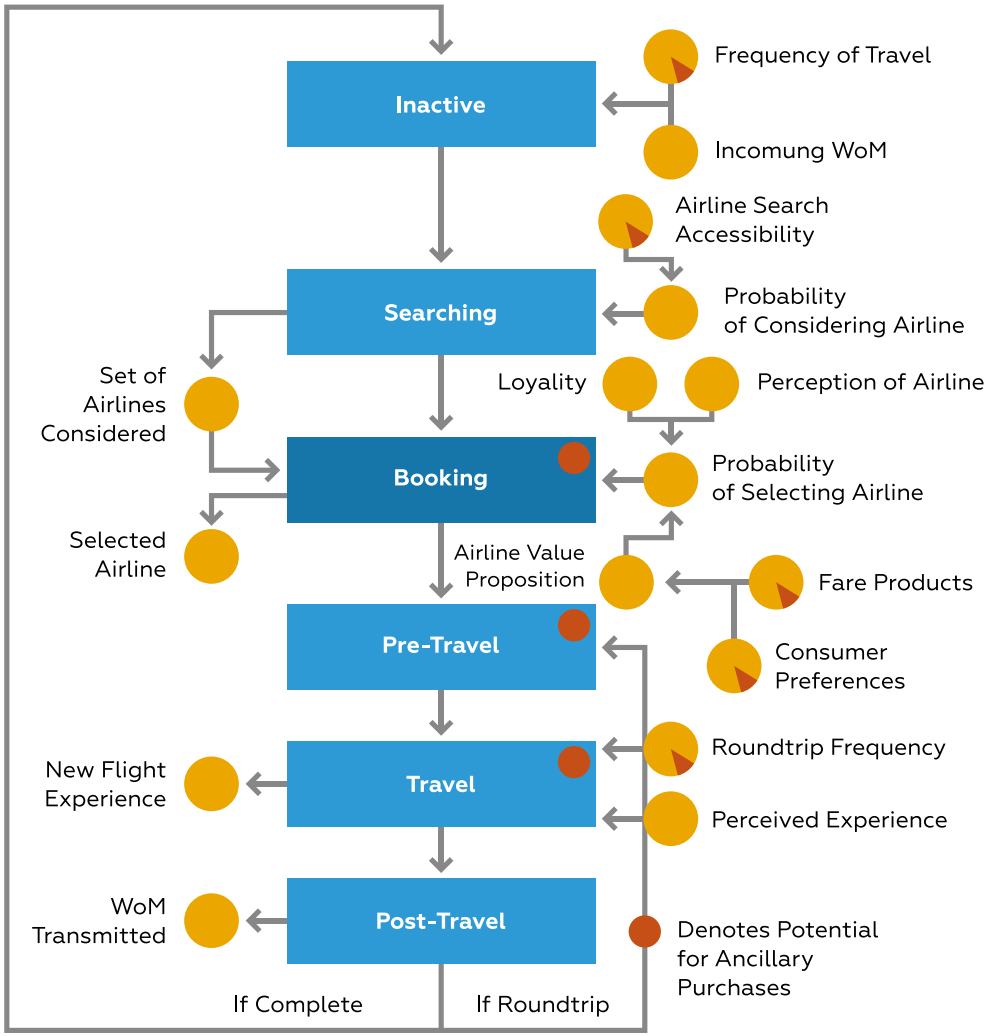
These restrictions, and an increased likelihood of inaccurate results, prompted PwC to explore other modeling options. They chose AnyLogic simulation software due to its flexibility, scalability, and capability to handle sophisticated, computationally intensive techniques that model the behavior of agents (consumers) in the market.

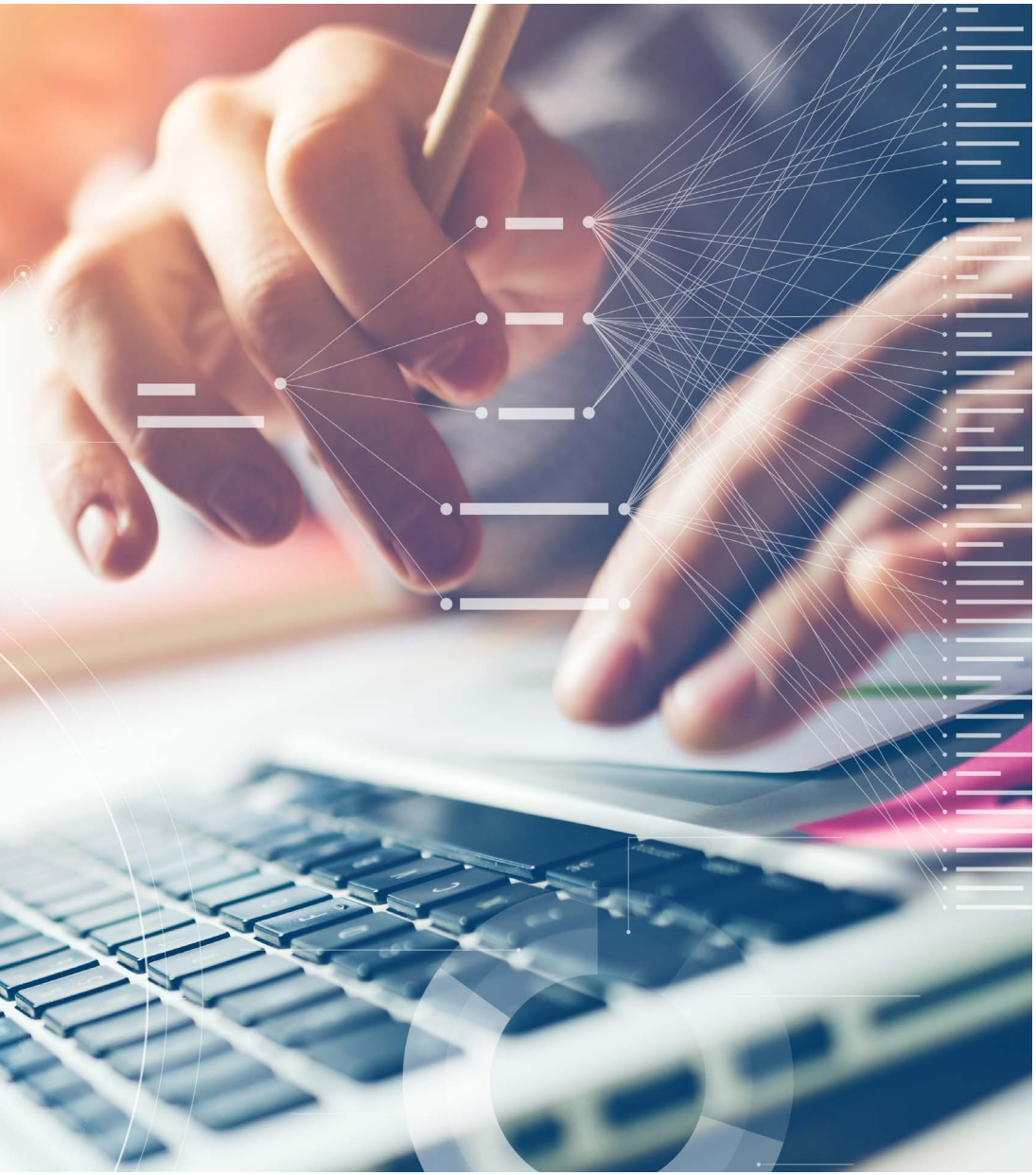
Utilizing AnyLogic software, PwC built the **Experience Navigator**, an agent-based consumer behavior model of multiple airline markets that included client competition, the process of consumers making choices, and a relatively complete representation of the ecosystem in each market. The project used historical industry data, behavioral economics principles, and measurable experiences to create a behavioral model to help understand the impact on customer purchase behavior and the airline's social contract. They built the behavior of each consumer at the market with an agent statechart (see right).

The information used during model building and calibration included:

- Time series of data on airline market shares (volume, prices).
- Cross-sectional data of individual travel behavior.
- Market research from PwC Experience Radar (a customer experience survey conducted by PwC).
- Market research from client discrete choice models.
- Processes and theories from consumer choice literature.
- Qualitative knowledge of the airline industry.

PwC and the airline were now able to understand how the interaction of different factors (fare utility, past experience, loyalty, and word-of-mouth) may shape behavior, influence market share, and modify markets overall.





OUTCOME

PwC's Experience Navigator is based on a model built with AnyLogic simulation software and was used to:

- Analyze the sales funnel at a particular segment and individual competitor level.
- Visualize consumers' changing beliefs over time.
- Dive into different agents to understand their positive and negative experiences.
- Forecast the revenue impact of change in consumer experience.
- Set price and marketing influence levels of the airline.

Ultimately, the model results showed that long-term losses in market share and revenue would significantly offset any gains from charging additional fees. In addition, the model demonstrated that if the company set its fees equal to those of the competition, its loss of market share would be considerably greater, since the customer choice behavior for this airline was driven largely by its strong brand equity and positive perception.

The model provided substantial evidence to convince stakeholders and Wall Street that the airline should not implement the charging of additional fees but should cultivate an alternate strategy to increase revenue.

CONCLUSION

Innovation disrupts an existing business ecosystem, creating a new economic reality that must be worked with. And, as we have proven, traditional methods, including popular spreadsheet-based approaches, are inadequate to fully understand this process.

In most cases we cannot afford to search for the right solutions by experimenting with real businesses. As such, modeling is about finding a way from the problem to its solution using a risk-free world where we are allowed to make mistakes, undo things, go back in time, and start all over again. This is exactly what people need when they are creating a business strategy.

Simulation software can be used in these situations to cover a range of issues by unveiling hidden interactions, testing dependencies, and revealing sensitivities. Simulation considers the randomness that characterizes the behavior of the real-life business environment and provides a safe way to test and explore different "what-if" scenarios. Visualization builds trust in a model, making it a lot more convincing than spreadsheets or slides. Professional users can set up complex data flows that utilize cloud computing to carry out in-depth strategy analysis, with thousands of simulation runs of a single model, with different scenarios and varying parameters.

Modeling results enable informed thinking and provide effective management, with mitigation strategies for risks and negative scenarios. Simulation is the perfect analysis tool for creating and evaluating innovative and disruptive business strategies.

ADDITIONAL RESOURCES

- White Papers
- Case Studies
- Videos
- Books
- Download AnyLogic Simulation Software
- Seminars and Trainings

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