

Integrating Dynamic Simulations With An OLAP System

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Abstract

This paper explains how a business simulation created in Powersim Studio can be linked to an online analytical processing (OLAP) system in order to provide enhanced strategy planning, forecasting and what-if scenario analysis.

OLAP systems and data warehouses (DW) allow corporations to collect and aggregate operational data with the aim of performing analysis. The data in the data warehouse form a blueprint for the company's history and past performance, and by studying these data, a corporation can streamline performance, correct its course, and in general be better prepared to face an uncertain future.

Although OLAP systems are excellent analytical tools, they operate by analyzing historical data, and can only offer limited forecasting and scenario planning capabilities. By using a business simulation to perform the forecasting and scenario planning, an OLAP system can be extended into a very powerful analytical planning tool.

Keywords: OLAP, Business Intelligence, Business Simulation, Strategic Planning, Decision Support.

Using Simulations to Perform Data Analysis

The power of an OLAP system lies in its ability to analyze data – the A in OLAP. Both comparative and projective calculations can be performed in order to determine variances, ratios and trends. Also, time-series analysis, forecasting and what-if modeling functions can be used to help project into the future. Overall, OLAP systems are very powerful Business Intelligence (BI) tools that help analysts get a comprehensive overview of large and complex data. They are excellent tools for identifying and analyzing trouble spots in the operations landscape, and for determining their causes by inferring trends.

Traditional OLAP systems perform forecasting and what-if scenarios by extrapolating trends, adjusting numbers and by performing statistical calculations. Although this kind of analysis is useful, it fails to take into account the interactions and feedback mechanisms at work in any large and complex system. Also, often lacking from the analysis are data traditionally not stored in the data warehouse – data about the market (total market size, growth rate, demographic information, customer trends and preferences, etc.) and soft variables (e.g. customer and employee satisfaction, brand and product awareness, marketing effectiveness).

Enter business simulations: a dynamic simulation can capture the dynamic complexity of a company and its departments, divisions, customers and markets to provide powerful analysis and forecasting capabilities, including sophisticated what-if scenario planning that takes into account soft variables as well as the relationships and feedback mechanisms making up the system. For example, a dynamic simulation can take into account factors like market saturation, price elasticity, competitor reaction to pricing and market cannibalization when performing analysis. Even complex relationships like how employee satisfaction impacts customer satisfaction, which again affects sales, price sensitivity and the effect of marketing campaigns can easily be modeled.

Thus, while traditional OLAP systems are good at organizing, visualizing and analyzing historical data to find current trouble spots and their causes, business simulations excel at forecasting and what-if modeling, advising on future courses of action.

Business Intelligence Using Powersim Studio

Powersim Studio is a system dynamics tool specialized for building simulation models to improve business performance. The software is easy to use, has powerful reporting capabilities and can connect to a variety of external data sources, including SAP's Strategic Enterprise Management (SEM) solution. The software enables corporations to build and deploy business simulation models for training, analysis, decision support, scenario planning and knowledge management, among others.

Figure 1 shows the development, execution and maintenance cycle for a simulation model built as part of an OLAP solution. First, a simulation model is built from information gathered about the company and its operations. This step often includes interviews with subject matter experts, managers and executives within the company in order to build a valuable, accurate simulation model.

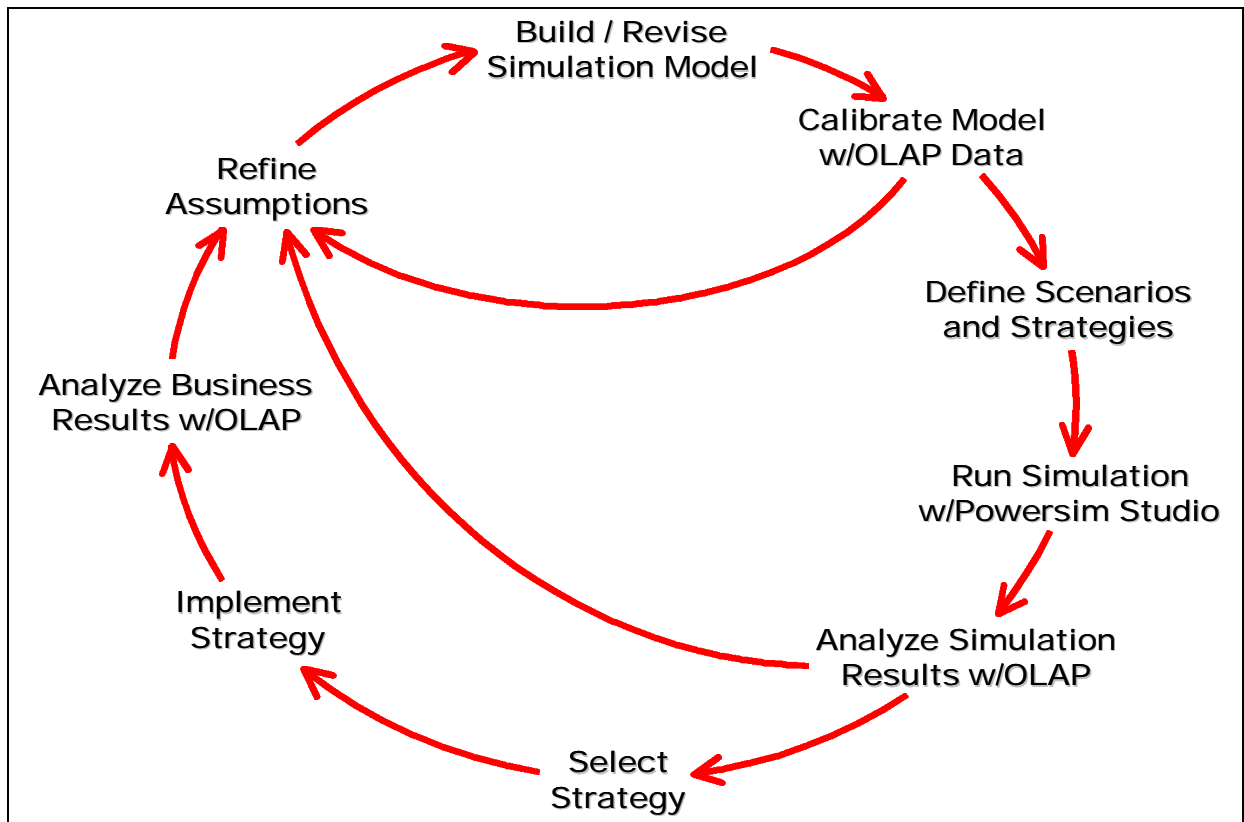


Figure 1: The business simulation development, execution and maintenance cycle

This detailed simulation model is then linked to the OLAP system. This OLAP system can either be an existing system within the company, or a separate hypercube built expressively for use with the simulation model.

Once the model is connected to the historic data in the OLAP cube, the model is calibrated to provide matching or near-matching results to the actual data. Another Powersim tool, Powersim Solver, can be used to aid in this process. If model calibration is not possible, the assumptions behind the simulation model are revisited and refined, and the business simulation updated, until the desired results are achieved.

After calibrating the simulation model, analysis can be performed. Different assumptions and decisions can be entered into the simulation model to test strategies and scenarios, to study the complex environment that is modeled, or to do financial forecasting. Using Powersim Solver, it is also possible to perform sensitivity and risk analysis, or to optimize the simulation model for a set of goals.

Once a satisfying set of decisions has been determined, often in combination with the use of other analysis tools, the strategy can be implemented by company management. For example, the simulation model can be used as an aid in determining next month's production numbers. These figures are then sent to the plant managers, who set the plant's operations in correspondence with these numbers.

Finally, the business results from the implemented strategy are gathered and evaluated using the OLAP system. It is also possible to compare the real life results with the simulated results from before the strategy was put into effect. If the actual results from operations differ from the

simulated results, the contributing factors and causes can be determined, and the simulation refined with renewed assumptions to provide more accurate results, if necessary. The same applies if the execution of the chosen strategy leads to new insights about the company and its business environment.

Optimizing Business Performance at Frank’s Foods: A Fictional Case Study

The following fictional case study explains in practical details how a business simulation tool can work together with an OLAP system to provide more powerful business analysis.

Frank’s Foods, a fictitious food and beverage company with three product lines (Ice Cream, Carbonated Beverages and Chocolate) and four sales regions (West Cost, Midwest, Central and East Coast) wants to forecast and track revenue growth over the next twelve months.

At the end of the year, the company examines it’s sales record for the last year, as well as the overall company performance, makes assumptions about the market in the year ahead, and combines this knowledge to create the official forecast for the next year. This forecast for the beverage division is shown in Figure 2.

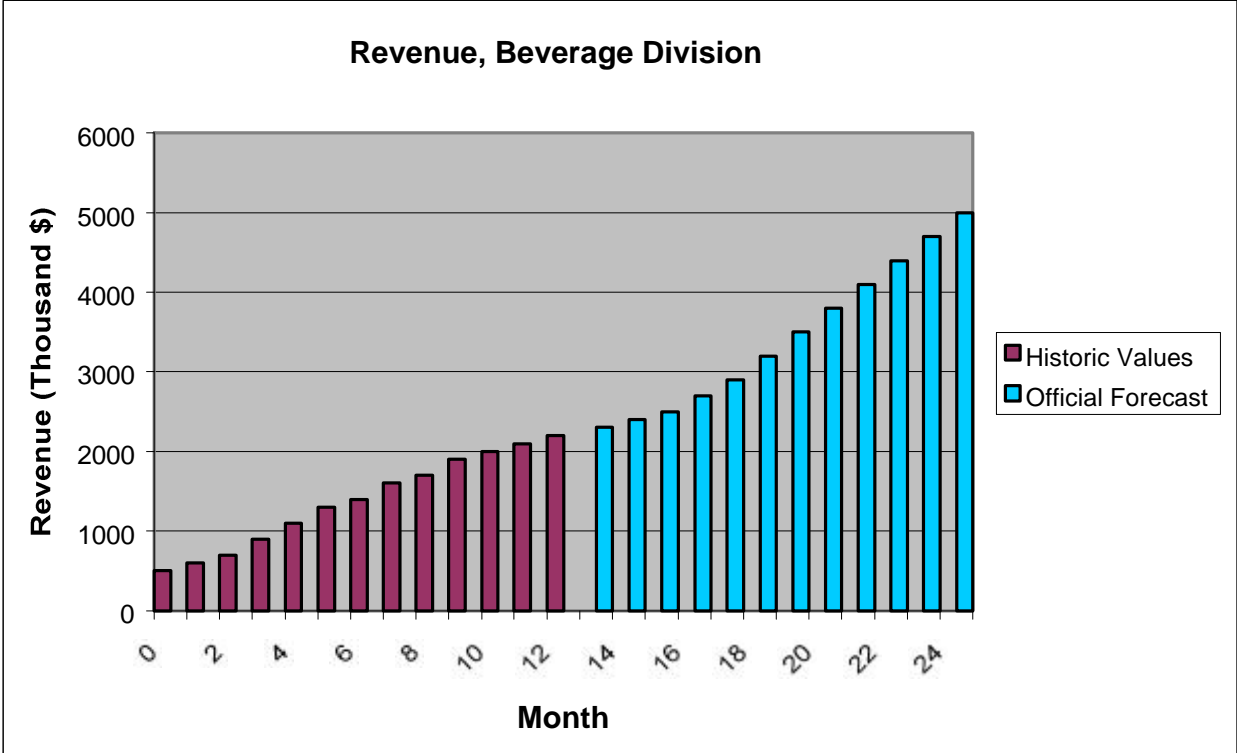


Figure 2: Last year’s revenue and next year’s revenue forecast for product group A.

Extending OLAP Functionality with a Business Simulation

In addition to creating a traditional forecast, the company can use its knowledge about itself and its products, customers and the market to create a dynamic simulation model using Powersim Studio. This dynamic simulation model can then be calibrated using Powersim Solver to fit last year’s sales data, stored in the data warehouse, and simulated to provide sales forecasts for the next year. By running the simulation model repeatedly with inputs that represent varying market

assumptions, a set of scenarios can be created that reflect how the business will perform given these market conditions. Figure 3 shows how two of these scenarios (High Growth and Low Growth) can be superimposed on the historic values and the official forecast.

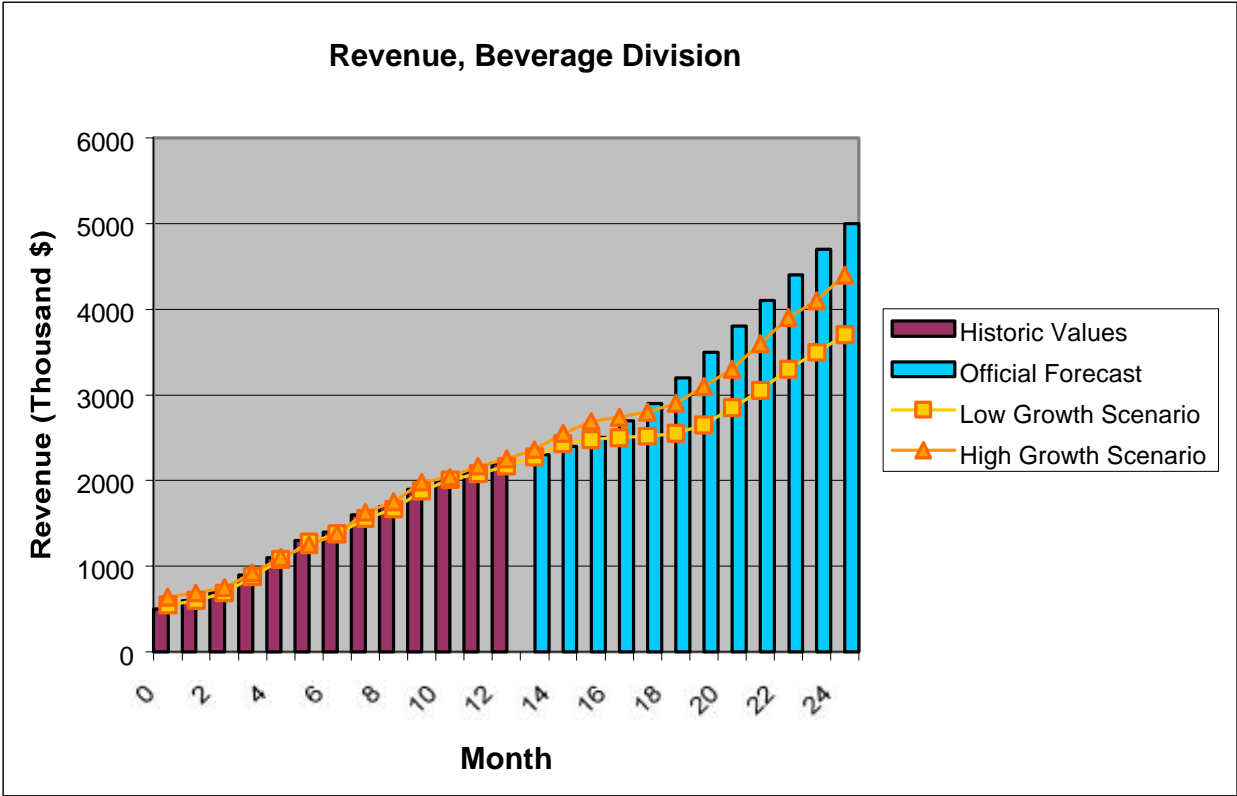


Figure 3: Simulated sales forecasts under varying market conditions (high growth and low growth).

As seen in Figure 3, both simulated scenarios forecast lower revenue than the official forecast. If the company has high confidence in the official forecast, i.e. the official forecast has historically been fairly accurate, the simulation model can be refined and extended until the official forecast is more closely met.

Alternatively, if the company has less confidence in the official numbers, the first year the simulation is used can be a test bed for how accurate the simulation model is. The simulated results can be compared with the actual results at the end of the year, and the model extended to improve accuracy, if necessary. Conversely, if the simulation model proves to be more accurate than the officially forecasted numbers, it can be taken into account when creating the official forecast in the future.

Analyzing Actual Results Using OLAP

Now let’s assume that five months have passed into the new year, and that the actual sales results look like those in Figure 4, below.

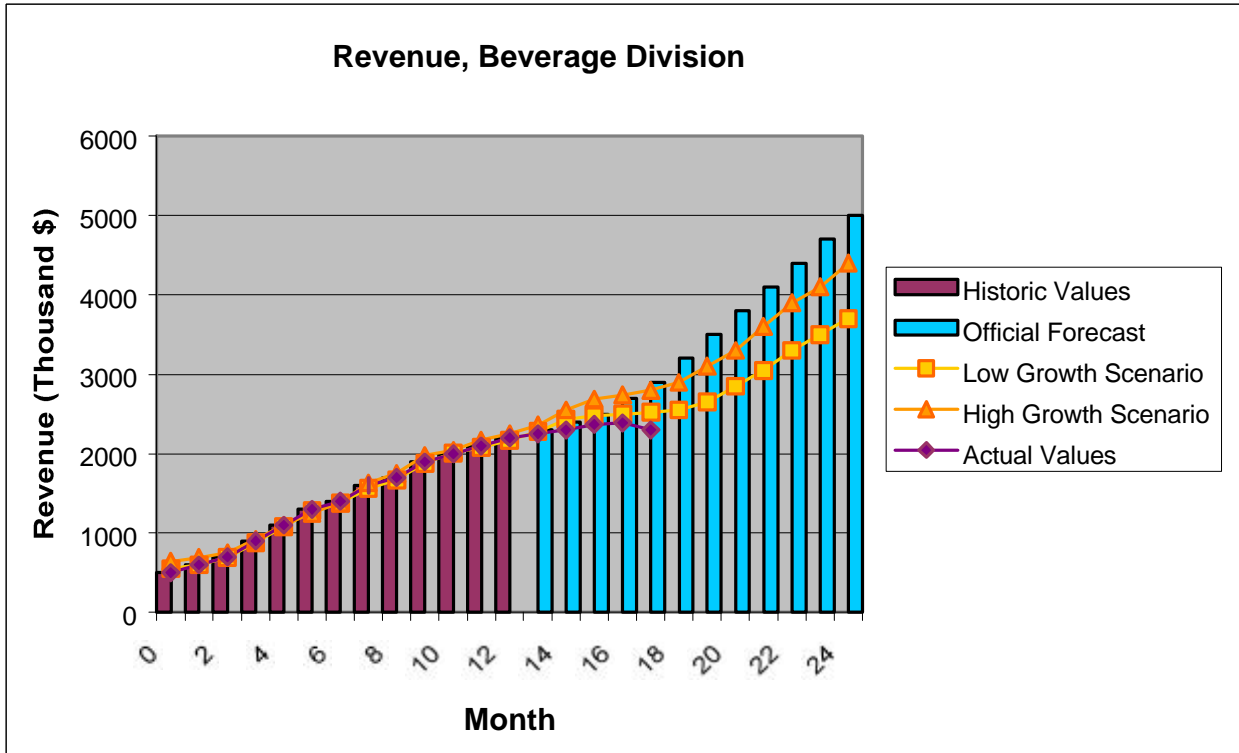


Figure 4: Actual sales results five months into the new year.

The results now indicate a shortfall in revenue, both compared to the simulated scenarios, but especially compared to the official forecast. A closer investigation is in order. Just like a traditional OLAP system, the user has the option to drill down into the chart and search for the region that is causing the shortfall (see [Figure 5](#)).

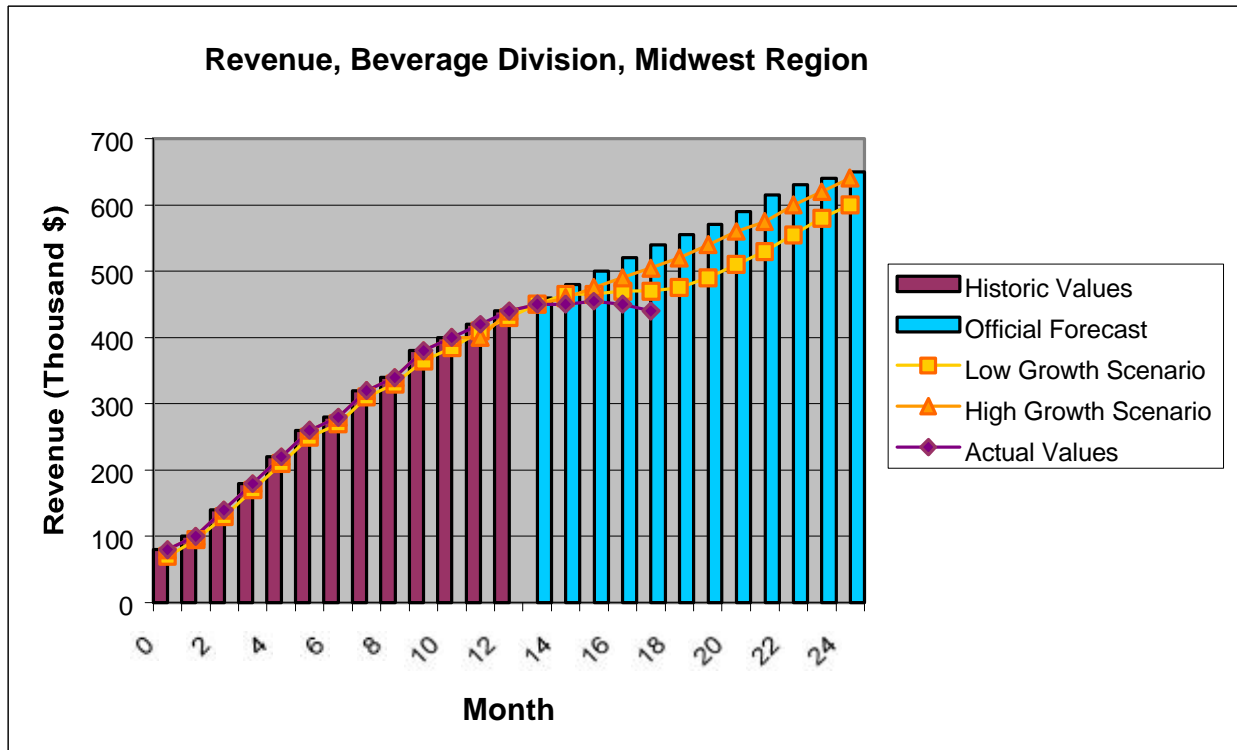


Figure 5: A drill-down into the Midwest region reveals the origin of the revenue shortfall.

As Figure 5 shows, the Midwest sales region is experiencing a significant shortfall in the sale of beverages. The question is: why?

Once the problem area has been found, the company can start looking for causes. Maybe the demand for Frank's beverages was overestimated. There might be delivery problems caused by a delay in production. Customer service in the Midwest region might not be up to par, or another company might have launched a competing product, leading to lower product sales. This is where the OLAP systems come in. Traditional OLAP systems are excellent tools to help understand the reasons behind the numbers.

Analyzing Solutions Using Powersim Studio

When the causes have been identified, the company can start looking for solutions. If the company has overestimated demand, strategies might include launching an advertisement campaign, lowering prices, promoting a different product, or modifying the product line. If the problem is internal, such as a delivery problem caused by an ineffective supply chain, a good option might be to invest in the supply chain, change manufacturer or launch a promotional campaign to repair customer loyalty.

This is where the real power of Powersim Studio's dynamic simulation models comes into play. Assuming that the affected subsystems (finance and pricing, marketing, supply chain, and/or production) are included in the simulation model, the user can test out various strategies by entering decisions into the simulation model. And if the desired subsystems are not yet included in the simulation model, the simulation can be extended by adding new subsystems to the model. Simulation models created with Powersim Studio are very flexible, and the model can easily be refined as needed as new details about the business and the market emerge.

After the model has been reviewed and refined as necessary, the simulation is recalibrated to match the new reality, as shown in [Figure 6](#). At this point, the company might also conclude that the low growth scenario more closely represents the current market conditions, and use this scenario for strategy testing.

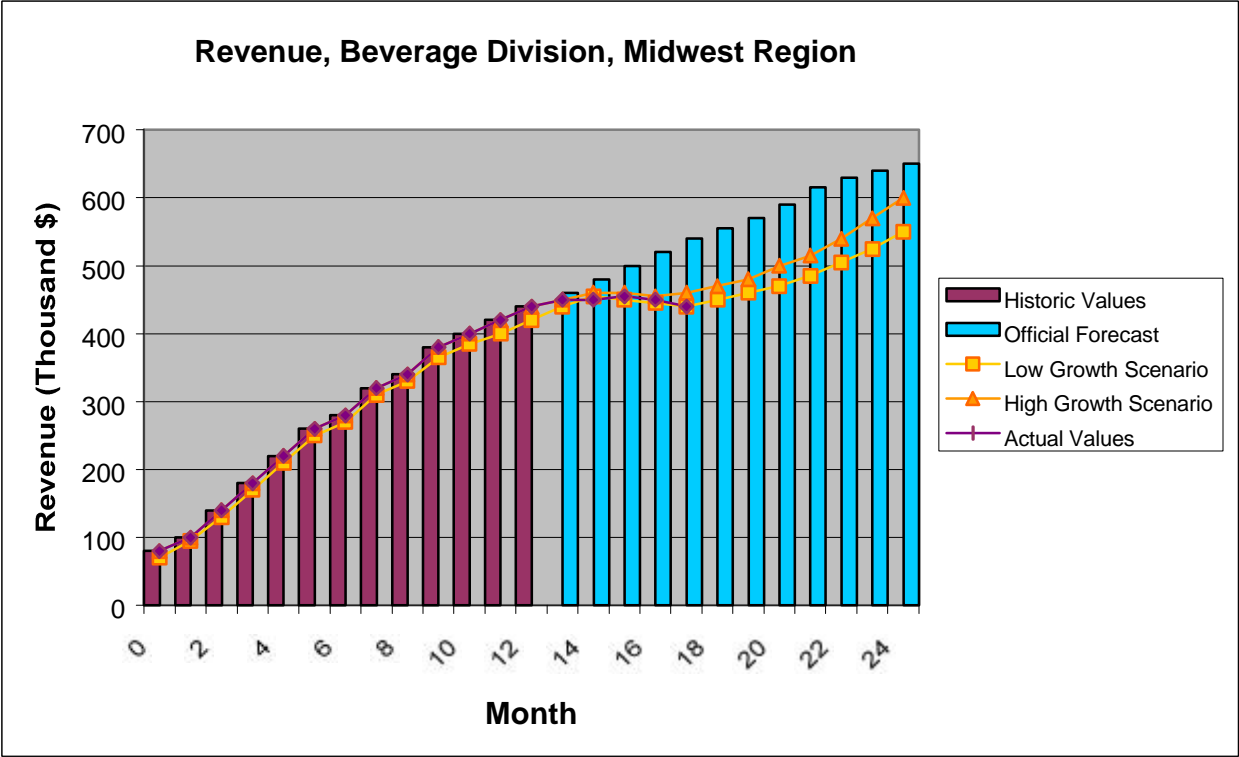


Figure 6: Recalibrating the simulation model to match the new actual results.

The company now has the option to test out different strategies to improve the lagging sales figures. [Figure 7](#) shows the results of three possible strategies, each representing a different set of decisions entered into the simulation model, using the market conditions set by the lower growth scenario.

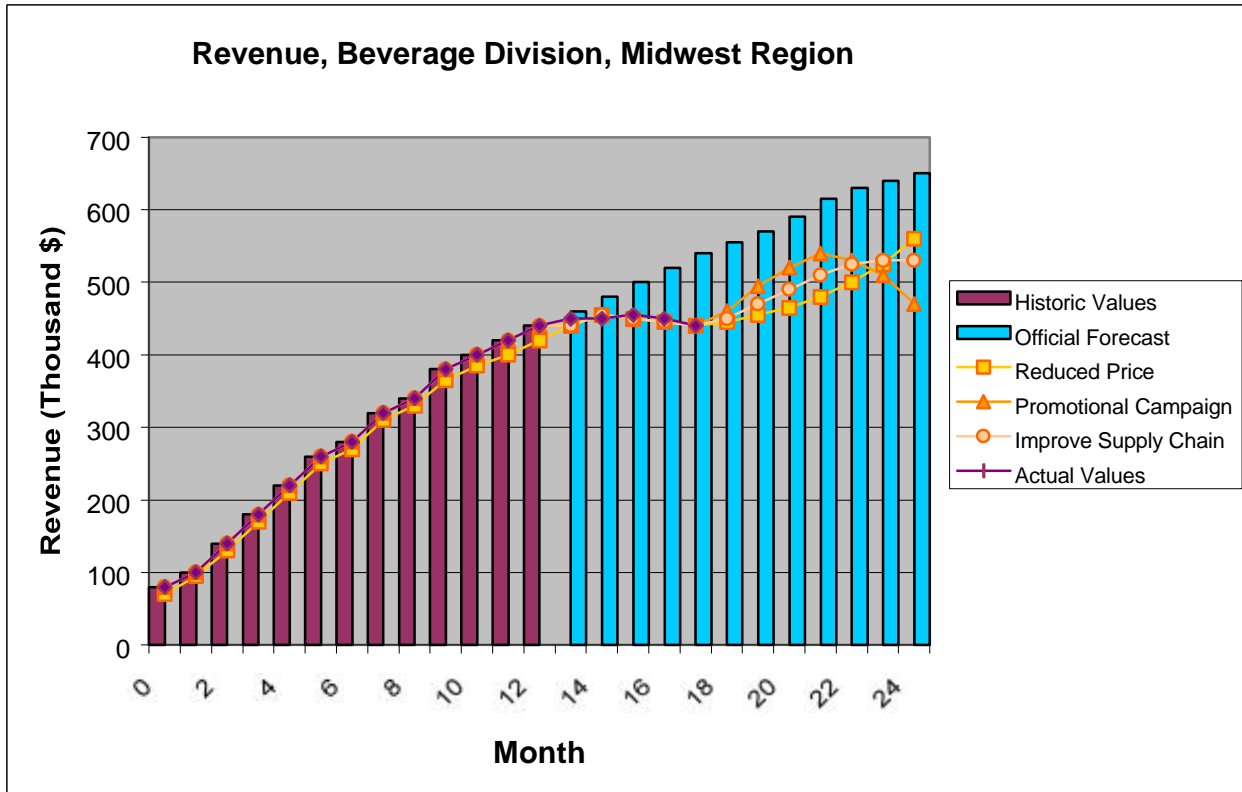


Figure 7: Testing out various business strategies to respond to a revenue shortfall.

As seen in [Figure 7](#), the first strategy looks like the best strategy for the company. However, the decisions that make up a strategy do not necessarily only have local impact. For example, a price break in the Midwest might affect sales in the Central region. Or an investment in the supply chain might benefit all sales regions. To get the full picture, it is therefore necessary to drill back up to the product level. [Figure 8](#) illustrates this. According to [Figure 8](#), the third strategy gives the best results, and not the first, as indicated at the regional level, in [Figure 7](#).

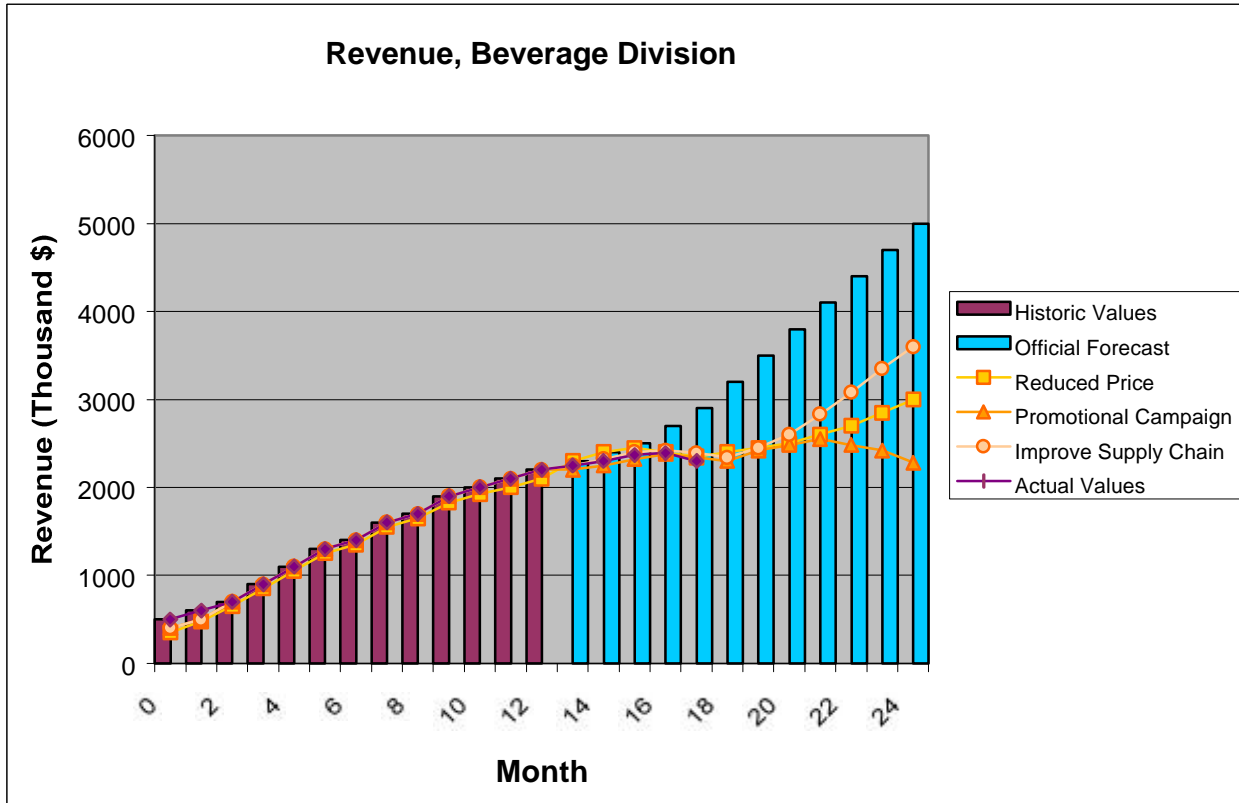


Figure 8: Strategy results at the product group level

None of the tested strategies succeed in reaching the officially forecasted revenue numbers. The company may choose to test additional strategies, or opt to adjust the official forecast.

Managing Risk With Powersim Solver

Given that a set of strategies may play out differently given varying assumptions about the market, it may be useful to perform some sort of sensitivity or risk/benefit analysis on the chosen strategies under varying market conditions.

Using sensitivity analysis, it is possible to determine the significance or range of impact of individual decisions on results, as opposed to the total impact of a given strategy, which typically includes many variables.

Similarly, risk analysis can be used to evaluate how sensitive a strategy is to changes in the underlying assumptions. Different strategies might have different sensitivity to changes in market conditions. For example, some strategies might be very robust in the face of an uncertain future, while other strategies fall apart when the underlying assumptions fail.

Both types of analysis can be performed using Powersim Solver. It is thus possible to build an even more powerful analytical solution by using the full range of capabilities that a statistical tool like Powersim Solver has to offer.

Conclusion

Both OLAP systems and business simulations are powerful tools on their own. Both fulfill a specific purpose: OLAP systems analyze the past; business simulations evaluate the future.

By integrating business simulations with an OLAP system, and by harnessing the full power of Powersim's Studio and Solver products, it is possible to build a very powerful analytical solution with excellent forecasting and scenario planning capabilities far exceeding those of traditional business intelligence products.