Racing for Success

What every business student needs to know about analytics

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End-to-End Analytics
Supply chain analytics company offers clients analysis, visualization, interaction and insight.

End-to-End Analytics is a supply chain analytics company based in Palo Alto, Calif. The firm was founded in 2005 on the premise that most organizations struggle to take full advantage of the opportunities presented by the exponential growth of data and its accessibility. End-to-End helps its clients make better data-driven decisions, generating significant value in the process.

End-to-End teams strive in every engagement to enable their clients to interact with the data and models so they can draw their own insights. Consequently, visualization of data and model results plays an important role in every project. Done well, this lets users focus on the “why” as much as the final result. The firm considers a project a real success if the client organization embraces the new analytical capabilities and further evolves them going forward.

Company History and Philosophy
The original End-to-End team comprised graduates of Stanford’s Management Science and Engineering program who had founded a software company focused on supply chain risk management and a core group of “alumni” from HP’s internal supply chain consulting team.

This dual heritage has been a source of considerable strength. For example, the HP team had pioneered many of the techniques of modern supply chain management, including postponement and multi-echelon inventory optimization. Now End-to-End applies these powerful methods across industries far from their origin in the technology sector. Of equal importance, the firm’s intimate knowledge of the software landscape puts it in a unique position to recommend the right kind of software solution to the client’s business problem — if indeed software is needed at all.

The firm has grown to a team of 20 professionals through careful hiring, with advanced degrees from leading universities the norm. The firm’s principals have been published in journals such as *Harvard Business Review*, *Sloan Management Review*, *SLAM Journal on Optimization* and INFORMS’ own *Interfaces*. Others hold patents relating to pricing and supply chain topics. Still others have taught operations research and industrial engineering at Stanford, Berkeley, Michigan and Santa Clara.

The firm’s work spans strategic and operational projects. Common strategic projects include supply chain network optimization, product portfolio rationalization and design for supply chain. Operational projects often revolve around forecasting, inventory management, and price and promotion optimization.

The operational projects generally have process and system components, and End-to-End has found that many clients seek a middle ground between seven-figure enterprise software projects and ad-hoc spreadsheets. In response to this demand, the firm often creates “lightweight” but robust and scalable solutions using Visual Basic, MatLab or R. Clients appreciate how these customized solutions are highly flexible and tailored to their needs, yet still capable of handling the full scope of their business.

End-to-End is especially proud of its impressive client list. Clients include one or more of the top three global firms in industries as diverse as automobiles, networking, cosmetics, semiconductors, food & beverage, consumer packaged goods, domestic appliances and Internet search.

Examples of Work
“Forecasting Reality Check”: Many firms have a bottom-up forecasting process in which individual salespeople or marketers pull together the numbers. Howev-
er, some of these forecasts are likely to be improbable, whether because of misaligned incentives, data entry errors or simple over-optimism. Even if all the forecasts are plausible at item level, the aggregate forecast at product category level might prove unrealistic.

Thousands or tens of thousands of item-level forecasts make manual review unfeasible. Forecasters need an automated way to find and rank for review potentially unrealistic forecasts. To meet this need, End-to-End has deployed an automated “Forecast Reality Check” system with several clients. For each item the system calculates the probability of the forecast being realized, given historical demand patterns. Then it lists the most “suspicious” forecasts in descending order of financial exposure.

A single click takes the users to a screen that visually shows the forecast in question, superimposing historical actuals and a statistically generated range forecast.

Clients using this system have routinely enjoyed an immediate 5 percent to 10 percent reduction in overall forecast error simply by detecting and correcting the most problematic forecasts before they have time to propagate through the supply chain.

**Pricing:** Pricing is another problem-rich area where quantitative analysis provides powerful insight. Price-related issues include price setting, price execution and price optimization. End-to-End has addressed these problems across a spectrum of industries – Consumer packaged goods (CPG) to process manufacturing to high-tech to oil & gas – representing both business-to-business and business-to-consumer environments.

For example, End-to-End broke new ground tackling challenging B2B pricing for a leading network equipment provider. The project team developed complex segmentation logic leveraging eleven different variables as a result of our quantitative analysis. Better price setting for the identified segments resulted in significantly improved margin realization.

In another engagement with a major chemical company, double-digit improvements in return on sales through segment-driven pricing of their new and old contracts were identified. In CPG, End-to-End used advanced analytics on pricing and promotions to effectively predict volume variations week-over-week and correctly plan for 10-times swings in weekly demand and production.

**Supply chain planning:** Some of the most successful engagements for End-to-End have focused on supply chain planning. These have led to ongoing multi-year relationships in the automotive, cosmetics and consumer packaged goods industries.

End-to-End has a long-standing relationship with one of the largest global automotive OEMs. Jointly developed process improvements span from long-range volume planning to stability of weekly part schedules for suppliers, distribution of vehicles to dealers and the best inventory strategies for accessory wheels. Many of the projects involve forecasting and capacity-planning challenges for future vehicle programs, with shared capacity and frequent demand changes driven by fuel cost, regulatory changes and technology evolution.

In the complex consumer packaged goods and cosmetics industries, End-to-End developed performance metrics and created tools to continually improve performance across the value chain – from procurement to distribution. Projects focused on tuning enterprise resource planning parameters that govern when and how much is procured, produced and distributed. Replacing the rules of thumb frequently used to populate planning parameters during initial implementation with analytical ones that trade off multiple costs and objectives of the corporation resulted in less inventory, more schedule stability and lower overhead. Savings register in the millions of dollars per year.

**Combinatorial Land Auction:** The varied nature of End-to-End’s work is well illustrated by a recent project to develop the analytics behind a major land auction in South America. The client had acquired and irrigated...
almost 100,000 acres of agricultural land and sought to sell it by auction. The client recognized, however, that the value bidders placed on a given lot depended on which other lots they were awarded. (For example, land is more efficiently farmed if arranged in a contiguous block.) In the absence of a mechanism to express these dependencies, bidders will tend to lower their bids.

Such situations are well-suited to combinatorial auctions in which buyers submit bids on groups of lots. Perhaps the best-known examples are the auctions used by the FCC to sell radio spectrum. Accordingly, the client designed a sophisticated combinatorial auction structure in which bidders could use flexible bid types such as “We bid $X per acre for any three of the following six lots.”

The client soon realized that in an auction structured this way it is not obvious which bidder has won each lot. In fact, the only way to determine the winner of each lot is to find the set of bids that maximizes revenue while observing the relevant constraints. This is known as the Winner Selection Problem (WSP).

End-to-End was able to formulate the WSP as a large-scale mixed integer program and developed an efficient solution algorithm using optimization techniques such as cutting planes and implicit enumeration. Just as important, however, were the firm’s contributions to the auction process itself. End-to-End consulted on the design of the auction and developed electronic bid forms that helped guide bidders through the auction process. End-to-End also created tie-break functionality to handle multiple solutions and developed compelling visualizations of the auction results.

The outcome was a successful auction that is estimated to have increased revenues by tens of millions of dollars relative to what might have been expected in a traditional auction.

Future

The adoption and application of analytics has been accelerated both by technological improvements and a broader acceptance of advanced analytics by the business community. More often than not, the limiting factor is access to resources with the right combination of analytical strength, technical competence and business acumen. End-to-End aims to deliver this combination of skill sets with each of its consultants and is enjoying considerable growth. If you possess this combination of skills, this may be the perfect place to further develop and expand your particular practice.