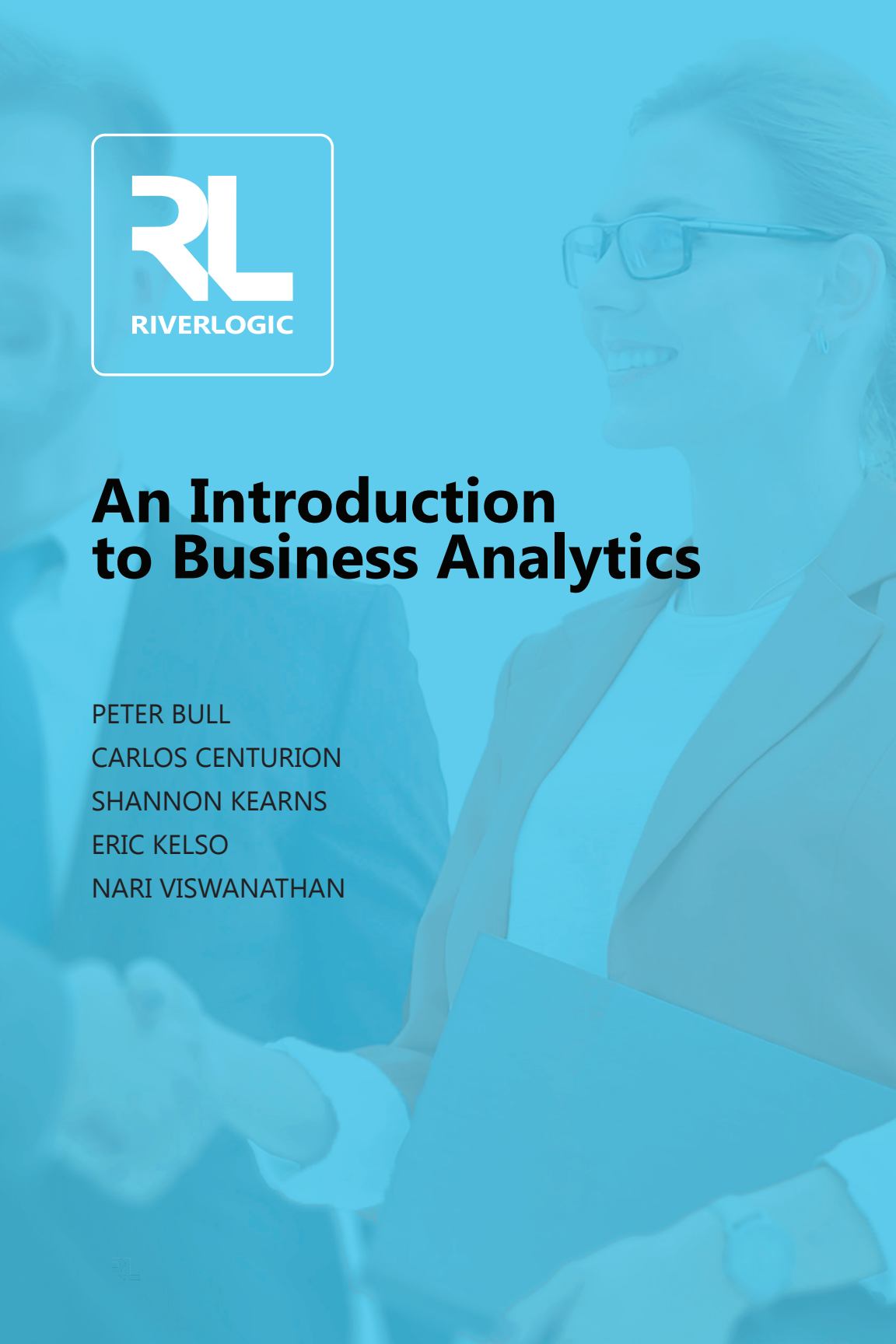

RIVERLOGIC

An Introduction to Business Analytics

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THE BUSINESS ANALYTICS MARKET

The analytics market is traditionally divided into three types of analytics:

- Business Intelligence
  - Description: What happened?
  - Diagnostic: Why did it happen?
- Predictive: What will happen?
- Prescriptive: What should I do?

Recently, the research firm Gartner added a fourth form of advanced analytics to the spectrum: cognitive and artificial intelligence, defined as insights and recommendations based on self-learning or natural language processing capabilities.

A plethora of content exists that defines BI, predictive, and prescriptive analytics. This book is not meant to regurgitate existing content. Rather, it's meant to help business leaders understand how they can apply prescriptive analytics as a form of decision support for enabling them to answer their most pressing problems.

Instead of using the highly technical definitions that already exist in the marketspace, we're going to talk about the kinds of questions and decisions that are supported by each form of analytics by walking you through a real-life example

BUSINESS ANALYTICS THROUGH THE **EYES OF A BUSINESS LEADER**

Let's assume we have Barry, a business analyst who works within the Marketing function of a consumer packaged goods (CPG) company that manufactures several hundred products. Barry is in charge of all business analytics activities. He's tasked with compiling dashboards and grabbing data that answers his boss's, Vice President (VP) Mary, most pressing questions.

BUSINESS INTELLIGENCE

Several years ago, VP Mary was struggling with reviewing her budget, so she asked Barry how she could guarantee she adhered to her budget. Barry decided the best option was to create a report for Mary that updates, in real time, what is being spent on promotions, paid advertising, trade shows, and any additional spend categories. He used Tableau to compile a series of dashboards that provided VP Mary ad-hoc insights into her spend and sent her notifications when she was nearing her pre-defined monthly budget limits in each category. Barry's Tableau dashboard is an example of descriptive analytics — it's a collection of historical events that are compiled into easy-to-digest dashboards, often reflecting events as they occur.

Because Barry is an exceptional Marketing Analyst, he also grouped Mary's spend in simple categories that allowed Mary to drill down to specifics, so she could identify exactly where she went over budget from within her dashboards. He also created charts and visuals that correlated Mary's real-time spend data with historical data and spend targets, allowing Mary to understand how she's doing compared to her past performance. Enabling these drill-downs and correlations is the diagnostic piece of BI. It involves grouping data appropriately in order to understand why something happened (i.e., identifying deviations from the target or identifying certain outliers).

PREDICTIVE ANALYTICS

Thanks to Barry's dashboards, Mary was finally able to stick to her predefined budgets. She was able to pinpoint which campaigns, lead personas, and channel initiatives had driven the most revenue for her company. However, she quickly realized that having these insights wasn't enough to streamline her marketing efforts. Sales remained irritated at receiving only "lukewarm" leads, some of her campaigns that she thought would be successful weren't resonating, and her Client Success Managers were frustrated with seemingly unpredictable customer churn.

When she brought this problem to Barry, he knew exactly what to do. "Simply describing our data isn't enough anymore — we need a form of analytics that will help us predict the likelihood of all these things like customer churn, deal close, etc. occurring," he said.

Over the next several months, Barry began compiling relevant marketing and sales data. This included information about deal closes and losses, social media, website engagement, detailed customer behaviors, brand engagement, and campaign information. He then used a variety of statistical modeling approaches to include regression analysis, forecasting, multivariate statistics, pattern matching, predictive modeling, and forecasting to correlate the data and predict the likelihood of outcomes that he and Mary knew had a significant impact on their Marketing performance.

Mary was thrilled with the outcome of Barry's work. She could now understand how likely her Marketing leads were to turn into customers (this satisfied the Sales team). She was able to segment the data by detailed persona characteristics, engagement metrics, campaigns and more in order to better target different market segments. She could also now predict the likelihood of customer churn, so her Client Success team could step in before churn occurred. Lastly, she was able to improve her messaging by understanding how likely a message was to resonate with her audience segments across websites, social channels, and emails. Over the next year, the company's average profit margin per customer and customer lifetime value both doubled — all thanks to Barry's predictive modeling.

PRESCRIPTIVE ANALYTICS

Despite the fact that Mary saw drastic improvements in her metrics since she began leveraging predictive insights, she still noticed gaps in her Marketing Plan (as did her boss — CEO Sara — and many of her higher-level colleagues). All this was impacting her promotion in the company.

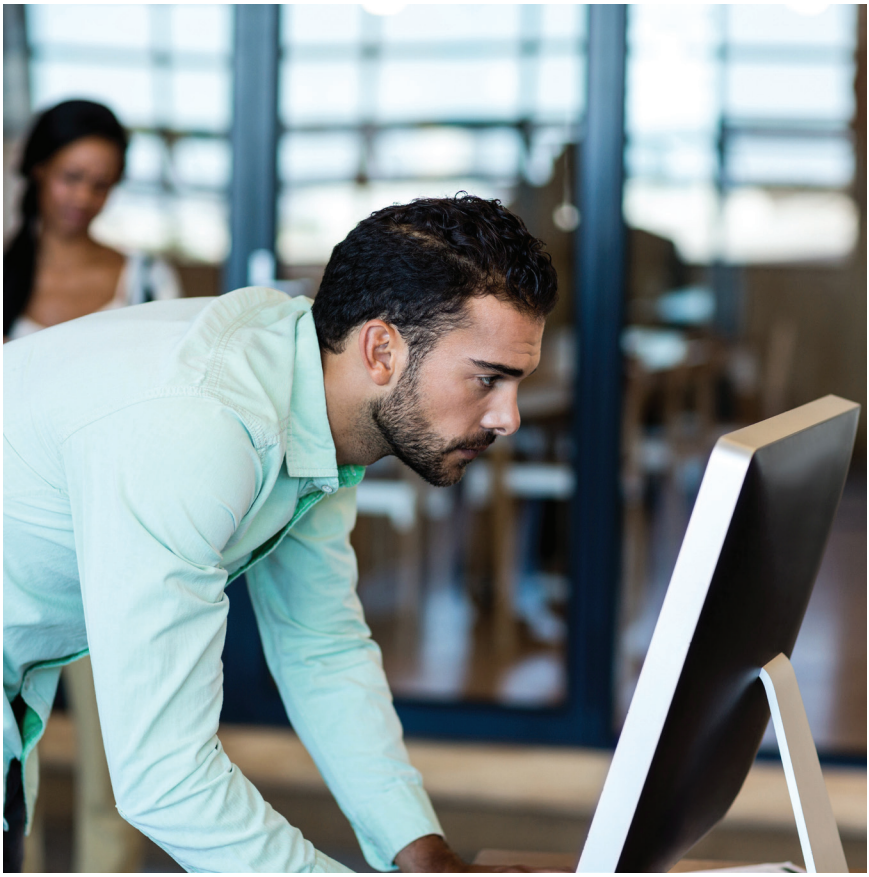
Mary continued to struggle with unanswered questions. Not only were they unanswered, but they seemed to be the most important questions she needed to address to drive the most impact organization wide and get the promotion she wanted. She wondered:

- "I know Google Adwords drives the most revenue, but I want to understand how much I should put toward all my forms of paid advertising across my different audience segments. How do I know where to put my advertising dollars in order to drive the most profit, and how much should I allocate to each channel and segment?"
- "I run a lot of product campaigns, but I don't know the exact dollar amount to put toward the product campaigns, especially when our business has so many constraints around product promotions already. Which product should I promote, when, and how much should I spend so I can optimize our overall profit?"
- "I'm getting pressure from my CEO to promote to new audiences. I have data around the messages that resonate and the channels they like, but I have no idea how much money I should put into each marketing channel so that I minimize cost while still maximizing income."
- "We do about 30 trade shows a year across different geographies, and every year I waste a large amount of money. How can I best allocate my tradeshow funds and understand how much I should spend in the first place to achieve the lowest customer acquisition cost?"

Once again, Mary approached Barry with her problems and, again, Barry found a solution.

"Want to know what all these questions have in common, Mary? They all ask 'what should I do'? And see, predictive analytics can tell you about likelihoods and probabilities, but it can't tell you where to allocate your marketing dollars, and it certainly can't tell you exactly how much to put and where to put it. What you need is prescriptive analytics."

Barry started working on developing a prescriptive model that represented Mary's end-to-end marketing business. Of course, he first had to find new software — his BI/predictive tool certainly wouldn't do the trick.



While we'll get into the "how" of prescriptive analytics later on, essentially what Barry did was create a model that describes how their CPG business works — he considered account business rules, business processes, objectives, constraints, preferences, policies, best practices, boundaries, revenue, and costs. He then used that model to provide his prescriptive system (the math piece) with the business intelligence to analyze their data and suggest the optimal way forward.

With a nice User Interface (UI) on top, Mary was able to ask her questions (what-if scenarios — we'll get into those later as well) and understand the financial impact of very specific decisions on her predetermined objectives. Finally, she had a trusted companion that guided her business decision-making process and gave her the best plan forward. She had actionable insights!

Mary used her prescriptive dashboards for everything:

- She created monthly plans that allowed her to see the expected Return on Investment (ROI) she'd get; and she was able to track her progress against those plans.
- She was able to understand which target markets and campaigns she should invest in. She even threw out ones she'd previously thought were the most profitable.
- She used it to run scenarios in order to prepare for sudden market shifts so she could plan, on the fly, the best way to react.
- She used them for more long-term, strategic planning around what new market/audience segments they might penetrate, how their budget was expected to grow, and what new products they might look into manufacturing and selling.

Prescriptive analytics turned Mary into a strategic business partner, and she finally got that promotion to Chief Marketing Officer she'd always wanted. Mary saw transformational value across the business, such as:

- A 15X ROI on her marketing initiatives
- Increased trust in her marketing plans, helping win the confidence of Sales, Finance, and Operations
- Increased ability to quickly respond to market shifts in optimal ways
- 4% of the company's annual Marketing-related revenue in additional profit

And, of course, Barry got a huge promotion!

SUMMARY

In this section, we defined the three main types of business analytics: BI, predictive analytics, and prescriptive analytics.

BUSINESS INTELLIGENCE

- Nearly 100% of businesses today use some form of BI. Several of the most common applications are:
- Compiling customer or seller profiles
- Assessing the success of product promotion campaigns
- Conducting performance reviews based on pre-defined metrics

PREDICTIVE ANALYTICS

The market penetration for predictive analytics is around 20%, and this number will continue to grow rapidly over the next several years. Common applications of predictive analytics are:

- Assessing the likelihood of customer churn based on levels of engagment and other relevant factors
- Feeding targeted product promotions to website visitors based on previous website activity
- Determining if a lead is sales-ready based on certain characteristics and engagements (i.e., lead scoring)

PRESCRIPTIVE ANALYTICS

Currently, at 5% market penetration, prescriptive analytics is expected to grow to 35% penetration by 2020. Section VII offers a deep-dive into common applications of prescriptive analytics, but here are a few more examples.

- Optimizing product mix or machine/resource allocation
- Optimizing bed capacity and overtimes shifts in a hospital
- Risk mitigation for future scenarios

While Mary's example may have given you an idea of what prescriptive analytics is, we're going to dive deeper into the category by looking at its progression over the last century.

"COMPANIES LIKE PEPSICO ARE ALL WORKING ON MOVING FROM THE TRADITIONAL DESCRIPTIVE AND DIAGNOSTIC ANALYTIC CAPABILITIES TO PRESCRIPTIVE ANALYTICS. ADOPTING PRESCRIPTIVE IS CRITICAL FOR SUPPLY CHAINS TO GAIN A COMPETITIVE ADVANTAGE NOW AND IN THE FUTURE."

LESLIE KEATING
FORMER SVP SUPPLY CHAIN, FRITO-LAY

DEFINING
PRESCRIPTIVE ANALYTICS

CONFUSION IN THE MARKETSPACE

To understand the progression of the prescriptive analytics category, let's revisit Mary and Barry's story. When Mary brought her problems to Barry, she had no idea Barry could solve them — she'd never heard of anything like prescriptive analytics! Further, while Barry knew it, he hadn't seen any consistency in the marketspace on a clear way to apply it in an actual business sense. In fact, one colleague of Barry's in the IT department told him it would be impossible for him to solve Mary's problems in the best way possible without adding a full-time programmer — what he called an "Operations Research Ph.D."

This problem of misinformation and lack of awareness isn't isolated to Mary and Barry. It's a problem that exists globally across almost every industry. To help dispel some of the false information and appropriately educate people within a business unit on prescriptive, let's walk through the history of prescriptive analytics.

If you search Google trends today, you'll see that interest in the topic "prescriptive analytics" has grown significantly since Google began collecting this data in 2004. The real boom began in 2013, and we've seen rapid growth in interest since then. It's worth noting that there is no sign of the trend curve flattening out, as it continues to grow each year.

Advanced optimization models combine the value chain (including key constraints) with financials, providing higher quality information than what's possible with single predictive or BI models. This also ensures internal data consistency and identifies infeasible outcomes. These models support unique analyses, such as contribution margin, activity-based costing, and Pro-forma financial statements to help users make the best possible business decisions.

Optimization is typically used to solve complex problems that involve numerous (20+) constraints, objectives, and trade-offs. Applying prescriptive analytics through optimization enables users to wade through all these factors and find the path that meets the most objectives given the defined business.

The "math" used in optimization is complex. The most important thing to note is that it uses mathematical algorithms that maximize or minimize one or more objective functions while still respecting business realities, thus always producing feasible plans.

HEURISTICS-BASED DECISION AUTOMATION

Rules-based decision automation is different. It means that when something happens, the system will decide what to do on the fly, given a set of predefined rules that have been plugged in. Mind you, these rules are typically determined by humans using gut feel and "best practices," not by using math.

Unlike optimization, this approach cannot provide an answer outside of what has been predetermined. Further, the "math" is very different from the math used in optimization. It typically uses a form of statistics and applies algorithms to find the answer.

The most important takeaway from this section is that different methods of applying prescriptive analytics exist, and — while it's not crucial for business leaders to dive deep into the "math" — they do need to understand the value that each approach can bring to an organization.

Earlier, we mentioned the kind of transformational value VP Mary saw from applying prescriptive analytics to help support her decision-making process. This is arguably the most important thing to know about prescriptive analytics: It truly transforms the impact one or more business units have on the entire company.

THE TRANSFORMATIONAL VALUE OF **PRESCRIPTIVE & WHY BUSINESS LEADERS SHOULD CARE**

Prescriptive analytics has been around for a long time. However, it's typically been used to solve highly complex, niche problems like scheduling, routing, and staffing — activities that are highly complex where the problem definition is stable, and have historically involved Data Scientists rather than people within a business unit. Now, however, we're seeing the application of prescriptive analytics move out of the hands of Information Technology (IT) or Data Scientists and into business units. This shift has shown that prescriptive analytics is most beneficial to the organization when it's understood and accessible to business leaders.

PRESCRIPTIVE ANALYTICS BELONGS IN THE HANDS OF BUSINESS LEADERS

Four key factors have caused a shift from using optimization to solve operational problems to using it to solve more strategic, cross-functional problems that business executives regard as important to their success.

1. We not only have more data, but it's better and more diverse data.
2. Prescriptive analytics technology is becoming significantly less black box, allowing business users to draw insights without the dependence on Data Scientists or Operations Research experts within IT Departments.
3. Business leaders understand the most pressing problems they need to address.
4. More and more organizations are doing it, so it's no longer a "nice to have," rather, it's a must have.

THE TRANSFORMATIONAL VALUE OF PRESCRIPTIVE ANALYTICS IN BUSINESS

Though it may be hard to believe, our VP Mary's story is a real example of the transformational value of prescriptive analytics, and the benefits she saw have been replicated across dozens of industries and hundreds of use cases. The typical value realized from prescriptive analytics is 10-20X ROI. While the exact ROI depends on the specific approach to prescriptive analytics and the type of problem addressed, it's clear that prescriptive analytics offers the most significant improvement of any of the other forms of analytics...by far!

Further, the impact can become transformational when applied end-to-end across business functions, especially when it affects the core business metrics such as operating income or return on invested capital (ROIC). Let's look closer at the value business leaders have seen from prescriptive analytics.

ACHIEVE HIGHER CONFIDENCE IN PLANS PLUS LOWER RISK

The foundation of a solid, effective plan is having confidence in it. Optimization-based plans are, by definition, feasible. Plans based on heuristics may or may not be feasible, depending on how simple the problem is and how well the rules are set up.

With optimization based decision making, because the operational and financial flow of the business is appropriately represented, there is a higher likelihood that the results can be achieved than if the company was using rules or Excel-driven hypotheses. This includes both the ability to deliver a plan and the understanding of required actions to implement the plan. Further, it provides an understanding of the operational and financial impacts of analyzed decisions on overall objectives. A manager that produces a plan with high confidence gains respect and the ability to affect further change in the business.

IMPROVE PERFORMANCE

Prescriptive analytics uncover unique insights that can lead to better financial and operational performance, especially when deployed across functions that were previously supported through tools relying on user intuition (i.e., Excel, BI). Different types of impact include:

- Improving the effectiveness of the business against one or more objectives (i.e., operating income, net income) — for example, in the application of integrated planning across demand, supply, and finance. Typical impact can range from 2-5% of revenue in additional profit.
- Increasing the efficiency of an operation (i.e., do more with same resources, achieve the current outcome with fewer resources) — for example by improving the use and allocation of personnel and resources to best meet a set of tasks. Typical impact includes 15-20% higher throughput or 10-15% reduction in addressable cost.
- Maximizing the return from altering the design of a system, subject to a defined maximum risk — for example optimizing the allocation of investments. Typical impact ranges from 25-100% better NPV than Excel or heuristics-based solutions.

ESTABLISH HIGHER AGILITY IN THE ORGANIZATION

Difficult decisions take weeks or months to make, often taking up a lot of personnel time and occasionally the use of external consultants. Routine decisions that are made weekly often don't get the same level of scrutiny or scenario analysis, as there is not enough time to manipulate and analyze so much data. Prescriptive analytics increases the organizational knowledge of how different functions impact one another and recommends a path forward, thus increasing the ability to evaluate more scenarios and delivering a faster approach to making trade-decisions.

MITIGATE RISK

Risks are often quantified in either operational or financial term, but usually not in a way that truly mirrors how the business operates.

Prescriptive analytics helps identify and better quantify the risk associated with both short and long-term decision-making and develop potential risk mitigation strategies.

EARN A HIGHER RETURN ON EXISTING ASSETS

Prescriptive analytics enable businesses to showcase how to leverage their prior investments in tools like Electronic Resource Planning (ERP) software that helps provide companies with clean, fresh data. Leaders can utilize that data for actionable insights while also guiding them on where they might be missing quality data. Lastly, because prescriptive provides the best path forward, employees can have a true impact on overarching business objectives and quickly progress their status within a company. Employees are thus motivated to continue using prescriptive analytics solutions.

ADDRESS NEW PLANNING CHALLENGES USING THE BEST METHOD POSSIBLE

Prescriptive analytics can address questions that other forms of analytics simply cannot. Further, it often helps uncover transformational opportunities across businesses that business leaders may even think are impossible to solve.

Table 1 shows a few of the most common examples of applying prescriptive analytics across various industries.

Table 1. Real-Life, Cross-Industry Applications of Prescriptive Analytics

INDUSTRY	SOLUTION
Financial Services	Cash Management Mortgage Services Strategy Portfolio Optimization
High Tech	Integrated Business Planning
Aerospace & Defense	Service Contract Profitability Modelingn
Healthcare (Providers)	Health Plan Benefit Design Optimization Staff, Service and Resource Optimization
Utilities	Operational Planning (weekly planning to 25+ year long-range planning)
Consumer Packaged Goods	Trade Promotion Optimization IBP/Sales and Operations Planning (S&OP)
Oil & Gas	Logistics Optimization Commodity Trading Optimization
Retail	Price and Promotion Optimization
Chemicals	IBP/S&OP CAPEX
Government	Army Recruiting
Natural Resources	Network Optimization IBP/S&OP CAPEX
Metals	Product Mix and Supply Planning
Mining	Supply Chain Planning Blend Optimization
Public Sector	Personnel Training Optimization
Telecomm-unications	Optimization of Channel Allocation to Spectrum

SUMMARY

Hopefully, after reading this chapter, you understand:

- How prescriptive analytics is different from BI and predictive analytics
- The types of approaches to prescriptive analytics and how they differ
- The importance of putting prescriptive analytics in the hands of business leaders versus Data Scientists and Operations Research PhDs
- The transformational value prescriptive analytics can drive

This is an exciting and opportune time in the prescriptive analytics market. Businesses are beginning to understand what they need to be successful — and the data is quickly becoming available (if it isn't already). By 2020, we expect 35% market penetration in this category. Ask yourself: do you want to fall behind?

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