OFFERING OVERVIEW

Tableau Advances the Era of Smart Analytics

A Look at Tableau's Intelligent Data-Prep, Discovery, Recommendation and Upcoming Query Capabilities

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EXECUTIVE SUMMARY

The next breakthroughs in business intelligence (BI) and analytics will see machine learning and artificial intelligence used to improve data access and data quality, uncover previously hidden insights, suggest analyses, deliver predictive analytics and suggest actions. What's more, natural language (NL) interfaces will make it easier for business users without knowledge of data science or query languages to explore information, gain insights and make better, data-driven decisions.

BI and analytics vendors are developing "smart" capabilities in at least four areas: data prep, data analysis and discovery, NL query, and prediction. Smart features will power the next step beyond self-service analytics, helping to further democratize data analysis for business users. This report explores the smart features that Tableau Software has introduced and is investing in and how these capabilities will benefit Tableau customers. The report concludes with recommendations for organizations seeking to implement smart analytics capabilities.

Business Themes		
Data to Decisions	Technology Optimization	

ABOUT TABLEAU'S EMERGING SMART CAPABILITIES

Organizations have been trying to democratize data analysis for decades. Frustrated by the complexity and IT support requirements of first-generation business intelligence (BI) systems, organizations started to embrace self-service products for data discovery and data visualization in a big way about a decade ago. The self-service approach freed analysts and data-savvy business users to analyze data without having to wait for help from IT. Demand for self-service has grown and, over the last five years, has been extended to data preparation and to basic predictive analysis.

Despite the success of self-service, it's increasingly clear that this approach alone is not enough to truly democratize end-to-end data analysis and data-driven decision-making. Self-service tools aren't always intuitive for nontechnical business users. Many untrained users still need help when selecting data, determining how to analyze that information and deciding how best to visualize and share insights.

Meanwhile, over the last five years we've seen big breakthroughs in machine learning (ML) and what some are describing as artificial intelligence (AI). Cloud computing has fueled advances in ML, neural nets, machine vision and natural language (NL) understanding. All of these advances have contributed to dazzling innovations in consumer-oriented "smart" personal assistants, such as Alexa, Google Assistant and Siri. These products, in turn, are stoking interest in ML- and AI-powered smart capabilities within business software.

Sure enough, smart capabilities are now emerging in the BI and analytics market. This report focuses on smart features now available in or soon to be added to Tableau. Tableau users can already take advantage of recommended best-fit visualizations, automated clustering and forecasting, and personalized, intent-driven recommendations. In April 2018, Tableau added self-service data-prep capabilities with Tableau Prep, which includes smart features for data cleansing and joining. Next up will be smart, NL-based query capabilities, which Tableau plans to bring into beta release later this year.
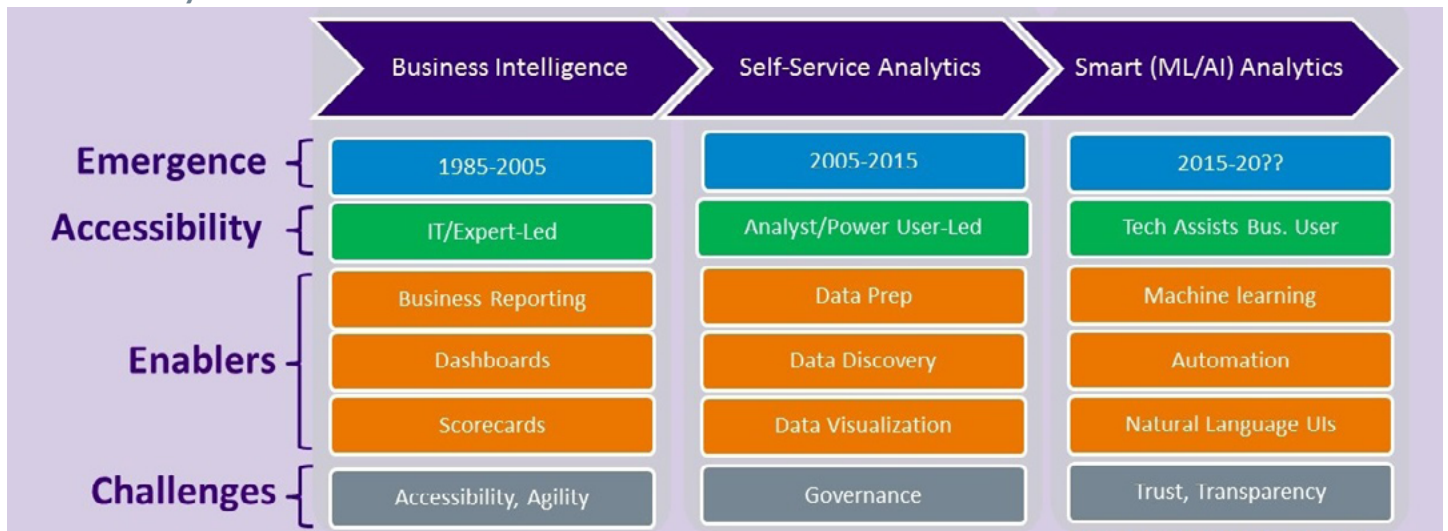
Market Segment

Tableau was an early pioneer of self-service BI and analytics, and for the last few years it has been the market leader, as measured by software revenue and number of customers. The analytics market is

evolving, however, into what Constellation Research has dubbed the era of Smart Analytics (see Figure 1).

Emerging smart capabilities harness ML to assist people with tasks including data preparation, data discovery and understanding of user intent based on historical data-access patterns. ML also powers emerging automated predictive capabilities while natural language understanding capabilities associated with AI power NL query. Self-service brought BI and analytics to a broader base of users, but even with comparatively easy-to-use tools, such as Tableau, analysts and power users typically build dashboards and reports for untrained business users. Smart capabilities promise to usher in the next era of democratization, making data discovery, analysis, prediction and even basic data prep more accessible to all users.

Constellation thinks of these ML- and AI-powered advances not as extensions of self-service analytics but as early signs of a new era of computer-assisted analytics. Smart capabilities complement human interpretive skills with computer processing power that can be harnessed to automate repetitive tasks

Figure 1. The Era of Self-Service Analytics Is Giving Way to the Era of ML- and AI-Assisted Smart Analytics

	Business Intelligence	Self-Service Analytics	Smart (ML/AI) Analytics
Emergence	1985-2005	2005-2015	2015-20??
Accessibility	IT/Expert-Led	Analyst/Power User-Led	Tech Assists Bus. User
Enablers	Business Reporting	Data Prep	Machine learning
	Dashboards	Data Discovery	Automation
	Scorecards	Data Visualization	Natural Language UIs
Challenges	Accessibility, Agility	Governance	Trust, Transparency

Source: Constellation Research

and tackle complex calculations. What's more, ML and NL understanding augments the analytical skills of employees and customers. Tableau couches its move into the smart space as its "augmented analytics" strategy. The twin goals are to spread data-driven analysis to a broader audience and to help existing Tableau users analyze data more quickly and easily so they can gain even deeper insights.

Target Markets

Tableau targets its platform at "anyone and everyone" who needs to work with data. Its products—including Tableau Desktop, Tableau Server and the Tableau Online hosted service—are used by more than 74,000 paying customer organizations. The free Tableau Public site has more than 300,000 active users who publish 7,000 analyses each week, on average. The company is fueling future adoption through the Tableau Academic program, which has reached more than 500,000 students and teachers.

Tableau shows up in every industry sector, but it sees concentrated usage and offers pre-built dashboards and analyses for a number of industries, including communications, media and technology; energy and natural resources; financial services; healthcare and life sciences; manufacturing; the public sector; retail and consumer goods; services organizations; and travel and transportation.

Tableau has added features for governing data and deploying and managing Tableau Server at scale in order to ease large corporate deployments. It's also promoting these deals by offering discounts for large-scale deployments with thousands of users. As a result, it's landing more big deals and enterprise customers with more than $1 billion in annual revenue. High-profile enterprise customers with more than 10,000 users include Charles Schwab, Deloitte, ExxonMobil, Johnson & Johnson, Nissan, PepsiCo and Wells Fargo. As of the end of 2017. The company is expanding and promoting cloud deployments on Amazon Web Services (AWS), Microsoft Azure, the Google Cloud Platform (GCP) and through its own Tableau Online service, which runs Tableau Server as a managed service on AWS.

Tableau's existing and emerging smart features and capabilities are integrated with its platform and products and are not separate products or offerings. Given the company's augmented analytics strategy, Constellation expects future smart features to be integrated in the same way rather than offered as separate products.

Functional Capabilities

Tableau's initial investments in smart capabilities date back to 2007, but deeper investments in smart functionality began in the middle of this decade, coinciding with the onset of the smart analytics trend, as depicted in Figure 1. Since 2016, Tableau has announced a steady stream of smart capabilities. The following is a chronological look at these introductions.

2007

Show Me

Tableau's Show Me feature, introduced in 2007, starts with a palette of all available visualization options. Based on the data selected for analysis, Show Me narrows the selection of available visualization types and highlights the recommended approach. Recommended visualizations speed analysis, suggesting the most appropriate charts or visualizations to use for a given type of data or analysis based on best practices for visual analytics. For example, bar charts are ideal for comparison and ranking, whereas scatter plots and bubble charts best show the relationships among variables.

2016

Clustering

Automated discovery methods based on ML spots correlations, patterns, trends and influencers in data, pointing business users toward specific dimensions or combinations of data that might be promising for deeper analysis. Tableau introduced a discovery-oriented Clustering feature to Tableau Desktop in 2016 to help users spot hidden relationships in data. Behind this feature is hyperparameter tuning of the k-means algorithm, but the tuning is automated, so users don't need to have data-science skills to use this feature. In its spring 2018 release, Tableau added a cluster refit capability that refreshes and automatically recomputes the data behind saved clusters, including Tableau Server extracts.

Forecasting

Smart predictive capabilities start with simple trending, whereby simple algorithms extrapolate historical trends into the future, but this a blunt instrument that doesn't take influences such as seasonality into account. Tableau introduced an automated Forecasting feature in 2016 featuring exponential smoothing.

This feature automatically selects from among eight different time-series forecasting models, picking the appropriate hyperparameters automatically.

2017

Smart Table, Join and Source Recommendations

Intent-driven recommendation features use ML to suggest tables, joins and sources based on data-connection patterns and user behaviors by individual, group, role, permissions and other variables. Tableau introduced the Smart Table and Join Recommendation feature in 2017. It mines existing data-connection patterns on Tableau Server to automatically suggest tables and joins.

In late 2017, Tableau added a more sophisticated data-source recommendation capability that infers intent based on the usage patterns of specific users and others like them (see Figure 2).

Figure 2. Tableau's Recommended Data-Source Capability Delivers User- and Context-Specific Suggestions
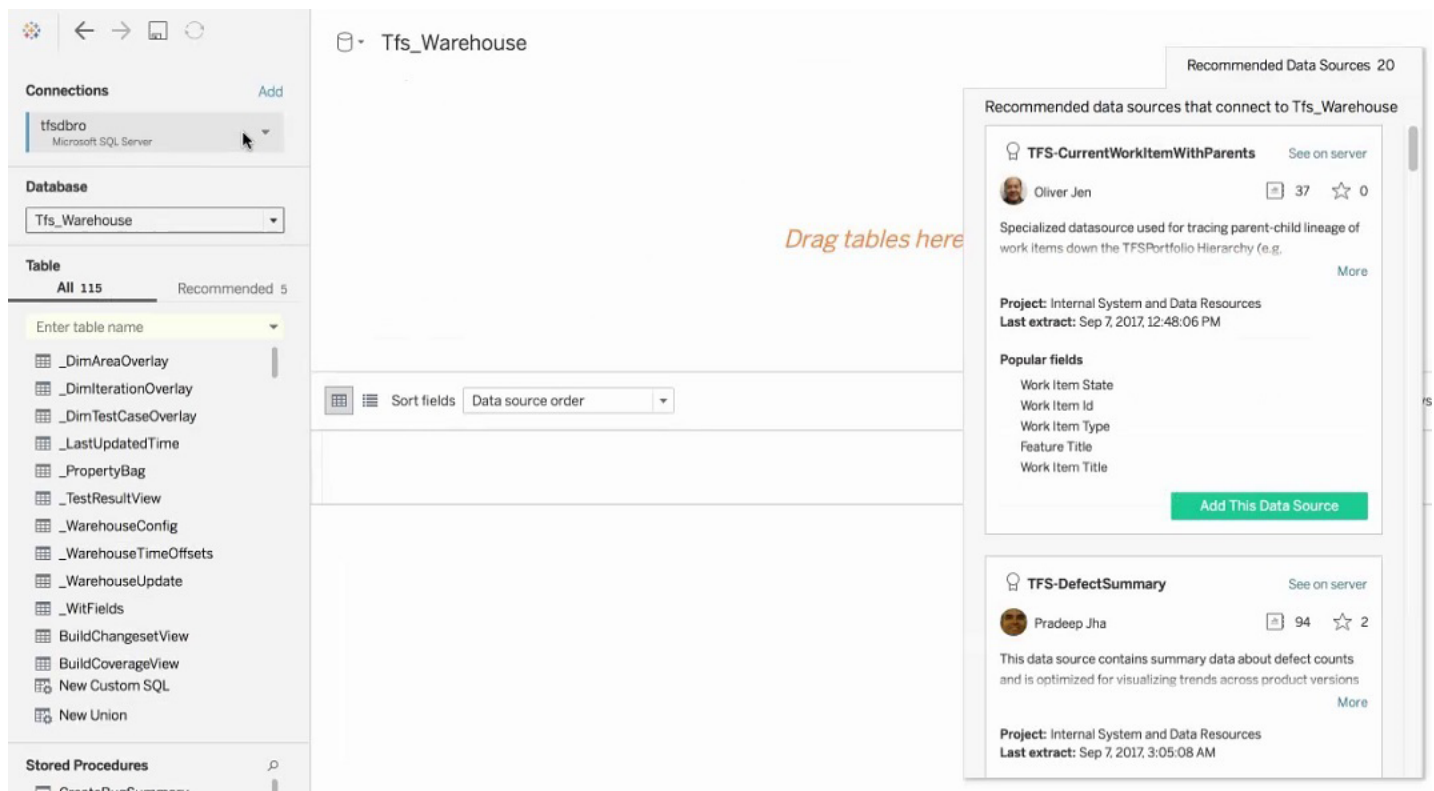
Source: Tableau

Dimensions of data are recommended as soon as the user connects to a data source. These recommendations are based on the user's past personal data-consumption patterns or, if they have no history, based on the patterns of other users in the same role and department. Behind the scenes, Tableau employs the same types of algorithms used in recommendation engines. Different users get different recommendations, even when connecting to the same data.

2018

Tableau Prep

Several BI and analytics vendors have introduced self-service data-prep capabilities built into their BI and analytics products. In April 2018, Tableau introduced Tableau Prep, a new visual data-prep capability based on two years of research and development through what was code-named Project Maestro.

Tableau Prep offers a dedicated feature set and separate user interface for data preparation, but the tool set is integrated with the rest of the Tableau workflow. For example, Tableau Prep users can draw on any data source that's connected to Tableau, and once data is shaped and cleaned in Prep, it can be previewed and explored in Tableau Desktop or a browser-based user interface.

What's starting to separate self-service data-prep products is the presence of smart features that can assist humans with data-preparation tasks. Smart capabilities included in Tableau Prep include:

- **Data profiling.** Tableau Prep offers a Data Profile pane as one of three views exposed through the user interface (see Figure 3). The Profiles show record counts and the distribution of values in each data field. Also shown is the number of null or missing values. Not called out, at present, are statistics such as average values and non-null exception or error values.

- **Auto DateParse.** Taking advantage of profiling statistics, formatting and cleansing features show prevailing data formatting for a given field and note exceptions so they can be repaired and validated or, alternatively, deleted. Tableau Prep's Auto DateParse

Figure 3. The Tableau Prep Interface Offers Data-Flow (Top), Data-Profile (Middle) and Data-Pane (Bottom) Views
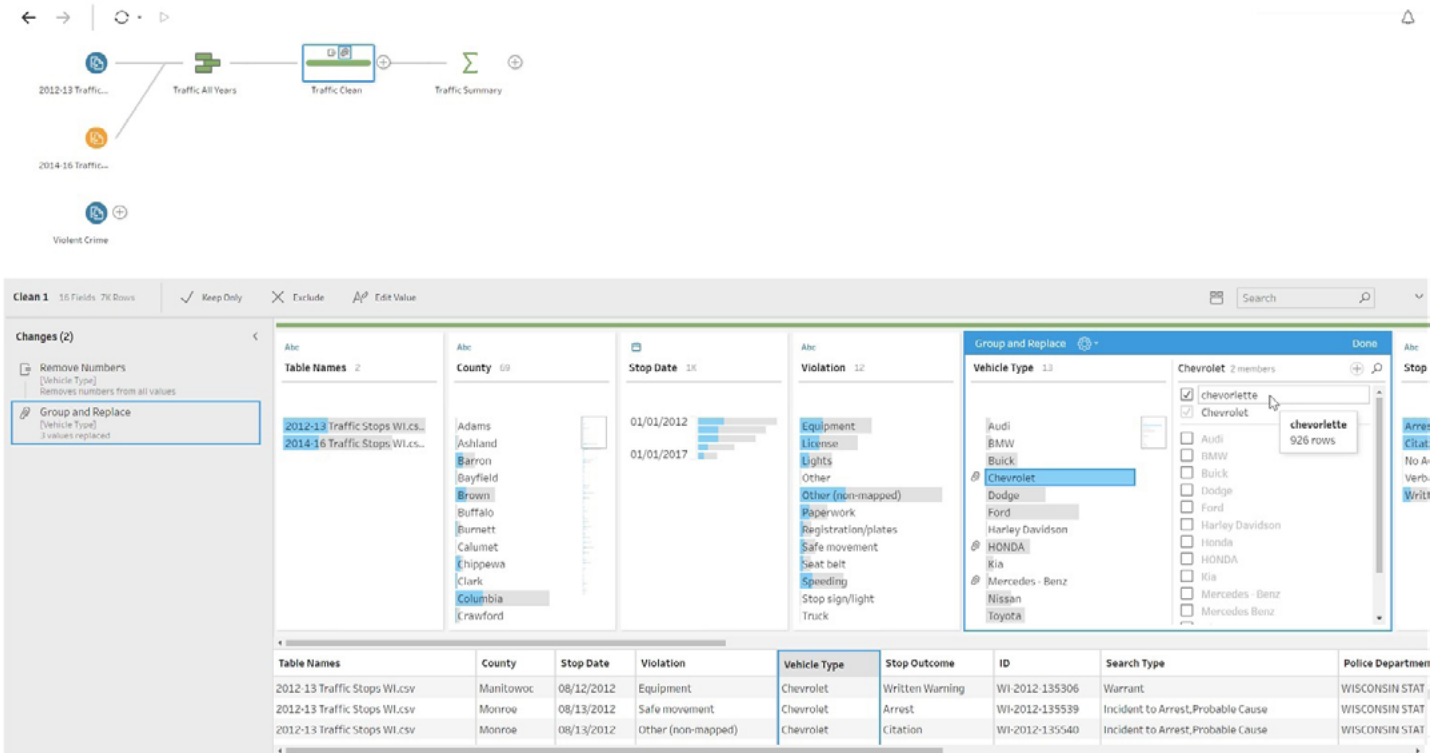
Source: Tableau

feature automatically normalizes all selected dates to available, commonly used formatting approaches.

• **Auto Split.** This feature finds a common delimiter and automatically splits values, separating, for example, Air Austria, Air Canada and Aer Lingus. Subject matter experts can inspect and review automated changes to ensure that they're appropriately applied.

• **Join Recommendations.** ML techniques are often used to spot opportunities to append or join data. Tableau Prep leverages basic capabilities already available in Tableau, whereby potential joins are recognized and suggested based on similarities in the names of primary keys, foreign keys, field names and data types. The company also plans to add its Smart Table, Join and Source Recommendations feature to Tableau Prep.

- **Fuzzy Matching.** Tableau Prep's Fuzzy Matching feature automatically groups and applies a consistent name to like values, combining, for example, "Southwest Airlines, South West, Southwest, Southwest Air" and "Southwestern." On the near-term road map is a capability that will recognize percentage overlaps in columns, using the Fuzzy Clustering capability, and will recommend joins accordingly.

Natural Language Query

Tableau has been doing research on NL query since 2016, but it accelerated these efforts through its August 2017 acquisition of ClearGraph, a startup focused on using semantic understanding, statistics and data-usage histories to improve natural language query. Semantics help to clarify what conversational questions mean and what popular synonyms for field descriptions might be. Over the last year, Tableau has been working on integrating ClearGraph technologies with its platform and plans to introduce its NL query capability in beta in the second half of 2018.

Tableau's upcoming NL query feature will enable users to choose data sources and type conversational, natural language questions to generate new visualizations. As shown in a pre-release view in Figure 4, the engine starts offering interpretations and recommended queries as soon as you start typing (as with the two recommendations shown in the screenshot). The suggestions dynamically refine as the typing continues, just as users experience with the type-ahead suggestions offered by Internet search engines. NL questions are often ambiguous, so the engine offers many options to choose from, and users can offer thumbs-up, thumbs-down feedback to help improve accuracy over time.

NL query is maturing, moving beyond the one-question-at-a-time interactions that are typical of personal digital assistants. To aid data discovery and data exploration, the next step is the ability to follow queries wherever they may lead, retaining the context of an initial query and drilling down to deeper insights. If the initial query typed into the NL interface was "Show transactions of more than $1 million in 2017," a user with advanced NL query could then add "in the last quarter," and the engine would retain the context of "transactions of more than $1 million." Tableau says this sort of iterative exploration capability users should expect in the coming NL query release.

Figure 4. Tableau's NL Query Interface Is Currently in Development and Set for Beta Release in the Second Half of 2018
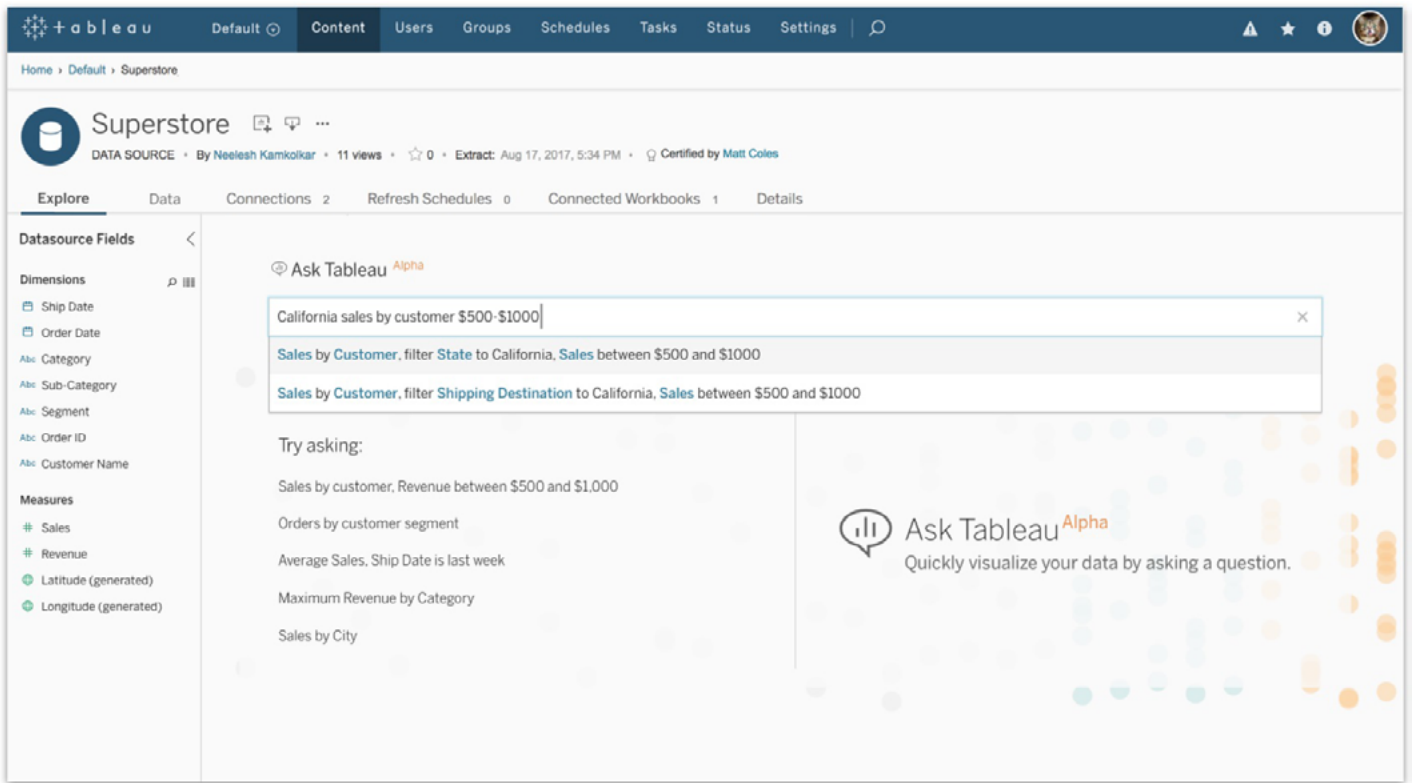
Source: Tableau

Next Steps Toward Smart Analytics

On June 13, 2018, Tableau announced the acquisition of Empirical Systems (Empirical), an AI startup that originated at the Massachusetts Institute of Technology. Founded in 2016, Empirical developed an analytic engine designed to automate the analysis a trained statistician would do and to make that analysis queryable both through human interfaces and APIs. The company's approach is similar to that used by automated discovery and analysis tools that spot influencers, key drivers and exceptions in data. Empirical executives say their technology is distinguished by its ability to work with comparatively small data sets, its ability to explain changes in data and its ability to help analysts quantify how confident they can be in a particular conclusion.

Tableau executives say it's far too early to speculate about what new capabilities the company might deliver based on Empirical's statistical engine and when new features might become available. The overall strategy is to leverage the intellectual property (IP) broadly across the platform, with smart prep,

discovery, analysis and predictive analysis all being possible use cases to deliver more sophisticated analysis to business users. Constellation expects the acquisition to drive new functionality, such as helping analysts to detect relationships between variables, to uncover latent factors driving patterns or spikes in activity and to infer missing values in data.

The Empirical purchase is not unlike the ClearGraph acquisition. In both deals, Tableau picked up the IP of the firm while also hiring its employees. Tableau also announced it will establish a research and development center in Cambridge, Mass. Based on the release pattern expected in the ClearGraph acquisition, Constellation anticipates that it may be 12 to 18 months before Empirical's capabilities will be integrated into the Tableau platform.

Partnerships and Alliances

Tableau also brings smart capabilities to its platform through third-party partnerships in the area of natural language generation. Here's a rundown of associated capabilities.

- **Natural language generation (NLG).** A picture may be worth 1,000 words, but concise descriptions and annotations can help people interpret and better understand visualizations. NLG technology interprets data and offers background context or analysis through textual descriptions. NLG descriptions add detail to, say, a chart showing year-to-date sales by product, by explaining in words that the third quarter was the biggest for product sales, that product X or category Y was the biggest contributor to profit or that the Eastern region delivered the largest increase in product sales.

  Tableau is working on limited NLG capabilities as part of its NL query capabilities (described on page 11). But like most analytics vendors, Tableau relies on integrated partner capabilities, such as those from Automated Insights and Narrative Science, to automatically generate textual descriptions of visualizations. Tableau announced a Dashboard Extensions feature in 2017 that makes it easier to integrate with these NLG partners.

- **Advanced analytics.** To support advanced, predictive analytics, Tableau lets you connect to R and Python libraries and packages, import saved models and write and embed new models into calculations. It also partners with vendors—including DataRobot and RapidMiner—to integrate their advanced analytics platforms designed to support sophisticated predictive modeling.

ANALYSIS AND OBSERVATIONS

Strengths and Weaknesses

Tableau has a strong start and multiple investments across the spectrum of emerging smart capabilities, but it's stronger in some areas than in others. Here's Constellation's analysis of Tableau's strengths and weakness in four categories:

Smart Data Prep

Strengths

- Tableau Prep delivers a solid start on profiling and customers can expect to see more automated cleansing and formatting options beyond Auto DateParse and Auto Splitting.

- Tableau Prep offers a good foundation of suggested best ways to join data with Fuzzy Clustering. Tableau says it's working on more functionality in this vein.

- The Tableau Prep experience is integrated with the rest of the Tableau workflow, reducing confusion, data-connection challenges and toggling between applications. Tableau is also working on an integration whereby data-preparation flows in Tableau Prep will be able to deliver and update Tableau Server certified data sets.

Weaknesses

- Data profiling and basic capabilities for data formatting and data cleansing are becoming expected. Tableau will have to add more formatting and cleansing capabilities to keep pace with the market.

- Best-of-breed data-prep vendors (and Tableau partners) Paxata and Trifacta offer more extensive ML-based guided cleansing and formatting capabilities and smart join recommendations.

- Tableau offers sample public data sets, but competitors IBM, Oracle and Qlik offer more extensive third-party data markets and data-enrichment features.

Smart Discovery and Analysis

Strengths

- Tableau was an early pioneer in offering recommended best-fit visualizations.

- The company has a solid start on automated discovery with its clustering and cluster refit capabilities.

- Intent-driven recommendations are on the cutting edge; Tableau's Smart Table and Join Recommendation and Recommended Data features are good examples of smart features that speed time to analysis and promote deeper exploration.

- NL generation is dominated by best-of-breed vendors. Constellation sees Tableau's reliance on partners such as Automated Insights and Narrative Science as appropriate and in line with competitors.

Weaknesses

- Best-fit visualization recommendations based on data types are becoming part of basic offerings. Advanced tools also assess the actual data. If there are negative values, for example, the recommendation might be very different.

- Smart discovery and automated analysis options are proliferating. Tableau must deliver additional capabilities beyond its current clustering and recommendation features to remain competitive.

Smart Prediction

Strengths

- Tableau's automated Forecasting feature goes beyond simple trending to account for affects such as seasonality. Data-science skills are not required to use this feature, but manual algorithm selections and filters are available to avoid black-box predictions.

- Tableau supports embedding of R and Python code and has a third-party integration with advanced analytics partner MathWorks to support more-sophisticated predictive requirements.

Weaknesses

- Forecasting is but one predictive technique. Tableau will have to roll out more automated options to keep pace with market demand.

- MathWorks is a notable vendor, but Tableau could add more third-party integrations with advanced analytics partners.

Natural Language Query

Strengths

- Tableau's NL query research extends into semantic understanding and query pragmatics—the ability to retain the context of an initial question and then iteratively explore the topic more deeply. These capabilities have yet to be released and tested in the real world, but they could leapfrog first-generation, one-query-at-a-time tools that simply spot keywords and map them to available field headers.

Weaknesses

- Tableau's NL query is late to the market compared with features already available in Microsoft Power BI since 2013, and IBM Watson Analytics, AnswerRocket and ThoughtSpot since 2014.

Competitive Positioning of Tableau

Tableau emerged as a leader of the self-service analytics movement at the start of this decade. The company's products continue to be the standard by which ease of use and data-visualization prowess are measured. First-generation BI vendors have added data-discovery and data-visualization modules of their own, yet defections to Tableau continue, as evidenced by strong sales growth. In contrast, growth appears to have slowed at long-time Tableau self-service analytics rivals Qlik and Tibco Spotfire, both of which were acquired by private equity firms within the past few years.

The biggest threat to Tableau has been the rise of large public cloud offerings and, particularly, Microsoft with its combination of Power BI, data-management tools and platforms, and Azure cloud services. Microsoft has priced Power BI aggressively and recently introduced Power BI Premium virtual server and Power BI Report Server options to fill gaps in the company's BI and analytics portfolio. Like Tableau, Microsoft is also appealing to companies that are eyeing larger deployments, but its offerings make the most sense for companies committed to using Microsoft platforms, data-management tools and services, and Azure. Not all companies are willing to make such a commitment.

Tableau has made a point of easing deployment in all of the leading public clouds, starting with AWS but also including Azure and the Google Cloud Platform. In 2017, Tableau introduced Linux support for Tableau Server for cost-effective cloud deployment. It has also made big strides in its long-running goal to bring functional parity between Tableau Desktop and the Tableau browser experience. More than a third of Tableau deployments are now in the cloud, and the company's subscription-based pricing approach is being adopted more quickly than the company anticipated. The next challenge for Tableau will be meeting expectations for automated and containerized cloud deployment and systems management capabilities to stay competitive with cloud-native analytics offerings.

Competitive Positioning of Tableau Smart Features

As noted in the "strengths and weaknesses" analysis regarding NL query, Tableau has not been the first to deliver many smart features, but its pace of investment has picked up since 2016. Constellation sees Tableau as now having a solid start on delivering expected smart capabilities. With this year's introduction of Tableau Prep and the impending release of NL query capabilities, the portfolio of smart features is growing, elevating Tableau to fast-follower status on this trend.

In the context of broad market demand, Constellation's view is that most organizations are not choosing company-wide standard analytics platforms based on available smart capabilities. While startups such as ThoughtSpot and AnswerRocket have been innovators in this space, they tend to be used in focused and experimental capacities initially. What's more, their respective customer bases are measured in dozens. Tableau, by contrast, is advancing the era of smart analytics by bringing its built-in capabilities to its tens of thousands of customers.

The risk for Tableau is that a large vendor will acquire an innovative startup and take its smart capabilities mainstream. Salesforce has not historically been a Tableau competitor, but the customer relationship management vendor's 2016 acquisition of smart analytics startup BeyondCore marked a turning point in the smart analytics market. Salesforce is now pushing Einstein Analytics (based largely on BeyondCore) as a mainstream offering, though early deployments have mostly been in the sales and service context.

Constellation is following the smart analytics moves of large vendors, such as IBM, Microsoft, Oracle, Salesforce and SAP; of independents such as Qlik and Tibco Spotfire; and of innovative startups. As of early 2018, Tableau is a fast follower of this trend. Customers and would-be customers should stay abreast of the latest developments in smart analytics and Tableau's road map and make their feature requests known.

Key Differentiators

Ease of use and state-of-the-art data exploration and visualization are the hallmarks of Tableau. Add-on modules and services for data visualization are now available from most competitors, but many are undifferentiated tool sets that are thrown in for free as part of large enterprise software deals or cloud services contracts. In contrast to commoditized tools that see tepid adoption, Tableau's products have a huge and loyal fan base. As Constellation has witnessed, enthusiastic customers turn out in droves to the company's annual **Tableau Conference**, most recently drawing more than 14,000 attendees in 2017.

Tableau is seeing increased competition, including from large cloud vendors. Like many independents, Tableau is responding to these threats with a hybrid cloud and multicloud strategy. The company has stepped up systems management and data-governance capabilities for large-scale deployments. The next challenge will be adding automation and containerized options promising consistent deployment of Tableau Server across on-premises, private-cloud and public-cloud options. It's an approach that independent database vendors are already supporting. The approach is being previewed (notably by Qlik) in the BI and analytics space, but these are still early days. It's not too late for Tableau to become a leader on containerized approaches for hybrid cloud and multicloud deployment.

With Tableau Prep, the company has stepped up its self-service capabilities significantly, yet it has included this functionality in its top subscription tier without an increase in price (see pricing section below). This upgrade gives Tableau's most capable and data-savvy users more functionality—including a number of notable smart data-prep features—without an increase is cost. Constellation sees this as a better approach than charging more for a separate data-prep tool.

USE CASES

Tableau's smart capabilities are built into its core products rather than delivered as distinct, extra-cost offerings. Thus, use cases are identical to those of the vendor's core products. Tableau is used across all industries to access, prepare and analyze data in a visual exploration environment. Data visualizations are the primary means of analysis, but statistical and predictive analyses can be surfaced and embedded within visualizations.

Collections of related visualization can be combined into dashboards or storyboard presentations. Visualizations, key metrics and dashboards can be shared through desktops, laptops and a variety of mobile devices. Collaborative features built into the software and integrations with third-party collaboration tools support group feedback and iterative analysis. Subscription and alerting capabilities keep users abreast of the latest conditions and exceptions that fall out of user-customizable ranges.

Here are a few summary examples of use cases and customer deployments across a range of industries:

In healthcare, Cleveland Clinic studies historical patient behaviors with Tableau to identify patients most at risk of seeking avoidable emergency-room visits. This drives proactive efforts to seek out similar patients and offer preventative care.

In insurance, Allstate Insurance uses Tableau to uncover out-of-pattern claims that are then referred to investigators, adjusters, attorneys and law enforcement to thwart insurance fraud.

In e-commerce, Zulily uses Tableau for self-service analysis of data related to Facebook Ads, Google Ads, email sends and other marketing touchpoints. This data is tied to clickstreams, transactions, and other customer behavior data with Google Big Query. With the aid of analytical models embedded in Tableau, Zulily can analyze customer spending over time and frequency of engagement with email and browsing habits while tying customer behaviors back to specific advertising and marketing campaigns.

In government, the City of Cincinnati uses Tableau dashboards to track geographical and temporal patterns in heroin-overdose emergency calls and then optimizes the deployment of police and emergency medical technicians to speed up response times.

In high tech, Cisco Systems' supply chain organization uses Tableau to analyze product-demand, distribution efficiency, spending and the flow of more than 14,000 items through a complex supply network. Insights help the company better manage inventory and speed the order-to-ship cycle.

PRICING

Tableau's pricing is based on per-user, per-month subscriptions available in three tiers with ascending levels of capabilities: Viewers, Explorers and Creators (see Figure 5). Not shown are prices for Tableau Online, the company's hosted offering, which are $15 per user, per month for Viewers; $42 per user, per month for Explorers; and $70 per user, per month for Creators. Discounts are available for large-scale deployments with thousands of users.

Figure 5. Tableau Subscription Pricing as of April 2018
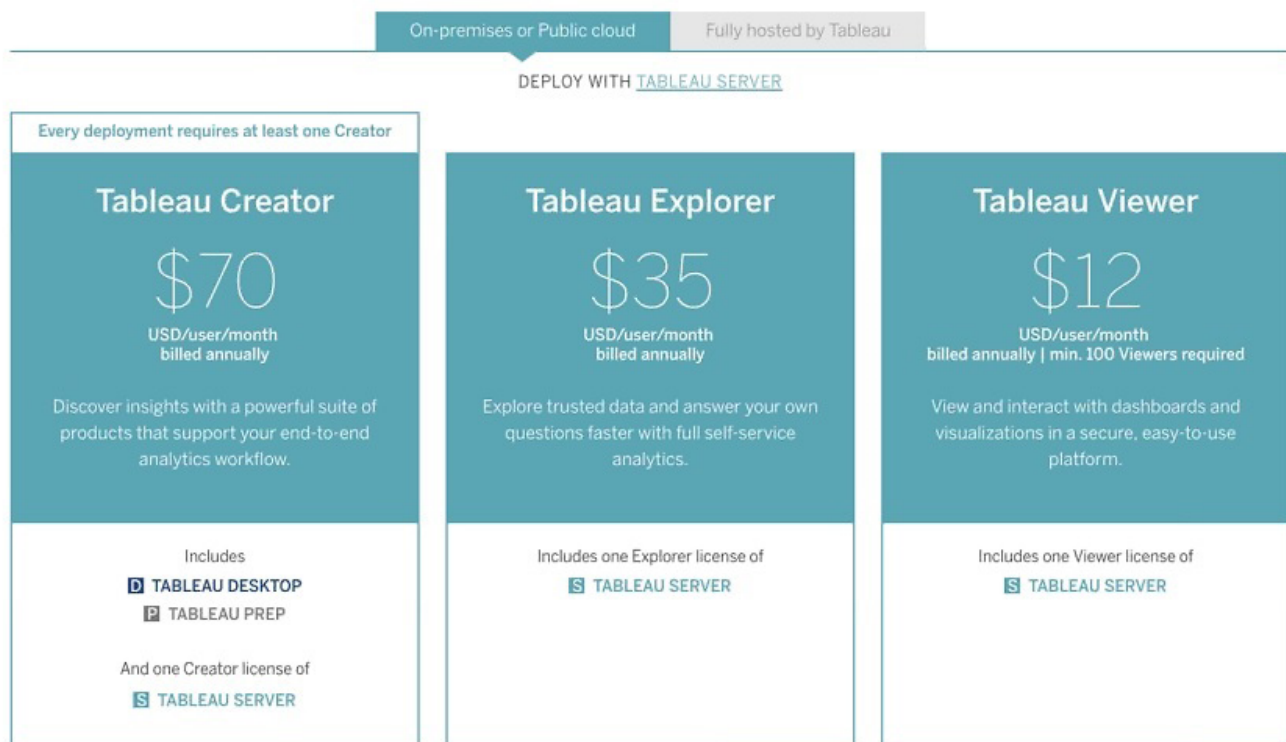
Source: Tableau

RECOMMENDATIONS

The trend toward self-service has been a hugely positive development in the evolution of data-driven decision-making, but it has carried us only so far. To take data analysis to an even broader audience and to speed and deepen analyses for existing users, consider emerging smart capabilities in the areas of data prep, data discovery and analysis, NL query and automated predictive capabilities.

Tableau started delivering smart data-discovery, data-analysis and automated predictive capabilities in 2016. It followed up with intent-driven recommendations in 2017 and smart data-prep features in April 2018. Next up is NL query, expected as a beta release in the second half of 2018. Tableau customers will obviously want to exploit these features, but these achievements place Tableau on the Constellation ShortList™ among the leading vendors pursuing smart analytical capabilities.

To make the most of these emerging capabilities, follow the recommendations on how to usher in the era of smart analytics.

START WITH BEST PRACTICES

The market may be moving from the self-service era to the smart era, but as businesses consider, test and deploy these new technologies, there's no ML- or AI-powered shortcut around these four IT project best practices:

- **Win executive support.** Given all the buzz and popular interest around all things ML and AI, leaders may have little trouble attracting executive sponsors for a project, but Constellation advises carefully choosing the executive sponsor. The best choice is someone who has influence and credibility in both the business sphere and IT.

- **Build a broad, cross-functional team.** Don't just strive for the proverbial business/ IT partnership; ensure that there's well-rounded representation on both sides of the team, including key business stakeholders as well as IT, software development and data, analytics and data science experts on the IT side of the house.

- **Pick the right project.** Whatever the smart capability or vendor you may choose (considerations addressed below), you should choose the right project as the pilot test case. Consider the Goldilocks principle—that is, choose the project that is not too big, time-consuming and risky yet not so small and inconsequential as to go unnoticed. If available, start with easy, quick wins that have notable payoffs. Build on early successes and move up to tougher projects that also promise significant dividends.

- **Take an agile approach.** Agile development operations (DevOps) approaches are characterized by rapid, iterative development cycles, frequent reviews by cross-functional teams representing the business and IT, and the application of automation and monitoring wherever possible. This approach has been proven to deliver fast results that match the needs and expectations of the business.

ADDRESS TRUST AND TRANSPARENCY

Constellation believes that trust and transparency are two of the biggest issues that organizations will face as they embrace ML and AI technologies. Expect change management and training to be required in order to promote trust in ML- and AI-based recommendations and suggested actions. People will more readily accept computer assistance and accept changes in processes if they understand how and why decisions and recommendations are made. That's where transparency comes in. Smart systems should be explainable, not magical.

To simplify complex technologies and support self-service, vendors including Tableau are applying automation and behind-the-scenes decisioning to inherently complex processes, such as the selection of algorithms. The danger is that "black box" (nontransparent) predictive systems may not make decisions or recommendations that are in the best interests of an organization or its customers. In general, Tableau's philosophy is to use algorithms to assist humans, and it should be noted that Tableau's auto-forecasting and auto-clustering features can be switched to manual control.

As stated earlier, smart predictions should be overseen by analytics professionals to ensure that they do not lead to potentially costly actions. One approach is to let analysts and data-savvy business users

experiment with automated prediction features and then share their findings with data scientists, who can enhance the analyses and put carefully curated models into production.

Constellation believes that ML- and AI-based systems and applications should be as transparent and explainable as possible. The truly smart ML- and AI-based systems will be those that can be explained, understood and trusted.

RELATED RESEARCH

For a look at smart analytics capabilities being introduced across the market, read "**How Machine Learning and Artificial Intelligence are Changing BI and Analytics**," a Constellation Research Big Idea report published in January 2018. The report includes details on smart capabilities and initiatives among 14 established BI and analytics vendors and 20 innovative startups.

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Doug Henschen is Vice President and Principal Analyst at Constellation Research, Inc., focusing on data-driven decision making. His Data-to-Decisions research examines how organizations employ data analysis to reimagine their business models and gain a deeper understanding of their customers. Data insights also figure into tech optimization and innovation in human-to-machine and machine-to-machine business processes in manufacturing, retailing and services industries.

Henschen's research acknowledges the fact that innovative applications of data analysis require a multi-disciplinary approach, starting with information and orchestration technologies, continuing through business intelligence, data visualization, and analytics, and moving into NoSQL and big data analysis, third-party data enrichment, and decision management technologies. Insight-driven business models and innovations are of interest to the entire C-suite.

Previously, Henschen led analytics, big data, business intelligence, optimization, and smart applications research and news coverage at *InformationWeek*. His experiences include leadership in analytics, business intelligence, database, data warehousing, and decision-support research and analysis for *Intelligent Enterprise*. Further, Henschen led business process management and enterprise content management research and analysis at *Transform* magazine. At *DM News,* he led the coverage of database marketing and digital marketing trends and news.

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ABOUT CONSTELLATION RESEARCH

Constellation Research is an award-winning, Silicon Valley-based research and advisory firm that helps organizations navigate the challenges of digital disruption through business models transformation and the judicious application of disruptive technologies. Unlike the legacy analyst firms, Constellation Research is disrupting how research is accessed, what topics are covered and how clients can partner with a research firm to achieve success. Over 350 clients have joined from an ecosystem of buyers, partners, solution providers, C-suite, boards of directors and vendor clients. Our mission is to identify, validate and share insights with our clients.

Organizational Highlights

· Named Institute of Industry Analyst Relations (IIAR) New Analyst Firm of the Year in 2011 and #1 Independent Analyst Firm for 2014 and 2015.

· Experienced research team with an average of 25 years of practitioner, management and industry experience.

· Organizers of the Constellation Connected Enterprise—an innovation summit and best practices knowledge-sharing retreat for business leaders.

· Founders of Constellation Executive Network, a membership organization for digital leaders seeking to learn from market leaders and fast followers.

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