November 30, 2021

Dresner Advisory Services, LLC

2021 Edition

Analytical Platforms (Excerpt)

Wisdom of Crowds® Series

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Definitions

Business Intelligence Defined

Business Intelligence (BI) is "knowledge gained through the access and analysis of business information."

Business Intelligence tools and technologies include query and reporting, OLAP (online analytical processing), data mining and advanced analytics, end-user tools for ad hoc query and analysis, and dashboards for performance monitoring.

Source: Howard Dresner, *The Performance Management Revolution: Business Results Through Insight and Action* (John Wiley & Sons, 2007)

Analytical Platforms Defined

Analytical Platforms are integrated technology environments that include all needed functionality to support multiple analytical/BI use cases without requiring additional technologies, including data engineering, self-service BI, data science and machine learning, embedded BI/analytics, natural language analytics, and cloud support.

Introduction

In 2021, we mark the 14th anniversary of Dresner Advisory Services. Our thanks to all of you for your continued support and ongoing encouragement. Since our founding in 2007, we worked hard to set the "bar" high—challenging ourselves to innovate and lead the market—offering ever greater value with each successive year.

At the time of publication of this report, the COVID-19 pandemic continues to affect millions worldwide and impacts businesses and how they leverage data and business intelligence. As our data collection took place from Q3 2020 to Q2 2021, the data and resulting analyses continue to reflect the pandemic's impact.

Through this period, we separately conducted specific COVID-19 research, which is not reflected in this report but is available on our blog at no cost. Additionally, we will continue to collect this data and will continue to publish research through the duration of the pandemic.

This is the first year we are publishing a report on Analytical Platforms. In the report, we consider the requirement on the part of many organizations to have a critical mass of core analytical and BI functionality in a single-vendor technology platform.

We hope you enjoy this report!

Best

Howard Dresner
Chief Research Officer
Dresner Advisory Services

About Howard Dresner and Dresner Advisory Services

The Dresner Advisory Services Analytical Platforms Report was conceived, designed and executed by Dresner Advisory Services, LLC—an independent advisory firm—and Howard Dresner, its President, Founder and Chief Research Officer.

Howard Dresner is one of the foremost thought leaders in business intelligence and performance management, having coined the term "Business Intelligence" in 1989. He has published two books on the subject, *The Performance Management Revolution – Business Results through Insight and Action* (John Wiley & Sons, Nov. 2007) and *Profiles in Performance – Business Intelligence Journeys and the Roadmap for Change* (John Wiley & Sons, Nov. 2009). He lectures at forums around the world and is often cited by the business and trade press.

Prior to Dresner Advisory Services, Howard served as chief strategy officer at Hyperion Solutions and was a research fellow at Gartner, where he led its business intelligence research practice for 13 years.

Howard has conducted and directed numerous in-depth primary research studies over the past two decades and is an expert in analyzing these markets.

Through the Wisdom of Crowds® Business Intelligence market research reports, we engage with a global community to redefine how research is created and shared. Other research reports include:

- Wisdom of Crowds® Flagship BI Market Study
- Analytical Data Infrastructure
- Cloud Computing and Business Intelligence
- Data Preparation
- Data Science and Machine Learning
- Embedded Business Intelligence
- Location Intelligence
- Self-Service BI

Howard (www.twitter.com/howarddresner) conducts a bi-weekly Twitter "tweetchat" on Fridays at 1:00 p.m. ET. The hashtag is #BIWisdom. During these live events the #BIWisdom community discusses a wide range of business intelligence topics.

You can find more information about Dresner Advisory Services at www.dresneradvisory.com.

About Jim Ericson

Jim Ericson is a Research Director with Dresner Advisory Services.

Jim has served as a consultant and journalist who studies end-user management practices and industry trending in the data and information management fields.

From 2004 to 2013, he was the editorial director at *Information Management* magazine (formerly *DM Review*), where he created architectures for user and industry coverage for hundreds of contributors across the breadth of the data and information management industry.

As lead writer, he interviewed and profiled more than 100 CIOs, CTOs, and program directors in an annual program called "25 Top Information Managers." His related feature articles earned ASBPE national bronze and multiple Mid-Atlantic region gold and silver awards for Technical Article and for Case History feature writing.

A panelist, interviewer, blogger, community liaison, conference co-chair, and speaker in the data-management community, he also sponsored and co-hosted a weekly podcast in continuous production for more than five years.

Jim's earlier background as senior morning news producer at NBC/Mutual Radio Networks and as managing editor of MSNBC's first Washington, D.C. online news bureau cemented his understanding of fact-finding, topical reporting, and serving broad audiences.

The Dresner Team

About Elizabeth Espinoza

Elizabeth is Research Director at Dresner Advisory and is responsible for the data preparation, analysis, and creation of charts for Dresner Advisory reports.

About Kathleen Goolsby

Kathleen is Senior Editor at Dresner Advisory ensuring the quality and consistency of all research publications.

About Danielle Guinebertiere

Danielle is the Director of Client Services at Dresner Advisory. She supports the ongoing research process through her work with executives at companies included in Dresner market reports.

About Michelle Whitson-Lorenzi

Michelle is Client Services Manager and is responsible for managing software company survey activity and our internal market research data.

Executive Summary

- Sentiment is divided toward "single-vendor integrated" platforms (52 percent) versus best-of-breed analytical platforms (48 percent). Function, industry, and organization size are all notable drivers of platform preference. Tool use and data culture also play into platform choices. BI Competency Centers (BICCs) more often advocate single-vendor platforms. Decreasing budgets coincide with single-vendor platform use. "Finding" information is easier on single-vendor platforms.
- Sixty-five percent of respondents "constantly" or "frequently" make use of data preparation in 2021. Top features are save/preview and automation. The top outputs are Excel and relational databases
- Top use cases for data pipelines and integration address cleansing, and transformation workflows, and ad hoc query, discovery, and exploration analysis.
- ETL and alerting are the most important transformation priorities.
- Data-orchestration priorities include scheduled workflows and synchronizing transformations.
- Collaboration preferences include email and virtual or face-to-face meetings. Top features are for sharing, annotating, and following content.
- The top governance features address defined access and integration with access management.
- Top Guided Analytics® authoring features address flexible content creation and author-defined navigation. Visual integration is a top user feature.
- Top data science / machine learning features address statistical models. Top usability features address customization and author-defined flows. Neural network support is also required.
- The top big data / open source requirements are for Spark and Kafka. Top technologies include R language and Tensorflow.
- Embedded BI users embrace interaction with objects and HTML. Targeted applications include Web portals and home-built apps.
- NLA priorities include query suggestion and model improvement. Industry and custom lexicon support are top priorities.
- Cloud BI requirements echo traditional features and support for relational databases. Security support is immature.
- Analytical Platform vendor ratings are on page 46.

Study Demographics

Our 2021 survey base provides a cross-section of data across geographies, functions, organization sizes, and vertical industries. We believe that, unlike other industry research, this supports a more representative sample and better indicator of true market dynamics. We constructed cross-tab analyses using these demographics to identify and illustrate important industry trends.

Geography

Survey respondents represent the span of geographies. North America (including the United States, Canada, and Puerto Rico) accounts for the largest group with 55.9 percent of all respondents. EMEA accounts for 31.4 percent, Asia Pacific for 8.3 percent, and Latin America 4.4 percent (fig. 1).

Geographies Represented
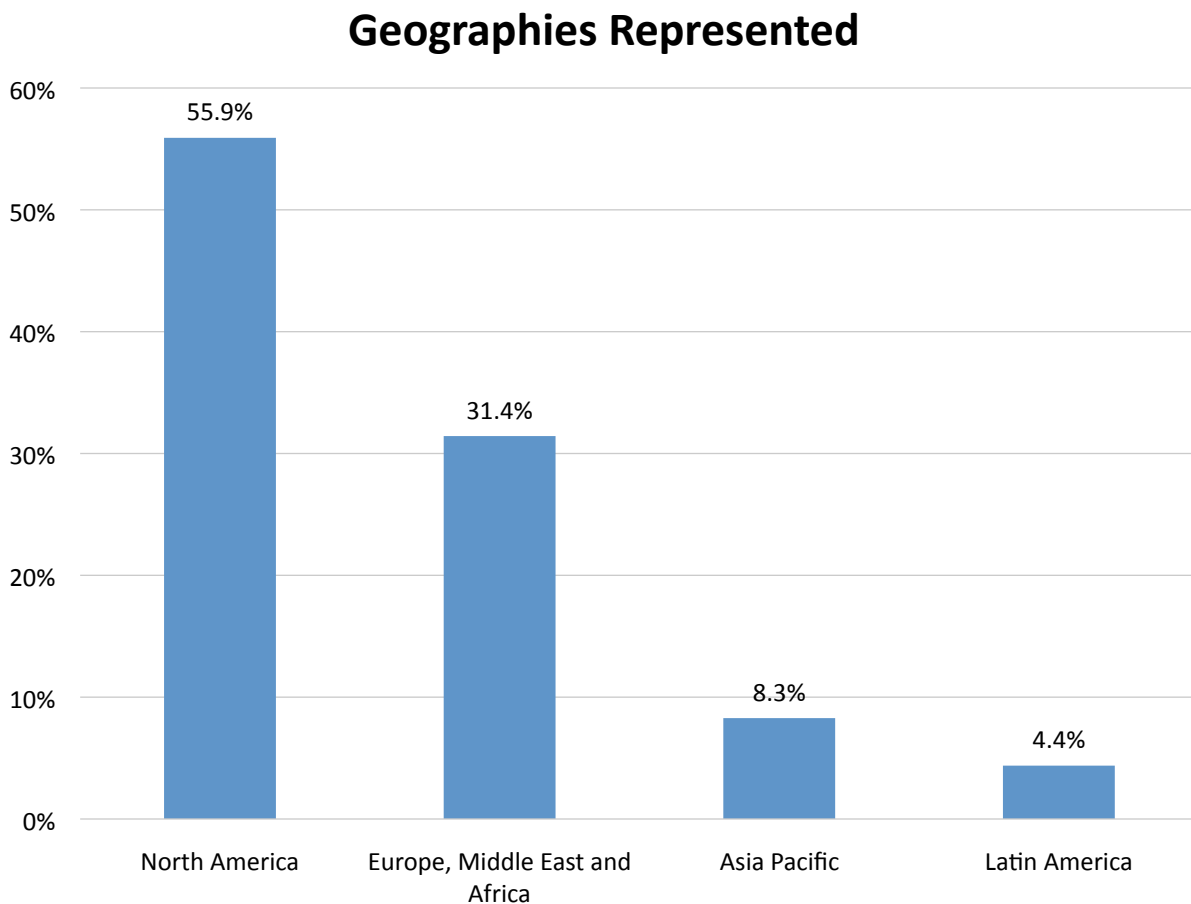
Figure 1 – Geographies represented

Respondent Functions

IT is the function most represented among respondents, with 32 percent of the sample (fig. 2). Finance follows with 23 percent, while Executive Management represents 15 percent. These three functions account for over 70 percent of respondents.

The BI Competency Center, Research & Development (R&D), Operations, Marketing and Sales, Strategic Planning, and Human Resources are the next most represented. Only five percent of respondents do not fall into our functional breakout.

Tabulating results by respondent function helps us create analyses that represent different perspectives by function.

Functions Represented
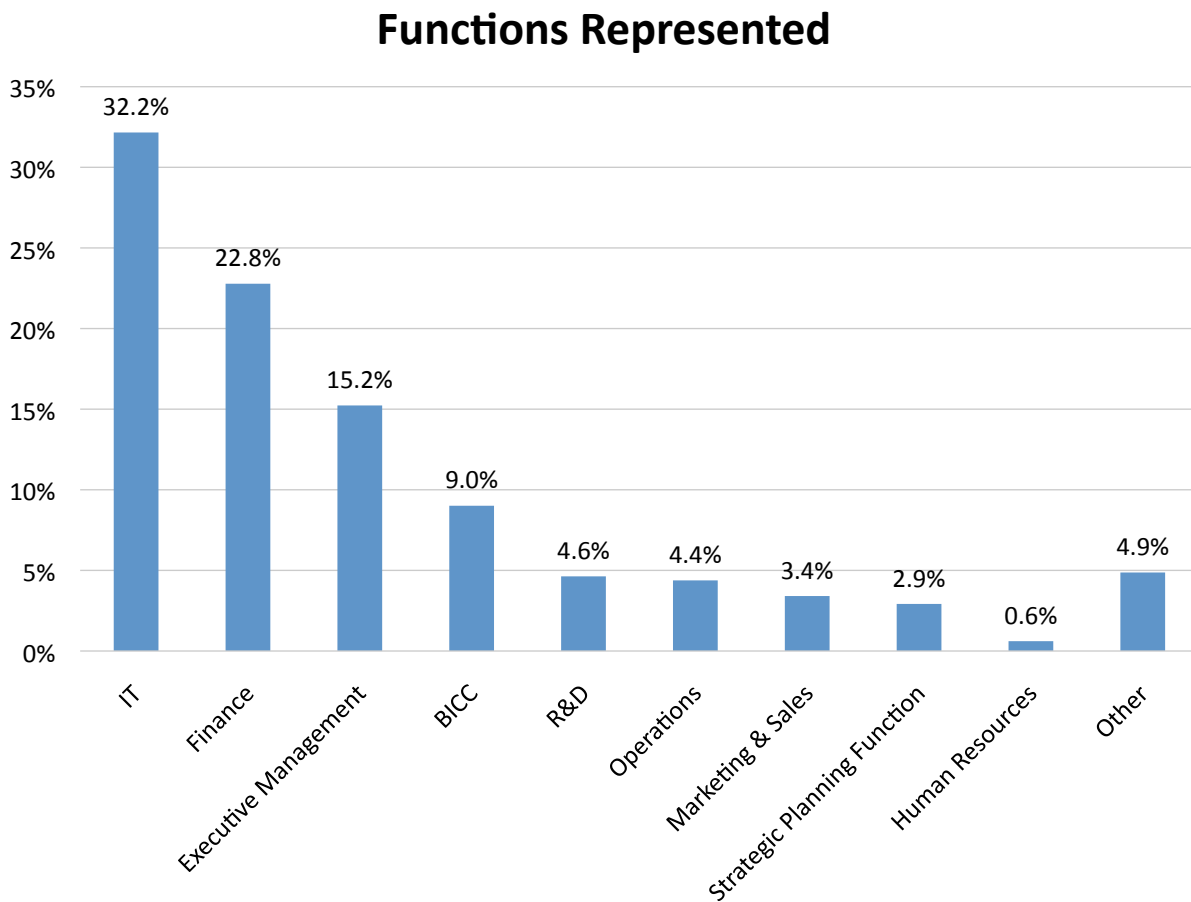
Figure 2 – Functions represented

Vertical Industries

Survey respondents are from a broad range of industries with no individual industry dominating the responses. Manufacturing and Business Services are the most represented industries, accounting for 25 percent and 17 percent of the sample respectively (fig. 3). Financial Services, Technology, and Consumer Services are the next most represented, with only around 4 percent not falling into our industry classifications.

Tabulating results across industries helps us develop analyses that reflect the maturity and direction of different business sectors.

Vertical Industries Represented
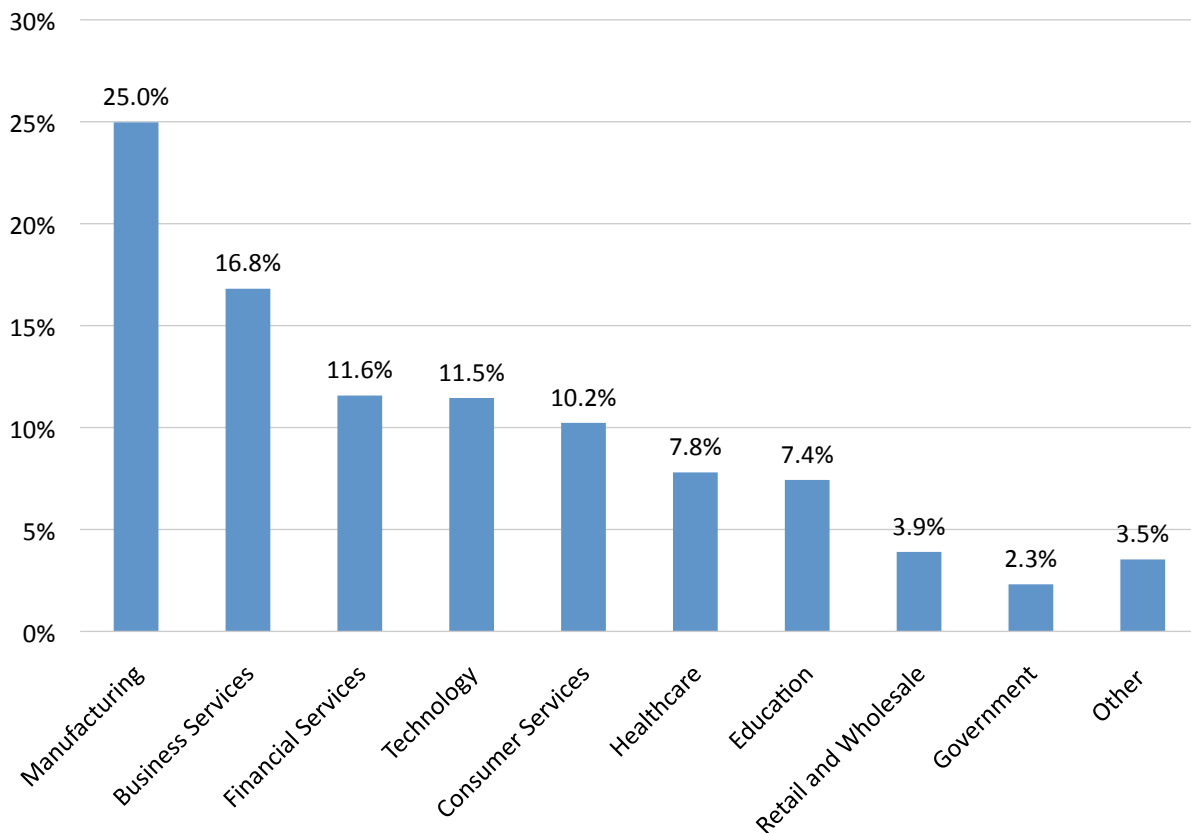
Figure 3 – Vertical industries represented

Organization Size

Survey respondents represent organizations of all sizes (measured by global employee head count). Small organizations (1-100 employees) represent 20 percent of respondents, mid-size organizations (101-1,000 employees) account for over 31 percent, and large organizations (>1,000 employees) account for the remaining 49 percent (fig. 4).

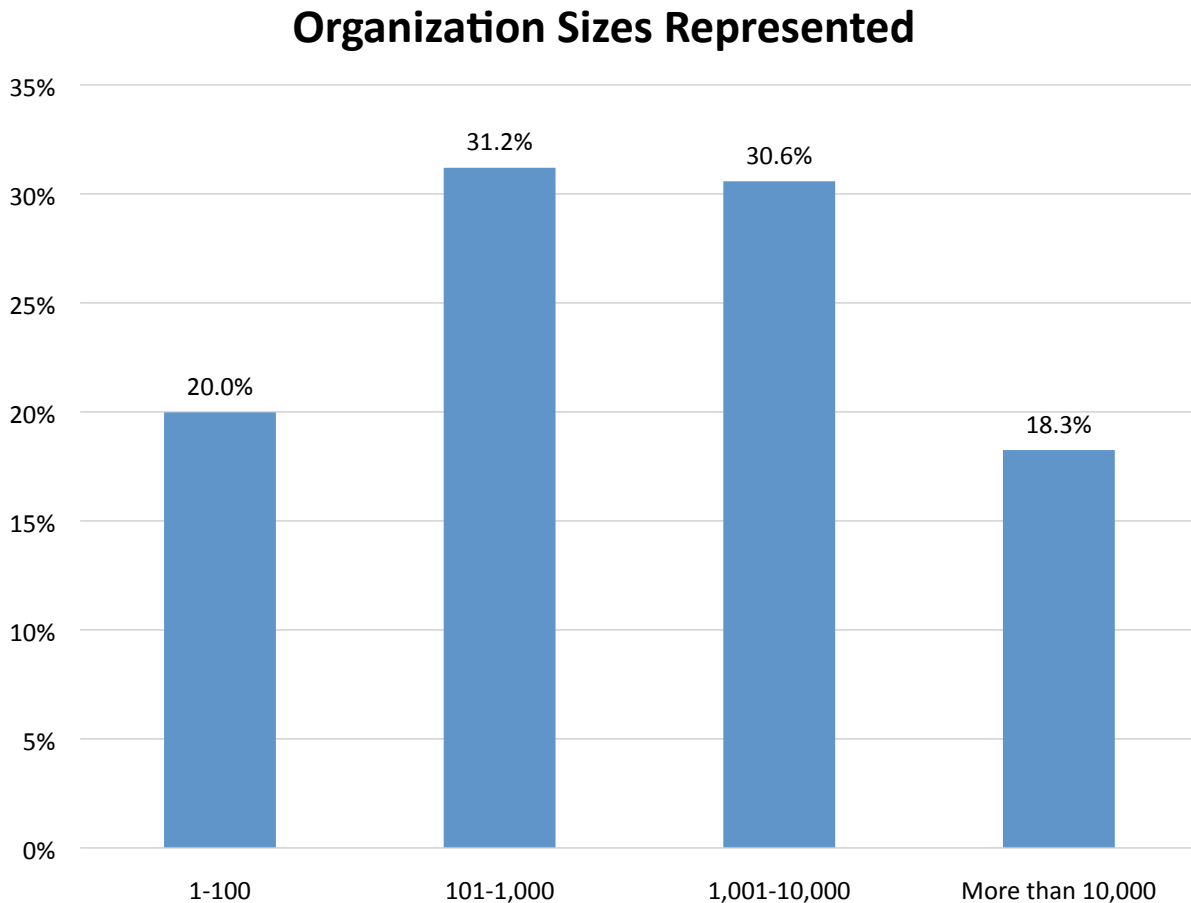Tabulating results by organization size reveals important differences in practices, planning, and maturity.

Organization Sizes Represented

Figure 4 – Organization sizes represented

Analytical Platforms

The notion of analytical (BI) platforms is not a new concept. However, as technology advanced, these platforms evolved and became more functional and more open, making them more viable than in the past.

For the purposes of this report, we define Analytical Platforms as integrated technology environments that include all needed functionality to support multiple analytical/BI use cases without requiring additional technologies, with the possible exception of analytical data infrastructure (ADI).

Analytical Platforms include the following capabilities:

- Data Engineering (data preparation, data integration, data workflows)
- Self-Service (including user governance, guided analytics, collaboration)
- Data Science and Machine Learning
- Embedded BI/Analytics
- Natural Language Analytics
- Cloud-Based Support, including SaaS

Data Engineering

Data engineering provides capabilities for users to develop engineered data workflows that access stored or streaming data and transform, prepare, and process it at scale, and efficiently and securely transfer pipeline results to and between the analytic data infrastructure repositories that manage the analytic content for BI users and use cases.

Frequency of Data Preparation

Sixty-five percent of respondents say they "constantly" or "frequently" make use of data preparation in 2021 (up 3 percent from 2020) (fig. 5). We cannot distinguish whether end-user efforts are unique or repeated manipulations; but overall usage of data preparation appears to be high, with a total of 88 percent reporting at least "occasional" data-preparation activity. Only about 13 percent of respondents "rarely" or "never" perform data preparation (down from 16 percent in 2020).

Frequency of Data Preparation
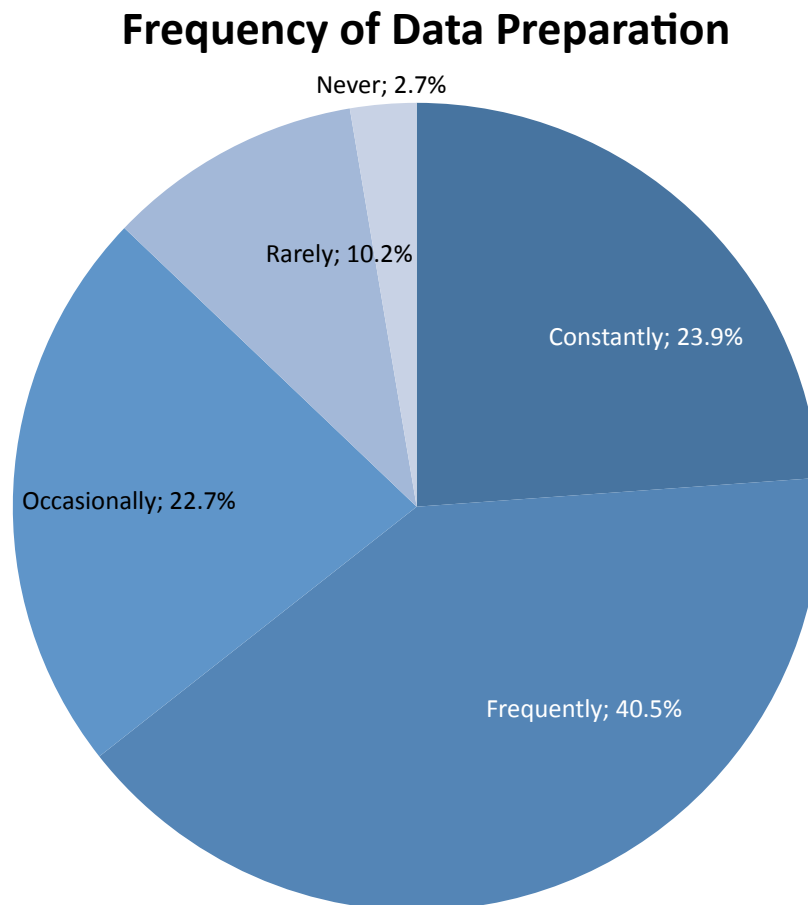
Figure 5 – Frequency of data preparation

Data-Preparation Usability Features

There is strong interest across 14 sampled data-preparation usability features, 12 of which are at least "important" to about half or far more of respondents (fig. 6). We believe this reflects good understanding of needs and high expectations for basic to advanced data-preparation features. The most important of these features is utilitarian save-and-preview capabilities, closely followed by automated detection and immediate preview and feedback. We note that machine learning, highly touted by the vendor community, is currently the least-required usability feature for data preparation.

Figure 6 – Data-preparation usability features

Data-Preparation Data-Integration Features

Demand for data-preparation data-integration features is selectively very strong across eight different choices we sampled in our 2021 study (fig. 7). The top three features ("ability to combine data across multiple data sets and sources," "access to file formats," and "access to traditional databases") are "critical" to between 48-54 percent of respondents and at least "very important" to between 70-82 percent of our sample. "Ability to access semi-structured data" is also high on the list, with more than 60 percent "critical" or "very important" scores. We also note that "access to big data" and "access to NoSQL sources" remain the least important data-preparation integration features among respondents.

Data-Preparation Data-Integration Features
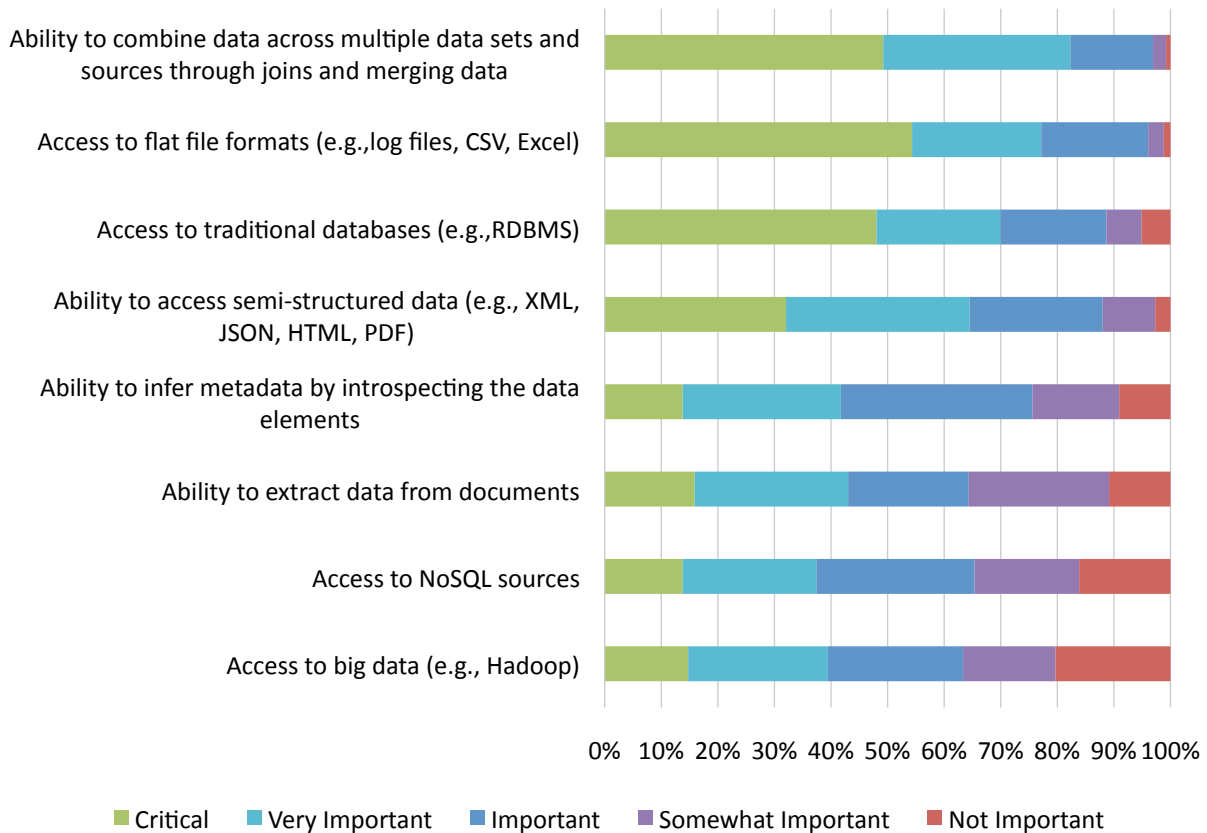
Figure 7 – Data-preparation data-integration features

Data-Preparation Manipulation Features

We asked organizations to score their interest in specific data-manipulation features and, once again, find a very high and broad level of interest (fig. 8). The top five features ("ability to aggregate and group," "ability to pivot," "ability to normalize," "support for cutting, merging, and replacing," and "ability to derive new data features"), are at least "very important" to 70 percent or far more respondents. The next two most important features ("simple interface for imposing raw structure" and "ability to manipulate order of data transformation steps") are nearly as important. All but the lowest-ranked feature ("session-ize log or event data") are, at minimum, "very important" to half or more of respondents.

Data-Preparation Manipulation Features
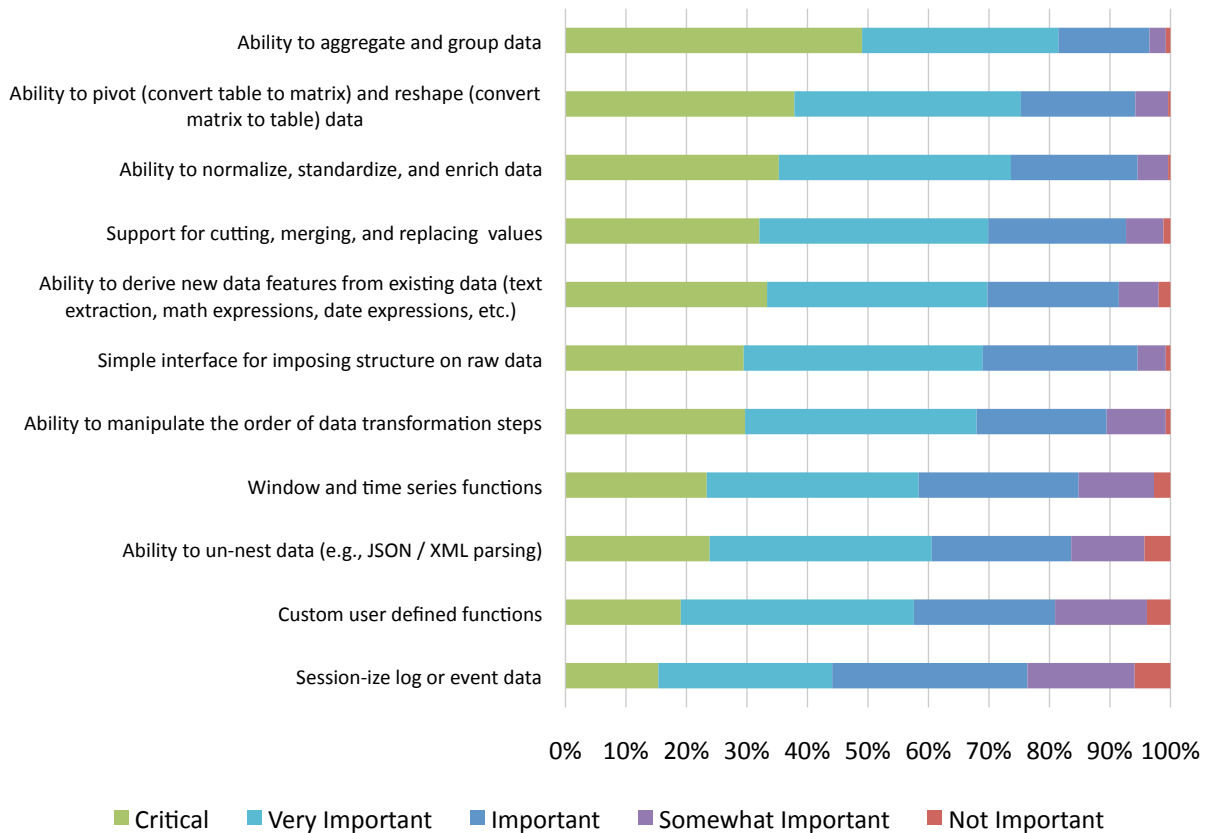
Figure 8 – Data-preparation manipulation features

Data-Preparation Supported Outputs

Respondents say the most important data-prep output is to Excel and CSV (89 percent), followed by traditional relational databases (69 percent) (fig. 9). The next most popular outputs are JSON (51 percent), popular third-party business intelligence tool formats (36 percent), and Azure (35 percent). After Azure, supported output interest drops for Amazon Redshift (30 percent) and Google BigQuery (27 percent). All remaining output support options are named by less than 20 percent of respondents. (The predominance of Excel, shown over time in the following chart, provides another useful perspective.)

Data-Preparation Supported Outputs
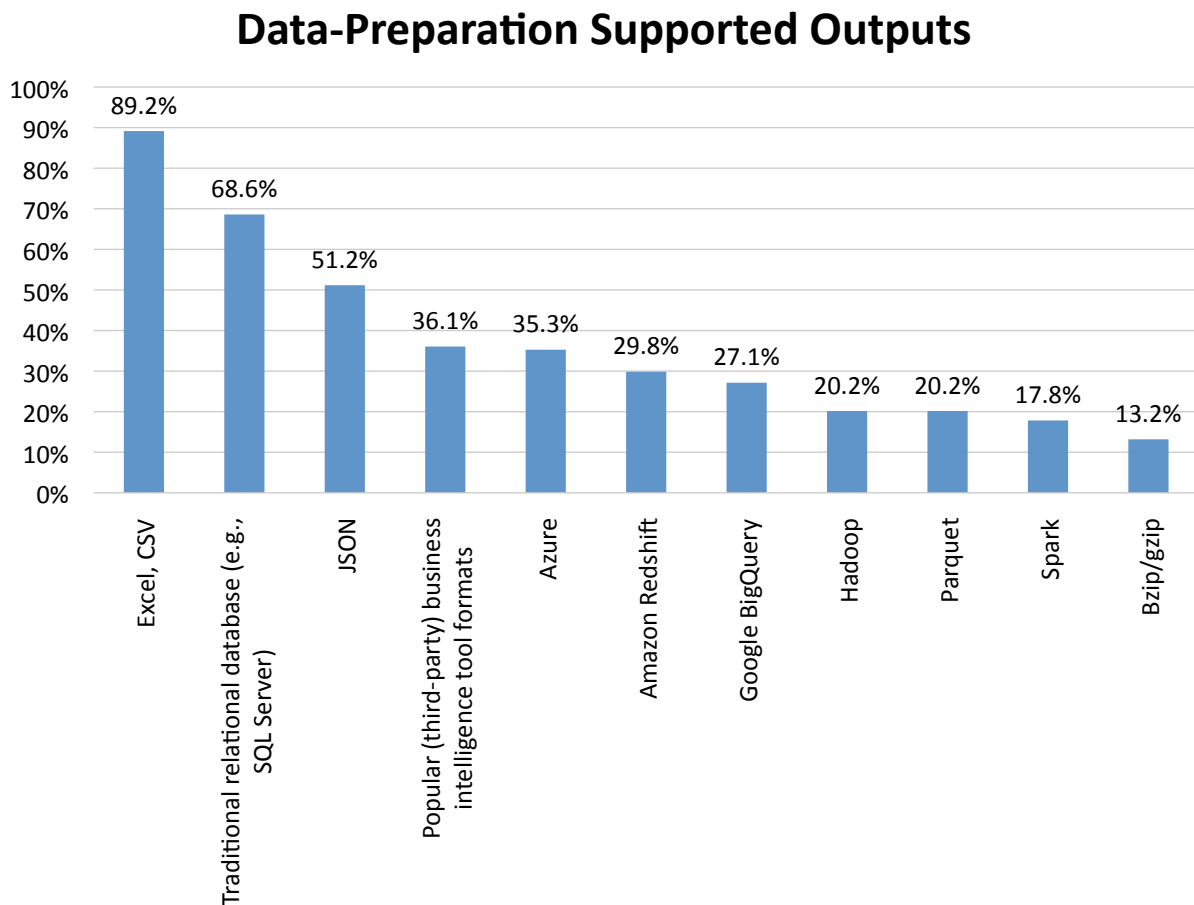
Figure 9 – Data-preparation supported outputs

Data-Preparation Deployment Features

We asked respondents about their preferences for scheduling, monitoring, and processing aspects that make data preparation part of a more formal ongoing process (fig. 10). While such deployment features resonate slightly less than other data-preparation capabilities, the three most popular features ("schedule a process to run on a time-based or trigger-based event," "ability to monitor ongoing data transformation," and "ability to schedule execution/replay of data transformation processing") are either "critical" or "very important" to between 64-81 percent of respondents. Interestingly, "API support" ranks fourth out of seven feature choices, up one place in ranking from our 2020 study.

Data-Preparation Deployment Features
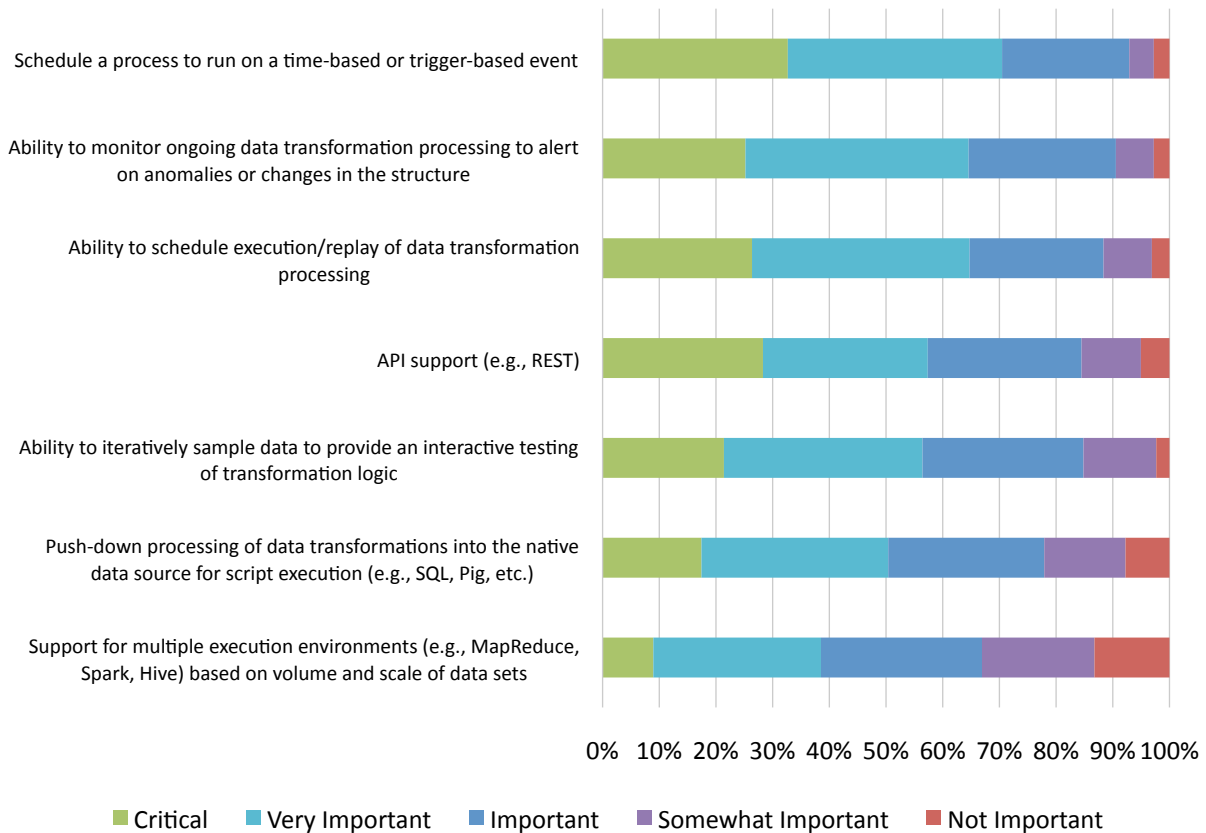
Figure 10 – Data-preparation deployment features

Use Cases for Data Pipelines and Integration

We asked what percent of BI/analytical use cases drive the purchase and use of data pipelines and integration (fig. 11). The most important (and common) use case is as part of the data integration, cleansing, and transformation workflows for a data warehouse used for reporting and dashboards. The next most important use case is for ad hoc query, discovery, and exploration analysis. Data sciences and augmented analytics are the lowest priority for data pipelines and integration. We may attribute this to stand-alone end-user data-integration/preparation tools and the use of in-memory data integration/transformation capabilities available to many data scientists.

Data Pipelines and Integration Use Cases
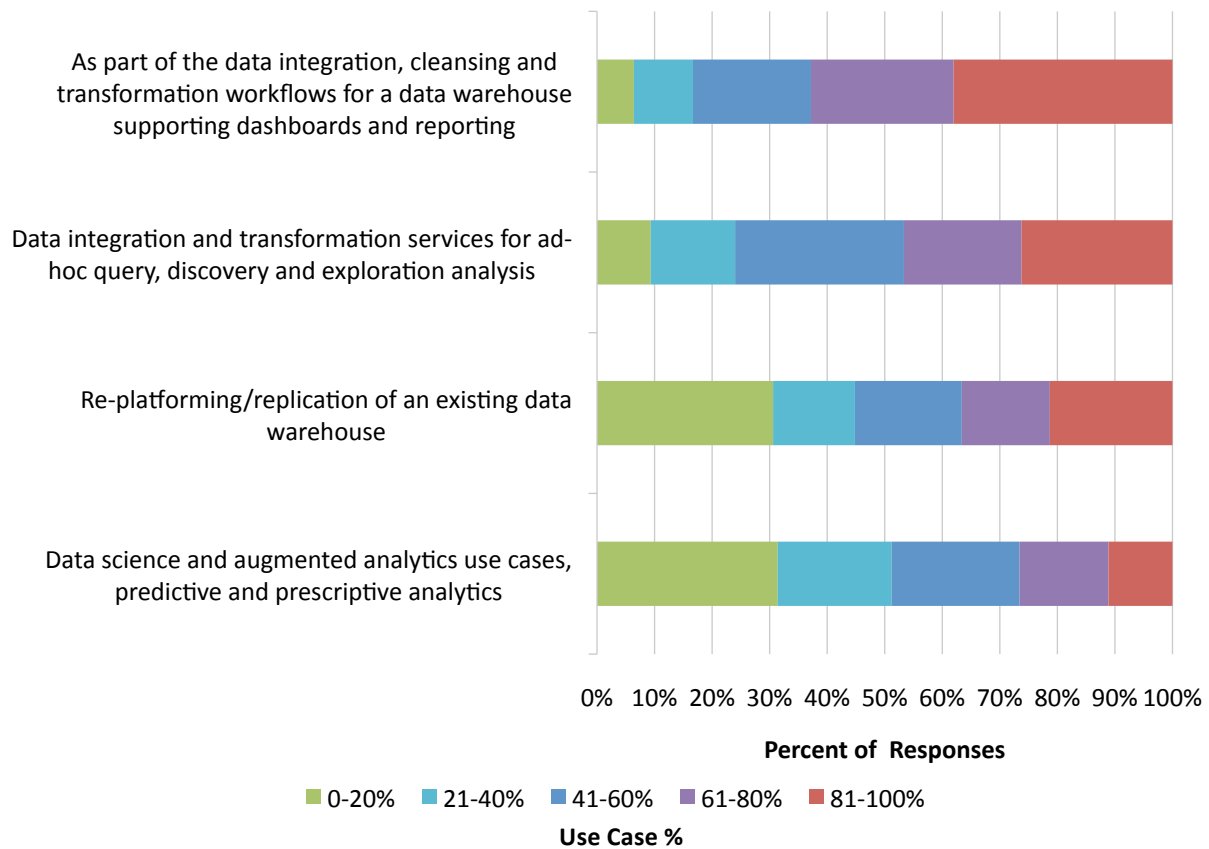
Figure 11 – Data pipelines and integration use cases

Data Pipelines and Integration Data Volumes

We asked survey respondents what average data volume (in gigabytes) they move/integrate through data pipelines and integration (fig. 12). Most organizations deploying data pipelines and integration process less than 100 GB/day. Twenty-four percent of respondents move/integrate more than a terabyte a day (between 1,000-10,000 GB per day). The number of responses indicating data volumes larger than 10 terabytes a day increased compared to 2020.

Figure 12 – Data pipelines and integration data volume 2020-2021

Data Sources and Targets

We asked our survey respondents to identify the sources and targets for data pipelines and integration. Most respondents indicate relational databases as the most important source/target (fig. 13). This is consistent with our 2021 market survey on Analytic Data Infrastructures, where the primary data types for analysis are transactional data.
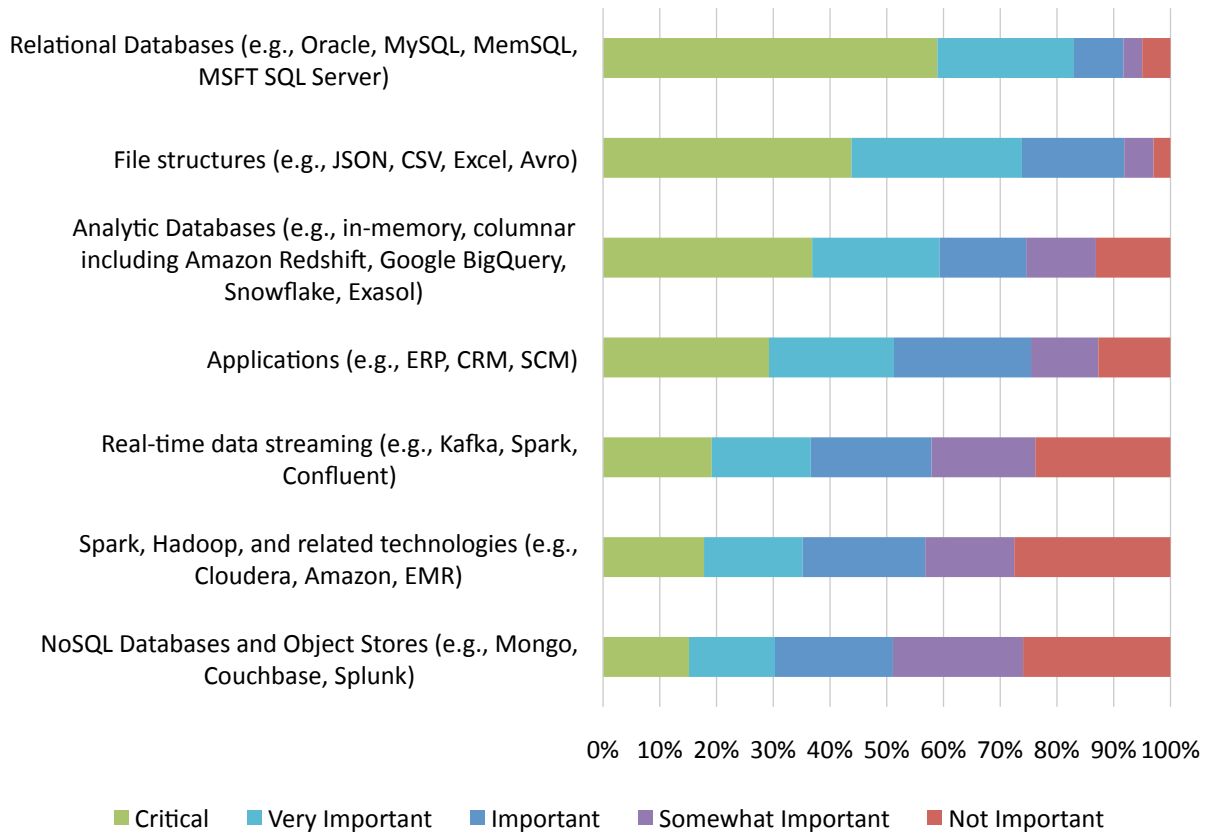
Data Sources and Targets

Figure 13 – Data sources and targets

Data Transformation

Figure 14 presents respondents' ranking of their data transformation functional priorities. Of interest, the two most traditional styles of data pipelines and integration functionality, Extract Transform and Load (ETL) and Extract Load Transform (ELT), are among the highest functional priorities. Of note is the low priority for integration of unstructured data.
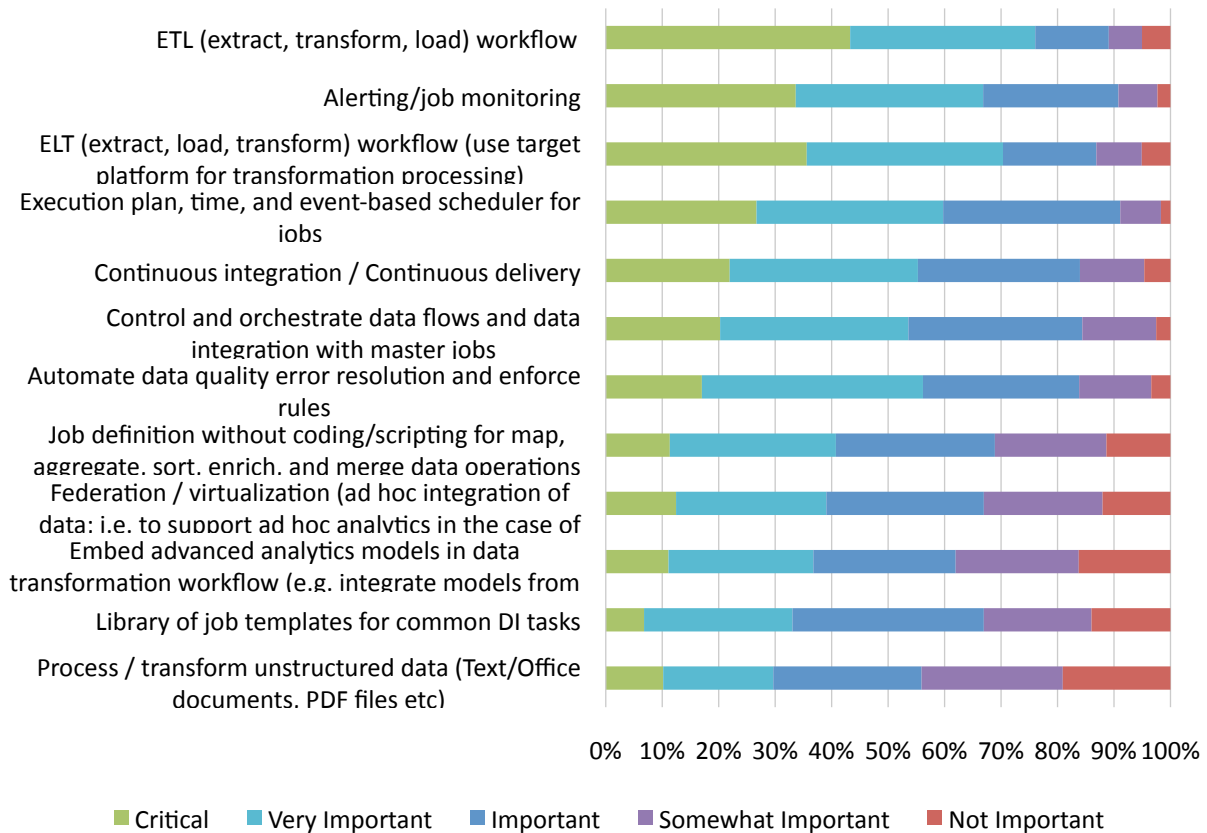
Data Transformation Priorities

Figure 14 – Data transformation priorities

Advanced Data Transformation

In this year's survey, we asked about the priority of advanced data transformations. More basic capabilities, found in most ETL / ELT products such as aggregations and user-defined functions, rank highly, whereas more advanced capabilities such as path/link analysis and sentiment analysis are not priorities for data pipelines and integration (fig. 15) according to our survey respondents.
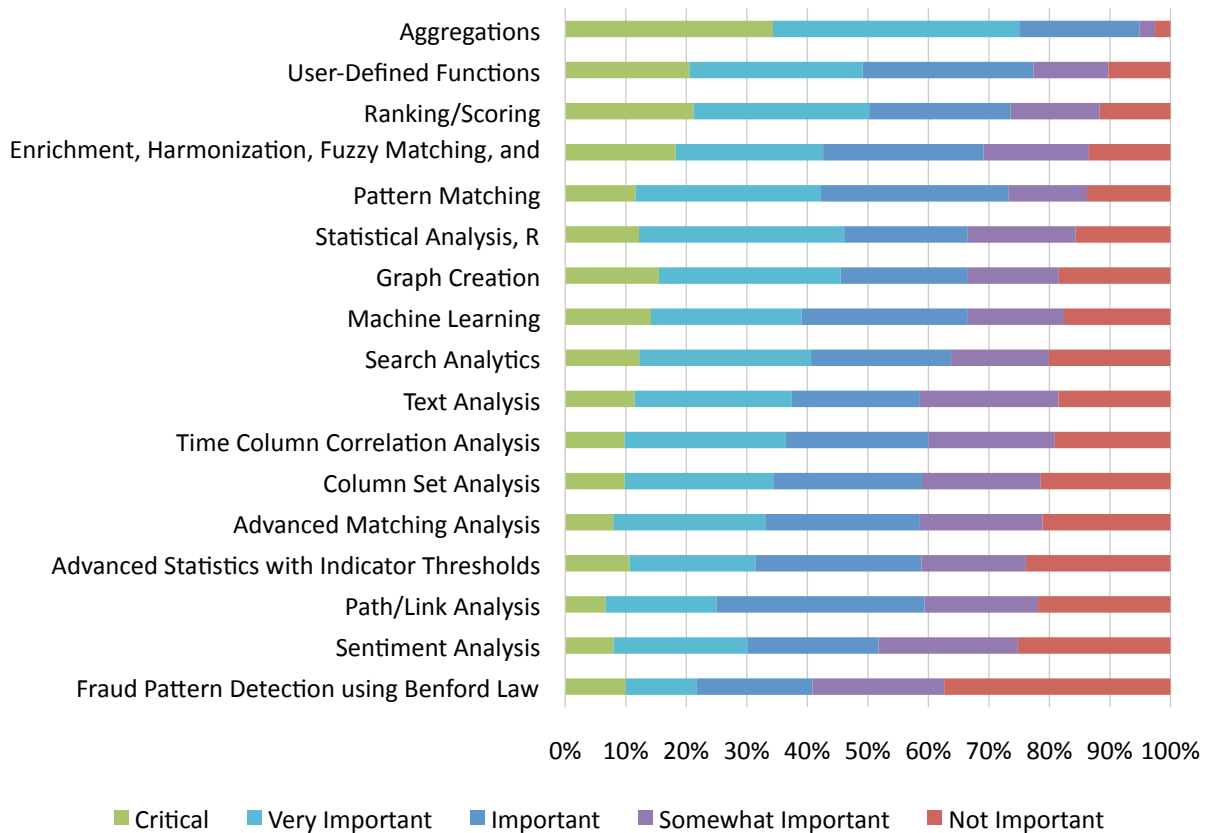
Advanced Data Transformation Priorities

Figure 15 – Advanced data transformation priorities

Data Orchestration

We asked survey respondents to rank the importance of data-orchestration capabilities (fig. 16). They place a higher priority upon functionality that allows data integration to be scheduled, synchronized, and connected (via connectors and metadata) to other workflows rather than making the development itself simpler (i.e., using a library of pre-built components or a graphical drag-and-drop designer).
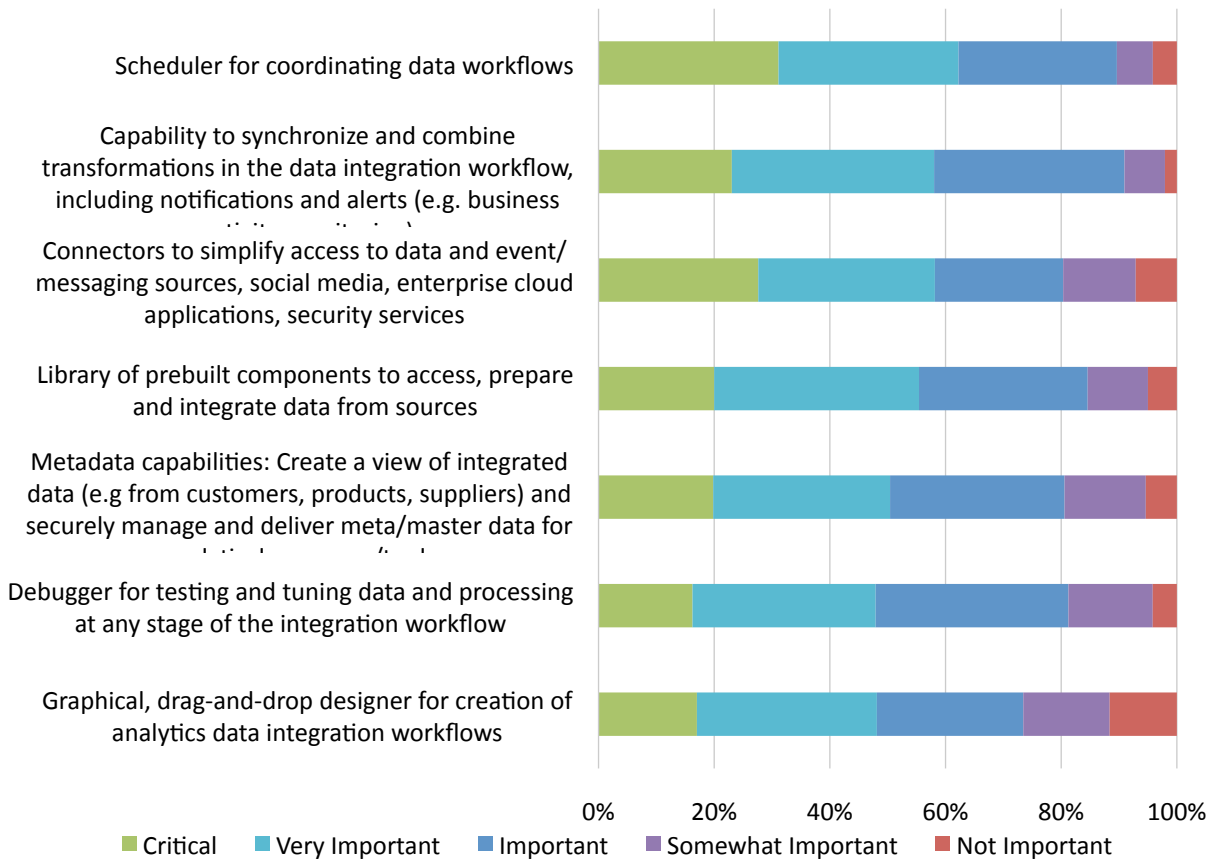
Data-Orchestration Priorities

Figure 16 – Data-orchestration priorities

Self-Service Business Intelligence

Self-service BI is an environment where users can easily create and share insights in a managed and consistent fashion. Self-service BI includes support for collaboration, guided analytics, and user content governance.

Methods of Collaboration

Multiple conventional avenues for collaborating with business intelligence are popular and widely used by respondents, led by email, virtual meetings, face-to-face meetings, and formal presentations (fig. 17). At least 80 percent of respondents also occasionally use collaborative features in BI tools. After this, 60 percent or more of respondents at least occasionally use a second tier of embedded, telephone, file sharing, instant messaging, and enterprise collaboration tools. Also notable is the finding that social media channels are the least used method for collaboration (> 60 percent "never").
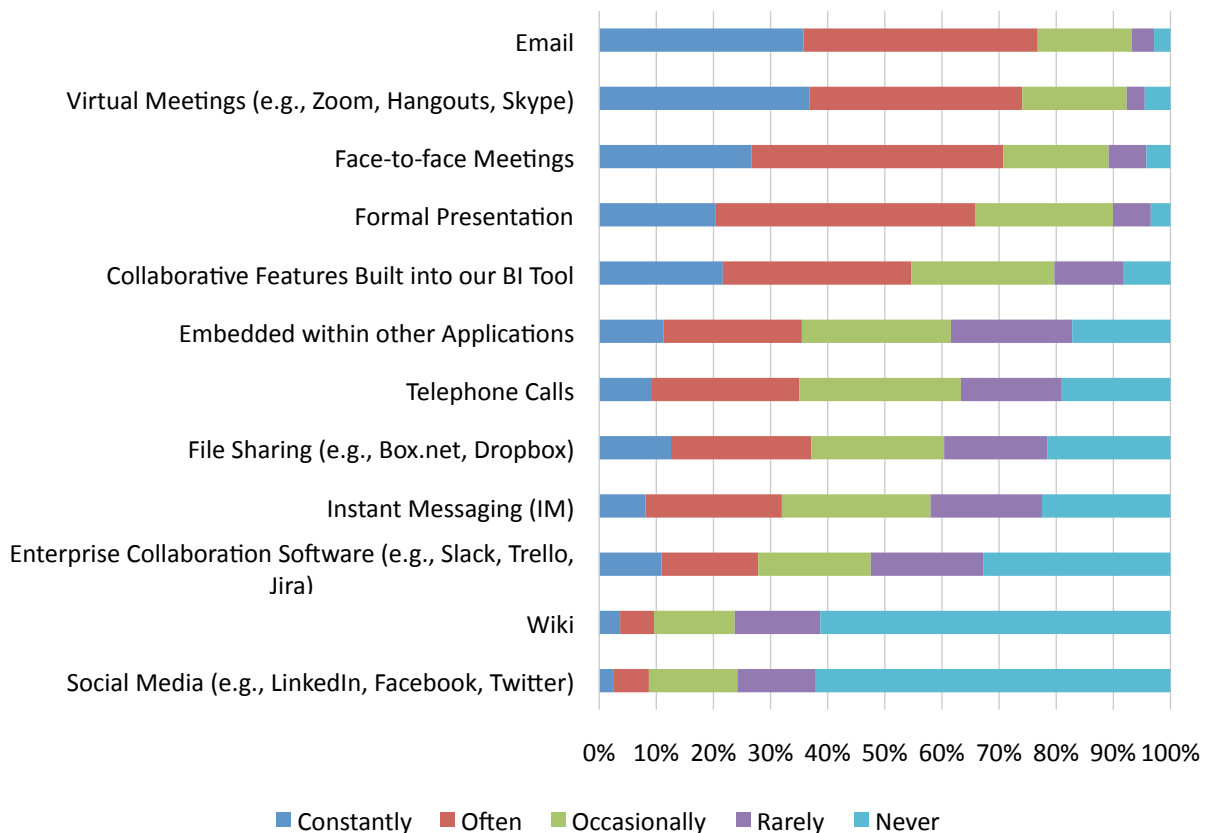
Methods of Collaboration Today

Figure 17 – Methods of collaboration today

BI Collaboration Requirements

In our 2021 study, "search and navigation for content" and "share content and commentary" are the top collaborative feature requirements among users (fig. 18). Along with "annotate content," the top three features are identical to our previous four studies. "Follow objects" is the next most important feature, narrowly ahead of "user-defined groups," which also echoes previous studies. Overall, adjusted-mean scores for all but two features are, at minimum, "important" to 60 percent or far more of our sample base.

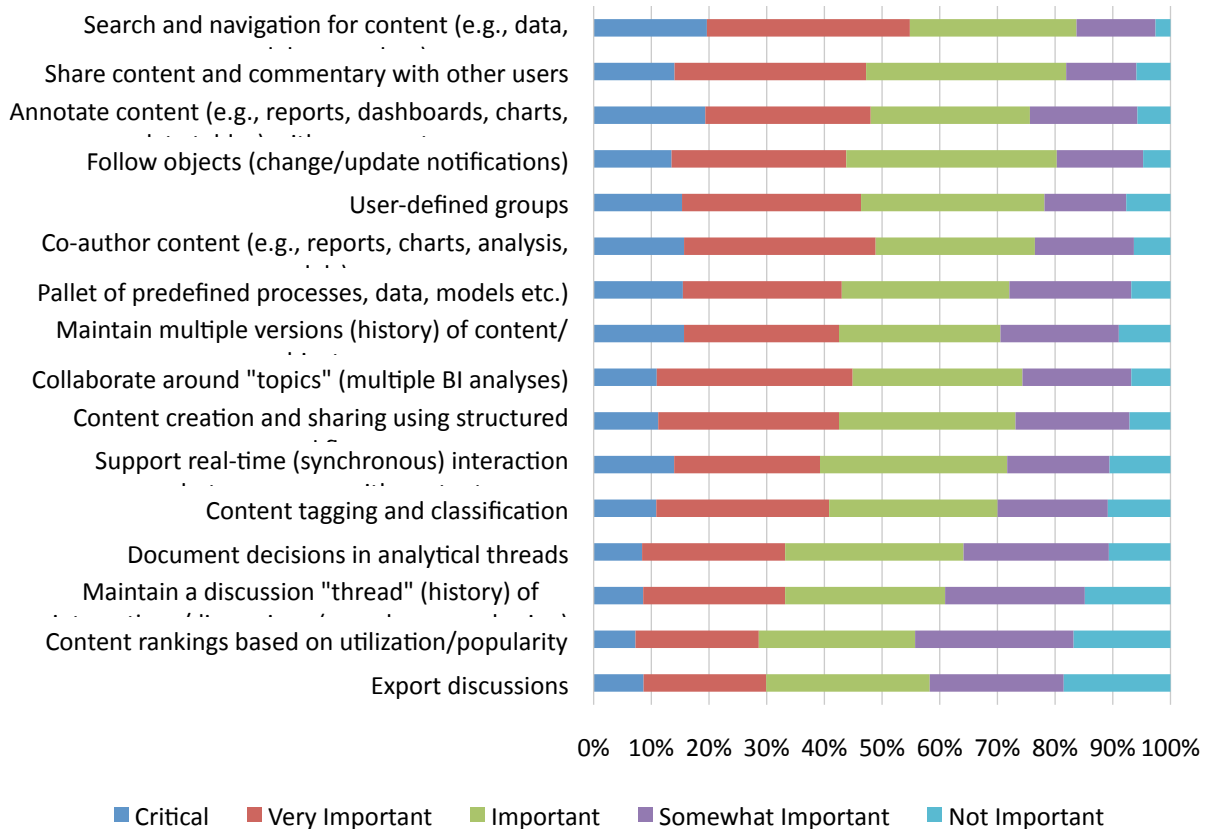## Collaborative Feature Requirements

Figure 18 – Collaborative feature requirements

Collaborative BI Features with Enterprise Frameworks

We asked respondents to score their interest in four collaborative BI features that might be available in enterprise collaborative frameworks: "inclusion of BI objects," "extended sharing," "ability to reference and search content," and "creating BI objects" (fig. 19). In our 2021 study, these features all elicit somewhat similar interest among respondents, led only marginally by "ability to reference and search BI content." None of the features summon more than about one-third combined "critical" and "very important" scores, though all are, at minimum, "important" to close to 60 percent or more respondents. Over the history of our study, slowly growing pluralities of respondents find these features at least "important;" but historically, fewer than 10 percent believe any are "critical."

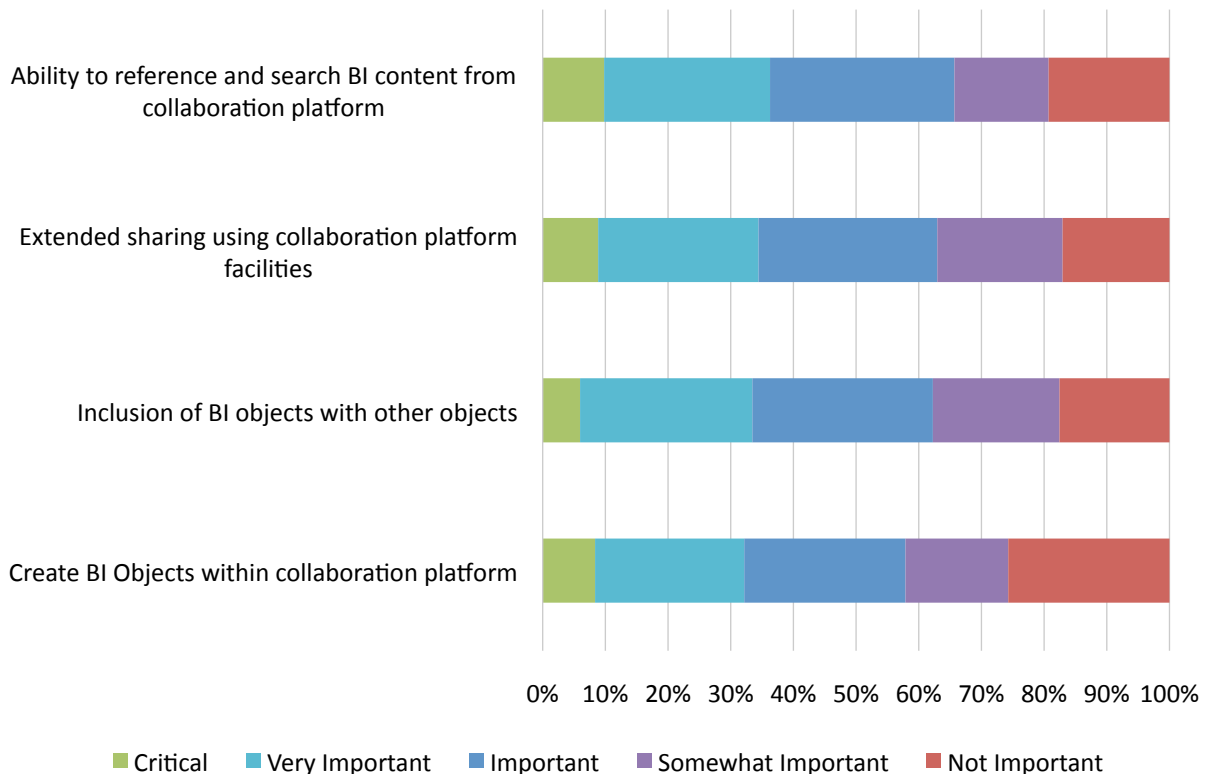**Collaborative BI Features with Enterprise Frameworks**

Figure 19 – Collaborative BI features with enterprise frameworks

Governance Features

We asked respondents to rank their preference for different BI content governance features and found broad appeal in our survey sample (fig. 20). As befits control of content creation specifically, the top feature need is the ability to "define levels of access to shared documents and data." "Integration with access management systems" and "ability to certify official versions of shared metadata, etc." are the next most important. These three top features are "critical" or "very important" to more than half of respondents. Not far behind, remaining requirements for administrative oversight, APIs, analyze/audit, and other review tools are, at minimum, "important" to three-quarters or more of all respondents. In sum, individual governance features are highly relevant though less important to respondents than the notion of governance itself.
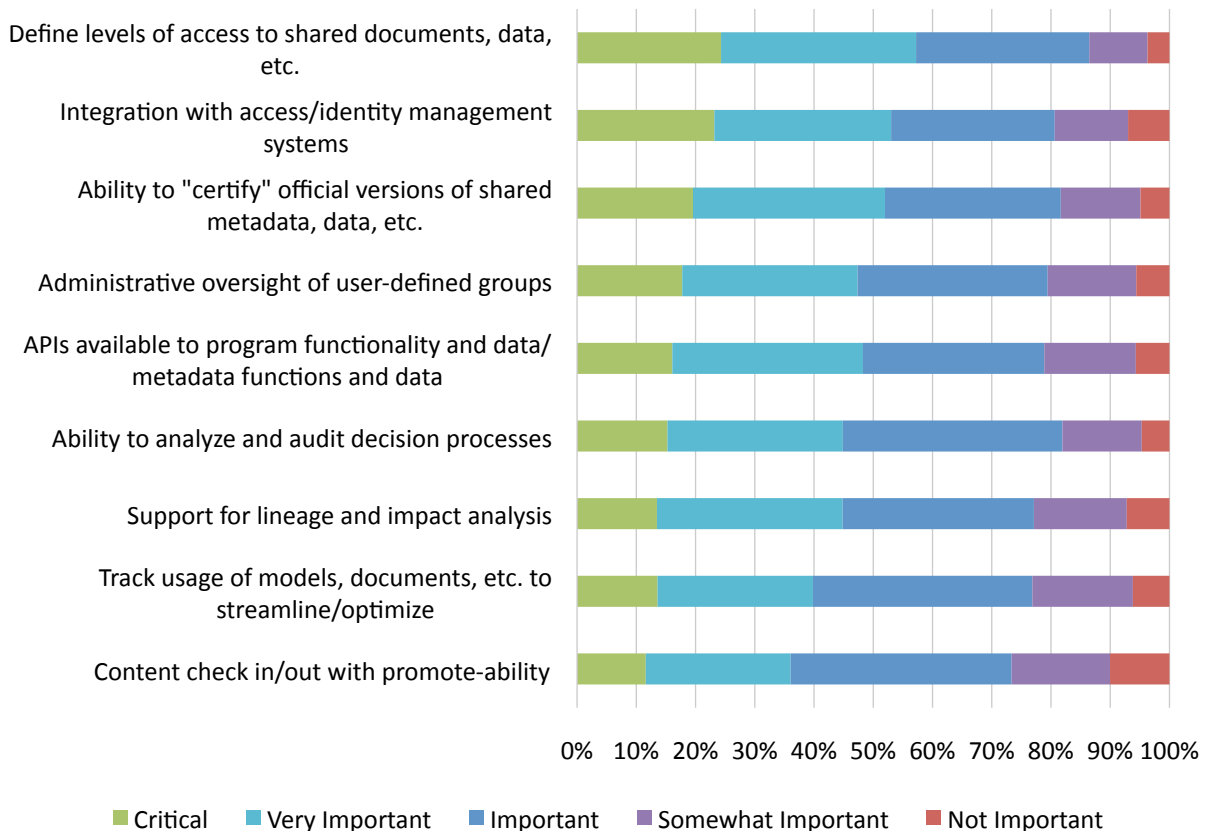
BI Content Governance Feature Requirements

Figure 20 – BI content governance feature requirements

Guided Analytics® Authoring Features

Guided Analytics is an outgrowth of our earlier research of data storytelling and related topics. Guided Analytics improves time to insight and action by supporting the creation of connections between related and relevant information and directing and suggesting analytical story flow.

We asked respondents to describe the appeal of a variety of authoring features in Guided Analytics in 2021 (fig. 21). The most important of these, "flexible, customizable authoring/content creation," is at least "important" to about 80 percent of respondents. The next six features are at least "important" to about 70 percent or more respondents and include "author-defined navigation," "ability to save/share guides," "navigational aids," "author highlighting," and "text annotations." Somewhat less important are features that involve machine learning, videos, and voice recordings.

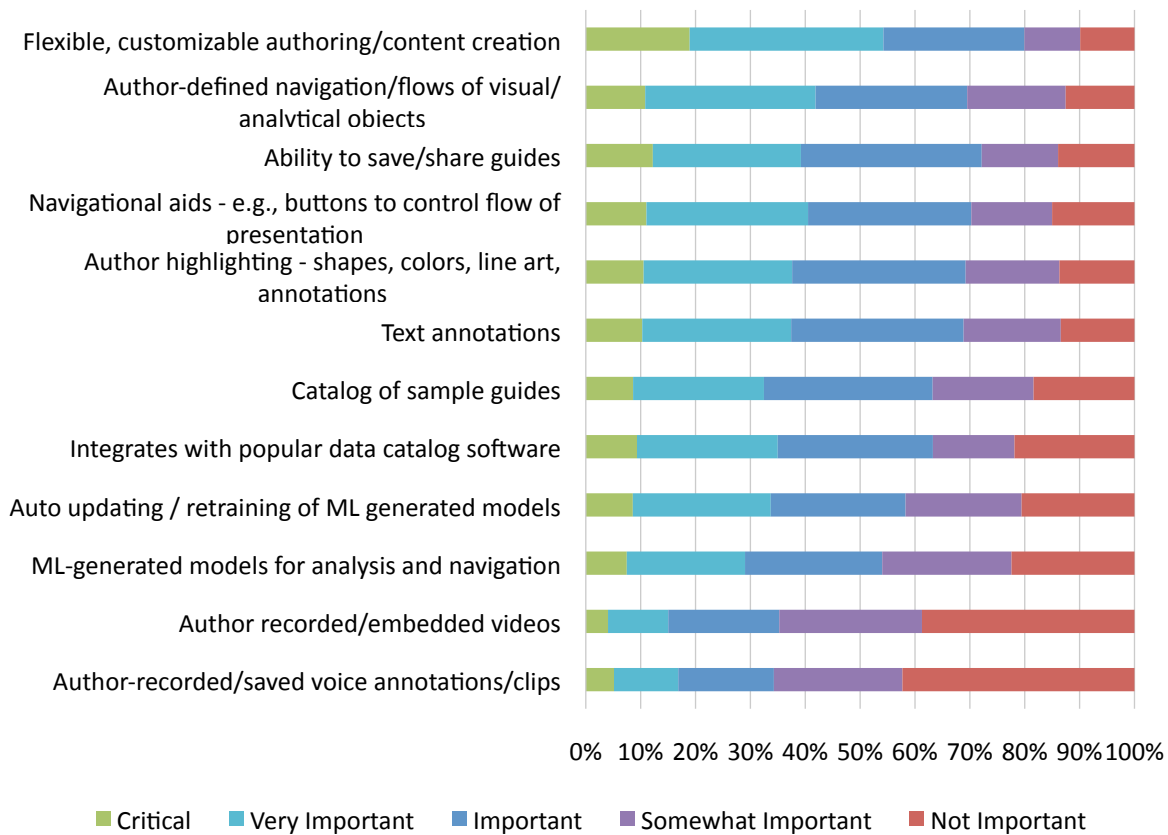## Guided Analytics Authoring Features

Figure 21 – Guided analytics authoring features

Guided Analytics User Features

We asked respondents to describe the appeal of 12 Guided Analytics user features in 2021 (fig. 22). The most important of these, "user interaction with visual/analytical objects," is "critical" or "very important" to about 45 percent of respondents and, at minimum, "important" to about three-quarters. A second tier of importance includes "directed navigation," "anomaly identification," "search/navigate/recommend available guides," "automated highlighting," and "contextual explanation capability." All these latter features are at least "important" to close to 70 percent or more respondents. Interestingly, recommendations engines, connections to governance systems, and machine learning-related functionality are all among lower-ranked features.
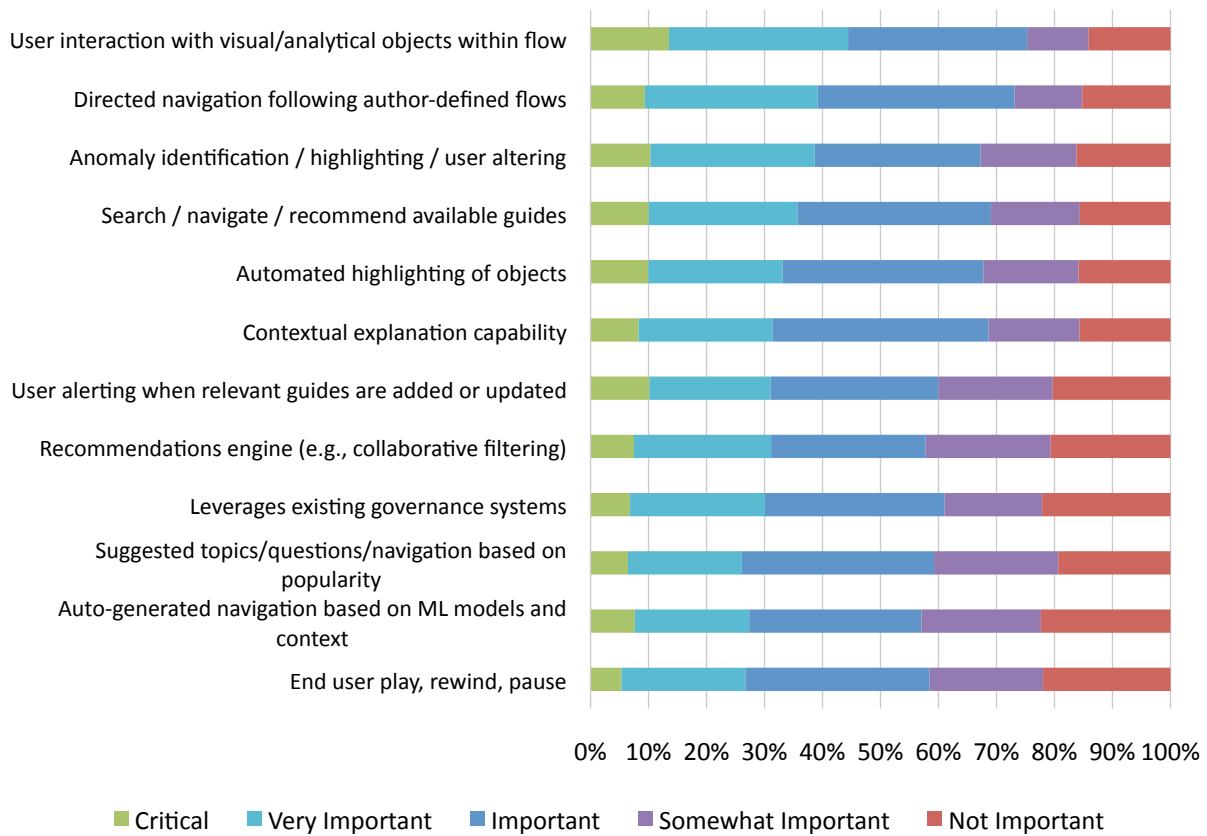
Guided Analytics User Features

Figure 22 – Guided analytics user features

Data Science and Machine Learning

Data science and machine learning includes statistics, modeling, machine learning, and data mining to analyze facts to make predictions about future or otherwise unknown events.

Analytical Feature Requirements for Data Science and Machine Learning

Respondents express significant interest in a broad range of feature requirements for data science and machine learning in 2021 (fig. 23). The most popular among these support traditional statistical methods: "range of regression models" and "hierarchical clustering." These two top features are, at minimum, "important" to close to 80 percent or more respondents. The next most important features include "recommendation engine included," "textbook statistical functions," "automatic feature selection," and "Bayesian methods."

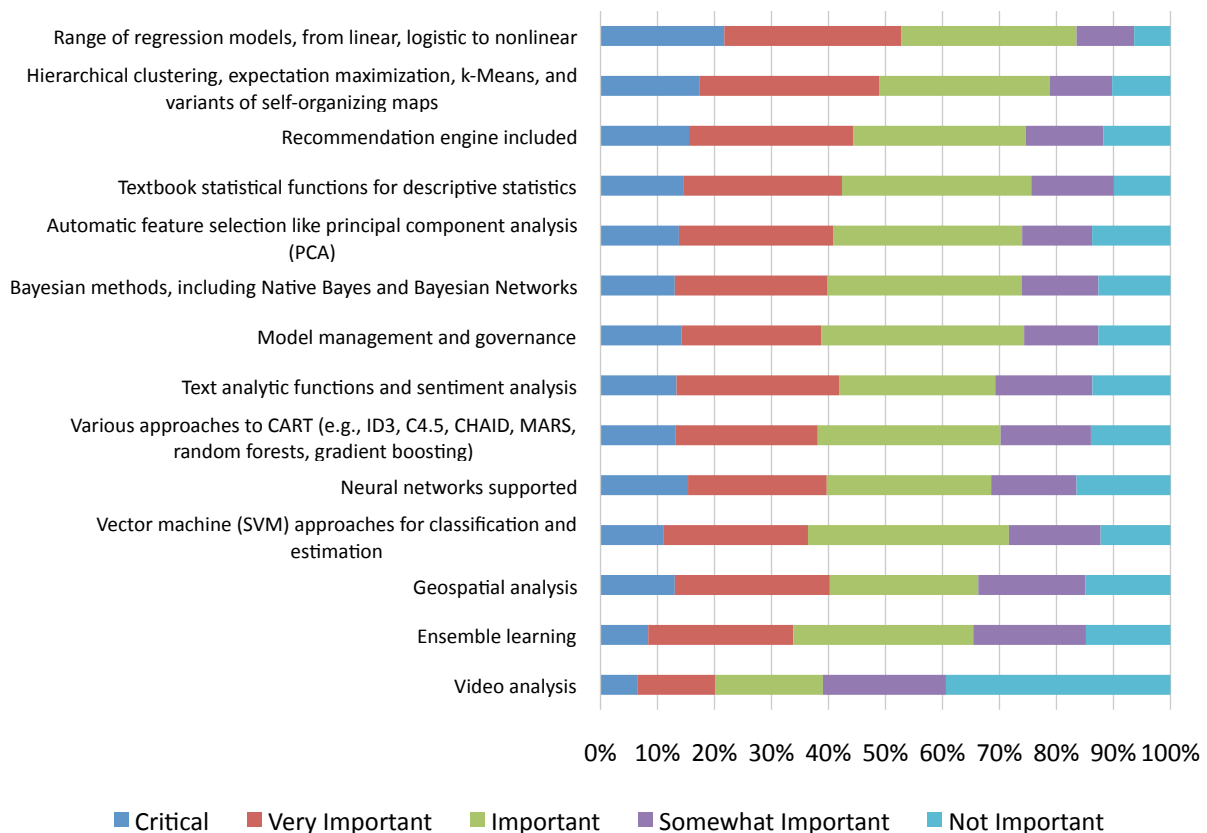## Features for Data Science and Machine Learning

Figure 23 – Features for data science and machine learning

Usability for Data Science and Machine Learning

Our study addresses a detailed set of nine usability benefits that support data science and machine learning activities and processes.

Usability features generally address process or activity simplification and automation and, without exception, respondents give them high importance. Across the nine criteria we sample, six are, at minimum, "important" to 80-89 percent respondents, and all are "important" to three-quarters or more (fig. 24). The top three features ("support for easy iteration," "access to advanced analytics," and "simple process for continuous modification") are "critical" or "very important" to 53-54 percent of respondents. Even at the bottom of this list, the feature "specialist not required" is still "important" to 75 percent.

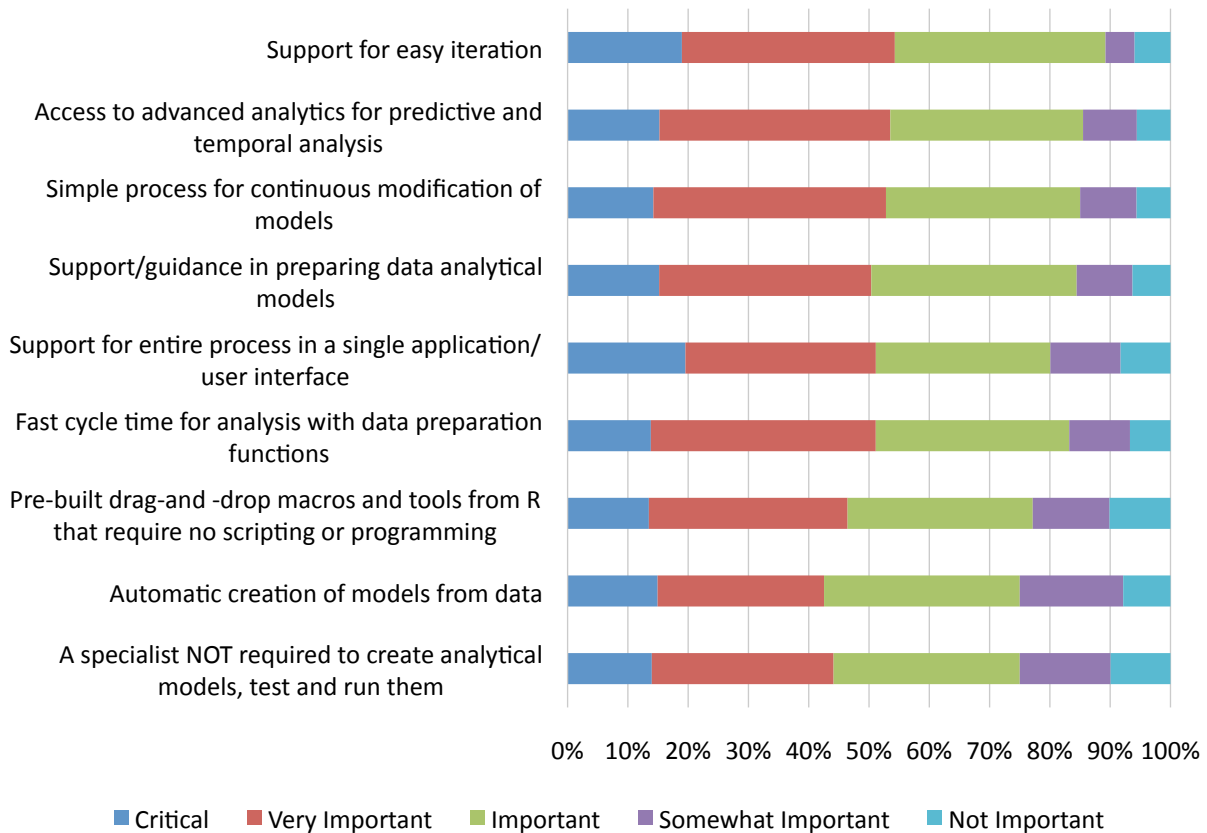## Usability for Data Science and Machine Learning

Figure 24 – Usability for data science and machine learning

Neural Networks for Data Science and Machine Learning

We asked organizations to gauge their interest in types and aspects of neural networks in the context of data science and machine learning (fig. 25). The top pick in 2021 is "artificial neural networks," seen as "critical" or "very important" to more than 40 percent of respondents, and, at minimum, "important" to greater than 70 percent. Interest in the remaining features is only somewhat lower and somewhat evenly divided. Close to or more than two-thirds of respondents say "recursive neural networks" and "convolutional neural networks" are, at minimum, "important," while more than half of respondents say "short-term memory" and "deep belief networks" are at least "important."

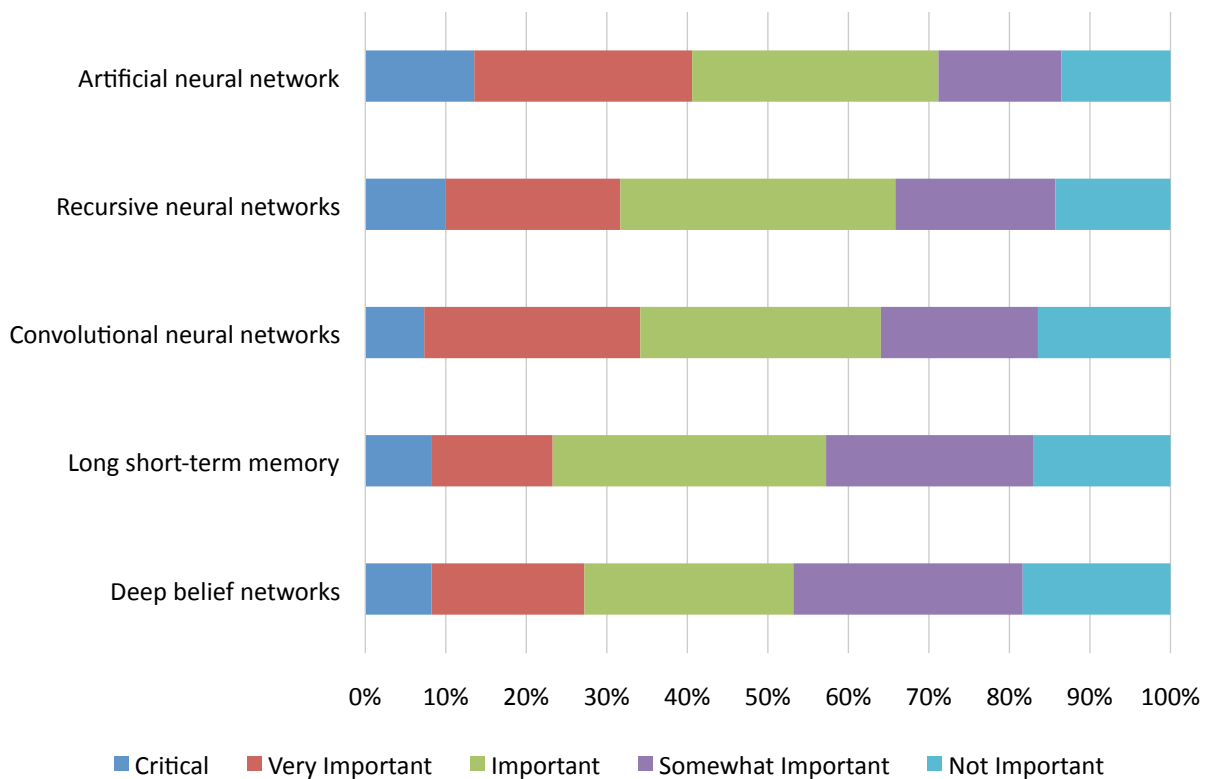## Neural Networks for Data Science and Machine Learning

Figure 25 – Neural networks for data science and machine learning

Big Data and Open-Source Features for Data Science and Machine Learning

We asked organizations to gauge their interest in 11 big data and open-source features for data science and machine learning in 2021 (fig. 26). The top pick in 2021 is industry stalwart Spark, seen as "critical" or "very important" to about one-third of respondents, and, at minimum, "important" to over half. Interest in remaining features falls off gradually to lower levels of importance than those sampled for features for data preparation or usability. Only the aforementioned Spark is "important" to at least 50 percent of respondents. Seven of eleven features are considered "not important" by half or more respondents.

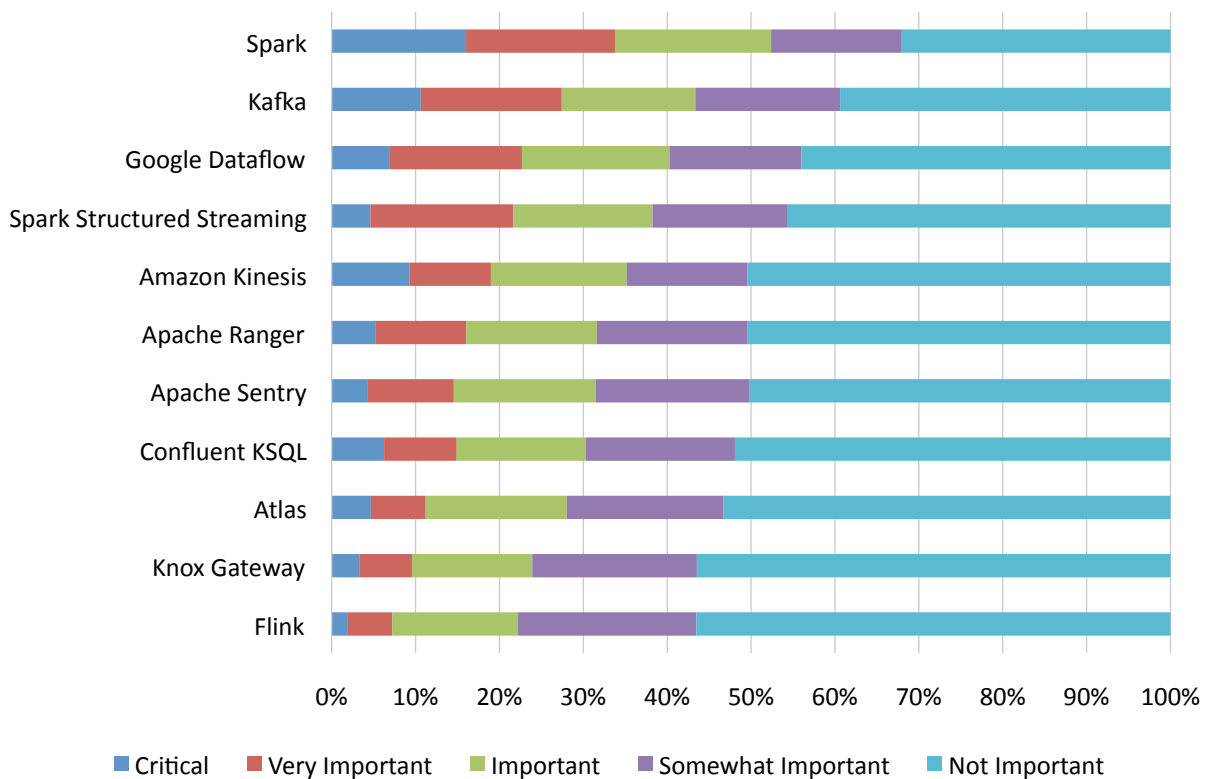## Big Data and Open-Source Features for Data Science and Machine Learning

Figure 26 – Big data and open-source features for data science and machine learning

Open-Source Statistical and Machine Learning Technologies

We asked organizations to gauge their interest in 10 open-source statistical and machine learning technologies for data science and machine learning in 2021 (fig. 27). Within this category, several choices have relevant importance, led by R language, which is "critical" or "very important" to 44 percent of respondents and at least "important" to close to 70 percent. The next two choices are Tensorflow and PyTorch, which are "critical" or "very important" to 38 and 35 percent respectively. All remaining options are "critical" or "very important" to 30 percent or less of respondents and are at least "important" to fewer than half or far fewer respondents. The lowest six choices are "not important" to between 40-55 percent of respondents.

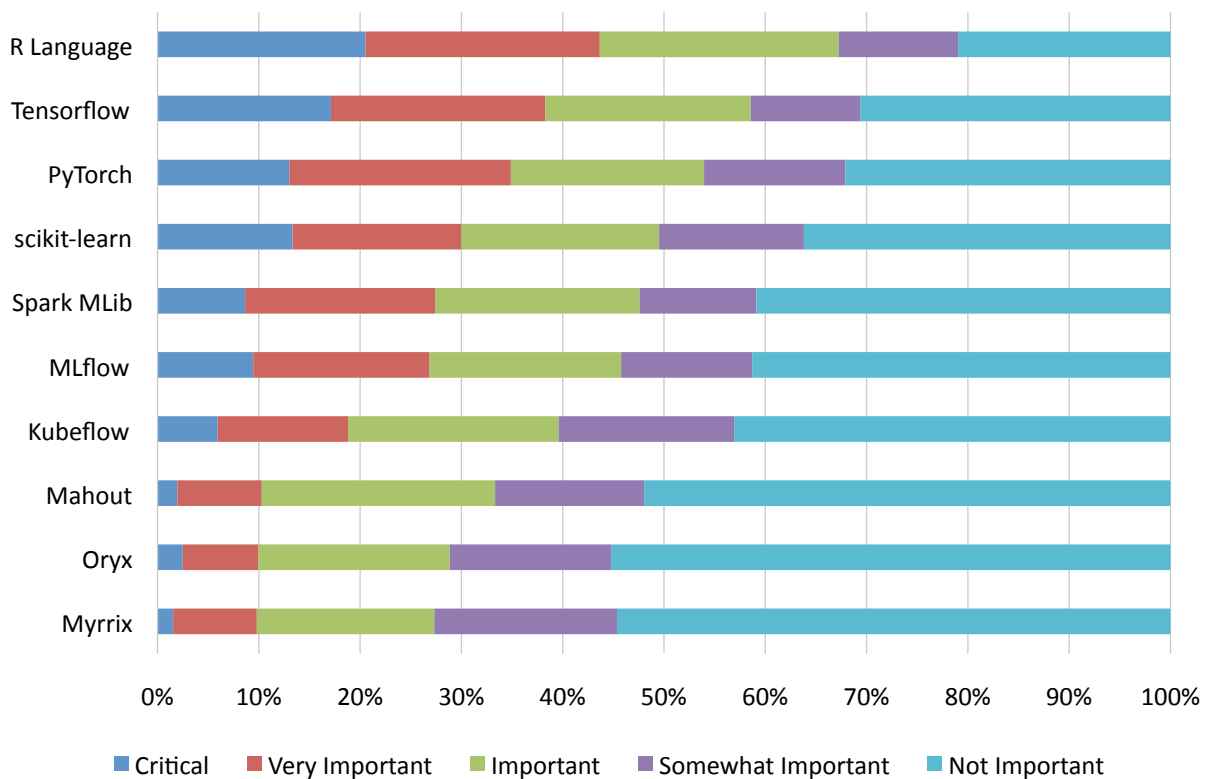## Open-Source Statistical and Machine Learning Technologies

Figure 27 – Open-source statistical and machine learning technologies

Embedded Business Intelligence

Embedded business intelligence is the technological capability to include BI features and functions as an inherent part of another application.

Objectives for Embedded BI

We asked organizations about their objectives for embedded BI and presented a choice of eight responses (fig. 28). We see a top tier of employee-facing priorities, led by "enhanced access to existing reports/analyses," "self-service for end users," "giving internal application users in-context insights and analysis," "and broader access for internal users." User enablement is clearly the theme for embedded BI objectives in 2020 (continuing a trend we also observed in 2018-2019), especially when compared to a much lower emphasis on monetization, external users, or cost control.
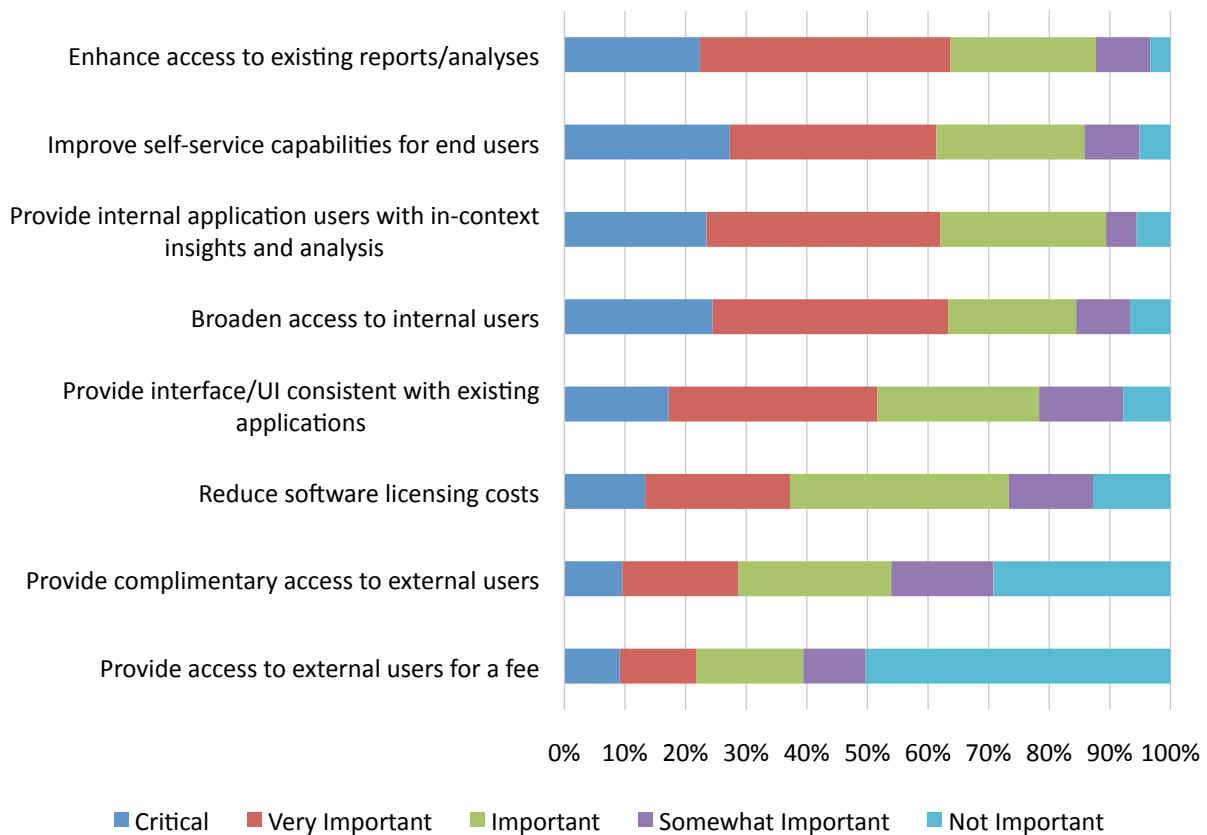
Objectives for Embedded BI

Figure 28 – Objectives for embedded BI

Embedded Business Intelligence Interface Integration features

We asked respondents to describe their interest in a variety of embedded BI interface integration features (fig. 29). The top feature is "interact with objects," and the second top choice is "HTML/iframe." "Browse/select from a catalog of objects," "workflow support," and "JavaScript API" are the next most required embedded BI features by weighted mean. "PHP framework," "D3," "Office API," support and "frameworks" (e.g., Force.com) are the lowest priorities. Over time, we expect integration in the form of lightweight services will bring the greatest adoption as older platform-based applications continue to migrate and sunset.

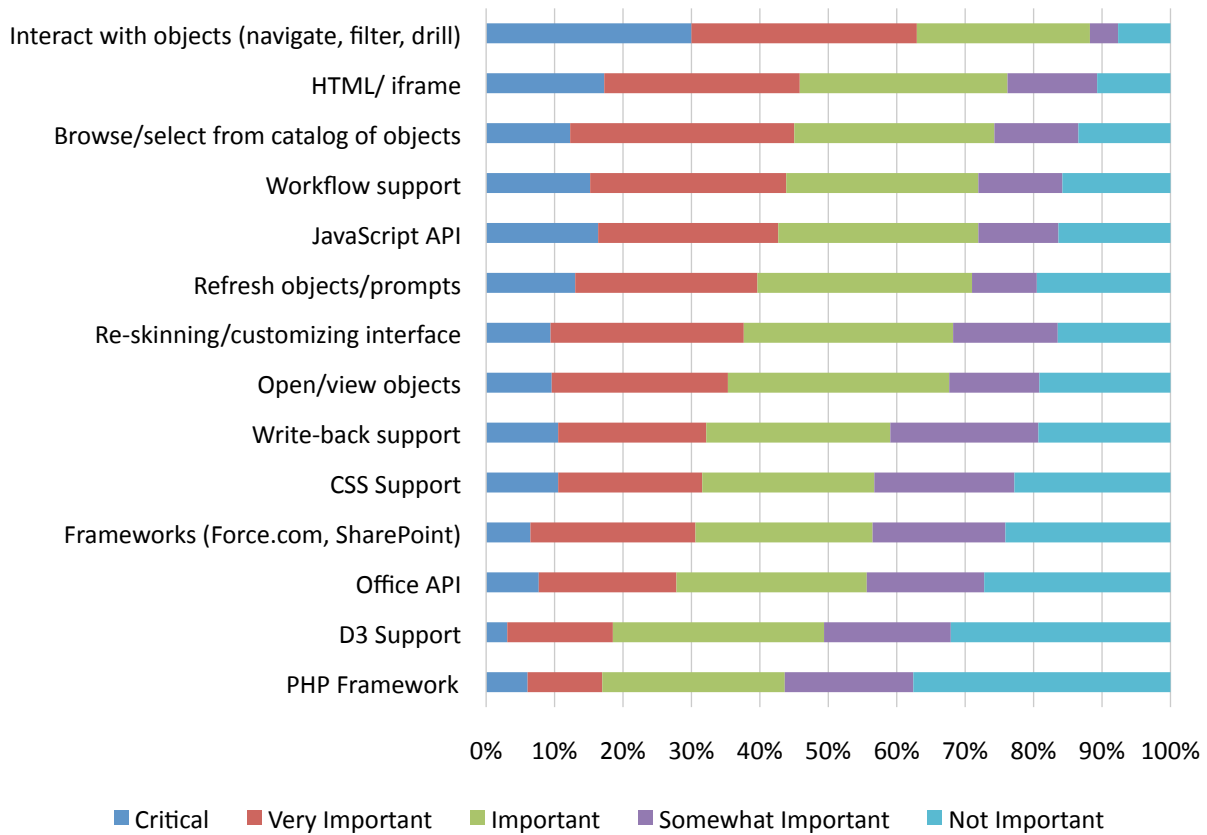## Embedded BI Interface Integration Features

Figure 29 – Embedded BI interface integration features

Embedded Business Intelligence Platform Integration and Extensibility

We asked respondents to prioritize seven embedded BI platform integration and extensibility features in order of importance to their roles and organizations. Their top choice, "single sign-on/security integration," is a nod to user experience; it most often scores "critical" (37 percent) and is, at minimum, "important" to about 84 percent of all respondents (fig. 31). The second and third choices, "REST API" and "Web services" are, at minimum, "important" to 79 and 75 percent of respondents respectively. "Run headless/invisibly" is at least "important" to 70 percent. Traditional .NET and Java APIs are the lowest priorities but are nonetheless "important" to majorities of respondents.

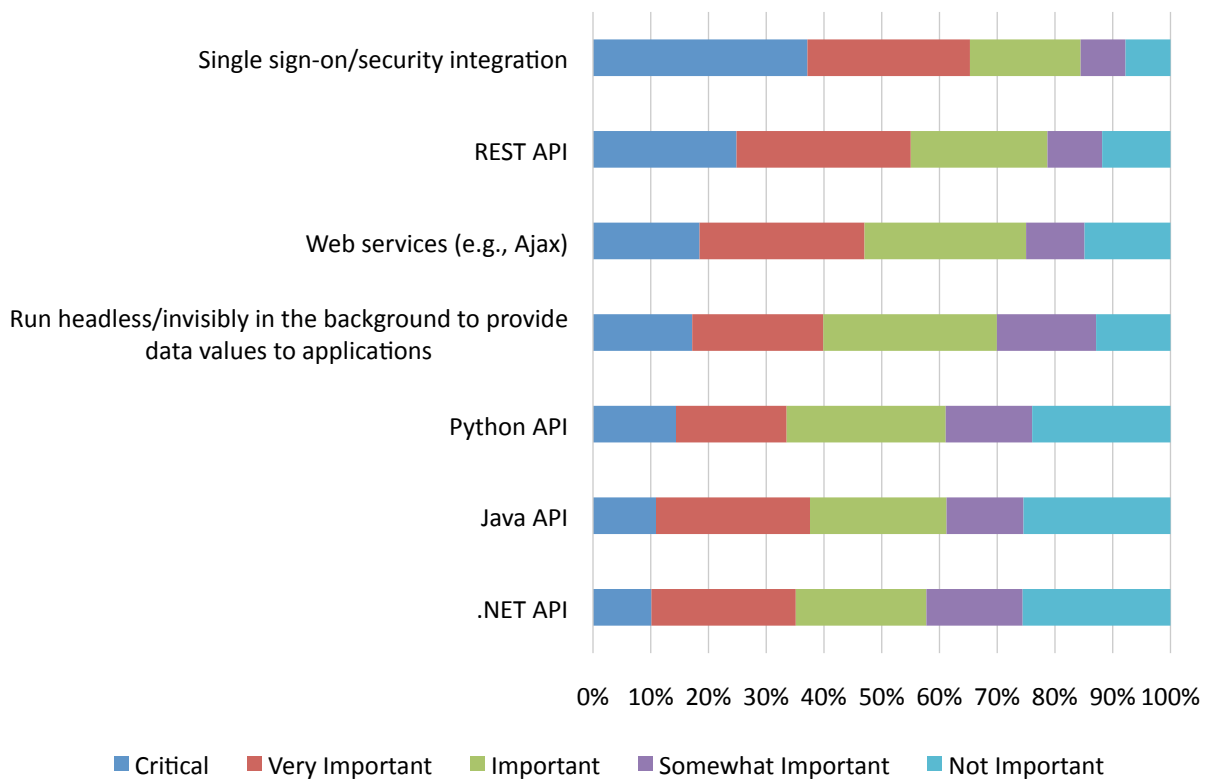## Embedded BI Platform Integration and Extensibility

Figure 30 – Embedded BI platform integration and extensibility

Embedded BI Analytical and User Feature Priorities

We asked respondents to describe the importance of seven different embedded BI analytical and user features (fig. 31). This year, "data visualization support" is the clear top choice and considered "critical" or "very important" to more than 80 percent of respondents. Respondents assign less urgency to "save and publish BI/analytical objects" and "user alerting," though these features are nonetheless "critical" or "very important" to more than half of respondents. Interestingly, "apply analytical algorithms, mining, predictive," comes in fourth place, a nod to basic functionality and information delivery over analysis and complex manipulation in embedded BI.

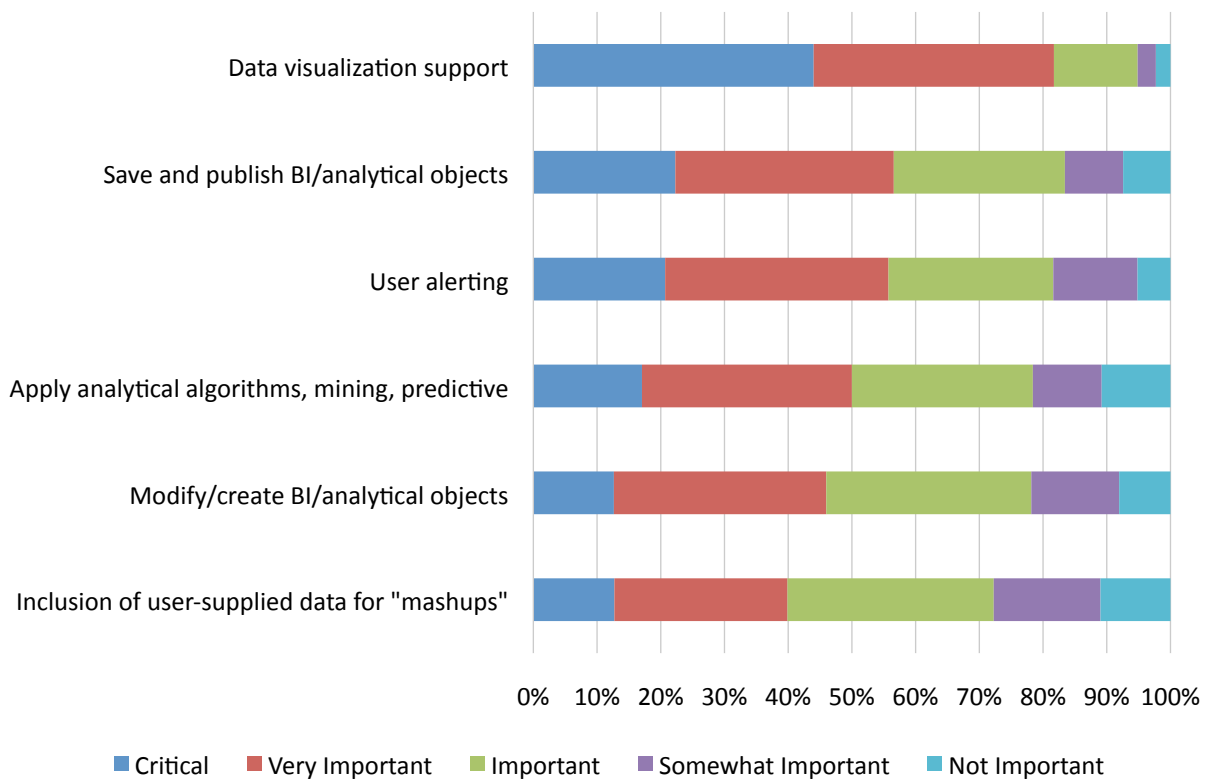## Embedded BI Analytical and User Feature Priorities

Figure 31 – Embedded BI analytical and user feature priorities

Targeted Applications for Embedded Business Intelligence

We asked respondents to describe specific applications they target for embedded BI (fig. 32). "Web portal" and "internally developed applications" are most critical and, at minimum, "important" to more than 70 percent of respondents. (Any of these targets might be internal or externally facing.) "Financial management applications" and ERP applications" are the next most important. Low priorities for embedded BI include "call center," "personal productivity," and "workforce management" applications. (Unlike generalized applications, electronic medical records rank lowest, due to industry bias in the overall sample.)
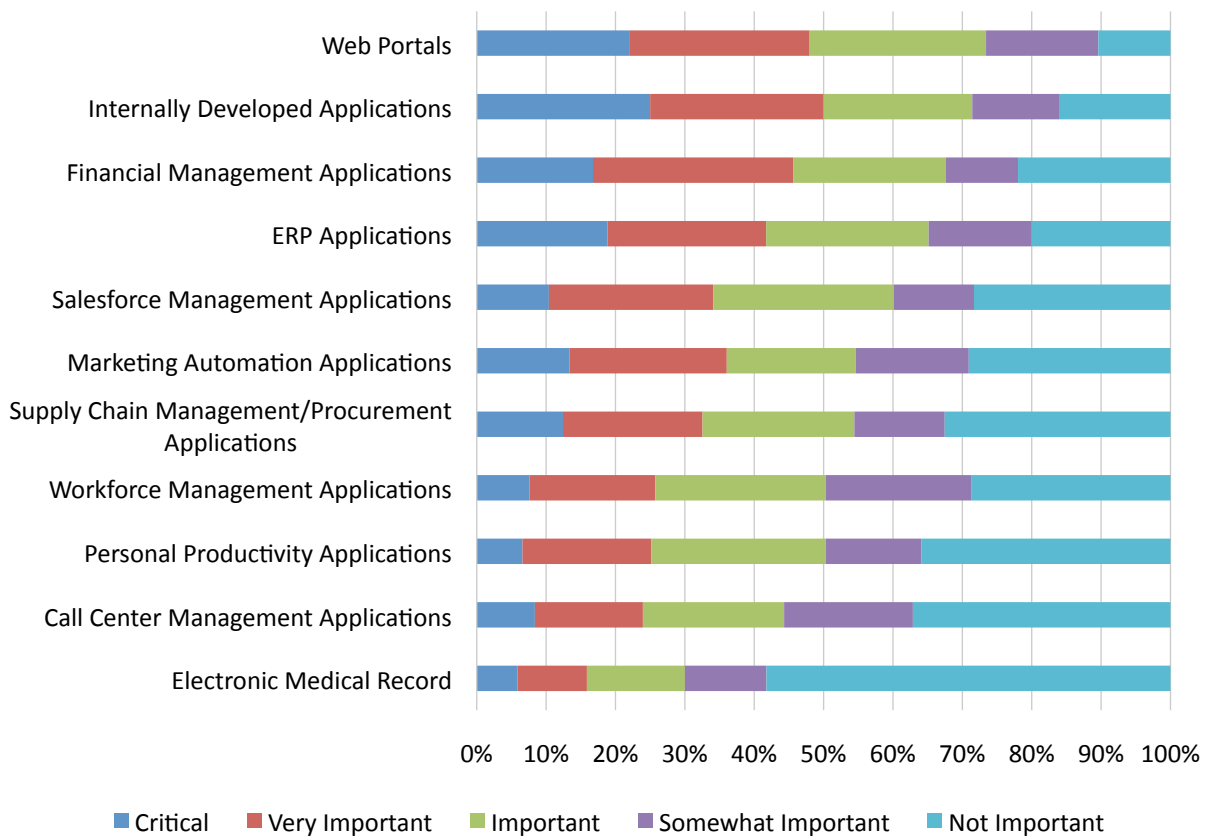
Application Targets for Embedded BI

Figure 32 – Application targets for embedded BI

Natural Language Analytics

Natural Language Analytics (NLA) is an emerging category that uses algorithmic and semantic technology to simplify BI problems—interpreting and converting human language into data manipulation language like SQL (NLQ) and creating associated user visualizations and analyses.

NLA Query Functionality

Natural language analytics query priorities, include "query builder suggestion interface," "maintain context," "learning from user actions for model improvement," "query result modification," and "English re-statement feedback for query confirmation." The top choice, "query builder suggestion interface," refers to query entry via NLA support and is either "critical" or "very important" to 60 percent of respondents.
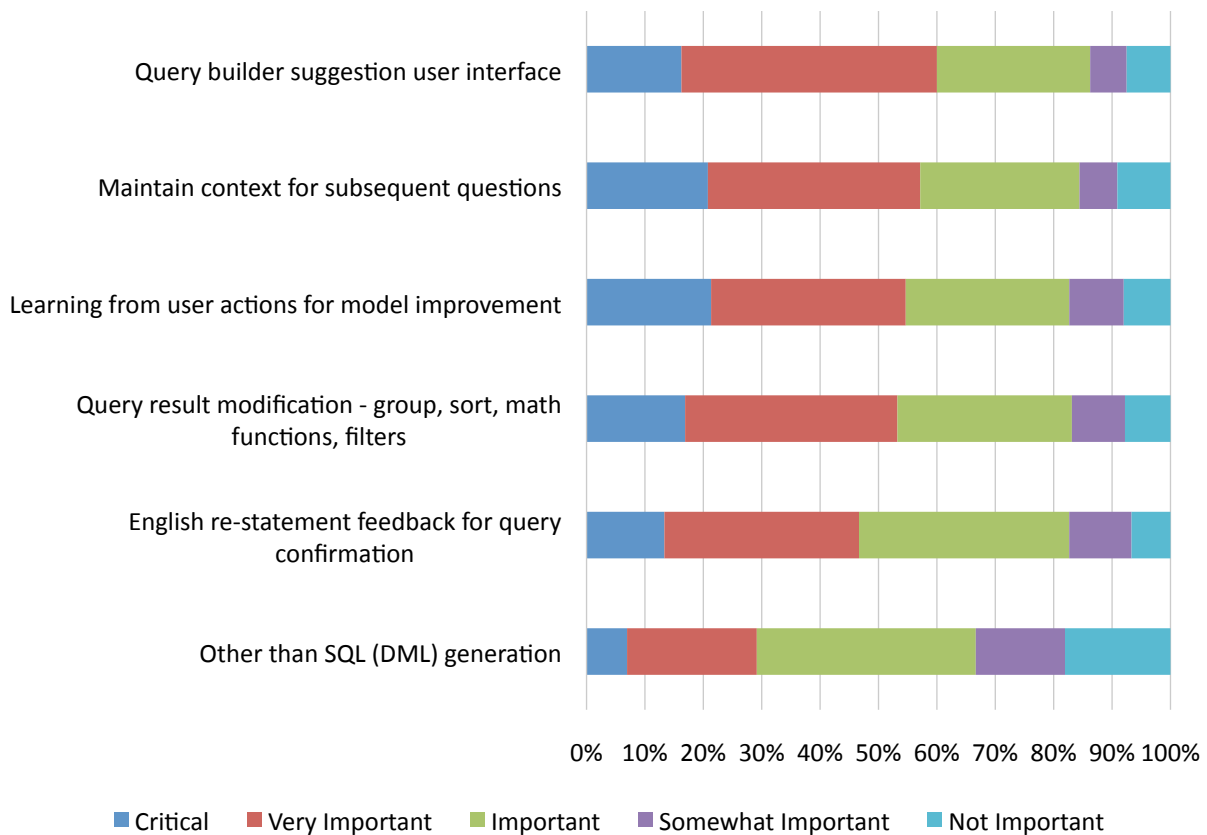
NLA Query Priorities

Figure 33 – NLA query priorities

NLA Configuration Support

We asked respondents to describe natural language analytics configuration priorities from a list of eight non-exclusive choices (fig. 34). Respondents report high interest in "industry/domain specific lexicons/dictionaries" and "custom lexicons/dictionaries" for specific more than generic applications. These top two choices are "critical" or "very important" for close to 60 percent or more of respondents, compared to a lower 54 percent for "generic lexicons/dictionaries." Other configuration priorities are nonetheless important to many users. For example, "automatic model generation," "model tuning/optimization," "expression/calculation engine," and "database introspection" are all "critical" or "very important" to about half or more of all respondents.

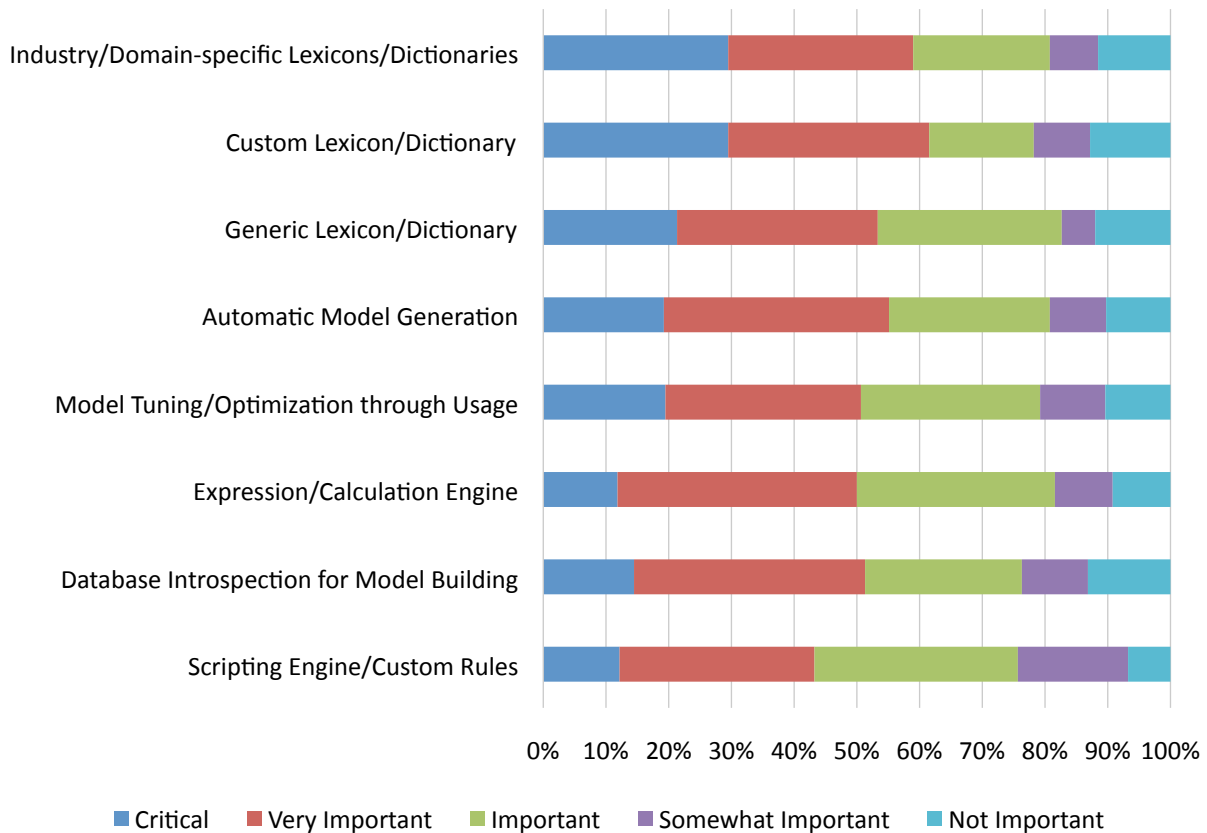## NLA Configuration Priorities

Figure 34 – NLA configuration priorities

Cloud Support

Cloud business intelligence is the technologies, tools, and solutions that employ one or more cloud deployment models including public, private or hybrid cloud.

Cloud Business Intelligence Feature Requirements

Respondents show interest in a wide range of cloud BI features that mirror traditional business intelligence requirements (fig. 35). In our 2021 study, the top three cloud BI features ("ad hoc query," "data visualization," and "data quality") are, at minimum, "important" to about 70 percent of respondents. A second tier of "data governance," "data pipelines and integration," "data exploration," and "personalized dashboards" is the next most important.
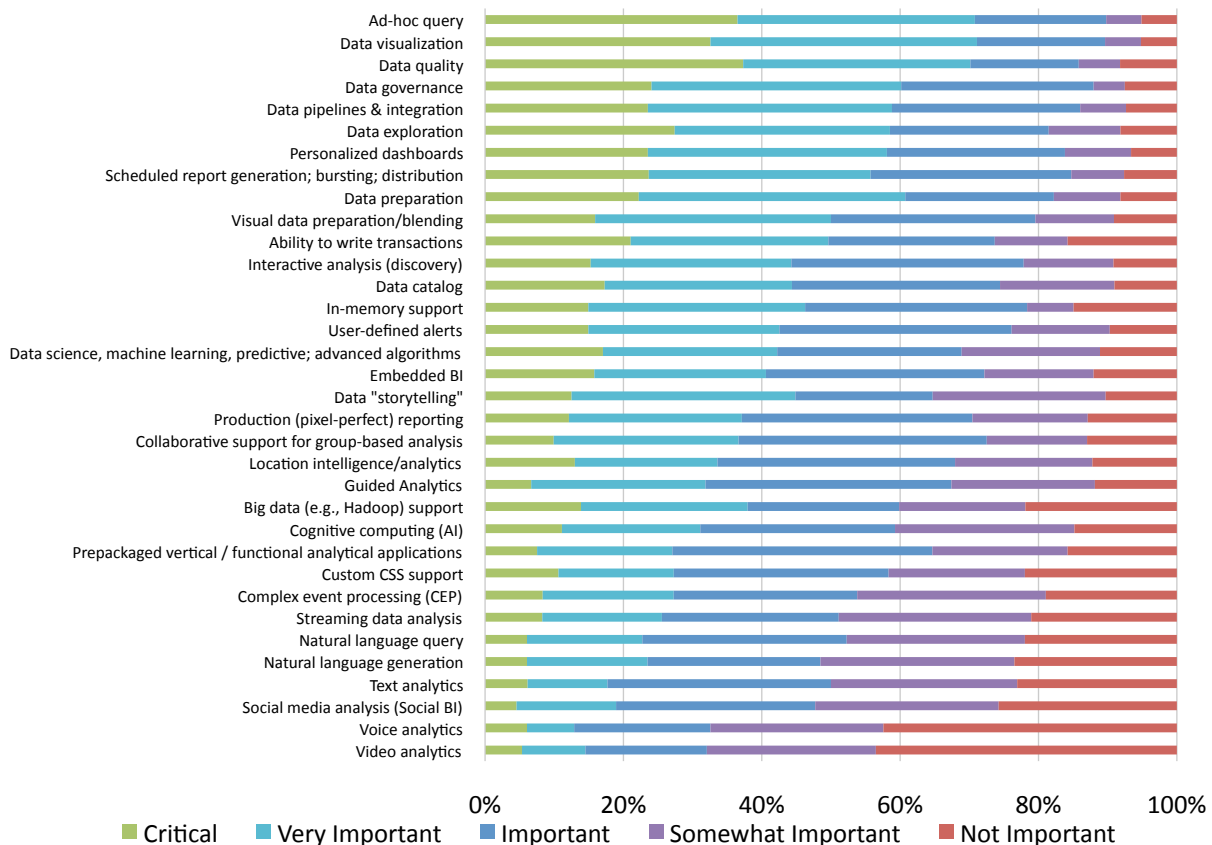
Cloud BI Feature Requirements

Figure 35 – Cloud BI feature requirements

Cloud Business Intelligence Architecture

Architectural requirements for cloud BI spread across several features of interest to respondents in our 2021 study (fig. 36). The top feature, "relational database support," is critical or very important to two-thirds of respondents. A second tier made up of "connectors to on-premises applications and data," "RESTful/Web Services API," "open client connector," and "multi-dimensional data support" are all critical or very important to more than half of respondents. Various connectors and data support types fill out the category. It is notable that "Kubernetes support" is the lowest-ranked cloud BI architectural requirement.

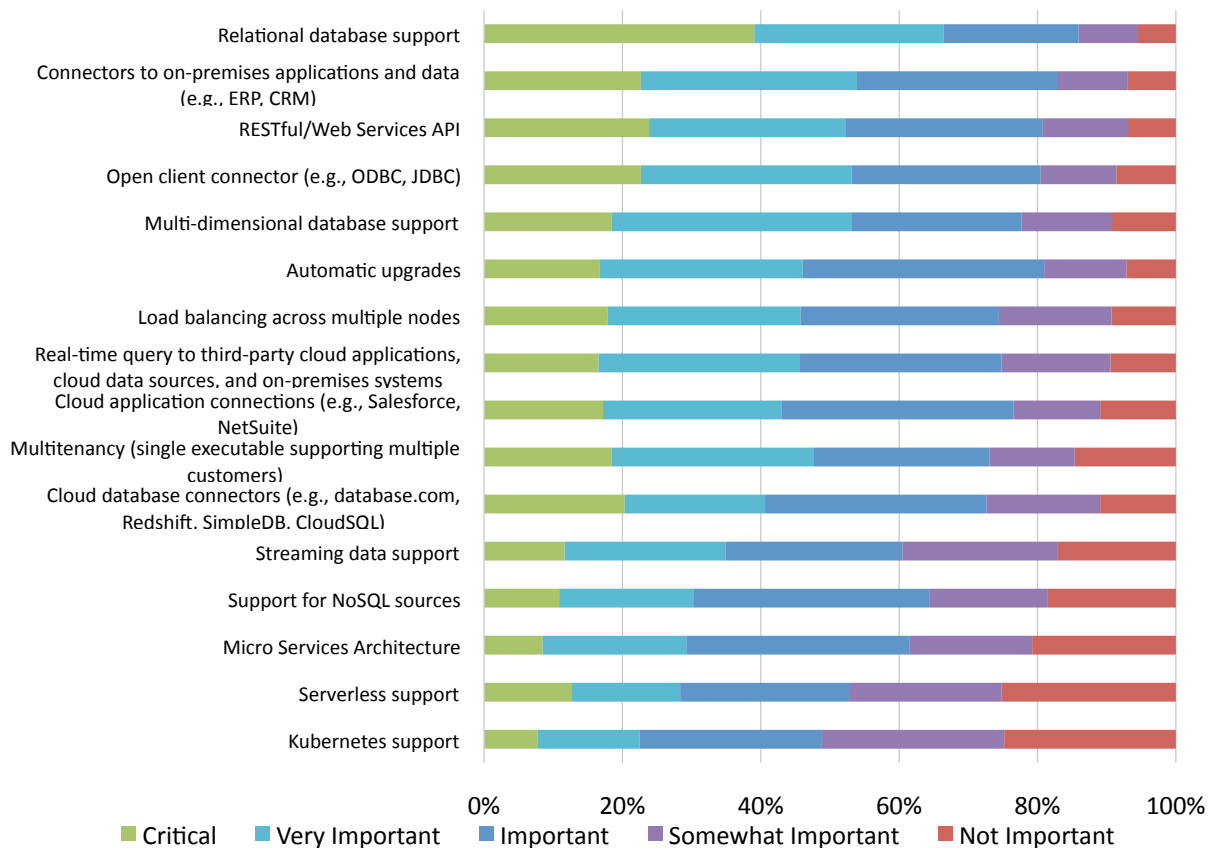## Cloud BI Architectural Requirements

Figure 36 – Cloud BI architectural requirements

Cloud Business Intelligence Security

We asked respondents to relate their interest in 17 cloud BI security requirements in 2021 (fig. 37). While many of these requirements are specific to industry or function, it is notable that fewer than 25 percent identify with any particular security standard. Respondents most often cite the ISO 27001 standard, specified by 23 percent of respondents. The next most cited is HIPAA, notable to 18 percent of respondents, followed by ISO 27018 (16 percent) and SOC 2 (15 percent).
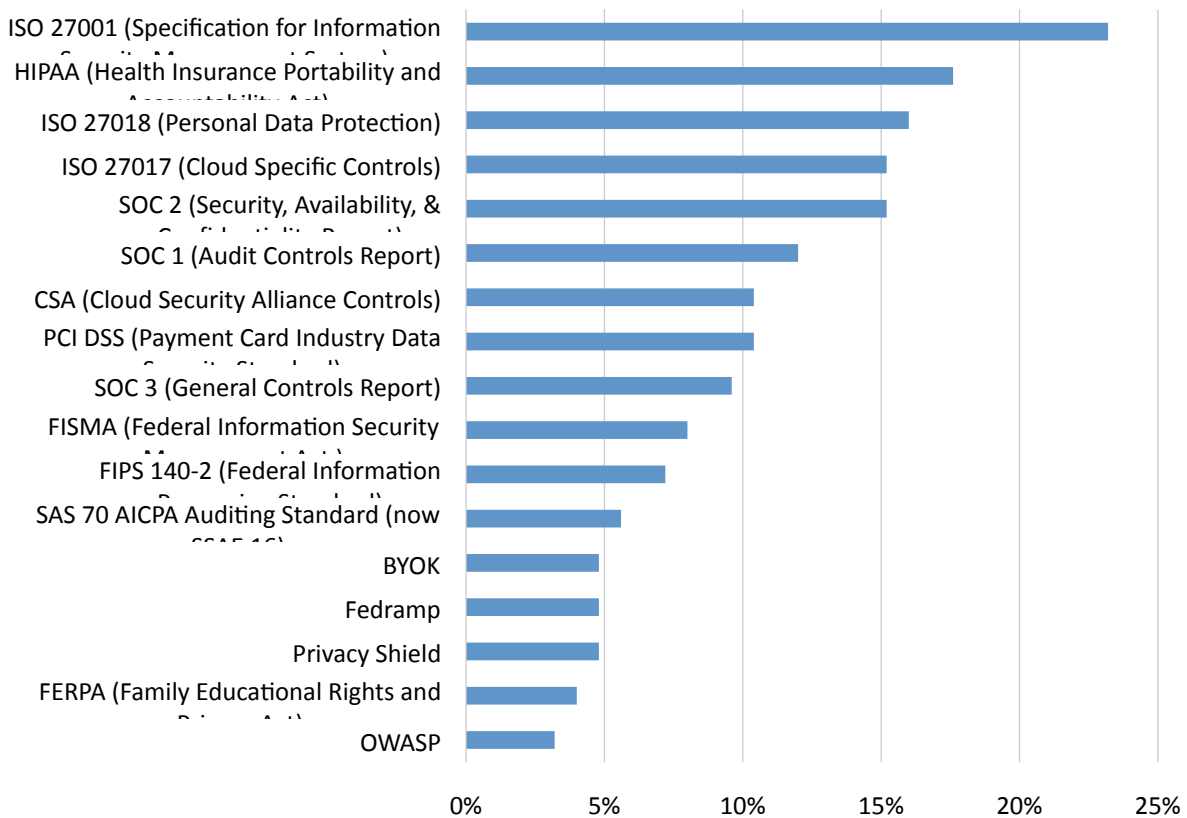
Cloud BI Security Requirements

Figure 37 – Cloud BI security requirements

Analytical Platforms Vendor Ratings

Vendor ratings are based on the collective functionality as reported and confirmed by vendors and weighted by user and analyst importance. Included in the assessment are scores for data engineering, self-service BI, embedded BI, data science and machine learning, natural language analytics, and cloud support.

Included vendors demonstrated sufficient capabilities in at least four of the categories cited above.

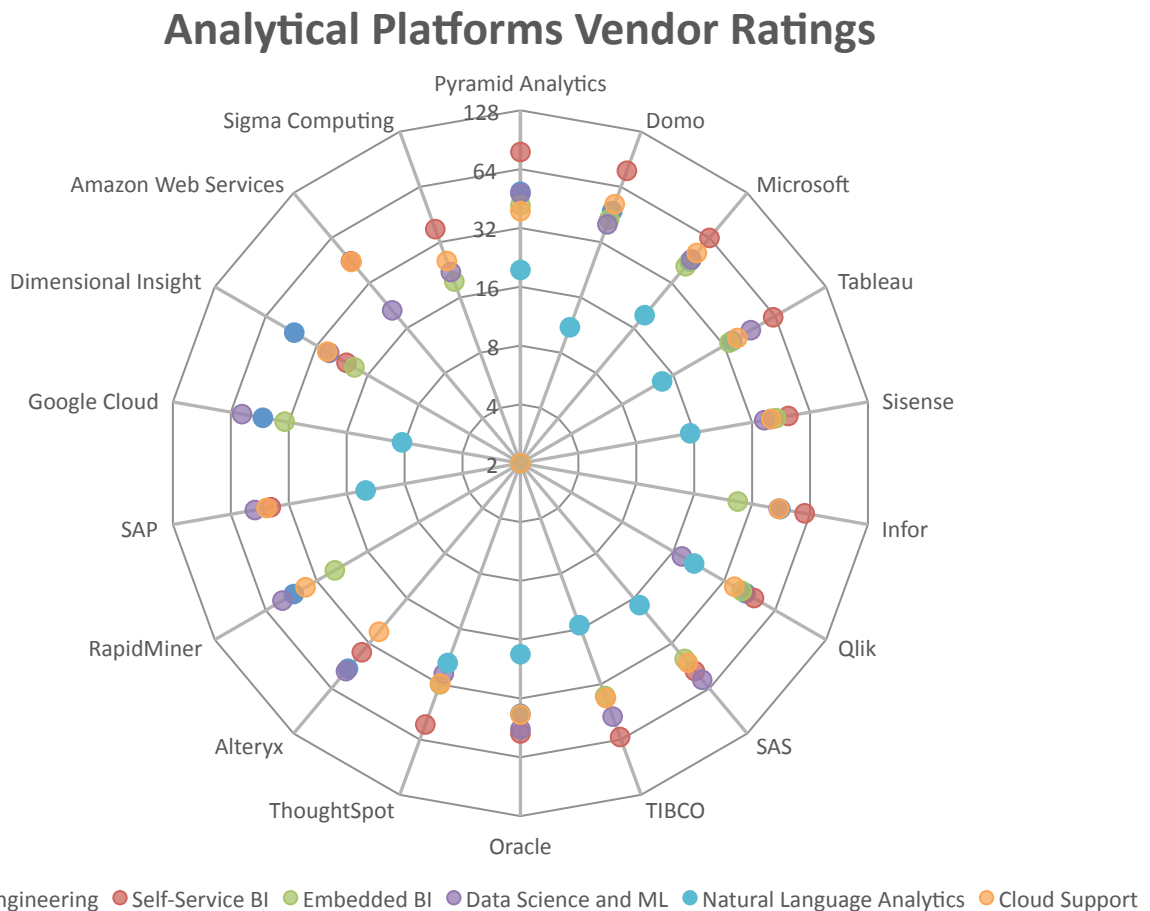Top rated vendors include Pyramid Analytics (1st), Domo (2nd), Microsoft (3rd), Tableau (4th), and Sisense (5th).

Figure 38 - Analytical platforms vendor ratings