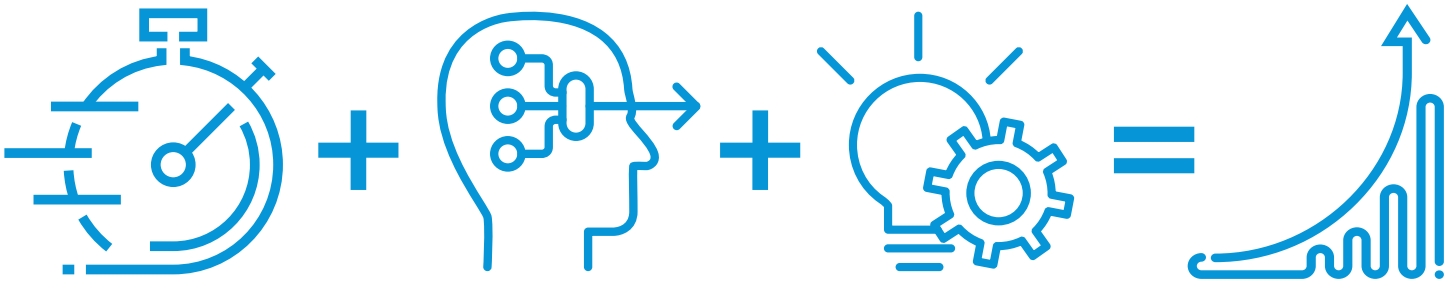
Speed the Time-to-Value

WITH THE VIA IOT ANALYTICS PLATFORM



Faster Analytics + Smarter Actions + Rapid Innovation = Better Outcomes Faster

VITRIA®

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I. INTRODUCTION/SUMMARY

The vast quantity of data available today combined with advanced analytics capabilities can yield more revenue, lower costs, and improve business processes. While the market value and potential of IoT is high, the time and skill required to develop and implement these projects is often a barrier to implementation. There is a need for a new kind of analytics platform that helps organizations speed development and enables implementation of the right actions to improve processes and business outcomes.

With the ability to connect millions of devices, IoT can yield an overwhelming amount of new data and new business insight. Operations managers are being tasked with leveraging this streaming data to detect anomalies, predict problems early, mitigate any disruption of service, and provide new customer experiences.

In addition to the explosive growth of streaming data, time is now measured in seconds and milliseconds and real-time decision-making with rapid response is needed to remain competitive. Organizations must be nimble to capture opportunities in this dynamic market environment.

Operations managers must address the need for faster analytics across static, historical, and streaming data. They need to have IoT analytic solutions developed faster to gain the critical business insights needed to transform and improve business processes.

Addressing these challenges and opportunities requires:

- **Tools and services** for **faster analytics** to handle the time critical nature of IoT challenges and deal with the variety and volume of real-time streaming data at massive scale.
- **Model-driven development tools** to enable IoT and IT analysts and citizen developers to innovate in days not months.
- **Self-service analytics** over real-time data, intuitive drill down and data exploration capabilities that enable operations managers and users to monitor Key Performance Indicators, explore problems, and take actions required quickly.
- **Unifying historical, real-time streaming, and predictive analytics** to build up rich context using all types of analytics and take the next best action. This reduces operational risks/costs, drives new revenue, and improves operating efficiency.

The **VIA IoT Analytics Platform from Vitria** delivers a unified platform that focuses on addressing the challenge of rapidly delivering better business outcomes and accelerating time-to-value for IoT initiatives and projects.

It accomplishes this goal by providing an IoT analytics platform that:

- Delivers faster analytics in real-time by integrating the analytics value chain across streaming, historical, predictive, and prescriptive analytics with relevant contextual and situational data that improves the quality of actions and their results.
- Enables integration with third party predictive and prescriptive analytical models through an open architecture that complements the core analytic engine of the VIA IoT Analytics Platform.
- Accelerates application development via a set of model-driven tools and automation that empowers citizen developers and power analysts to create analytics solutions more rapidly, in days not months
- Provides a rapid path to insights that enables organizations to take smarter actions that lead rapidly to better business outcomes.

II. MARKET POTENTIAL

The industry estimates over 25 billion IoT devices by 2020[1] and $15 trillion of global GDP by 2030[2]. IoT devices are proliferating across industries from manufacturing and utilities to retail. Whether it's a smart grid or more efficient consumer shopping, the data from sensors or devices is continuously flowing across the network.

Network connectivity of devices, equipment, factories, products and business processes is leading to massive volumes of data every second. This volume of data combined with advanced analytics provides the insights and patterns that can bring timely outcomes to improve operational efficiency, grow revenue, and reduce risk.

1. **Reducing risk** impacts both revenue and cost. Examples include detecting and avoiding fraud or systems intrusions, avoiding outages, and eliminating out of stock events.
2. **Increasing efficiency** though better management of key operational performance metrics by using real-time monitoring and predictive analytics reduces cost. For example, in manufacturing, a 1% improvement in operational efficiency, such as predictive maintenance and asset optimization, translates into $300 billion in savings over 15 years.
3. **Growing revenue** through the introduction of new business models and services and implementing predictive one-to-one marketing.

[1] *Gartner*
[2] *General Electric, Wikibon*

Use Cases for the VIA IoT Analytics Platform from Vitria

Industry	Outcomes
Utilities	• Eliminate disruptions and service degradation with predictive maintenance and proactive actions to prevent problems before they occur reducing: – exposure to regulatory penalties, – exposure to non-billable energy cost, and – customer complaints and escalations. • Maintain a secure & resilient grid by detecting & preventing problems in real-time minimizing variability in supply and demand. • Transform operational process and reduce cost by: – Improving work force management and – Implementing smart metering • Grow and maintain revenue by offering real-time pricing options such as time of use and demand response services • Improve emergency response preparedness
Banking	• Identify early at-jeopardy transactions for closing and compliance • Detect anomalies and fraud while in-progress
Telecommunications	• Optimize networks in real time • Implement one-to-one location-based marketing to increase revenue • Improve customer intimacy and engagement processes to increase loyalty
Manufacturing	• Maximize equipment uptime and establish reliable and resilient manufacturing infrastructure with predictive maintenance • Enhance client satisfaction and experience with faster deliveries and dramatic lead time reductions • Improve operational efficiency with real-time monitoring of complex processes to spot anomalies, take automated action, and reduce defect rates
Retail	• Shape demand via personalized offers and promotions in real-time by matching available goods and services with location and preferences • Optimize the supply chain through constant monitoring of inventory, Point of Sales trends and external factors • Leverage real-time sensing for context-based workforce management • Leverage real-time monitoring to enhance the customer experience, increase retention, and improve share of wallet
Service Providers	• Improve service performance consistently meeting and exceeding customer expectations • Reduce or eliminate penalties for non-conformance against Service Level Agreements

III. BUSINESS IMPERATIVES IN IoT: TIMELY ACTION AND FASTER TIME-TO-VALUE

a) Time-to-Action

With the advancements of IP-based technologies for ubiquitous connectivity, mobility and cloud services, customers, and users expect 24x7, always-on service availability with minimal service disruption. Time to act in real-time is also becoming a key Service Level Agreement (SLA) for many use cases. Time windows with IoT shrink from days to minutes and minutes to seconds. As time-to-action increases, the value realized decreases rapidly.

Time to Action Defines the Business Value in IoT

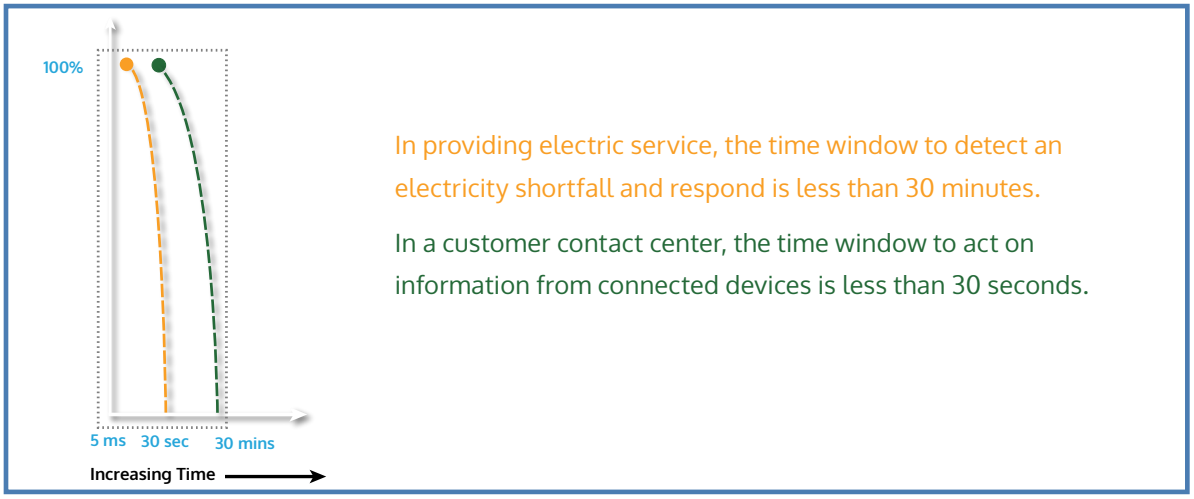


Figure 1: Time to Action defines the Business Value in IoT

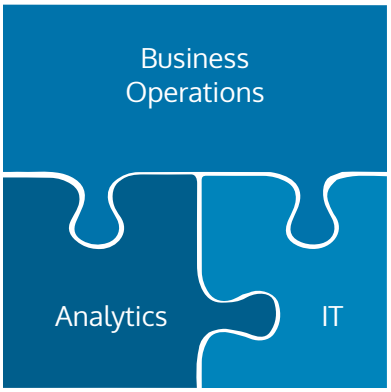
With the growing volume of real-time data in IoT and with the reduced time for decision making, companies need to leverage advanced real-time analytics with predictive and historical models to rapidly assess opportunities or threats before they occur. To do this, broader and richer context is needed for timely action. Enabling this requires new unification of disparate software components and data sources.

b) Time-to-Value

Reducing the development and implementation timelines for IoT projects is another critical business imperative. The typical approach of building analytic models and Key Performance Indicators (KPIs) over months is not viable in the IoT era. IoT use cases and applications often involve the integration of new data sources. Development teams need Visual Development tools that can dramatically increase programmer productivity and streamline the development of the core analytical building blocks of an IoT analytics application. Analysts and other end-users need self-service analytics tools that enable rapid diagnosis and resolution when anomalies are detected. And, these tools must be accessible to citizen developers and power analysts. Use of these tools should not be limited to data science specialists and highly skilled advanced developers.

IV. A NEW VISION AND SOLUTION IS NEEDED FOR IoT ANALYTICS

a) Business Operations Managers Lead for IoT Projects



In considering a new approach to analytics, it is critical to clearly define the business operations owner for the solution. The business operations owner that is responsible for achieving the business outcomes should lead the IoT initiative. IT and data scientists need to work together with the business owner to enable the capabilities and applications needed to support the desired outcome.

b) New Analytics Approach for IoT

Effective IoT initiatives typically need to integrate multiple sources and types of data to maximize value. Figure 2 shows a version of a traditional analytics model. Descriptive and diagnostic analytics, sometimes combined as historical analytics are often developed independently and have multiple connection points to the various sources of data. The structured, semi-structured, and unstructured data that is often stored in different data warehouses and logical locations is connected independently and requires multiple connectors to consolidate all the relevant information. Leveraging this type of model to build an IoT application is time consuming, often cost prohibitive, and does not scale.

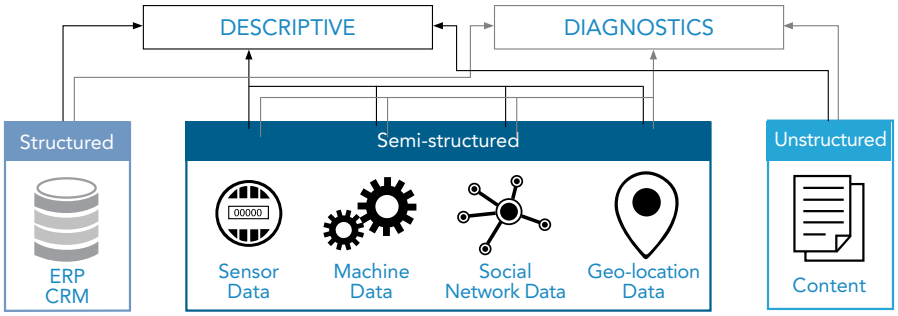


Figure 2: Traditional Analytics Approach

The first step in designing a new IoT approach is to simplify the process by integrating all the structured, unstructured, and semi-structured data needed for the applications. Better business outcomes are achieved when data silos are removed and analytics are used across a broad spectrum of data and data sources.

The second step is to unify the analytics layer to ensure scalability and real-time performance. In the traditional model, descriptive and diagnostic analytics are challenging because of the "siloed" approach to data access. By scaling and adding predictive and prescriptive analytics, the challenge increases exponentially and becomes unworkable for IoT applications. The explosion of

data in all forms requires a more robust and broader lens to enable smarter, more timely actions and better outcomes.

A unified engine includes historical analytics (descriptive and diagnostic), real-time streaming analytics, predictive analytics, and prescriptive analytics. In addition, it requires an open design philosophy to accelerate solution development. Businesses seeking to deploy IoT applications cannot be expected to "rip and replace" their existing investments. Businesses need to be able to leverage their analytics and data investments and migrate them into a larger unified framework.

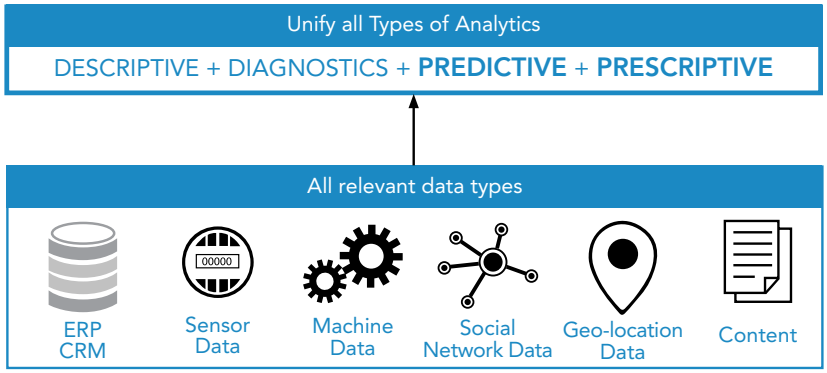


Figure 3: Analytics Approach for IoT

Once a unified framework is in place, more time can be spent on insights and delivering better business outcomes and less time spent on development, operationalizing, and managing the solution.

c) The Analytics Value Chain

The approach to analytics outlined above is a good first step for IoT. However, it is the ability to execute analytics in real-time across the analytics value chain (streaming, historical, predictive, and prescriptive analytics) with relevant contextual and situational data that addresses the critical "last mile" for timely outcomes. When combined with the ability to take the next best action, the business gains the greatest value.

The value chain depicted in Figure 4 shows how each process step refines the data and adds more value and context.

- Ingesting data at speed and volume sets the stage for additional processing.
- Real-time streaming analytics processes incoming streams of data from IoT sensors and devices.
- Refined data is then correlated with contextual and historical data to provide a baseline for advanced analytics. Contextual data can include information like geographic information systems data that may be of value to many IoT applications.

- From there, predictive analytics, based on machine learning over historical and situational data predicts failures and detects anomalies or patterns.
- Finally, prescriptive analytics can determine the next best action to take. This next best action can be associated with lowering risks, addressing an outage, or making a real-time offer to a customer to capture a sales opportunity.

Real-time analytics based on a rich understanding of history and context enables immediate action and maximizes business value. To achieve this ambitious goal for IoT requires new analytics platforms and tools.

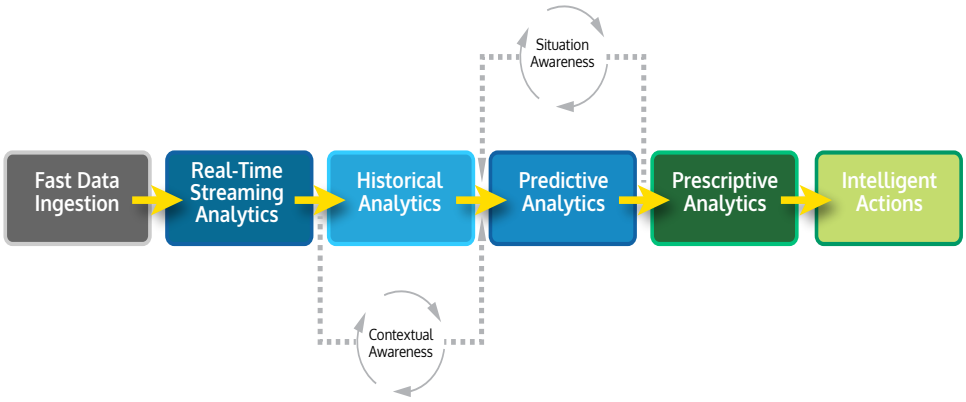


Figure 4: The Analytics Value Chain

V. THE VIA IoT ANALYTIC PLATFORM FROM VITRIA

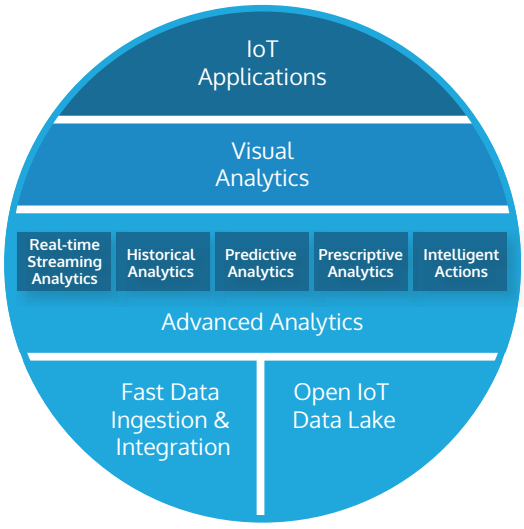


Figure 4: The Vitria Analytics Platform

The VIA IoT Analytic Platform is designed to empower business operations to effectively deliver outcomes that address IoT business imperatives. The VIA IoT platform leverages fast analytics, a self-service, model-driven development environment, and machine learning to apply the power of predictive and prescriptive analytics to deliver highly effective IoT applications. It includes intelligent actions and automation capabilities that are critical in maximizing IoT business value and taking timely action.

a) Fast Data Ingestion and Integration

Any analytics platform begins with the challenge of acquiring data from multiple sources. In IoT, there is the additional challenge of ingesting real-time streaming data from a multitude of devices. The VIA IoT platform addresses this challenge with its streaming ingestion capability.

b) Open IoT Data Lakes

The platform's open approach enables customers to leverage their existing data warehouses or data lake solutions. This is another key foundational capability at the data access layer. These existing data management solutions are unified into VIA's broader framework for comprehensive analytics processing.

VIA's Open IoT Data Lake provides the open, scalable data services required to support the complete analytics life-cycle: raw data ingestion, data enrichment, data exploration, model building, and analytics processing. Data at all stages are captured, stored, secured, and curated, along with its appropriate metadata. An Elastic Query Service supports access by IoT applications, self-service analytics, and third party data consumers via SQL standards.

c) Advanced Analytics

The heart of the platform's differentiation is the Core Analytics Engine and its complementary Analytic Data Flow. VIA's Core Analytics Engine delivers faster analytics in real-time with a unique methodology that integrates the analytics value chain across streaming, historical, predictive and prescriptive analytics with relevant contextual and situational data. VIA's ability to blend analytics across time frames in real-time is not found in any other IoT analytics platform.

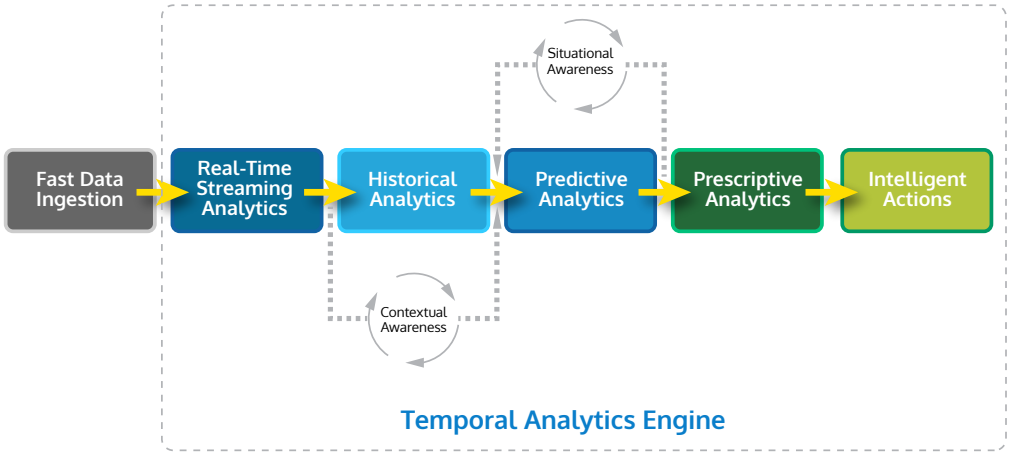


Figure 6: Vitria Temporal Analytics Engine

VIA's Real-Time Streaming Analytics supports the scale and speed of the most demanding IoT use cases – often involving millions of events per second with fast, sub second processing latency. Real-time descriptive analytics describes the world as it is right now and provides contextual awareness and situational intelligence. Real-time predictive analytics predicts what will happen next; while real-time prescriptive analytics prescribes the next best actions to optimize business outcomes.

VIA's Historical Analytics provides the historical context for interpreting real-time analytics, baselines for anomaly detection, and input for machine learning. The same analytical techniques available for real-time analytics are also available for historical analytics and batch processing.

VIA's Descriptive Analytics describe the world as it is right now (real time) or as it was in the past (historical). VIA's descriptive analytics includes KPIs and baselines, statistical summaries, multidimensional analysis, pattern matching, anomaly detection, trend analysis, and behavioral analytics. Descriptive analytics can be performed either continuously in real-time over streaming data or periodically over large batches of data.

VIA's descriptive analytics capabilities include:

- Correlation
- KPIs
- Multidimensional Analysis
- Summary Statistics
- Anomaly Detection
- Geospatial
- Pattern Matching
- Time-series Analytics
- Population Analytics
- Trending
- Activity Analytics
- Behavioral Analytics
- Track and Trace
- Link Analysis
- Hypothesis Testing
- Root Cause Analysis

Predictive and Prescriptive Analytics supports regression, classification, and clustering using hundreds of predictive techniques based on machine learning algorithms to recommend the next best action based on the current situation and latest predictions. Hundreds of prescriptive techniques are available. VIA can score predictive and prescriptive models in real time (streaming) or batch mode and features elastic scaling over big and fast data.

Machine learning provides a rich and flexible environment for continuous learning and refinement. Machine learning is executed over historical data in the VIA Open IoT Data Lake to produce predictive and prescriptive models. VIA's machine learning capabilities include:

- Supervised and unsupervised learning
- Repertoire of classification, regression, and clustering algorithms
- Visual design of analytic pipelines for model building and iterative refinement.

Machine learning algorithms supported by VIA to build predictive and prescriptive models includes:

- Clustering
- Neural Network
- Regression (linear)
- Logistic regression
- Decision Tree
- Support Vector Machine
- Random Forest
- Association Rules
- Naïve Bayes Classification
- Time Series (ARIMA, ...)
- Exponential Smoothing
- k-Nearest Neighbors
- Scorecard Model
- Rule Set Model
- Plus, many more ...

Intelligent Action is the final key step in capturing analytics value. Predictive and prescriptive analytics can trigger intelligent actions within VIA's process automation suite, which supports both fully automated processes and human-guided workflows. It enables intelligent business processes that are analytics-driven, situationally aware, and adaptive. Key capabilities include:

- Ability to act instantly using automated actions and processes directly triggered by prescriptive analytics or rules
- Processes and guided workflows that can be specified rapidly using visual models based on the Business Process Model and Notation standard.
- "Intelligent processes" that support adaptive process behavior based on continuous situational and contextual awareness, and advanced analytics
- Integration with enterprise workflow systems, ERP, CRM, and other enterprise systems
- Analytics enablement of Business Process Management with adaptive capability to handle IoT use cases where both complex logic and fast actions are required.

VIA's unified platform and Core Analytics Engine are the keys to accelerating the pace through the analytics value chain and simplifying the process. Each step in the process adds increasing value and ultimately leads to concrete actions. By unifying ingestion of all types of analytics, real-time contextual awareness, situational awareness, and intelligent actions, VIA's Core Analytics Engine enables organizations to build applications that deliver dramatically reduced time-to-action and time-to-value.

d) Analytic Data Flow

Analytic Data Flow is VIA's visual modeling environment that empowers citizen developers and analysts to rapidly create analytics-based solutions using visual models requiring little or no coding. ADF has a visual modeling paradigm for streaming and batch applications consisting of descriptive, predictive, and prescriptive analytics. This visual modeling environment enables the rapid creation of IoT Analytics solutions in days, not months.

A visual dataflow language enables solution developers to rapidly lay out "analytic pipelines" consisting of multiple data and analytic processing steps using an extensible library of reusable "drag and drop" building blocks. Beyond the pre-built building blocks, ADF has an SDK to enable the creation of custom libraries of reusable building blocks. Building blocks include:

- Data sources and target connectors supporting protocols and data formats for a wide variety of data
- Data preparation (e.g. filter, parse, transform, enrich)
- Descriptive analytics, including, correlation, statistical summaries, multi-dimensional analysis, KPI computation, pattern matching, trending
- Machine learning, supporting a wide variety of regression, classification and clustering algorithms
- Predictive and prescriptive analytics, based on machine learning models and supporting real-time streaming, online, and batch processing
- SDK for encapsulating custom-built or imported code and creating custom libraries of reusable blocks.
- Time-series analytics with deep capabilities for handling delayed and out-of-order events
- Geo-spatial analytics with built-in libraries optimized for fast geospatial analysis
- State machines for pattern matching.

VIA's ADF Modeling Environment supports interactive testing with runtime debugging, and provides full lifecycle management of ADF models. ADF's runtime environment manages the deployment and secure running of ADF analytic pipelines. The runtime environment manages the data flows and the handling of late and out-order-events. Leveraging leading big data

technologies, including Spark and Hadoop, ADF provides a robust, scale-out architecture, and can handle volumes exceeding tens of billions of events per day.

e) Visual Analytics

VIA's Visual Analytic tools accelerate IoT insight and support and enable the right decision or action to be taken at the right time.

VIA's Visual Explorer makes it easy for operations and business analysts to explore and visualize analytical results, identify key relationships, spot anomalies, test hypotheses, and diagnose problems. The Visual explorer capabilities include:

- Joining data from disparate data sources
- Interactively exploring real-time and historic data
- Ad-hoc computation of roll-ups and aggregations
- Saving analytic perspectives into operational dashboards
- Pivot analysis with rich visual options
- Discovering correlations
- Testing hypotheses

The Visual Explorer is perfect for diagnostic analytics to rapidly discover patterns, uncover root causes, and gain the insight needed to address issues and opportunities.

VIA's Dashboard Builder makes it easy to design visually rich and interactive dashboards that deliver real-time visibility of Key Performance Indicators, provide situational awareness, and enable the interactions to analyze faults, action and implement problem resolution.

Key capabilities include:

- Real-time operational intelligence on a "single pane of glass"
- Streaming of real-time analytics to the glass
- "Mash-up" real-time, historical, and contextual data
- Overlay of multiple datasets on geospatial maps, charts, and other visualizations
- Configure interactive controls for drill-down, drill-in, zooming, and roll-ups.
- Custom forms to enable seamless integration of actions
- Support any device or location – mobile / pad / tablet
- Select from a large and growing library of charts and graphs – data grids, gauges, heat maps, bubble charts, and many more
- Playback time series data and analytics using innovative "DVR-like" controls

e) IoT Applications

Each of the functional capabilities described is important, but to meet the business imperatives for IoT – speed to value and scalability requires that the user interface, model-driven development environment, analytics engine, data access and visualization tools all work in harmony.

Designed from the outset to drive faster analytics, more rapid IoT innovation, and smarter action, VIA IoT Analytics is an open platform that can interoperate with various other forms of predictive analytics and data warehouse technologies. Its design accommodates in-place technologies and analytics and works seamlessly with them to deliver a unified IoT application that delivers better outcomes faster.

VI. INNOVATION & FASTER BUSINESS OUTCOMES – THE VIA IoT ANALYTICS PLATFORM FROM VITRIA

Achieving better outcomes faster can only be done if the intelligence and associated action is executed in seconds, or in some cases, sub-seconds. The VIA IoT Analytics platform provides faster analytics in real-time via its unique Core Analytics Engine. Figure 7 illustrates how faster analytics delivered from VIA builds value.

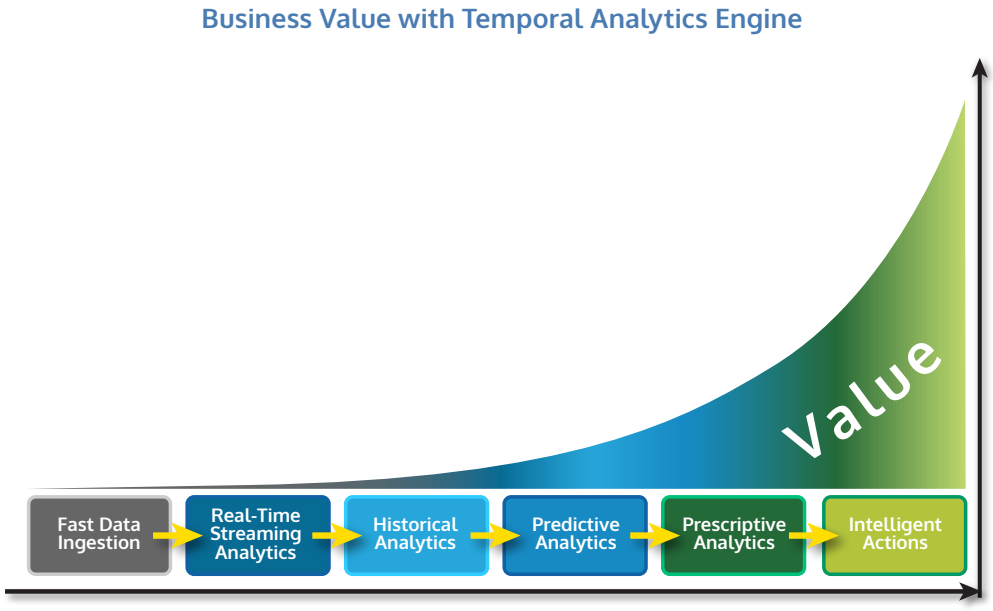


Figure 7: Business Value with the Vitria IoT Analytics Platform

To maximize business value requires the use of predictive and prescriptive analytics to drive intelligent actions. Such value cannot be achieved without a unified analytics platform and leading edge visualization services. VIA's self-service development tools deliver faster time to innovation by enabling power analysts and citizen developers to create and test IoT solutions in days with minimal coding. The VIA platform combines rapid application development, broad analytical context for real-time IoT scenarios, and provides the tools to act at the right time.

VII.SUMMARY/CONCLUSION

Operations leaders need to lead IoT projects that leverage data and analytics as key strategic assets. New processes are needed to maximize the value delivered with IoT analytics by both dramatically reducing the time to develop solutions and accelerate the time to action.

Development teams, analysts, and operations staff need automation and new tools to empower them to innovate more rapidly. Capitalizing on IoT value requires the ability to monitor key indicators by aggregating and analyzing disparate data fast. The ultimate value in IoT is the ability to accelerate and implement the right action at the right time.

The VIA platform by Vitria is the first of its kind to bring streaming analytics together with the capabilities and tools to support business process management. VIA addresses both the need for rapid IoT implementation time-frames and enables smarter actions. VIA accelerates analytic processes across multiple, diverse data sources, empowers operations with powerful self-service analytic visualization tools, and provides the ability to implement the next best action to drive business performance. It offers an open platform that unifies its powerful Core Analytics Engine with a wide range of in-place software and databases to leverage existing investment. It provides a model-driven, self-service development environment that accelerates time-to-value for even the most complex IoT applications.

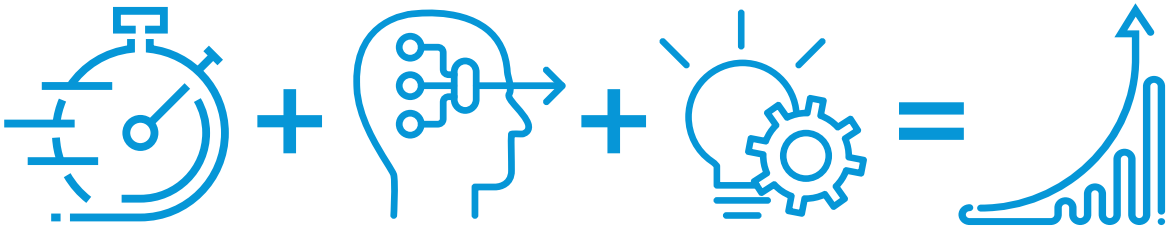
VIA offers much more than just new technical approaches or faster "speeds and feeds." It is a unique IoT Analytics platform for business operation managers to accelerate their IoT projects and drive better business outcomes faster.

ABOUT VITRIA

Vitria's advanced analytics solutions empower enterprises and industrial customers to achieve better outcomes faster in their business operations.

The company was founded in 1994 and has a long history of success in streaming analytics, business process management, enterprise application integration, and operational intelligence. Vitria is also a leading player in the rapidly growing IoT (Internet of Things) analytics market. Customers include Fortune 500 companies and enterprises across a wide range of industries, including finance, manufacturing, telecommunications, utilities, retail and more. For more information, visit www.vitria.com

Contact us to learn more about how our platform can help you achieve better outcomes faster



Faster Analytics + **Smarter Actions** + **Rapid Innovation** = **Better Outcomes Faster**

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