

Thinking Smarter: How TIBCO & AWS Put You on the Path to Al-informed Decisions and Faster, Better Outcomes

Executive Summary

Today's most mature, innovative, early adopters have successfully employed analytics and data science for a competitive advantage; They're identifying insights in real time, acting on intelligence for informed decision-making, and realizing better business outcomes. These enterprises continually optimize and refine their businesses with agile decision models to outperform their peers, deliver amazing customer experiences, and ultimately win in their markets.

With a single decision environment for diagnostic, predictive, and real-time analytics, static point-in-time reporting generated from traditional BI tools is transformed into a hyper-aware nerve center for <u>rapid learning</u>. The result is substantial net-new value and opportunity creation.

Want to realize the same benefits? This whitepaper explains how you will be able to make AI-informed decisions and adapt to market changes in real time by converging the capabilities of TIBCO and AWS analytics solutions.

Hyperconverged Analytics for Smarter Business

The converging of analytics, business intelligence (BI), and data science represents a huge opportunity for enterprises looking to digitally transform. This is what is known as hyperconverged analytics, the fusion of technology and teams. On the technology side, it brings together human insights, data, automation, and machine learning on a single platform. But it is more than a fusion of technology; It is the evolution of teams that collaborate to maximize the value of data. By bringing these capabilities together on one platform, your business can make faster, smarter decisions and dramatically accelerate digital transformation.

Simply put, hyperconverged analytics identifies actionable insights for everyone in less time. It fully leverages value from disparate enterprise systems — static reports and real-time and prescriptive analytics — to propel traditional BI into a hyperaware nerve center informing decision models with embedded data science.

With hyperconverged analytics, companies are:

- Accelerating insights with Al-infused analytics. With hyperconverged analytics, artificial intelligence (AI) not only supports the human decision process, it can serve up actionable, automated findings, alerting decision-makers as needed.
- Enabling data analytics at scale for richer analysis. Rather than being limited to representative data samples, Al and machine learning (ML)-infused analytics enable smart, automated data prep so analysts can work with the largest datasets available. Based on the most comprehensive and thorough datasets, analyses are smarter and resulting outcomes better.
- Supporting more holistic analysis. Smart analytic solutions support all of your data in one analysis—data from streams, transactions, historic sources, Internet of Things (IoT) devices—and let you use drag-and-drop, low code Python scripts for a seamless and smarter analytics experience.

Benefits of Hyperconverged Analytics

Built to Uncover High-value Insights

TIBCO Hyperconverged Analytics was built with the explicit purpose of driving better business outcomes. The first goal it serves is to deliver deeper, more valuable insights than traditional BI.



Figure 1: This fully brush-linked geoanalytics application offers an immersive experience for interactive exploration and discovery. Drill down and across multi-layer maps to uncover location-based insights.

With analytics applications applied to various data sources, both at rest and in motion, smart hyperconverged systems offer visibility into behavioral and transactional event streams across channels and interactions. They provide the ability to run calculations on those events in real time and help you distill insight that inspires next actions for driving top and bottom line business results for greatest impact.

While visual analytics is powerful as a standalone experience, with fully interactive and responsive dashboards or apps, its strengths are amplified exponentially by the force-multipliers of smart and real time. With real-time analysis driven by embedded data science models that inform mission-critical, data-driven operations, immersive analytics gives decisionmakers the confidence to act in the moment.

Built to Maximize Efficiency

Secondly, hyperconverged analytics allows your business to reach your goal of maximizing efficiency. Hyperconvergence of immersive and smart analytics promotes greater productivity and operational gains for teams. With guided recommendation systems baked into analytics workflows, non-technical workers can "borrow the brain of a data scientist" and act on AI-driven suggestions. This capability also shortens time to insight considerably for analysts and IT personnel who support executive and managerial decision-making. Given that once discrete data and analytics domains are now converging, citizen developers can now build advanced analytics applications with low-code Python and R scripting on-the-fly.

Meanwhile, information explorers in other corners of the adaptive organization can help themselves to immersive apps built on constantly refreshing models. Sub-minute analysis runs continuously as citizen data scientists drill down and iterate analytics queries, changing course at the speed of thought, essentially running Python functions as an engine within dashboards. From line of business reporting and executive support to analyst productivity, everyone arrives at datainformed decisions faster.

Immersive and smart analytics also liberate data science teams from manual, low-value, time-consuming data preparation tasks. Duplicate efforts of copying and translating projects across multiple environments, including open source platforms, are extremely wasteful for such expensive resources. Beyond eliminating high-costs of task switching, immersive and smart analytics makes data scientists optimally efficient as they have more time to model deeper analyses and provide higher value for the organization.

Real-time Adaptation and Response

When informed by smart, advanced applications and real-time analysis, immersive visual analytics enables decision-makers to sense, adapt, and respond much faster.

For enterprises that produce high volumes of information, enabling faster and more frequent response can provide big differences and often millions in cost savings. For any business relying on its ability to change fast, real-time visibility and awareness is needed; yet technology is too often stuck in legacy systems devoid of insight.

The Growing Popularity of Smart, Hyperconverged Analytics

Ensuring Trustworthy AI: Explainability & Responsibility

Underpinning the convergence of analytics capabilities is the growing demand for trustworthy artificial intelligence (AI), especially for explainability and responsibility.

Trust, explainability, and correcting for bias are top trends in the market and continue to pose significant hurdles for widescale adoption of Al-driven systems. A study from global services firm Accenture notes:

- 98% of leaders are adopting artificial intelligence, yet only 42% of laggards have done so
- 94% of leaders trust their data; 64% of laggards trust it to be reliable enough to use it as the basis for driving real business change

It's becoming increasingly clear that those who ensure trustworthy AI reap the benefits, while those who don't fall behind.

Making the Business Case for AI

Many are finding that the greater risk is getting left behind the innovation curve. Fast-moving early AI adopters have already emerged from initial projects with key learnings as they shift from early stages into applied technology. To keep pace with the rapid rate of change in highly competitive markets, there's an imperative to scale business insight faster, and with less human capital.

In the coming years, accelerating investments in smart AI technology is an advantage that will become "table stakes" before long. And if firms aren't already investing in AI, they will risk quickly falling behind the rest of the competition.

The Path Forward: How to Make an Al-Informed Organization a Reality

Join the ranks of the leaders and adopt Al-driven solutions. With machine learning and anomaly detection, your organization can quickly scale insights across the enterprise and drive greater business value from your smart analytic investments.

In the following sections, we move the discussion from "why" to "how" with specific information your developers or enterprise architects will need to get started. Read on for hands-on guidance on implementing the strategies discussed above.

Why Is Anomaly Detection Important?

Large volumes of data from business operations are generated daily. If used correctly, this data can help your business make better decisions—and one way to gain a competitive advantage with this data is through anomaly detection. Detecting anomalies can stop a minor issue from becoming a widespread, time-consuming problem.

An anomaly is an unexpected change or deviation from the expected pattern in a dataset. Therefore, anomaly detection is a way of detecting abnormal behavior. It's important to note that anomalies aren't necessarily good or bad, but companies should be alerted to any break in pattern to assess whether actions need to be taken.

The use cases and prescriptions that follow will help you build an actionable path from present state to a better, Al-informed future state.

Anomaly Detection AWS ML Use Cases

There are several practical applications for starting to put automation to work. As an AWS Partner Network Advanced Technology Partner for ML, TIBCO supports the following use cases:

Fighting Financial Crime

In the financial world, transactions worth trillions of dollars execute every minute. Identifying suspicious ones in real time can give you a necessary competitive edge.

Over the last few years, leading financial companies have increasingly adopted big data analytics to identify abnormal transactions, clients, suppliers, or bad actors. Machine learning models are used extensively to detect anomalies in streaming data.



Figure 2. Detecting anomalies in real time and the probability a transaction is fraudulent

Monitoring Equipment Sensors

Many types of equipment, vehicles, and machines now have sensors. For example, your "simple" smartphone has many that include those for ambient light and back-illumination, accelerometers, digital compasses, gyroscopes, proximity, near-field communication, GPS, and fingerprints. Monitoring these outputs can be crucial to detecting and preventing breakdowns and disruptions. Unsupervised learning algorithms like autoencoders are widely used to detect anomalous data patterns that may indicate impending problems.

Healthcare Claims Fraud

Insurance fraud is a common occurrence in the healthcare industry. It is vital for insurance companies to identify claims that are fraudulent and ensure that no payout is made for them. In the past few years, many companies have invested heavily in big data analytics to build supervised, unsupervised, and semisupervised models to predict the likelihood of insurance fraud for each claim submitted.



Figure 3. Monitoring manufacturing anomalies (left) and monitoring oil well equipment (right)

Manufacturing Defects

In manufacturing, manual processes to find anomalies is a laborious and reactive process, and building machine-learning models for each part of the system is difficult. Therefore, some companies continuously monitor sensor data on manufactured components with an autoencoder model. As the model scores new data, any defects (anomalies) are quickly detected and preventative actions can be taken.

Other Examples

Beyond the most common use cases already described, there are many other examples of how anomaly detection can be applied across a wide variety of industries:

- Military surveillance: Image recognition
- Cybersecurity: Intrusion detection
- Safety systems: Fault detection
- Hack protection: Anomalous network traffic detection
- Weather variables: Heat wave or cold snap detection
- MRI imaging: Alzheimer's or malignant tumor detection
- Spacecraft sensors: Faulty component detection

Building ML with SageMaker

Integrating TIBCO Spotfire analytics with Amazon SageMaker allows businesses to democratize foresight, moving past descriptive and diagnostic analytics to predictive and prescriptive analytics with sophisticated machine learning and statistical models. Below are several techniques possible through this integration:

Supervised Learning

In this technique, persons with business knowledge in a particular industry label a set of data points as normal or abnormal. A data scientist then uses this labeled data to build machine learning models that will be able to predict anomalies on unlabeled new data. Supervised learning is a great technique to use when you have known patterns in data that you would like to model. However, in a case where new patterns are continuously emerging (fraud, manufacturing), you may need to implement an unsupervised learning method.

An immersive and smart visual analytics environment, for example, Spotfire software and Amazon SageMaker, allows for identifying anomalous data much faster in the instances when humans are involved in exploration of modeling output.

Visual Discovery

Anomaly detection can be accomplished through visual discovery. In this process, a team of data or business analysts create advanced analytics applications containing bar charts, scatter plots, statistical process control (SPC) graphs, and other visualizations to identify unexpected behavior. This technique often requires prior business knowledge in the industry domain along with creative thinking to ensure the right visualizations are used. Because humans are inherently visual, we can quickly spot patterns when immersed in a data discovery environment. However, the downside is that we may not be able to visually inspect all of the data available in a reasonable timeframe.

Making machine learning accessible across the workplace, TIBCO's AWS SageMaker AutoPilot integration with Spotfire analytics provides powerful autoML capabilities for both data scientists and business analysts. In this case, AWS SageMaker Autopilot builds, trains, and optimizes the model creation process by analyzing top performing models and making them exploration-ready in Spotfire software. With model explainability rendered through auto-generated visualizations, Al-driven insights for SageMaker model performance are only a button click away.



Figure 4: This analytics application uses TIBCO Spotfire and Autopilot together, offering a visual exploratory environment to analyze relationships and identify variables for predictive models. After a few configurations on the top left, Autopilot jobs are initiated in AWS with the click of a button and identify the best machine learning model fit for the given data.



Figure 5: On the top left, auto-generated Spotfire visualizations render Autopilot job results for the "best candidate" model.

Image Recognition

With applications spanning Industry 4.0 to business-toconsumer (B2C) customer experience, analyzing images at scale alongside structured data is yielding actionable new insights and competitive advantages. Companies are achieving this success by pairing real-time analysis of such unstructured formats alongside historical, structured data.

What new technologies exist to recognize and analyze the unstructured data of images, such as object detection?

Autoencoders

Unsupervised neural networks, or autoencoders, are used to replicate the input dataset, but only approximately; if the input is replicated exactly, the model cannot usefully be applied to new data. The approximation is made by restricting the number of hidden layers in a neural network. A reconstruction error is generated upon prediction. The reconstruction error is defined as the difference between the model output and the new input data. The higher the reconstruction error, the higher the possibility that the data point is an anomaly.

This is possible using native Python Data Functions in Spotfire software. You can easily unlock infinite possibilities by connecting your Python libraries to a myriad of AWS services, including: Rekognize, S3, SageMaker, DynamoDB, and several other IoT data streams.



Figure 6: This figure illustrates a real-time, always-on dashboard incorporating image recognition services that analyze streaming webcam video using classification techniques for object detection of vehicle classes.

Amazon Redshift, Underpinning It All

For today's most mature enterprise cloud architectures, ultraquick querying capabilities on petabytes of data is what the modern pace of business demands. And for enterprises running AWS, Amazon Redshift is most certainly underpinning all of it. With its size, flexibility, and scale, Redshift is a key part of the data warehousing picture. Fast, fully-managed warehousing services make it simple and cost efficient to analyze all your data right within your business intelligence and analytics platforms.

TIBCO is a part of the AWS Service Ready program, and Spotfire software is "Redshift Ready." It supports nativedriver integration, providing robust analytics on top of files in Amazon S3. There is no requirement to access data via custom queries, just point, click, and consume S3 buckets easily from within Spotfire analyics. Additionally, you get the complete power of Amazon Redshift directly on your S3 data as a result of this integration. By combining Redshift Spectrum with Spotfire GeoAnalytics, the in-memory data engine combines the ability to drill down and across multi-layer map charts with ease by connecting to geospatial files in S3. The certification also demonstrates that Spotfire software meets a standard of demonstrating best practices in its integration with Amazon Redshift and the AWS Cloud.

How TIBCO Spotfire & AWS Combine to Create New Value for Customers

A primary advantage of having a fast database is the ability to perform in-database analytics, performing SQL queries both live and ad hoc. This may include data extracts that can be imported on demand, for example to feed data functions and custom expressions back into Spotfire analyses.

Smart Analytics In Practice

Interested in how smart hyperconverged analytics works in the real world? Explore the following examples of how TIBCO customers are putting hyperconverged analytics to work for their businesses and reaping the benefits:

Hyperconverged Analytics In-practice: Hemlock Semiconductor

One company that unites immersive, smart, and real-time qualities of visual analytics is Hemlock Semiconductor. As the largest producer of polysilicon in the United States, Hemlock had the strong imperative to optimize cost of predictive maintenance, product quality, and reliability, as well as statistical process control. Historically, the company struggled with legacy systems that relied heavily on IT for daily and weekly batch data analytics and reports. These systems made fast, highimpact operational decisions extremely difficult; The lack of visibility into manufacturing processes caused bottlenecks and high costs due to high variability of production.

With smart data science models built on real-time event streams, Hemlock closed the monitoring loop and applied a predictive approach to managing operations. Continuous learning helped fine-tune model development and accelerated processing by 1,000x with savings of over \$1 million.

To learn more, read the full story here.

Hyperconverged Analytics In-practice: OAG Analytics

OAG Analytics, a Texas-based software company, uniquely combined oil reservoir physics, machine learning, and data visualization software to deliver transparent and interpretable hybrid ML models. These models automated the well spacing process for multiple operators, allowing companies to work five times faster and at one tenth the cost of an internal effort.

OAG analytics optimized well spacing using domain expert algorithms and machine learning techniques, leading to billions of dollars of annual cost savings for its oil and gas customers.

To learn more, read the full story here.

Hyperconverged Analytics In-practice: Bayer Crop Sciences

Another great example of how hyperconverged analytics can open the door for Al-informed decision-making is Bayer Crop Sciences. The company leveraged drones and image recognition technology for precision agriculture. Analyzing the images captured using Al, it was able to place the right crops in the right place at the right time. This innovative solution allowed Bayer Crop Sciences to help farms grow crops that are more resistant to disease, insects, and weather damage.

To learn more, read the full story here.

Conclusion

Hyperconverged Analytics for Meeting the Challenge of Digital Transformation

Organizations like those above are realizing tangible results from hyperconverged analytics. But even organizations early in their digital transformation journeys will find similar benefits from this new analytics approach. Recent research from IDC notes:

"While analytics, business intelligence, and artificial intelligence strategies and technologies have made information collection and synthesis familiar to most businesses, most will need to address serious challenges to achieve future of intelligence capabilities.... [This future of intelligence] retains the best of business intelligence and analytics, but extends them with other capabilities for synthesis of information and learning."

Decision environments that are immersive, smart, and real time can synthesize insights and embed intelligence to extend learning throughout the enterprise. With hyperconverged analytics, you can embed learnings and intelligence into all business processes for:

- Richer, deeper, immersive discovery—without needing more resources
- Decision support where and when your users need it
- Game-changing new opportunities for cost savings and market opportunities

With TIBCO, from one analysis environment, you can seamlessly connect to any data source, whether in the cloud or a hybrid environment. This affords teams in large organizations ultimate flexibility and alleviates the need to use valuable data science resources to solve complex challenges across any and all cloud platforms.

The combined strength of TIBCO Hyperconverged Analytics and AWS allows for the innovative use cases discussed previously, including anomaly detection, machine learning with Sagemaker, and image recognition and object detection.

Learn more about TIBCO Hyperconverged Analytics and the TIBCO/AWS solution.

I Vesset, Dan. IDC. ibid.



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