



## OVERVIEW



**CAPTURE ANY DATA**  
**DRIVE DECISIONS**

# Introducing **KX**



## ABOUT KX

Right now, continuous intelligence is at the forefront of digital transformation – but it’s always been at the heart of our business and our technology. In addition to powering the financial markets for over 20 years, KX is also the driving force behind the transformation of some of the world’s most valuable businesses looking to their data to help them work smarter, react faster and perform better.



**KX is the only technology that can capture any data – any time – and run anywhere. And no one else comes close to our powerful streaming analytics capabilities, with businesses now able to make the best-informed decisions. In-the-moment. In-context. And, in real-time.**

**SEAMUS KEATING**  
CEO - KX

# Introduction



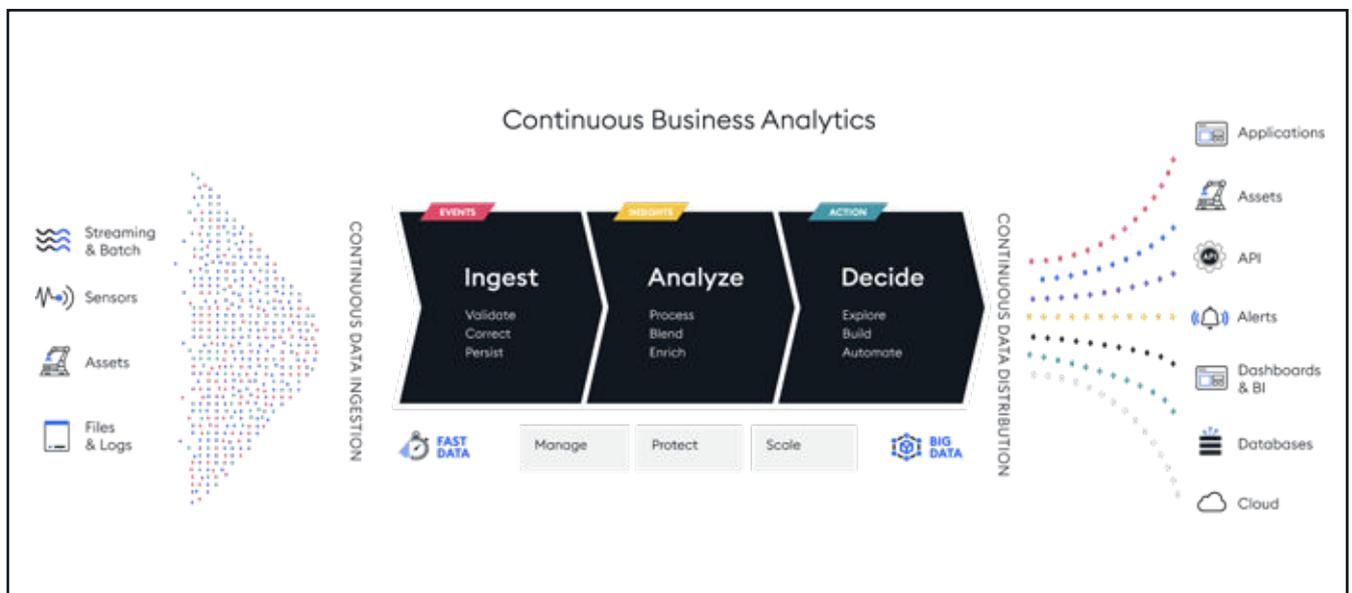
**KX is used across a range of industries – from manufacturing to finance – to solve complex problems that other data platforms cannot address.**

It is used to derive insights and improve outcomes in areas like performance, quality, yield, and design in industries ranging from automotive and semiconductors to energy and telecommunications, where the volumes of data from sensors, machines, and edge devices are especially challenging.

KX is similarly used by financial institutions to trade, manage risk and detect fraud through analysis of the enormous volume and velocity of data they accumulate across prices, quotes, and transactions.

In this overview, we explain how they do it using KX.

**One platform to instantly capture, analyze, and visualize real-time and historical data simultaneously**



# It's better to be proactive than reactive



Data, in all its facets and formats, is the new force fuelling innovation and guiding successful organizations in informing their decisions, reforming their processes, and outperforming their competition. It's all about data: digital transformation is premised on it, machine learning is built upon it, operational efficiency is measured by it. Data is, without doubt, the new power and KX can help you harness it.

## **The Problem – Knowing too Late**

At one time the humble abacus provided a competitive advantage by enabling faster and more accurate calculation than by hand. But speed is relative, and some of today's analytics platforms remain unfortunately abacus-like in their mode of operation. Many are based on an old-style polled model where data is persisted into a repository by certain processes, retrieved in queries by different ones only to be evaluated in yet another set before the results are finally returned to the user. The problem is that in the interim the data has changed and with it the market has moved, the fault has occurred, or the opportunity has passed. In short, they tell what has happened rather than what is happening, or even better, what might happen. For that, you need streaming analytics.

## **The Opportunity – Knowing Now, and Knowing in Advance**

Streaming analytics enables instantaneous decision-making based not only on data as it arrives but crucially on factoring in historical data as well. It moves beyond simple threshold analytics like "Has it exceeded a limit?" on real-time data to include more contextual analysis that identifies patterns and insights based on moving averages, correlations, and machine learning over historical data. In short, it goes beyond telling you what has happened to telling you not only what is happening, but more importantly, what may be about to happen.

# Overview



OVERVIEW

## The Analysts' Views – Knowing How

In his paper on “The Five Levels of Streaming Analytics”, Nick Heudecker from Gartner outlines the difficulties organization face in achieving streaming analytics from disparate interconnected technologies:



**“Streaming analytics is a cross-functional discipline integrating technology, business processes, information governance and business alignment. It’s the difficulty integrating these areas that keeps many organizations from realizing the value of their data in real-time.”**

Mike Gualtieri from Forrester agrees on the complexity of the problem, the opportunity from getting it right, and the components necessary to do so. Visit [www.KX.com](http://www.KX.com) to come to hear him outline the “7 Must-Haves for a Streaming Analytics Platform” which, like KX, covers the full lifecycle from data capture and processing through to development flexibility and fault-tolerance.

## The KX Solution – Providing the Answers

KX has been a pioneer and trusted leader in in-memory computing, streaming analytics, and operational intelligence for over two decades. In independent tests, KX technology has been shown to be many orders of magnitude faster than traditional technologies; retrieving data in microseconds, aggregating data and performing complex queries in seconds to provide anomaly detection and predictive analytics that competing technologies may take hours or even weeks to deliver.



# The **KX** Difference



## ABOUT KX

KX is the fastest, best-informed, real-time decision-making engine in the world. Elegantly simple. Connect to the data you need. KX can capture any data – run anywhere – and is the highly efficient way to do incredibly difficult things. Our unrivaled streaming analytics capabilities drive the most demanding business decisions with real-time continuous intelligence.



### **Continuous Realtime Intelligence**

KX enables real-time analysis of any data, whether at speed or at rest, providing firms with dynamic insights into what’s happening, right now. Continuous updates enable them to make decisions instantly, and automatically.



### **World’s Fastest Time Series Database**

Independently verified as outperforming competing technologies, KX delivers powerful sub-microsecond latency for stream event processing with the ability to ingest and store 30 million updates per second and over 10 TB per day - in the moment, in-context and in real-time.



### **Cloud-Optimized for Maximum Flexibility**

The world has moved to the cloud and it’s easy to see why: instant scalability, cheap storage, easy integration, robust security and a new development approach based on microservices that revolutionises how quickly applications can be developed and deployed. KX leverages them all with both cloud-first and self-managed streaming analytics options for clients.



# Streaming Analytics



## Simplify, Consolidate, Visualize.



KX is a cloud-based integrated platform to enable organizations to reduce costs and improve productivity through anomaly detection, analytics, predictions, corrective action, and automation based on both real-time and historical data. It can also run on-premises, on edge devices or in hybrid configurations of all as required.



KX simplifies data analysis because it interprets streaming and historic data simultaneously within the same solution. This approach, coupled with open interfaces to other technologies, enables it to capture data from multiple sources, and run across multiple environments in order to analyze data and automate decision making in real time, in any environment



KX provides full life-cycle data ingestion, processing, analytics, and data management enabling mission-critical operations, 24x7, with resilient failover capabilities to ensure no downtime and no data loss.

# KX Solutions and Core Components



CORE



KX provides streaming analytics solutions that cater for all operating environments: **KX Insights™** is a cloud-first solution that leverages cloud services, protocols and technologies but simultaneously supports hybrid configurations while **KX Streaming Analytics** is an enterprise solution for self-managed deployments.

Underpinning them both are four key components:



## Kdb+ Time Series Database

The world's fastest time-series database for high-performance in-memory streaming analytics



## Machine Learning

KX Auto ML automates the process of applying machine learning techniques to real-world problems



## KX Dashboards

Visualize, Stream and Share Big Data Insights



## KX Interoperability

For integrating with other technologies, programming languages, and APIs





## Kdb+ Time Series Database – The World’s Fastest Time Series Database



WHY KX?

Fast,  
Powerful,  
Scalable.

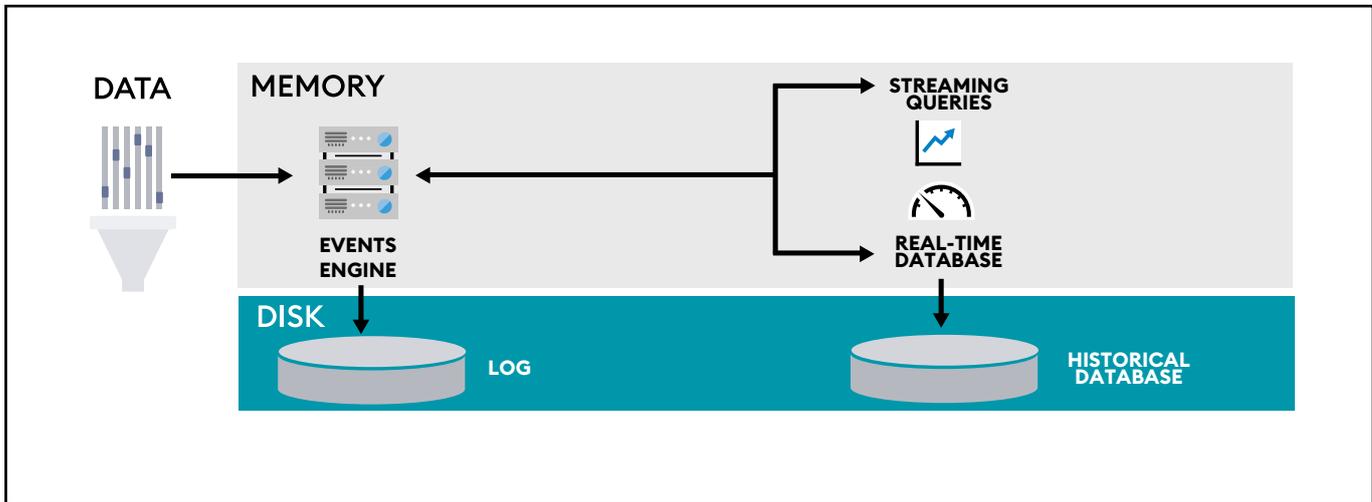
At the core of KX is kdb+, a powerful time-series database with a very low footprint executable of below 800K that includes the following components:

- a high-performance time-series columnar database
- an in-memory compute engine
- a real-time streaming processor
- Q, an expressive query and programming language

Integral to kdb+ are its time-series analytics with temporal datatypes including nanosecond precision timestamps, a hybrid in-memory/on-disk architecture with a vector-oriented analytics engine, all supported by robust message handling that enables multi-process and distributed solutions. Most significantly, it operates on commodity hardware in the cloud running Linux, Windows, and Mac and on edge devices where local processing may be necessary for specific use cases.



## Kdb+ Time Series Database – The World’s Fastest Time Series Database



## High-Performance, In-Memory Processing.

The diagram above illustrates a high-level reference architecture for a typical KX solution

- Data is collected by the events engine which logs messages to a transaction log file for resilience purposes
- The event engine persists the incoming data to the in-memory Real Time Database (RDB) via IPC.
- Dedicated streaming query engines subscribe to the event engine (for a subset of the data) to compute real-time analytics (e.g. weighted averages, standard deviations, interpolations) as data arrives
- At the end of a given time period (typically once per day) the RDB persists data from memory to disk.
- This data is immediately available in the Historical Database (HDB), allowing the RDB to purge the data from memory

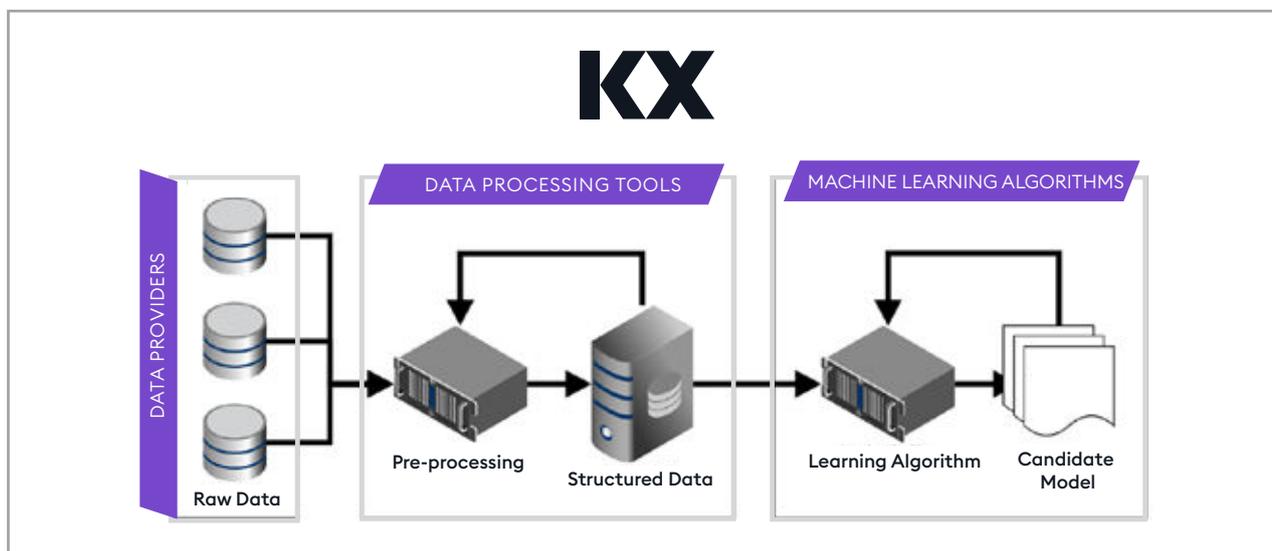
Under this architecture, the most recent data lives in memory, which is the fastest to access, while older data lives on persistent disk, which is cheaper to maintain. An additional advantage of the architecture is that it allows users to query on-disk tables as if they were in-memory and vice versa, with no change to query syntax, hence reducing development and maintenance overhead.

As kdb+ processes can easily be connected via REST or chained via IPC, it is also very simple to move processes from one server onto multiple servers to enable horizontal scalability and distributed processing for performance and fault tolerance requirements.





## KX Auto ML - Automating the process of applying Machine Learning



While much of the focus of machine learning tends to be on the underlying algorithms, the framework that exists around them is arguably even more important as data preparation, feature engineering, model optimization and deployment, take up the majority of data scientists' time.

Kx AutoML automates the entire task of applying machine learning solutions to real world problems. It provides a complete machine learning workflow, including pre-processing, feature engineering, model selection/ optimization and report generation. It also provides the ability to run previously completed workflows on new data, making use of saved framework information and models.

With KX Auto ML you get the benefits of :

- Fast prototyping and testing of models
- Optimized for large, structured datasets
- Specific support for time-series data
- Extremely customizable and extensible
- Workflow oversight and report generation
- Saving and deployment of models

KX integrates with many of the leading ML platforms, both open source and commercial, including Anaconda, TensorFlow, Theano and Keras.



## KX Dashboards – Visualize, Stream and Share Big Data Insights



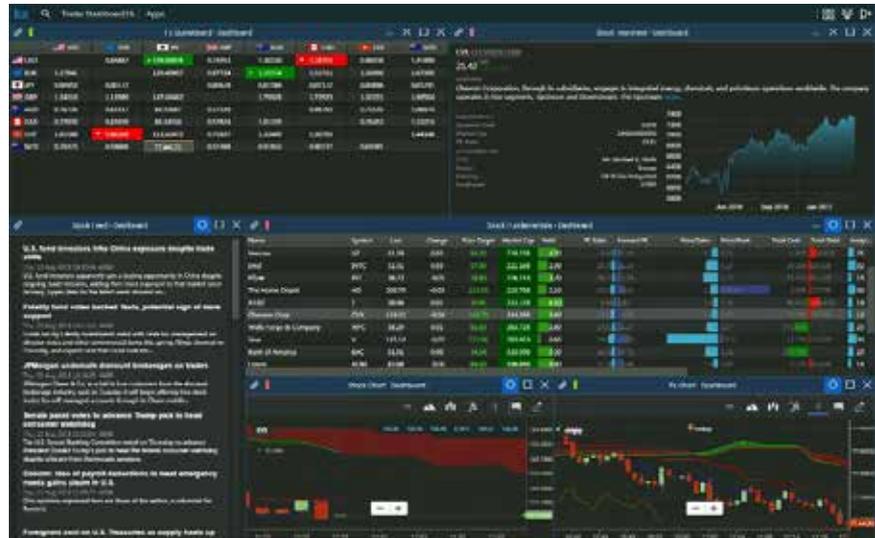
➤ **KX Dashboards provides a fast, accessible way to visualize big data, making it easy to query, transform, share and present and include comprehensive security and entitlement frameworks to meet your security, audit, and regulatory requirements.**

By combining hardware-accelerated rendering with virtual scrolling to reduce display time, and binary transfer to optimize data throughput, KX Dashboards can render millions of records per second. Throttling, conflation by time intervals and server caching provide further support in maintaining high-frequency updates across multiple users.

Built for today's data-driven world, KX Dashboards makes it easy to uncover actionable and timely insights by visualizing both historical and real-time data, dynamically and interactively. In contrast to standard, largely static business intelligence visualization tools, KX Dashboards support streaming analytics and provide the flexibility to amend views and explore data in real time, as it arrives, eliminating the need to pre-process and store aggregated data. As a result, KX Dashboards let you to know now what your data is saying right now, and act upon it instantly.



## KX Dashboards – Visualize, Stream and Share Big Data Insights



In addition to a wide range of native display options including tables, charts, 3D graphs, maps it includes filter, join, aggregate, and drill-down functionality to gain insights with real-time OLAP.



**KX Dashboards also includes an extensible visualization layer for 3rd party integration and embedding custom visualizations via an SDK and a simple framework-agnostic API.**



## KX Interoperability – Simplifying Integration



**While KX offers a single-stack solution to support the complete data analytics life-cycle from ingestion to processing and visualization, it also provides interfaces to other technologies and languages.**

This approach enables organizations to preserve the value of existing investments and technical skills in other areas and accelerate solution development through code reuse and industry-standard interconnectivity. As well as supporting open-standards like ANSI SQL, PostgreSQL, ODBC and JDBC that enable reuse of existing queries and simplify migration, the functionality enables non-KX programmers to interoperate with kdb+ data structures via a range of APIs including:



KX provides two-way integration with Python for maximum flexibility. EmbedPy loads Python into kdb+, allowing access to a rich ecosystem of libraries such as scikit-learn, TensorFlow, and PyTorch. Python variables and objects become q variables – and either language can act upon them. Pykdb, on the other hand, is a Python-native API that enables developers to access the power of q from within Python without having to write native q code directly.



R can connect to kdb+ and extract data. Alternatively, you can Embed R inside q and invoke R routines. Q can connect to a remote instance of R and Q can load the R maths library



KX also includes publish and subscribe interfaces to commercial and open-source message buses like Kafka and Solace for further flexibility and ease of integration.



KX, given its capacity for storing and processing vast amounts of both streaming and historical data, is a particularly powerful platform for machine learning. There are additional technical reasons too including:



- array and times-series operations are perfect for the feature-engineering steps of sampling aggregating and joining datasets
- streaming analytic capabilities enable online training of models and real-time prediction
- the ability to manage, ingest, store and analyze huge datasets make KX the ideal engine to feed deep neural networks, where enormous volumes of data are required for effective training



**Further interfaces include HDF5, Jupyter, Java, SQL, PostgreSQL, LDAP, MQTT, Prometheus, Protobuf, and FFI, an extension to kdb+ for loading and calling dynamic libraries using pure q.**

Please visit [code.KX.com/q/interfaces/](https://code.kx.com/q/interfaces/) for further information.





**KX Insights™**

Cloud-native development and delivery of powerful real-time insights on streaming and historical data with unlimited scalability and zero maintenance.



**INSIGHTS**

The world has moved to the cloud: data, tools, development, security, connectivity, operations, maintenance have all been reengineered to tap the power of the cloud. KX can help you leverage that power.

**KX Insights™** is a cloud-native platform for critical real-time performance and continuous actionable intelligence. It presents a microservices architecture and supporting services for capturing, storing and visualizing high-volume, high velocity data using cloud technologies and protocols.

As a result, **KX Insights™** is able to solve the most demanding problems, fast. Using complex event processing, high-speed analytics and machine learning interfaces, it enables fast decision-making and automated responses to be executed in fractions of a second.

**Cloud-Ready, Certified and Optimized**

KX is built for the cloud. Our streaming analytics capabilities take advantage of native cloud architectures to deliver superior scalability and flexibility with cloud economies of scale. No longer limited to physical hardware constraints, KX can scale up or down instantly, as needed, depending on storage and compute requirements. Best of all, running KX in the cloud enables users to focus on delivering results rather than maintaining hardware infrastructure.



# Cloud-First Streaming Analytics Platform

Google Cloud Platform

aws marketplace

Microsoft

Azure Marketplace





# Fastest to develop deploy and run

While cloud adoption focussed initially on storage and compute elasticity, it has extended to operational and development areas that similarly transform how new capabilities can be developed and deployed. Cloud-native architectures like serverless deployments, Docker and Kubernetes, enable developers to focus on business functionality rather than dealing with hardware infrastructure and deployment environments.

**KX Insights™** is a cloud-first platform from KX that leverages those services for streaming analytics, enabling powerful insights to be realized faster, easier, and more reliably.

- Units of functionality are delivered as microservices, self-contained units that can be quickly and easily orchestrated into applications, all benefiting automatically from the supporting scalability and fault-tolerance of the cloud
- Building upon open standards like Docker and Kubernetes provides both portability across cloud environments and deployment robustness to support regular updates on a Continuous Integration/Continuous Delivery (CI/CD) paradigm
- Adopting cloud-native best practices for security, access control and messaging increases interoperability and simplifies integration, while standards-based logging and monitoring protocols simplify support and maintenance

This combination of faster development, services reuse and streamlined delivery transforms the software development lifecycle and enables quicker insights and response to business opportunities.

KX is a certified Amazon Solutions Partner, Google Cloud Partner, and Microsoft Azure partner. Our platform is available via KX or marketplace purchase from AWS, GCP, or Azure directly. Customers using KX via the marketplace can onboard quickly, get automatic updates, and leverage unified billing all from their cloud vendor of choice.

**KX Insights™** is optimized for native technologies and offers first-class connectivity to each cloud provider's native services. Whether you want to leverage object storage in AWS S3 or container deployments via GKE, **KX Insights™** provides a seamless elegant way to utilize your cloud investment.



## KX Streaming Analytics

A flexible platform built for enterprises that need streaming analytics everywhere – on-premises, on the edge, in the cloud or in combination.



STREAMING ANALYTICS

# Enterprise Streaming Analytics for Self-Managed Deployments



KX Streaming Analytics is designed for organisations that need the flexibility to analyse data in complex deployment scenarios where, for a variety of reasons, some data processing may need to be distributed across multiple environment - on-premise, on edge devices, in the cloud and combinations of all three.

For that reason, KX Streaming Analytics can integrate with existing on-premises installations and operate over public, private and hybrid environments. This level of flexibility allows workloads to be distributed accordingly to preferred platforms of choice while future-proofing for any future cloud migration needs.

**KX Streaming Analytics** include two components to make self-managed deployments easier to deliver and deploy;



**KX small footprint for flexible deployment**



**KX Analyst** - Making Big Data Accessible, Usable and Valuable



## KX Small Footprint for Flexible Deployment



SMALL FOOTPRINT



# Enterprise Streaming Analytics for Self-Managed Deployments

Despite all the advantages of centralised processing, there may be use cases where local computing is essential. They may be for reasons of performance where latency cannot be tolerated, as in HFT trading or connected cars, they may be determined by regulation or privacy laws where data must remain in-situ, or they may arise from infrastructure constraints that compromise connectivity.

In these situations, where it is not possible to deploy fully to the cloud, KX Streaming Analytics makes it possible to distribute processing in a hybrid fashion across on-prem hardware locally, centrally in the cloud (both public and private) and on edge devices in the field or on the factory floor. This widespread deployment capability is derived from the extremely low footprint of KX Streaming Analytics that make as equally suitable for operating in low-power, low memory devices as on high-spec hardware in data centres.

Moreover, as it is the same KX software running in each environment, the same data analytics can be distributed and performed across multiple nodes simultaneously. Data can then be forwarded securely to a centralized location for consolidated analysis. This not only ensures consistency but also reduces development and maintenance overhead and is one of the reasons why it operates as an OEM component of a number of high-tech manufacturing solutions.

- Runs in low-resource infrastructure environments while delivering big data performance
- Highly-configurable and optimised for low-memory, low environments
- Same software running on commodity software on-prem, in the cloud and on edge devices



## KX Analyst – Making Big Data Accessible, Usable and Valuable

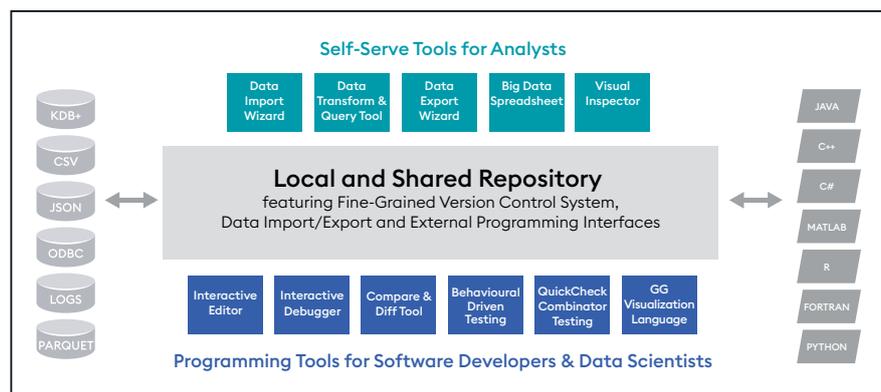


KX Analyst provides an environment to manage, manipulate and explore massive datasets in real-time giving users the ability to easily load, transform, query, and visualize massive datasets in near real-time with minimal or no programming.

It includes a powerful transformation (ETL) tool that enables users to import, transform, join, and export any sized dataset without programming. Operations such as type casting, column renaming and reordering, data filling, and complex query filtering are all supported. It also provides a complete test-driven development framework with support for automated test creation using a behavioral data-driven (BDD) testing framework and a property library for automatically generating test cases. Code coverage is also supported.



# Simplify, Consolidate, Visualize

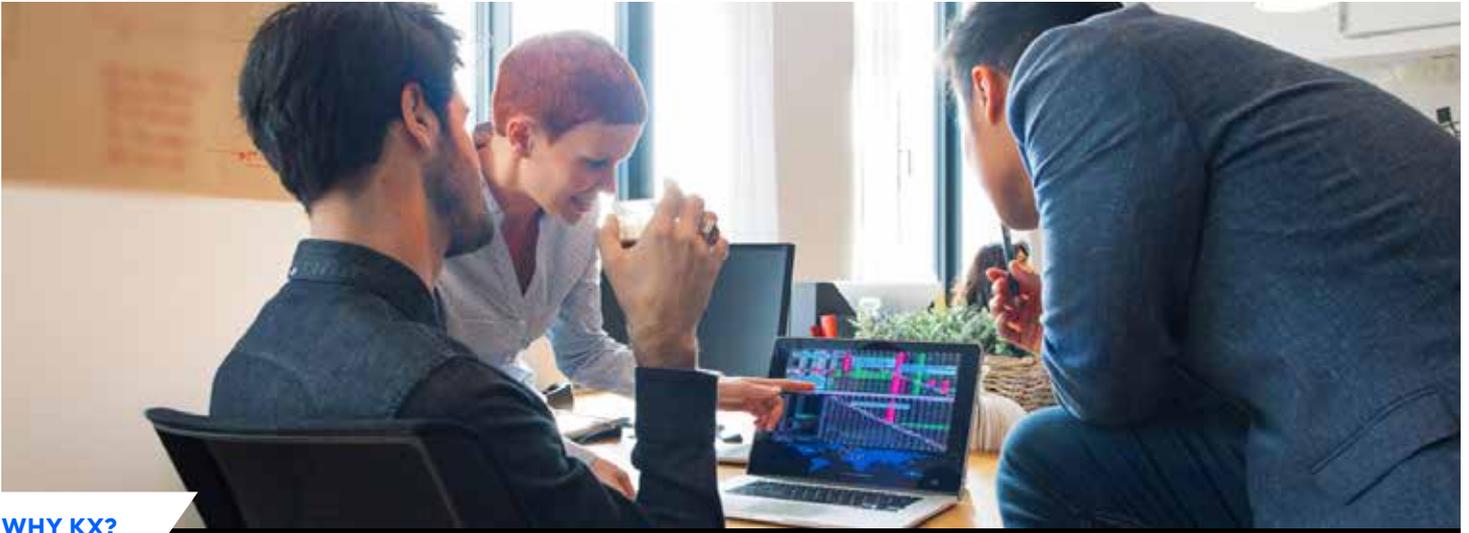


By leveraging KX's server-side rendering technology, analysts can query and visualize tens of millions of records in a few seconds. This means that analysts can now search for and find patterns in large datasets in seconds or minutes, rather than days or weeks. With this functionality, it enables experienced developers and data scientists to quickly and easily create robust analytic libraries using a complete edit-debug-test development environment.

Simple	Fast
<p>Most operations require no programming,</p> <p>Complex transformations, joins and AND/OR Where queries without coding</p> <p>Wizard interface for importing, exporting, and transforming data</p> <p>Point-and-click visualization of massive datasets</p>	<p>Immediate answers, even for massive datasets,</p> <p>100M record queries complete in milliseconds</p> <p>100M record binned visualizations render in 2-4 seconds</p> <p>100M record visualizations render in 6 minutes</p>



# What Some of Our Clients say



WHY KX?

**“Through the power of KX what we found was that our data flow would be 10 times faster than what it used to and would use only a 10th of the CPU. Which is fantastic ”**



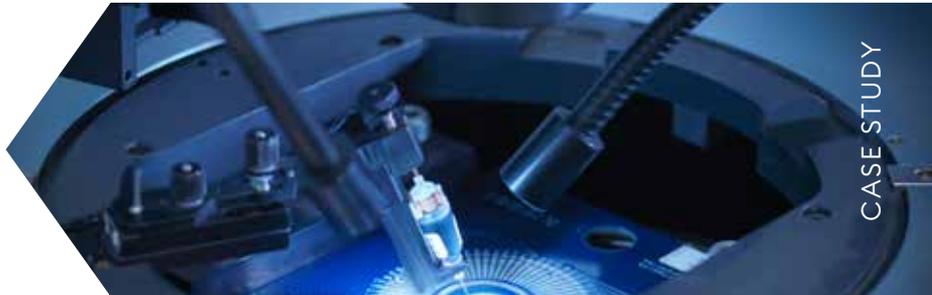
**BRIAN JONES,**  
HEAD OF SOFTWARE DEVELOPMENT,  
ASTON MARTIN RED BULL RACING

**“Within 5 hours of us bringing our transaction core online in KX we had detected and were able to stop a network of accounts that were being used for fraudulent activity.”**



**TONY BRAUND,**  
PADDY POWER BETFAIR

## Case Studies



# Global Leader in Materials Engineering Solutions Saves Over 10,000 Hours a Year using KX

Global Product Manager

“We’ve revised our database architecture to include a [KX] database, a more performance based database to provide for that high speed data querying, as well as the data storage”

Organization: **Leader in Materials Engineering Solutions**  
Geography: **Global**  
Industry: **Semiconductors**  
Employees: **22,000+**

This organization is the global leader in materials engineering solutions used to produce virtually every new chip and advanced display in the world. It’s application is the most comprehensive control and productivity suite in manufacturing. It is powered by technologies that are widely proven and deeply mature in high volume factories worldwide.



**Replaced legacy system at significant lower cost, including a 10x improvement in required hardware**



# Case Studies



## Leader in Materials Engineering Solutions

### THE CHALLENGE

For years, the semiconductor and electronics industries has looked for solutions to solve complex manufacturing problems. A key challenge is the need for faster speed-to-data. A common customers complaint is that with the explosion of data, query speeds are too slow and want see improvements in speed to data and total cost of ownership. As an industry leader with a vast customer base, this organization proactively searched for a solution to meet these customer needs.

### WHY KX

Over a year, 7 vendors were evaluated across 10 different objectives to enhance its application. This was an opportunity to look beyond the scope of traditional databases and found timeseries databases as a preferred solution that has had huge growth in adoption over the years. KX proprietary database is built for real-time data use cases taking advantage of a timeseries architecture coupled with relational database technology, a programming language to enable real-time calculations in the database, and the ability to manage both streaming and historical data in the same database. KX was selected for its superior performance results on ultra-fast speed to data, lower total cost of ownership, its ability to scale, and new user experience.

➤ Saved **10,000+ hrs a year** from false alerting and improved detection.

### THE BENEFITS

 Over <b>100 million readings</b> per day	 Delivers <b>high performance</b> historian and streaming analytics
 <b>Supports +600 utilities</b> in electricity, water, gas, and transportation	 <b>Detect and predict</b> conditions faster



## Case Studies



### Improved Query Speeds by over 30x for an AI based Fault Detection Application.

Przemek Tomczak,  
Sr VP IoT and Utilities, KX

“New tools are needed for this new era of digital information overload. Rich real-time analytics presents a significant opportunity for optimizing business operations, customer engagement, and offering new services and products.”

Organization: **Provider of Advanced Data Analysis Solutions for Manufacturing**  
Geography: **Global**  
Industry: **Manufacturing**  
Employees: **350+**

This global manufacturer is a leading provider of real-time, engineering and automation solutions for the global semiconductor and manufacturing industries for 20+ years. Its AI solutions for smart manufacturing are shaping the factories of the future, by connecting data driven manufacturing organizations with the knowledge to act.



**Supporting next generation fault detection within its AI application, delivering full sensor trace analysis in real-time, 10x reduction in false alarms, and limitless modeling.**



## Case Studies



### Provider of Advanced Data Analysis Solutions for Manufacturing

#### THE CHALLENGE

As a leading supplier of smart manufacturing applications, it was mission critical to find a solution to manage massive volumes of sensor data closer to real-time, and that can be easily integrated within its ecosystem of applications. They needed a solution to replace their traditional database solution, to keep up with the requirements around smart manufacturing and can integrate with its innovative AI solution. To stay competitive and expand their capabilities for its customer base they needed a database system that manages timeseries data providing performance with ingestion and queries, fast analytics in real-time, the ability to work with both streaming and historical data in real-time, and a scalable and interoperable architecture.

#### WHY KX

After extensive testing against their legacy solution, KX outperformed for queries and ingestion, while greatly enhancing the ability to scale at lower TCO. In addition, with KX they exceeded their performance requirements, by orders of magnitude faster than the alternative – saving significant capex and opex costs.

➤ Over **30x speed improvements** in queries enabling real-time action

#### THE BENEFITS



Easily able to **ingest 17 Million records per second**



**Over 30x speed** improvements in queries enabling real-time action



Supporting **next generation fault detection**



New capabilities added for **enhanced service**



# KX Clients



CLIENTS





## OVERVIEW



CAPTURE ANY DATA  
DRIVE DECISIONS

