Event Streaming at the Core of Industry 4.0

What is Industry 4.0?

> **"We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before."**
>
> — World Economic Forum

Since the advent of mechanization and the surge of factories in the 18th century, technology has driven the human experience. That was the very first industrial revolution, and now here we are on the cusp of the fourth: Industry 4.0.

Across almost every industry today, real-time access to data and analytics gives organizations insights and capabilities they've never had before. And while Industry 4.0 is often thought of as simply advanced manufacturing, it goes way beyond smart factories. The lines are now blurred across sectors as companies of all kinds lean into automation, the Internet of Things (IoT), artificial intelligence (AI), robotics, virtual reality (VR), and quantum computing. Industry 4.0 connects the physical and digital worlds into the fields of healthcare, insurance, retail, and more.

The companies furthest along the digital transformation journey are full-scale internet companies employing horizontal and vertical systems integration, with the ability to act quickly on data and connect an ecosystem of products, services, lines of business, external partners, and customers.

> **"Industry 4.0 is about more than just advanced technologies: It is about the ways in which those technologies are brought together, and how organizations can harness them to drive operations and growth."**
>
> — Deloitte

Industry 4.0 is helping complex enterprise organizations stay operational, competitive, and efficient in a time when markets are increasingly sped up and global, customers have incredibly high expectations, and the sheer volume of data at every company's disposal is beyond what anyone could have imagined even just ten years ago. Industry 4.0 companies are tapping into data like never before to optimize and elevate business. If you're a leader in a business that could or does benefit from automation, IoT, and real-time data, read on.

A window into Industry 4.0 across sectors

Industry 4.0 largely refers to the manufacturing sector, and there are many exciting use cases in that area alone. But other industries—retail, healthcare, government, financial services, energy, and more—also lean into Industry 4.0 technology to take advantage of IoT devices, sensors, smart machines, robotics, and connected data in the cloud.

Manufacturing 4.0

Smart factories and manufacturers—called "Lighthouses" by the [World Economic Forum](#)— are leading the movement to adopt Industry 4.0 technology at scale. They're using data to install smart shop floor technologies, enabling real-time data collection, processing, and analytics to monitor equipment and the workforce. With the use of sensors, transmitters, and remote monitoring, corrective diagnostics occur more quickly and staff know when parts need to be ordered and materials replenished, cutting down on a traditionally time-consuming process. Costly production delays caused by safety issues and batch or item quality issues are eliminated.

Retail 4.0

Digitalization and modern technology impacts the retail sector in areas such as inventory management, product design, customer service, supply chain management, and more. A data-driven approach to retail today enables companies to strategize customer-centric product and marketing strategies. Additive manufacturing enhances supply chains and simplifies production processes. Robotics enable warehouse management, delivery service, and in-store customer service. AR gives customers an experience of "trying out" a product before purchase. And, of course, big data lends itself well to personalization for even small retailers.

Healthcare 4.0

Digital technology is ushering in a new era for healthcare and the life sciences, getting medications and devices to market faster. AI in medical imaging is granting faster, more accurate diagnosis. Wearables advance the treatment of long-term conditions and telemedicine efforts as well as lend themselves to extended clinical studies. Robotic technology, coupled with machine vision to pinpoint problems, is innovating all kinds of surgery.

Government 4.0

Less paperwork? Happier citizens and public sector workers. Processes move faster and save government organizations money when data can be securely and compliantly shared across agencies. Application processes are automated. Operational efficiency drastically increases. Smart cities become possible when IoT devices allow sensors to collect data and manage assets, resources, and services more effectively.

Financial Services 4.0

Financial services is taking abundant advantage of Industry 4.0 technology in banking, insurance, mortgage, stocks, and countless digitally native startups revolutionizing a stodgy industry. Fintech is driving business models of big banks for sure. But fintech disruptors are on the scene too, with cashless transactions, the sharing economy, and blockchain just three of the paradigms shaking up traditional banking.

Energy 4.0

Machinery is a huge element of the energy industry, so Industry 4.0 is evolving power companies tremendously. From monitoring the electricity grid to servicing remote wind turbines, data and digital services in the cloud are making paradigms possible that were unimaginable a decade ago: drones inspecting equipment and power lines, smart grid meters providing data in real time, IoT devices that monitor changes in temperature and other conditions that could lead to equipment failures and jeopardize human safety.

The lifeblood of Industry 4.0: Streaming data

" **We're in the middle of a fourth Industrial Revolution—and this one goes far beyond manufacturing. Smart, connected technologies are transforming how parts and products are designed, made, used, and maintained. And by ushering in a digital reality, they are transforming organizations themselves."**

— Deloitte

It's an exciting time for industry. But it's also a confusing time, with so many advanced technologies offering both immense potential and dizzying complexity. The ways in which each sector takes advantage of Industry 4.0 vary, and each company has its own unique potential. There is one common thread: at the center of all this technology is data, the great enabler.

While we used to talk about "big data," as Confluent's co-founder and CEO, Jay Kreps, puts it: "That phrase has kind of fallen out of use. Now big data is kind of just like oxygen, in that we expect that all the new modern systems we adopt have that ability to scale elastically."

Real-time analytics are key to the success of most Industry 4.0 initiatives. This involves collection and analysis of extremely large and complex datasets, especially from new data sources that traditional data processing software cannot handle. This data is generated by things like production equipment and systems as well as enterprise and customer management systems. But analytics are often performed on static data after the event. With Industry 4.0, it is much more interesting to act on the events as they occur—in real time.

While data is central to every technology system in use today, it is more than a collective of static, siloed information to be stored in a server somewhere. Enterprise companies on the cutting edge of technology must use data in a more dynamic sense. In fact, you could argue that Industry's 4.0's lifeblood is datafication—the transformation of events into data that can be stored digitally and used in real time.

Industry 4.0 in action

Real-time production resource monitoring
A digital dashboard mounted in a smart factory pinpoints fault triggers and helps track production resources distributed in various plants. Real-time monitoring of production resources on the shop floor enhances visibility of both machine and workforce performance.

Sensor-based control
Data collected by sensors can provide real-time analytics on things like pH value, color, viscosity, and volume of finished goods. When deviations or potential failures are identified, corrective measures can be applied immediately. In healthcare, IoT devices and sensors monitor biometrics—for instance, devices that can predict intracranial pressure (ICP) in traumatic brain injury patients result in real lives being saved.

Sensor-based quality control cuts down reworking and quality complaints by 50% and achieves a throughput time reduction of 24 hours. (source)

Digital dashboards for OEE optimization
Triggering the machine alarms at the right time for possible faults helps to improve overall equipment effectiveness (OEE), a key performance indicator in manufacturing facilities.

End-to-end supply chain synchronization
Analytical modeling tools at the site management and department level can identify supply chain tension points. Each site is represented as a node, and operators can perform deep-dive analysis of each node. This reduces the amount of capital bound in inventory, as well as the number of stock-outs and returns. It increases supply chain efficiency and improves speed to market.

Modeling and simulation
Design and operations of systems can be optimized with the use of "digital twins"—virtual replicas of systems that can be used to run simulations before actual devices are built and deployed. This grants the ability to predict implications of changes to production lines and eliminates the cost of testing in a productive environment. Modeling and simulation are also used to support analysis, training, and planning needs for healthcare institutions and epidemics.

Changeover optimization
On production lines, changeover has traditionally resulted in lost time and material waste. An integrated solution consisting of a sensor, camera, and wrapper system can be used to detect and verify each zone of the production line in order to change propagation and turnover without stopping the line.

Changeover optimization can reduce changeover duration by 50% and reduce minimum order quantity by 30-40%. (source)

Sensor-based reporting
Dynamic interactive dashboards in smart factories display data about production milestones (KPIs). The data is collected via digitized machines with mountable sensors. Sensors are used in the energy industry to monitor assets and in healthcare to monitor biometrics via wearables and other IoT devices.

Rapid design prototyping
In manufacturing, automotive, construction, and engineering companies, 3D printing is used to produce small batches of customized products, with greatly reduced cost in design and prototyping.

The emergence of event streaming in Industry 4.0

> "The change that the public cloud has brought is incredibly cross-cutting. It touches every aspect of how applications are built, how they're deployed, how they're archi-tected, how they're configured, and how we observe them. Everything has changed."
>
> — Jay Kreps, Co-Founder and CEO, Confluent

To tie these types of big, complicated initiatives together requires a strong underlying technology infrastructure and data architecture that enables speed, flexibility, and innovation. That's where event streaming comes in.

Event streaming is the real-time capture, processing, and management of all your data in order to drive these technology initiatives. When you have a universal data pipeline that can capture all events, it's easier to tie other technologies together and run them in a way that's efficient, scalable, cost-effective, and transformative. An event streaming platform can be used to intelligently automate processing, ensuring you gain operational efficiencies, cost benefits, and access to new revenue streams.

Traditionally, databases were designed around storing data you might need to access occasionally. This model was built to enable humans to manually access data when they needed it. The data systems were passive; the human actors were active. The world that databases were created for had applications that were islands of data unto themselves.

But that world has changed, and these assumptions are no longer true. Today, companies build applications that are no longer passive islands waiting for human input, but active and connected parts of a greater organization. So when you apply the limited legacy architecture of data today, including all the integrations you need to make it work, you get a giant mess:
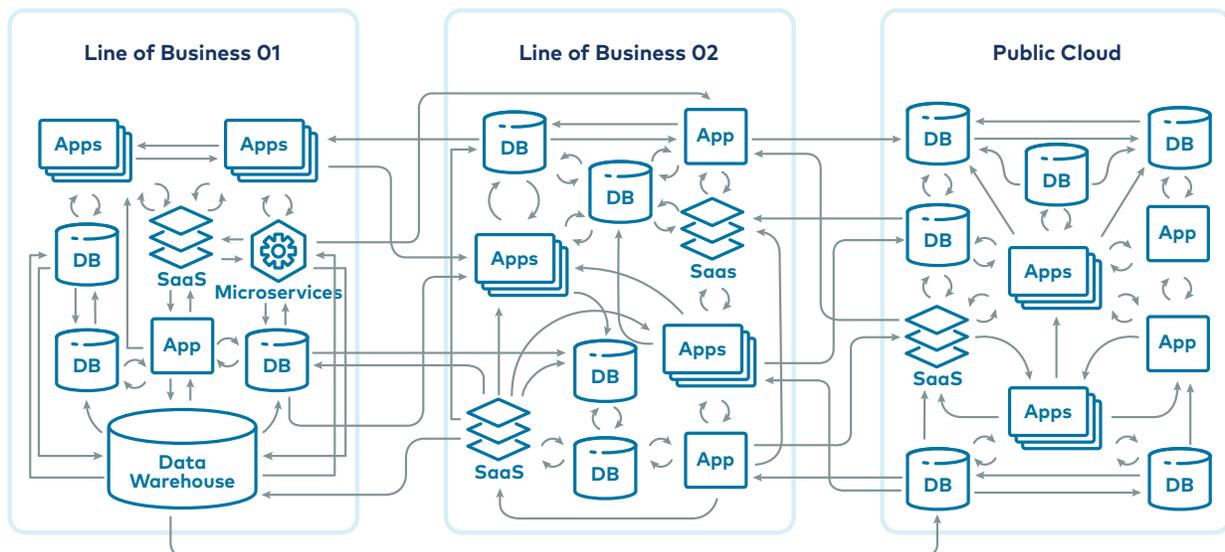

This Leads to a Giant Mess

Industry 4.0 is contingent upon the entire apparatus working together. Both internal operations and customers demand it. In the modern world, applications no longer stand alone. The user is no longer always or even usually a person. Often, the user of software is more software—particularly when it comes to implementing sensors and transmitters, remote monitoring, real-time quality and safety data, and other types of automated systems.

With the rise of the public cloud and cloud-native technology, organizations of all types are now able to build and run scalable applications in a modern, dynamic environment. Now, data management is no longer about storage, but the flow of data and the ability to use it in real time.

To enable that, we're seeing the emergence of event streaming platforms that can connect many parts of the company across systems in a decoupled way and allow the company to act as one. An event streaming platform should enable you to see everything that's happening across a company at once.

Event Streaming Platform
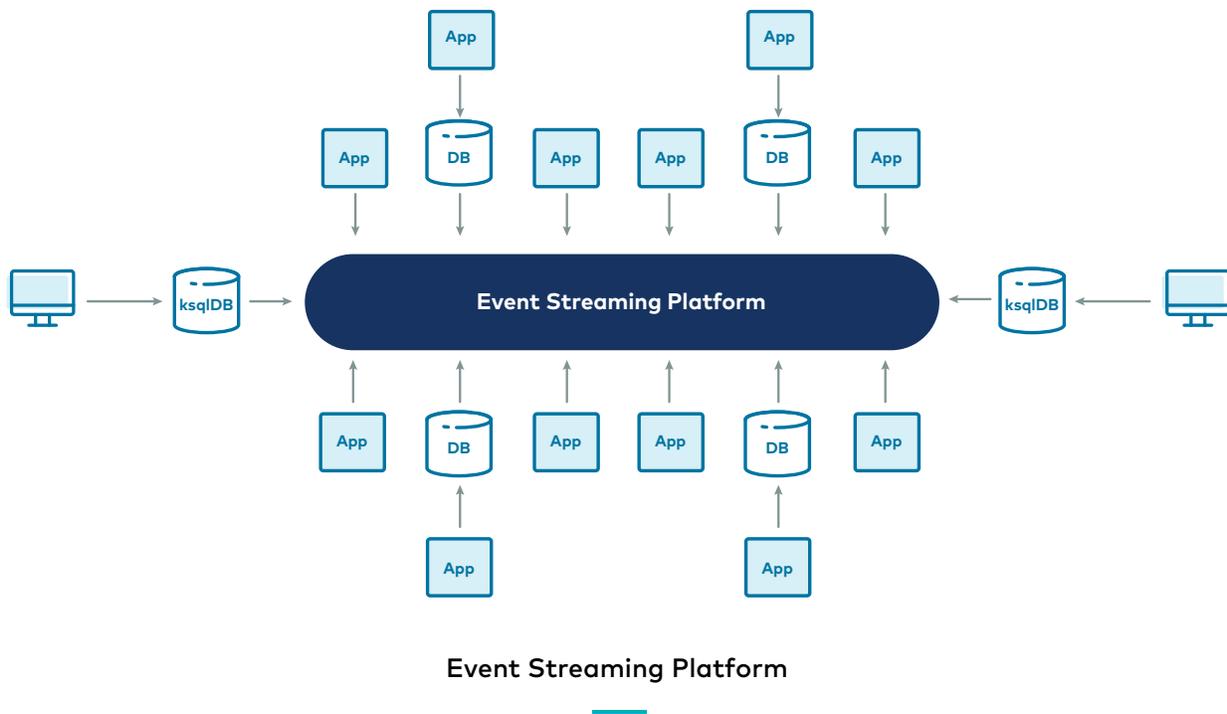
This is where Apache Kafka® came from. Originally a developer project at LinkedIn, Kafka was created as part of an effort to enable capabilities around data systems that could scale and help power the business. Today, Kafka is a community distributed event streaming platform capable of handling trillions of events a day. It's an open source, full-fledged platform with remarkably high performance and value driven by an enormous community of participating developers.

Because of its open source nature, there's a huge ecosystem of products and systems associated with Kafka. But as we move more and more of our workloads and environments to the cloud, and increasingly rely on cloud-native data systems, self-managing Kafka may become limiting.

Confluent solves that challenge by combining the robust capabilities of Kafka in a cloud-native environment. And with that, enterprise companies can embed real-time event streaming into their processes and put data to use in a much more integrated way. Confluent Cloud is the industry's only fully managed, cloud-native event streaming platform powered by Kafka. Deploying this, instead of self-managing Kafka, enables teams to focus on building real-time applications, knowing they've based them on a simple, scalable, resilient, secure, fully managed infrastructure.

Real-life examples of Industry 4.0 applications

Here are two examples of Confluent customers who have been early adopters of Industry 4.0, globally recognized for their digital manufacturing capabilities.

Bosch Power Tools

Bosch, a leading global IoT company and supplier of technology and services, replaced manual data collection and processing with an industrial IoT framework that connects real-time, event-based data sourced from machine-condition sensors and individual cutting tool information, and feeds the data within the ERP.

The company used out-of-the-box big data and analytics tools (including Confluent Cloud), data analysts, and a machining expert to develop custom-izable reports for associates and managers. This real-time data solution has powerful analyses, including diagnostic, predictive, and prescriptive functions.

The company also applied other use cases, including predictive maintenance and bottleneck analysis, via the same tools and setup. As part of training and development, Bosch rolled out basic data analytics training for all engineers. The big data solution (crunching data about everything from raw materials to tools and machines) now supports decision-making for Bosch executives and shop floor staff across several functions, including logistics, manufactur-ing, and quality assurance.

Read the full customer story

> **"Confluent Cloud and Kafka are the heart of all our projects, serving as a backend for new mobile apps and for collecting data from assembly lines and legacy systems."**
>
> — Ralph Debusmann, Solution Architect at Bosch, Power Tools BDO Digital Offerings

Nuuly

Nuuly is a clothing rental subscription service under the Urban Outfitter brand umbrella. Offering rental garments from up-and-coming designers, iconic labels, and unique vintage finds, Nuuly is highly personalized to meet the expectations of its Gen Z and millennial consumer audience.

Nuuly executed its initial launch in half the expected time (six months versus one year) using real-time event streaming architecture based on Confluent Cloud. The development team used Kafka Connect to write services that link Kafka with BigQuery, which enable a real-time inventory system and stable product operations even as subscribers join en masse. Nuuly was also able to address the unique challenge of building its own warehouse management and order management systems within a year.

Relying on a foundation of streaming data allows Nuuly to align the sup-ply chain to available inventory in real time so that customers always know what's available and receive it quickly.

Read the case study

> **"We truly think of Confluent Cloud and Kafka as the central nervous system of our business, spanning everything from the customer-facing applications to distribution center operations from a technology perspective."**
>
> — Chirag Dadia, Director of Engineering, Nuuly

What benefits can you expect from implementing Industry 4.0 technologies?

In a global survey of 1,000 manufacturing sites, the World Economic Forum collected empirical evidence indicating that manufacturing sites attain the following benefits through sustained application of Industry 4.0 technologies.

REDUCTION	IMPROVEMENT
• Automatic changes to products on production lines leads to a reduction in change over time	• Use of "digital dashboards" leads to improvement in OEE (Overall Equipment Effectiveness)
• Machine-alarm aggregation leads to reduced reaction times for alarms	• Improved workforce productivity as repetitive tasks are outsourced to machines/sensors/robotic arms
• Use of mixed reality (MR) apps for maintenance work reduces time to diagnose and repair	• Predictive analytics applied to assets increases energy efficiency by 2%
• AI-based image recognition reduces cost of yield losses	• Rapid design prototyping based on 3D printing decreases time to market by 89%
• Use of a "digital assistant" for operators reduces issues from customer claims by 100%	
• Implementation of automation reduces "labor avoidance" by 45%	
• In-process quality control reduces the amount of scrap during testing and production	

The common thread of Industry 4.0-enabled enterprises

Global consulting firm McKinsey analyzed financial results of 1,000+ public companies between 2007 and 2017 over a decade-long cycle of downturn, recovery, and growth. The analysis revealed that the companies with the most successful track record often changed their business mix.

Industry 4.0 companies use data and information to gain end-to-end visibility across processes, people, and assets. Each interaction is tracked; the data is fed into the system and then analyzed in the cloud, mostly via data processing and analytics technologies. Visibility cannot be achieved without analyzing data, and doing so in real time. Underlying all of the amazing technologies driving Industry 4.0, companies must first adopt an event streaming platform to take full advantage of their data.

Confluent has helped global leaders, innovators, and enterprises successfully implement an enormous range of unique digital transformation programs with one common platform: event streaming. From this foundation, today's Industry 4.0 leaders act on big data, implement IoT, leverage predictive maintenance, and launch machine learning (ML) initiatives.

Whether your goal is to increase earnings via enhanced efficiency and product quality or to roll out modern applications that support real-time alerting with dashboards, Confluent has the right products and offers you 24/7 availability of Kafka as a managed service to help you become an Industry 4.0 leader.

About Confluent

Confluent, founded by the original creators of Apache Kafka®, pioneered the enterprise-ready event streaming platform. With Confluent, organizations benefit from the first event streaming platform built for the enterprise with the ease of use, scalability, security and flexibility required by the most discerning global companies to run their business in real time. Companies leading their respective industries have realized success with this new platform paradigm to transform their architectures to streaming from batch processing, spanning on-premises and multi-cloud environments. Confluent is headquartered in Mountain View and London with offices globally. To learn more, please visit www.confluent.io. Download Confluent Platform and Confluent Cloud at: www.confluent.io/download