

The Rise of
**SYSTEMS OF
INTELLIGENCE**

How The Internet of Things
and smart systems will
change everything

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1. Introduction: The Tsunami of Information

Our world today is composed of the 1s and 0s that make up the binary code created by the streams of data flowing through every sector of the global economy. How much data is that?

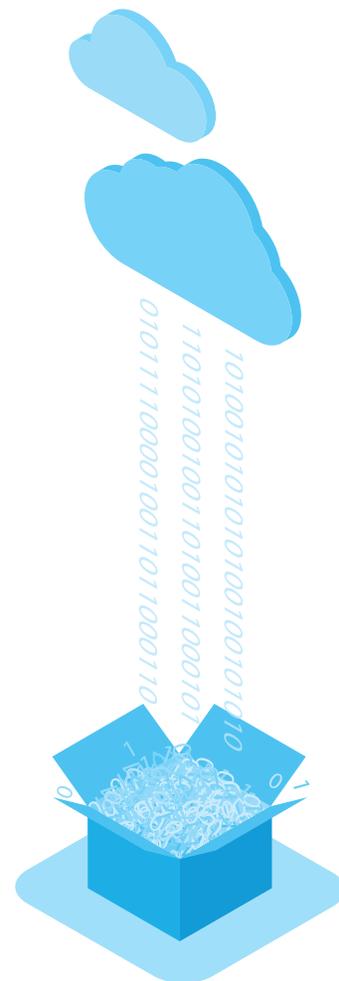
According to IBM ¹, 2.5 exabytes of data were created every day in 2012. That's 2.5 billion gigabytes of data in a single day! Facebook alone was responsible for 500,000 gigabytes a day in the same year ².

The importance of data is becoming so big, even the US Government has launched an initiative, Data.gov, to help access and analyze it. The good news is that data processing and storage costs have decreased by a factor of more than 1,000 over the past decade ³. But once that data is stored, it's difficult to retrieve and use.

According to the Boston Consulting Group ⁴, one third of all bank data is never used. A big part of this is the fact that 75% of the data we generate is unstructured it's randomly organized, difficult to index, and therefore difficult to retrieve.

Where is all of this data coming from? An obvious source is the data that's being generated from your legacy systems of record. It's data from cloud software as witnessed by the rapid adoption of SoftwareasaService (SaaS) as the new business application model.

"Why store all data? Because we can. What's in this data? Who knows?" Svetlana Sicular, Gartner



It's data being created every second from mobile phones, devices, and sensors that are being placed on just about everything that can be monitored in the physical world. And social media represents the single largest data streams that are being created at astronomical volumes.



Forget about texts, just think of all the photos and videos being uploaded via smartphones to popular services like YouTube, Facebook, Instagram, and Twitter.

The smartphone is currently the major enabler of this data tsunami. PCs and feature phones (mobile phones that are not smartphones) are both in decline while smartphones are growing in the opposite direction, even in regions such as Sub-Saharan Africa. And where there's a smartphone, there's an app. An app for practically every human endeavor.

Apps are the smartphone control point for all of the real-time data streams being created by our fingers, the camera, the motion sensor, GPS antenna, Bluetooth antenna, and gyroscope. Smartphone manufacturers continue to jam more sensors and capabilities into these devices while developers continue to build apps that delight us all.



According to The Economist, 50% of the adult population in 2015 own a smartphone. That will grow to 80% in 2020.

But as impressive as smartphones are, the biggest ripple is just forming. To use a term coined by [Andreessen Horowitz](#), it's the "sensorification" of the physical world. The combination of cheap, connected miniaturized computers and sensors will create a world of smart, connected products and industrial equipment.

This new technology category is often called the "internet of things" (IoT). General Electric goes one step further with the term, industrial internet, to include things like jet engines, locomotives and MRI machines.

The internet of things represents a major and transformational wave of IT innovation. [The Harvard Business Review](#) calls this the third wave of IT driven competition, with the first two waves brought to you by mainframes and minicomputers, and the rise of the internet. Needless to say, harnessing and analyzing these data streams will represent the biggest challenge IT and businesses will face over the next decade.

The term of art used to describe this massive volume of data is aptly named, big data. For big data, traditional data storage technology is inadequate to deal with these large, highspeed volumes. And the challenges don't end there.

Enterprises will also need to figure out how to not only capture this data, but how to search, analyze, and visualize it as well as connect it with data on their business and customers. The ultimate goal is the ability to perform predictive analytics and real-time intelligent decision making. This is going to require an IT transformation from systems of record to systems of intelligence.



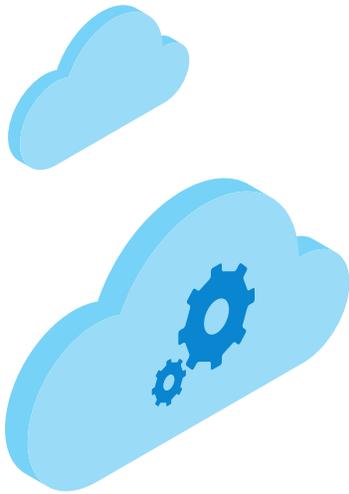
1.1 The Democratization of Data

Before the advent of big data, the concept of business intelligence (BI) had already become a commonly used phrase back in the 1990s. A number of newly formed BI software vendors also entered the market at that time.

BI provided the methods and tools required for the transformation of data into meaningful and useful information for the business. The functions of BI during this period were fairly basic, namely, get and organize the data and visualize it in a presentable way.

Innovations continued and the introduction of data warehouses drastically reduced the time it took to access enterprise data from systems of record. Despite these innovations, a core challenge remains. Setting up these data warehouses require deep expertise and using BI tools require significant training.

The mere mortals in the line of business still can not use these tools in an accessible way. Most BI tools are pretty good at getting answers when you know ahead of time the questions you're asking. Sometimes you simply don't know what questions to ask. In short, these tools don't enable the business user to obtain the insights when, how, and where they need them.



Fortunately, this is all changing. For the first time, data analytics tools are being built that are entirely designed and run in the cloud. There is no need for IT to provision hardware, install and configure the data platform. Performing all of the associated integration and schema development has gone from months to days. This new found agility has allowed innovation in technology to eliminate the traditional two step service bureau model where every request from the line of business required IT's involvement.

These innovations are paving the way for democratization of data where business users can not only get access to data but participate in it's analysis. This means a selfservice model with direct access to answers without the need for analysts, data scientists, or IT. Every business user can find and share answers instantly. There's no hard requirement of needing to know ahead of time what questions to ask of the data. Business users can quickly bang out questions that allow them to explore and gain insights into the data sets.

Furthermore, this democratization is powered by mobile. Using their smartphone, tablet or wearable, workers can now gain access to data and answers to pressing business questions whenever and wherever they are. The democratization of data has become a necessary phase in the journey towards building systems of intelligence.

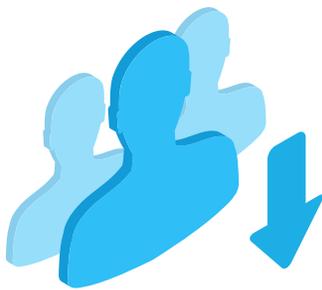
1.2 Turning Big Data Into Meaningful Action

While the fruits of data democratization are plenty, it mostly deals with empowering business users with access and analysis of data from legacy systems of record and cloudbased business applications. At best, some of these new BI tools can provide near real time access and analysis of data. But they are not engineered for capturing and analyzing actual real-time streams of data emanating from smartphones, wearables, and the coming explosion of sensors in the physical world.

Realtime data streams deliver information that is quite different from the backward looking, historical data most BI tools and platforms harness. Realtime data is perishable. That means it not only needs to be detected, it needs to be acted upon. The concept of "time to insight" emerges as one of the key performance indicators for systems of intelligence. These insights are going to require a whole new of level packaging and consumption. The information needs to be delivered in context, at the right time, and in a way that cuts through the cacophony of data we are exposed to in our daily work lives.

Systems of intelligence require knowing what to do with the data insights and how it should be delivered to the appropriate workers based on their job function and role inside the organization. These systems are every bit as democratic as modern BI tools in that they are easy to configure and get up and running. They are also designed to deal with the daily deluge of data we are confronted with every day at work. Consumer apps such as social media, traffic and news aggregating apps help us more intelligently deal with the things that matter to us most.

The bar for apps connected to our systems of intelligence is just high as for consumer apps. This means one click installation, a lovely and simple user interface, and accessibility via mobile device of your choosing. The harnessing and analysis of real-time data streams begins to open up not only action in real time, but anticipate what's going to happen. This has traditionally been the realm of data scientists who handle everything from statistics and computational modeling to visualization and reporting. Models created by data scientists mostly look at past historical trends and use it to predict patterns and future trends. Trying to build computational models that look at large volumes of realtime data streams presents a significant human resource challenge for enterprises.



By 2018, the United States alone could face a shortage of 140,000 to 190,000 people with deep analytical skills as well as 1.5 million managers and analysts with the know how to use the analysis of big data to make effective decisions.

McKinsey Global Institute

Few companies have the data scientists to both analyze real-time big data streams and do something with it. Many organizations simply cannot fill existing open jobs with qualified individuals. Nor will universities spit out enough data scientists to meet the demand in the coming years. But let's say you get your data scientists in place to analyze and structure the data. What next? How do you translate this into something actionable? How do you train your line managers and directors to make sense of the analysis in order to make the right decisions?

While systems of intelligence won't be replacing data scientists anytime soon, it will go a long way towards needing to hire a huge staff of data scientists. Systems of intelligence harness and scale the collective wisdom, expertise, and gained insights of the organization such that intelligent decision making becomes the sum of all these. The collective intelligence can be expressed like rules in a rules engine. These are powerful tools that allow business users to take this collective intelligence and compose simple, logical business rules that evaluate and analyze real-time data streams to produce intelligent decisions.



Data science is the process of formulating a quantitative question that can be answered with data, collecting and cleaning the data, analyzing the data, and communicating the answer to the question to a relevant audience. **Blog:** simplystatistics.org

Most of the initial fruits harvested by enterprises from their systems of intelligence will be of the low hanging variety, namely, value obtained from the expression of simple business rules described above. But as organisations gain greater insights from their systems of intelligence and more devices and sensors become part of the equation, the role of algorithms and machine learning will play a larger part in intelligent decision making.

- Enterprises will increasingly turn to artificial intelligence as they will never be able to hire enough business analysts and data scientists to sift through all the data. Credit card fraud detection is a great example and it's becoming quite sophisticated.

Artificial intelligence doesn't totally eliminate the need for a trained fraud expert, but it drastically reduces the number of suspicious cases that require human investigation.

There will be many considerations to explore as organizations spin up their big data efforts. It's going to require the right people, the right tools, and the right methods. The technology that is coming together today is essentially unbounded in the sources and magnitudes of the data sets. It is completely ready to handle ad hoc questions to whatever depth you care to go.

The next step beyond this are the systems of intelligence that start to tell you what questions you should be asking. Getting there will require a blueprint for systems of intelligence.

2. A Blueprint for Systems of Intelligence

How will systems of intelligence begin to take form? In order to answer this question we need to follow the flow of the data streams. What follows is a blueprint for systems of intelligence.

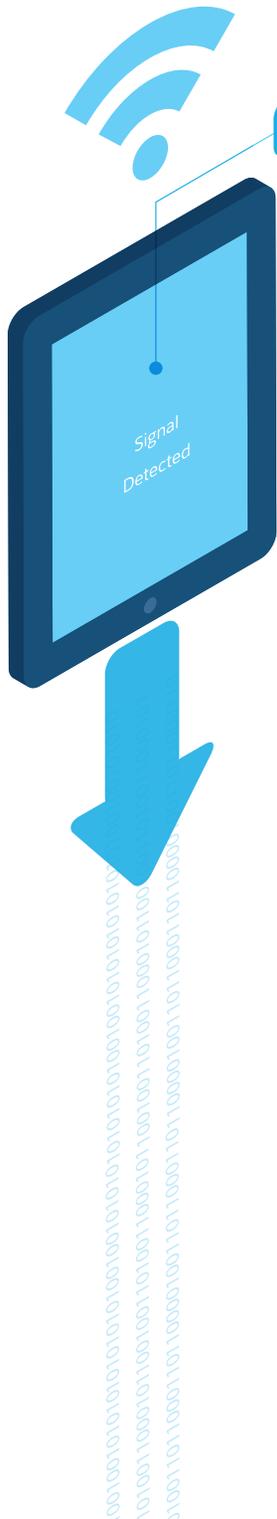


This blueprint looks at every major critical element of the data stream, from its initial creation as digital signals, to its capture, storage and processing, and its transformation into intelligent outputs.

2.1 Real-time Signals

The source of data streams are the signals emanating in real time from mobile devices such as smartphones and consumer wearables like the Fitbit and Apple Watch. The control point for these signals is the app.

The app is what puts context behind the raw data that gets created by human inputs and the sensors embedded in these devices.



A sensor is a transducer whose purpose is to sense or detect some characteristic of its environs. It detects events or changes in quantities and provides a corresponding output, generally as an electrical or optical signal. [Wikipedia](#)

Tying all of this together is the digital plumbing, or application programming interfaces (APIs). Along every critical element of the data stream flow represented in this schematic, APIs will enable this end to end transport of high speed and high volume data in the system. Although the term, API, may not be in the common vernacular outside of IT, it will be, much in the same way that terms of art to describe the web and internet are common language in business communication today.

The major gushers of data streams will be the connected consumer products and industrial equipment and machines. These real-time signals will emanate from product sensors inside our automobiles, inside our homes, on our valuables, our security systems, and anywhere in our physical environment that matters.

Signals from the industrial internet will emanate from sensors on any piece of equipment or machine that requires monitoring, maintenance and repair. Anything that can be digitally monitored with sensors in the physical environment will be. Systems of intelligence must be able to identify these signals and harness them.



2.2 Capturing Data Streams

In order to capture the high volume and high speed data signals, a “digital watchdog” is needed to monitor these signal inputs. If anything significant happens with these digital signals, an event is registered. A very simple example of an event is when a temperature sensor goes off in your automobile to audibly warn you of freezing conditions outside.

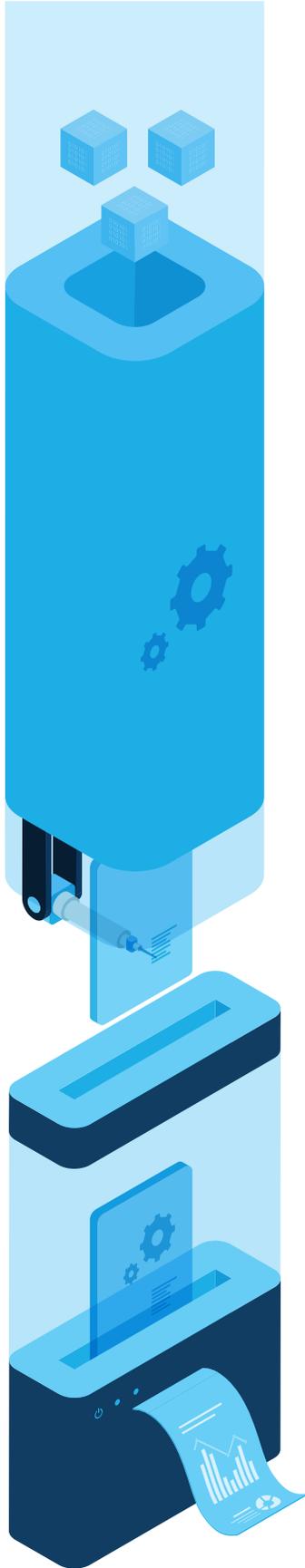
Systems of intelligence will require the technology to ingest and monitor these data streams. The events created by the digital signals get broadcasted via messages and moved through the system so that the digestion process can proceed as planned. This is where filters can begin their job of further analyzing these data streams. For the system to function properly, it must be able to handle growing volumes and increased speeds of data flow and must not be lost if there is a breakdown or crash in that system.

2.3 Digesting and Filtering Data Streams

Once data is captured and processed, it moves along into the digestion phase. This is where some of the magic starts to happen. This includes the monitoring and analytical processing of real-time data streams. Once the data is analyzed and processed, it needs to be put somewhere.

The data streams flowing in are not suitable for traditional database storage such as relational databases using structured query language. This requires specialized technology that can handle and store very large data sets, an essential element of systems of intelligence.

Another key component of this system is the ability to apply filters in the form of business rules that get applied to the analysis of the data streams. This will begin the process of eliminating human errors by expressing the collective wisdom and expert knowledge of the organization directly into the system. Artificial intelligence in the form of machine learning and algorithms can also be applied to these data streams for further analysis.



2.4 Enterprise Data

Enterprise data is comprised of the systems of record and systems of engagement that represent the mainstream of enterprise IT today. As IT migrated from mainframes and minicomputers to PCs and the internet, systems of record have largely been about moving what was paper and manual processes into the digital era. Systems of record have been about automating everyday activities, capturing their information by products, and reporting what are essentially historical documents.

Systems of engagement are fundamentally different from systems of record in that they focus on the social nature of conversations and interactions with customers, partners and employees. Social media and the consumerization of IT shape how these conversations occur and across what channels. Instead of digital artifacts that are document based, systems of engagement add the elements of time, context and place. Systems of record don't go away, it's just that enterprises need to embrace next generation communication and collaboration with systems of engagement.

Systems of engagement and systems of record will be essential elements in providing context to the data streams, filtering and analysis. You can't make sense of the data streams and outputs if you don't have the full picture of the customer, the partner, the employee. These systems will be essential to illuminating the analytical insights and intelligent decisions driven by systems of intelligence.

2.5 Intelligent Outputs

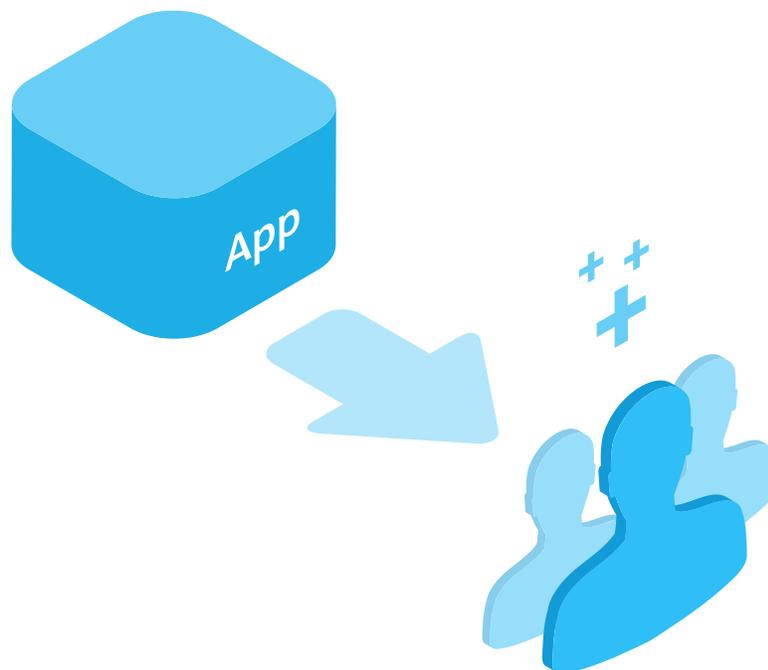
After ingesting, digesting, and applying enterprise context to the data streams, the intelligent outputs are produced and delivered in the right form, at the right time, and to the right channel. The first two channels are dashboards and insights. These drive visualization and context of what is and what has happened so that humans can explore and take action like launching new company initiatives, tweaking existing marketing programs or

refining your rulesbased intelligent decision making. The next two channels rely more on delivering real-time decision making. It's a key difference from dashboards and analytical insights. Expressing the collective knowledge and expertise of the organization through business rules goes a long way towards eliminating bad decisions that are easily avoidable. As signals increase and data streams flow into systems of intelligence, data scientists will be able to better apply their methods and models to create machine learning algorithms that deliver intelligent decisions in a predictive manner.

2.6 Business Transformation

Moving along to the final phase of our data streams journey, the enterprise can now begin to apply the fruits of the intelligent outputs to commence the transformation of the business. Our central premise is that behind every app, device, connected product, and sensor is a customer.

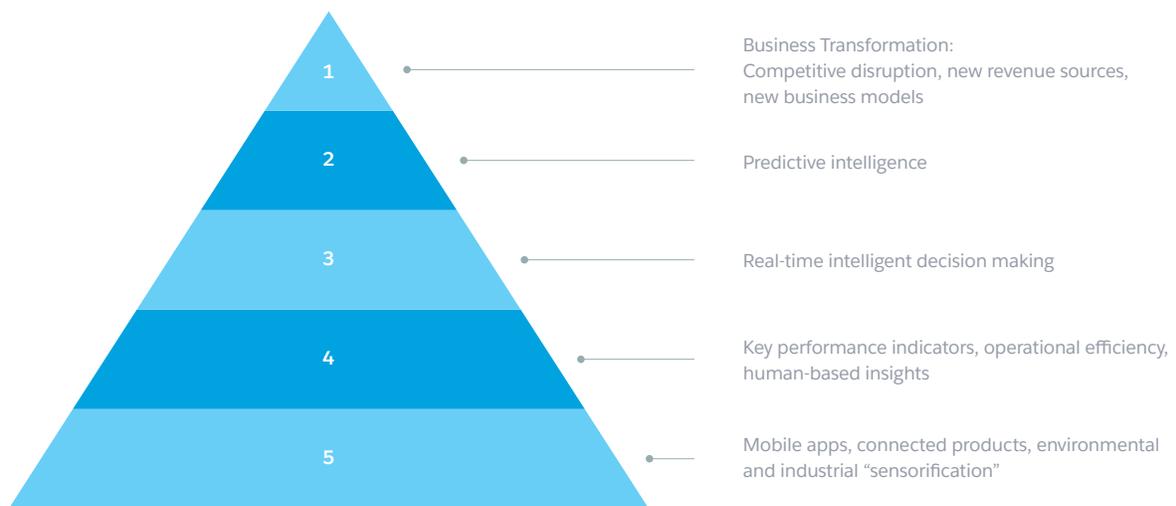
The role of the IoT Cloud is to connect your device data to the customer success platform where you can engage customers through sales, customer service, marketing, communities, apps, and analytics.



3. The Big Payoff

So what does all of this mean? It means enabling higher levels of organizational productivity, new pathways of innovation and opportunities to disrupt competition.

Just looking at the potential in the public sector, a [McKinsey Global Institute](#) report found that if the US healthcare were to harness the value of big data, it could drive \$300 billion in value on a yearly basis simply through driving efficiency and quality into the system.



How do you get started? Building systems of intelligence is not an overnight task. It is a journey, a hierarchy of value, with each step adding more insights into your business and customers. The leading brands of tomorrow will take a similar journey, leveraging a platform designed for the modern world. These platforms will use the concepts decided within this paper to enable everyone to grow their own business based on the System of Intelligence Hierarchy of Value. Your first step starts now.

