Why you'll never get full value from your IoT/big-data investments with yesterday's decision-support tools

How radical enhancement to the art of data visualization is finally delivering on the expectations and needs of today's stakeholders

by Michael Stonebraker, Ken Smith, Gant Redmon and Ricardo Mayerhofer

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Why are we drowning in data that isn't actually helping people make better decisions?

There are currently more than **10 billion active IoT devices** delivering data, and according to analysts that this number is on track to more than double by the end of the decade.[1] Unfortunately, the pace and scale of data collection has accelerated beyond our ability to analyze these massive and growing data sets.

Chief Data Officers—tasked with 'democratizing data'—for use by every level of enterprise decision-maker are now bumping up against the limitations of a **chronic shortage of data analysts** constricted by **data-visualization tools that are now two decades old** or (or more).[2]

Some of the main challenges with today's solutions are:

> ***People can't get dynamic data fast enough***
Whether it's stock data or traffic delays, milliseconds can spell the difference between success and failure. The majority of today's solutions can only provide after-the-fact reporting.

> ***People can't freely navigate to see data in context***
Spreadsheets, graphs, and charts are abstract representations. When users can associate real-time data with relevant visual touchpoints (think maps, schematics, AR graphics) it is much easier to make novel and important data-driven connections.

> ***Data isn't being presented in the way human minds are proven to make connections and gain insight***
We are constantly learning more about how the brain work in "discovery mode." Tomorrow's tools must leverage these proven principles to marry big-data potential to human-scale decision-making.

Tomorrow's advantage will go to those who most quickly (and easily) convert data-collection to business insight.
Next-generation data visualization capabilities and a human-optimized approach to navigation has recently been giving a leg up to leaders in industries such as **global logistics, healthcare, manufacturing, and IoT devices themselves.**

Chapter 1

The evolution of enterprise data in B2B decision-making

by Michael Stonebraker, MIT Computer Science and AI Laboratory (CSAIL)

When I saw the world needed a practical and efficient implementation of the relational database model, I built a team and we created Ingres. When I saw the limitations of the relational model, I created Postgres to address and resolve those limitations.

Welcome to the Hey Day of Big Data
Today, databases are everywhere, and they are getting really, really big. Enterprises see the enormous value locked up in corporate datastores so they've invested in data science and other technologies. However, there is still a major opportunity being overlooked: corralling all of that data for day-to-day, data-driven decision-making.

Harmonizing Our Data
Currently there are lots of ways people try to see their data. They put it in spreadsheets or feed it to dashboards with bar charts and graphs. They write queries for their data and look at the results. The problem now with these approaches is two-fold:

1. *Data still exists in far-flung silos, separated by difficult-to-merge formats, collection modes, and locations.*

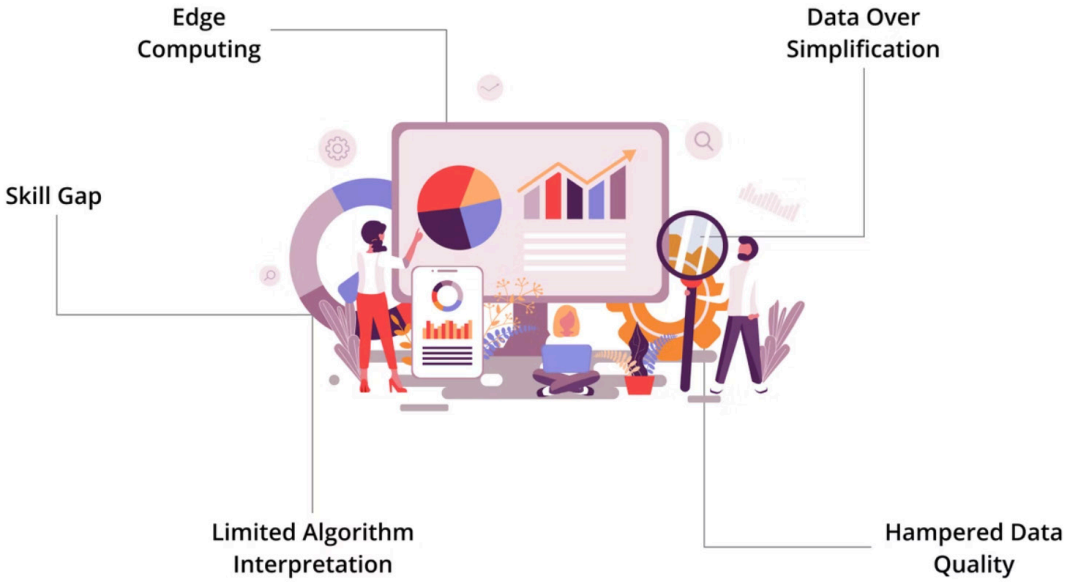
2. *Most of today's integration and visualization tools are built using 30-year-old technology that is, frankly, not very good at helping users see patterns or explore their data in context (especially for line-of-business users.}*

Harnessing the Potential of Big Data for Actual Humans
The way I see this being solved is by giving people the ability to pan and zoom around their data. Obviously, you can't look at everything in a big database at once and get the full picture. You need to be able to see something interesting from "a high altitude" and then drill down into it to get more detail. Then return to a high altitude and drill down somewhere else to explain why you are seeing what you are seeing. And you people to see this *in context*, like having data on a topographical map or a building floor plan or a network diagram.
When given the right data in context the human eye is a great pattern matcher, and the human mind will come to brilliant conclusions.

Professor Michael Stonebraker:
Inventor of INGRES and POSTGRES
Winner, 2015 Turing Award
Educator, MIT (CSAIL), UC Berkeley
Founded eight commercial startups

Figure 1

Challenges in Data Visualization



Chapter 2

Tom Cruise is not impressed

The gap between user expectations and today's user experiences

Back in the age of small data sets, user interfaces had much simpler tasks. The problem is, today's data sets may have millions or even billions of records. Enterprises are drowning in data and struggling to convert investments in data collection into value for the company. This data deluge is breaking traditional techniques of visualizing and analyzing data, which were designed for historical small data sets of thousands of records.

With these limited visualization tools, before a user can perform specific analytics, like run a simple analysis between data element X and data element Y, they need to "see the lay of the land." They need to fly over the data and drill into areas of interest.

Mike Stonebraker's work at MIT has created new options that are closer to the "Minority Report" vision, as opposed to trying to navigate through a glossed-up spreadsheet.

Stonebraker's solution—as commercialized by his newly-launched company, Hopara—is currently the only commercially available technology that truly embraces a visual information-seeking approach: Overview first, zoom and filter, then access real-time/live-data details on-demand and in-context.

Hopara's **Total Immersion Data Environment (TIDE)** enables a more immersive experience that delivers easier detail discovery, faster enlightenment, and more intelligent decisions.

It can also unleash innovation and information-sharing, helping leaders fulfill the value of creating data-driven decision-making and empowered employees at all levels of the enterprise.

In Steven Spielberg's 2002 film, Minority Report, Tom Cruise's character effortlessly navigates through terrabytes of real-time data using an intuitive and exciting UX.

Ten years on, today's data visualization tools are still eons behind.

But that is about to change...

Better information-finding in the age of COVID (and beyond)

More than ever, enterprises and IoT innovators are struggling to support **a workforce that is increasingly remote**. The implications of this unprecedented transition include finding ways to make it faster and simpler for decision-makers at every level of the organization (and who are constantly multi-tasking) to explore, navigate, and visualize vast stores of data—in real-time.

To complicate the challenge, there is **a growing shortage of qualified data scientists and data analysts**, making it imperative that emerging visualization solutions are easy-to-use, robust, and powerful enough to handle the near future's explosion of IoT data.

These drivers have led the Hopara team to focus on a suite of unique capabilities:

- **The ability to ingest limitless quantities of live data**
- **The ability to support real-time, actionable insights**
- **The ability to be used by anyone, without specialized training**

The science behind human information-seeking across vast oceans of data

In a 2019 paper entitled "The Eyes Have It," Professor Ben Schneiderman outlined his famous "Visual Information Seeking Mantra," which consists of the following principles:

1. Overview
In this step, it is recommended to visualize the given data set in a simple way without going into too much detail.

2. Zoom and Filter
Here, we proceed to focus on the part of the data set that is of value to us. Zooming and Filtering help highlight the objects of interest using various techniques.

3. Details on-Demand
Allows users to find the exact details which will help them find interesting facts from the data set.

4. Relate
Relate allows users to view relationships between data points. This principle allows users to further explore networks or maps that help in determining additional courses of action.

5. Provide (navigable) History
Create a history of actions in order to let the user undo or redo any action taken while visualizing the data. (Give the user flexibility to undo or redo the necessary steps.)

6. Extract
Allow users to visualize a part of the graph in order to focus only on the data that is necessary for immediate use.

Visualization and UX pioneer Ben Schneiderman has been studying how the human brain processes complex data sets since 19##, and is widely recognized as the world's foremost authority.

Photo courtesy of University of Maryland Department of Computer science

B. Shneiderman, "The eyes have it: a task by data type taxonomy for information visualizations," Proceedings 1996 IEEE Symposium on Visual Languages, Boulder, CO, USA, 1996, pp. 336-343, doi: 10.1109/VL.1996.545307.

Chapter 3

Helping human brains reach "the ah-ha moment"

Hopara's groundbreaking feature set allows innovators (like manufacturers in the IoT space) to imbue their devices and visualization tools with capabilities that can finally deliver on the mission defined by experts like Ben Schneiderman.

This **Totally Immersive Data Environment (TIDE)** is helping the users and facilitators of big data sets to visualize and deliver vast stores of information in a manner conducive to human exploration, discovery and insight.

Discovery and exploration leading to action (a.k.a. "The ah-ha moment")

For the earliest phases of data exploration, "fly over" visualization at this level can help create a sort of "augmented big data," making it easier and faster for users to quickly spot data anomalies at the highest levels.

For example: A major US bank wanted to better understand the characteristics of their most successful clients to improve ROI of investments in customer adoption and retention. Using a map-based visualization, managers in different service areas were able to quickly identify these customers by "flying over" geographical maps of their territories.

Now the zoom and filtering. But not all zooms are alike. **Hopara supports both syntactic zoom** (think Google Maps) **and semantic zoom** that instantly changes the way data is depicted, such as going from a map of IoT to a bar graph of a particular sensor's output over time.

Finally, to achieve an even greater level of detail-on-demand and the kind of quick navigability that supports human-brain connections and insights, Hopara's solution can allow users to "teleport" in a single click or motion between different realms or locations.

Elevate the decision-making potential of older tools—today.
Alone, conventional toolkits such as Tableau, Spotfire and Excel can't give users the required functionality for discovery & exploration—especially when dealing with very large data sets. Hopara can help extend these tools and fill critical functionality gaps.

Are you trying to manage a global library without a card catalogue?

With terabytes of data at their disposal, the problem for today's decision-makers isn't lack of data, it's the inability to explore, navigate, and connect those virtually limitless data points.

Hopara allows you to finally collect all of these disparately-held data sources, translate them into dynamic visualizations, and serve them up to non-analyst users in a way that they can navigate and customize to support their own objectives.

Why have so many (>70%) IoT initiatives failed to demonstrate real ROI?

In late 2020, a report from IoT analysts at Beecham Research summarized the findings of other industry research from the likes of McKinsey, CISCO, and CapGemini to provide a high-level view of how companies fare with IoT technologies.

The Beecham reports says that 74% of IoT initiatives are considered failures by the companies that undertook them.

McKinsey found that 70% of companies have trouble integrating IoT projects into existing workflow, and 48% struggle to manage the data involved. We believe that the majority of these failures to capture ROI from IoT projects center around two pitfalls:

1. Ingested data is not being presented to line-of-business managers in a manner that they can easily contextualize and gain insight from (see Figure 1)

2. IoT data is being used only to look at operating performance using KPIs, instead of exploring data to find new business opportunities, inspire new data products, etc.

The Beecham report recounts an interview with an IoT project manager in the logistics sector who says, "It is important to have [IoT] technology, but **the technology needs to be adopted by the people.** We have created communities at an IoT level, showing that everyone could adopt it. **It can't be reserved for experts alone.**"

Hopara is helping non-analyst users surf (and fly-over and dive down into) the tsunami of IoT data...

Hopara lets you give managers and non-technical folks the world's most powerful tools for navigating big data faster than ever-and exploring it in the way actual human brains make insightful connections.

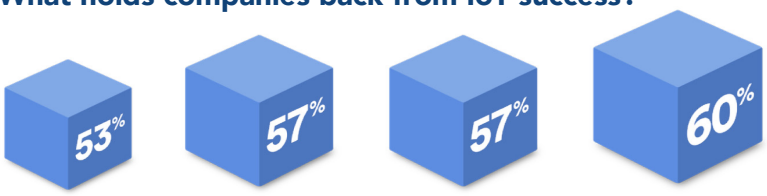
For example:
A major hospital in Boston was looking for ways to lower their post-surgical infections.

Hopara helped them discover how a patient's proximity to a nurse's station impacted infection rates—a connection no one could have seen before.

Each morning, the hospital was able to quickly identify infectious disease 'hot spots' in a more timely manner, and share that information with various members of the care team from doctors and nursing staff to facilities & maintenance.

Figure 1.

What holds companies back from IoT success?



Lack of technological readiness

Current data landscape not ready to manage IIoT data

Uncertain regulations and standards

Current analytics capabilities not ready to take advantage of IIoT data

Source: CapGemini

Chapter 4

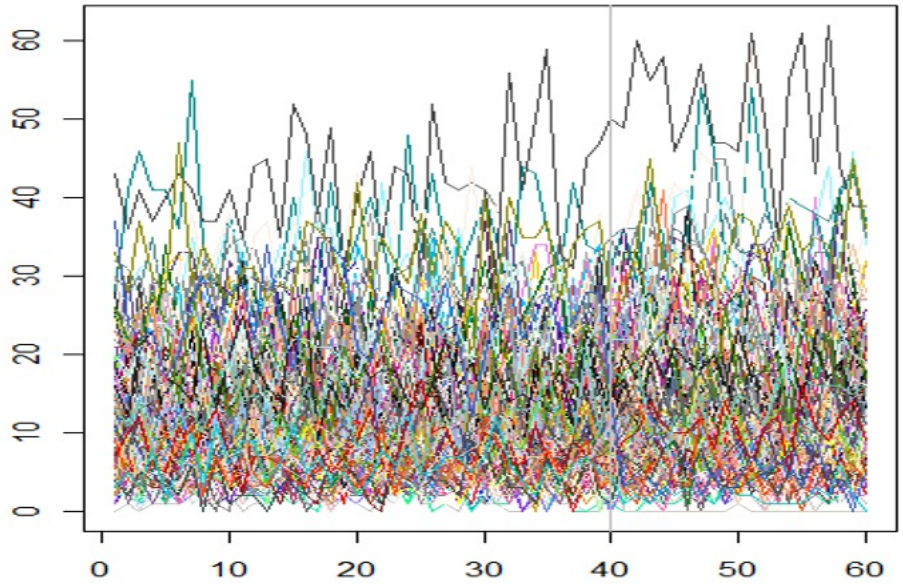
The visualization breakthrough that's unstalling a 20-year plateau

Bringing visualization up to current expectations (without abandoning your favorite tools)

The technology the underpins Hopara is a powerful adjunct to current data viz tools like Tableau, Looker, and Scisense. Hopara is available to work alongside these solutions and significantly enhance their functionality across an enterprise.

No more "painting the screen black"
The amount of data being processed today will overwhelm older approaches, to the point of rendering a visualization useless—without the ability to zoom.

Data presented in this manner simply isn't actionable and only leaves users confused and frustrated.



No more overly simplistic visualizations
At the other end of the spectrum, some tools only allow for the most rudimentary (and static) visualizations.

Tools that cannot accommodate drill-down for further discovery, exploration and detail examination won't deliver the kind of insight that powers "ah-ha moments."

Also, data presented in simple dashboards often lacks context (e.g. location within a geography or facility.)


FASTER MULTI-PART SEARCHES
Users completed multi-part data searches faster using Hopara vs. traditional methods
93%
65%
83%
No lag between real-time data feeds and availability
No more data silos or format challenges
Help current data viz tools work better and faster

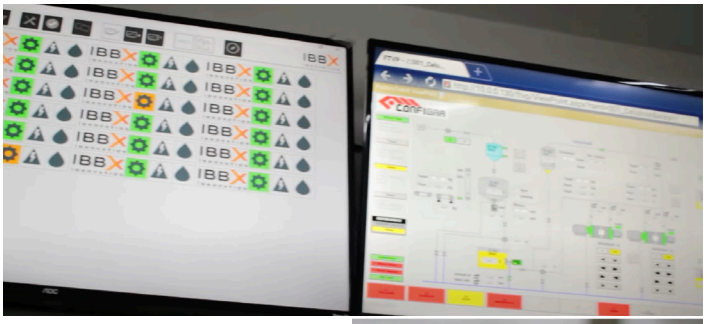
The Hopara revolution in-action:

How four early adopters are leveraging "totally immersive" data visualization...

IoT-powered energy recapture for major industries/infrastructures

IBBX

Sao Paulo-based IBBX is on a mission to rid the world of cables and batteries. They have developed a revolutionary technology that "recycles" previously lost energy from EM waves. For heavy industry and infrastructure enterprises, the company has focused on creating a self-powered IoT ecosystem that is already improving maintenance and repair capabilities for large factories. A critical differentiator, for IBBX is that their solutions support very intuitive operation by factory-floor managers and personnel.



Using Hopara, IBBX added a dynamic viz component to their sensor reporting dashboard to eliminate the need for training and make data access easier. Showcasing that feature in demos has helped the company support 5X growth in just four months.

"Hopara helped us instantly distinguish our solutions in the market. When our clients take a walk through our solution and see every factory in their global environments overlayed onto maps they can navigate and drill down into—to the level of individual components—they are truly amazed."

—Antonio Barros, Director of Revenue, IBBX—

Managing a diverse contractor fleet for last-mile logistics

eu entrego

Eu Entrego was able to give all third-pary fulfillment carriers access to delivery data using to determine the best type of vehicle, range by region, and weather & traffic. Now they direct orders only to the best performing carriers, improving SLA performance for Eu Entrego and increasing revenue for independent partners.

Supporting pharma labs in avoiding costly product loss

ELEMENTAL MACHINES

Elemental Machines will let everyone at its client's labs see sensor data across a network of labs, and drill in to alerts at each facility, so anyone can respond in real-time to temperature changes on a single device preventing millions of dollars of losses in product research.

Real-time global device intell helps perfect customer service

A major manufacturer of laser printers and imaging products plans to let its clients access a SaaS App to monitor devices across a global network of offices—each with a custom floor plan
They will be improving JIT operating updates & supply orders, while helping the company improve customer response and secure repeat business.

Sources

This material is presented for educational purposes only and has been drawn from a wide variety of public and protected published sources, including:

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Cap Gemini

About the Authors

Michael Stonebraker is a pioneer of database research and technology. He joined the University of California, Berkeley, as an assistant professor in 1971 and taught in the computer science and EECS departments for 29 years. While at Berkeley, he developed prototypes for the INGRES relational data management system, the object-relational DBMS, POSTGRES, and the federated system, Mariposa. He is the founder of three successful Silicon Valley startups whose objective was to commercialize these prototypes. Mike is the author of scores of research papers on database technology, operating systems and the architecture of system software services. He was awarded the ACM System Software Award in 1992 (for INGRES) and the Turing Award in 2015. He was elected to the National Academy of Engineering and is presently an adjunct professor of computer science at MIT's Computer Science and AI Laboratory (CSAIL.)

Ken Smith has built a 30-year career helping innovators find their product/market fit, and capture scalable market traction. He is currently Founder & Chief Growth Officer of Hopara. Prior to this venture, Ken was a managing partner at Snowball Enterprises and Crypto Fund. He has served as a start-up mentor for several organizations, including the MIT Enterprise Forum. He holds an MBA from the Quantic School of Business and Technology.

Gant Redmon is a versatile and accomplished business leader with a strong foundation in corporate law, backed by an exceptional record of building and optimizing asset value. Gant's expertise is helping venture-backed and public companies, particularly those in the technology sector, to quickly scale and grow to new levels, both organically and through acquisition. Over his career, Gant has successfully led initiatives for businesses in the startup, high-growth, and turnaround phases, including acquisitions, divestitures, integrations, and international market expansions. He has a Juris Doctorate degree from the Wake Forest School of Law and a BA from the University of Virginia.

Ricardo Mayerhofer is an entrepreneur and software developer from Rio de Janeiro. He has been innovating in the data visualization and e-commerce spaces for the past ten years. He was the co-creator of restQL (an open-source microservice query language). Before joining Hopara, Ricardo spent time at B2W Digital and Ideais, where he was invited to become partner after servings as the firm's Technical Lead for three years. He has a Bachelor of Computer Science from Universidade do Estado do Rio de Janeiro (UERJ).

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