Vaidy Krishnan, Tableau Software

Solving the Internet of Things' Last-Mile Problem

With the rise of low-cost sensors, connectivity everywhere, and our fast-growing volume of data, the Internet of Things is likely to reshape the world as we know it. According to Gartner, Inc., a technology research and advisory corporation, there will be nearly 26 billion connected devices by 2020. From wearables to home automation, to manufacturing optimization, the possibilities are immense, but so are the challenges. Making the IoT work for the masses is more of a data challenge than a device connectivity problem. We first have to extract the data from devices then figure out what it all means.

So far, the market has been focused on getting smart gadgets online. We've seen little innovation to help us consume all the data that these gadgets and machines collect. As a result, many IoT solutions suffer from the last-mile problem. In other words, these solutions are gathering data, but fail to help people see and understand the data they mine. What good is data you can't use? And if you can't use it, why go through the trouble of collecting it?

So how do we read, interpret, and understand this IoT data, be it from a smart home appliance, a wearable, or an industry-scale solution like GE's Predix platform? We have to address four hurdles that stand in the way:

1. Iterate and Move Fast

2. Enable Deeper Exploration with Interactivity

3. Allow Broader Analysis with Data Blending

4. Foster Sharing and Collaboration
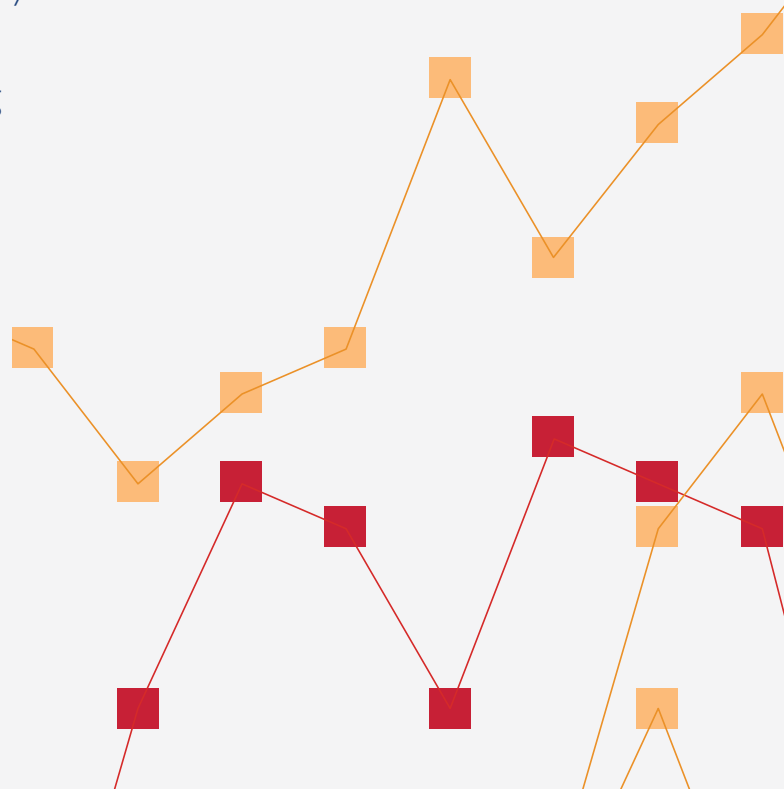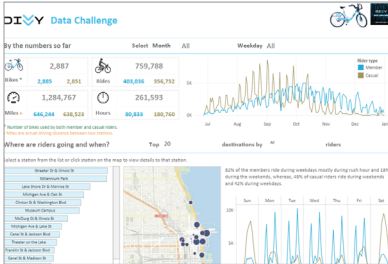
▶ *Further reading:*
All the Things: Data Visualization
in a World of Connected Devices

I.

Iterate and Move Fast

We live in a world where "perfect data" is increasingly becoming an oxymoron. Regardless of how the data may be compiled, it's likely stored in a source you can't connect to. The data may also be incomplete in some key areas, or is formatted in a way that's less conducive to deep analyses. These drawbacks are increasingly prevalent for IoT applications since there is no consensus on standards and protocols to support device interoperability.

Rather than having bad or incomplete data paralyze our business, we must work with what we have and iterate toward the right answers. As we iterate, we learn to separate the "good enough" data from the really bad data. Good-enough data is usually sufficient to answer most if not all questions directionally. Moreover, better understanding of data gaps leads to better data. It will help fix process issues that will improve how data is captured and ingested.

And the good-enough data you have continues to evolve and get analyzed to drive value, which builds further momentum and demand for good data. People start seeing the value and become willing to invest in making their data accurate and reliable.

These "launch and learn" cycles originate from the Agile methodology that's been honed and perfected in the area of software development by many companies. We believe this should be applied in the analysis of IoT data as well. Speed of technology adoption, after all, is the one thing CEOs care about the most. This finding was loud and clear in Boston Consulting Group's 2015 survey of fifteen-hundred CXOs from the most innovative companies. In the survey and in follow-up interviews with executives, "the word that keeps coming up is speed," said Andrew Taylor, a senior partner at BCG and co-author of the report. The study found CXOs wanted to accelerate traditional innovation processes to rapidly develop products and experiment with ideas.
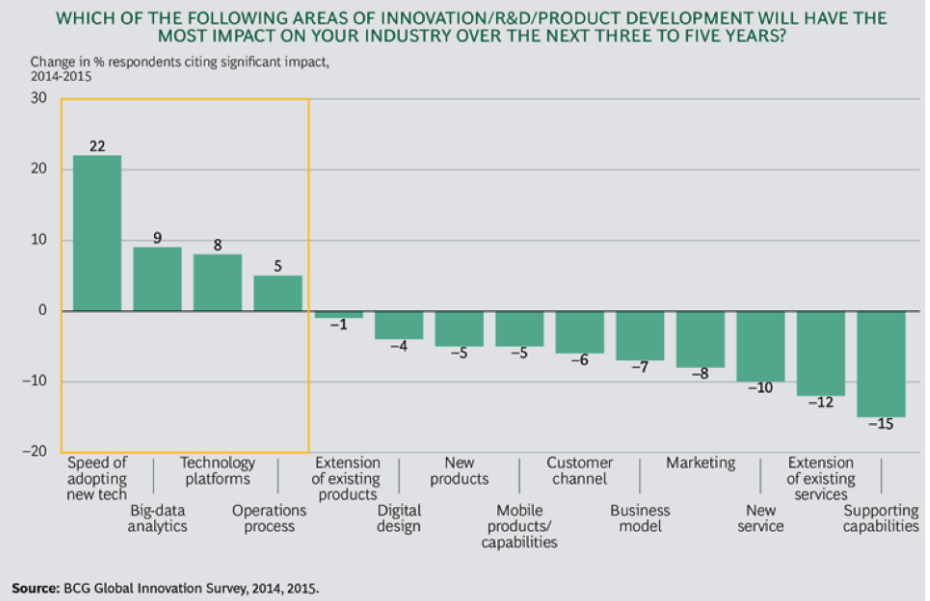
EXHIBIT 1 | Speed of Adoption Increased in Importance in 2015

WHICH OF THE FOLLOWING AREAS OF INNOVATION/R&D/PRODUCT DEVELOPMENT WILL HAVE THE MOST IMPACT ON YOUR INDUSTRY OVER THE NEXT THREE TO FIVE YEARS?

Source: BCG Global Innovation Survey, 2014, 2015.

For organizations to achieve speed, you need an analytics platform that is fast, flexible, and easy to deploy. It should let you test different approaches and identify the shortcomings in your data during analysis. It shouldn't be development-intensive lest you get frustrated and give up before you've extracted an ounce of insight.

Flex, an industry-leading supply-chain solutions company also known as Flextronics, faced a similar challenge. Flex is increasingly transforming itself from a low-margin contract manufacturer of PCs, routers, and basic electronics to a maker of devices, sensors, and industrial equipment that fuel and service the IoT. To improve margins, Flex needed to better understand its IoT performance data to lower costs and optimize manufacturing. It also needed to deliver unparalleled value to customers in the form of faster repairs and refurbishments. All the while, Flex needed to move fast to avoid getting crushed by huge Asian manufacturers and stay ahead of nimbler startups.

However, with its data locked up inside "Excel hell" or behind the doors of complicated enterprise BI platforms, Flex was struggling to make headway. With the transition to an on-demand self-service analytics framework, Flex can now act fast. The automated, standardized, and repeatable reporting framework is saving hours of non-value-added time and cost. And the team is free to focus on serving customers. In the words of Flex's advanced analytics lead Joel Woods, the company has gone from "measuring performance to maximizing performance."

2.

Enable Deeper Exploration with Interactivity

We all remember Steve Jobs's blockbuster keynote at the 2007 Apple WWDC that introduced the iPhone to the world. Leading up to the big reveal, Jobs emphasized the contrast between the revolutionary new "giant screen" design and the existing technology that put buttons on phones. It was a giant leap, and his argument supporting the innovation was simple: Every app needs its own screen, its own UX (user experience). In his words, buttons don't work "because buttons and the controls can't change. They can't change for each application, and they can't change down the road if you think of another great idea you want to add to this product."

You could apply the same argument to the world of data as well. We humans are innately curious. The answer to a question often leads to more questions. The more we see, the more we learn. That's why you need a flexible tool that lets you sculpt and mold your data in different ways as your needs evolve.

Unfortunately, most IoT applications ship with one-size-fits-all views, or dead-end dashboards. They answer a predetermined set of questions and users can't go beyond what they've been given. For example, we might have an IoT application that looks at the historical activity data of a broken engine and predicts which conditions led to failures, and how often a failure is likely. But what if we want to drill down on the parts that fail the most often? Maybe we want to see which factories manufactured these parts and when, or which suppliers caused the most issues. What then? Our curiosity is insatiable, and we get frustrated when we can't go beyond the initial questions.

In the rare case that we can ask follow-up questions, we'll likely have to migrate our data or engage in long development cycles to adjust our reporting. And since questions, by their very nature, involve exploring the unknown, it can be difficult to justify the costs for a big IT project. But if we don't explore, we also don't know what we could have learned or what opportunities we may have missed.
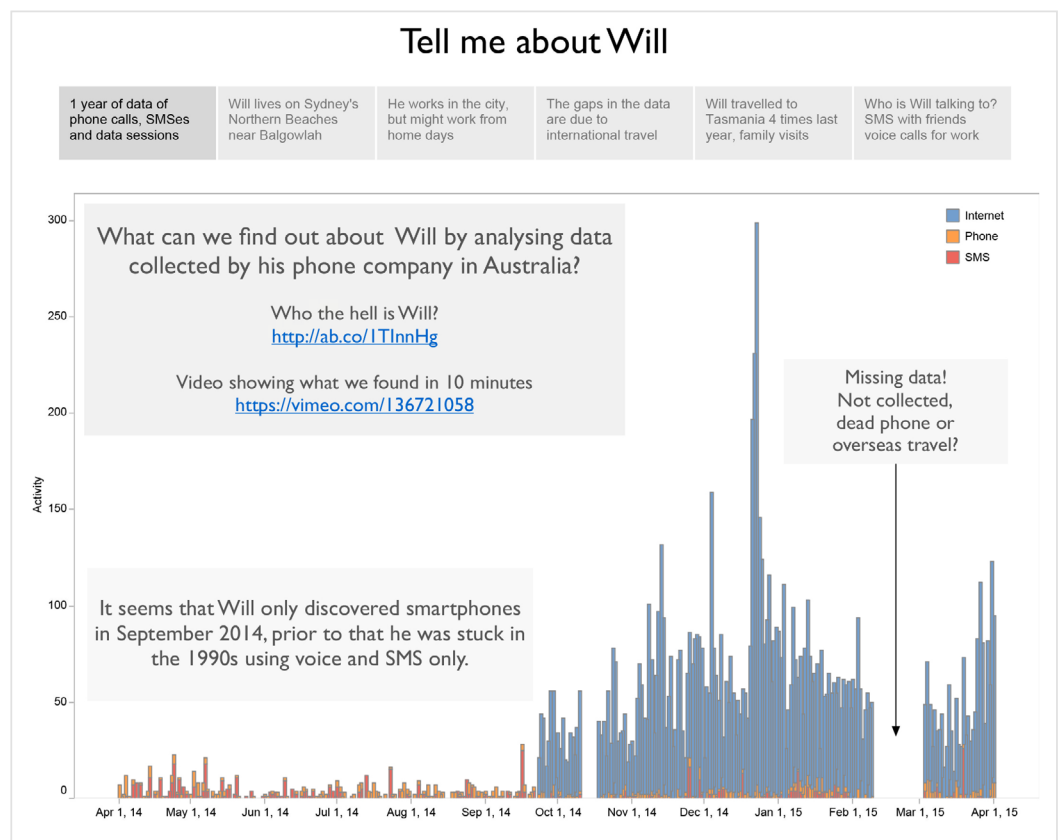
So how do we get meaning and depth out of IoT data without having to fund a huge IT project? The answer lies in interactivity. When you can interact with your data, you can have a conversation with your data. You can explore all sorts of permutations and even discover surprising patterns.
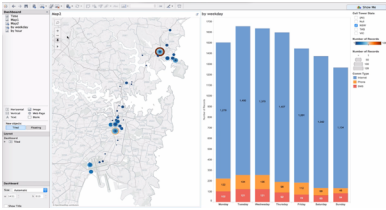
▶ *See what Mac Bryla learned about Will Ockenden in just 10 minutes.*

Mac Bryla made some surprising discoveries when he explored the phone metadata of Australian journalist Will Ockenden. In the spirit of discovery, Will procured and released his own data to the public, and was rather surprised by what Mac discovered in just 10 minutes! The viz below illustrates how Mac peeled back the onion, layer by layer. This is an amazing showcase of what's possible if users are empowered to ask and answer their own questions. It's a far cry from static, closed-ended views that limit discussions before they even have a chance to take shape.

Tell me about Will

| 1 year of data of phone calls, SMSes and data sessions | Will lives on Sydney's Northern Beaches near Balgowlah | He works in the city, but might work from home days | The gaps in the data are due to international travel | Will travelled to Tasmania 4 times last year, family visits | Who is Will talking to? SMS with friends voice calls for work |

What can we find out about Will by analysing data collected by his phone company in Australia?

Who the hell is Will?
http://ab.co/1TInnHg

Video showing what we found in 10 minutes
https://vimeo.com/136721058

It seems that Will only discovered smartphones in September 2014, prior to that he was stuck in the 1990s using voice and SMS only.

Missing data! Not collected, dead phone or overseas travel?

Legend: Internet, Phone, SMS

3.

Allow Broader Analysis with Data Blending

Interconnected devices have changed daily life in ways we couldn't have imagined a few years ago. And deep within their data, they contain stories that have yet to be told. Uncovering these stories involves combining IoT data with additional context.

Kaj Peltonen, product consultant at Tableau, wanted to explore his Fitbit data for a possible link between his exercise regimen and sleep patterns. The native dashboards in Fitbit only allowed him to him analyze his fitness data in isolation. But he wanted to look at his FitBit data in a broader context. He wanted to know:

• How does physical activity during the day impact my sleep patterns?

• Do I perform better when I have had ample sleep?

Thankfully, Fitbit allows you to export data tracking your physical activities as well as your food intake, body measurements, and sleep patterns. (An export is not ideal, but it's sometimes the only way to broaden the scope of analysis.)

In no time, Kaj blended the data in Tableau and matched up his sleep patterns with his daily exercise regimen (see dashboard on page 8).

Kaj learned that a good night's sleep (particularly on Monday nights) is often followed by an active day.
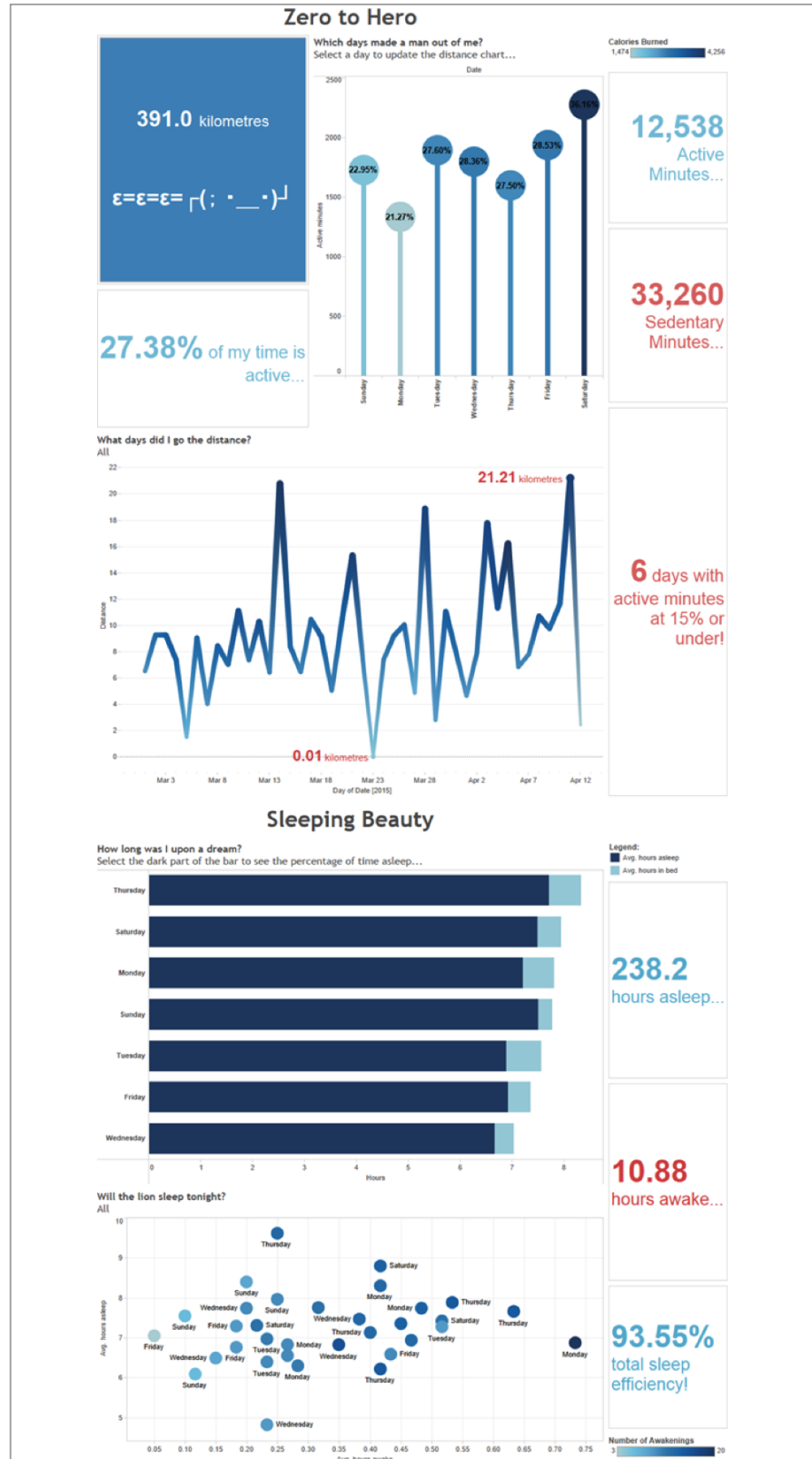
► *Learn more about MainPower's self-service analytics.*

Imagine applying this same data blending and analytical freedom of discovery to the business environment. Sensors embedded in a jet engine can help us predict when it might need service. It could help us preempt failures and save billions of dollars. But what if we want to know how those savings compare to our projected budget by product and region? It could be a great way of aligning our IoT investments with where the greatest needs and opportunities of my business are.

Or imagine a public utility company looking to explore the smart grid. Imagine all the points of the power grid are linked to the Internet so the utility could monitor breakdowns and prevent outages. What if the company wanted to marry asset performance and reliability data with load-demand data for capacity planning? This would allow the government to diversify energy mix, including renewables with conventional energy sources for the smooth management of smart, sustainable cities. The power of blending disparate data sources on the fly can help answer those questions.

New Zealand utility company MainPower is an example of this. The company analyzes a wide variety of data from different sources, most of which are channeled from a geographic information system to map all assets with coordinates. Joining data, MainPower can identify where data collection is lacking or of poor quality. Data is now displayed on a map, allowing MainPower to identify problem areas and reorganize its workflow to prioritize jobs that need to be attended first. The utility suddenly had a way of unlocking existing data. It could see how different jobs in one particular geographical area could be grouped together for maximum efficiency. These new insights save time and money.
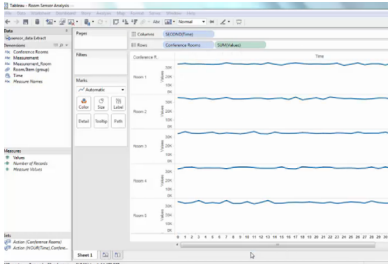
▶ *See interactivity in action.*

4.

Foster Sharing and Collaboration

Last but not the least, it's imperative that we can easily share our IoT data and insights with others in a meaningful way. Now that we've gone through the trouble of collecting and analyzing the data, we want to maximize its impact. People are busy and lack the time to pass along information effectively. Tools should help us do that.

When combined with interactivity, sharing becomes even more powerful. For example, watch how the operations manager for a mid-sized business can quickly dive into conference-room sensor data (stored in a Datastax warehouse, leveraging an Apache Cassandra database) to better understand energy usage patterns in the office building. He can go back and forth between the questions he wants to ask, and the questions that come to him as he digs in. That's the beauty of interactivity.

But more importantly, once he shares the interactive canvas, he enables others to discover more unasked questions and explore new vectors. They have their own aha moments. And when they discuss these discoveries and find common threads, they expand the collective wisdom of teams, identifying more unknowns and this continues the cycle.

Sharing also helps us be more strategic at identifying problems. In an IoT-enabled manufacturing plant, this could mean being more proactive at understanding why, where, and on which job a defect occurred as opposed to simply pouring money into rework, removals, and fixes of defects over and over again with the blind hope of improvement.

Before long, you realize that everybody in the organization is actively participating in data-informed decisions. They're reducing waste and improving processes as only teams can and individuals cannot. They're driving change.

Conclusion

When IoT data starts to help drive decisions, things go from being cool gadgets that carry signals to being agents of empowerment that transform organizations. That's how we close the last-mile gap.

We've only scratched the surface. As devices light up, things get interesting— if we can decode what the devices have to say. Once we see and understand IoT data, we'll be able to make smarter decisions about our personal well-being, our professional performance, and the world we share.

About Tableau

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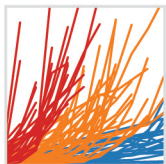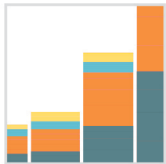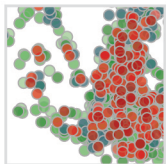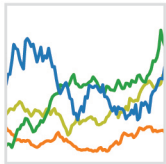
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