Where has the IoT been going wrong?

And why is it important?

RIOT RESEARCH (RETHINK INTERNET OF THINGS)

A Riot Research IoT explanation

Authored by Alex Davies

RETHINK
TECHNOLOGY
RESEARCH

Bristol & Exeter House,
Lower Approach Road,
Temple Meads,
Bristol
BS1 6QS

Phone: +44 (0)117 925 7019
Fax: +44 (0)117 329 1480
Email: info@rethinkresearch.biz

"Leading the way with independent thought and no regurgitated analysis"

Where has the IoT been going wrong and why is that important?

In the four years that Riot has been published, we have seen countless estimates of the size and growth of the IoT. All of these have been misleading, and now a few years removed from some of the most optimistic, we can see that the IoT hype-balloon has withered. The wider technology industry is now, slowly, waking up to the fact that the trend pitched as the answer to so many problems is actually quite problematic – an evolutionary rather than revolutionary panacea.

As such, Riot wants to issue a manifesto of sorts. The main thesis is this: "the Internet of Things" is no longer a useful term, as it is no longer doing its job, as a catch-all umbrella term, properly anymore. The market has split into specific verticals, and as time goes on, there is less chance of a grand IoT unification. This trend is doomed to be split into islands, separate from each other – with the notion of a global hyper-connected data utopia now appearing rather quaint.

The second element of the argument is that we should begin discussing these verticals directly, because using "the Internet of Things" does not accurately discuss the industry-specific technologies and practices being used. To this end, referring to things as a "connected-X" is a better way of framing a discussion – such as 'connected cars,' 'connected manufacturing lines,' or 'connected metering equipment.' Those three are so different that the only real thing they have in common is an internet connection.

The third angle is that the high-level view of "the Internet of Things" is not useful from an analysis point of view, because very few people want or need such a view.

They are, instead, focused on their own specific area within the umbrella term, such that a developer of agricultural robotics has no interest in the latest advances in low-power WiFi or warehouse logistics. Despite both being under the umbrella, they are entirely disparate.

They are, instead, focused on their own specific area within the umbrella term, such that a developer of agricultural robotics has no interest in the latest advances in low-power WiFi or warehouse logistics. Despite both being under the umbrella, they are entirely disparate.

And finally, somewhat related to the first point, the "Internet" in "IoT" is somewhat misleading, as all its devices are not sufficiently connected to actually refer to it as an internet. One cannot navigate to these end-points, nor can these end-points freely connect with any other end-point as a laptop could. Many of these isolated networks are essentially one-way traffic. We may never see the IP-native IoT, which could at least somewhat facilitate such traffic.

Very few IoT devices are actually connected to the internet, directly or indirectly – they are usually hidden from view in the clouds. The utopian view of completely shared and integrated data, akin to the World Wide Web, is very unlikely to come to fruition – instead, the IoT will exist within these islanded verticals and geographies. As such, "Internet" is the misleading element. "Web" is more accurate, as it denotes the information sharing aspect, rather than the pure networking focus of "internet," but either way, a "Web" doesn't look like it's in any hurry to emerge.

Initially, this sounds quite defeatist, but that's not necessarily the case. Data integrations are complex at the best of times, and while data marketplaces are an exciting prospect, they are not simply going to spring into existence.

They are huge logistical headaches, and while they are potentially incredibly useful, bringing them into existence is going to be a pretty painful process – in terms of both the technology and the business case. Promising examples are Here's Open Location Platform, and Terbine's recent ITSA project, but even these will only connect a fraction of the total number of "IoT" devices

Instead, we should try to move immediately beyond the "IoT" umbrella, and quickly get down to brass-tacks. The term is now only useful for broadly referring to a connected object, and discussions should focus on the specific business problem or application at hand, as the idea of everything being interconnected seems decades away from achieving, at least.

The IoT is Dead. Long Live the IoT.

Broadly, most hold a dim view of "the IoT" – the term is now a loaded one, with mostly negative meaning and connotations.

As many of you will know, not a week passes without another bad headline for IoT security. GPDR and Cambridge Analytica have brought the concern of data privacy to the fore, and a lack of easily quotable success stories, have led to what looks like major doubts on the part of the executives – a lack of leadership buy-in for "the IoT."

However, when you frame the problem differently, in terms of Hardware X + Software Y + Cloud Z = 20% Return on Investment, then the benefits become obvious - usually. Most business executives will see the opportunity here, even if "the IoT" means nothing to them, or conversely if they've heard of the latest disaster caused by default passwords and sloppy coding.

So what is, or was, the Internet of Things? Our in-house definition has settled on: "the process of connecting a previously unconnected thing to the internet, either directly or indirectly, and deriving a benefit from that connection."

It's sufficiently simple and broad to cover all the bases, but of course, has one major unknown – what exactly is a thing?

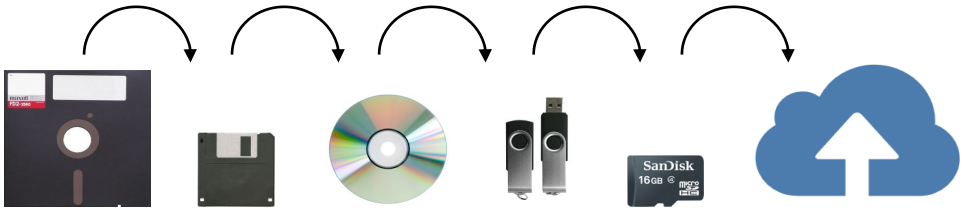
Well, here's where forecasting gets tricky. Is a connected car one thing, or is it dozens or hundreds – do you consider the whole finished product, or the individual components that comprise it? How do you adequately express that problem on a curve or graph? Same with a shipping container – just one box, but is it "and/or" the contents?

Further, does a canned good count as an IoT thing if it has an indirect internet or web connection via that RFID system? Going further, could we count the can as an IoT thing if we use its barcode to track its way through a supply chain? Where's the threshold for internet/web proximity?

There are some other safer bets – fixed assets like a smart meter are easier to count as a single device within a single forecast or estimation. With the meter, there is likely only one connectivity chip, which is used for connecting it to the wider internet – easier to break-out than the dozens of connected elements within a modern car, for instance. But some more unorthodox options might include professional American Footballers, via sensors from Zebra, which are used to track how they move around during a game – so that this data can enrich the video content.

Further to this counting problem, the virtual representation of such data could still be considered as distinct from the physical thing. After all, the IoT is fundamentally about the data generated by these devices – not the device itself, rather, the data it creates and the applications it enables.

These 'Digital Twins', the digital representation of an analog physical object, are often the thing that is doing more interacting with the wider ecosystem than the object itself, but if you follow that line of thinking, you end up in weird places – that smart meters are more the lines in a database than they are the box measuring your electricity consumption. It gets a bit wonky on the extremes.



Evolutionary — Absolutely not revolutionary

So now that those issues have been thrown into the air, it is important to stress a much more concrete problem in "the IoT" – that unless you extremely precisely define your terms, any conversation about it will quickly get confusing. Forecasting at macro-scale becomes very 'finger-in-the-air', and once you narrow it down sufficiently, you're usually looking at one specific market or vertical – and so it's not really useful for gauging "the IoT".

But this isn't to diminish the scope of the IoT. Even at 1% or a fraction of a percent, of total industrial output, its monetary worth is huge. Similarly, there will soon come a time when every company is interacting with the IoT in some manner – although it's worth noting that there are no "pure IoT" companies, as none are all-encompassing and all have their own angles.

It must be emphasized that the IoT has always been an evolutionary technology – not the over-hyped revolution that many raced out of the gates wanting it to be. It is a way to improve or augment an existing process, rather than a way to reinvent the wheel – a gradual, rather than seismic, change.

No longer only a buzzword for marketers, the IoT is now something that an IT department now has to get its head around, rather than something to be pitched to the C-Level execs by a vendor, consultant, or systems integrator.

There wasn't really a step-change moment for the IoT – for those who have adopted some element of it, it just slowly happened. On the whole, companies bought into the trend as it arose in their replenishment cycles – replacing an outdated appliance or system with the shiny new one, which was now an IoT-ready version. Largely, there aren't IoT Divisions within companies. Instead, it has enmeshed itself with the existing teams and departments – emerging pretty organically, rather than being forced into being. Of course, some companies used dedicated teams, but soon those teams will be absorbed into day-to-day operations.

Smart meters are a very good example of the value at stake here, as they provide the data-generating basis that allows an energy utility to completely transform its business – on-boarding renewable energy, experimenting with demand-response, getting more into the services game. Without the meters, none of the upper layers of the stack are possible – but if the meters don't work properly, they could scupper all those potential benefits.

But have we already got the mold for the IoT, going forward? It doesn't look like there will be a radical reinvention of this wheel. The dust has settled – it seems very unlikely that new contenders will emerge to disrupt existing markets. It seems very unlikely that we'll see another Sigfox or LoRa emerge to tackle the low-power wide area networking sector, nor is another low-power personal area networking technology going to emerge and storm the likes of Z-Wave, Zigbee, Thread, or Bluetooth.

Rather, what you see today is largely all that will impact business going forward. This seems to be it. It is now time for these IoT technologies to begin to take root and scale, working their way through organizations and providing tangible and measurable benefits – taking hold within specific markets and verticals, not necessarily cross-pollinating. But they have a very big hill to climb before they can be considered influential, in terms of total dollars at least.

Global Domestic Product

Global GDP in 2017 was around $127 trillion (tn) in 2017, and has been consistently growing at 3.1% to 3.5% annually since the 2008 financial crisis. The global population was around 7.5bn people in 2017, and grows by around 80m each year. By 2025, it will hit 8.19bn at this rate, and the UN estimates that it will reach 8.5bn by 2030, 9.7bn by 2050, and 11.2bn by 2100. In most countries, growing populations are going to compound economic and social pressures, and new technologies need to help solve these emerging problems.

In terms of how the world's GDP is comprised, 63% is attributable to the Service industry, 30% to Industrial, and the remaining 6.4% to Agriculture. Assuming those ratios remain pretty constant, in 2018, the proportions represent $82.4tn, $39.2 tn, and $8.4tn. In 2025, those will have grown to $101.3tn, $48.2tn, and $10.3tn.

By labor force, the Service industry employs 45% of workers, Industrial employs 23.5%, and Agriculture accounts for 31.5%. Of course, not every person is a worker, but you can use those ratios to gauge the percentage of population reliant on the jobs at hand. It is also worth noting that in terms of household incomes, the bottom 10% account for 2.6% of the total household spending, while the top 10% account for 30.2%.

Agriculture is the sector with the most obvious imbalance, which makes it more vulnerable to technological disruption – especially through labor automation, which is something that Riot has tackled in a paper. Resource-efficient vertical farming and robotics are key here – but don't underestimate human capabilities and dexterity – it's very hard to replace a human with a robot, more so to do it within a given wage budget.

But Agriculture isn't alone here – next-gen business software could decimate call center and clerical labor demand, through natural language processing and computer vision. Once the likes of SAP or IBM can offer a pre-packaged system that could remove the need for 75% of those workers, it's going to be hard for a profit-seeking business to turn them down – especially if it has to answer to shareholders.

Meta-analysis— 'The Wisdom of The Crowd'

The early days of the IoT saw some pretty big claims thrown out there. The most (in)famous one was Ericsson's 2010 claim that there would be 50bn IoT devices by 2020, which it has now successively revised down – adjusting to 18bn IoT devices by 2022, in its most recent Mobility Index.

Another early estimate was IBM's 2012 prediction of 1tn "connected devices" by 2020. For context, Ericsson's revised figures think there will be 29bn connected devices by 2022, of which the 18bn IoT devices comprise some 62%. In 2018, ARM predicted a trillion IoT devices by 2035.

Of course, the previously discussed issue of what exactly is an "IoT device" complicates comparisons, but through recent years, the forecasting onus from the community has shifted to concentrate more on dollar amounts than device volumes. To this end, McKinsey projects a $6.2tn impact on the global economy by 2025, attributable to the IoT, growing to as much as $11.1tn annually by 2028 – of which $5tn will be B2B solely.

But some form of consensus emerged in the device number predictions, falling within the 20bn to 30bn range (admittedly, quite a big spread). In 2016, Gartner predicted 20.4bn by 2020, Ericsson's 2016 projection said 28bn by 2021, the IEEE expected 30bn by 2020, and then IHS said 30.7bn by 2020.

This is where the 'wisdom of the crowd' comes in, a form of collective opinion that can sometimes be quite accurate. The best example is the fairground exercise of trying to guess the number of jellybeans in a jar or the weight of a pig. A single guess is not likely to be accurate, but the average of all these guesses is usually quite close to the mark.

So while there's not an entire fairground of guesses to work with, perhaps we might concede that these estimates have had more time spent on them than those made to win the hog or the jar of candies, and therefore might be more accurate. This allows you to examine a bit more about what these numbers might mean.

Using the wisdom of the crowd here results in the following. The number of devices on the earth per person is only around 2.4 in 2017. When you factor in the estimated 'worth' of the IoT, the average comes to around $78 per device. When you factor these together, you end up with an IoT that is comprised of 17.9bn devices in 2017, worth a total of $1.39tn (1.1% GDP), which then grows (if growth continues in the same fashion, at least) to 64.28bn in 2025, worth a little over $5tn (about 3.11% of GDP). By 2025, there will be 7.8 devices per person.

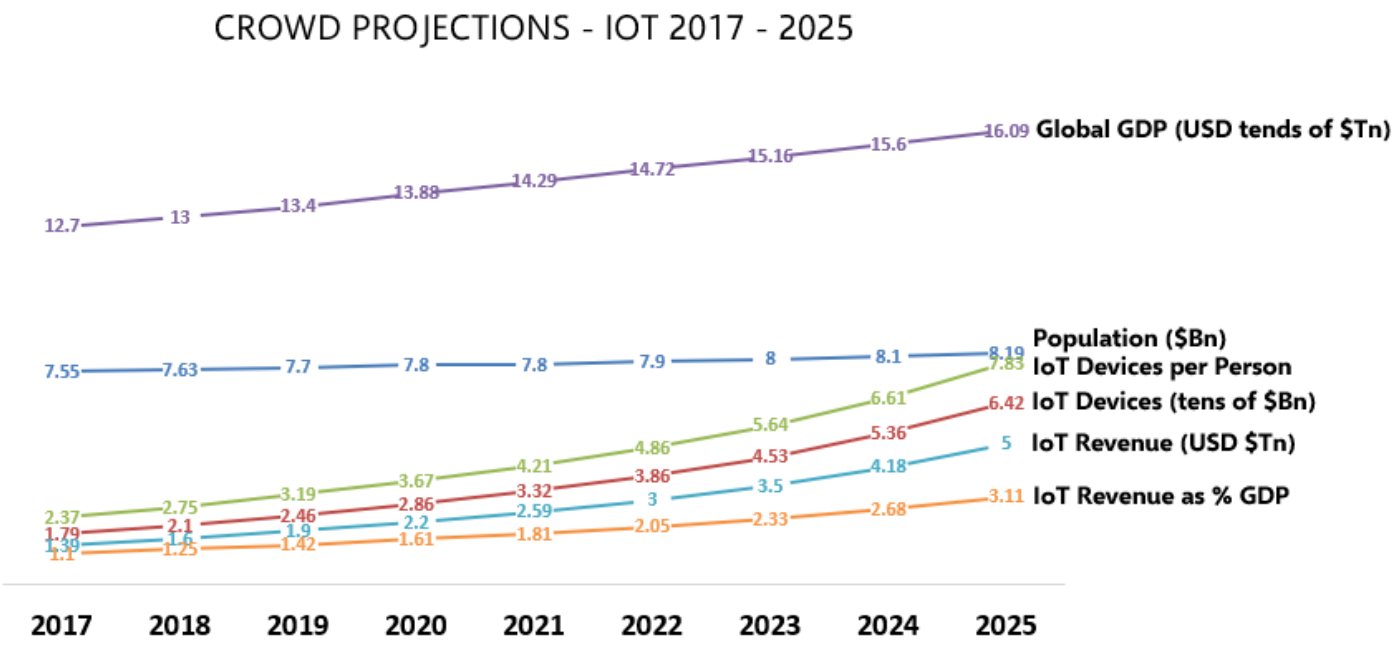
Analysis of the Crowd

To reiterate, this is just a quick examination of some of the numbers out there. As discussed above, there are so many way to define an "IoT device" that the sky is pretty much the limit, and so focusing in on that metric is not a good pursuit.

The number of devices per person is actually quite interesting, when considered as a sort of thought experiment. In the day-to-day life of an average western consumer, how many devices that are connected to the internet do they currently engage with each day? How many do you expect that to be next year, and the year after? How many of these devices would you say are definitively "IoT devices?"

Within a decade, we expect smart meters to be found in most households in developed economies, and that connected street lighting and smart grid technologies will have strong penetration. If the average household has a water, gas, and electricity meter, as well as an average of 10 connected smart home products, suddenly that devices-per-person metric looks really quite low. Once you start factoring in industrial and agricultural sensors and equipment, it gets warped even more, and then there's the entire logistics ecosystem and supply chain to contend with.

Consequently, that 7.83 looks comically low, although it does seem to be a question of definitions, again. Similarly, the lives of consumers in developed and emerging economies are quite different, but not to the extent that would explain 7.83. It seems likely that this number could quite easily be doubled or even tripled. However, the crowd-wisdom revenue forecasts also seem quite low. That $78 per IoT device should represent its entire worth within the entire global economy. Even low-cost LPWAN devices are going to account to more than that level through a ten-year life cycle, and that's before you consider how much value a single connected car might generate.



As such, we think the average value of an IoT device is much higher than that crowd-derived $78. The $5tn by 2025 is in the same sort of ballpark as the McKinsey estimate, but $78 seems like such a low number – unless we are into the territory of defining every single RFID tag (18.2bn tags in 2017, according to IDTechEx, worth $11.2bn total,) as an IoT device, which we can't be at those crowdderived device volumes.

So again, we think that you could easily double the value of each IoT device here, which would bring the global worth of the IoT to around $10tn in 2025. And that could be a conservative estimate, given how data marketplaces might emerge in the period, or how enterprises might realize the value of their data reserves if they can open them up to each other.

	2017	2018	2019	2020	2021	2022	2023	2024	2025
Population (billion)	7.55	7.63	7.7	7.8	7.8	7.9	8	8.1	8.19
Crowd Devices (bn)	1.79	2.1	2.46	2.86	3.32	3.86	4.53	5.36	6.42
Devices per Person	2.37	2.75	3.19	3.67	4.21	4.86	5.64	6.61	7.83
Global GDP ($Tn)	12.7	13	13.4	13.88	14.29	14.72	15.16	15.6	16.09
IoT Revenue ($Tn)	1.39	1.6	1.9	2.2	2.59	3	3.5	4.18	5
IoT Revs as % GDP	1.1	1.25	1.42	1.61	1.81	2.05	2.33	2.68	3.11

But once again, there are a lot of variables at play, and it needs to be reiterated that this top-down view of the IoT is not particularly useful to anyone. People are concerned with their own regional markets within their own specific industries – not a high-level global view. What these rough calculations should provide is some perspective on how your proposition fits into the rest of the ecosystem – whether you're building a $3 Bluetooth temperature sensor, or a $3,000 edge gateway.

So where is the IoT?

In closing, it is important to stress that we've passed the point where referring to the Internet of Things as a single thing is useful. Those days are over – it is now mostly settled into verticals, and the technologies used in each are not going to change radically. Large businesses will swallow smaller ones, and there will be waves of consolidation, as each market shakes out. AI and 5G are major influencing factors, but even the lowliest hardware is going to improve significantly throughout the period.

We should now be talking about how this umbrella term affects your particular industry, business, country, or street. The IoT evolution is ticking along, but collectively, you've mostly been misled by promises of a new immediate golden age. This is an era of continual but small improvements – which add up to a whole load of cash.

What's more, there's all manner of new concerns that have to be carefully considered. This discussion touched on labor automation earlier, but connectivity begets security risks – and a hyperconnected world, where security remains as low a priority as it currently appears, is one that is doomed to strife. Surveillance is another area of concern, and this post-Snowden world is definitely at risk of governments using IoT technologies at the expense of personal freedom and democracy.

Compounding this is the impact that AI-based tools are having on the idea of an objective truth. Fake news and deepfakes are powerful propaganda tools, and a fundamental concern of the IoT is the notion that all data is useful – but if we can't trust that the data pulled from a device is reliable or true, then the entire proposition could fall apart. You might trust your own data, but if you can't trust your neighbor's, then the collaborative utopia notion crumbles.

"Connected" is a more useful term than "the IoT", in many ways. We should start using it properly. The Internet of Things is so much more than just an umbrella term, and we're well past the point of no return. It's here, hopefully to stay, but it is no longer a catch-all – it's the future.

"Connected" is a more useful term than "the IoT"

Riot Research: Forecasting disruption to guide industry decisions

The Riot AI/IoT service has built a reputation for clarifying the issues surrounding the so called IoT, from sensors and actuators, to cloud apps which lean on AI and every other step in the chain. We offer a weekly set of research notes, a weekly assessment of what we see around the web, and a monthly forecast, and we do it well within your budget.

This report is free, to give you some idea of the standards we set in analysis around AI/IoT. If you like what you read we can give you a trial of the core weekly services for 4 weeks, and then we will ask if you'd like to subscribe. The moment you subscribe you will gain access to all of our forecasts and research.

Here are some sample titles of reports we have produced recently:

- Show me the money; AI Forecast to 2023
- LPWAN Revenue Forecast to 2023
- Monetizing Connected Cars - A multi-billion dollar 7 year loss leader

Subscription Costs

The price to subscribe is $1,850 a year (1 - 5 readers), or enquire about a corporate subscriptions (permitting unlimited distribution within your organization).

RIOT'S MAIN CONTRIBUTORS

Alex Davies - **Principal Analyst**

alex@rethinkresearch.biz

+44 (0)117 329 1480

Phil Hunter - **Research Fellow**

phil@rethinkresearch.biz

+44 (0)208 682 0862

RETHINK LEADERSHIP

Peter White - **Co-founder and CEO**

peter@rethinkresearch.biz

+44 (0)117 925 7019

Caroline Gabriel - **Research Director**

caroline@rethinkresearch.biz

+44 (0)207 450 1230

www.rethinkresearch.biz

About Rethink Technology Research

Rethink is a thought leader in quadruple play and emerging wireless and IoT technologies. It offers consulting, advisory services, research papers, plus three weekly research services; Wireless Watch, a major influence among wireless operators and equipment makers; Faultline, which tracks disruption in the video ecosystem, and OTT video. Riot on enterprise disruption from the combination of AI/IoT and cloud.

Need more information?

Chloe Spring - **Head of Marketing**

chloe@rethinkresearch.biz

+44 (0)117 925 7019

Bristol & Exeter House
Lower Approach Road
Temple Meads
Bristol
BS1 6QS
United Kingdom

Tel. +44 (0) 1173 291480
Tel. +44 (0) 1179 257019

www.rethinkresearch.biz

Published August 2018