

Assessment
Initiating Coverage

Previous Assessment
NA

Company/Region
Quantum Computing Vendor Landscape

Sector
Quantum Computing Vendors

Date
August 27, 2018

Previous Date
NA

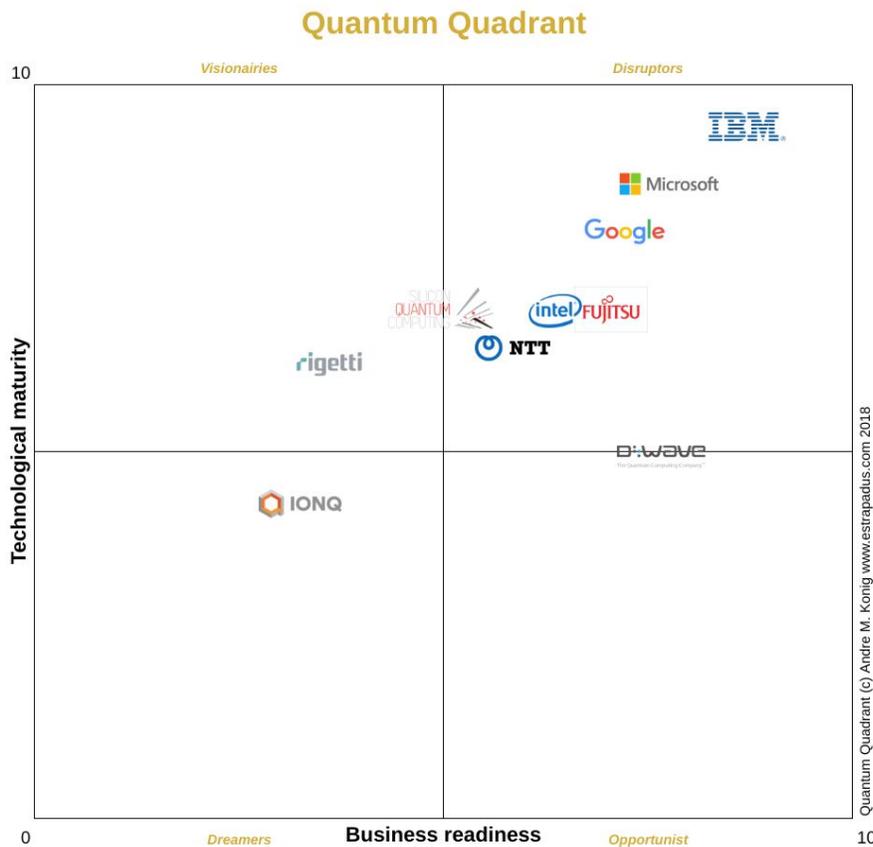
A tight race to the starting line with IBM as the leader of the pack.

Opinion and summary

This is the introductory “Quantum Quadrant” by Estrapadus, LLC - its goal is to bring process and metrics to the quantum computing vendor landscape to help better understand and distinguish the various providers of Quantum Computing hardware.

Cognitive Insights Rail

A cognitive analysis of Google news for the past 2 months around “Quantum Computing” shows 77% positive sentiment and 22% negative sentiment



This is an increase in positive sentiment over an increasingly large dataset, showing the generally high expectations for quantum computing.

As you surely have already implied from the title of this inaugural Quantum Quadrant, this is by no means a “winners podium” but much rather a race to the starting line. Like Quantum Computing, this initial Quantum Quadrant is noisy, imperfect and by all means a work in progress. Yet, we firmly believe, that it structures and assesses the many vendors in a more objective and constructive fashion. And much like a sailboat race, half of which is won during the race to the starting line, we view this Quantum Quadrant as a take on who is in the race, what is their strategy, what equipment they work with and what their odds are of making it to the starting line, and potentially be a leader in the real race that will come down the line.

One unique feature of the Quantum Quadrant is that it goes beyond the technical and scientific aspect of quantum computers. At Estrapadus, LLC we strive to understand, explain and promote quantum computing from the perspective of a business executive or a corporation. In that vein, quantum computing is only going to be a breakthrough innovation, if beyond the science and hardware there is a business use case, savvy managers and a focus on a specific problem/solution set that will help executives and corporations to be more successful.

We believe that a new technology such as Quantum Computing is only a viable technology if brought to market and able to help address real world problems. At Estrapadus, LLC, we view Quantum Computing through this very business lense.

Insights from Quantum Quadrant

The first Quantum Quadrant brings maybe no big surprises but factual validation of what many experts believe and know. And an opportunity for those who disagree to make their - data driven - case.

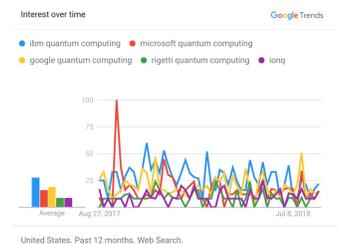
IBM is the leader in the race to the starting line of a commercially viable quantum computer. This is due to their technical prowess, which is up there with the very best. But, also, to their immense experiences and resources in bringing to market new technologies. For us, this makes IBM the undisputed leader in this field.

Google and Microsoft are no laggards, though. Technically just as strong, they might lack a tad in terms of live experiments experience or go to market channels but that’s only because we’re being very picky.

There’s a close pack of global vendors behind those top 3 who all are in a position to compete effectively.

The new ventures all have most respectable technical achievements. Where they fall behind is on the business side of things and their ability to put the same resources behind their efforts.. A crucial ingredient to success, that could turn out to be an advantage if they are able to identify specific niches, get to market first or succeed with a radically different approach that is hard to mimic for the

An analysis of Google Trends shows a steady volume of searches for the top quantum computer vendors.



Significant spikes are observed and associated with major announcements.

IBM receives about triple the search queries than the other major competitors, hence sentiment expressed on IBM is more reliable.

larger tech giants.

We were surprised by the number of customers, channels to market and partners that all of these vendors in general have already been able to engage and cooperate with. It is nothing new to see the market test new technologies early on, but the scope, depth and breath of these efforts across virtually all providers is a very encouraging sign.

While IBM dominates our first Quantum Quadrant, in the end it will all come down who is able to solve a real world problem first, and replicate this for customers over again. This will depend on resources, skills and approach - both technically and on the go to market strategy. Victory is up for the taking!

Individual Vendors

IBM

Technological maturity: 9.2

Business readiness: 8.4

IBM is putting tremendous resources against quantum computing, in fact making it one of its core corporate strategic bets alongside the cloud, IoT and A.I. They have a working cloud service for quantum computing with tenths of thousands of users, some of the best researchers and the full power of big blue to bring it to market with specific use cases and applications (slowly) emerging.

In short, IBM is clearly the boat to beat in the race to the first useful quantum computer that will actually solve a real world problem.

And frankly, it's their race to lose. How could they potentially lose it? Two challenges come to mind. First, their approach to superconducting quantum computing, while currently the best understood and most advanced, has some academic distractors. Truth is, nobody knows today what approach to QC will lead to the best results but with a heavy bet on superconducting and no apparent technical hedges, IBM is taking some exposure here.

Second, IBM is notoriously bad at bringing business solutions to market. Once their amazing research labs unleash a new, often unfinished technology onto their IBM managers, consultants, product and industry experts it gets messy fast. And the customer seldom wins in this scenario. We are confident that IBM as a sales & marketing organization has learnt their lesson, especially from the painful go to market of the fabulous IBM Watson platform. Current efforts around other new technologies out of IBM, such as Hyperledger, give reason for hope. But the race to a commercially viable solution is not won with technology, science and hardware alone, and IBM needs to demonstrate that they are able to execute on this.

A cognitive analysis of sentiment towards the vendors from Google news over the last 2 months shows overwhelming positive sentiment, with IBM receiving a bit more scepticism than Microsoft and Google.

IBM Quantum Computing



Microsoft Quantum Computing



Google Quantum Computing



Google

Technological maturity: 7.8
Business readiness: 7.6

No need to revel in Google's amazing intellectual, scientific and academic prowess. No need to explain their smarts and scrappiness in building market ready solutions that customers actually want. Google, with an approach to quantum computing that goes beyond superconducting (looking at adiabatic), a fast growing cloud business and ever increasing list of enterprise customers is in strong contention for the top spot in our race to the starting line.

But Google, who is rarely the first to innovate and rather the one to dominate a market that's proven, has some catching up to do. They need to quickly advance their technical capabilities of bringing a live quantum computing solution to early customers and partners.

And they need to say what they stand for. We don't believe, at least not in the near future, that quantum computing will be a consumer solution or an open API type platform. To be successful, it needs to be brought to market with a purpose. One potentially promising opportunity for Google here is quantum computing for A.I., especially machine learning.

If Google is able to come to market quickly with an experimental solution so that they can engage and build their ecosystem and develop a focused solution, while we all figure out the underlying science and technology, then they have a shot at beating IBM to be the first across the starting line.

Microsoft

Technological maturity: 8.8
Business readiness: 8

Microsoft, not unlike IBM, has a very strong sales & marketing organization backing their strategic and extremely well funded quantum computing efforts. Microsoft, not unlike IBM and Google has a very strong and striving enterprise cloud business with a strong go to market ecosystem of corporate clients and partners.

Microsoft, not unlike Google, has somewhat of catching up to do when it comes to a live quantum computing experiential solution that these partners can play with and gain experience.

Microsoft, with their topological approach to quantum computing, is taking a big technical risk that might fail completely or emerging as technically superior. Like IBM, they do not seem to hedge their scientific bets.

Due to the strength and experience of their research team they might be slightly ahead of Google but they are certainly in a tight race with Google and IBM for

Rigetti and IonQ show significantly more negative sentiment than the large vendors.

Rigetti



IonQ



the top spot at the starting line - if they can demonstrate a working, cloud based solution of their hardware for customers and partners to experiment with they might quickly turn into the leader of the “real” quantum computer race.

Intel

Technological maturity: 7.2

Business readiness: 7.2

Intel is struggling with their chip manufacturing processes and bringing new innovation to market at scale, they have lost their leadership position in the traditional silicon chip market.

Yet, they are not to be counted out with their vast resources, decades of experience, savvy and aggressive sales & marketing organization and hunger to win back the glory of days past.

Having recently demonstrated the first results of their efforts to manufacture quantum computing chips the way they have done it forever, meaning production at scale, as well as their strong partnership with QuTech, they deserve everyone’s consideration in this race.

While it is unlikely that they will emerge as the leading quantum computing vendor down the road, they have the opportunity to play an important role in the development of this industry and might emerge as the dominant quantum chip manufacturer that other vendors rely on.

IonQ

Technological maturity: 4.8

Business readiness: 3.4

IonQ might be the leader of commercial vendors when it comes to quantum computing by trapped ions. With an impressive academic and scientific pedigree, they are a force to be reckoned with.

Yet, in the race to the starting line of a commercially viable quantum computer, they are arguably the underdog. With a very limited budget and resources, no real experience of a live quantum experiment and a total lack of apparent business use cases or sales & marketing organization, they are fighting strong headwinds.

If they can build on some of the early partnerships to address a very specific problem/solution that executives or corporations see value in, they might get a late boost of resources to compete in the “real” race. Sometimes the underdog turns out to be a very useful expert solution provider, and maybe the technology god's will bless trapped ions with success.

Rigetti

Technological maturity: 7

Business readiness: 4

Rigetti ended up as visionary in our first Quantum Quadrant and that might turn out to be a fitting classification. Rigetti's accomplishments and credentials are impressive. Most importantly, their ambitious efforts to bring to market a full solution, which includes a live cloud experiment and API, software and real world partnerships and clients to explore challenges and solutions.

Rigetti is the aggressive, smart boat in the race to the starting line. But Rigetti also doesn't have the resources and budget and business and sales & marketing skills to ultimately compete.

Yet, they appear to want to be the quantum computer for everybody but without the resources of an IBM, Google or Microsoft. Entrepreneurial history has proven many pundits wrong, but business wisdom dictates that unless they focus on a niche or specific market, they will end up being an also-ran in this race. And that is assuming that superconducting quantum computing will be the most viable technical solution to make it to market.

D-Wave

Technological maturity: 5.4

Business readiness: 8

D-Wave has been accused of many things, do they even build real quantum computers have asked many. All these questions and accusations are fair and deserve an honest answer, which is why D-Wave ended up in our "opportunist" quadrant, not far from the dreaded bottom left part of our Quantum Quadrant.

That was the middle of August 2018. And then D-Wave made big... waves. Announcing the first quantum computer to have simulated natural quantum phenomena.

While this breaking news does not address many of the concerns surrounding D-Wave, it puts them on the verge of our "disruptors" quadrant. In our, somewhat myopic business driven, view, no new technology is useful unless it can help solve a real world problem. D-Wave was able to demonstrate that they are closer to achieving that, at least for one very specific question, than many others. With an impressive team of business experts, sales & marketing savviness and a strong list of partners as well as solid funding, D-Wave has to be taken seriously.

We hope that time will show that their technical and scientific accomplishments prove just as respectable. When they do, D-Wave might sweep the race out of left field. A sailboat race is not always about being the fastest, sometimes it is about calling the winds better than the rest of the fleet.

Fujitsu, NTT and SQC

Fujitsu	NTT	SQC
<i>Technological maturity: 7.2</i> <i>Business readiness: 7.2</i>	<i>Technological maturity: 7.4</i> <i>Business readiness: 6.4</i>	<i>Technological maturity: 7.6</i> <i>Business readiness: 5.8</i>

While we possess less reliable information on Fujitsu, NTT and SQC all of them deserve the utmost of consideration in the race for the starting line.

All of them have the academic and scientific pedigree for quantum computing greatness, and documented efforts of live quantum computing experiments. All of them have the business skills and sales & marketing experience to bring new technologies to market, and documents clients and partnerships with whom they are working on quantum computing experiments.

All of them have the resources and budget to succeed, and documented public announcement on the strategic importance of quantum computing.

None of them, currently, have reliable public information to truly assess their capabilities and current state of their programs - our hunch is that they are trailing IBM, Microsoft and Google but are likely ahead of newer quantum computing ventures in our Quantum Quadrant.

The above list is our first review of the most prominent quantum computing vendors. There are many more in the race, mostly out of research labs and universities, that might disrupt the race. For the purpose of this inaugural Quantum Quadrant we ignore these, since our ambition is a commercially viable solution. With a close eye on these competitors, we look forward to future updates.

There, surely, also are many Russian, Chinese and some European ventures that deserve very close attention as we strive to learn more about their efforts and capabilities. We hope that this inaugural Quantum Quadrant will spark sufficient debate to learn more about all the key players in this space, already included in the Quantum Quadrant or yet to come.

In a sailboat race you put yourself into a position to win by being the first across the starting line. That is, unless you read the winds and currents better and have found a spot on the starting line that everybody else ignored. The current Quantum Quadrant is like the race to the starting line of a sailboat race - the futuristic carbon fiber boats are going for the first spot across the line and highest speed. The salty dogs are looking for that spot on the line that will give

them better winds or currents down the race course. Who will win? Impossible to tell just yet!

Quantum Quadrant Methodology

To compose the Quantum Quadrant we look at two dimensions. First, the technological maturity. Second, the business readiness of the vendor's efforts.

Both dimensions are scored on a scale from 0 - 10 with 10 being the high score. For both dimensions, we are using the same set of questions to which we try to find answers for each vendor; and then score them.

This set of questions will be expanding over time, getting increasingly detailed and complex. What will not change, is that we will apply the same yardstick to all vendors and do our utmost to compare them objectively.

Caveats

The present Quantum Quadrant operates under the well known and discussed limitations and insufficiencies of the current quantum computing hardware, it is not an attempt to claim that current vendors can solve specific problems or have a ready made solution. It is merely an attempt to factually compare the current state of quantum computing hardware.

In that sense, any given score is presently not to be understood as an absolute measure of the solution but as a relative assessment compared to the peer group.

Furthermore, while we strive to be as exhaustive and inclusive as possible we have not included all known vendors, some of which are in "stealth mode", heavily academic or still unknown. This Quantum Quadrant focuses on vendors with the highest potential to bring a working quantum computer to market for clients, companies and executives to use on real world challenges.

Future improvements

It is our wish that all vendors will engage in an ongoing and constructive dialogue to address potential shortcomings and oversights, add improvements and new ideas, and make the Quantum Quadrant a fair, useful and objective tool for every business executive and corporation that is trying to better gage the state of quantum computing.

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