

# THE TECHNOLOGICAL REVOLUTION

Second Quarter 2017



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# THE TECHNOLOGICAL REVOLUTION

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BY DOUGLAS BRODIE

*The evolution of technology and innovation can often appear deceptively smooth. We seem to adopt them with such ease that what was once novel quickly becomes ubiquitous. We focus on the successes and forget the things that fail, such as the Betamax video recorder and the Blackberry smartphone. It is only when we look back that the real growth becomes evident. And, with the benefit of hindsight, we see that it has been explosive rather than smooth or logical.*

Over the past 50 or 60 years, we have seen some huge advances, driven by miniaturisation of the transistor and Moore's Law, with processing power growing at a faster pace each year. We now have code and algorithms that control increasing amounts of the world around us, and we carry smartphones that have more processing power than was used by NASA to put man on the moon.

Then the internet arrived and arguably touched every aspect of our lives in some way. We have digitised how we store information, how we communicate and how we socialise. We have unlocked the code of life itself – we can manipulate and sequence DNA with relative ease. We have done all these things in two or three generations and the rate of development will increase ever more quickly from this point onwards.







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## *INNOVATIVE EVOLUTION*

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The more we understand about their evolution, the more we see a pattern that innovative technologies ultimately give rise to other technologies. They don't exist in isolation and are constantly bumping into each other. For example, advances in digital and semiconductors impact on healthcare and our understanding of disease DNA. It is that self-perpetuating aspect of technology that ultimately means its impact is much more exponential than it is linear.

Recent decades have seen the development of unprecedentedly innovative tools. We are now in the phase of applying those tools to solve many problems – how we shop, how

we travel, how we communicate. Technology is a problem solver and drives long-term productivity. It can be disruptive, deflationary and challenging at times, but ultimately adds to the quality of life. And yet, it is pertinent to ask why, if technology is modular and is built on previous achievements, so many attempts at predicting the future are so wide of the mark.

One answer is that forecasting is difficult and is uncomfortable. It is a human trait to be cynical about prediction, and we tend to be quite risk averse. We also tend to have an approach of only wanting to believe something when we see it. That attitude is particularly rife in

investment. Indeed, when money is at risk, those human attributes tend to be magnified. However, accepting uncertainty is probably the most misunderstood aspect of investment – it is ultimately what makes it possible to invest in businesses that can become many times their starting size.

Successful prediction requires thinking about where technology might get to. It is not sufficient to simply extrapolate the here and now, it is also essential to assume that some barriers will be overcome. Increasingly, technological developments mean the only real barriers are the laws of physics and morality.

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# INVESTMENT CONTEXT

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There are patterns that do repeat and patterns that are helpful when trying to put things in an investment context. There are seemingly very strong super-cycles of innovation. Looking back hundreds of years, this pattern has occurred every 50-70 years or so. There tends to be a core foundational advancement which then undergoes many efficiency improvements. It combines with adjacent technologies to shape a multi-decade period of growth. This pattern produced the coal breakthrough, steam power for much of the industrial age, the oil age giving rise to combustion engines and petrochemicals and, since the 1950s, silicon which have powered much of the digital age.

Historically, that key advancement has eventually petered out in terms of the efficiencies it can drive and it is then time for something else to come along. The general consensus is that we are currently in the autumn phase of the first wave of digital and silicon. Over the next ten to 20 years, there probably will be the dawning of a new cycle. That is not to say that each of the previous technologies will disappear. Each wave was built on previous achievements – we still use coal and steam, and it is clear that semiconductors and processing power will not go away. However, the efficiency gains of those new technologies do diminish. Processing power cannot continue to grow at the current level, so something will supplement it or displace it.

The second pattern is that all big ideas tend to start small and can be raw and immature. It is often easy to find fault with them in the early days but, increasingly, the early experimental age of a digital business is when companies tend to carve out their competitive advantage and lay foundations for the future. It is the phase when stock markets struggle most with ascribing value. However, if businesses do progress through that experimentation stage, the rewards to investors can be huge. A good example of this is Tesla.

Another pattern worth bearing in mind is that new businesses and new ideas grow much faster than used to be the case. It is now possible to reach scale through using the internet and outsourced non-core computing in a way that was not possible ten years ago. That means companies can reach a much bigger audience, much more quickly. It tends to be the case that smaller businesses are better at deploying the relevant toolkit and trying to use it to innovate and solve problems.

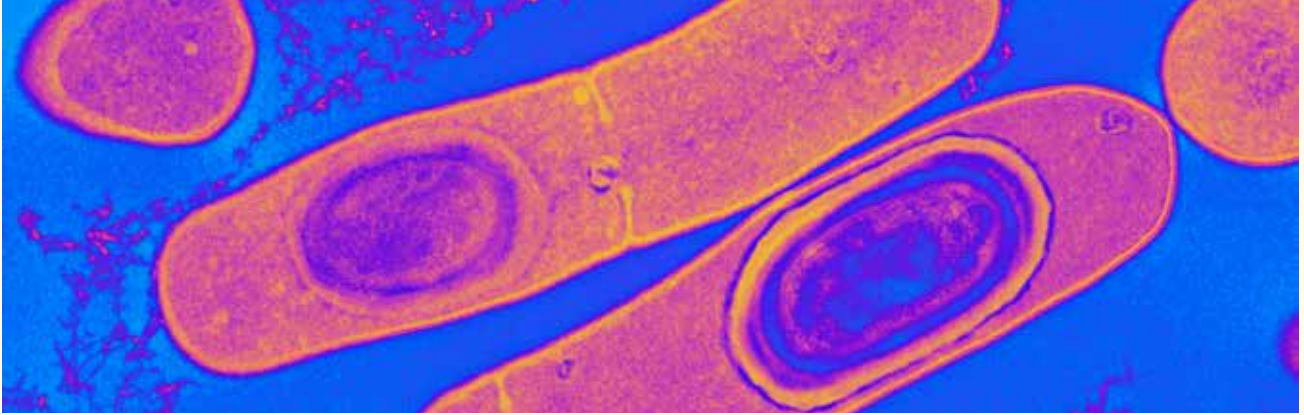
Technology feeds off what is possible. It is shaped by our knowledge and understanding of the world around us. We have come through seven decades when our awareness has increased massively. With everything we now know, there are grounds to believe that we will achieve substantially more in future. In addition, the opportunity to invest in companies exists in a way that it hasn't done before.



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## WHAT IS CHANGING

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There are some things that could really shake the world in the coming decades. High on the list is nature, which routinely deals with uncertainty and complexity and does so over timescales that dwarf anything we would consider. Nature handles those issues through evolution. At its core is a problem solving element which is like a longer-term version of how businesses try to innovate and change the world around them. Nature can come up with some intricate and really staggering ways of problem solving, and gives us the best apparatus to go and solve our own problems. Examples are graphene, which existed long before we gave it a fancy name, and artificial intelligence (AI), which feeds off how we lay down neural networks with our brains and process things. With all the cancer therapies that are coming through, we are trying to mimic what goes on in our own bodies. The more we understand,

the more we can deploy it, and that window on to how nature works is now wide open.

For example, over many years, the idea has evolved that all bacteria are bad and we should live in a cleansed society. Yet, each of us has around two kilogrammes of bacteria in our upper intestines. We are increasingly learning that there are many mechanisms in our bodies feeding off

that in terms of priming the immune system and developing neurological functions. It is believed that if certain strains of bacteria disappear through antibiotic use or lifestyle changes, it can create a risk of disease. The question is whether it is possible to harness the bacteria and put them back into patients to fix them or stop them from becoming ill. Technology enables that to be investigated.

*Nature can come up with some intricate and really staggering ways of problem solving...*

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## GETTING CONNECTED

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Another area set for major change over the coming decades is connectivity. The world is becoming connected in a way that it hasn't been in the past. There have been previous revolutions such as printing presses connecting people through the printed word, and steam having an impact on the rail networks, power grids and highways. However, the upcoming wave of connectivity is potentially much more profound because it is connectivity that is instant, as well as being infinite in its capacity and what it can achieve. It is happening because sensors, processing power, batteries and key enablers of connectivity are now so cheap and abundant that connectivity can be added to pretty much everything we use.

The more sensors there are, the more connected the world is, and that leads to more data being available. There has been a general explosion in recent years and it is ongoing. Big companies such as Apple, Google and Facebook have clear advantages in terms of data and great potential in terms of the resulting business opportunities, although there are some issues around privacy and intrusion. The area that could change most in terms of data

and connectivity is healthcare. For much of the past century, there has been a centralised network where the patient at a time of crisis engages with a doctor or a hospital and any data will be in the form of handwritten notes. It is a central, archaic structure. Connectivity and data could transform that massively. An example of this is

the company Dexcom, which makes a blood glucose sensor that is worn by the patient and beams blood glucose information to a handset, allowing diabetics to use the information to dose directly. It also means that parents of diabetic children can monitor them and a doctor can obtain real time information on patients.



*Big companies such as Apple, Google and Facebook have clear advantages in terms of data ...*

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# *ADAPTING INTELLIGENCE*

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Analysing data is not new. Software began to displace manual interpretation of data in the 1980s. However, while early stage software was logic-based, data sets are now so big and the processing power so huge that there are other ways of reaching solutions. We are moving to an age when machine intelligence and artificial intelligence are coming to the fore. They are generally overused terms, but this intelligence is software that works around probability and an ability to learn and adapt as it goes. It is very different from the software that runs Excel spreadsheets or Word software which is hardwired and rules-based. AI software can explore vast datasets, it can look for the anomalous, it can look for correlations and it is transforming various aspects that we are starting to see now. Real time translation of languages is also now working. All of this will bring on an age when there will be much closer collaboration between man and machine. Machines will take on human-like characteristics and we, as individuals, will be much more comfortable wearing technology.

The ability of computers to see – image recognition – is basically driven by software that interprets multiple images in real time incredibly quickly, and is powered by an AI type system. Image recognition software is highly accurate in terms of what it can achieve. Robots will

be deployed in more and more sectors, and probably in manufacturing, picking of goods and moving goods. Technology will increasingly be deployed in this way over the coming decade. It is a sensitive area because of people's concerns over job security. However, it is not going to stop. The technology is coming and it is probably up to humans to use their initiative, as they have done in all the super-cycles before. The argument in the past was that new developments would cause jobs to be lost. Yet, through each of those cycles, people emerged with new ideas and new opportunities and it should happen again in this latest phase.

There have been some concerns about the morality of some of these developments. We are at the stage where regulators around the world are grappling with what they will face. That can be seen with autonomous vehicles and it is almost as if the companies are shaping the regulatory landscape to some extent. Another example is gene editing, and its impact in terms of the food we eat or the therapies that we undergo. The AI aspect gets a lot of attention but it probably is application specific in terms of how the regulatory landscape pans out. It is striking that the technology companies on the West Coast of the United States don't like regulation and often try to skirt round it or push heavily against it.





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# INVESTMENT OPPORTUNITIES

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To invest successfully – in this technologically evolving world – it is important to have an appreciation of the problem a company is trying to solve. This makes it essential to know whether the problem is real, how big that problem is and the likelihood that the company will solve it. It is impossible to be an expert on everything that is going on, so it is important to seek external input. For example, it is difficult to analyse an up-and-coming healthcare company, but the minute it partners with a big pharmaceutical company that can do due diligence and a technological assessment that we as investors would struggle to do, that helps to reduce the risk.

Furthermore, the active versus passive argument is likely to become increasingly relevant in terms of the potential returns. The biggest risk is that so much of the technological development comes to fruition but big indices are full of dull incumbent businesses that may, on a two-year view, look quite stable. But if, at some point, something comes along and displaces what they do, that notion of defensive industries could change radically. It also can lead to other considerations, such as whether

companies need to list on stock markets if they can scale so quickly. Despite new areas emerging, technologies that break through probably have a minimum of five, and up to ten, years when they are in the experimentation phase. That is almost certainly the case in biotech but it could shrink in other areas such as internet companies which scale quickly.


The prodigious rate of technological innovation is clearly increasing, like a rising wave, this tsunami's effects are likely to be felt far and wide. The explosive nature of which will spawn new business models and applications that will further fuel the exponential growth that underlies it, along with the opportunities that could arise from it.

Of course, we do not have all the answers as to what will emerge in such an environment. However, by approaching the challenge with a genuine long-term perspective we believe we are well positioned to contextualise the investment opportunity that lays ahead, and avoid the pitfalls and biases that will accompany the understanding of this protean subject.

– *The prodigious rate of technological innovation is clearly increasing, like a rising wave, this tsunami's effects are likely to be felt far and wide.*







*An unwavering focus on the long term allows us to accept a degree of uncertainty that can often arise from the more enigmatic, entrepreneurial companies that are willing to embrace innovation in order to challenge conventional profit pools. Furthermore, we are able to appreciate the shifting paradigm that underlies these opportunities, and the need to adapt with them. This is reflected with our assessment of such opportunities. For example, companies experimenting with new technology, established on a small capital base, and capable of reaching – previously untenable – scale are becoming less amenable to conventional forms of financial analysis.*

*There are clearly exciting times ahead as the world becomes more connected and intelligent. We believe we possess what is necessary to identify and support the businesses most likely to shape the world in which we live.*

*These are exciting times for investors in technology companies.*

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# **CURIOUS ABOUT THE WORLD**

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