The Leading Edge

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Following on from our previous edition of *The Leading Edge*, we present a window to the future and consider how the global tech giants are looking to reshape our lives.

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Message from the CIO

A 'structural slowing' of potential growth has been a feature of the global economy for many years, principally due to demographic factors. A shrinking workforce in many western countries is the easiest way to grasp the trend.

This is more troubling than 'secular stagnation', a term first used in the 1930s to describe the slow growth in the aftermath of the Great Depression which has been resurrected recently. The secular slowing that we are seeing is caused by a number of different factors, and if the deceleration continues we fear economic capacity may start contracting in years to come as an aging population leads to increasing dependency rates and a fall in spending.

Policy makers have mistaken this slower growth for a shortfall in demand, when in truth the underlying demand is simply not there. The remedy of monetary stimulus and credit creation has simply brought forward future demand. The major economies are only growing through further debt accumulation; unaided, the world would probably slip into debt deflation.

These strong and powerful deflationary forces, countered by reflationary monetary policy, have left the global economy seesawing between reflationary booms and deflationary busts, and financial markets have ebbed and flowed in sympathy.

The result is an unstable equilibrium, however even with moribund growth capacity constraints are closing rapidly. Employment and product markets are tightening with US initial unemployment claims at record lows and wages reigniting.

The Brexit decision was a watershed in shifting the political consensus in favour of populist policies, from protectionism through to fiscal profligacy. Austerity and sound money principals are being subjugated for political expediency. These policies will further rekindle inflationary forces.

The collapse in bond yields following the Brexit decision was a false signal and will prove to be a turning point in the secular bull market for bonds, which we believe is now over. We foresee a shift in monetary policy away from the quantitative easing that has supported bond values, to debt monetisation which is fiscal policy co-opted with the central bank. A passing of the baton to fiscal stimulus should see yields move higher as bond issuance increases. With the influence of policy on bond markets reversing and the deflation/inflation pendulum shifting, bonds are now in a bear market, and this will have important implications for equities. The risk of a blow-out in bond and credit spreads and a repeat of the taper tantrum we saw in 2013 is rising.

With additional stimulus in the pipeline, US growth picking up, profit headwinds abating and corporate M&A building, this bull market may have one last rally left in it. There will be a change in leadership however, with bond proxies such as utilities, infrastructure, REITs and telecoms likely to underperform as their bull run ends. Cyclicals and financials that benefit from a rising yield curve should lead the market higher.

The medium term picture is unchanged. The growth outlook is poor and valuations are high, so we believe returns from owning shares, and bonds for that matter, are likely to be low. At the same time, given high prices and leverage, risks are also elevated leaving a less than favourable mix of risk and return. Hedging strategies like those offered by Watermark are well suited to this environment – we are at the tail end of a multi decade reflation cycle, leverage is high and policy support is fully deployed leaving little to counter the next downturn.

In this edition…

In the previous edition of *The Leading Edge*, we introduced the giants of the Internet. The so-called 'FANG' stocks (Facebook, Amazon, Netflix, Google) have dominated much of the growth in the global digital economy. We painted a picture of a 'winner-takes-all' world, as these large established platforms become ubiquitous and their substantial engineering and financial resources present an insurmountable barrier to new entrants.

Building upon the theme, this edition will present a window into the future. We will explore the key areas in which the global tech giants are looking to reshape our lives, both from an industrial and consumer perspective. Consequently, we outline the implications for investors as it becomes clearer that some of these disruptive technologies will create winners and losers in many sectors.

Artificial Intelligence (AI)

What is AI?

Two of the hottest buzzwords in the tech community at the moment are 'artificial intelligence' (AI) and 'machine learning' (ML) – for all intents and purposes the two are interchangeable. Most readers would have heard of the term; in fact, we already live in a world running on AI.

Simply put, artificial intelligence is an area of computer science seeking to develop computers that are able to exhibit human-like intelligence. There are three generally accepted 'stages' of AI advancement:

1) Artificial Narrow Intelligence ('weak' AI)

This refers to AI that specialises in a single particular area. One of the first publicised instances of computers dominating the human mind was in 1997 when IBM's Deep Blue computer beat the grand chessmaster Garry Kasparov (who has an IQ of 190, no less). Earlier this year Google's AlphaGo AI engine triumphed over Korean grandmaster Lee Sedol in the board game 'Go' – a 2,500-year-old Chinese game known to be one of the most complex in the history of mankind, with an infinite amount of move combinations. As impressive as these feats may be, winning in that one particular game is *all* that both of these intelligent machines can do. Some examples of 'weak' AI that you may be familiar with are voice recognition software like Siri on your iPhone, websites like Amazon which recommend products based on your purchase history and even the filters that analyse your incoming emails to keep spam out of your inbox. A bit closer to home, more than half of equity trades in the US are generated by algorithmic high-frequency AI traders. Weak AI has been around for almost as long as computing itself, and new applications continue to be developed such as autonomous or self-driving cars.

2) Artificial General Intelligence ('strong' AI)

This next evolution in AI refers to computers that are as intelligent as humans across the board, and can perform any task humans can to the same capacity. A 'strong' AI would therefore be capable of abstract reasoning, could solve problems on its own without human input, and learn from its own experiences. There is a huge step-up in complexity from 'weak' AI to reach this stage, and we are likely still many years away. Thought leaders and experts have doubted such a system will ever be possible, and even caution whether this would be a desirable development with Stephen Hawking warning that "Strong AI would take off on its own, and re-design itself at an ever increasing rate. Humans, who are limited by slow biological evolution, couldn't compete and would be superseded".

3) Artificial Super-Intelligence

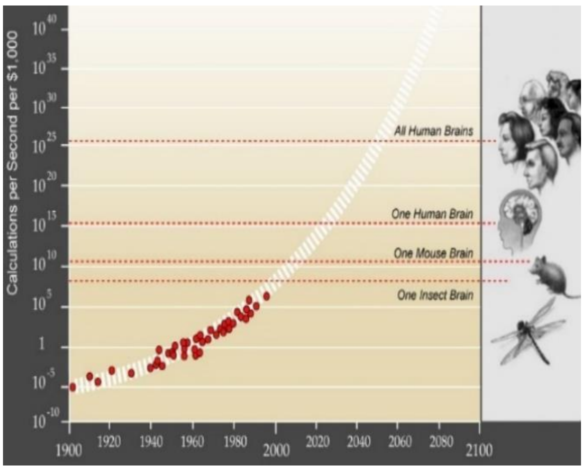
The final frontier, where computers and machines are considerably more intelligent than humans in every field. Computers can run 24/7; human brains fatigue easily. Computers can be upgraded and replaced; human brains deteriorate over time. The brain's internal communications also move at around 120 metres per second, compared to optical communications at the speed of light which is more than a million times more.

What is the path from 'weak' to 'strong' AI?

By now it may be clearer that the goal of AI is essentially to replicate the workings of the human brain. Of course the brain is an extremely complex organ, and there are two significant technical limitations which will need to be breached for this to be possible.

The first is **processing power**. The average human brain has about 100 billion neurons (nerve cells), which are each connected by up to 100 thousand synapses. Each of these neurons can fire information at around 100 times a second – the computing equivalent would be a machine that performs 1000 trillion operations per second. Among other complexities the human brain processes multiple pieces of information at a time, as opposed to a computer processor which executes one instruction at a time. In equivalent terms the most powerful supercomputers in existence today can run at only 1% of the brain's processing power. Most of the research efforts today are directed towards developing 'neural networks' or a replica of this neuron/synapse structure. As **Fig 1** shows, we still have a long way to go.

Exponential growth of computing (logarithmic plot) FIG 1

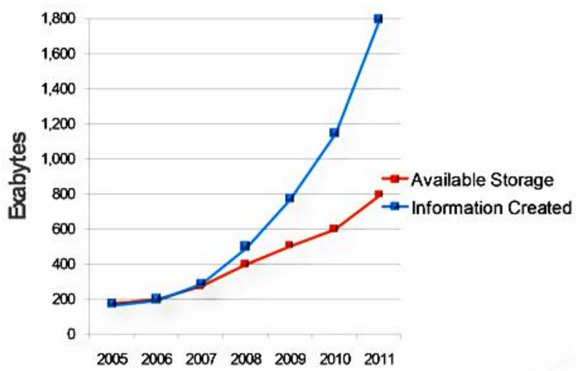


Source: Kurzweil Technologies

The second limitation of existing technologies relates to **data storage**. Very rough estimates place the amount of data that can be stored by the brain at around one petabyte, which is equal to one million gigabytes. IDC estimates that the total amount of available data storage in the world is approximately a million times this – creating a huge shortfall to the 7.5 billion different sets of human knowledge and memories in existence. More pressingly, as we have highlighted in previous editions of *The Leading Edge*, every year there is more information being created than the incremental growth in data storage (**Fig 2**). In 2011 the amount of data in the world was doubling every two years; by now it is thought to double every 12 months. This has created a field in itself around 'big data' or making sense of all this data, where AI also plays a role. The importance and value of this data has coined the phrase "Data is the new oil."

Statistics aside, it is important to understand how AI works at its core. 'Weak' AI products are built under the 'expert system' approach where human programmers input a decision tree of what the program should do when it reaches a particular circumstance – for instance for a calculator to know that 1 + 1 = 2, or for a traffic light to know how many seconds it should remain green. The quantity of data required therefore increases in line with the growing complexity of the problems we wish to solve with AI. Applications such as medical diagnosis using AI, which is the focus of IBM's Watson program, bear life-threatening risk if the program interprets the information wrongly and so massive volumes of data will need to be carefully checked and fed into Watson to ensure accuracy (*see our 'IBM Watson' case study on **page 7***). The ability to progress onto 'strong' AI that are self-modifying and require no human input will hinge on having the storage capacity available to store not only the data fed into the program, but the theoretically infinite quantity of data the program will be generating by itself from its own experiences. We are very far from a solution to this issue also.

Estimated amount of data in existence (exabyte = 1b GB) **FIG 2**



Source: IDC

As we mentioned, AI is already in use all around us. Most of the large Internet and software companies have been reallocating resources toward the development of AI systems, and we outline some of the key applications and their implication below – in both a consumer and industrial setting. It's important to note that this is only just the beginning, and as we progress further towards 'strong' AI these technologies will inevitably become life-changing.

Consumer applications

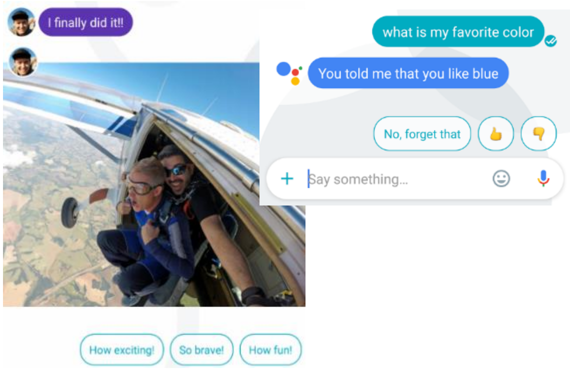
Digital assistants

What are they? The purpose of a digital assistant is quite simply to help organise your life and provide you with information to make your day-to-day life easier. Although digital assistants have been available in various forms for many years (remember Microsoft Clippy?), advances in AI technology have allowed them to become much more personalised and to offer better predictions that can even assist you with your own decision-making (**Fig 3**). A lot of these assistants are powered by voice recognition, where significant strides have been made in recent years (Google processes a third of its US searches through voice).

Who is developing them? Most of the large Internet companies. Apple acquired the Siri technology in 2009 which has since been ingrained in iPhone, iPad and Mac devices; Amazon recently launched 'Echo' portable speakers in the US which feature its Alexa assistant; and Google unveiled its Assistant only a month ago, which will make its way to new Android devices.

What will they disrupt? There are two main risks here. As uptake of digital assistants increases consumers, will likely rely directly on the assistant for making Internet searches, posing a threat to Google's advertising search business. Secondly, the assistant will act as an intermediary for many common consumer transactions (e.g. purchasing cinema or flight tickets, finding a place to eat) which challenges Apple and Google's app ecosystems.

Google Assistant can remember details about you, and even suggests pre-filled message responses **FIG 3**



Source: Google

Autonomous cars

What are they? Driverless cars will open many new possibilities such as allowing those who cannot drive (young, old and disabled) to be mobile, reducing or even eliminating accidents (of which around 94% are currently caused by human error) and allowing for better traffic management. Many autonomous features (self-parking, collision avoidance) are already in place, but we are still likely many years away from a fully autonomous car from both a technological and regulatory standpoint. One of the biggest challenges in developing AI systems is not only replicating human intelligence, but also replicating the senses. Computerised vision still suffers from poor depth perception and interference from glare or dust. Self-driving cars and drones both rely heavily on cameras and sensors to navigate around their environment. As the car/drone is moving, there is an incredible amount of visual information that needs to be processed on the fly to make decisions with at least the speed of a human's reaction time. There will also need to be heavy regulatory scrutiny as human lives are being put in the hands of computers. Who will be liable in accidents? How does the computer respond in a hazardous situation or where both the driver and a passer-by are potentially at risk? In reality, moving vehicles are dangerous objects and real consideration needs to be made to the possibility of a car automatically responding to false information with endangering consequences.

Most of the excitement centres on self-driving cars, but we would highlight other forms of transportation open to automation and in many instances already here – such as driverless trains in Japan and soon the Sydney Metro, and driverless watercraft. Another exciting area is autonomous drones with a multitude of potential applications across package delivery, crop management, policing and traffic management, and rescue situations.

Who is developing them? While automakers such as Tesla have been more vocal with their autonomous vehicle efforts, all of the large carmakers are actively developing both the cars and the underlying software to make this a reality. Regulators are a key impediment in driving adoption, and are still far from establishing a legal framework to deal with autonomous cars. Large tech companies like Google (**Fig 4**) and Apple are working on their own self-driving car (perhaps more focussed on the AI software). Drones are in wide use across many applications today, with some of the key innovators including Google/Facebook (drone delivery of Internet services) and Amazon (drone package delivery). Mobileye and Ambarella are two of the primary manufacturers of autonomous camera modules and chips.

Google's driverless cars have driven more than 3mn kilometres combined, with only one recorded incident — FIG 4

Source: Google

Augmented/virtual reality

What is it? The first thing to note is that these are two very distinct technologies. Augmented reality (AR) is the real-time interaction between the physical environment that surrounds you, integrated with an overlay of visual/audible/tangible technologies that can adapt to and build upon the real world – ergo 'augmenting' your reality. Virtual reality (VR) on the other hand is an entirely artificial computer-generated simulation that consumers will engage with as an alternative to the real world. A lot of hype has built up around virtual reality recently, however we believe the applications of virtual reality are quite restricted around gaming/entertainment and training simulations (e.g. for pilots or military), and see an incredible amount of potential in augmented reality which is still in a nascent stage. Virtual reality will require the use of a headset or other physical equipment and completely immerse you in that environment – whereas augmented reality serves to enhance your experience of everyday life. Augmented reality is already present in various forms today (e.g. GPS navigation, displaying live scores on a televised sports game and barcode scanning apps) but as computers can visualise more effectively and see things the way we see them, the technology behind AR is taking off.

Who is developing it? In the case of VR, as mentioned so far the applications have been limited to gaming/entertainment use, with major sellers of VR headsets including Facebook (who acquired the Oculus VR company), HTC (who are partnering with the video game developer Valve), Samsung, Sony and Google. Augmented reality has much broader use-cases; there are already many apps out there making use of AR abilities, with one example being the global hit game Pokemon Go, which uses a smartphone's camera to overlay Pokemon characters onto the real world around the player. One of Google's better known moonshot projects was called Google Glass (**Fig 5**) which placed a transparent informational overlay in front of the user's eye – this project has unfortunately been put on hold.

Google's 'Glass' augmented reality glasses FIG 5

Source: Google

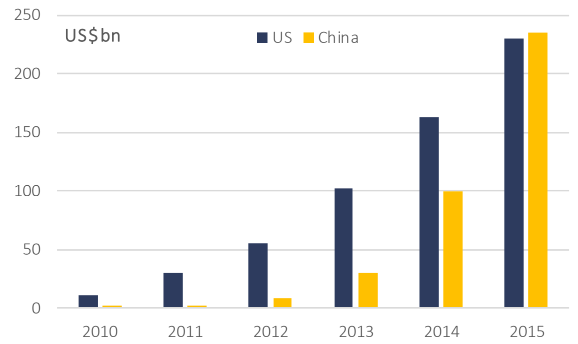
What will it disrupt? Virtual reality will allow for a much more immersive gaming experience, and may reshape the form factor of gaming consoles from a box that sits under your TV to a series of components that you wear while playing a game physically. Other forms of entertainment such as movies could become an interactive experience – rather than going to a cinema, you enter your movie pod and the film plays out around you. VR will allow for more realistic simulation-based training, particularly for hazardous situational training (e.g. pilots, astronauts, policemen and firefighters). Augmented reality will take on various forms, and will likely disrupt a broader list of more specific use-cases.

Automated customer service and 'chat bots'

What is it? A growing trend in many large retail businesses has been to move more customer service interactions online. We've grown from waiting on hold with a call centre for hours, to interacting with automated robotic answering systems which expedite the service delivery, to now being able to converse with a customer representative in real-time through online chat. This provides a better experience for the customer while saving costs (as a representative can juggle multiple chats at a time). The next step is moving the actual point of purchase interaction online, usually automated. Companies will set up accounts with the largest messaging services (e.g. Facebook, WhatsApp) so customers can not only engage with the representatives but even make purchases directly from the messaging app. Most of the time these services are automated, hence the nomer 'chat bots'.

Who is developing it? All of the largest messaging apps in the world are looking at developing chat bot ecosystems, benefitting not only from the growth in users but also taking a clip on any purchases made. Emerging Asian markets such as China are far ahead of the Western world in building out this mobile ecosystem. Estimates place mobile purchases in China at a whopping $500bn in 2016, overtaking the US (**Fig 6**). The leader is Alibaba, the Chinese Amazon, however a lot of the growth has been driven by the Wechat messaging app (owned by Tencent) which has around 250 million users on its chat-based payments system. At Facebook's 2016 developer conference they unveiled a chat bot platform for Facebook Messenger and WhatsApp, with 30,000 different bots now available.

Value of mobile payment transactions – China now leads FIG 6



Source: Wall Street Journal, Euromonitor International

What will they disrupt? Most disrupted would be retailers and other businesses who have not yet adapted an online transaction model. Facebook is clearly trying to position its Messenger app as a storefront, and alongside the launch of its community listings Marketplace is also likely to eat away at existing online marketplaces like eBay and Amazon. In China the Internet companies have set up their own payment systems and earn transaction fees on those – while so far Facebook has partnered with the likes of PayPal, these businesses may come under threat further down the track.

Industrial applications

Development of artificial intelligence by the likes of Google will have profound long-term implications for manufacturing. The largest application of industrial robots so far has been in the automotive industry, where robots have found significant use in such areas as welding and spray-painting. Companies such as ABB and Fanuc have been leaders in supplying robot technology, which has already been employed for decades. Although robots are tireless, they are still quite "dumb" and struggle with many tasks a human can easily perform. A human can easily look at a bag of components, pick out the part needed for product assembly, identify flawed components and not use them. Parts to be assembled by a robot need to be presented in a completely standardised way that the robot can handle, with pre-checking of components for quality.

Bernstein research estimate that a US$50,000 industrial robot will often need US$500,000 of integration costs in terms of reorganising the industrial process to introduce robotics to an assembly line. The emergence of sophisticated AI will mean a wider range of applications for industrial robots – in manufacturing of consumer products such as electronics, short product life-times, and the variety of products that have not previously been economic for robotics. Google's AI in robotics software (**Fig 7**) is capable of self-learning, which will increase the scope for robots to replicate activities currently best suited to humans – picking and sorting, assembly, packing, inspection for quality defects and the like. The result should be significant improvements in the economics of robotics in manufacturing processes, and cheaper more efficient production processes.

Google's neural network arms learning shape recognition FIG 7

Source: Google

AI Case study: IBM Watson

IBM Watson is a cognitive computing platform that uses natural language processing and machine learning to provide insights from very large amounts of unstructured data. The Watson platform and division was named after IBM's first CEO Thomas J. Watson but is perhaps best known for its ability to answer questions on the quiz show Jeopardy! In 2011 Watson competed on Jeopardy! and defeated former champions Brad Rutter and Ken Jennings, taking home a prize of US$1 million.

But what does Watson really do? Watson is a software-as-a-service platform that with the support of IBM's supercomputing hardware, is able to process and analyse vast amounts of 'big data' (100TB per day) from various sources and formats including PDFs, videos, images, webpages, sensors and documents at a rapid rate. After it has processed and 'learned' this information it can then be asked to make predictions or provide real-time answers to complex questions related to the topic it has just learnt. The system is never 'asleep' and constantly learns as new information is published. IBM estimates ~80% of data generated today is unstructured, meaning in the form of natural language or not in a structured computer database format of rows and columns. More simply put Watson is an advanced question answering system which processes massive amounts of unstructured data to provide a user with answers to questions or hypotheses posed to the system.

Narrowing this down to real world use, Watson is being developed for specific industry purposes in areas such as healthcare, financial services, retail and customer service.

IBM's proposed uses for the Watson platform FIG 8

Source: IBM

Watson Health cloud launched in 2015 marking the first commercial application for the Watson platform – targeting physicians, researchers, insurers and companies focused on health and wellness solutions. IBM estimates the healthcare market opportunity at ~US$200 billion which includes solutions to minimise waste in the healthcare system and also to help doctors diagnose diseases. One of Watson's first commercial applications targeted utilisation management decisions in lung cancer treatment at Memorial Sloan Kettering Cancer Centre in the US. Watson has since announced numerous high profile collaborations with companies including Medtronic, Johnson & Johnson and various cancer institutes globally.

While we are excited at the opportunities that IBM's Watson may present in the long-term, there is a lot of hype. We are cautious that it will take a long time for the business model to develop to such a point that returns become material (or indeed positive) given the huge multi-billion-dollar investment IBM has made in Watson and numerous acquisitions to obtain data to feed the platform. Some analysts estimate that revenues attributable to Watson are at best $200 million out of a total $81 billion annual revenue base.

Additionally, the financial model for Watson is still not clear to us. At IBM's recent investor briefing the company suggested there were multiple ways to monetise this platform including 'pay-for-insight', subscription (based on number of users), 'shared value with partners', revenue share and licensing. For our mind this suggests that predicting future revenue streams and in fact creating an annuity business out of Watson is far from assured. Also we highlight that Watson is not a one-platform-fits-all, as it has to be trained in the specific area in which you want insight. For instance if you wanted to train Watson in cancer medicine so it can diagnose and predict outcomes based on the treatment method selected, you would have to spend years teaching the platform how to interpret the medical literature, images, pathology reports and test it out rigorously before it would be able to generate valuable insights. This is at your cost without guarantee that the end product will be valuable or deliver a return on your initial investment.

At this stage we remain excited by the opportunity, but highly cautious as to how material this opportunity may become in the next few years. It is also worth noting that Watson is not alone, with competitors at Google, Amazon and Microsoft Azure all developing and launching their own cognitive analytics platforms and applications at a fast pace. It will take a long time to turn the 'old iron' IBM mainframe ship around…

Internet of Things (IoT)

What is IoT?

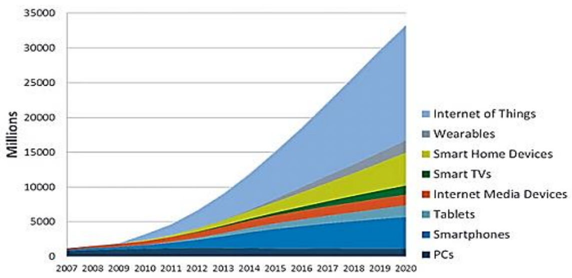
From the origin of spoken language 10,000 years ago to where we are today, the pace of evolution in communication technologies has been extraordinary. In 1835 the invention of the telegraph changed how people perceived time and distance, allowing messages to instantly be sent across the world for the first time. Soon after in 1876, Alexander Graham Bell patented the telephone. Mobile phone technology emerged for commercial use with the car phone in 1979, progressively evolving to become an indispensable part of our lives. In 1994 the Internet was introduced to the public, enabling the instantaneous transmission of any form of data or medium (written, voice, visual). Finally, traditional wired connections to the Internet were challenged in 1997 with the invention of Wi-Fi.

In this brief and incomplete history, the one thing each of these advancements have in common is that they have allowed us to connect with more people and access more information in faster, easier and more affordable ways. Greater connectivity has become a powerful tool in driving productivity and social change.

This brings us to 'Internet of Things' (or IoT). You may have noticed that over time communications have become more mobile, with a greater proportion of information being transmitted through wireless media – be that your mobile phone, Wi-Fi or satellite television. Wireless technologies have become faster, more reliable and more widespread (in fact in many emerging markets, mobile phone penetration is higher than broadband penetration). Internet of Things is essentially a loose term describing the ever-growing network of objects and devices that are connected to the Internet and each other. Connectivity is no longer just about the actual communication device – we now live in a world of connected appliances, watches and coffee machines. Research firm Strategy Analytics estimates that by 2020 there will be nearly 35 billion connected devices – a doubling from today (**Fig 9**).

Global install base of Internet-connected devices

FIG 9



Source: Strategy Analytics

The concept of IoT emerged around 2008, and it is only recently that the building blocks of wireless technologies have been put in place. With the development of 802.11ac technology in the last year, Wi-Fi now has the ability to deliver theoretical speeds close to those of the fixed broadband connection it retransmits. Mobile telephony on the other hand still has a long way to go. The advent of 4G or LTE technology, which is now largely rolled out across developed markets and now emerging markets, for the first time will mean that mobile networks are entirely 'IP-based' i.e. voice calls are now transmitted along with other data.

IoT is likely to truly take off when the next generation mobile network, 5G, is introduced in the early 2020s. The purpose of 5G will be to enhance the density of mobile networks by installing 'small cells' at greater frequency throughout the mobile network, compared to the traditional 'macro' mobile towers that cover a large population. Aside from allowing data to travel across mobile networks at much faster speeds (being able to transmit more data), it will also lower the latency i.e. increase the physical speed with which data travels, which is particularly important when considering applications like a connected car or industrial machinery that needs to be able to react instantly to any hazards. Another consideration is that each individual device will need to have a unique identifier or 'IP address'. The current generation of IP technologies (IPv4) is close to running out of unique addresses (4 billion maximum), and we are currently in a transition to IPv6 which can support trillions.

From a hardware perspective, IoT-enabled devices require very little computational power. Microcontrollers are small computing devices embedded in a product that help control and manage its operation, including connecting the device to a base station. The affordability of these controllers and sensors has improved markedly, with average microcontroller selling prices of $1 compared to a mid-range Intel CPU at $200.

There are some very real security concerns around IoT that will need to be addressed – the more devices that are connected, the greater the security threat and potential for privacy invasion. Among enterprises there has been a concern that IoT is growing faster than the ability to secure it. Due to the high number of different devices involved, it is crucial that there is a standard communication protocol in use so all the devices can talk to each other – but this also means that if the connection is ever compromised on one device it may render many others insecure.

5G will enable near-instantaneous data communications at speeds 100x faster than 4G, which we believe will drive an acceleration in IoT adoption. Below we consider some of the existing applications across both the consumer and industrial Internet, and where they could head in the future.

Consumer Applications

Connected home

So far consumers have been reluctant to make their homes 'smart'. This is not without reason – many 'smart' appliances are still much more expensive, whitegoods are replaced infrequently which slows the take-up, and a lack of standardisation between devices from different firms has added a layer of unnecessary complexity. That hasn't deterred the tech giants from trying to break into the space – Samsung has gained infamy for ingraining questionably useful smart features into its appliances (including a recently launched $6,000 'smart fridge' with three(!) internal monitoring cameras and an inbuilt tablet front), while Google made a statement by acquiring smart thermostat maker Nest in 2014 for $3.2bn followed by security cam maker Dropcam for $600mn. The acquisitions proved a disappointment with a series of internal conflicts and underinvestment leading to low unit sales. As a result of the underperformance and Google's renewed cost discipline they ceased sales and shut down all existing Dropcam products and servers – which left any consumer that had purchased a $600 security system with an expensive paperweight.

This cautionary tale underscores one of the big pushbacks on connected home products, which is that there is a mismatch between the longevity of the hardware and software which tends to be updated for a few years at best until the appliance makers refocus their efforts onto the newer models. Not only does this mean that many of the 'smart' features you bought the device for in the first instance will stop working, but the lack of security updates will render the appliances vulnerable to hacking attacks – not a problem you want to be facing when your home security system is involved.

Despite these issues, various parties are pushing further towards a connected home environment. As aforementioned, Google and Amazon among others have developed physical in-house assistant boxes that respond to voice commands and can control other compatible smart devices within the house (e.g. lights). The real battle is in developing the platform that all of these devices will run on akin to what Google accomplished with Android's domination of mobile devices – and the tech giants face competition from the appliance makers here too, with Samsung investing $1.2bn in its Artik IoT platform. As the world's largest appliance maker, they are in a formidable position. Even the sleepy utilities are looking to diversify into new growth areas with connected home being one of them. Many parts of the world are embarking on rollouts of smart (digital) electricity meters within the home, which not only allow for more accurate reading and better grid management but provide the utilities with detailed live information about energy consumption patterns and which devices they are using. Centrica, owners of British Gas, have advanced furthest in this arena with nearly half a million customers of its smart thermostat hub (Fig 10) – which allow it to tailor energy plans to the user's consumption patterns.

Centrica's Hive product allows you to track your energy usage live and manage other household devices

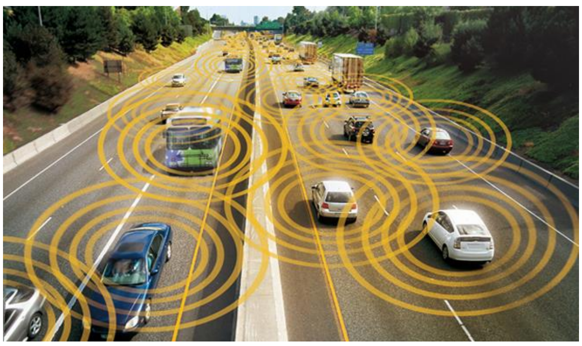
FIG 10

Source: Centrica

Connected car

At a time when automakers are faced with new disruptive entrants in electric vehicles and driverless cars, they are focussing attention on enhancing the in-car experience. There is ever-growing complexity within a car in terms of automation, sensors, connectivity and the software bringing these elements together. With over 130 separate electronic control units in the average modern car, each running millions of lines of code, the diagnostic information we can extract from a car through software and the level of integration with the driver is higher than it's ever been. This has opened up the opportunity for a truly connected car – both to other cars around it and to its environment. A communications ecosystem equips the connected car with real-time information to deal with factors impacting driving conditions (e.g. weather, hazards nearby) and the actions of other drivers. For instance, as soon as the driver hits the brake pedal to slow down or the indicator to change lanes, any nearby cars that may be impacted by the action will be alerted. Of course in a theoretical future of driverless cars these actions may be even more automated. Should an accident or breakdown occur, the car will automatically notify the relevant authorities. An even greater opportunity lies within the car being able to interact with the infrastructure around it – with examples including more efficient traffic light flows and street lights powered on demand (Fig 11). To date the main beneficiaries of connected cars have been consumers and the sensor/chip manufacturers, to which the connected car opened up a new addressable market. It remains to be seen whether the automakers are willing to take the leap into becoming true technological leaders, albeit the reverse is definitely possible as seen with the successes of Tesla (who see themselves as a tech company first and foremost) and Apple's secretive driverless car project 'Titan' on which they have staffed thousands of engineers – *see our 'connected cars' case study on **page 12***.

Cars will be connected both to each other and surroundings **FIG 11**



Source: Wired

Smart retailing

Consultancies such as Deloitte and Accenture have hailed IoT as a complete revolution for the way retailers do business. Much of this stems from the wealth of data about consumers that previously wasn't being captured, which companies can leverage to serve their customers better. Retailers can already mimic customer intimacy, for instance where online stores recommend products based on your purchase history, but now retailers will be able to combine this new individualised information with technologies such as location-based beacons that can track consumer paths around a store to enrich the customer experience. There is a further benefit in being able to more effectively optimise both the supply chain and store layout with a real-time view of which products are in demand. Finally, IoT will open up new revenue streams for retailers such as being able to monetise their data on consumer preferences and using connected devices to bridge the gap between online and offline retail (as Amazon has done with its new 'Dash' button, which can reorder a selected product with the press of a button – Fig 12).

One click of Amazon's Dash button delivers a new box of laundry detergent – usually by the next day **FIG 12**

Source: Amazon

Industrial Applications

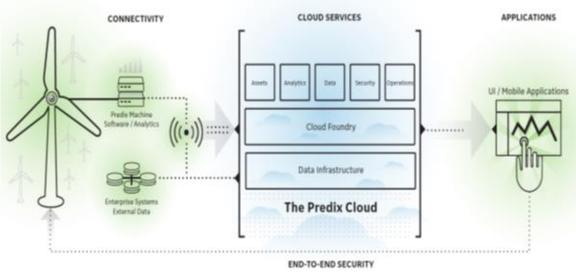
Whilst much of the focus on the internet revolution has been at the consumer level (the proliferation of mobile phones, online search etc.), behind the scenes another revolution is underway in the application of internet connectivity and big data analytics for industrial and commercial applications. This is important because much of the tremendous increase in productivity growth in recent decades has slowed in recent years. Application of new digital tools to big industry could see a step up in productivity growth.

Industrial automation (think automation at the factory floor level, replacing human workers with machines) has been an increasing trend since the industrial revolution. Similarly, in process industries such as oil and gas, chemicals and mining, companies have long employed electronic monitoring and control systems. The industrial internet is taking automation and monitoring to another level. Enabled by a proliferation of low cost sensors connected to the Internet, there is an opportunity to collect data in vast quantities across companies and industries, where it can for instance be analysed to improve uptime, predict equipment failure or lift energy efficiency. This data is distinguished from big data collected across financial services (transactions), and consumer internet (web browsing), as it is time series based and often larger in its total quantity.

Up until recently this next phase of progress has been limited by a lack of connectedness of machines and plants to the overall company ERP (stranded data), partly a result of closed/proprietary systems, and partly due to the conservative nature of many industrial customers. Bernstein research estimate that currently only 15% of machines in the US are 'connected'. McKinsey estimates that a modern oil rig has 30,000 sensors with only 1% of the data being continuously analysed.

GE is seeking to lead in developing platforms for these new analytics with its Predix platform, based on the company's internally developed asset management software. As a world leading manufacturer of aircraft engines, power plants, locomotives, wind turbines and other heavy equipment, GE had developed remote monitoring technologies to assess performance of this equipment in the field. Predix software is installed at the individual machine controller level, and at interfaces (gateways) between the industrial control system and the ERP system, where it sends data to the Predix cloud (internet connected storage). Predix is open-source, allowing GE and other companies to develop apps to analyse this data. Using wind farms as an example, Predix could capture the entire farm-level sensor data, external operating conditions (wind, temperature etc.), and optimise not only the pitch of the blades for optimal direction, speed and wear; but also asset optimisation algorithms to take advantage of real time power pricing and predicting likely equipment failures/optimal maintenance schedule (**Fig 13**).

How GE's Predix cloud will interface with machinery FIG 13



Source: GE

GE is now offering Predix to industrial companies as a platform to provide big data analytics. The total quantum of efficiency gains from even a 1% improvement in efficiency are quite staggering (**Fig 14**) – in a single industry such as gas fired power generation a 1% saving in fuel could be a saving of US$66bn globally. McKinsey estimated possible savings of US$4 to 11 trillion per annum within a decade.

Potential performance gains from IoT in key industries FIG 14

Industry	Segment	Type of Savings	Estimated Value Over 15 Years (Billion nominal US dollars)
Aviation	Commercial	1% Fuel Savings	$30B
Power	Gas-fired Generation	1% Fuel Savings	$66B
Healthcare	System-wide	1% Reduction in System Inefficiency	$63B
Rail	Freight	1% Reduction in System Inefficiency	$27B
Oil & Gas	Exploration & Development	1% Reduction in Capital Expenditures	$90B

Source: GE

Other companies are also developing similar platforms, such as Siemens' Mindsphere (a joint venture with SAP), aiming to provide an alternative solution. Whilst this advancement is only now emerging, unlike other innovations which favour more entrepreneurial companies, this wave will likely favour the larger resourceful industrial companies in partnership with large tech providers like Microsoft and Oracle.

IoT Case study: Connected cars - BMW vs. Tesla

Investors have been enamoured with the recent emergence of electric cars and with Tesla. Over the past four years, Tesla's share price has risen more than 400%. Tesla, with a market capitalisation of US$30bn, is valued at US$600,000 for every car it delivered last year, and about US$30,000 for every car it hopes to produce in four years. Tesla produces all its cars out of one factory in California, with US$3.4bn of capital invested in its plants. By comparison, BMW operates 30 plants in 14 countries and has invested US$57bn of capital in its plants. Tesla produced 50,000 vehicles in 2015 while BMW produced 2.3mn vehicles in the same period. Clearly, there are striking differences between the two companies but Tesla trades on a forward P/E multiple of 234x while BMW trades on 8x – and with Tesla valued at two-thirds of BMW's market value.

BMW

If one were to judge BMW solely by its low stock market valuation, one might think BMW was a troubled business, ill-prepared for the dramatic technology innovations taking place today – such a view would be misguided. By comparison with Tesla, which continually grabs headlines with its charismatic leader Elon Musk, BMW has risen to the top of the global premium car market over many decades. Despite the lack of hype, BMW has also innovated in electric vehicles, hybrids, and connectivity. Moreover, the group remains highly profitable with an industry-leading profit margin of around 9%.

BMW was an early starter in the electric vehicle market, first releasing the all-electric i3 in 2013 and refreshing the model this year with a range of up to 300km on a single charge. BMW has also been releasing hybrid electric versions of all its major models, in addition to the flashy i8 hybrid sports car (**Fig 15** – the vehicle of choice for Apple CEO Tim Cook).

BMW's i8 electric hybrid sports car **FIG 15**

Source: BMW

BMW's approach has been to progressively launch electric and hybrid models to supplement its traditional petrol/diesel engines, while achieving profitable growth in the overall business. This has proven a successful model of steady reinvestment in the business supported by its heavy commitment to research and development (US$7bn in 2015) to support future innovation.

The same approach applies in the area of connectivity, where BMW has been a leader in developing intelligent in-car assistance. The BMW Connect system wirelessly interacts with a driver's smart phone, syncs with personal appointments and addresses, suggests departure times and provides live information on traffic delays. Automatic driver assistance and safety systems are also being refined, with higher end models enabling hands free lane changing and limited time hands free driving, automatic parking and assisted braking upon detection of possible collision.

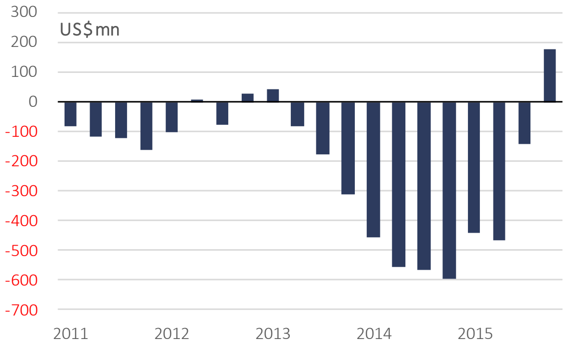
BMW's strategic framework is targeting further heavy investments in electric vehicles and connectivity. While less hyped than Tesla's, we should continue to see BMW launch innovative products, with major refreshes of the product line-up planned over the next two years. Having doubled sales and tripled profits over the past decade, the current BMW stock valuation gives little credit to the company for these achievements and its sensible, carefully planned innovation strategy which should enable further growth.

Tesla

Tesla has captured the imaginations of the public and stock analysts under the leadership of charismatic visionary Elon Musk. However, underneath this attractive facade, Tesla's true financial health is much more fragile than what is portrayed. The company has been burning through cash at an astonishing rate, posting negative cash flows in most quarters over the past five years, as can be seen in **Fig 16**.

It is likely that Tesla will need billions of dollars in additional funding over the next two years to ramp up its battery "Gigafactory" and new Model 3 electric vehicle production. While more recently attempting to downplay the need to raise cash, earlier in the year Musk said that Tesla will raise funds again this year after raising capital in May. Musk is gambling the company's future on a wildly ambitious ramp-up in production that, if it falls short, will leave the company deeply in debt and scrambling to avoid bankruptcy. Tesla did almost enter bankruptcy in 2009 due to cost blowouts and delays, but was bailed out by the US government.

Tesla has been bleeding cash most quarters since listing FIG 16

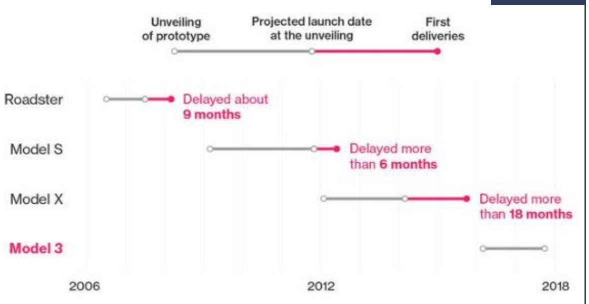


Source: Company data, Bloomberg

Almost every major automaker (as well as tech companies such as Google) has an electric car program that's moving ahead with renewed urgency. In addition to GM's effort with the Chevrolet Volt, Ford is investing billions in its program and even paid $200,000 for an early Tesla Model X, presumably so it could reverse-engineer it. Competition could spell trouble for Tesla, but it's also necessary if electric cars are to replace the internal combustion engine.

Tesla has a history of consistently missing incredibly optimistic sales targets and it has become notorious for delays of new models. **Fig 17** shows each of Tesla's unveilings and the forecast for delivery Musk provided when he began taking reservations. Every car missed its deadline, most recently with the Model X overshooting by more than 18 months. These problems have been masked by growing excitement for the company's future.

Tesla's history of project delays FIG 17



Source: Bloomberg

In May, Tesla announced that it will pull forward its production target of 500,000 vehicles from 2020 to 2018 and indicated a target of 1 million vehicles by 2020. This would imply that Tesla would produce 22% of BMW's car volumes today by 2018 vs. ~2% now (**Fig 18**). At the model level, Tesla's estimate of 300,000-400,000 Model 3s produced by 2018 would make the Model 3 the third best-selling luxury vehicle in the world (**Fig 19**).

Top OEM car production FIG 18

OEM	2015 Production
Volkswagen	9,914,613
Toyota	9,902,788
Renault/Nissan	8,263,768
Hyundai	8,075,640
General Motors	7,674,779
Ford	6,398,041
FCA	4,734,556
Honda	4,535,375
PSA	2,956,318
Suzuki	2,924,558
Daimler	2,451,682
BMW/Mini	2,279,455

Source: UBS, IHS

Top OEM luxury car production FIG 19

Brand	Model	CY 2015
Mercedes	C-Class	469,378
BMW	3-Series	393,844
TSLA	Model 3	350,000*
BMW	5-Series	339,729
Audi	A4	297,368
Audi	A6	288,531
Mercedes	E-Class	275,772
Audi	Q5	265,937
Audi	A3	240,584
Audi	Q3	198,465
BMW	Mini	189,568

Source: UBS, HIS, Tesla; * midpoint of 300-400k guide

Elon Musk effectively controls three big companies: Tesla; his private space startup SpaceX; and SolarCity, a publicly-listed solar panel manufacturing and installation company. Musk is in the process controversially acquiring SolarCity by Tesla. However, SolarCity, like Tesla, loses money and has US$3bn of debt. Between the $3bn offer to buy SolarCity and the debt obligations at SolarCity which Tesla would inherit, Tesla doesn't have the funds on hand to acquire SolarCity. Musk has ruled out an equity offering (which would dilute Tesla's stock price) or raising new debt to meet this funding requirement which means he most likely will tap the $1.3 billion in lines of credit that Tesla has access to. Although Musk has talked about the synergies from having an integrated electric car company and solar company, it's hard to see why the same outcome couldn't be achieved through a joint venture without acquiring the equity of SolarCity. More importantly, the Board of Directors of Tesla has refused to provide SolarCity bridge financing until the deal completes which then raises the question of why the Board is comfortable purchasing the equity of SolarCity.

Musk's ability to build an almost cult-like following around Tesla has enabled the company to mask problems like financial losses, production delays and increasing competition. Eventually, if that following breaks down, or Tesla doesn't live up to expectations, the support could collapse, leading to a downward spiral.

Performance Review

Global share markets shook off Brexit-related concerns and rallied strongly to begin the September quarter. While it seems that central banks are keen to begin the process of normalising interest rates and withdrawing stimulus, there is little in the way of sustainable economic momentum to give them confidence that the global economy is resilient enough to adjust to such changes.

There were two clear themes during the September quarter that explained fund performance. The long portfolios strongly outperformed the short and the international portfolios fared better than the domestic exposures.

Each of the Watermark Funds produced a positive return for the quarter, with the two listed funds outperforming the trust, by virtue of their higher international exposure. The ALF and WMK portfolios rose by over 3% net of all fees while the trust delivered a 1.3% net return over the quarter.

In the domestic portfolio, the September reporting period proved a difficult one for stock pickers, as capital flowed out of defensive, higher dividend paying shares such as *Transurban* and *Tatts Group* into cyclical exposures.

Defensive sectors provided mixed results during the period. Healthcare provided a number of highlights, particularly within the international portfolios, where an investment in *Ionis Pharmaceuticals* and short exposures in *Novo Nordisk* and *Grifols* performed well. A core short exposure in the domestic telecommunications sector was the best performing position in the quarter.

In the cyclical parts of the portfolio, investments in *Downer EDI* and *Super Retail Group* performed well. A timely investment in *Nintendo Co* buoyed performance with global hype surrounding the global launch of the new Pokémon Go mobile game.

Exposures in the technology sector have also been strong contributors to the international performance. The Funds are positioned to capture the uplift in demand for analogue chips used in cars and industrial machinery, while holding short exposures in logic, as demand is softening alongside PC sales. An investment in *NXP Semiconductors* was a strong performer in this vein.

In Financials, returns were mixed. While we remain circumspect on the outlook for banks domestically and abroad, the Fund's net short exposure weighed on performance. Outside Australia, the Funds have long exposures to Benelux banks *ABN Amro Group* and *ING Groep* which continue to perform well. Domestic investments in *IOOF Holdings* and *Flexigroup* also performed well during the quarter.

There was significant variability within the commodities complex in the quarter, with bulk commodities and oil continuing to perform well. A short exposure in the domestic LNG sector was a standout performer while a small net short exposure to iron ore producers detracted from returns.

WATERMARK FUNDS MANAGEMENT

AUSTRALIAN LEADERS FUND

Fund at a Glance – September 2016

ASX Code	ALF
Fund Size	AU$365m
Fund Strategy	Variable Beta
Shares on Issue	269.9m
Dividend (HY16 Interim)	5 cents
Dividend Yield (annualised))	6.6%

Net Tangible Asset (NTA) Backing

	Aug 16	Sep 16
NTA Before Tax	**$1.31**	**$1.36**
NTA After Tax	$1.33	$1.36

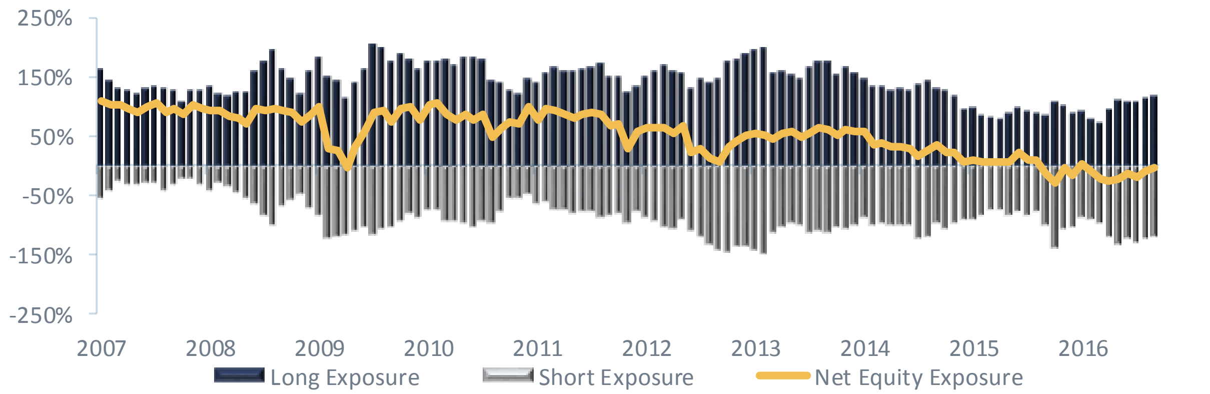
Gross Portfolio Structure

	Aug 16	Sep 16
Long Exposure	114.8%	117.8%
Short Exposure	-124.4%	-120.7%
Gross Exposure	239.2%	238.4%
Cash	109.6%	102.9%

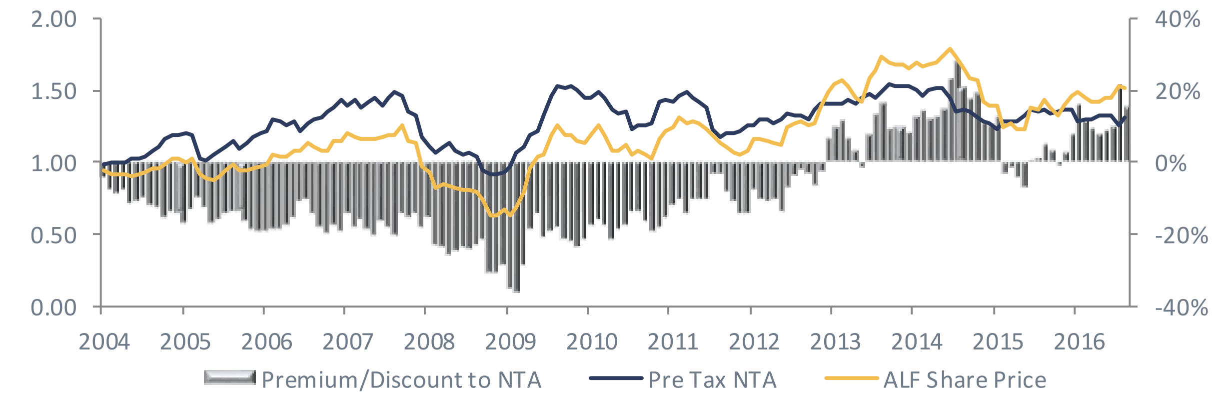
ALF Performance

	1 Mth	6 Mths	1 Yr	3 Yrs (pa)	5 Yrs (pa)	7 yrs (pa)	S.I. (pa)
Portfolio Return (net)	3.9%	5.6%	5.6%	6.8%	16.5%	10.3%	13.9%
All Ords Accum Index	0.4%	9.5%	14.0%	6.4%	11.0%	6.7%	8.7%
Outperformance (net)	**3.5%**	**-3.9%**	**-8.4%**	**0.4%**	**5.5%**	**3.6%**	**5.2%**

Net Equity Exposure



Historical Premium/Discount to NTA History



Market Neutral Trust

APIR: WMF0001AU

Fund at a Glance – September 2016

Fund Size	AU$121m
Strategy FUM	AU$214m
Fund Inception Date	August 2012
Fund Strategy	Equity Market Neutral
Application/Redemption	Daily
Management Fee	1.5%
Performance Fee	20%
Benchmark	RBA Cash Rate

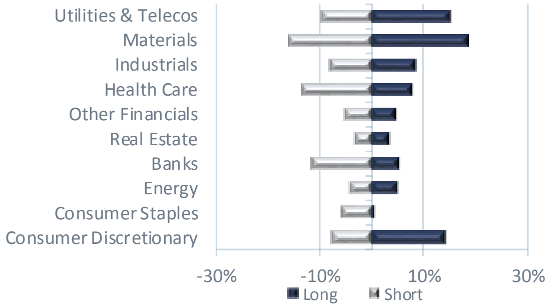
Return Characteristics[1]

Positive Months	70%
Portfolio Beta	-0.2
Sharpe Ratio	1.6
Sortino Ratio	4.7
Standard Deviation	7.4%
No. Long Positions	70
No. Short Positions	68
Gross Exposure	169.9%

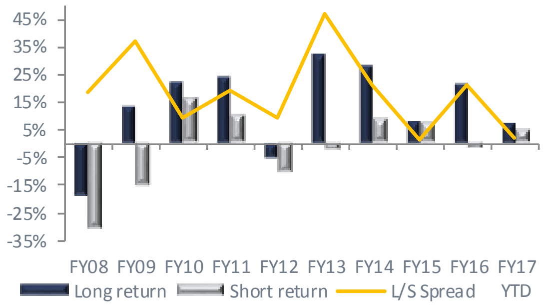
Performance[2]

	1 Mth	6 Mths	Fin. YTD	1 Yr	2 Yrs (pa)	S.I (pa)
WMNT (net return)	2.2%	4.8%	1.3%	7.0%	10.%	14.6%
RBA Cash Rate	0.1%	0.9%	0.4%	1.9%	2.1%	2.4%
Outperformance	2.1%	3.9%	0.9%	5.1%	7.9%	12.2%

Sector Exposures



Long/Short Spread[3]



Monthly Net Performance (%)

Cal. Yr	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2012	-	-	-	-	-	-	-	1.36	0.97	0.00	6.51	2.88	**11.72**
2013	-0.71	0.21	4.60	1.55	5.83	5.31	1.11	2.57	1.43	1.86	0.35	-0.06	**24.05**
2014	1.71	1.45	-1.17	2.80	1.21	0.84	-4.38	-1.77	2.52	-1.57	-1.58	-1.32	**-1.26**
2015	-1.18	0.70	3.23	0.96	-0.61	3.39	3.82	4.04	2.73	-1.36	1.53	2.93	**20.19**
2016	-0.14	-1.92	1.13	0.53	1.08	1.76	0.60	-1.46	2.23				**3.81**

[1] Return Characteristics are in relation to the market neutral strategy using long/short return series recorded from April 2008
[2] Performance data is net of all fees and expenses. The Fund's inception date is August 2012
[3] Long/Short spread shows the gross performance of the long and short portfolios. The Fund makes a profit where the long portfolio outperforms the short portfolio, after the payment of fees. Returns prior to the Fund's inception date are based on return series from the long and short portfolios of the Australian Leaders Fund Ltd in a market neutral structure

Watermark Market Neutral Fund Ltd

WATERMARK FUNDS MANAGEMENT

Fund at a Glance – September 2016

ASX Code	WMK
Fund Size	AU$93.4m
Fund Strategy	Equity Market Neutral
Shares on Issue	87.1m
Dividend (HY17 Interim)	3 cents
Dividend Yield (annualised)	5.6%

Net Tangible Asset (NTA) Backing

	Aug 16	Sep 16
NTA Before Tax	$1.04	$1.08
NTA After Tax	$1.04	$1.07

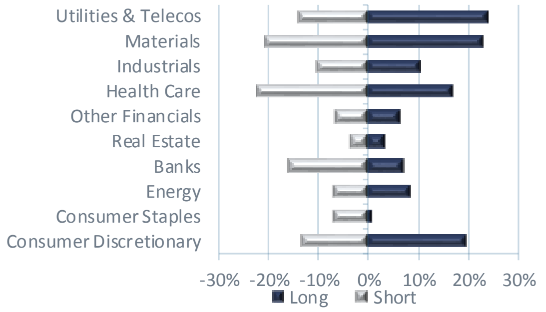
Gross Portfolio Structure

	Aug 16	Sep 16
Long Exposure	117.8%	121.5%
Short Exposure	-120.8%	-120.5%
Gross Exposure	238.6%	242.1%
Cash	103.0%	99.0%

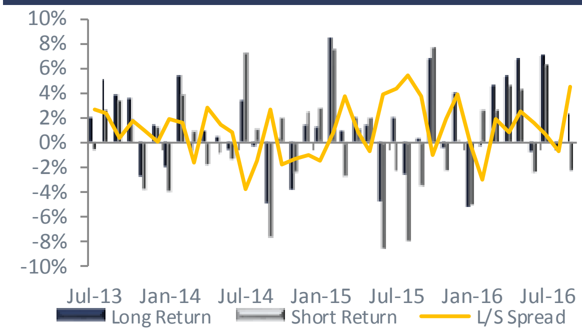
WMK Performance

	1 Mth	6 Mths	1 Yr	S.I. (pa)
Portfolio Return (net)	3.3%	6.0%	7.4%	8.7%
RBA Cash Rate	0.1%	0.9%	1.9%	2.3%
Outperformance (net)	3.2%	5.2%	5.5%	6.5%

Sector Exposures

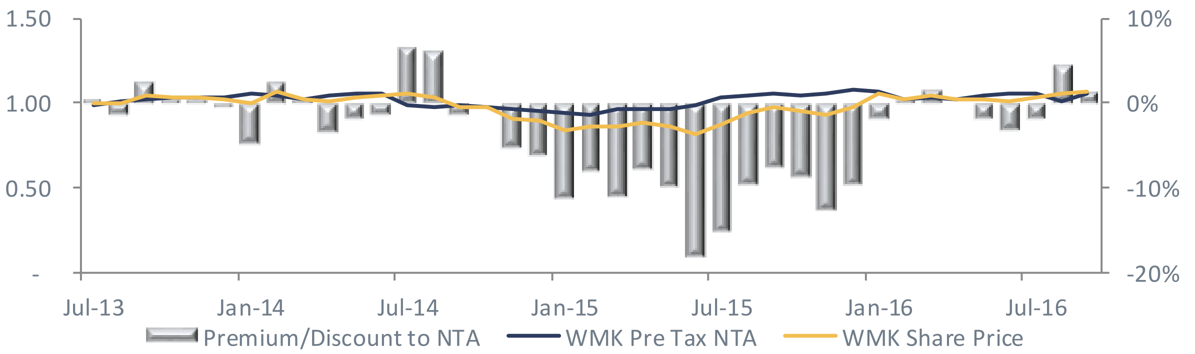


Long Short Spread*



* Long Short spread shows the gross monthly performance of the Company's long and short portfolios. The difference between the two represents the gross performance of the portfoio as a whole. The company will make a profit where the long portfolio outperforms the short portfolio, after the payment of fees and expenses.

Historical Premium/Discount to NTA



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FUNDS MANAGEMENT

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