

## Technologies Reshaping Our World



### March 2012:

Technological advances are moving at exponential rates. Ponder this for a moment: your parents have lived through the development of the computing era from the earliest electromechanical devices in the 1940s to IBM's supercomputer Watson that outperformed the best human brains. Today, many five year olds have no concept of a world without technology – it is quite simply part of their lives. This month, we'd decided to look ahead – a long way ahead in some cases – at radical and innovative technologies that will potentially reshape our world in the decades to come. In today's world, it's easy to get swamped by short-term thinking and firefighting but we don't like to encourage it...

Technology advances will not only impact how we work and live, but also humans as a species. From developments that allow us to overcome the resource challenges presented by population growth to advances that will reshape the production of goods and services, our environment and our humanity, technology will challenge us to rethink every aspect of what we do and how we do it. While some of the breakthroughs will be exciting and easy to embrace, others will challenge vested interests and the status quo. The definition of value will be challenged and change. Our comfort zones will be disrupted and pressures could easily spill over into social, political and business tensions or conflicts. But, like it or not, these changes will come – sooner than we think in some cases. What is your organization doing to get ready? Who do you need to partner with to do so? What will be the impact on your customers and consumers more broadly? What are YOU doing?

### Technologies reshaping our resources

The United Nations has designated 2012 as the International Year of Sustainable Energy for All. Energy has the power to transform economies, lives and how we impact our planet. The challenge is to move from excessive dependence on fossil-fuel while improving energy efficiency, reducing wastage and developing sustainable energy sources. The future is about energy that is accessible, cleaner and more efficient. The good news is much new technology already exists to tackle these challenges and more is in the development pipeline – see examples below. The bad news is some entrenched interests in government and the corporate world seem to be slowing the process down.

Managing our resources better, however, extends well beyond energy. We have written before on the challenges of food and water security – and the new and exciting technologies emerging for this sector, which we revisit in more depth next month. Think too about new and renewable materials,

from the wonder material graphene which is edging closer towards commercialization, to natural materials designed to replace non-biodegradable ones. In designing and producing these new materials, as well as solutions for energy, food and water challenges, nanotechnology will play an ever-increasing role. And don't forget geo-engineering – while the debate continues about whether we are able or ready to try to manage the impacts of a changing climate, technological advances are giving us tools to address these challenges.

### ***In Action!***

**Storing energy:** Storing electricity or energy is one of the holy grail's for utilities as increasing amounts of variable renewable energy make their way on to the grid. At Stanford, Professor Yi Cui and his team have developed a stationary large-scaled renewable energy storage system by using crystalline nanoparticles from a copper compound. It is a cheap, durable and efficient solution. The same university has also developed a transparent battery by using liquid silicone. This battery type will be useful not for just in renewable energy but consumer-oriented gadgets. A patent has been filed and before you know it -- you may well be the owner of a transparent iPhone, laptop or e-reader! (Source: [CleanTechnica](#) and [Stanford University](#)).

**Erbium – the new Graphene?:** Graphene is a wonder material, the strongest material ever discovered. It is flexible, extraordinarily light and transparent. A single layer of carbon atoms can supercharge computer chips, optical circuits, lithium-ion batteries, and solar power generation but does it have a competitor? [Arizona State University](#) electrical engineering professor Cun-Zheng Ning discovered a material, called *erbium chloride silicate* – somewhat by accident. Erbium can be used to improve the capabilities of the Internet, increase the efficiency of silicon-based photovoltaic cells and enhance the quality of solid-state lighting and sensor technology – in addition to the next generation of computers. (Source: [Science Daily](#))

**Next generation food:** To feed 9 billion people by 2050, predictions suggest that global food supplies may need to increase by 50-70%. New technologies, including genetic modification, cloned livestock and nanotechnology have an important role to play here. But a major survey suggests that 70.9% of Europeans are opposed to GM foods. An overwhelming percentage of respondents, 94.6%, said they wanted the right to choose whether or not to eat GM foods. Another survey, conducted in the US, found many Americans, like Europeans, are sceptical about GM foods. 90% of American consumers say that GM foods should have special labels on them, and 48% say that they would not buy fresh vegetables if they were labeled GM. Both polls also found that the public lacks knowledge about biotechnology and GM foods. The reality is that American consumers already consume significant amounts of genetically modified food, but the lack of awareness of this and how many use and consume nano-based products is a cause for concern. There is very little public awareness of nanotechnology. A survey found that 49% of Americans haven't heard anything about nanotechnology and only 7% have heard a lot. How much do you know about it? (Source: [The Organic & Non-GMO report](#))

### ***Look Out For...***

**Saving energy using the “internet of things”:** According to [Pacific Control](#) and researchers at the [Vienna University of Technology](#), automatic communication between electronic devices and infrastructure, removing the need for a human interface, can save money, energy, and CO2 emissions and potentially lives. Together, they are developing intelligent computer software systems that could, for example, alter heating and air conditioning systems in offices based on how many workers are staying late and which offices they're using. By creating a smart grid, where everything using energy is connected, monitored and controlled, energy efficiency could be increased, while improving service levels and response time for consumer/customer needs. With such smart grids, public defibrillators, for instance, could automatically call an ambulance in case of emergency. (Source: [The Futurist](#) & [Pacific Controls](#))

**Eat your Wrapping:** We have mentioned bio-degradable food-wrapping in an earlier brief but what about food packing technology that eliminates the need for plastic wrapping or containers? A team from [Harvard University](#) has already developed packaging to hold pumpkin soup in a spinach membrane, lemon juice in a lemon membrane and melted chocolate in a cherry membrane. The new edible packaging technology

WikiCells is made from a charged polymer liquid and actual food particles, which hardened around a food substance and could hit the market within 12 months. (Source: [FoodProductionDaily.com](http://FoodProductionDaily.com))

**Geoengineering:** As the climate change debate accelerates and efforts to reduce emissions stall (instead of cutting greenhouse gas emissions in the two decades since the 1992 U.N. Earth Summit in Rio, it has risen 49%), some scientists and policymakers believe it may be time to look in a completely new direction. They are exploring the possibility of altering the Earth's climate using geoengineering to keep warmth from getting into the atmosphere by cutting down on sunlight or taking climate-warming carbon dioxide out of the atmosphere. The big question is: Is it worth the risk? (Source: [Reuters](http://Reuters))

## Technologies reshaping production

The industrial revolution reshaped the world and built efficient and productive economies. Mass production and increasing affluence allowed us to consume an increasing range of goods and services. Trade in goods and services brought the world closer together and allowed countries to specialize based on their resources to lift levels of growth even further. As we move beyond the industrial age into an era where knowledge dominates, technology advances will once again reshape economies and how and where production happens. At its most extreme, consumers producing their own customized goods using 3D printing in the home could make factories and some industries obsolete, while completely eliminating the need for transportation. The internet of things (see below) and intelligent materials could similarly reshape service industries, as consumers manage their own services or have sensors and computers do it for them. Smart machines and robots will reshape how we get to work – if indeed we need to physically move to do so -- along with all aspects of production of goods and services. In this world where jobs, training and education are shifting, we need a radical rethink to prepare the next generation to operate economically and develop socially.

### *In Action!*

**The internet of things!** The internet of things, also known as the internet of everything or the internet of objects is driving many emerging trends. Defined as a self-configuring wireless network of sensors whose purpose is to interconnect all things -- what does it mean in reality? More and more objects are becoming embedded with sensors and gaining the ability to communicate, suggesting the communications revolution is now extending to objects as well as people. Already smart meters and energy grids are helping to optimize energy use across networks. Looking ahead, try envisioning sensors discreetly attached to your body so you constantly are informed about how your vital functions are doing. Or pill bottles that tell you when to take your medicine; wine glasses that let you know when you have had enough to drink; sugar bowls warning you about your sugar intake. And what about presence-based advertising and payments based on locations of consumers, inventory and supply chain monitoring. Everything seems possible!

**Smart workplaces:** The automation of the workplace is gathering pace. Production lines have long been automated, now checkout jobs in supermarkets and pharmacies are disappearing. As the internet of things develops, real-time information will flow directly from consumers to businesses and back. This means the disintermediation of many services from service technicians who read your meters to intelligent inventory and supply chain monitoring. As these technologies develop, consumers will do what professionals once did. This might sound fantastic for the digital elite but for the less-skilled worker the consequences may be devastating and the need to acquire new skills critical.

**Smart machines/automation/robots:** If you find it hard to get a new and reliable receptionist or assistant look no further. For about US\$2,400 a month, [Anybots](http://Anybots) will send you a QB robot, and a professional (human) assistant will log in to the robot and be available 40 hours a week (Source: [IEEE Spectrum](http://IEEE Spectrum)) The South Korean Ministry of Education recently announced that they would place a robot in every kindergarten classroom by 2013. Also in South Korea, by March 2013 prisons will see five foot tall four wheeled robots patrolling cells, on alert for suspicious activity while also monitoring prisoner health. Any situation that requires attention will be relayed to human guards. (Source: [Singularity Hub](http://Singularity Hub))

**The mobile enterprise:** The workplace is not only getting smart, it is becoming ever-more mobile thanks to the rise in the use of mobile devices such as smartphones and tablet computers to access business software, applications and knowledge anywhere, anytime. Just a few years ago a mobile worker would be outside the company's walls, but today many workers are mobile at least part of each day, accessing information and working away from a stationary desk or office in meeting rooms, cafeterias or outside spaces. As employees increasingly insist on using their own devices at work, the "consumerization of IT" is continuing, with younger workers also sourcing their own applications, often via recommendations from their personal networks. (Source: [ZDnet](#)) While studies have found varying conclusions on whether enterprise mobility increases or decreases IT costs and employee productivity, a 2011 report from [iPass](#) suggests that the rise of enterprise mobility will continue to reshape work, with two-thirds of companies surveyed intending to increase their spending on mobile devices and solutions.

### Look Out For!

**3D printing:** In use for 30 years in industrial settings 3D printing has been used for manufacturing everything from tools to shoes to jewelry, or even car and aerospace parts. The reality, however, is that 3D printing is still in its infancy and has the potential to enable much more. According to [PC Magazine](#), these printers will be found on workbenches, in studios, home offices, even in the kitchen or in your living room within a decade. Lost your remote? Simply print a new one. 3D printing has the potential to revolutionize manufacturing as well as bringing power into the hands of consumers!

**Intelligent materials:** Imagine placing your electronic device down on just about any flat surface and it is charged almost instantly. With new intelligent materials, intelligent power on surfaces means worry about where to charge your cell phone, your laptop or even your e-reader becomes a thing of the past. Or what about electronic-enabled packing technology like QR codes (on smartphones) or Snap Tags (2D codes that can be used on any camera phone) that enable brands to inform, entertain, protect, and connect with consumers beyond the printed label. Just scan an advertisement with SpyderLynks Snap-to-Buy reader and complete a purchase from your mobile phone (Source: [The Barcode News](#))

**Thinking in atoms:** Though the technology is still in its infancy, nanotechnology is already a buzzword generating excitement. Those in the know recognize its potential to reshape and redefine a broad range of industries, from health care, to transportation to manufacturing. Manufacturers are already incorporating nanotechnology into their processes, using nanomaterials and nano-enabled equipment that makes products lighter, stronger, and more energy efficient. Nanotechnology has the potential to have vast consequences. Imagine, if you will, a day when computer manufacturers produce nanochips that deliver over 50 gigahertz of speed, in other words the processing power of ten supercomputers, for the price of a quartz watch and smaller than a key chain? Source: [Global Futurist](#))

**New jobs for the future:** Speaking at the TEDxReset Conference in Istanbul, innovation editor Thomas Frey from [The Futurist](#) predicts that over 2 billion jobs will disappear by 2030. Sectors that will be particularly hard hit include: Power, automobile transportation and education, as well as industries vulnerable to replacement by 3D Printers, e.g. manufacturing, and the next generations of robots, e.g. mining. Over time these sectors could see hundreds of millions of jobs disappearing —however at the same time these changes will create new kinds of jobs. The challenge will be to ensure a workforce that is ready and skilled for them. See more [here](#). (Source: [World Future Society](#))

### Technologies reshaping daily life

So work will never be the same but what about technology's impact on our daily lives? The story is similar – for better or worse – depending on your perspective. We don't need to tell you ubiquitous communications and new devices have already reshaped how we connect with other people, be they friends, family, colleagues or those we don't know but with whom we share similar interests. As devices get smarter so too do the underlying connective technologies, which will reach every corner of our lives, at home, at work, at leisure – want a mood change, tell your home control system. Need the latest news, just fire up your kitchen table's intelligent surface. Need food for a party – speak to your refrigerator who creates a list and transmits it to the local store for home delivery. If we do need to move physically to work or meet friends, new forms of transportation will

take us there. If we walk, new materials will harness the kinetic energy and power our devices. Will all these advances benefit our quality of life? Surely, many will, both saving us time and making our lives more sustainable. But there will also be areas of discomfort, which will require flexibility, adaptation and tools to manage societal changes.

### ***In Action!***

**Connectivity everywhere:** Today more than 30% of the world's 7 billion people are connected to the internet. There are 5.9 billion mobile-cellular subscriptions and mobile-broadband subscriptions have grown 45% annually over the last four years! Technological advances, lower costs, more network, cloud and off-the grid options have made it possible to reach out to every corner of the Earth via wireless and mobile web connections. As internet penetration grows, along with new types of devices and solutions like clouds, tablet and apps so too does the range of services provided in this interconnected world – anywhere and anytime. And these connecting technologies reach deep into the connected society changing our daily life. Technology has no doubt made life more comfortable but has it given us more time to spent on things that we really want?

**Smart transportation:** Auto manufacturers have already installed systems that automatically call for help if you are in an accident. Other new concepts to look out for include cars that brake when they detect pedestrians, digital road signage on the dashboard and vehicle systems that help drivers save fuel, money and the environment (Source: [ITS America](#)). Intelligent variable speed limit and automatic road enforcement are well established as are sophisticated telematic systems connecting EVs to the smart grid. According to Scott Belcher, however, president of the Intelligent Transportation Society of America: *"Intelligent transportation is the largest industry you've never heard of"* and the industry is predicted to grow from US\$48 billion in revenue in 2009 to US\$67 billion by 2015 in the U.S. (Source: [GreenBiz](#))

**Smart housing/cities:** When you think about it, real-time monitoring of every aspect of your house is already here, from electrics to plumbing, saving consumers time and money. Today appliances can be connected, networked and integrated making our life more comfortable and consumption more energy efficient. But this is just the tip of the iceberg. At the Consumer Electronics Show 2012, manufacturers showed future appliances and smart solutions that in many cases are already a reality. LG has developed a refrigerator to help people manage their diets by connecting food storage to their smartphone. Lowes, a home-improvement retail chain in the US, is to release a connected home kit set in 2012. It will enable users to wirelessly link all of a home's devices and systems, such as heating and air, lighting and home theater systems, enabling each to be controlled from a single mobile device. (Source: [Mobiledia](#))

### ***Look Out For...***

**Photonics:** Researchers at [Columbia Engineering School](#) have built optical nanostructures to engineer the index of refraction and fully control light dispersion. But why is this important? Well, basically it means that they can get light to behave the way they want and the discovery could lead to a new generation of highly precise and efficient photonic devices, particularly fiber optic telecommunications equipment. Fiber optic communications may be revolutionized, and if the phase control could be expanded to spectra other than visible light, wireless communications could be as well. One for the longer-term, but keep an eye on developments. (Source: [TechCrunch](#) & [Reuters](#))

**Vehicles of the future:** Driverless trains have existed for years and driverless cars are no longer solely in the sphere of science fiction writers. Building on existing technologies, automakers are developing complex systems that allow cars to drive themselves. Audi has recently unveiled its version of a driverless car while Google has been granted a patent, having successfully navigated a driverless car 190,000 miles around California – although a driver was there just in case (Source: [Shaping Tomorrow](#)). At TED 2011, Stanford University robotics professor and Google Driverless Cars program leader [Sebastian Thrun](#) pointed out that driving accidents are the number one cause of death for young people and almost all of these are due to human error, so could be prevented by machines. Other benefits of driverless cars include increasing the capacity of highways by a factor of two or three by relying on robotic precision, increased mobility for disabled drivers, increased car sharing in urban areas, and a reduced need for parking. (Source: [SEO](#)).

**Homes/cities of the future:** Microsoft has joined a plan to build a smart city filled with smart homes in Portugal. These smart homes will have environmental sensors that feed data to the central management systems so heating and power management can be handled more efficiently and in a more environmentally friendly way. To include detailed monitoring of building occupancy, the city itself will be built along the same engineering principles as cars and aircraft. The resulting urban zone will be a 21st century approximation of the integrated, digital, smart cities that tend to pop up in certain kinds of future-looking science fiction, although we may expect more conventional building designs and less "big brother" behavior. (Source: [Fast Company](#)). Included in this smart city home is a kettle that is powered wirelessly, so you can leave it anywhere in the house. The surface senses a kettle has been set down and automatically powers it. By using magnetic fields to heat only the kettle's coil, there is no danger of burning your hand or cooking the meat you have thawing on the counter by mistake. (Source: [BBC](#))

## Technologies reshaping YOU and ME!

We know more about **us** than ever – often before we even are born. Not only can we, to some extent, be our own doctor, but also breakthroughs in technology might extend our lives or cure illnesses never thought to be curable. Technology is a life changer and a lifesaver. Using advanced technology, a new study suggests it is possible to detect autism in a six month old baby, a diagnosis normally be made in only children 18 months to 2 years of age and, in this case, early diagnosis can be life changing. Advances in medical and neurosciences have made it possible for us to live longer, look younger, prevent and treat diseases that previously were immune to science. We have come a long way in the past century, while every day new discoveries show that there are even more breakthroughs to come!

Technology has forever changed US as a species – how we live, learn, work and think. Want to learn something new or know something about your health, turn on your connected device, download the latest app or connect to a university 7000 miles away. It's not all good news, however, as technology is also starting to impact our brains, in some cases making us think less logically and critically as it takes over some difficult tasks for us. There is clearly a world of difference between restoring impaired or degraded human capacities to a more normal level as opposed to enhancing capacities that might alter human functioning beyond the normal. However, the latter area is where we should expect to see increasing breakthroughs – and controversy – in the future.

### *In Action!*

**From help to self-help:** Increasingly we act as our own doctors. Popular websites like [PatientsLikeMe](#) and [iMedix](#) connect patients with the same symptoms and enable users to share experiences and treatment information. Selftracking is a new and emerging trend - software, gadgets and apps collect information to help us make informed decisions regarding our health and productivity. We measure how much we sleep, walk, drink, our blood pressure, even our mood. You name it – it's possible. In fact, Apple's App Store currently offers 9,000 mobile health apps (including nearly 1,500 cardio fitness apps, over 1,300 diet apps, over 1,000 stress and relaxation apps, and over 650 women's health apps) and by mid-2012, this number is expected reach 13,000. How will this emerging trend change the health care system? (Source: [MobiHealthNews](#), September 2011 via [Trendwatching](#)).

**Changing learning:** "Be quiet and listen" – remember what your teacher used to say.... Today technology has given teachers, students and employees tools to expand beyond old fashion teaching styles and text-based learning, and the theory is these help keep us motivated and make learning easier. Gamification is a new and growing trend in the world of learning and education and it is taking off big time – whether you are a preschooler, a college student or an employee. Professor Karl M. Kapp at the Bloomsburg University and author of *The Gamification of Training: Game-based Methods and Strategies for Learning and Instructions* says that "*Studies indicate that games, when designed properly, motivate learners, improve learner retention and encourage students who aren't typically 'academic' to partake in the learning process.*" (Source: [Mashable](#))

**Outsourcing the brain:** As the data deluge accelerates, are we entering an era where we outsource some of our cognitive capacity to the “global brain”? Books, computers and, increasingly, the internet help us to learn. Studies suggest, however, that internet use is changing our mental habits, meaning significant amounts of information are now stored “off-brain”. In other words, we have search engines so there’s no need to actually remember anything. It may also impact the way we read and think – from reading a full article to only searching, surfing and skimming. How will this affect our ability to process and reflect in the long term? (Source: [The Atlantic](#))

### **Look Out For...**

**Make Me Healthy:** More than 160 million people globally are considered technically blind but according to [Monash University](#) help is on the way. Researchers claim they will have a bionic eye implant ready for human trials in 2013. The implant will use a camera to feed the implant with signals that have been processed to extract the most useful information, depending on what the person needs. (Source: [Science Alert](#)). At Glasgow University a new silicon chip, Ion Torrent is revolutionizing the DNA sequencing by speeding up the process making it both cheaper and easier to sequence genes. The potential impact on every aspect of human life is huge, including discovering genetic abnormalities in ourselves and unborn children (Source: [Extreme Tech](#))

**Enhancing future minds:** The term “singularity”, most commonly associated with futurist Dr. Ray Kurzweil, refers to a time of rapid and accelerating development of various sciences and technologies, including biotechnology, nanotechnology, artificial intelligence, robotics and genetics, when machine intelligence surpasses that of humans and irreversibly alters human existence. Ultimately, technological advances may enhance human capacity and intelligence to deal with radical change and complexity, through new human-machine interfaces -- dramatically impacting how we think, live and work in the future. Imagine a world where computers do all the logical thinking for us leaving us free to do creative and conceptual thinking?

**In April: Look out for updated trends in action on Water, Food and Energy!**