



Notes from the Edge



Insights into an Evolving Future

VOL 6 – ISSUE 11

NOVEMBER 2016

A Product of the *Futures Assessment Division*

TABLE OF CONTENTS



Demographics	1
Economics	1
Forecasting	2
Energy	2
Urban Futures	3
Technology	3
Medical Technology	4
Resource Scarcity	4
Art of the Future Project	5

DEMOGRAPHICS

The Global Demography of Aging: Facts, Explanations, Future. Last month, we brought you “Here Come the Young,” an article about the coming population boom. Concurrently, population aging is the 21st century's dominant demographic phenomenon in developed countries. Declining fertility, increasing longevity, and the progression of large-sized cohorts to the older ages are causing elder shares to rise throughout the world. This phenomenon is unprecedented in human history, and brings with it sweeping changes in population needs and capacities, with potentially significant implications for employment, savings, consumption, economic growth, asset values, and fiscal balance. While population aging certainly poses new challenges, doomsday scenarios about irreparable economic strain are likely overstated. Mitigating the negative consequences of population aging will involve some combination of increased labor supply from women, immigrants, and older people; investment in education and training at all ages; increased rates of savings during the working years; slower growth of benefits; and faster growth of tax contributions to finance government transfers to older people. [Demographics of Aging](#)

ECONOMICS

IMF and other GDP and GDP per capita Projections. The International Monetary Fund has projected GDP and GDP per capita out to about 2021. By 2021, on a purchasing power parity basis, China's economy will be 50% larger than the US economy (they were roughly equal in 2013). However, in terms of per capita GDP China will still fall far short of the US. [GDP / GDP per capita Projections](#)

Move Over Bitcoin, the Blockchain is Only Just Getting Started. The author opines that the blockchain at the heart of cryptocurrencies contains the seeds of something revolutionary, such that even governments have taken an interest. Sir Mark Walport, the UK government's chief scientific adviser, published a report on the blockchain in January this year, outlining how the massively distributed shared ledger is "a database that tracks who owns a financial, physical or electronic asset". Many firms are already using the blockchain to trace and record ownership, and to cut out middlemen. The paper in the attached pdf, seeks to provide clarity on what blockchain technology can do and how it has unfolded ever since its invention in 2008. While outlining the opportunities for governance brought forth by the technology, the paper also surfaces important caveats about its possible uses in the future and the likely challenges to national security. Ultimately, the paper aims to deflate excessive hype and paint a realistic picture of the technology's transformative potential.

[Move Over, Bitcoin](#) [New Kid on the Block\(chain\)](#)

FORECASTING

What is Disruptive Innovation? For the past 20 years, the theory of disruptive innovation has been enormously influential in business circles and a powerful tool for predicting which industry entrants will succeed. Unfortunately, the theory has also been widely misunderstood, and the "disruptive" label has been applied too carelessly anytime a market newcomer shakes up well-established incumbents. In this article, the architect of disruption theory, Clayton M. Christensen, and his coauthors correct some of the misinformation, describe how the thinking on the subject has evolved, and discuss the utility of the theory. The authors acknowledge that disruption theory has certain limitations. But they are confident that as research continues, the theory's explanatory and predictive powers will only improve.

[What is Disruptive Innovation?](#)

Why the Next 20 Years Will See a Lot Less Technological Disruption Than the Past 20. In his new book, *The Inevitable*, Wired co-founder and Silicon Valley guru, Kevin Kelly, argues that adding machine intelligence to everyday objects — a process he calls "cognifying" — "would be hundreds of times more disruptive to our lives than the transformations gained by industrialization". On the other hand, economist Robert Gordon, who believes the IT revolution has ended, documents the dramatic economic changes of the 20th century — electricity, cars, indoor plumbing, antibiotics — and predicts that nothing of that scale is on the horizon. While the truth is probably in between the two views, the author feels that Gordon's approach to the uncertain future could be nearer the mark. He highlights that there are a number of industries — with health care and education being the most important — where an inherent limit exists on how much value and impact information technology can add. [Limited Disruption](#)

ENERGY

Energy Giant Shell Says Oil Demand Could Peak in Just Five Years. Royal Dutch Shell has a good track record when it comes to looking at energy futures. They are the world's second-biggest energy company by market value, and are projecting that global demand for oil could peak within 5 to 15 years. Shell's view puts it at odds with some of its biggest competitors. For instance, Exxon Mobil, the largest publicly traded oil company, said in its annual outlook that "global demand for oil and other liquids is projected to rise by about 20 percent from 2014 to 2040". Tied to this, the World Energy Council has forecast that if renewable energy and other technologies such as electric cars continue their rapid advance, then petroleum use will reach its maximum level in 2030. [Peak Oil Demand Coming Soon?](#)

Could China build the world's smallest nuclear power plant and send it to the South China Sea? A top mainland research institute is developing the world's smallest nuclear power plant, which could fit inside a shipping container and might be installed on an island in the disputed South China Sea within five years. Researchers are carrying out intensive work on the unit — dubbed the *hedianbao*, or "portable nuclear battery pack". Although the small, lead-cooled reactor could be placed inside a shipping

container measuring about 6.1 meters long and 2.6 meters high, it would be able to generate 10 megawatts of heat, which, if converted into electricity, would be enough to power some 50,000 households. [Ed note: When discussing the possibility of portable nuclear reactors, please bear in mind Admiral Rickover's [eloquent 1953 letter](#) on the difference between an academic reactor and a practical reactor.] [China's Portable Nuclear Reactors](#)

URBAN FUTURES

The Pentagon Envisions a Horrible and Dystopian Metropolis of the Future. A video titled "Megacities: Urban Future, the Emerging Complexity" produced by the Pentagon has been shown at the Joint Special Operations University. In it, visuals of crowded urban sprawl, riots, poverty, and military operations are splashed across the screen as a narrator somberly describes a hugely complex and tactically bankrupt combat environment of the future. The video describes megacities in great detail, including the unique and complex social structures that will propagate from high-rise penthouse dwellers all the way down to "subterranean labyrinths" governed by their own laws and social norms. Above all else, the video makes it clear that future cities will be breeding grounds for organized crime, cybercrime, and terrorism. As populations increase along with urban density and sprawl, certain tactical challenges will increase significantly and demand our attention as we build the future force. [Pentagon's Future Urban Environment](#)

Smart cities: The 5-year Outlook. This article is inside FAD's preferred 15-30 year horizon, but time horizons are altered by the rate of change of technology. Expect these changes to come faster or slower. The author predicts that the explosion in numbers of connected devices will continue to offer opportunities to improve service delivery, reduce environmental impact, and reduce costs. Positive developments from autonomous cars to the use of accumulated data in all aspects of public utilities and urban systems are becoming a reality. Conversely, the challenges of cybercrime, severe climate events, and government inefficiency are increasing. Smart city technologies will offer more cities improved resilience, disaster mitigation, and response. [Smart Cities: Five-Year Outlook](#)

The Gridlock: How Can We Keep Our Cities Moving? It is forecast that by 2050, two-thirds of the world's population will live in urban areas, and transport planners face the formidable task of mitigating congestion. The *Guardian*, supported by Heathrow, hosted a roundtable discussion to address how the transport systems can cope. [Avoiding Future Gridlock](#)

TECHNOLOGY

Designing the future internet. As part of the National Science Foundation initiative, Future Internet Architecture launched in 2010, researchers at Rutgers University proposed a "MobilityFirst" project which is centered on shifting from the current internet protocol to name-based routing. Names would represent people, mobile phones, internet devices, small sensors, or any other objects connected to the internet. The benefits of the MobilityFirst project include more flexible services, better security, support for mobility across many technologies, efficiency, and the ability to handle large volumes of traffic and data. [Designing the Future Internet](#)

No GPS, no problem: Next-generation navigation. Instead of adding more internal sensors, researches at University of California, Riverside have been developing autonomous vehicles that could tap into the hundreds of signals around us like cellular, radio, television, Wi-Fi, and other satellite signals, called "signals of opportunity (SOP)". The system can be used by itself, or, more likely, to supplement Inertial Navigation System (INS) data in the event Global Positioning System (GPS) fails. The team's end-to-end research approach includes theoretical analysis of SOPs in the environment, building specialized software-defined radios that will extract relevant timing and positioning information

from SOPs, developing practical navigation algorithms, and finally testing the system on ground vehicles and unmanned drones. [Next-Gen Navigation](#)

Engineers develop new magnetic ink to print self-healing devices that heal in record time. A team of engineers at the University of California, San Diego has developed a magnetic ink that can be used to make self-healing batteries, electrochemical sensors, and wearable, textile-based electrical circuits. The key ingredient in the ink is neodymium microparticles. Because of their orientation, particles on both sides of a tear are magnetically attracted to one another, enabling a device printed with the ink to heal itself. The devices repair tears as wide as 3 millimeters — a record in the field of self-healing systems. Existing self-healing materials require an external trigger to kick start the healing process. They also take anywhere between a few minutes to several days to work. By contrast, the system developed by Joseph Wang and colleagues doesn't require any outside catalyst to work. Damage is repaired within about 50 milliseconds (0.05 seconds). [Self-Healing Devices](#)

Combat Lasers and hybrid power for Next-Generation US Combat Vehicle. The U.S. Army's Next-Generation Combat Vehicle will probably run on alternate-power sources, have directed-energy weapons, advanced-composite armor, and an active protection system. The U.S. Army is looking to a multi-decade effort to get the first unit equipped in 2035. [Deep Future Army Combat Vehicle](#)

3D printing hackers down drone with self-destructing propellers. In the near future, an F-35 fighter plane on a routine flight kicks in its afterburners and it goes supersonic. Suddenly, there's an almighty bang as one of the turbine blades in the jet engine disintegrates and within seconds the \$85 million plane is tearing itself to pieces. Is it an accident or sabotage? According to researchers at Ben-Gurion University (BGU), this scenario could be an example of a new type of cyber warfare where saboteurs can fool 3D printers into creating self-destructing parts that are indistinguishable from the real thing. [3-D Printer Hacks](#)

MEDICAL TECHNOLOGY

Making artificial 'cells' move like real cells. This continues our October 2016 *NFTE* discussion about delivering medicines to specific cells, this time using artificial cells vice micro-robots. Artificial "cells" could someday zoom around in the body and deliver medicines to specific locations, act as in-tissue diagnosticians and provide viable replacements for whole cells and organs. To do this, they will need to be able to navigate the complex environments of our bodies. Now, in the American Chemical Society's journal, *ACS Central Science*, researchers report development of lab-made cells that use enzymes to move just like real cells. [Artificial Cells](#)

RESOURCE SCARCITY

Field Trials with Genetically-Modified Wheat Plants. Ensuring food security is a major challenge given the projected need to increase world food production by 40% in the next 20 years and 70% by 2050. Scientists at Rothamsted Research, in collaboration with researchers at the University of Essex and Lancaster University, have developed wheat plants that can carry out photosynthesis more efficiently, i.e., convert light energy into plant biomass more efficiently. This trait has the potential to result in higher yielding plants. The purpose of the proposed trial is to evaluate the performance of the engineered plants in the field. Wheat is one of the major grain crops worldwide and provides approximately one-fifth of the total calories consumed globally. However, wheat yields have plateaued in recent years and predictions are that yield gains will not reach the level required to feed the 9 billion population predicted for 2050. Traditional breeding and agronomic approaches have maximized light capture and allocation to the grain. [GM Wheat Field Trials](#)

ART OF THE FUTURE PROJECT

The Atlantic Council's *Art of the Future Project* (formerly *Art of Future Warfare*) seeks to cultivate a community of interest in works and ideas arising from the intersection of creativity and expectations about how emerging antagonists, disruptive technologies, and novel warfighting concepts may animate tomorrow's conflicts. The Project partnered with the Futures Assessment Division to host a Science Fiction Futures Workshop in which published authors Max Brooks (*World War Z*), Charles E. Gannon (*Caine Riordan* series), and August Cole (*Ghost Fleet*) worked with 18 talented science fiction writers from across the services, with the goal of bringing the [2015 MCSEF](#) future worlds to life. Look for the stories to be published very soon. [Art of the Future Project](#)



This newsletter is intended to highlight issues and ideas which may prove significant in the evolving future. In keeping with our focus on both alternative futures and analysis, items in this bulletin will generally be of an alternative nature, or drawn from atypical sources.