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Daniel Burrus'

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TECHNOTRENDS[®] NEWSLETTER

*The biggest ideas that are
changing everything*

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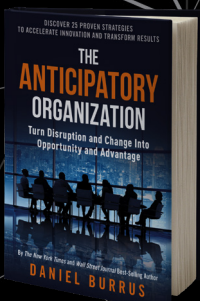
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Future Insight Prize 2020

By Daniel Burrus, CEO of Burrus Research

I've stated this several times and will continue to explain it to everyone I advise: Change is the only constant in the world today.

While my platform has been predominantly digital disruption and technological change, the reality we face as the human race on this planet is that negative change caused either by damage to the planet or damage to one another is ever growing as well. Bacteria and illness transform and outsmart our immune systems; non-sustainable energy sources and volumes of food are consumed at an alarmingly fast rate; and the population continues to increase.

Yet, despite the doom and gloom of the aforementioned realities, the increasing population also means there is a surplus of young, anticipatory minds paying attention to the Hard Trends that will shape the future and change things as we know them. These anticipatory minds understand that the change happening in and to humanity every year will inevitably change them as well, causing them to evolve into entrepreneurial anticipatory minds. And now, there is a massive incentive for them to use their anticipatory minds in shaping and changing the future in incredible ways never before seen.

In celebration of its 350th anniversary in 2018, Merck KGaA of Darmstadt, Germany, pioneered the Future Insight Prize to stimulate groundbreaking science and innovative technologies for the benefit of humanity. With a targeted 1,000,000 Euro grant over the next 35

years, the inaugural Future Insight Prize winner of 2018 will be announced in July 2019, marking the first of many prize winners and, more importantly, providing critical grant support for development of the winning groundbreaking innovation.



Emergence of a new, potentially lethal infection that is easily transmittable from person to person is among the greatest threats to humanity.

The Future Insight Prize will be awarded annually for the next 35 years, honoring achievements in science and technology that stimulate progress in key areas of importance for humanity—namely, health, nutrition and energy. The 2019 prize will be allocated in the field of pandemic preparedness, for work in anticipating a later realization of the visionary dream product coined as the “Pandemic Protector.” Working from a clinical sample of a person infected with an unknown pathogen, this product produces an agent for cure or prevention of further infection within a clinically relevant timeframe.

Emergence of a new, potentially lethal infection that is easily transmittable from person to person is among the greatest threats to humanity. Risk of this eventuality has already increased due to global urbanization, ease and speed of travel, climate change and the constant concern of bioterrorism, with current developments of

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TECHNOLOGY NEWS HIGHLIGHTS

Recycled Plastic Home

A construction and design company in Nova Scotia has come up with a building solution that addresses two of the world's most pressing problems - excess waste and extreme weather. Their first project is a 2,000 square foot home - built from more than 600,000 recycled plastic bottles and clad with recycled aluminum siding - that can withstand hurricane force winds.

The startup partnered with a Belgian company that shreds and melts bottles which have been rejected by recycling plants to create a foam core. The foam is laminated to form six-inch thick insulated walls that are strong and lightweight. In certified tests, an eight foot panel was subjected to 326 mile per hour winds (the equivalent of a Category 5 hurricane) without damage.

The panels are chemically bonded together,

eliminating the need for framing and nails while making the whole structure more robust. Although the cost of construction is comparable to traditional construction, the prefab design saves time. In addition, over the life of the home, maintenance and energy costs are greatly reduced.

The technology is already receiving worldwide attention as a solution for disaster relief housing as well as cost-effective buildings in areas that are plagued by hurricanes, typhoons and other extreme weather conditions. The prototype house, which is situated on a beach in Nova Scotia, will be available for rent on Airbnb before being sold.

For information: JD Composites Inc., 7578 Highway 1, Meteghan, Nova Scotia, Canada B0W 2J0; phone: 902-778-1793; email: jdcomposites@gmail.com; Web site: <https://www.jdcomposites.ca/>

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Electric Airplane

German engineers have been making headway on a “zero-emissions” aircraft, a development that could represent the next big thing in air travel. The electric-powered plane uses a combination of fuel cell technology for long range and battery technology for short bursts of power, such as those needed during take-off. In its current configuration, the plane can carry four people and a total payload of 450 kilograms (nearly 1,000 pounds) for a distance of up to 800 kilometers (about 500 miles) at an altitude of 1,700 meters (5,500 feet).

By year end, the designers expect to increase the range to 1,300 kilometers (800 miles). Over the next few years, they anticipate that it will be possible to develop a fully electric plane that will be able to carry 40-60 passengers over a range of 2,000 kilometers (1,200 miles) at a speed of 600 kilometers (370 miles) per hour through advances in hydrogen storage capacity and integrated aircraft design.

In Germany alone, it's been estimated that 20 million passengers per year fly from distances less than 1,500 kilometers to connect with longer flights. Hydrogen fuel cell technology has the potential to greatly reduce the noise and emissions associated with internal combustion engines on these regional flights.

For information: Josef Kallo, German Aerospace Center (DLR), DLR Institute of Engineering Thermodynamics, Pfaffenwaldring 38-40, 70569 Stuttgart, Germany; phone: +49-711-68620; Web site: <https://www.dlr.de/dlr/en/desktopdefault.aspx/tabid-10002/>



Solar Desalination System

A new, stand-alone system for generating potable water from seawater could help address the extreme droughts that many areas of the world are experiencing as a result of climate change. Housed in a small shipping container, the reverse osmosis (RO) system can operate totally off the grid, without the need for batteries or diesel power.

Although the use of reverse osmosis devices for desalination is not new, this system represents a breakthrough in technology because it automatically maintains the constant pressure required for RO to function properly. This greatly reduces the amount of electricity required, enabling it to work off of solar panels connected directly to the system. It can also be switched to generator or grid power during non-solar hours.

A modular design allows the device to be scaled to suit the needs of the consumer – up to 7,000 liters (more than 1,800 gallons) per hour for seawater and up to 10,000 liters (more than 2,600 gallons) per hour

for a system that processes brackish water. The technology also includes a membrane filter to remove bacteria, viruses and other contaminants.

As smaller countries throughout the world look for ways to generate their own renewable power, systems such as this will allow them to integrate clean drinking water into the local infrastructure to meet the demands of households as well as agriculture.

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IoT for Plants

Researchers in Greece have found a way for plants to let farmers know when they need to be watered. Using lemon trees as models, they have created an FM network of sensors and receivers that enables them to “listen” to the moisture levels in the plants using inexpensive, low-power components.

An antenna attached to a lemon growing on a tree receives a signal from an existing FM radio station. This signal is passed to a transistor which is modulated by a humidity sensor inside the lemon. If the moisture level is high, the humidity sensor switches the transistor on and off at a low rate; if the moisture level is low, it switches the

transistor at a higher rate. The antenna then broadcasts the transistor signal to a radio receiver, which can be located on a mobile phone, to let farmers know when they require watering. Multiple sensors at various locations within a grove of trees could even be used to optimize water levels for variations in the soil and reduce overwatering.

The researchers used FM rather than other technologies like Bluetooth to reduce cost and power requirements. By “borrowing” existing electromagnetic signals and re-modulating them, the electronics can be made simple and small enough to be powered by a lemon.

The developers have applied for a United States patent on the innovative technology which could empower a new level of monitoring in the field of agriculture.

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Ultrasound Therapy for Arthritis

While ultrasound has been widely used as an imaging tool for decades, recently neuroscientists have begun looking at using it to stimulate nerves for the treatment of

inflammatory diseases such as rheumatoid arthritis.

The research grew out of past work in which the vagus nerve – a bundle of fibers that connects with the immune system – was stimulated in order to encourage the circulation of immune cells throughout the body.

However, this approach requires surgically implanting electrodes. In two new animal studies, the researchers targeted a main branch of the vagus nerve which passes through the spleen. When this area was stimulated with ultrasonic waves, the result appeared to be equally effective as direct stimulation of the vagus nerve.

In the first study on rats, inflammatory response to an injected toxin was diminished after only a few minutes of ultrasound treatment to the splenic nerve. In the second study, it was found that stimulating the splenic nerve for 20 minutes per day over the course of a week reduced arthritis symptoms in mice.

By targeting the spleen, the researchers are hopeful that the overall effect on the body will be lessened, but it is still unknown if long term ultrasound stimulation will have any harmful effects. A clinical study is currently underway to assess the safety and effectiveness of the method for treatment of rheumatoid arthritis in humans.

For information: Hubert Lim, University of Minnesota, Biomedical Engineering, 312 Church St. SE, Minneapolis, MN 55455; email: hlim@umn.edu; Web site: <https://twin-cities.umn.edu/> or <http://soniclab.umn.edu/research/neuromodulation-inflammation-and-immune-system>



21st Century Stethoscope

As much as clinicians rely on stethoscopes, they haven't really changed much in 200 years. But with advances in digital data collection, analysis and storage, the humble stethoscope is finally undergoing some much needed updates.

One such device, known as Duo, combines a stethoscope (for listening to heart and lung sounds) with an electrocardiogram (ECG) in a digital platform that enables data to be captured anywhere for telemedicine and remote monitoring applications. Instead of simply listening for heart irregularities, high resolution displays allow the signals to be visualized for more detailed analysis. And soon, artificial intelligence (AI) will permit automated interpretation of many cardiac abnormalities including arrhythmias, valve disease and congestive heart failure.

Although Duo has been approved for patient use as a stethoscope and ECG device, diagnostic algorithms will require separate testing and evaluation for specific abnormalities. For example, asymptomatic left ventricular dysfunction (ALVD) is a disorder that rarely presents symptoms, but is often a precursor to heart failure. By training an algorithm on more than 45,000 sets of patient data, a team of clinicians was able to achieve diagnostic accuracy of 93 percent as compared to the "gold standard"

echocardiogram, a test that can cost upward of \$750.

With escalating health care costs and the need for more specialized care, devices like this will play an important role in providing faster diagnoses and earlier intervention, all of which translate into better patient care.

For information: Eko; phone: 844-356-3384; email: contact@ekohealth.com; Web site: <https://ekohealth.com/>



DNA Origami

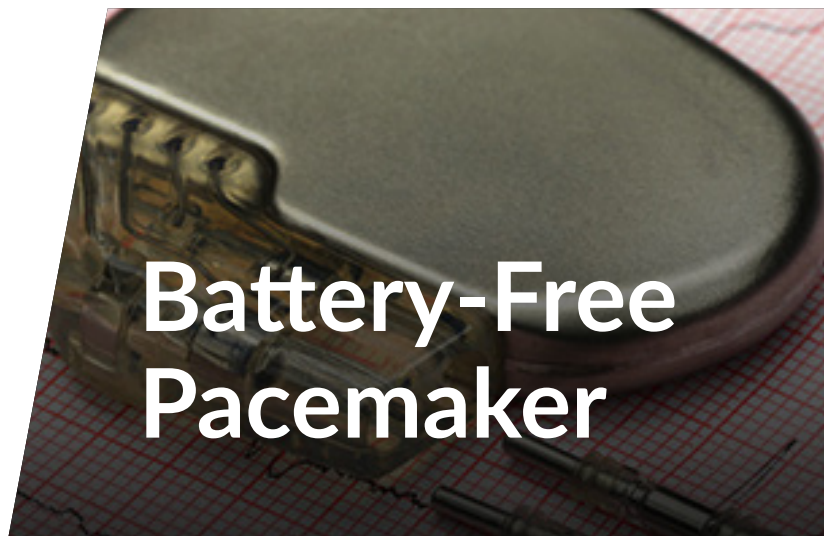
Researchers have successfully demonstrated the use of nanorobots to seek out and shrink cancer tumors without harming healthy cells. They do so by delivering a molecular payload that cuts off the blood supply feeding tumor growth, effectively starving the tumor.

The nanorobots were made from flat, rectangular DNA “sheets” measuring 90 by 60 nanometers. Thrombin, a blood clotting enzyme, was attached to the surface and the DNA was “folded” to form a hollow tube about 1/1000th the diameter of a human hair. In order to make the nanorobots selective for cancer cells, a special cell called a DNA aptamer was attached to the outside of the tubes. The aptamer targets a protein called nucleolin that is only present on the surface of endothelial tumor cells.

In testing on melanoma in mice, the nanorobots were injected with an IV. In a matter of hours, they surrounded the tumor and released the thrombin like a Trojan horse. Tumor tissue damage was evident within 24 hours and ultimately the median survival time of the mice more than doubled. Furthermore, the nanorobots caused no detectable changes in normal cells and showed no evidence of spreading to the brain where stroke or other unwanted side effects could occur.

If testing continues to produce positive results, the collaborators estimated that nanorobots could be available clinically within five years.

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Battery-Free Pacemaker

An experimental pacemaker that’s powered by a beating heart has been successfully implanted in living pigs, bringing science one step closer to developing battery-free implantable devices. Dubbed “symbiotic pacemaker” (SPM) the new device derives power from a wafer-like piezoelectric generator that attaches to the surface of the

heart and converts mechanical energy from movement into electrical energy to operate the device. A capacitor stores excess power to stimulate the heart when needed.

In one animal, which had a healthy heart, the generator was tested to see how well it harvested energy. The results indicated that the pig's heart produced more than enough power to operate a human version of the device. In the second animal, the SPM was allowed to charge for approximately an hour. Then an irregular heartbeat was induced and the SPM was used to successfully convert the abnormal rhythm.

Although human testing is still off in the distant future, devices such as these are likely to become more widespread as researchers continue to look at other options for harvesting kinetic energy from within the body, including respiratory movement, blood flow and muscle flexion. Since replacing batteries in traditional implantable devices involves expensive surgeries every seven to ten years, the promise of battery-free operation will be well worth the effort.

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Future Insight Prize 2020

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medical countermeasures functioning far too slowly to prevent widespread illness or death.

Therefore, participants observe that we must anticipate, adapt and change in new, innovative ways in order to stay ahead of this risk curve, much as an organization using my Hard Trend Methodology stays ahead of the curve by anticipating and solving problems before they exist.

The Future Insight Prize was first announced at Curious 2018, the Future Insight conference. The event was home to more than 60 top speakers, including six Nobel laureates, and was attended by more than 1,300 delegates from academic and corporate environments all around the world. Given the turnout, it's no surprise that the announcement of the first Future Insight Prize inspired more than 70 top scientists to join the Future Insight Prize jury that collaborated to select the first year's prize winner.

This is only the beginning. For the coming years, three more product topics have already been announced. The 2020 dream product is likely to build upon the 2019 "Pandemic Protector," as participants work to develop a multi-drug resistance breaker. This dream product is a series of novel, narrow-spectrum antibacterial agents that are capable of curing any bacterial infection without induction of drug resistance, that is accompanied by a one-hour diagnostic test.

With antimicrobial resistance threatening the effective prevention and treatment of an always transforming range of infections, the rationale for focusing on this imperative research in 2020 is very clear. The CDC estimates that in the United States alone, over two million people

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are sickened every year with antibiotic-resistant infections, with at least 23,000 deaths as a result. Worldwide, there is evidence of antibiotic resistance in bacteria that cause common and treatable infections, such as pneumonia. This is a frightening statistic when you think about it.

In yet another cumulative way, 2021's prize focuses on the topic of our dramatic population increase and on ways to sustain such an increase with innovative ways to produce food without further compromising the integrity of our planet. The rationale behind 2021's prize stems from projections that feeding the global population of 9.1 billion people predicted by 2050 will require raising overall food production by approximately 70% between 2005 and 2050. The only way researchers believe this will be feasible is to develop truly unconventional methods for producing food — methods that will require highly innovative new technology.

The topics for the Future Insight Prize currently extend as far as 2022. That year's topic pertains to something we're already on track to develop: renewable sources of energy that will first slow and ultimately eliminate our constant consumption of natural resources for fuel. In conjunction with this concept, researchers hope avidly to prevent further increases in our atmosphere's CO2 levels. Since electric vehicles are already slowly increasing in presence in the marketplace and on the roads, the focus of 2022's prize is on the exploration of innovative ways to reduce CO2. The challenge in this relates to CO2's remarkable thermodynamic stability, which will require a significant transfer of energy to modify. Achievements in the fields of photocatalysis during the last decade have increased interest in the production of solar fuels.

While I view the Future Insight Prize as a mainstream example of paying attention to and differentiating between Hard and Soft Trends,

and of maintaining an anticipatory mindset and applying it to the greater good of the human race, I am not alone in seeing its value. Professors and scholars of Harvard University, Princeton, and many more Ivy League institutions sing the prize's praises for providing renewed hope in ensuring the future sustainability of our planet.

And several of these scholars are on the panel that will determine the winner. Some of the criteria involved in deciding who walks away with the grant money include the following: Has the recipient's work provided important breakthroughs to enable a realization of the dream product? Is the recipient's work of utmost scientific quality, as recognized by top peer review journals? And will the recipient be able to make good use of the prize money to advance research in this area?

Looking ahead beyond 2022, the future plan for the prize is to continue to support research laying important foundations for the realization of the four published dream products as discussed here. In addition, new visionary dream products may be announced in years to come.

The Future Insight Prize is a perfect example of a company using its available resources to anticipate and positively shape the future, not only for itself, but for humankind. I believe it is imperative that attention be brought to this incredible opportunity for entrepreneurs and innovators alike, as Hard Trends are not limited to the business world. We all face change in our personal lives every day, but with the ability to pay attention to the Hard Trends and anticipate what's to come, we should be able to shape our future in a more positive, sustainable way than we've so far been on course to do.

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