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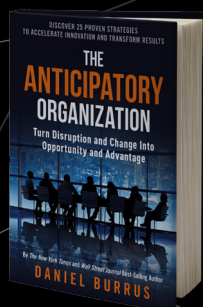
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A.I. in Business

By Daniel Burrus, CEO of Burrus Research

For many of us, our experience with artificial intelligence (A.I.) may be, for a lack of a better way to put it, "helpfully cool." That can mean asking Amazon's Alexa to play a particular song or querying Google's Home to see if butter is a suitable replacement for vegetable shortening.

But the potential for A.I. goes far beyond cool. Its application in businesses and industries of all sorts will exponentially revolutionize how we both think and work.

That sort of change is coming faster than you might expect. And organizations that anticipate the most effective ways to leverage A.I. will profit handsomely.

A Hard Trend That's Gaining Speed
I first identified artificial intelligence way back in 1983 as one of 20 core technologies that would become powerful drivers of exponential economic value creation. Looked at in the context of my overall Anticipatory Organization Model, A.I. is an ideal example of a Hard Trend—a future certainty—which in this case means our overall increasing use of this technology in a broad array of applications. Further, this Hard Trend is not just a future fact, but one that's accelerating in power and application at a predictable, exponential speed.

> *A Google supercomputer defeated a grandmaster in a a game of Go, which is often considered the most complicated and involved board game ever invented.*

While many of us are familiar with A.I. thanks to consumer-oriented devices such as Siri, Alexa and Home, the fast-developing potential of A.I. was highlighted in May of this year when a Google supercomputer defeated a grandmaster in a game of Go, often considered the most complicated and involved board game ever invented. The computer bested its human counterpart using its advanced A.I. software.

That remarkable victory also underscored another component of my Anticipatory Organization Model—the role of the Three Digital Accelerators, specifically, the exponential growth of computing power, bandwidth and digital storage. Since all three of those accelerators had reached a "tipping point" of sufficient growth and development, Google's A.I. software was able to learn by playing millions of games of Go against itself to hone its tactics through trial and error. That helped ensure a victory that few expected.

The Power to Disrupt
The issue of disruption is another central element that pertains to the potential of artificial intelligence. As I repeatedly stress in my books, presentations and consulting work, many different kinds of products and services haven't merely changed their markets or industries, they've thoroughly disrupted them, completely shattering the status quo. Further, there are only two sides to this particular fence—either you're the one causing the disruption or you're the one forced to react as best you can to this powerful disruptive force.

That's the kind of disruptive opportunity that artificial intelligence affords organizations of all sorts.

Here's an illustrative example with which you're likely familiar—IBM's Watson, a cognitive computer that learns over time. Cognitive computing, another form of A.I., is being increasingly used in a wide variety of applications including healthcare, travel and even weather forecasting, to name just a few.

With regard to weather forecasting, after IBM acquired

TECHNOLOGY NEWS HIGHLIGHTS

Human Gene Editing

For the first time in the U.S., researchers have demonstrated that it is possible to correct defective genes in human embryos using CRISPR genome-editing technology. As we reported previously, CRISPR (which stands for clustered regularly interspaced short palindromic repeats) works by modifying specific segments within a DNA sequence to disrupt abnormal gene expressions that cause genetic diseases. Also known as "germline engineering," the alterations would also be passed on to subsequent generations to potentially eradicate these abnormalities.

In earlier experiments conducted in China, the technique was found to cause an effect called mosaicism, in which only some cells of the embryo were changed. However, this latest research indicates that, by injecting CRISPR into the eggs earlier (i.e., at the same time they are fertilized with sperm), mosaicism can be avoided.

While none of the embryos were allowed to develop beyond a few days, and none were ever intended to be implanted into a womb, critics are understandably concerned about the use of genetic engineering to create "designer babies" or "enhanced humans." In the U.S., the intelligence community has labeled CRISPR as a potential "weapon of mass destruction" and any attempts to allow an edited embryo to develop to full term have been blocked by Congress. But these legal restrictions do not apply worldwide, and it's likely that this milestone is just the beginning of an inevitable journey toward genetically engineered humans.

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RNAi Corn

Moon Mine

In another application of genetic engineering, the U.S. Environmental Protection Agency recently approved a new variety of corn that is genetically modified to kill western corn rootworm – the "billion dollar pest" that wreaks havoc on corn crops and has demonstrated an uncanny ability to develop pesticide resistance. Known as SmartStax Pro, the new seed utilizes RNA interference (RNAi) to kill rootworm by shutting down a gene inside any larvae that try to eat it.

So what makes SmartStax Pro so special? RNAi is a natural biological process that inhibits the expression of specific genes and has been widely used in agriculture to engineer things like apples that don't turn brown or pesticides that target only specific organisms. However, in this latest development, the pesticide has been engineered directly into the plant to silence a gene in another living organism.

SmartStax Pro is not due to be released commercially for a few years. Although the EPA has approved it in the U.S., other countries have not yet given the green light to import the crop. Some scientists also remain skeptical of releasing yet another "magic bullet" for pesticide resistance, as it can discourage farmers from utilizing simpler and safer methods of pest control such as crop rotation.

A U.S. firm has reportedly raised $45 million for three expeditions to the moon – the goal being to develop a robotic mining outpost by 2020. If successful, they will represent the first private enterprise to reach the moon, and will reopen the lunar frontier for the first time since 1972.

The first mission, known as Lunar Scout, will carry a variety of payloads, including a telescope and the "MoonLIGHT" Lunar Laser Ranging Array to the equatorial region of the moon. In 2019, a second excursion, dubbed Lunar Outpost, will establish a research outpost at the lunar South Pole to prospect for minerals and water. The polar location will also enable continuous direct communication with Earth. Finally, the Harvest Moon lander will begin mining in 2020, with the capability (hopefully) of bringing samples back to Earth. Thanks to recent legislation that allows private entities to seek, obtain and utilize space resources, these samples will be used to benefit science as well as industry, while bringing new opportunities and resources to Earth from our "8th Continent" – the Moon.

AI in the Boardroom

DNA Video

In a new and interesting application of artificial intelligence (AI), researchers have used an intelligent algorithm to research corporate diversity. Although the results are not surprising, the use of machine learning may enable us to examine diversity in new ways.

The study compiled photographs of top executives from nearly 500 companies representing some of the largest in the world. The complete dataset consisted of more than 7200 individuals in 38 countries. Image recognition was used to automatically determine the executives' ages, races and sexes. The results were then compared to population profiles for their countries.

In every case, the percentage of female board members was below the percentage of women eligible for work. Of the companies represented, 22 had no women on their boards. Overall, nearly 79 percent of board members were male and nearly 80 percent were white, with only 3.6 percent black and 16.7 percent Asian.

The results suggest that more public discourse is needed to address these biases and ensure that leading companies and industries truly represent and understand the needs of the people whose lives they influence every day.

It turns out that CRISPR genome editing is useful for more than altering gene expression. Harvard researchers recently reported that they have used the tool to encode video into live bacteria, turning them into active record-keeping librarians.

DNA can store extremely large amounts of data – the equivalent of 100 billion DVDs – in a single gram. In fact, synthetic DNA has already been used to store images and text. But in the first experiment of its kind, the team encoded video of a galloping horse into thousands of E. coli bacteria.

First, a fragment of the video was injected into the cells. Once it was detected, the bacteria cut and pasted it into their own genomes. When subsequent frames were introduced, they were also added to the individual genomes in the proper order. The researchers were able to read it back and confirm the arrangement of the frames by sequencing the DNA of more than 600,000 cells.

This study confirms that the technique can not

only be used to create a detailed history, but that the information can be amended at a later time. Also, since the data is recorded in the genome, it is passed down from generation to generation.

Solar Invisibility Cloak

In recent years, a number of approaches to developing invisibility cloaks have been tested, with varying degrees of success.

One such approach utilizes metamaterials etched with tiny grooves smaller than the wavelength of light, which, when properly constructed, effectively bend the path of light around an object and render it invisible. Now, a team of engineers has applied the idea to solar panels as a way of increasing their efficiency.

Solar collectors contain metal strips that extract the current generated. However, these strips also reduce the efficiency of the collectors because they block sunlight from reaching the solar cell.

By placing a polymer coating etched with

grooves over the metal strips, the researchers were able to direct light around them so that light would be trapped within the cell rather than being reflected.

There are still a few design issues that will need to be addressed. For example, over time the grooves could collect dust and block the sunlight.

Ultraviolet light might also degrade the polymer and decrease its effectiveness. But the boost in efficiency is significant enough to warrant further investigation.

Reversing Memory Loss

It has long been assumed that the memory loss associated with Alzheimer's Disease (AD) is permanent – that the clumps of protein accumulating in the brain destroy neurons, and therefore, the memories stored there. But new research suggests that memories are not lost; they're simply harder to access. Furthermore, they may be able to be recovered.

In a study performed on genetically engineered

mice, researchers developed a way to make neurons glow yellow when storing a memory and red when recalling one.

They then created two sets of mice – one healthy and one with a condition resembling AD. Both sets of mice were then exposed to a lemon scent followed by an electric shock. One week later, when exposed to the same lemon scent, most of the healthy mice immediately reacted in anticipation of the shock, while less than half of the AD mice appeared to remember the link between the smell and the shock.

In the healthy mice, the yellow and red neurons overlapped, indicating that the memory was recalled from the same area in which it was stored. But in the AD mice, different cells glowed red, meaning that they were recalling different memories.

More importantly, the team was able to stimulate the yellow memory-storing neurons in the AD mice by activating them with a blue laser, after which they responded normally to the lemon scent.

All of this points to the theory that memory is not lost, but may be "misplaced." Just as music can sometimes reawaken memories in AD patients, targeted therapies such as deep brain stimulation may improve recall.

The technique may also one day be used to help witnesses remember details of crime scenes, or enable us to tap into early childhood experiences.

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Robo-Therapist

Over the past several years, we have reported on a number of assistive devices to help victims of strokes or spinal injuries to regain movement. Many of these devices act to support a person's weight, but do little to relearn correct posture and gait. Now a system developed in Switzerland uses artificial intelligence (AI) to offer individualized treatment and improve a patient's ability to walk normally.

The RYSEN system combines a supportive harness with a neural network to monitor leg movement, stride patterns and muscle activity. An AI algorithm determines the optimal amount of support needed to help rebuild muscle mass while deciding how much force is necessary to produce a natural gait. By pushing people forward and backward, or side to side, the system helps retrain their brains to regain a balance between gravity and forward motion.

Tests have shown that after single, one-hour sessions with the harnesses, spinal cord injury subjects showed improvement in their gaits outside of the harnesses. The developers intend to commercialize the device following additional clinical trials.

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A.I. in Business

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the Weather Company to boost its cloud capabilities (no pun intended), cognitive computing such as that employed by Watson allowed the Weather Company to manage more than 26 million inquiries every day on its website and mobile app. And, in handling that enormous level of information and data, it learned from daily weather changes as well as from the questions being asked.

Consider the disruptive impact that sort of technology can have. Estimates hold that weather is responsible for $500 billion in losses across any number of industries. Think about how Watson could help farmers who not only rely on favorable weather conditions to plant and harvest their crops, but depend on worldwide weather conditions and forecasts that can help them strategically plan as well as inhibit or even prevent shipping to markets. Nor is the effect limited to those out growing crops in the fields. Pharmaceutical companies are increasingly relying on accurate forecasts to predict increased demand for allergy, cold and flu medications.

Real-Time Analytics and More

The potential of artificial intelligence also relates to its capacity for real-time analytics from the ever-increasing amount of Big Data, and the ability to accumulate vast amounts of data and information as they occur and interpret them with the goal of producing knowledge that is both meaningful and actionable. Even better, by employing algorithms that iteratively learn from data, this sort of "machine learning" allows computers to identify significant insights without being specifically programmed to look for them.

Given that potential, it's no surprise that numerous organizations and industries are racing to embrace A.I. I've been helping companies and governments both understand and identify new opportunities for applying A.I. For example, a few years ago, I was the keynote speaker at KPMG's annual partner meeting, and in my speech, I suggested that if a company like KPMG had IBM's Watson learn the tax laws and regulations for all countries, that company would have a major competitive advantage. KPMG leaders took action and partnered with IBM to use Watson, and that partnership

will greatly enhance KPMG's ability to analyze and quickly act on critical financial and operational data, not to mention identify potentially lucrative new business offerings and services.

KPMG is anything but a voice in the wilderness. Other clients of mine including Deloitte & Touche, Ernst & Young, and PricewaterhouseCoopers are earmarking hundreds of millions of dollars into using advanced A.I. and high-speed data analytics to bring new insights and value to their audit, tax and advisory services.

One important question is, if you are a smaller firm in this space, does that mean you are left out? The answer is not at all! It's not the tool, it's how you use it that counts, and the use of any tool, whether it's A.I. or anything else, is only limited by your imagination and foresight.

Other Areas Poised for A.I. Opportunity and Disruption

The financial services industry provides just one example of organizations employing artificial intelligence to both improve existing services as well as develop groundbreaking new products. In fact, optimism about the potential of A.I. is pervasive. As this article points out, a recent survey of 2,500 U.S. consumers and business decision makers identified widespread confidence in the role of A.I. in the future. In fact, more than 72 percent of survey participants labeled A.I. as a decided "business advantage." If they understood the concepts I teach of Hard and Soft Trends, that percentage would be 100%.

That begs the question: Where else will artificial intelligence effectively transform entire industries?

Public safety is one. Artificial intelligence is poised to help anticipate and address such critical issues as cybersecurity, civil unrest and even outright acts of terrorism. It's already been successfully used for these and many other areas. For example, officials at the 2016 Olympics in Rio de Janeiro were successful in maintaining security in a wide array of venues and locations using technology such as automated smart detection.

In the United States, a number of cities are using artificial intelligence for public safety and security. As this Stanford University study projects, by 2030 most metropolitan areas throughout the country will rely on

artificial intelligence not only in combating crime but in "predictive policing" applications.

Here's just a sampling of some other industries positioned to leverage A.I.:

• **Healthcare.** Major medical and pharmaceutical companies are already using artificial intelligence in a broad array of applications. One example is A.I. health assistants being used to streamline clinical processes. Rather than doctors earmarking time for rudimentary tasks such as getting information from a patient and checking vital signs, medical assistants augmented with A.I. instructions, insights and actions can cover a large part of those sorts of clinical and outpatient services, freeing up doctors' and nurses' time to attend to more serious cases and patients.

AI is also gaining traction in disease diagnostics. Watson was first applied to oncology and now knows more than any one doctor. Does that mean we don't need human oncologists? No! We need human oncologists who have access to Watson. In addition, leveraging real-time analytics, A.I. algorithms can quickly evaluate millions of samples and identify meaningful patterns. Moreover, like any doctor at the top of his or her game, A.I. never stops learning as it's working.

• **Transportation.** Almost everyone is aware of the growing use of artificial intelligence in autonomous and semi-autonomous cars. That's not just a matter of hopping in and enjoying the ride but also involves the vehicle's capacity to gather detailed driving information about routes and destinations to anticipate and pre-solve problems, as well as the driver's current and future needs and interests. That same technology can be applied to public transportation, delivery drivers and other uses. The overall result will be a decreased number of accidents, less traffic congestion and significantly lower energy costs.

• **Education.** Artificial intelligence is fast taking hold in a broad array of uses in education. For example, there's "smart content" creation, including chatbot guides of textbooks and customizable learning interfaces. These are starting to show up from elementary schools to corporate environments. Add to that intelligent tutoring systems. For instance, Carnegie Learning's "Mika" software employs cognitive science and A.I. technologies to provide personalized tutoring and real-time feedback for post-secondary education students. That's especially beneficial for incoming college freshman who would otherwise need remedial courses.

• **Manufacturing.** Manufacturing companies have been using robots to assemble products and package them for shipment for a long time now. Automation and robotics are now moving into other, more complicated manufacturing areas, such as electronics, cars and even home construction with intelligent e-assistants.

• **Customer Service.** With a focus on personalization and human interaction, artificial intelligence is increasingly becoming a major player in customer service. One such example is DigitalGenius, which helps companies automate basic text question-and-answer chats with customers. Even more fascinating, that system and others are also using natural language processing and machine learning to create reactive robots that mimic human speech patterns, and soon emotion, with facial expressions. When there is a task that needs a human helper, the e-assistant routes the customer to a human with the correct expertise to help. Service is both quick and comfortable for consumers and much less expensive for companies.

• **Law.** A.I.'s impact isn't limited just to fields with an overriding focus on technology. With regard to the law, artificial intelligence is poised to streamline and improve efficiency in legal work. Additionally, with regard to litigation, natural language processing (or text analytics) can summarize thousands of pages of legal documents within seconds, as opposed to several days for a human employee—not to mention reducing the probability of error. Further, as A.I. technology such as Watson can learn from all of those legal books, lawyers, their clients, and the entire legal community stand to benefit greatly.

Artificial intelligence's potential across any number of industries is further supported by the financial activities of a number of major players. In addition to Google and IBM, Facebook, Samsung, Apple and Salesforce are all jockeying to acquire private A.I. companies. Overall, more than 140 private companies working to advance artificial intelligence technologies have been acquired since 2011.

They all see the game-changing opportunities afforded by A.I. So consider: How might you and your organization benefit from the potential—both realized and anticipated—that artificial intelligence affords? As I mentioned earlier in the context of disruption, you can be the disruptor or you can choose to stay on the sidelines and react after you are disrupted—quite possibly at your own peril.

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