

FAST FORWARD

Emerging Technology and Actuarial Practice

By Annmarie Geddes Baribeau

REMEMBER THE SLIDE RULE? For actuaries of a certain generation, slide rules were an invaluable accessory. Invaluable, that is, until the invention of the personal calculator. In the same way, many experts believe that Excel spreadsheets, the current workhorse of most actuarial departments, will soon be replaced by calculating in the cloud. Disruptive technology—the term of art for any technological advance that unexpectedly displaces an established process—is now expanding so quickly that one disrupter often is almost immediately superseded by another. (Consider the rapidity with which we’ve moved from using GPS devices in our cars to letting mobile apps on our smartphones do the job. By the end of the decade, it’s likely that automatic cars will not only navigate but also do the driving.)

Innovations that qualify as disruptive technology are actually both disruptive and connective, said futurist Jim Carroll. Not only is the way that people and devices are getting connected “unprecedented,” Carroll said, so is the manner in which all the interconnected data are being analyzed and used.

From intelligent interfaces like Google’s Explorer glass to ingestible microsensors, virtual reality, and artificial intelligence, burgeoning technological advances stand poised to disrupt traditional practices within the actuarial profession and the insurance industry. It’s no stretch, in fact, to think that disruptive technology could lead to the ultimate disruption for the actuarial profession—obsolescence. To be relevant in the future, experts say, actuaries not only must keep up with technological change, they must embrace it. (See Page 38.)

Data Boom

It wasn’t so long ago that actuaries, in their quest for greater predictability, began pursuing data sources beyond insurer databases. Determining rates and new underwriting approaches for homeowners’ insurance, for example, meant seeking out realtor information and feeding it into predictive models.

In recent years, because of the multiplicity of sources (many of which began life as disruptive innovations), available data

have exploded. A prime example is the growth in data coming from body monitoring devices. Body monitoring and big data “are naturals for each other,” said David Snell, technology evangelist at RGA Reinsurance Co., adding, “It could be an actuary’s cornucopia.”

“Body monitoring is a big deal,” agreed William Halal, professor emeritus at George Washington University and the founder and president of TechCast Global Inc., a research corporation that uses collective intelligence to forecast the future. With body monitoring devices, Halal said, doctors will be able to collect personalized health information and monitor serious illnesses, such as heart disease.

This, along with other body monitoring innovations that TechCast Global calls “e-health,” are likely to be mainstream by 2020—30 percent of the population of the industrialized, or G-20, nations will be using the technology. Already, more people are keeping track of health information about themselves. Fitness devices, such as Fitbit, Jawbone Up, and Nike+Fuelband, track

soundness of sleep, number of steps, calories burned, and other information. Apps are also available that check heart rate, blood pressure, glucose levels, weight, body fat, and physical activity.

In a next step, nano medical devices that enter or adhere to the body for tracking personal health are coming online. Proteus Digital Health, for example, is developing “digital medicines”—ingested sensors that attach to medication to determine its effectiveness. In March, the company announced plans to manufacture and test in the United Kingdom drugs for chronic conditions that have been integrated with mobile technology via ingestible and wearable sensors.

Motorola is working on a digital health pill that has been approved by both the U.S. Food and Drug Administration and European regulators. The “pill” is a battery-powered computer chip that uses stomach acid to create a unique signal (like an electrocardiogram) that outside devices can access to verify identity and health.

SURVIVAL OF THE FITTEST

ADVANCING DISRUPTIVE TECHNOLOGIES

could lead to an ultimate disruption of the actuarial profession as it is practiced today. Because machines will be handling the complex calculations that have been the mainstay of the profession since its inception, actuaries need to embrace new roles for the profession to survive, sources say.

Technology is already eliminating jobs in many professions. “One of the reasons why job growth is low at this time is because the economy is being structured differently,” said William Halal, a professor emeritus at George Washington University professor and founder of TechCast Global Inc., a research corporation that uses collective intelligence to forecast the future.

Artificial intelligence, for example, will force actuaries and other professionals to redefine their roles to keep their jobs, Halal said. Already, the role of lawyers in determining appropriate legal precedents for cases is being diminished due to automation. And because machines are able to diagnose illnesses with frightening accuracy, doctors’ jobs also are changing. Some doctors have started using artificial neural networks (ANNs) to screen for heart murmurs in

children, detect lung nodules in chest radiographs, and find polyps with computerized tomography colonography. In one study, researchers found ANNs correctly classified diagnoses in 95 percent of cases with 99.8 percent accuracy, according to TechCast Global.

ANNs have a good chance at being part of actuarial work, said David Snell, technology evangelist at RGA Reinsurance Co., Inc. ANNs can use internal links or classifications to train a model to learn for itself, which can certainly be applied to actuarial calculations.

Actuaries need to pay attention to technologies such as these, Snell said. One reason actuaries are resistant to using them is that the ANN “does not provide a neat formula where you can easily follow the bread crumbs to validate your answer.”

So how should actuaries go about adapting to ANNs and other technological innovations? Snell’s advice is to embrace the new techniques as additional tools, without ditching the classical tools available to actuaries. It’s analogous to using a hammer for the quick hanging of a picture without having to set up the air compressor and the electrical line. “The true artisan will

have a wide range of skill sets and know which to use for the particular application,” Snell said.

Engaging ANNs is not as far-fetched as it may seem. Researchers at Robert Gordon University in Aberdeen, Scotland, are developing robots that evolve more sophisticated “brains” by trial and error in a way that mimics biological evolution. The robot brain has a neural network that adds links/neurons as needed to handle more complex tasks.

TechCast Global predicts there is a 60 percent probability that in the next 10 years, artificial intelligence will be good enough to eliminate routine intelligence work, Halal said. “More sophisticated artificial intelligence systems means computers will handle the routine work of actuaries, thus displacing the number-crunching role,” he said. Actuaries will have to think of their function in industry minus the trademark tasks that many have been doing.

“The people who are more adept at artificial and machine learning will get enough statistics and machine learning to replace actuaries and statisticians,” Snell warned. In the past, companies relied on actuaries to determine the likelihood of various types of risks. “Now,

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At Northeastern University, researchers have developed nanosensors for implantation under a person's skin that can track blood glucose, sodium, and alcohol levels in real time through the camera of an iPhone.

These technologies, along with genetic testing and therapy, artificial intelligence, telemedicine, and the creation of replacement organs with 3-D printers stand to have a huge effect on everything from how doctors monitor and treat patients to increasing human life spans (Halal's TechCast Global estimates that in 25 years, average life expectancy will be 100 for the millennial generation and younger).

Insurers have been using big data for traditional macro analysis for some time, said John Houston, principal and actuary

with Deloitte Consulting LLP and the leader in the advanced analytics and predictive modeling area of its human capital practice. "Now there are the tools to make very granular prediction statistics at the customer level, based on almost any information that comes in," Houston said.

Using more personalized information will lead to what Carroll calls "performance-oriented insurance," which he defined as coverage in which the risk will be accurately understood. "And if your measurable activities reduce or eliminate any risk, you will be rewarded through a rebate or reduction in insurance cost," Carroll explained—something that is already happening with one of Progressive's auto-insurance products.

"There will be an emergence of insurance companies for

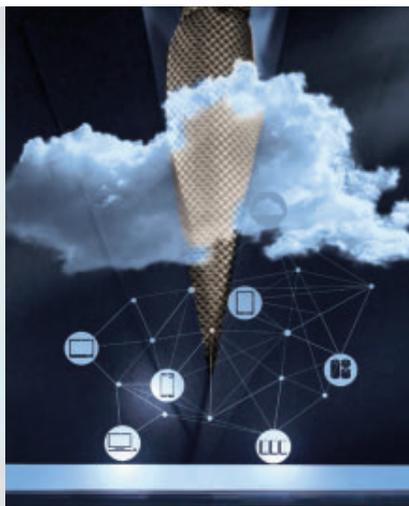
many of these risk probabilities, like a severe storm damaging your crop yield, or a plane crashing with an entire insured basketball team aboard, can be found instantly or in more detail on a hand-held device with a weather app or aviation safety stats," he said.

Health actuaries who specialize in how to set up a network for a company and find the right provider groups, he said, also face replacement. "That can be done with a spreadsheet and a simple 'genetic' algorithm. Again, where does the actuary come into play?"

Actuaries must adapt and acquire new roles as the old ones become redundant. "I think disruptive technology is going to diminish the need for actuaries unless we embrace it in a way that shows value," Snell said. "Some people do not want to rock the boat, but others of us think if we don't we will become obsolete."

Halal also said that there will be a role for actuaries who are more sophisticated, demanding, and creative. "They will be working more with clients, understanding their needs, and addressing the limitations of the automated systems," Halal said. "This is a big issue they need to think about."

But it's not just the automation of actuarial calculations and choosing predictive elements that will change the profession. "With a lot of change



happening very quickly, we are headed for a world in which the very nature of risk evolves and changes," said Jim Carroll, an internationally recognized futurist. "What happens to actuaries when risk changes at a furious pace?"

Citing location devices he uses for his luggage as an example, Carroll said location technology will make people aware of everything. "What happens to risk when things can't disappear anymore?" Carroll also mentioned disruptive technology currently under development, such as automatic automobiles. They can reduce the risk of human error—which is the main cause of car accidents—thereby reducing that kind of risk.

Through the use of augmented reality, a form of virtual reality, social automotive features now in development will allow cars to communicate about their surroundings and themselves to drivers and even other cars. This technology, which is being pursued by all the major car manufacturers, could help a car detect something a person might not see—even telling drivers when to brake.

On another front, State Farm insurance, the University of Michigan, and Ford Motor Co. are joining forces to research how the driverless car will affect risk. Current information from Progressive's Snapshot program also is being used to structure underwriting for the automatic car of the future.

The need for such insurance is coming soon. "In less than 10 years, intelligent cars will be mainstream," Halal said. Intelligent cars and other technologies also introduce new kinds of risk, and actuaries will be needed to help manage those, he said.

"The whole world is going to change," he said. "It will be a catastrophic, more turbulent world."

In that world, different professions will be engaged in a struggle to determine the survival of the fittest, Halal said. The winners will be those who not only embrace technology but also can weld it into new opportunities.

those who are willing to give up their privacy, while other insurers might write coverage for those who want to maintain their privacy,” Carroll said. “It is going to change business models.” The connectivity goes further when real-time vitals are sent not just to the doctor but also to an insurance company that’s considering pricing, Carroll said. But the question remains whether patients would be willing to share that information with their insurer.

If the incentive is big enough, they might, Houston said. “If customers are willing to give up fluids for life insurance, will they be willing to allow insurers access to their Nike fuel band or Fitbit data?” he asked.

Progressive’s Snapshot, a usage-based car insurance plan in which customers install a box that tracks driving behavior, may shed some light on the answer (Progressive has the highest number of customers participating in such a program). Those who praise Snapshot tend to be those who received discounts—up to 30 percent—for safe driving behavior, according to the article “Heard on the Street,” in the March/April 2014 issue of *Contingencies*.

But just as it’s probable that Snapshot is more popular with good drivers, those who have more to brag about than hide when it comes to personal health likely will be more willing to share personal health information through body monitoring. This could lead to discriminatory pricing. It will be up to state insurance regulators to determine how much insurers can use such data, including digitized information from social media, for insurance purposes.

Mega Computing and the Cloud

Ultimately, determining what’s predictive and what’s useless in big data will require more sophisticated computing. Thanks to other innovations, however, harnessing and empowering the best information from disruptive technology and other sources should become easier.

“Machine learning techniques are progressing to meet the demands of big data expansion,” RGA’s Snell said.

It won’t be long, for instance, before actuaries can run parallel calculations at breakneck speed by using general purpose computing on graphics processing unit (GPGPU) technology, a tool that originally was developed for computer graphic applications such as video games.

“In the next five years it will not be a hardship to be programming for this,” predicted Phil Gold, vice president of research and development at GGY Axis. “It will become more mainstream than today.”

The GPGPU chips, which process single operations simultaneously across a vector of values, have been used in gaming technology for some time. With the rapid development of

sophisticated programming languages used to program these chips (such as CUDA C and C++ AMP), it’s becoming easier to develop programs that take advantage of GPGPU chips to perform specific types of actuarial calculations, Gold said.

“At the moment, this is difficult, but the tools are getting better and better,” Gold said. Because GPGPUs are “power hungry,” manufacturers are offering workstations and servers optimized for their particular requirements. “GPGPUs are extremely well suited for certain very specific types of calculations, and within that niche they will achieve significant traction,” Gold said.

All of these technologies are likely to be used in the cloud, which is where the most complex calculations will be taking place. Cloud computing, which for the purposes of this article can be defined as deploying a network of remote servers hosted on the Internet to store, manage, and process data, has seen tremendous growth in recent years. A popular example is Google docs, which allows users to share and access files in its cloud.

Cloud computing is an area of vast potential, said Gold. At one end of the spectrum of possibilities is the cloud’s application for “embarrassingly parallel computing,” in which everything being done is independent of everything else as thousands of scenarios are tested (embarrassingly parallel is a term of art for a computer problem or workload that’s easily separated into a number of parallel tasks). At the other end of the spectrum, Gold said, is “closely coupled computing, where different nodes talk to each other constantly.”

Distributing embarrassingly parallel calculations in most cloud environments is fairly easy, Gold said. Closely coupled computing in the cloud is far more demanding of both the hardware and of the programmer. But, Gold said, it supports higher overall performance over a much wider range of complex actuarial modeling problems.

TechCast Global predicts that delivering digital information via cloud or grid computing will become common by the later years of this decade. Among the many sectors that are showing an interest in cloud computing, insurers are particularly intrigued because it allows for complex calculations that transcend spreadsheets and can be less expensive than owning the capacity necessary for these calculations.

The actuarial firm Milliman began offering cloud computing in its life insurance computational software in 2010, said Pat Renzi, a Milliman principal with more than 30 years’ involvement in actuarial software. The firm developed its offering in a pilot project with Phoenix Life, an insurer based in the United Kingdom. The resultant savings in labor, operational, and capital costs were compelling. Some of the results, published last year in InsuranceERM, an online media service about risk and capital investment in the insurance industry, show that by operating in the cloud:



The challenge, and the promise, for the actuarial profession is managing a shrinking world in which connections among the data—and the size of the data—are expanding exponentially.

- The production of quarterly numbers took 97.5 percent less time and required 95 percent fewer staff hours;
- Manual processes were reduced from 900 to 44;
- Individual modeling and processing systems decreased from hundreds to one unified platform;
- Opportunities to grow business expanded;
- The firm was better prepared for Solvency II and ICAS+ (a two-phased approach by the U.K.'s Financial Services Authority that enables insurers to use internal models developed in preparation for Solvency II in meeting financial capital adequacy standards);
- Operational risk was lowered.

Since starting with Phoenix, Milliman has expanded its cloud-based option to 22 other clients. “We have two paths that companies are taking,” Renzi said, with use of the cloud for calculations finding quicker acceptance. Three clients are in the early stages of using Milliman’s computational software in the cloud. The others have taken the next step by also employing the actuarial firm’s collaborative software. Using the cloud has been “incredibly powerful for actuaries,” said Renzi, who believes it’s just a matter of time before cloud computing is a common tool.

Because it supports complex calculations, Renzi said, the cloud will play a strong role in the development of new products. Calculations are made in the cloud via desktop or a mobile device using the Windows 8 operating system. “If you put your application in the cloud,” Renzi said, “it is accessible from anywhere and becomes collaborative.”

There are also cost savings. It’s less expensive to rent out cloud time than to invest in mega processors to run stochastic and other complex calculations. This makes the cloud a competitive leveler between life insurers. “The cloud allows everyone to have access, and you pay for it only when you need it,” Renzi said.

Finally, the cloud is almost infinitely scalable. By renting cloud time, Renzi said, clients have gained access to as much as 50,000 complete cores or processors—the equivalent of 50,000 single-processor personal computers or laptops.

Artificial Intelligence

Someday it might be possible to do these and other calculations with intelligent interfaces. “We are all going to be working with what I call an intelligent interface,” Halal said. “Instead of

hunching over keyboards, we will be talking to the machines, and they will display rich information.”

These intelligent interfaces are a form of artificial intelligence, Halal said, that employs elements such as hand gestures, first introduced by Apple, eye movement, which is being tested by Google, and voice recognition, like Apple’s virtual assistant, Siri.

TechCast Global predicts that intelligent interface will become mainstream by 2020. The stage is already being set. Just consider Google Glass, a wearable computer with an optical display mounted on a pair of glasses. Featuring a screen in the upper right corner, Google Glass employs Siri-like technology that lets users receive texts and e-mails or seek turn-by-turn directions. The glasses, which aren’t yet available to the general public, currently cost about \$1,500. Google hasn’t announced an availability date, but some believe the glasses might be offered to consumers as soon as the end of this year.

Virtual reality will also affect how actuaries and other professionals perform their jobs. Carroll says insurers are already creating virtual locations to determine the risk expense for 100-year floods. “It is already going on, but it will become more sophisticated,” Carroll predicted.

Virtual reality also is being used to develop personal medical modeling. The European Union’s IT Future of Medicine Project is creating virtual computational models (aka patients), based on individual genomic and physiological information, to simulate the unique workings of each person’s body. The goal? To prevent disease, diagnose illness, prescribe specialized treatments, and test for drug reactions. At the U.K.’s Bangor University in Wales, medical students already are using the models to practice surgical procedures.

Small World, Big Data

Actuaries can expect that all of these technologies will continue to become more interconnected, said Carroll. The challenge, and the promise, for the actuarial profession is managing a shrinking world in which connections among the data—and the size of the data—are expanding exponentially. □

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