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Workers' COMPENSATION: Future Turbulence *Ahead*

May/June 2014

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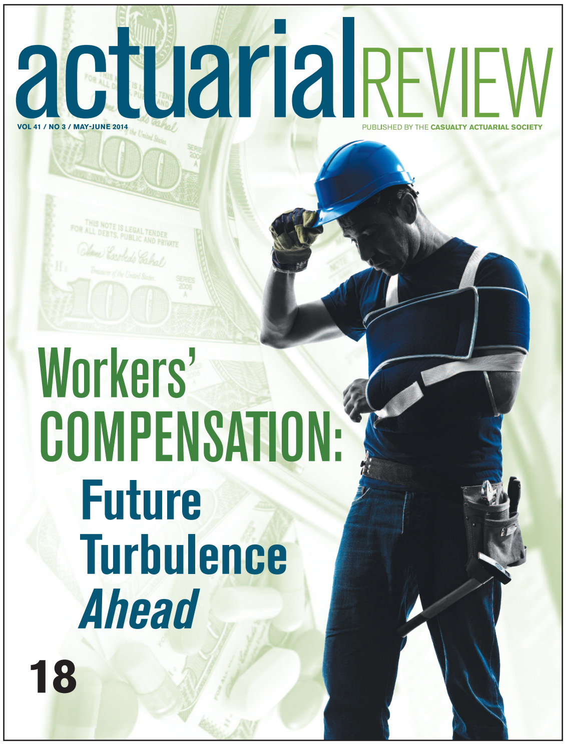

Workers' Compensation: Future Turbulence Ahead

BY ANNMARIE GEDDES BARIBEAU

The market, laws and outlays, and a growing epidemic of opioid abuse—will these and other factors wreak havoc on workers' compensation?

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actuarialREVIEW

The magazine of the Casualty Actuarial Society

editor's NOTE By ELIZABETH A. SMITH

I Like Ike

On October 21, 1957, International Congress of Actuaries (ICA) delegates assembled for a group photo in front of the White House with U.S. President Dwight D. Eisenhower (see photo, right).

At the close of ICA 2014, Deutsche Aktuarvereinigung (DAV), the actuarial society in Germany and host for ICA 2018 in Berlin, presented the organizers of ICA 2014 with the panoramic photo from the XVth International Congress of Actuaries (see page 16 for the full picture). This remarkable photo will be displayed in the CAS office.

During ICA 2014, fellow staff member Matt Caruso and I took photographs of the proceedings. We had a lot of interesting subjects to choose from—people from all over the world—but none of those could compare to the photo opp of a lifetime that presented itself at the 1957 ICA.

Full Circle

This issue rounds out the *Actuarial Review*'s first year in its new format. It's been a year of excitement and adjustment, working out new schedules and developing content.

For this issue, special thanks go to Squaw Design Communications Inc., who created the cover, and Annmarie Geddes Baribeau, who wrote the cover story. Baribeau is an expert in workers' compensation, whom readers may recognize from the pages of *Contingencies*. We look forward to working with these and other talented professionals in upcoming issues.

Speaking of *Contingencies*, the magazine is celebrating its 25th anniversary. We at *Actuarial Review* congratulate *Contingencies* and wish it continued success. Be sure to check out its frothy first cover on page 10.

Correction

The *Actuarial Review* March/April 2014 story titled, "CAS Leaders Reflect on China Visit," contains an error. In the photo caption on page 18, the name of the university should be Central University of Finance and Economics.

Actuarial Review always welcomes story ideas from our readers. Please specify which department you intend for your item—Member News, Solve This, Professional Insight, Actuarial Expertise, etc.

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Casualty Actuarial Society
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Follow the CAS

A Point of Pride—CAS in Action

For two weeks beginning March 25, 2014, I experienced an absolutely exceptional time being part of the CAS. No doubt you are already well aware of the CAS's commitment from its volunteers and staff, but these two weeks really drove home the breadth and strength of this dedication. I want to share a few of the many activities with you, knowing you will be as proud of the CAS and our volunteers and staff as I am.

The International Actuarial Association (IAA) meeting came first, with more than 272 delegates from 42 countries. Our staff supported the IAA in all aspects of the meeting coordination and, most importantly, facilitated a number of bilateral meetings with representatives from various actuarial organizations as well as CAS volunteer and staff participation in the various IAA committees. Several CAS members took part in one or more of the IAA committee meetings.

But then the action really started with the International Congress of Actuaries (ICA 2014) and our Ratemaking and Product Management Seminar (RPM). The CAS conducted both events simultaneously in the same hotel. That was quite a challenge, but we were up to it!

ICA 2014 attracted nearly 1,200 actuaries from 107 countries, plus accompanying guests. The CAS led a dedicated team of 35 staff members and 137 volunteers from all five of the U.S.-based organizations; this team handled all the detailed planning and logistics as well as on-site meeting management and hospitality, not to mention selecting and recruiting 300 actuaries and other experts to hold four plenary sessions, three limited attendance workshops and over 100 concurrent sessions. Second to the outstanding scientific program were the networking opportunities in the Town Square. Other highlights included a welcome reception at the Smithsonian Museum of American History, a gala dinner and dancing, and a trip to the Smithsonian National Air and Space Museum's Udvar-Hazy Center.

ICA 2014 was also a family affair; some 20 spouses pitched in for the Hospitality Committee and pulled together a range of interesting tours and informal gatherings to make the Congress a fun event for all attendees. Taken together, ICA 2014 was quite a challenge, but our team of volunteers and staff pulled it off! Special recognition is owed to Bob Conger, chair of the ICA 2014 Organizing Committee, and Cynthia Ziegler, CAS executive director. Together they coordinated all the myriad planning and logistical work for the 10 years leading up to the event.

These two weeks really brought home to me what a strong and resourceful organization we have in the CAS.

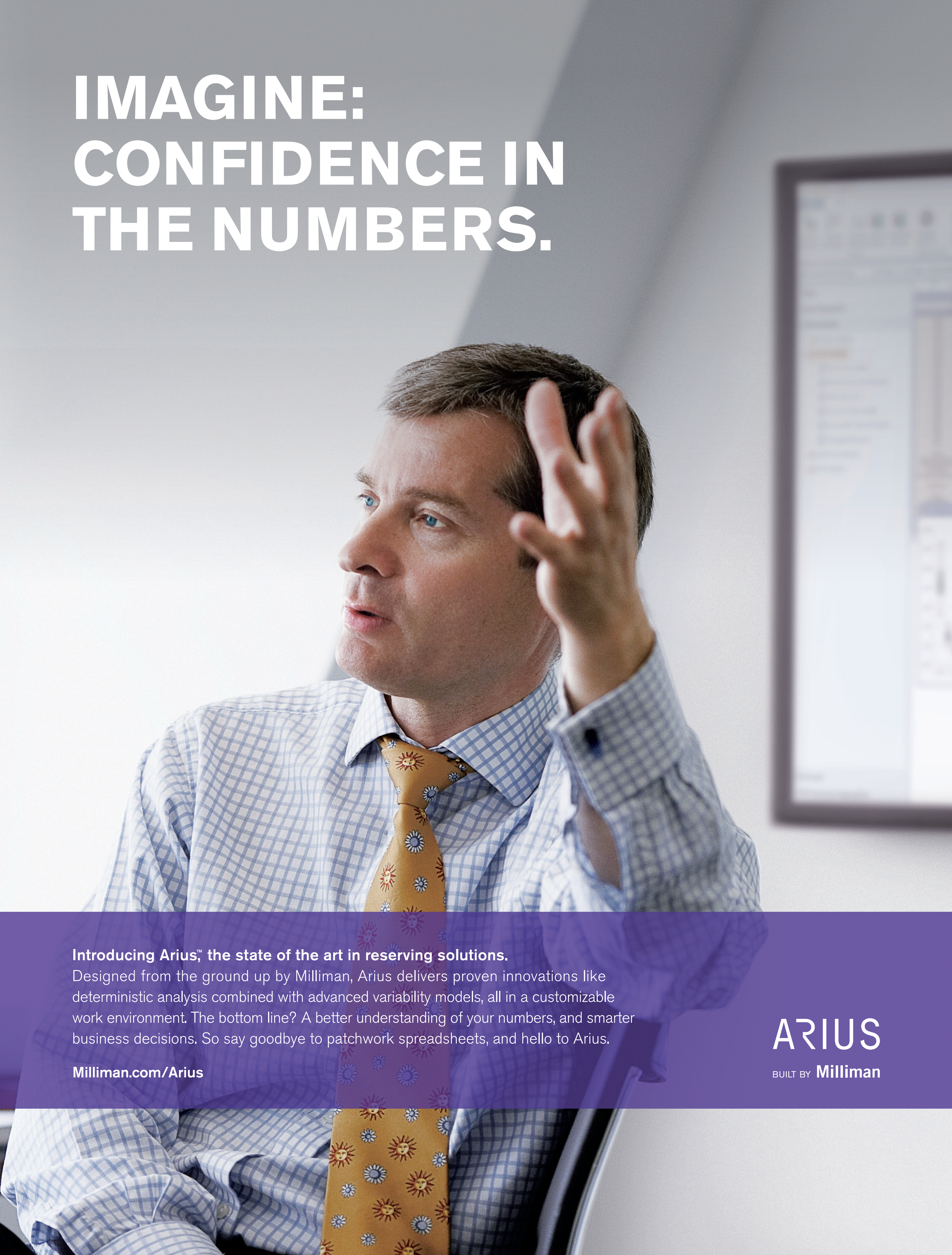
Meanwhile, just to complicate matters, we were holding the RPM Seminar with 650 attendees on the other side of the hotel! Here, besides the same logistical challenges, our 22-person RPM Seminar Planning Committee, led by Kelly McKeethan, recruited moderators and panelists for five workshops with 28 separate parts, 13 roundtables and 67 concurrent sessions. Whew!

During the IAA and ICA meetings, we held bilateral meetings separately with the leaders of actuarial organizations in Australia, Canada, China, the U.K. and South Africa. Meetings were also conducted with leaders from the Institute and Faculty of Actuaries' (U.K.) General Insurance Research Organising Committee (GIRO) and the IAA section Actuarial Studies in Non-Life Insurance (ASTIN). These meetings served to reinforce our relationships and to explore how the CAS might forge alliances with other general insurance practitioners, the goal of which is to efficiently organize and exchange research and presentations for the mutual benefit of our respective members. This alliance concept was well received and soon we will be organizing a working party with representatives of the different organizations to explore how we can make the idea come to fruition.

We also held our first CAS Employer Advisory Council (EAC) meeting. Pat Teufel organized and chaired this meeting with senior actuaries representing a diverse cross section of employers, who are our largest stakeholders after our members. The employers provided important feedback about how the CAS provides value to employers through basic and continuing education and practical research. We'll continue to meet with the EAC quarterly and factor their insights into our planning.

One last observation pertains to

President's Message, page 8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President's Message
from page 6

our university engagement initiatives and CAS Student Central. During the RPM Seminar, Wes Griffith, chair of our University Engagement Committee, and Tamar Gertner, CAS university engagement manager, organized a day with some 30 local university students who are studying actuarial science, some local, others who had traveled from other parts of the country. Each student had a mentor for the day and participated in RPM sessions as well as a special program arranged for them. The feedback we received was excellent and I expect that word will ripple further when the students get back to their campuses and talk with their faculty and classmates. And, by the way, if you haven't checked out www.CASstudentcentral.org, please do so. This new website is the hub of our outreach and communications with university students.

These meetings served to reinforce our relationships and to explore how the CAS might forge alliances with other general insurance practitioners.

I'd be remiss not to mention and thank the other U.S. actuarial organizations and the IAA for their very active and full support of ICA 2014. They each willingly supplied staff and volunteers to support all aspects of the planning and logistical work, which included managing the details of various events, supporting the sponsorship program, designing and printing on-site materials, staffing the registration desk and hospitality room, stuffing bags with meeting and sponsor materials and setting up meeting rooms. While we may have our differences, ICA 2014 really showed what we can do if we work together.

These two weeks really brought home to me—and I think all the attendees, volunteers and staff—what a strong and resourceful organization we have in the CAS and why our next 100 years will be as successful as the first 100.

We can all be very proud to be a part of the CAS! ●

COMINGS AND GOINGS

Dave Moore, FCAS, CERA, MAAA, has started his own consulting practice, Moore Actuarial Consulting, LLC, in Elmhurst, IL. Moore is president and consulting actuary in the firm, which specializes in pricing and reserving for management and professional liability, warranty and other standard commercial lines. Moore previously was vice president and senior actuarial officer for CNA.

Timothy C. Mosler, FCAS, MAAA, has joined Pinnacle Actuarial Resources, Inc. as a senior consulting actuary in the firm's Atlanta office. Since 2001, he was a senior consultant with Towers Watson, where his practice focused on medical professional liability (MPL) and workers' compensation. Prior to that, Mosler was an actuarial consultant for the National Council on Compensation Insurance in Boca Raton, FL. Mosler currently serves on the CAS Member Advisory Panel and the CAS Committee on Health Care Issues. He is recognized in the industry for his work with MPL and workers' compensation clients including health care systems, corporations and commercial insurers.

James L. Norris, FCAS, CERA, has been named the new chief actuary for Atlas General Insurance Services, LLC. Norris will be responsible for Atlas' actuarial and analytic areas while helping to identify and research profitable growth opportunities nationwide. He will be based in Dallas, Texas. Prior to joining Atlas, Norris was the president of Lapis Resources, where he performed actuarial consulting for a variety of insurance and reinsurance companies as well as Atlas.

Stephen Lowe, FCAS, CERA, and coauthors Tim Hodgson and Liang Yin of Towers Watson, were awarded one of three prizes given for best paper in the category of financial and enterprise risk at the 2014 International Congress of Actuaries (ICA). The paper, "Risk Appetite Revisited," was one of over 225 papers and presentations in seven tracks delivered during the Congress: life; pensions, employee benefits social security; professionalism and education; financial and enterprise risk; consulting; health; and non-life. Each paper was awarded a USD $1,000 prize. For a list of all the prize-winning papers, visit the ICA 2014 website at www.ICA2014.org. ●

EMAIL "COMINGS AND GOINGS" ITEMS TO AR@CASACT.ORG.

CALENDAR OF EVENTS

Interactive Online Courses
"Understanding CAS Discipline Wherever You Practice"
"Introduction to Predictive Modeling"
www.casact.org/education/interactive/

July 13-16, 2014
49th Actuarial Research Conference
University of California
Santa Barbara, CA, USA

September 15-17, 2014
Casualty Loss Reserve Seminar & Workshops
Manchester Grand Hyatt
San Diego
San Diego, CA, USA

November 9-12, 2014
CAS Centennial Celebration & Annual Meeting
New York Hilton Midtown
New York, NY, USA

March 9-11, 2015
Ratemaking and Product Management (RPM) Seminar
Intercontinental Dallas
Addison, TX

May 17-20, 2015
CAS Spring Meeting
The Broadmoor
Colorado Springs, CO

25 YEARS AGO IN THE *AR* BY WALTER WRIGHT

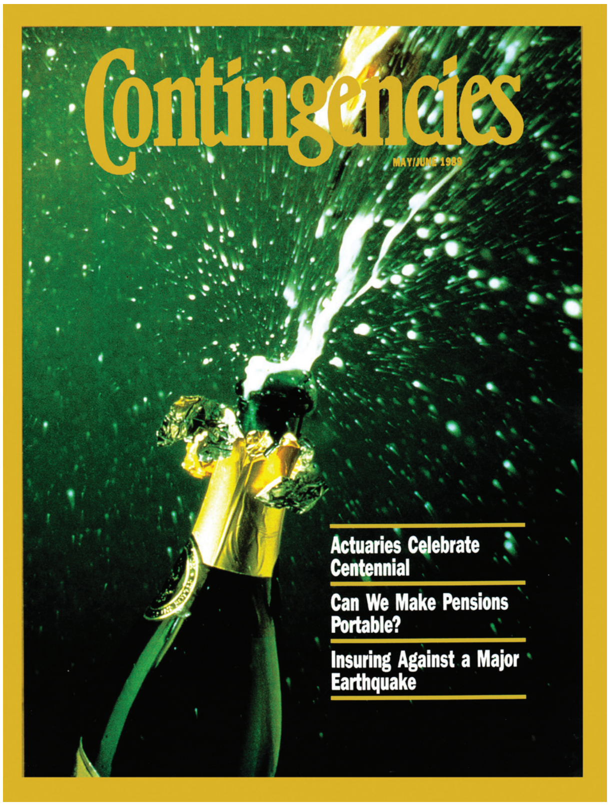
Contingencies Debuts

In the May 1989 issue of Actuarial Review*, Dana H. Murphy, Editor of* Contingencies*, announced the first issue of this award-winning magazine. Happy Silver Anniversary!*

On May 15, the first issue of the actuarial profession's exciting new magazine, *Contingencies*, will be in the mail. As editor, I believe that the quality of the magazine's content, as well as its graphic presentation, can rival any magazine on the newsstand. Like the publication of E.J. Moorhead's definitive history of the actuarial profession in America, *Our Yesterdays*, the premiere of *Contingencies* will demonstrate to a wide audience the past achievement and future potential of practicing actuaries. We invite your full participation in the magazine.

The magazine is being published by the American Academy of Actuaries in Washington, DC, and will appear every other month. It will be sent out to an estimated 12,000 practicing actuaries. Every member of the Academy will receive *Contingencies* as a benefit of membership.

Since one of the crucial missions of the new publication is to get the word out about the depth and the comprehensiveness of actuaries' work, and the unique applicability of that work to many of our pressing national problems, *Contingencies* will be mailed on a regular basis to a supplementary roster of approximately 10,000 national leaders—CEOs and CFOs of the Fortune 500 companies; insurance companies executives, including chief underwriters; risk managers; accountants; key Congressmen and their staffs; and state insurance commissioners.



Global Futurist Jack Uldrich to Discuss “Unlearning” in the Future of Risk Management at CAS Centennial Meeting

Renowned global futurist and best-selling author Jack Uldrich has been selected featured speaker for the CAS Centennial Celebration and Annual Meeting in New York City. Scheduled for Monday, November 10, 2014, Uldrich’s address is titled “Why Future Trends in Risk Management Demand ‘Unlearning’ Today.” Uldrich’s expertise on organizational change and unlearning (or as Uldrich puts it “an internal act that requires you to release something old”) will offer a unique point of view on the challenges that the actuarial field will face as technology and society evolve.

“We are thrilled to have Jack Uldrich as our keynote speaker,” said Gail Ross, chair of the CAS Centennial Steering Committee. “As the CAS celebrates and reflects on its first one hundred years, we also consider the future of the organization and the profession. Our meeting’s theme is ‘the next 100 years,’ so we look forward to hearing Jack’s perspectives.”

Uldrich is the founder and “chief unlearning officer” of the School of Unlearning—an international leadership, change management and technology consultancy dedicated to helping businesses, governments and non-profit organizations prepare for and profit from periods of profound transformation. His clients include Fortune 100 companies, state and regional governments, and venture capital firms. He is also a regular contributor on emerging technologies and future trends for a number of publications.

Uldrich is the author of 11 award-winning and bestselling books and has addressed topics ranging from assessing nanotechnology’s impact on business, staying ahead of emerging technology and using unlearning to achieve a successful future. He frequently lectures on technology, change management and leadership, and he has spoken to numerous businesses, trade associations and investment groups around the world. His expertise and ability to deliver provocative, new perspectives on competitive advantage, organizational change and transformational leadership will present an exciting and thought-provoking exploration of the future of the actuarial profession and risk management.

As the CAS Centennial featured speaker, Uldrich will explore how to adapt to the “predictably unpredictable” future of risk management. With the understanding that the CAS is at a pivotal point in history, Uldrich will reflect on the CAS’s rich history and share his advice and predictions for the future of property-casualty actuaries. “Looking back over the last 100 years gives us perspective on how quickly and dramatically things change,” said Ulrich. “What might the future hold for casualty actuaries? Are you looking far enough down the road to be sure you’re proactive rather than reactive? No one can predict the future, but I want to help you prepare for what the next 100 years may bring.”

Jack Uldrich

More information on Jack Uldrich and his background is available on the CAS Centennial Celebration and Annual Meeting website.

DOWNTIME BY MARTY ADLER

A Rugger Made, Not Born

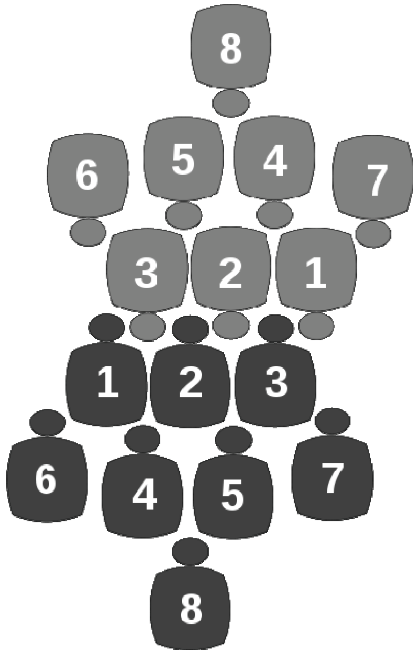
Kevin Madigan did not play rugby until college. In fact, he did not play any sports prior to college other than little league baseball, which he loved but was just average. Although tall and large for his age as a boy, he was a late bloomer. In college he started running and lifting and became pretty fit, and he realized that he wished he had played high school sports and that the college years could be the last opportunity to do so. A friend was a member of the rugby club, and he decided to try that. Oddly enough, by the time he started playing, his friend had quit the club.

Kevin attended Auburn University, where he started playing rugby in the spring of 1985. At that time, his rugby club was not very good. They lost every game that he played as a member of the Auburn University Rugby Club. The club had been very good in the early 1980s, and the members decided to move up to a more competitive division. However, the best players began to graduate or join other teams, leaving Kevin's club with a bunch of newbies like him. They didn't even have a coach or an active faculty advisor. Despite these challenges,

Kevin had fun. He didn't learn too much beyond the basics, but he did learn that he loved playing the sport that he did not quite yet understand.

To explain a little bit about the sport, there are 15 positions on a rugby team—eight forwards and seven backs, although one of the backs, the scrum half, is a hybrid. The diagram at right shows the forwards of two teams in position for a "scrum down." The players marked 1, 2, and 3 are the "front row," consisting of the hooker (#2) and the two prop forwards (#1 is the "loose head" and #3 is the "tight head"). Positions 4 and 5 are the "second row", otherwise known as "lock forwards." Positions 1-5 are known as the "tight 5" and tend to be the largest players on the field. The forwards are akin to the linemen in American football. The tight five are roughly analogous to the center/nose guard, guards and tackles. These position descriptions only apply during scrum downs, which occur after stoppage of play for minor infractions or because the ball is bottled up in a "ruck" or a "maul."

Due to a serious lack of speed, Kevin usually played forward, except for one season when he played the position known variously as "second row" or "lock forward" (positions 4 and 5 in the diagram). In the fall of 1987, after some serious weightlifting and bulking up from 210 to 270 pounds (he had grown from 5'11" to 6'3"), but still being fit enough to play a full game in the southeastern U.S. heat, he played "tight head



prop forward" (position 3) because his club at the time had a surplus of second rows and a shortage of props.

After his first year of graduate school, Kevin took time off to sort out what he wanted to do with his life and moved back in with his parents in Clearwater, Florida. While there he played with the Clearwater Pelicans in the Florida Rugby Union in the fall of 1987. After that he attended graduate school in Albany, New York, and played from 1989-1992 with the Albany Knickerbocker Rugby Football Club, which at the time was part of the Upstate New York Rugby Union. (They are now part of New England Rugby.) He got married in 1992 and finished his Ph.D. in 1993. He then began a long hiatus from rugby.

In 1998, after working hard to get back into shape, he decided to play again. He was 34 years old and just wanted to play for the fun and social aspects. He played with the Chicago Griffins for three seasons. Later, after moving his family to New Hampshire, he played for Amoskeag Rugby Club in Manchester. All of these clubs and the various leagues (called unions) in which they play are part of USA Rugby.

At the age of 40, Kevin played one

season in Bermuda. He played only as a way to meet people after having just moved to the island.

In Bermuda the ground is extremely *hard*. Everyone on the island understands the sport. Although not as huge as soccer and cricket, it is a part of the island's culture. Many are avid spectators of international rugby, so one isn't viewed as an exotic creature for playing the game. Many, if not most, of the people who play rugby on the island have been doing so since childhood, whereas in the U.S. people tend to pick it up in college or thereafter.

Bermuda holds an international rugby tournament every year with retired players from around the world representing their countries. Although Kevin never played in that tournament, he finds it pretty cool the way the entire island gets swept up in rugby for a week every year.

While in Bermuda, Kevin's son, who was seven or eight at the time, played mini-rugby. Kevin enjoyed helping out, but the other coaches had much more coaching experience.

During his playing days, Kevin devoted about 10 to 15 hours a week to the organized club training and the running and lifting to keep fit and strong, in addition to the game time itself. Travel, playing, and the post-match gatherings sometimes absorbed an entire weekend.

Among his most memorable experiences is the Saranac Lake Rugby Tournament, held in August every year in Saranac Lake and Lake Placid, New York. This entire part of the Adirondacks is swept up by rugby, with 100 clubs converging for the tournament. Playing in the Northeast knockouts for the Albany Knickerbockers around 1989 they got thumped by a bigger, fitter team from Boston. It was the highest-level game in which he ever participated.

For Kevin, the social aspects of the sports are probably the most memorable. There is much camaraderie and a real culture to the sport. When a player is injured, clubs and the entire community band together to help. Also, he still fondly recalls several times when he saw someone familiar on a rugby pitch and both realized that years before they had been teammates—or meeting someone in a business setting and recognizing that years earlier they had played against one another.

Kevin Madigan, ACAS, CERA, is a director at PricewaterhouseCoopers LLP.

HUMOR ME BY MICHAEL ERSEVIM

The Royal Family of Honorary Managing General Agent Titles

But first, some rules of etiquette! Upon meeting the owner of a managing general agent (MGA), one should make a small curtsy or bow, keeping eyes lowered to the ground. Offer up free food and rounds of golf in abundance. Slay the fatted calf and let the wine flow! Caution—no matter how unprofitable a program is, take care not to disturb or disgruntle the Exalted Agent who gave you the losses. Remember—you could lose the business! Be sure to use an appropriate title below to show deference and respect.

His Royal Highness of Unsustainable Growth
Chancellor of Continually Climbing Claim Counts
His Eminence of Emerging Excess Losses
Tudor of Top-Line Treachery
Count d'Money (de Mo-*NAY!*)
Countess of Contingent Commission
Captain of Capricious Captive Collateralization
Duke of Dastardly Development
Regent of Run-off
Emir of Emaciated Earnings
Queen of Questionable Reserving Practices and her business partner, Sir Stair-Step
Lord Most High Loss Ratio
Prince of Program Administration Puffery
Princess of Premiums-Just-Need-to-Catch-Up-to-Losses
His Eminence of Hastily Entering New Markets
Her Grace of Gratitude for Renewing
Poobah of Puny Profitability
Exchequer of Unsupported Comp
The Sultan of Sky-High Self-Worth
The Almighty of Alarming ALAE
The Tutankhamen of Treaty Torching

CAS Academic Central Begins Anew—A Q&A with Rick Gorvett

BY TAMAR GERTNER, CAS UNIVERSITY ENGAGEMENT MANAGER

In March 2014, the CAS renamed its Academic Correspondent Program to CAS Academic Central and announced several changes to the program that demonstrate its commitment to supporting the academic community. CAS staffer Tamar Gertner discussed the new initiative with the CAS member who championed the changes, Rick Gorvett.

I've had a lot of interaction with you because you're a super-active volunteer. It's hard to believe sometimes that you have a "day job!"

I'm the director of the actuarial science program at the University of Illinois at Urbana-Champaign. One great thing about a university faculty position is that academia does value national and international activities that serve to enhance and expand an area of interest, such as the actuarial profession and the CAS. Since becoming a member of the CAS "mumbledy-mumble" years ago, I've had the great fortune to participate on numerous committees and task forces with important and worthwhile goals. One current example of a topic very close to my heart is the University Engagement Committee (UEC), being very ably and effectively chaired by Wes Griffiths. I chair one of the four subunits of the UEC, the Academic Working Group. I'm also in the second year of a three-year term on the CAS Board of Directors, for which engagement and relationships with academia is a huge area of interest.

What do you think of the recent university engagement efforts made by the CAS?

The CAS has had formal programs in place to support academics and students since the early 1990s through the Academic Correspondent and University Liaisons Programs. However, those efforts were sometimes inconsistent, and probably inadequate relative to the new professional landscape in which we find ourselves competing for talent more frequently, both within and outside the traditional actuarial profession. Over the last couple of years, the CAS has begun making tremendous strides in its university outreach and support. This increasing level of engagement, with both university students and faculty, will be critical going forward, from many perspectives: marketing the CAS and the casualty actuarial profession to university students; providing advice and resources to universities and faculty for training students, to help ensure a pipeline of talent with appropriate skills for evolving and emerging actuarial jobs; and connecting with faculty on mutually beneficial research projects.

What was the "Academic Correspondent Program" and why was it created?

It was created to provide non-member academics teaching actuarial science, mathematics, economics, business, and related courses, with an opportunity to be affiliated with the CAS and gain access to the Society's resources. Academic member benefits have included access to CAS publications, complimentary CAS exam study kits, and invitations to attend some CAS meetings or seminars with the registration fee waived.

What prompted the CAS to reexamine the program and retool it as CAS Academic Central?

Rick Gorvett

In the fall of 2013, the UEC administered a survey to many academics involved in teaching actuarial students; 100 responses were received. The responses provided valuable and surprising insights. Particularly eye-opening was that more than two-thirds of academic respondents did not know that the Academic Correspondent Program existed. However, 87 percent of respondents were interested in joining the program—with a strong suggestion that membership be free. The survey results prompted the UEC to recommend specific actions to renovate the Academic Correspondent Program. One key recommendation was to discontinue the $75 annual fee for academics to join the program, and this recommendation was unanimously approved by the CAS Board. Other recommendations involved expanding the panel of benefits provided to program members, and to modernize, rebrand, and aggressively market the program.

How then is CAS Academic Central different than the program under

the previous name (notice I'm trying to get it out of my vocabulary)?

We started with the name. Since CAS Student Central had recently gone online as a community and resource for university students, we felt the parallel title of CAS Academic Central for a similar resource and community for faculty was both appropriate and irresistible.

As mentioned, we have eliminated the fee to join the program. We have also streamlined the membership registration process. New benefits for members include access to complimentary webinars and to content within the University of CAS. But most noteworthy is that academic members now have their own online community, featuring monthly blogs, a resource library, a calendar of key events and deadlines, and a discussion forum. The online community provides a place for academics to share ideas and best practices, post questions and connect with one another.

What would you say to fellow academics to encourage them to join the program?

Historically, most academics with a connection to actuarial science have had backgrounds on the life side. And yet, when speaking with these academic colleagues at conferences, my experience has been that they are surprised by how interested and intrigued they are by property-casualty topics and issues when they are exposed to them. They are also increasingly aware that the casualty actuarial profession is a viable and attractive career opportunity for their students. So I think an appeal to my fellow academics to join CAS Academic Central on the basis of either (or both) teaching and research/scholarship can and will be effective.

What other initiatives related to CAS support of the academic community are being considered by the Academic Working Group?

We are completing a curriculum guide that describes each of 15 or 20 skills important for students preparing for casualty actuarial careers; this guide will soon be available on CAS Student Central. We are preparing a guide that can be used by faculty and by CAS University Liaisons, to help schools consider and implement topics of relevance to casualty actuarial science into their curricula and courses. Finally, we are examining ways to enhance the scholarly link with academics, possibly through research relationships, calls for papers directed toward academics, research project challenges for student-faculty teams, and so forth. No idea is off the table if it has the potential to mutually enhance the CAS-university relationship!

Do you have any closing thoughts you'd like to share?

The speed and effectiveness of recent CAS efforts to enhance our engagement with both university students and faculty exemplifies the best of our Society: a ground-up approach to developing a program or capability, spearheaded by numerous free-thinking and dedicated volunteers, and facilitated by an excellent staff. Regarding the CAS staff, you, Tamar, and Mike Boa have provided exceptional guidance, insights and hard work. My compliments and appreciation!

Thank you, Dr. Gorvett! I appreciate your time!

My pleasure. Thank you!

Academics interested in signing up as members of CAS Academic Central can do so at www.casact.org. Please feel free to contact Tamar Gertner with questions at tgertner@casact.org. ●

Volunteers Needed for Cyber Risk Task Force

The CAS is looking for volunteers for a newly formed Task Force on Cyber Risk, focusing on contingent events arising from cyber risk and the financial implications.

Every company faces the risk of cyber attacks or failures, but many aspects of cyber risk are poorly understood. With few exceptions, the expertise needed to analyze cyber-related events, their probabilities, and their ultimate financial impact is limited. There is a growing body of research on some of the specific IT aspects of the risk, but it is particularly difficult to tie that research to financial outcomes and insurance coverage.

"It is essential to follow a multidisciplinary approach that brings together experts in actuarial science, cybersecurity and information technology, big data analytics, legal and other fields," said Alex Krutov, chairperson of the Task Force on Cyber Risk. "We encourage other professionals and organizations to join us in the important effort."

To volunteer for this task force, contact Matt Caruso, CAS Membership and Volunteer Manager at mcaruso@casact.org. ●

Photo credit: Matt Caruso

Photo credit: Matt Caruso

Photo credit: Schutz

SCENES FROM ICA 2014

1. The ICA 2014 welcome reception was a star-spangled event held at the Smithsonian National Museum of American History. 2. Two ICA delegates enjoy the Gala Dinner. 3. Representatives of Deutsche Aktuarvereinigung (DAV) presented this panoramic photo to organizers of ICA 2014. Taken in 1957 during the XVth International Congress, the photo features U.S. President Dwight D. Eisenhower. The DAV will host ICA 2018 in Berlin. 4. Jeremy Todd Benson, FCAS, (right) makes a point during the parallel session "Survival of the Fittest: The Actuary as Modern Dinosaur vs. Preeminent Professional in the New Data-Driven (Business) World." Benson is senior pricing actuary-medical expense group for Swiss Re in St. Joseph, MO. His co-panelists are Alietia Caughron (left), vice president of economic capital for CNA in Chicago, and Jasmina Selimovic, Ph.D. (center) of the School of Economics and Business in Sarajevo.

Photo credit: Elizabeth Smith

Photo credit: Matt Caruso

Photo credit: Elizabeth Smith

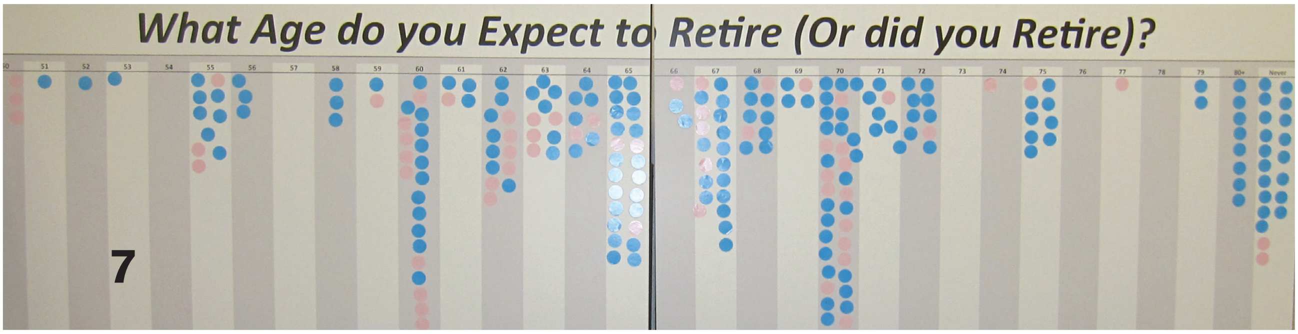


Photo credit: Elizabeth Smith

5. A Dixieland band plays at the closing ceremony for ICA 2014. 6. Bob Conger and Nicole Seguin consult before the opening ceremony of the 2014 ICA. Conger chaired the ICA 2014 Organizing Committee and Seguin is executive director for the International Actuarial Association. 7. The ICA Data Wall posed a different question every day for ICA delegates to consider. 8. An ICA delegate chooses her desired retirement age on the ICA 2014 Data Wall. 9. A Julia Child impersonator delights the crowd during the ICA 2014 welcome reception held at the Smithsonian National Museum of American History. From left to right are Elizabeth Duda, government affairs assistant for the American Society of Pension Professionals and Actuaries, "Julia Child" and Kathleen Dean, CAS director of meeting services.
10. Margaret Oyugi, actuarial manager for Jubilee Insurance Company in Kenya, presents during the parallel session "Developing World Issues, Part One."11. Nasser Hadidi, FCAS, takes a break in the ICA 2014 Town Square. Hadidi is a professor at the University of Wisconsin-Stout.

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Workers' COMPENSATION: Future Turbulence *Ahead*

By ANNMARIE GEDDES BARIBEAU

The market, laws and outlays, and a growing epidemic of opioid abuse—will these and other factors wreak havoc on workers' compensation?

Workers' compensation has always been beset by financial twists and turns. Because it is a long-tail insurance line, workers' compensation requires forward-looking assumptions about the economy, legislation, cost trends and other factors.

Reforms that impact workers' compensation can take years to affect system results. Anticipating what could happen requires more than a close eye on the nation's 50 state jurisdictions. Federal legislation—such as the Patient Protection and Affordable Care Act (PPACA), The Terrorism Risk Insurance Act (TRIA) reauthorization and potential changes to Medicare set asides—are also affecting the nation's oldest form of social insurance.

Evaluating the status of the workers' compensation line always depends on access to quality data and its interpretation. From a national historical perspective, workers' compensation is not in crisis, but there are lingering issues that affect its financial predictability.

Premium increases have been the norm across the market during the last three years, said Bruce R. Hockman, executive vice president/specialty client development manager of JLT Re Inc.'s North America division. These increases are continuing. MarketScout, which monitors pricing, reports that workers' compensation premiums have been going up about 3 to 4 percent in recent months. Workers' compensation rates went up 4 percent in January 2014 compared to the same month in 2013, according to PropertyCasualty360.com. (See the February 5, 2014, article by Phil Gusman.)

Despite premium increases, the combined ratio shows the line is not profitable, said Nancy R. Treitel-Moore, FCAS, director of workers' compensation product management for Liberty Mutual Insurance.

According to the Insurance Information Institute (III), the workers' compensation line produced an average return on net worth of 6.2 percent for 2011, the most recent year available. The industry needs to earn about 9 to 10 percent to be financially healthy, said Steven Weisbart, III's senior vice president and chief economist. "It is an industry trying to reach profitability that it can sustain," he added.

The combined ratio for calendar year 2013 is 106, according to estimates available at press time from the National Council of Compensation Insurance, Inc. (NCCI), the largest workers' compensation rating bureau in the United States.

This mirrors the average of 105.9, for the past 10 years, which is down from 108 for 2012, according to NCCI. The A.M. Best Company reports a higher combined ratio than NCCI's for 2012 at 110.3, which is the first decline since 2006.

Profitability has always related to underlying claim costs. But this is not the only issue. The industry has not had to operate in a low interest rate environment before, said Treitel-Moore. As a result, for insurers to be profitable, they need a combined ratio in the mid-90s, which represents an industry "mind shift."

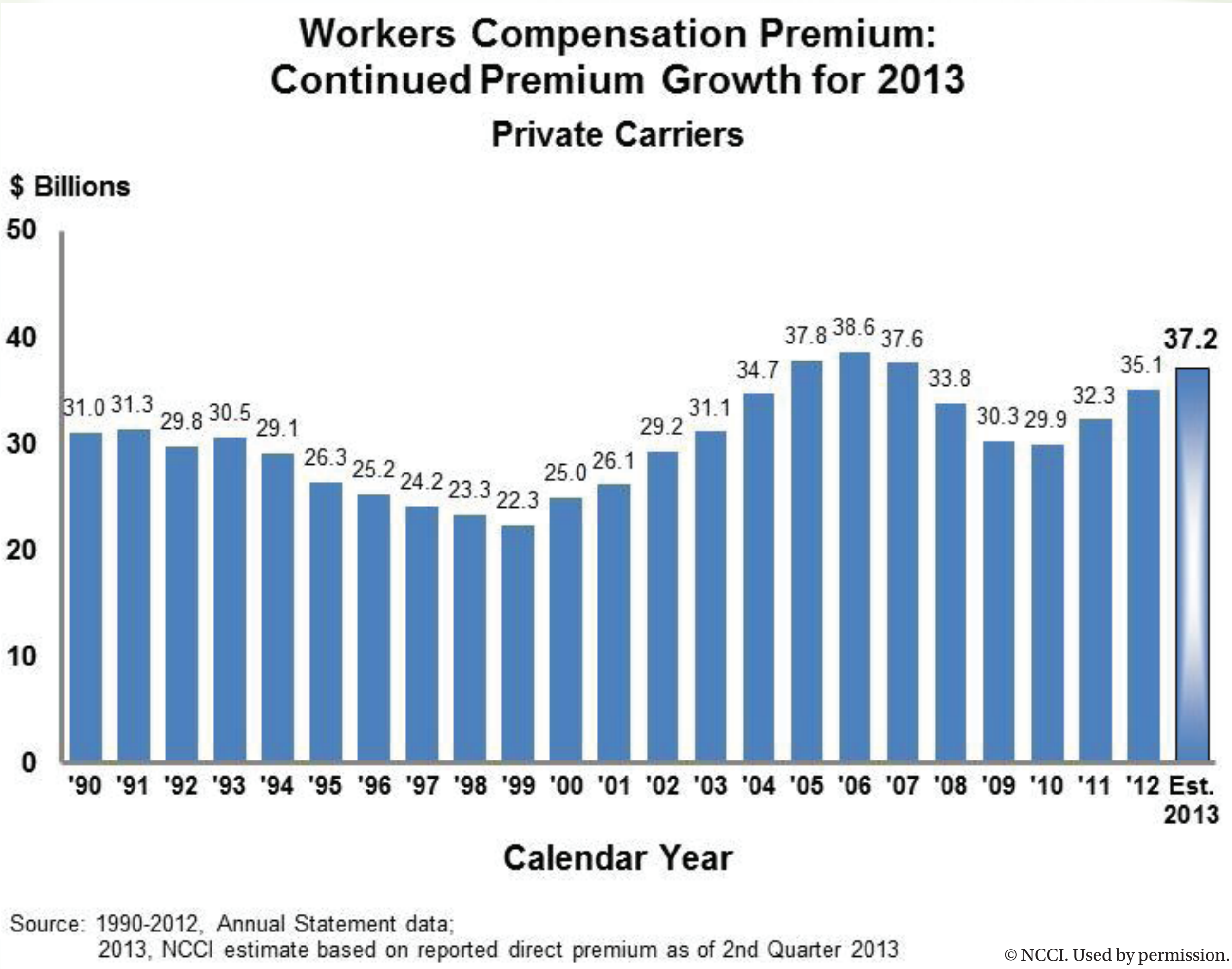
"Interest rates drive what we can afford to write workers' compensation at," she said. While premiums have been increasing, she is concerned they will not increase enough to make up for the income shortfall.

This has also changed the dynamic for writing large deductible policies, said Treitel-Moore. Higher reserves drive need for more surplus (a.k.a. capital) to support holding the reserves, she explained. But due to the low interest rate environment, insurers are not getting much investment income, while still needing a lot of surplus to support reserves on deductible business. "Insurers need more underwriting profit to generate adequate returns (for these policies)," she said.

Additionally, interest rates will not be going up soon since the Federal Reserve recently announced its intention to keep rates low for the next 10 to 24 months, according to Harry Shuford, NCCI's chief economist.

Shuford also commented on approved loss costs, noting that the lost cost changes filed by NCCI for calendar year 2014 are estimated at minus 0.6, the first decline since 2010. Loss costs across NCCI's 36 states are flat, with about half the states seeing small increases and the rest experiencing modest decreases.

There is continued modest growth in the residual market in NCCI states as well. From 2011 to 2012 policy years, the market rose $300 million, from $500 million to $800 million in premium. This growth continued in 2013.



Returning injured workers to some form of work helps keep indemnity costs down, but employers are struggling to offer jobs to the workforce in general, let alone those on workers' compensation.

While the voluntary market has shown signs of tightening over the last three years, Shuford does not expect the overall market to harden in the near future for NCCI states.

Meanwhile, net written premium has increased to $37.2 billion for calendar year 2013, according to NCCI, but it has not reached its pre-recession high from calendar year 2006. A.M. Best, which uses other data to reach its conclusions, estimates net written premiums rose 9.5 percent from $41 billion in 2012 to $44.3 billion for 2013.

Rising Claim Costs

Workers' compensation indemnity and severity costs for lost-time claims are going up steadily in NCCI's 36 states, but declines in frequency are helping to keep total costs at bay.

Frequency of claims resulting in seven or more days lost from work for NCCI states declined 5 percent for accident year 2012 following a 3.9 percent decline in 2011. Other than the 10.8 percent frequency uptick in 2010, frequency numbers have been declining since 1998. In fact, since 1991, only three years have shown frequency increases. "Indemnity/severity levels in many states are essentially flat after considering wage increases," Shuford said.

Average indemnity per claim for accident year 2012 rose a mere 1 percent and returned to 2009's amount of $22,400 per claim. Returning injured workers to some form of work helps keep indemnity costs down, but employers are struggling to offer jobs to the workforce in general, let alone those on workers' compensation. "As long as that is the situation, indemnity costs are going to increase," Hockman said.

Another challenge, said Treitel-Moore, is that there are states changing benefits retroactively, "and of course we are not allowed to adjust our premiums retroactively."

Curbing Medical Costs

Medical costs per claim, which began surpassing indemnity costs in the 1990s, continue to rise, albeit at a slower pace than in the past. For accident year 2012, NCCI estimates that the cost per claim for medical was about $28,500, up 3 percent from $27,700 in 2011.

Medical treatment for workers' compensation cases has been higher than that for group health for decades and the challenge continues. Multiple studies by the Workers Compensation Research Institute (WCRI) confirm this is still a problem. One study last year, based on data from 22 states, revealed that non-hospital prices paid for common surgeries were two to four times higher than the same ones covered by group health insurance in almost all states in the study.

Since 2009, workers' compensation medical costs have risen nearly 3 percent per year, Shuford said. Workers' compensation, however, has a history of much higher, even double-digit medical cost increases that began more than 20 years ago. And the industry does not want to see that again.

"What is making workers' compensation actuaries nervous are the rates of change in medical severity," Shuford said. He also noted that actuaries are concerned because it is unclear as to why the rate of medical costs has tapered and if this will continue.

The question is whether these modest increases were the result of the Great Recession or a more permanent trend. Medicare actuaries, he said, attribute the decline to the recession. Others believe pre-recession structural changes in the health care industry—such as doctors giving up sole practices and hospital consolidation—caused permanent reductions.

"Such changes suggest that at least some of this decline is due to permanent changes as opposed to lower employment or contracting health care coverage," Shuford said.

Pharmaceutical costs have been the most quickly rising segment of workers' compensation medical costs in recent years, Hockman said. According to a study by NCCI, drug costs make up about 18 percent of claim costs.

Since it is more difficult in today's economy to find return-to-work jobs, disability periods for injured workers are extended and extensions of medical treatment normally follow. "Very often the only way to mitigate such rising costs is, when and where possible, to negotiate a claims settlement," added Hockman.

The insurance industry is aggressively addressing part of those costs. "The most urgent issue facing workers' compensation nationally remains the costs of prescription drugs—especially opioids," said Bruce C. Wood, associate general counsel and director, workers' compensation for the American Insurance Association (AIA).

"We have situations where we have to pay for opioids even though we've raised concern about injured workers becoming addicted to them. Then they get addicted and then we have to pay for the drug rehab program."

It is urgent because injured workers on opioids might never get back to work. "Think about the reserves that would have to be posted," he added.

Opioid abuse is being confronted and addressed in many jurisdictions, Wood said. Because the issue has been getting a lot of attention lately, the industry "might be reaching the peak when it comes to the severity of the problem," said Mark Walls, market research leader of Marsh USA's Workers' Compensation Center of Excellence. Thanks to the attention the issue is getting, physicians are more hesitant to prescribe opioids for workers' compensation and otherwise, he added.

There is another wave of potential costs associated with the opioid epidemic, Walls said, in covering injured workers suffering the long-term side effects of being treated with opioids. "As an industry, we are just starting to see those side effects come up," he added. Walls predicts that these costs will grow much worse going forward, affecting claims and legal expenses for both workers' compensation and the health care industry.

If injured workers can tie long-term negative effects of the drugs back to the work-related injury, then insurers may have to cover them, said Treitel-Moore. As a simple example, she added, "We have situations where we have to pay for opioids even though we've raised concern about injured workers becoming addicted to them. Then they get addicted and then we have to pay for the drug rehab program."

The other urgent issue is physicians dispensing medication, Wood said, which is another medical cost driver. A study released last year by the California Workers' Compensation Institute showed that the cost of physician dispensing, in repackaging and ancillary costs, generated higher medical and indemnity costs. "The AIA objects to physician dispensing, period," Wood said.

There is evidence that addressing this issue does save money. The Workers Compensation Research Institute (WCRI) reported that new regulations in Georgia reduced prices paid for physician-dispensed drugs by 22 to 36 percent. Additionally, many physicians continued to dispense medication to injured workers despite the resulting price caps.

Treitel-Moore is also concerned about the rise of comorbidities in injured workers, such as obesity and diabetes, which can interfere with treatment for work-related incidents. NCCI released a study in 2012 that shows the claim duration of obese claimants on temporary total and permanent total benefits is more than five times that of the non-obese. For injured workers on permanent partial benefits, the indemnity benefit duration is more than six times as much.

Besides legislative measures, there is more good news for addressing claim costs. Ensuring that the right doctors treat injured workers as soon as possible does save on medical costs. "We have some internal studies to show this is true," Treitel-Moore said.

Anecdotal evidence shows upfront investment in medical care does save money. For example, A.I.M. Mutual Insurance Companies experienced increases in client acquisition, premium growth and persistency after applying this and other best practices with The Best Doctors Occupational Health Institute (BDOHI).

These practices included a software tool to identify high-risk workers at time of injury, utilizing nurse patient advocates to help injured workers get access to occupational health centers and medical specialists with proven clinical expertise, and a willingness to treat their patients as industrial athletes.

As a result, the insurer saw the incidence of lumbar fusions decrease by 50 percent, said Michael Shor, managing director of BDOHI. The amount of prescriptions written, including opiates and "me too" brand name medications, also declined annually.

Ensuring the best medical care immediately and other best practices are important for managing workers' compensation costs. Hockman is worried these important initiatives could get lost if the Affordable Care Act begins to affect workers' compensation.

Impact of The Affordable Care Act

Granted, any prediction about the impact the Affordable Care Act will have on workers' compensation is speculation. Since it continues to change, its potential effect on comp is a "moving target," Wood said.

But Hockman sees danger ahead if the Affordable Care Act reaches into workers' compensation medical treatment. It's not a far-fetched concern. Many experts believe that it is just a first step to nationalizing health care completely.

He points to the state of Vermont, which already has universal health care. Last year, he said, workers' compensation medical care was folded into the state's health care plan. Workers' compensation best practices for health care fell away with it.

Timely access to quality care with appropriate diagnostic capabilities are critical requirements of successful disability management, Hockman said. It is not at all certain that these are clear objectives of the Affordable Care Act, Medicare, Medicaid or any other governmental medical system anywhere.

More immediately, Walls is concerned about cost shifting since workers' compensation is the "last bastion" of first dollar medical coverage. The higher costs associated with the Affordable Care Act could give workers incentive to claim an injury is work-related.

Access to care is another concern, Walls said. Since the Affordable Care Act increases the insured population and there is a limited supply of physicians, workers' compensation payors need to ensure that injured workers have access to the best medical providers. This means payors need to move away from traditional physician network models, which focus on discounts. Instead, Walls noted, they should identify medical providers who produce the best outcomes for injured workers.

Other legislation in Congress can improve workers' compensation health care costs. A bill is being considered that would improve Medicare set-aside procedures for settled workers' compensation claims. Called the Medicare Secondary Payer and Workers' Compensation Settlement Agreements Act, the bill, if enacted, would establish a predictable and efficient process while also providing reasonable protection for injured workers and Medicare.

"The bill would provide certainty about the method of determining future medical amounts and reduce the risk of workers' compensation plans having to carry unnecessary reserves," said Doug Holmes, president of UWC Strategic Services. This would have a positive actuarial effect on premiums and amounts reserved, he added.

There is evidence that settlements became more prevalent as interest rates fell, Hockman said. "It was less advantageous for an insurer to place potential loss dollars into reserves given the relatively low investment income potential in doing so," he added. Giving carriers greater settlement capabilities—to the extent they are provided for by law, and where the rights of injured workers are protected, will play a large role in the claims mitigation process. Hockman noted that this should save loss valuation and administrative costs.

Chances of Congress passing the bill depend on remaining time on the legislative calendar and opportunities for the issues to be addressed. "I think we have a better chance of passage this year because of the increased attention being paid to Medicare and Centers for Medicare and Medicaid Service policy," Hockman said. Wood added that the bill's provisions could also be amended to other legislation to assure passage.

Terrorism Risk Backstop

Congress is also considering whether to extend the Terrorism Risk Insurance Program Reauthorization Act of 2007 (TRIPRA). This legislation extended the Terrorism Risk Insurance Act of 2002 (TRIA), which provided a reinsurance backstop from the federal government in the event of large-scale terrorist attacks.

TRIPRA is in effect until December 31, 2014, so supporters are urging Congress to act this year. "Failure to extend TRIA would have a significant impact on workers' compensation," Wood said.

Ultimately, Shuford of NCCI said, this would expand the residual market.

Although senior executives of insurance companies believe it will be reauthorized, Shuford sees this as a concern. "It seems to be the right thing to do, but Congress has this tendency to wait until the last minute, so we probably won't know until the end of this year."

Conclusion

Determining how the economy and this year's workplace injuries, illnesses and deaths will affect future claim costs will not be known any sooner than how state and federal legislation will leave their mark in the years ahead. But workers' compensation actuaries are always dealing with the unknown.

What is known, however, is that the industry has kept itself going for more than 100 years. And if the past is a predictor of the future, workers' compensation will remain resilient in the years to come. ●

Annmarie Geddes Baribeau has been writing about workers' compensation and actuarial issues for more than two decades. Find her musings at annmariecommunicatesinsurance.wordpress.com.

ORSA is on Its Way—Be Prepared

BY ALICE UNDERWOOD AND DAVE INGRAM

Insurance regulators in the U.S. are bringing about a quiet revolution in terms of how they monitor company solvency. The new Own Risk and Solvency Assessment (ORSA) fundamentally changes the conversation in two ways: shifting responsibitliy and looking forward.

Shifting responsibility. The opinion about solvency will now come from company management, based on their *own* judgment of what is needed (hence the name). This contrasts sharply with prior practice, in which U.S. regulators specified the solvency standard and laid out specific procedures for determining whether companies met that standard. Asking insurers themselves to make their own assessment of solvency is a major shift in philosophy and responsibility. While some companies have long been making their own assessment, many have been relying on regulatory and rating agency surplus requirements and expectations.

Management will need time to understand the relevant topics; getting their buy-in will be crucial.

Looking forward. The ORSA takes a forward-looking approach. Whereas previous practice looked backwards to assess whether surplus was sufficient at the end of the last year, under ORSA insurers must look at solvency for the next year or even the next several years into the future.

Who Must Prepare?

According to the Risk Management and Own Risk and Solvency Act (RMORSA) model law adopted by the National Association of Insurance Commissioners (NAIC) in 2012, ORSA requirements come into effect in 2015; these requirements apply to groups writing over $1 billion of direct premium and single companies writing more than $500 million of direct premium. So, larger companies and groups certainly must be ready.

But the model law also gives the commissioner the authority to request any company to provide an ORSA—and *requires* an ORSA from particularly troubled companies regardless of size. Many of those involved with the process of developing the new standard believe that once regulators see the insights offered by a good ORSA report, they will want to have ORSA conversations with *all* insurers as a part of their quadrennial examination. Insurers exempt from the formal requirements would therefore still benefit from reviewing the NAIC ORSA guidance manual, and they may want to consider a much less formal internal solvency assessment process that puts them in position to immediately answer ORSA-type questions.

What Will It Take For Companies To Get Ready?

Companies without an established ERM program or risk evaluation system may need two to three years to lay the groundwork for their first ORSA report. But even companies that do have established ERM programs and are using an economic capital model may still need a year or more of work to expand their processes to meet the broad requirements of the ORSA and to create the supporting documentation.

Acclimatizing management and the board of directors to the new process will also be a major consideration. Like the Sarbanes-Oxley requirement on financial statements, ORSA requires management (not the company actuary) to submit their opinion on surplus adequacy—and also requires that the board receive a copy of the ORSA report. Management will need time to understand the relevant topics; getting their buy-in will be crucial. And obviously, the board should be able to review preliminary versions of the ORSA report and become familiar with its content well before it is finalized for sending to the regulator.

Don’t Expect a Walk in the Park

For insurers who have done ERM and economic capital modeling for some time without significant outside scrutiny, the heightened ORSA documentation requirements may come as a shock. In the summer of 2012, a committee of insurance regulators reviewed some voluntary ORSA reports; presumably, these voluntary submissions came from companies who felt they had the process well in hand. The committee found only half of the reports submitted to be satisfactory, with lack of specificity being the major complaint against reports judged unsatisfactory.

Although regulators expect concrete details in the ORSA report, this report is actually expected to be a summary of much more detailed materials that will be made available for inspection during the quadrennial exam.

What Does This Mean for Actuaries Involved in ERM?

In order to be prepared for the January 1, 2015, deadline, U.S. insurers need to start thinking about their ORSA compliance requirements now. Following are some suggestions for actuaries who may be compiling or contributing to their company's ORSA report.

1. **Be prepared for a lengthy walk-through discussion with the regulator.** The ORSA Report is intended as a summary document; the regulator will want to review supporting documentation and speak with key personnel to understand the full story. This will be your opportunity to demonstrate that the risk management process is more than a "checking-the-box" exercise—that it is truly woven into the business processes of the firm.
2. **Provide a flowchart of your risk management and control processes.** This will help the regulator get a high-level understanding of how things are done at your company. Also, it's a useful reference point to have handy when going through more detailed documentation, to emphasize where each piece fits into the process.
3. **Give concrete supporting details.** For example, show actual risk limits to support the assertion that the company has risk limits in place and provide examples of how those limits are enforced. Graphical exhibits can add a lot of value to text and tables. Be sure that your attachments and supporting exhibits demonstrate the rigor of your process.
4. **Explain the company's risk identification and mitigation processes.** How are risks identified, and what methods are used to evaluate their significance? Under what circumstances is risk reduced, offset or transferred? What strategies are employed to achieve the desired degree of mitigation? Again, in discussions with the regulator, it will be useful to offer specific examples to illustrate the process in action—for example, provide examples of risk heat maps and explain how they are used.
5. **Perform robust stress testing.** This has multiple advantages. While economic capital modeling *may* be used in the NAIC ORSA process, stress tests are *required*. But beyond the requirements, many companies find that stress tests offer their management and board extremely useful insights. Stress testing uses concrete scenarios that help to make the risk measurement "real" by offering a narrative frame—so take full advantage of this. In addition to single stress scenarios, perform combined stress scenarios and a reverse stress test; include stress testing on liquidity as well as other major risk factors.
6. **Explain any use of economic capital models.** If you're using an economic capital model (ECM), provide an overview of how it works, how it was validated and how its results are used in the business. If multiple capital models are used, compare the various results and explain how a final selection is made. Explain how the ECM is related to or reconciled with stress tests.
7. **Describe the treatment of diversification effects.** What dependencies have you assumed among the different risk drivers? How were these selected, and what validation or sensitivity testing has been done? If economic capital is allocated to sub-units (for example, operating entities or lines of business), how is this done, and is any benefit of diversification also allocated or simply held centrally?
8. **Compare the most recent results to previous ones.** If your methods have changed over time, be prepared to explain the change, its rationale and its effects. Benchmark results using the most recent data against prior analyses and be prepared to explain the differences.
9. **Discuss emerging risks and other difficult-to-quantify factors.** By their very nature, emerging risks are difficult to identify and quantify, but the regulators expect companies to have thought about this issue. Similarly, operational risk can be quite difficult to quantify, but it should not be ignored. As part of your ERM

For insurers who have done ERM and economic capital modeling for some time without significant outside scrutiny, the heightened ORSA documentation requirements may come as a shock.

program, your company should be assessing these and other issues that may or may not factor directly into solvency calculations. A clear explanation of your company's approach will help assure the regulator that such issues are being addressed appropriately.

10. **Explain management actions if needed to support solvency in some scenarios.** The ORSA allows the forward-looking solvency test to be supported by changes in plans under extreme duress. Those changes or management actions may be things like changes to business levels, reinsurance programs, product offerings, prices, capital raising or other actions that would be seen as major business decisions.

In summary, this will be a challenging process, but it will prove worthwhile. In fact, it would be sensible for even those companies below the regulatory threshold for the mandatory ORSA to voluntarily perform a similar (albeit less formal) process. A company that has its *own* view of risk and solvency is in a much better position to make strategic decisions and plan for a profitable future. ●

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Casualty Actuaries Grapple with the Details of the Telematics Revolution

BY JIM LYNCH

At the intersection of insurance and technology, you'll usually find an actuary.

The crossroads of auto insurance these days is telematics, the use of an electronic device to monitor how an automobile is being driven. The device monitors where a car is and how it is being driven, and in theory, should help separate good drivers from bad drivers.

At the CAS Ratemaking and Product Management Seminar, held March 30-April 1, actuaries learned how telematics works and how well it works in the insurance industry. And, they were told, actuaries are critical to making telematics successful in the future.

Jim Weiss, FCAS, spoke about how ISO, a Verisk Analytics company, developed its telematics product, which rolled out in 2013. Jerel Cestkowski of American Family Insurance described some of the nuts-and-bolts issues involved in developing the infrastructure of customer service and claims that lie behind the product.

Allen Greenberg, a senior policy analyst at the U.S. Department of Transportation, described the government's interest and stake in telematics.

It turns out that learning intimate driving behaviors doesn't automatically translate into more accurate rates for consumers or higher profits for insurers, said Weiss, the ISO actuary.

Here's how insurers use telematics these days: If a customer is interested, the insurer gives him a device called a "dongle," which is hooked into the car's computer systems. Typically the dongle monitors when and where a car is driven along with the length of the trip and the amount of fuel used. Sometimes it monitors the speed of the car, use of seatbelts, engine temperature and "acceleration events"—speeding up and braking.

If a driver is aware of these things, he or she will become a better driver. Weiss pointed to studies indicating that crash rates fell between 20 percent and one-third in cars monitored via telematics.

But monitoring an automobile is not cheap, he noted. The dongle typically costs about $100 and lasts three years. It communicates with the insurer via wireless, which costs about $5 a month.

To be viable, the savings from better driving must offset those costs. Weiss estimated that loss ratios would have to drop 22 percent to justify a permanently installed dongle.

One alternative: Move the dongle to a new vehicle every six months. That's enough time for long-term driver behavior to improve but at a much lower cost per vehicle. Loss ratios would still have to fall 13 percent to break even, Weiss estimated—difficult, but possible.

For an insurer, actuaries would need to show that all the work is worth it. Over the decades, actuaries have developed a powerful set of rating factors. And in recent years actuaries have, through predictive modeling, refined their craft even further.

Those old factors do a good job—almost as good as telematics, as Weiss showed by example. In a traditional rating plan, younger drivers are a higher risk. The risk ebbs as the driver ages, then increases a bit as the driver heads past middle age. By comparison, telematics track, for example, the propensity to slam on the brakes, which can be a sign of an incautious driver. ISO found that young drivers tend to slam on the brakes a lot. The tendency ebbs as they get older, then increases a bit around age 60.

In other words, the telematics research affirmed the old rating factor.

There were surprises, Weiss said. Older vehicles typically were assessed lower rates, but telematics showed that risky maneuvers increased with older vehicles.

At ISO, the actuary's job became to tease out the added precision the telematics product gave. The result: Telematics gave ISO's rating plan "lift," meaning that the better a driver's telematic score, the lower that driver's expected claim cost.

Learning intimate driving behaviors doesn't automatically translate into more accurate rates for consumers or higher profits for insurers.

Monitoring the driver and developing the rate are important, of course, but Cestkowski of American Family pointed out that telematics creates other expenses and challenges.

Take customer service. The device opens up a new set of questions that a company's representatives must know how to handle, questions like:

- How do you install the dongle? (The answer differs, he said, depending on the model. And company reps will have to know them all.)
- Do you share data with police? (No.)
- What data does the device monitor?
- When will I get my discount?

A company must either train its current support staff or create a new level of specialist to handle telematics questions.

"You're going to have to invest in education and resources to handle this in your support areas," Cestkowski said.

Agents will need training, too. At companies like American Family, the agent is often the first person a customer calls. The agent will have to understand the product and its nuances.

The introduction of telematics will have an impact on marketing issues, such as whether the product should be used to target new customers or to try to retain existing customers. And there are privacy considerations, which constitute one of the main reasons consumers hesitate before trying a telematics product.

Even with the logistical challenges, usage-based or telematics-enabled pricing remain an insurance concept that the federal government tends to favor, said U.S. Department of Transportation Analyst Greenberg.

Operating an automobile is deceptively expensive, he said, because most costs—the car itself, parking, vehicle taxes and fees—are fixed. There is little incentive to avoid using a vehicle, he said. Even high gas prices don't make that much of a difference.

Telematics convert one of those fixed costs, insurance, into a variable cost. If people understand the cost-per-mile to operate a car, they drive less. That leads to a host of social benefits: fewer crashes, less congestion, less pollution and less urban sprawl. ●

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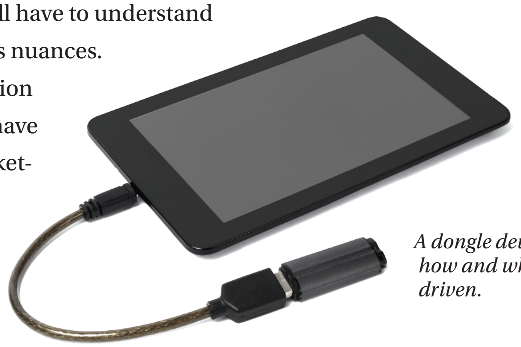

A dongle device monitors how and where a car is driven.

ACTUARIES ABROAD BY XIAOXUAN LI AND LI ZHANG, MEMBERS OF THE CAS C-ROSS TASK FORCE

From Scale-Oriented to Risk-Oriented: The Development of the China Insurance Solvency Supervisory System

In November 2013, the CAS formed a special task force on the China Risk-Oriented Solvency System (C-ROSS) to support the development of the China insurance solvency supervision regime and to acquire more details of the upcoming changes. Why does China intend to reform its current solvency supervisory system and what will its new insurance solvency supervisory regime be like? Follow our C-ROSS Task Force and you will find full and up-to-date information on these topics.

China's insurance market is a developing one and continues to maintain sound momentum. In 2013 the gross written premium of China's non-life insurance market amounted to U.S. $107 billion with a growth rate of 17.2% compared to last year. Additionally, by the end of 2013, the number of property-casualty (P&C) insurance companies had reached 64.

Solvency supervision is the core of an insurance supervisory system whose emphasis is on the protection of insurance policyholders' interests. As an emerging market, China is highly attentive to international insurance solvency supervisory reform, actively explores an appropriate solvency supervision model for its domestic insurance market and promotes insurance solvency regulatory reform in the country.

China's current insurance solvency supervisory system, also known as the first-generation insurance solvency supervisory system, was established in 2003 as a factor-based hybrid solvency system. On one hand, the valuation methods for assets and liabilities follow the U.S. National Association of Insurance Commissioners' (NAIC) statutory accounting principles; on the other hand, for minimum capital requirements, China adopted the framework of the European Union's Solvency I regime.

The reason for a hybrid system is obvious. At that time, Chinese insurance companies had not implemented the strict categorization of risks, with the result that the companies couldn't adopt the U.S. risk-based capital (RBC) framework. The EU Solvency I regulatory system, in contrast, uses a relatively simple method to calculate the minimum capital requirement for an insurer. What's more, the data and information needed could be directly obtained from financial statements and regulatory reports. Therefore, China's first-generation insurance solvency regulatory system conformed to the reality of China's insurance market at that time.

Under China's first-generation insurance solvency supervisory system, the amount of the required solvency margin for P&C insurance underwriting is equal to the higher of two results. The first result is the sum of 18% of the net written premium up to 100 million yuan (U.S. $16.5 million) and 16% of the net written premium in excess of 100 million yuan. The second is the sum of 26% of the average net incurred claims during the past three years up to 70 million yuan (U.S. $11.5 million) and 26% of the average net incurred claims during the past three years in excess of 70 million yuan. Then the solvency adequacy ratio is calculated by dividing the actual capital by the required solvency margin of an insurer. The insurers are classified by the regulator into three categories according to their solvency adequacy ratios: Inadequate insurers whose ratio is lower than 100%, Type I Adequate insurers whose ratio is between 100% and 150%, and Type II Adequate insurers whose ratio is higher than 150%. The insurers in different categories are regulated by the regulator with different regulatory measures.

China's first-generation insurance solvency supervisory system worked well in the early stages of market expansion. It does consider certain risk factors, but it is not a strict "risk-oriented" system; rather it is known as a "scale-oriented" regulatory system. With the growth and increasing complexity of the market, the current solvency regime falls short of reflecting the actual risks being taken. Therefore, as China's insurance regulator, the China Insurance Regulatory Commission (CIRC) kicked off a project to establish a robust second-generation solvency supervisory system, known as the China Risk-Oriented Solvency System (C-ROSS), in March 2012. C-ROSS will be a true "risk-oriented" solvency regulatory system and is expected to be effectuated within three to five years. Its goal is not only to accomodate the reality of the Chinese insurance market but also to meet the international regulatory standards such as the Insurance Core Principles and Standards published by the International Association of Insurance Supervisors (IAIS). For the construction of C-ROSS, CIRC has set up 15 working groups to research different special topics, as shown in the following table. Some completed research projects have assessed that China's current solvency supervisory requirements are more stringent than the U.S. RBC system but looser than EU's Solvency II regime.

ID	Project Name
1	The Comprehensive Review Project 1
2	The Comprehensive Review Project 2
3	The Overall Framework Project
4	The Pillar 1 Project: Non-Life Underwriting Risk
5	The Pillar 1 Project: Life Underwriting Risk and Interest Rate Risk
6	The Pillar 1 Project: The Minimum Capital of Asset Risk
7	The Pillar 1 Project: Other Risks and Risk Correlation
8	The Pillar 1 Project: Valuation Principles of Assets and Liabilities
9	The Pillar 1 Project: Dynamic Solvency Tests
10	The Pillar 1 Project: Actual Capital and Capital Classification
11	The Pillar 2 Project: The Risk Management Requirements and Assessments of the Insurance Companies
12	The Pillar 2 Project: Liquidity Risk
13	The Pillar 2 Project: Integrated Risk Rating
14	The Pillar 3 Project: The Public Disclosure Requirements
15	The Solvency Supervision on the Insurance Groups

The CIRC carried out the first quantitative impact testing for the life and P&C insurance industries in the second half of 2012. Then CIRC officially released the conceptual framework for C-ROSS in May 2013, which consists of three components: system characteristics, three supervisory-pillars (quantitative capital requirements, qualitative supervisory requirements and market discipline mechanism) and supervisory foundation. The overall framework of C-ROSS is compatible with the international standards on one hand and, on the other hand, it reflects the local characteristics of the Chinese insurance market. CIRC wants to achieve a balance between the costs and benefits of the new solvency supervision regime in the initial phase of implementation, so the insurers will be using standard formulas to calculate their quantitative capital requirements under Pillar I. Internal models will gradually be encouraged when the market matures.

This year is a critical one for the implementation of C-ROSS. CIRC hopes that the C-ROSS standards can be formed by the end of June for P&C insurance companies and by the end of September for life insurance companies. Then the second quantitative impact testing will be carried out. Thereafter, CIRC will amend the "Rules on Administration of Solvency of Insurance Companies," which were enacted six years ago, and upgrade its Solvency Supervisory Information System. Shortly thereafter, CIRC will research and establish the scheme and timetable for the transition from the first-generation insurance solvency system to C-ROSS.

As to whether the second-generation solvency supervisory system will call for more capital in China's insurance institutions, it depends. Generally speaking, riskier insurers will be required to put up more capital and less risky insurers will require less capital, regardless of the scale of the insurers. "Risk-oriented" is the direction of insurance solvency supervision development, not only for China but also for the world. ●

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The Casualty Actuary's Tools Can Fix All Sorts of Problems BY JIM LYNCH

A dictionary definition of an actuary is "a person who calculates insurance and annuity premiums, reserves and dividends."

That definition is too narrow. Casualty actuaries use their analytical skills to predict what will happen in an uncertain situation. In insurance, the uncertainties are how much to charge for an insurance policy or how much to set aside for claims that haven't even been made yet.

But the actuary's analytical skills can do much more.

At the Casualty Actuarial Society's Ratemaking and Product Management Seminar, held March 30-April 1, two actuaries showed how they used traditional pricing and reserving skills in fields far removed from insurance: cell phones and project management.

First, Frank Chang, FCAS, described how, as lead actuary at Google, he projected phone sales for the company's Motorola division using standard actuarial reserving methods. Chang is now lead actuary at Uber Technologies, a company whose app lets riders summon rides via smartphone.

Chang held a fairly normal insurance-related job, helping Google manage its captive, an insurance company used for self-insurance. But around 2012, he was asked to help Google improve its monthly sales forecasts for Motorola phones. The company needed forecasts to allocate funds to the division. If the forecasts were wrong, then the funding decisions would suffer.

Enter the actuary. Chang noted that every week, the division re-estimated a given month's sales. For example, based on sales figures through the first week of August, the division would project sales of January-made phones, February-made phones, March-made phones and so on. The next week, it would re-estimate all of those numbers based on updated sales figures.

Chang recognized that estimates for each month would change in a predictable fashion. They would start out wildly inaccurate—because no one would pay attention to an estimate until a few months had passed. At six months, the estimate would be "low-balled," Chang noticed. Then the estimate would creep upward.

Company officials can see the cost of the riskier project. They might still undertake it, but they have a better idea what they are getting into.

In the insurance world, this would be called loss development—the tendency for a group of claims to grow and shrink in a predictable pattern as they settle.

To an actuary like Chang, this seemed obvious. Actuaries "think about things like development," Chang said. "What happened to January as of January [then] as of February [then again] as of March.

"That kind of mindset, surprisingly, is not that prevalent" among the finance people he dealt with at Google. By projecting the patterns of the past onto the latest set of estimates, Chang was able to hone forecasts, helping Google get a better handle on their phone business.

A second panelist, Loren Nickel, FCAS, of Aon Risk Solutions, applied skills used in insurance pricing to assess the value of IT projects.

IT projects are infamous for being late and over budget. Nickel, an associate director at Aon, noticed that the cost estimates for projects didn't typically take into account the risk of the project.

He applied what he called an "underwriting analysis" to each project, trying to get a "risk-adjusted" price for each project. Suppose there were two projects with identical projected expected costs, but one has a much greater chance of failure. That risk of failure, using Nickel's actuarial analysis, would get a bigger risk load and end up being priced higher—the same way insuring a property exposed to catastrophe often ends up costing more than a more safely located risk would.

This helps companies compare projects on an "apples-to-apples" basis and, Nickel said, lets companies better assess which projects they want to carry out. Company officials can see the cost of the riskier project. They might still undertake it, but they have a better idea what they are getting into.

Though, in these particular projects, Chang and Nickel were far removed from the insurance world, both showed what casualty actuaries really can do: evaluate the likelihood of future events and design ways to reduce the likelihood of undesirable events. At Google and in the IT world, both were helping manage risk. Their work wasn't insurance—but it *was* actuarial.

Jim Lynch is chief actuary and director of research and information services for III.

The Advent of the Automated Car: Casualty Actuaries Face the Insurance Questions BY JIM LYNCH

The car of the future pictured in an imagined scene in a 1950s science magazine depicts a family sitting in a big convertible, a tail-finned monster. Mom, Dad and the kids (brother and sister) are in a circle, playing a board game. Dad sits in the driver's seat, oblivious to the oncoming traffic. Of course he is not driving. The Computer is. Dad is concentrating on the game.

Getting from today's cars, which are already pretty smart, to the fully carefree highway won't be easy, although scientists and engineers predict the day is near. And the carefree highway won't in fact be entirely carefree. There will be accidents, and someone will be liable for them. That means someone—it isn't yet entirely clear who—will need insurance. So Michael Stienstra, FCAS, an assistant vice president at QBE North America, and actuaries like him will have to figure out how much to charge for insurance—for the cars today, which can sense whether they are too close to the car in front of them—and for the cars of tomorrow, which may be able to take your kids to school.

Stienstra, along with Robert Peterson, a professor of law at Santa Clara University, and Frank Douma, a research fellow from the University of Minnesota, shared their ideas on "Autonomous Vehicles and the Impact on the Insurance Industry" at the CAS Ratemaking and Product Management Seminar in late March. The dream of a fully automated car stretches back to the 1939 World's Fair, Stienstra said. The first actual autonomous car was called Stanley, Stanford University's experimental vehicle that won the 2005 DAPRA Grand Challenge, traveling 132 autonomous miles through the Mojave Desert in 6 hours and 54 minutes.

Most automakers say they will have a version by 2020. Google says it will have one by 2017. Some, such as Raj Rajkumar, director of the Carnegie Mellon-GM Autonomous Driving Collaborative Research Lab, "estimate an autonomous package might only add $5,000 to $7,000 to the sticker price.[1]"

The cars, by all accounts, will be much safer. Human error contributes to more than 90 percent of all auto accidents. Fewer accidents, of course, means cheaper auto insurance—$475 cheaper every year, said Peterson, citing a Princeton study by Kornhauser.

Getting that new car on the road is an engineering dream. Estimating the insurance costs is an actuarial challenge.

The first actuarial obstacle is data. This time, Stienstra points out, the problem could be too much data that is exceedingly complex. An automated vehicle will likely transmit upwards of 750 megabytes per minute of data. An actuary would have to cull the data before collecting it, and then find the predictive variables, the ones that foretell an accident.

The best predictors could differ by the vehicle's technology. Variables that can predict a Honda crash might not accurately predict a BMW crash. Stienstra believes that actuaries will have to be far more involved in the collection of data than before.

Regulators could present another hurdle, says Peterson. California, for example, has mandatory rating factors that insurers must use, such as driving record or number of years as a driver. And safe drivers receive a discount. With an automated vehicle, those factors may prove irrelevant. State insurance laws will have to accommodate the new automobiles.

As the autonomous vehicle does more and more driving, Peterson says, the car owner may not be responsible for accidents at all. If a flaw in the auto or its computers causes an accident, liability may end up falling to the manufacturer or the company that installed the driverless system—in which case, the insurance pricing would fall to actuaries who specialize in product liability coverage.

But this all considers the end state in automation, where every car on the road is completely automated. Between now and then, there will be a mix of three types of vehicles: fully automated cars, where the owner does nothing; partially automated cars, where the owner does some or almost all the driving; and non-automated cars, where the person behind the wheel does all the driving. Douma spelled out the five levels of vehicle automation, from no automation (level 0) to fully self-driving automation (level 4). Current developments are moving toward deployment at level 3, he said, where the vehicle performs all safety-critical functions under certain conditions.

For a long time, Douma explained, the driver will be switching off with the computer. The driver might back out

[1] http://www.bizjournals.com/pittsburgh/blog/techflash/2013/09/at-cmu-cars-drive-themselves-and-the.html?page=all

of the garage onto the street, and then the computer will take over. Just shy of the destination, the computer might hand control back. The handoffs create another issue, Douma said: "How do you keep somebody sharp enough to take over the car?"

The technology promises to fundamentally change the relationship between the driver and automobile. As the technology progresses towards a fully autonomous state, the risks and the variables actuaries use to price the risk of driving are likely to change dramatically. It will take time to produce the experience needed to recognize this change in insureds' premiums.

Douma also said that issues of access and use of that data will be critical to how quickly and how well automated vehicle technologies are deployed. He cited the current controversies regarding use of automated enforcement of red light running and speeding as examples of where political perception has overshadowed the potential safety benefits of the deployment of these technologies.

Douma noted that most automated vehicles do not actually need personally identifiable data to work, only needing to "trust" other vehicles through use of randomly assigned certificates that can change many times daily. Although this data is nearly anonymous, he further recommended actuaries strongly consider whether personally identifying data will be necessary in setting future rates, and, if so, whether the data that drivers voluntarily share would provide a sufficient sample, rather than requiring data from drivers and vehicle owners without their prior consent.

Meanwhile, outside forces—regulators, automakers and the public—will expect that the safer automobile will translate into lower insurance premiums. That could put more pressure on insurers, and their actuaries, than they are used to.

Stienstra believes that actuaries will have to be proactive on this issue, and he notes that the CAS has an Automated Vehicles Task Force to make sure casualty actuaries have the ability to partner with engineers and researchers to properly understand and insure this challenging risk. ●

Jim Lynch is chief actuary and director of research and information services for III.

EXPLORATIONS BY JIM GUSZCZA

Clinical versus Actuarial Judgment—Some Out-of-the-Box Thinking

Using the Solvency II concept of "actuary-in-a-box" as a foil, Don Mango's recent Explorations column ("Actuary-In-the-Box," *Actuarial Review*, January-February 2014) provides a vigorous—and welcome—argument for the primacy of *judgment* in actuarial work. Along the way, Don points out that our profession seems to have a PR problem: For many people, *actuarial* calls to mind not-so-glorified number crunching—rote, mechanical and formula-driven. The notion of actuary-in-a-box (the technical term is *re-reserving*) abets this perception. It calls for a capital modeling team to encode the process by which an actuarial best estimate (ABE) of simulated future losses is arrived at. The unsettling implication would seem to be that loss reserving work is indeed mechanical in the way that popular imagination suggests.

Hopefully, few readers of this column believe that a purely formulaic approach to estimating future liabilities—one that dispenses with the need for professional judgment—will be forthcoming any time soon. As Don also points out, there is however a venerable school of decision science going by the name of "Clinical versus Actuarial Judgment" that seems to relegate actuarial work to the realm of rote, formulaic thinking. The field compares two modes of interpreting data. Clinical judgment involves processing and combining information in one's head; the actuarial method dispenses with human judgment in favor of statistical tables or regression equations that encode empirical relationships and correlations. Once again, actuarial science seems to be identified with algorithmic decision-making that is free of the need for professional judgment. But contrary to appearances, this school of decision science in fact implies the opposite of this popular misconception. The actuarial work of building, criticizing and interpreting models is, has been and always will be infused with human judgment. And, far from entering an age where actuaries can be replaced by algorithms, we are entering an age in which these skills are needed more than ever.

The University of Minnesota psychology professor Paul Meehl initiated the field with the 1954 publication of what he later called his "disturbing little book," *Clinical versus Statistical Prediction*. The studies Meehl discussed in this book, together with a cottage industry of studies that followed, overwhelmingly point to the conclusions that mechanically calculated scoring model predictions outperform those based on expert professional judgment. It turns out that the human mind is bad at aggregating information when making judgments concerning uncertain outcomes. Surprisingly, this is true even of highly trained experts seasoned with many years of professional experience.

Examples are not hard to come by. Predictive scoring models prove more accurate than clinicians' diagnoses. They outperform admissions university officers' judgments in predicting future academic success. They outperform the unaided judgment of expert underwriters at selecting and pricing insurance risks. In fact, they can even perform a limited, though reliable, form of marriage counseling: The late Robyn Dawes found that a particularly simple actuarial scoring model (subtract the frequency of quarrels from the frequency of lovemaking) is highly predictive of couples' ratings of their marital happiness. The eminent psychologists Richard Nesbitt and Lee Ross drove the point home stating, "Human judges are not merely worse than optimal regression equations; they are worse than almost any regression equation."

No matter how familiar these results become, they remain deeply unintuitive. To a statistically minded person surveying the evidence, it might seem plausible that, for example, a regression model could outperform a clinician's judgment of the likelihood of the recurrence of a disease. But in the diagnostic heat of battle, it can be hard for clinicians or their patients to trust a model score over nuanced expert judgment. Subsequent findings shed light on why this is. Daniel Kahneman, the Nobel Prize-winning father of behavioral economics, was influenced by Meehl in his younger days. In *Thinking, Fast and Slow*, Kahneman writes that one's degree of confidence in a prediction tends not to be based on a reasoned assessment of the predictive power of the evidence at hand. Rather, confidence is a feeling determined by the "narrative coherence" of the story, even when it is woven around sparse data. No wonder actuarial models run circles around expert judgment: Our confidence is increased by narrative details that, from a statistical point of view, are pure noise! Kahneman's point also helps explain both the well-known phenomenon of overconfidence bias (we tend to believe our own narratives) as well as what Kahneman calls "the hostility to algorithms" (predictive model scores offer little in the way of narrative coherence).

The science of clinical versus actuarial prediction takes on added relevance now that business analytics and data science have entered the mainstream. Today it is fashionable to attribute the power of business analytics to big data: tweets, transactions, webclicks and all the rest. But many business analytics projects owe their success less to the volumes, varieties and velocities of data involved than to the fact that they serve as correctives to the limitations of expert judgments. This, as Michael Lewis himself has recently acknowledged, is an implication of the book and movie *Moneyball*, and it also helps explain why scoring models outperform the unaided judgment of insurance professionals responsible for underwriting complex risks, judging instances of fraud or premium leakage, hiring agents or adjusting claims.

The actuarial work of building, criticizing and interpreting models is, has been and always will be infused with human judgment.

Returning to the initial question, do the Meehl school findings provide aid and comfort to those wishing to characterize actuarial work as routine or formulaic in nature? No. To paraphrase Albert Einstein, statistical models are "free creations of the human mind." Meehl and his followers established that models are surprisingly effective essentially because the alternative—weighing information in one's head—is so unreliable. But it does not follow that the models *themselves* can be algorithmically generated.

Barring radical breakthroughs in artificial intelligence, judgment will remain indispensable to the process of data analysis. There is no reliable way to algorithmically outsource the tasks of evaluating alternate model forms, selecting variables and blending qualitative background knowledge with incomplete or limited datasets. And this is doubly true of *implementing* (acting upon) model indications. Often even the best possible model is based on incomplete information. Furthermore, as Nassim Taleb discusses and loss reserving actuaries are keenly aware, there is never a guarantee that the data is complete or that historical patterns will carry into the future. Critical judgment is therefore indispensable in evaluating *model risk*: the possibility that a model indication could mislead in a particular situation. Judgment is therefore also needed to counterbalance the limitations of models with the case-specific knowledge of human experts.

The lesson of Meehl's work is not that expert judgment is outmoded; rather that judgment is best directed away from the process of making case-by-case decisions in one's head and toward the construction of models that weigh evidence so that these decisions can be made more consistently, accurately and economically. Actuarial judgment, in the sense of the type of professional judgment needed to be an effective data scientist, is essential to this process. Decision-making is central to all business, and the implication of Meehl's work is that there is virtually no limit to the applicability of predictive models to improve decision-making. Actuarial judgment is entering its heyday. ●

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IT'S A PUZZLEMENT BY JON EVANS

It Only Takes a Googolplex To Run

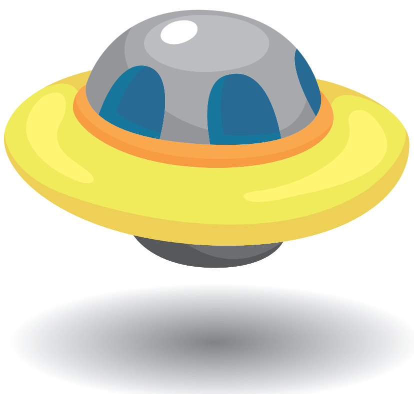
A computer science student runs a simulation that starts on a Thursday and finishes a few weeks later on a Tuesday. The student then starts a more general simulation that same Tuesday. However, with great dismay the student calculates that the new simulation will take a googolplex, 10^(10^100), as many days to finish as the first simulation took. If the student could wait that long, on what day of the week would the new simulation finish?

Flying Saucers Encircle Earth

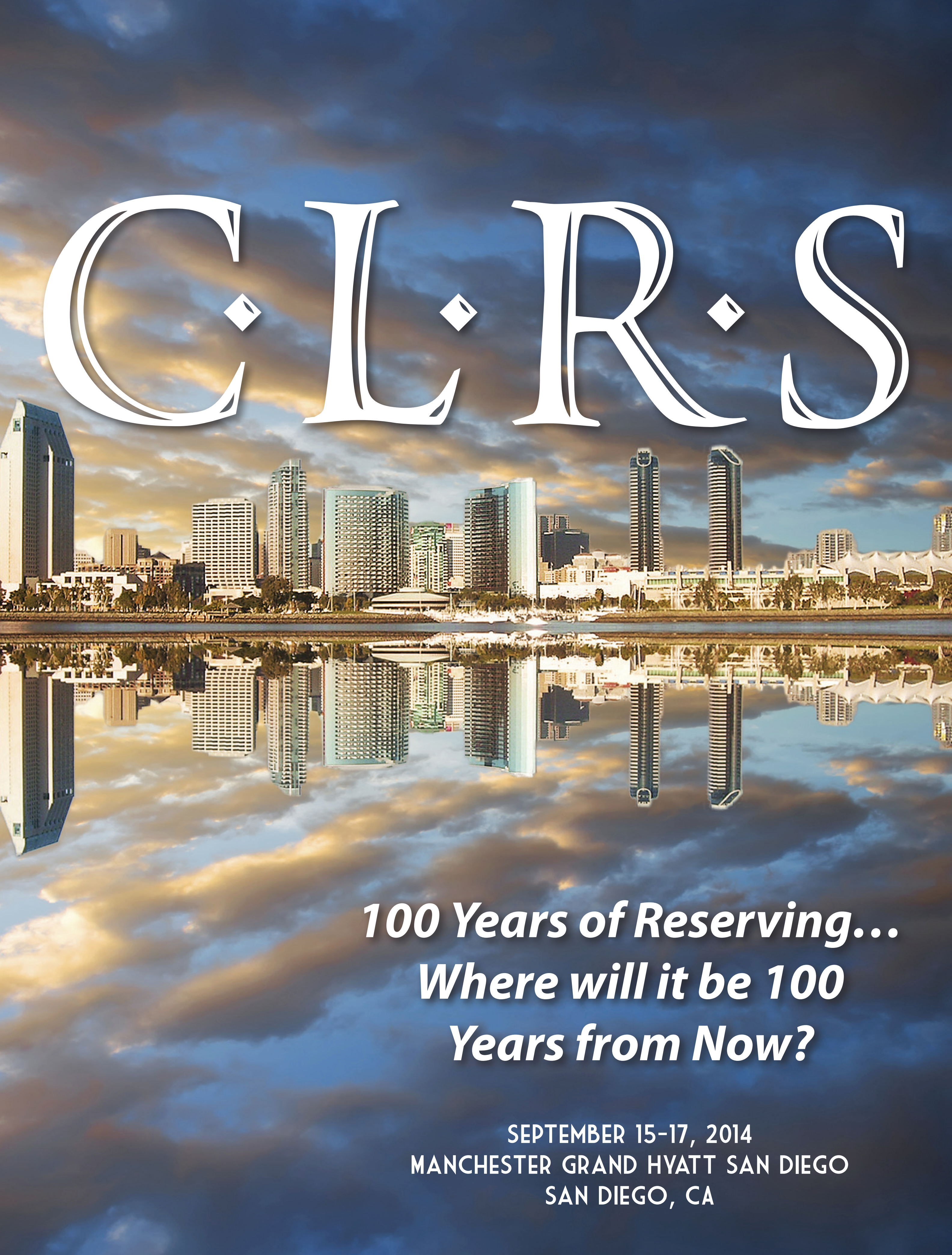
This puzzle asked the minimum number of, and lowest altitude for, flying saucers to hover so that at least one saucer is able to hit any point on a perfectly spherical 6,400 kilometer radius Earth at any time with a laser. Three saucers will not be enough. To see this, construct the plane containing these three saucers. Then construct the line perpendicular to this plane and passing through the center of the Earth. At least one of the "poles" where this line intersects the surface of the Earth will be occluded from any laser ray fired from the plane. However, if four saucers hover in a regular tetrahedron formation that contains the Earth, any point on the surface will be a clear shot for a laser from at least one of the saucers. The lowest altitude occurs when the Earth is inscribed in the tetrahedron. The distance from the Earth's center to the flying saucers is the same as the radius of a sphere circumscribing the tetrahedron. This is three times the radius of the inscribed sphere, namely the Earth, as we discuss below. So, the flying saucers are 3 x 6,400 = 19,200 kilometers from the center of the Earth, or 12,800 kilometers above the surface of the Earth.

By proportionality, it suffices to get the ratio of the radii of the circumscribed to inscribed spheres for any regular tetrahedron. We assume the sides of the tetrahedron have length 1. Describing points as vectors in three-dimensional space, let $p_1 = (0, 0, 0)$ and $p_2 = (1, 0, 0)$. To construct a third point to form an equilateral triangle let $p_3 = (1/2)(p_1 + p_2) + (0, y, 0) = (1/2, y, 0)$. Since $|p_1 - p_3| = 1$, $1/4 + y^2 = 1$, let $y = 3^{1/2}/2$ so that $p_3 = (1/2, 3^{1/2}/2, 0)$. To construct a fourth point to form a regular tetrahedron, let $p_4 = (1/3)(p_1 + p_2 + p_3) + (0, 0, z) = (1/2, 3^{-1/2}/2, z)$. Since $|p_1 - p_4| = 1$, $1/4 + 1/12 + z^2 = 1$, let $z = (2/3)^{1/2}$ so that $p_4 = (1/2, 3^{-1/2}/2, (2/3)^{1/2})$. The center of the tetrahedron is $c = (1/4)(p_1 + p_2 + p_3 + p_4) = (1/2, 3^{-1/2}/2, 6^{-1/2}/2)$. So the radius of a circumscribed sphere is $R = |p_1 - c| = (1/2)(3/2)^{1/2}$. The center of a face of the tetrahedron is $f = (1/3)(p_1 + p_2 + p_3) = (1/2, 3^{-1/2}/2, 0)$. So the radius of an inscribed sphere is $r = |c - f| = (1/2)(1/6)^{1/2}$. $R/r = ((3/2)/(1/6))^{1/2} = 9^{1/2} = 3$.

Solutions were submitted by Bob Conger, Mario DiCaro, Jim Muza, Brad Rosin, Anthony Salis, Gregory Scruton and David Uhland.



Know the answer? Send your solution to ar@casact.org.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