



SOCIETY OF
ACTUARIES

REINSURANCE
SECTION

Reinsurance News

ISSUE 93 • MARCH 2019

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Reinsurance News

Issue 93 • March 2019

Published by the Reinsurance Section
Council of the Society of Actuaries

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This newsletter is free to section members. Current issues are available on the SOA website (www.soa.org).

To join the section, SOA members and non-members can locate a membership form on the Reinsurance Section Web page at <http://www.soa.org/reinsurance>.

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Call for articles for next issue of *Reinsurance News*.

While all articles are welcome, we would especially like to receive articles on topics that would be of particular interest to Reinsurance Section members.

Please email your articles to
Ronald Poon-Affat (rpoonaffat@rgare.com) or
Dirk Nieder (nieder@genre.com).
Some articles may be edited or
reduced in length for publication purposes.

Publication Schedule
Publication Month: July, 2019
Articles Due: May 1, 2019

Chairperson's Corner

By David Vnenchak

As I sit down to write my first Chairperson's Corner article of 2019, it is New Year's Day. As it turns out, the New Year's holiday might just be the perfect day to draft this type of commentary. For starters, there are absolutely no interruptions. Everyone I know—from family and friends to colleagues and clients—is home fitting in one last relaxing day before it's back to business as usual. What is even more ideal than the quiet of this day is that New Year's brings a special kind of mood. A mood of reflection and hope. We all slow down just long enough to reflect on the past and dream about the future. For whatever reason, my thoughts this year are focused on how quickly our lives and the world around us are changing due to the impact of technology. It has changed the way we communicate with one another, how we make purchases, and what information about us is available for the world to see. These days, our children grow up downloading apps rather

than playing with toys. Packages seem to effortlessly appear on our doorstep, all with the click of a button. Our news and entertainment continually show up via new media and formats. We live in very exciting times, where the solutions to many of life's problems feel like they are just one innovation away from being revealed.

This theme of change has been a frequent topic of conversation over the last year at the Reinsurance Section Council. As we think about how we can continue to engage the actuarial base and our section members, we contemplate the media formats we use, the type of content we deliver, and what constitutes meaningful information to reinsurance actuaries in 2019. The topic of change was front and center as a major theme during the Reinsurance Section Council's full-day face-to-face planning meeting this past December. Based on our deliberations from that day, here are some of the important changes and updates we have planned for this year:

- A brand-new digitized newsletter format. While you may be reading this newsletter as a paper copy, be aware that in 2019, the Society of Actuaries (SOA) has launched a brand-new digital platform that we will use to share the newsletter moving forward. The new platform will allow for newsletter articles to be viewed in a variety of formats and on a variety of devices. There is also a feature that reads

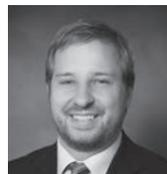


the articles aloud for those of you who would like to get through your reinsurance newsletters while focusing on other things. Special thanks to Ronald Poon-Affat and Dirk Nieder for all the time they put in as editors of the Reinsurance Section newsletter.

- Podcasts. Thanks to the valuable efforts of Jing Lang, we have a number of podcasts planned for 2019, including a Women in Leadership series that will be offered jointly between the Reinsurance Section and the Leadership & Development Section. If you haven't done so already, I suggest subscribing to the SOA podcasts on your phone or tablet by searching for "Society of Actuaries podcast" in iTunes or Google Play Music.
- Reinsurance webcasts, sessions and seminars. For those in search of Continuing Professional Development or those looking just for timely updates on reinsurance hot topics, you'll be able to find the information in a variety of venues. There are three reinsurance specific webcasts planned for 2019. We'll also have plenty of reinsurance content this year at the Life and Annuity Symposium, the Health Spring Meeting, the Valuation Actuary Symposium and the Annual Meeting & Exhibit. Last, the Reinsurance Seminar will be back in 2019; the details are currently being finalized for a conference later this year.
- LEARN. We have been working through an exciting promotion of the Life Education and Reinsurance Navigation (LEARN) program, which provides a comprehensive overview of life and health reinsurance knowledge to state regulators and other interested parties. The SOA has been canvassing a number of state department of insurance regulators on their interest in a presentation, and we expect to hold as many as eight sessions in 2019. Thanks to all our volunteers who make the LEARN program such a huge success.

- Member survey. To further aid us in our efforts to ensure that we meet the needs of our members, a member poll was distributed earlier this year. We intend to share these results with you in an upcoming newsletter. We will rely on this survey to help guide the Reinsurance Section Council's decision process and research agenda into 2019 and beyond.
- Research projects. The Reinsurance Section is heavily involved in developing research that impacts the reinsurance industry and related disciplines. In 2018, we completed two research projects: "The Impact of Genetic Testing on Life Insurance Mortality" and "Mortality Analysis of 1898-1902 Birth Cohort." As of the time of this publication, planning is already underway to kick off our new research projects in 2019.

As you can see, there are lots of activities taking place in 2019. At this point, I'd like to keep with the theme of my New Year's mood of reflection (despite the fact that you are reading this well after the fact). My last thought is one of awe. Awe for the tremendous effort put forth by all our volunteers. I'd like to say thank you to all our Section Council members, friends of the council and section volunteers for the time they spend working to advance the mission of the Reinsurance Section. While we are thankful for this support, we're always looking for new members to be active in the Reinsurance Section. If you are interested in helping out, please look to the website of volunteer positions or contact me or one of the Reinsurance Section Council members directly for more information. ■



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Save the Date

2019 Underwriting Issues and Innovation Seminar

July 28–30
Chicago, IL

Collaborate with actuaries, underwriters, medical directors and other life insurance innovation leaders at the seventh annual Underwriting Issues and Innovation Seminar. Engage with your peers at numerous networking events and get a leg up in the industry with important input from thought leaders.

Gain key industry insights on topics such as:

- New underwriting tools
- Insights from two new in-depth surveys on accelerated underwriting practices
- Continuous underwriting and pricing
- What to do now to prepare for EHRs



Information to come soon at [SOA.org/Underwriting2019](https://www.soa.org/Underwriting2019)

Letter From the Editor

By Jing Lang

“Nobody wants to read your work” is the most powerful lesson I learned about writing, marketing, art and commerce of all forms. People have limited attention spans and are bored easily, myself included. When we—writers, creators or marketers—have something to say, we are asking readers for a donation of two very precious and nonrefundable resources: their time and their undivided attention. We must provide something compelling in return.

How? Here are three things you can start doing today to hone your creativity:

BE CONCISE AND TO THE POINT

We don't have to be Michelin-starred chefs to appreciate good food, and we don't have to be Pulitzer-prize-winning authors to appreciate good writing.

In *The Elements of Style*, Strunk & White wrote: “Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a drawing should have no unnecessary lines and a machine no unnecessary parts.”

W. Somerset Maugham, renowned British playwright and novelist, wrote: “The secret of play-writing can be given in two maxims: stick to the point, and, whenever you can, cut.”

So, how do you start? The next thing you have to write—a comment to a LinkedIn article, an email to your boss, a memo on variable annuity pricing—before you submit it, look at it again. Did you stick to your point? Could it be more concise?

MAKE IT FUN: COMIC STRIP, ANYONE?

We all have our amusements—things that happened that make us laugh, stories we tell over and over again. What if these stories could be turned into comic strips? What if we could make a connection via this powerful form of visual storytelling?

Can't draw? No worries. Me neither. This is where collaboration comes in. If you have an idea, script it out. I can connect you with a network of cartoonists who can turn your idea into a comic. (See Figure 1)

Figure 1

Accelerated Mortality?¹ by Eric Sondergeld at LIMRA.



Commentary from author: Mortality experience is expected to deteriorate under accelerated underwriting, but in the grand scheme of things, it's all a timing difference (since everyone dies eventually).

BROADEN YOUR AUDITORY SCOPE

Not yet a podcast listener? I was skeptical for a while too. Here are some benefits I have since recognized and appreciated:

1. It doesn't take additional time. A podcast is a great secondary activity where you can listen while commuting to work, exercising or running errands.
2. It's free.
3. There are many niche topics: news (*The Daily*), long-form interviews (*The Tim Ferriss Show*), business (*Business Wars*), meditation (*Waking Up*). Your choices are limitless.
4. I learn something new.
5. There's little disruption—uninterrupted original content.
6. Episodes are flexible in length. Depending on the show, an episode can range from 10 minutes to more than four hours.

Already a podcast user? Excellent. Subscribe to the Society of Actuaries podcast. In 2018, SOA Reinsurance Section released three interview-style podcasts:

- Episode 3: Blake Hill, "How one actuary turned marketer is transforming the insurance industry."
- Episode 2: "Communicate, and preparing to communicate." Jim Miles shares his mojo from 40+ years of actuarial career.

- Episode 1: Peter Liebwein, "Natural catastrophes, alternative capital and the crossover from L&H to P&C."

As podcast producer for the Reinsurance Section, my goal is to have in-depth conversations with influencers of our industry. The planning for 2019 podcasts is well underway. We expect to have two more episodes released by beginning of March. Subscribe and stay tuned.

SUMMARY

I hope this article gives you some creative inspiration: Challenge yourself to write more effectively, open your mind to visual expression, and give podcasts a go. Again, if you have an idea about a potential comic strip or a suggestion for a new podcast or feedback for any published podcast, please let me know! ■



Jing Lang, FSA, FCIA, Capital Management & Initiative Origination, vice president, Globals, Swiss Re America Holding Corporation. She can be contacted at Jing_Lang@swissre.com.

ENDNOTE

1. Sondergeld, Eric. Engaging Mortality, https://www.limra.com/Research/Abstracts/2018/Engaging_Mortality.aspx (accessed January 1, 2019) (LIMRA member access required).

Interview With Tian Meipan, General Manager of China Life Reinsurance Company

By Dr. Dirk Nieder



Tian Meipan, General Manager of China Life Reinsurance Company

Chief actuary of China Re Group, director and general manager of China Life Reinsurance Company Ltd.

Mr. Tian joined China Re Group in 2001. He has participated in the design of China's second-generation solvency system and pioneered the RMB reinsurance business. With China Re Life being the leading domestic reinsurer, Mr. Tian has been the project leader of a number of basic research and standards development projects, such as construction of China's first industry morbidity table, third set of industry life tables, accident insurance incidence research project, and tax-premium health insurance study. He holds a master's degree in finance from Nankai University and is a fellow of the Society of Actuaries, member of China Actuarial Association (CAA) and Casualty Actuarial Society (CAS), and director of CAA.

Dirk Nieder (DN): China's insurance industry has experienced huge regulatory change in the past few years. What's your view of the impact to the market?

Tian Meipan (TM): The regulatory environment in China has changed drastically in the past couple of years. The whole industry is talking about deleveraging, restricting saving products with fast and subsequent survival benefits, turning back to protection products, which is the essence of insurance, and thus serving the real economy. Especially in 2018, the regulator has issued some rule-based requirements regarding product development, such as detailed provisions on policy design, pricing and distribution, which is aimed to prevent disorderly market competition and improper product innovation. Moreover, even the regulator itself has changed (i.e., China Insurance Regulation Committee (CIRC) and China Bank Regulation Committee (CBRC) have merged together).

These regulatory changes have caused a far-reaching impact on market structure, business strategy and product evolution. On

one hand, some major insurers have been transforming their business profiles to more regular premium protection products. As a result, the product innovation pace has become faster and the protection product market, especially health business, has become a highly competitive market. On the other hand, from the perspective of distribution channel, the traditional agency channel is still dominated by some leading insurers and will probably not change much in a short period, while the small to midsize companies are exploring potential breakthroughs in the online distribution channel, and this has caused fierce competition.

DN: You mentioned that the development of health insurance in recent years has been very popular. What kinds of risks should we pay attention to in this respect?

TM: China's urbanization rate has been largely increased for the past decade. The people's lifestyle, medical environment and disease spectrum have tremendously changed. The diagnosis rate of modern diseases, such as thyroid cancer, has increased significantly, and the medical cost has increased a lot due to new treatments, new drugs, etc. Meanwhile, the survival rate continues improving, and people need more money for rehabilitation. As a result, people's demand for health insurance protection is very strong nowadays, and the awareness of purchasing insurance has raised significantly. On the other hand, some insurers have treated health products as a breakthrough point for company transformation, and they have become a major contribution source to premium volume and embedded value. Therefore, health insurance such as critical illness insurance and mid-end medical insurance have developed rapidly in recent years. From the product supply perspective, the insurer and reinsurer need to focus on the following extensive but not exclusive risks.

- The incidence rate and diagnosis rate for cancer, especially thyroid cancer, have leveled up, which is quite similar to the situation in the Korean market, where there used to be an issue of excessive medical treatment and anti-selection risk.
- The trend of morbidity is uncertain. Currently, some disease rate is going down, but overall the rate is increased by some level; there is no clear view on it. Especially new

technology, new drugs and new medical examination could make this more complex.

- Critical illness claims are based on the definition of listed diseases, some of which may not be matching with current medical practice, causing disputes and lawsuits. Considering the current legal environment, insurers normally have to pay finally. Also, due to fierce competition, some disease definitions are not strictly designed, which could cause massive claims in the future.
- The premium rate for critical illness products in the domestic market is guaranteed, which is different from the market practice in Hong Kong, where CI products are normally designed as participating and thus could enable insurers to absorb some morbidity risk by dividend declaration.
- Medical cost inflation is another risk. This risk could be normal inflation because of new technology, new drugs. It could also be related to moral hazard.

Considering the large scale for in-force critical illness policies and fast innovation in medical technology and market practice development, it won't be a big surprise if some of the above issues cause systematic risk.

DN: What is your opinion regarding the life industry's future in China? Especially for the product with combined risk protection and saving features?

TM: For the prospect view of the year of 2019, the life insurance industry will continue the structure transformation due to the impact from the policy, demand and technology development.

- The product structure optimization and policy value enhancing will become the industry mainstream.
- The technology support will turn to be more practical instead of theoretical. The internet companies will be more in-depth participants in the growth of the life insurance market.
- The product type will be more diversified, and the market will face the challenge and opportunity of faster innovation.

Above all, China's life insurance market is still in the developing stage, with different types of problems and many areas to improve. Also, China is a huge market, with diversified customers, products and business models, which allows for development of companies with different business strategies and cultures.

DN: You mentioned that online business is growing rapidly recently. What's your opinion of the future of internet business?

TM: Based on our understanding, the distribution model will not be much different from present stage (i.e., the agents still dominate the distribution channel). We think the internet platform is not just the distribution channel but more like an operation tool and service intermediary. The insurer can build up the platform to enforce convenient and close interaction with customers through the internet and also improve customer service and operation efficiency. In the future, internet business is not just sales through the internet, but could also be an OTO (online to offline) model, which means the internet could introduce customers and agents could help customers understand their demand and products and finally close the deal.

DN: What is your opinion of the current and future insurance technology application in the Chinese market?

TM: Tech support is becoming popular by driving the industry innovation. The major insurers have all pronounced a large investment in digital strategy to support their future growth. The internet tycoon BAT has more in-depth participation in the life insurance industry, such as providing a distribution platform with policyholder profiling, precision marketing, services upgrade, and other technology and business model support to promote industry evolution.

DN: Regarding the reinsurance market, what is your opinion on the future major growth point?

TM: For China Re Life, the major task in the coming years is to continuously strengthen core competences, including data analysis ability, product innovations and development, application of new insurance techs. With that, we are reasonably confident to support our clients as well as the whole industry to turn back to risk protection products, promoting the growth of company value.

As for the tech application, China Re Life has issued "data + strategy." We are keeping on expanding our data resources with various business partners. We've developed several generation text-mining tools, which could enable us to do more specific claim reason analysis. We've also completed some pilot projects where predictive modeling has been applied for customer profiling and risk classification. Empowered by data, we could get more ideas for product innovation. ■



Dr. Dirk Nieder, FSA, is regional director, Gen Re, Life/Health North East Asia. He can be contacted at nieder@genre.com.

Variable Annuity Blocks—Deal Activity

By Simpa Baiye

HISTORY AND BACKGROUND OF INDIVIDUAL VARIABLE ANNUITIES

Individual variable annuities (VAs) have been around since the 1980s and were initially developed by insurance companies to provide middle-class individuals with tax-deferred investing and estate-wealth-transfer options via death benefit guarantees. With the tech boom and bust spanning the late '90s through the early part of the century, VA products became very popular as baby boomers watched the value of their retirement accounts gyrate and grew more concerned about their ability to support their guaranteed income needs in retirement. Insurers responded by developing and enhancing VA contract options, such as guaranteed minimum income benefits and guaranteed minimum withdrawal benefits. Advisers and their clients then bought in to the value of these guarantees, which allowed policyholders to remain invested in the equity markets while providing retirement income security through various guarantees.

With the increased popularity of variable annuity products in the early 2000s came more competitive pricing. Many insurers strove to differentiate their products and meet investor and analyst expectations for new sales. This resulted in new and more complex riders, which some insurance companies neither fully assessed nor appropriately hedged against the eventual downturn in the financial markets.

LEGACY BLOCKS

The decline in equity markets during the great financial crisis of 2008, coupled with the subsequent reduction in long-term interest rates stemming from the Federal Reserve's quantitative easing programs, caused many of these guarantees that insurance companies provided on their VA products to become "in the money." This change in market conditions, coupled with the variance between statutory and GAAP accounting for variable annuities, also exposed significant flaws in the risk management and hedging programs in place at some insurance companies. As a result of VA-driven earnings and capital volatility, many insurance companies stopped writing new VA business and

put some or all their existing VA business in runoff. These runoff blocks were often designated as legacy businesses. Other carriers also revamped their VA product offerings to mitigate future exposure.

In the decade since the financial crisis, insurance companies have continued to manage their legacy VA blocks of business through more robust hedging strategies and capital management via VA captives—and in some instances, they have offered buyouts to policyholders to reduce exposure.

Until recently, there were very few announced deals involving variable annuity blocks. We believe this was the result of 1) unwillingness to address investor discounts on their equity valuations for their legacy VA blocks, and 2) other business priorities, including digitization and adapting business models to the low interest rate environment in the U.S.

WHY SELL NOW?

It appears that boards and C-suite executives at many insurance companies have recently been focusing more on legacy VA blocks and are giving serious consideration to divesting them. This is primarily the result of:

- **Market volatility.** While equity markets have performed well over the last several years, the last few months have seen considerable volatility. Rising interest rates and political uncertainty are likely to drive further market volatility over the next 12 to 24 months, which could adversely impact the performance of these blocks, even in the presence of hedging programs.
- **Diminished scale.** The dual regulatory status of VA products as securities and insurance products results in significant regulatory compliance, training, licensing and operational costs. Many companies stopped selling VA products several years ago, while others have scaled back on their sales. As these blocks continue to shrink, the operating costs on a per-policy basis increase, thus impacting the profitability of the business.
- **Evolving accounting standards.** Evolving US GAAP accounting standards for variable annuity guarantees are likely to require fair valuation of all contract guarantees and thus move away from the hybrid insurance/derivative model in place today. IFRS 17 standards (applicable to foreign domiciled insurers with U.S. operations) become effective in 2021 and also will require a fair valuation measurement model for VAs. These changes may translate to additional income volatility and could require that companies bring the liability values of VA guarantees under the insurance accounting model more in line with values that

reflect analyst discounts on valuations of VA carriers with legacy blocks.

IMPACT ON DEAL ACTIVITY?

In the last few months, we have already seen several large insurance companies divest their VA blocks and expect this trend to continue through 2019 and beyond. The 2018 block sales by the Hartford and Voya, along with MetLife's spinoff of the Brighthouse business, and AXA US's IPO are just the beginning of what we see as a trend that is similar to the fixed annuities divestitures that took place between 2011 and 2015. In most of these divestitures, the announcements were well received and sellers were rewarded via significant increases in their market capitalization. These events have not gone unnoticed by industry executives.

Investors now perceive an opportunity to acquire these legacy blocks and transition them out of publicly traded, short-term-earnings-focused entities and run them off as privately held entities away from the scrutiny of public shareholders and the analyst community. Furthermore, investors see an opportunity to consolidate these legacy blocks in order to reduce the per-policy costs of administering these regulated products. This could lead to an increase in the overall profitability of these runoff businesses as a whole.

WHAT ARE KEY BUYER CONSIDERATIONS?

While VA business could represent an attractive investment opportunity with sellers that are currently open to divestitures, potential buyers should not underestimate the complexity of both this business and the associated transactions. Furthermore, regulatory considerations and the complex structure of many insurance organizations make it very difficult to complete deals in this space. Considerations include:

- **Transaction structuring.** Legal entity sales and reinsurance are two likely structuring approaches. Legal entity sales likely require pre-close entity restructuring, as most companies did not use separate insurance entities to underwrite VA business. On the other hand, reinsurance transactions—while avoiding some of the complexity associated with a legal entity sale—also can be quite complex and often require multiple reinsurance transactions with varying structures (coinsurance, modified coinsurance and funds withheld arrangements) to transact in a manner that is efficient and also optimizes the capital and tax considerations of both parties. Other specific-tax considerations include the optimal harvesting of net operating losses from existing hedge programs and the impact of onshore or off-shore affiliate captives on taxable income.
- **Asset management optimization.** Legacy blocks offer varying possibilities to improve returns on liability funding.

For example, VA guarantees that are in the money or have been exercised provide more stable funding requirements for which an attractive variety of less liquid or alternative investment options would be suitable. Well-hedged blocks of business (net of any hedge collateral requirements) could also provide less volatile funding sources for these investment opportunities.

- **Post-transaction liability optimization strategies.** Variable annuity contracts may contain levers that allow for buyers to increase ultimate deal value while making good on policyholder obligations and meeting product compliance standards. Such levers include the ability to increase fees, rationalize fund offerings and institute buyout programs, but they vary by block of business.
- **Complex accounting.** The accounting for VA business and, in particular, reinsurance of VA riders is complex and needs careful analysis. Additionally, the reserving and the related hedge programs are unique and add to the complexity of the accounting and the related valuation of the business. For example, hedges of interest rate risk can have counterintuitive impacts on current statutory reserving and capital requirements. This requires that buyers understand the tradeoffs in hedging interest rate risk and mitigate accordingly.
- **Data quality and financial model integrity.** VA guarantee liabilities are highly dependent on the quality of policyholder data and the integrity of models underlying their valuations. Data issues may have developed over time with the upgrade or consolidation of policy administration systems, and complex VA insurer models may have unnoticed errors or may deviate from prescribed valuation standards. The importance of pre-assessing both data and models cannot be overstated.
- **Separate accounts and brokerage operations.** As we noted earlier, VA products are both insurance products and securities. As a result, insurance regulatory filings need to be supplemented by SEC registration and annual filings. Nonpublic companies may not be familiar with these filing requirements. Furthermore, both public and private insurers have to maintain a licensed broker dealer to administer the business. ■



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Annuity Reinsurance: Trends & Solutions

By Gokul Sudarsana, Rachel Funk and Greg Mitchell

The global demand for reinsurance solutions in annuity markets has skyrocketed over the past decade, and the industry expects this growth trajectory to be sustained for the foreseeable future. In this article, we examine the top thematic trends driving this growth as well as explore the top reinsurance solutions being developed to address this trillion-dollar opportunity.

TOP TRENDS

Macroeconomic Environment

The past decade has proven to be a challenging interest rate environment amid various quantitative easing programs pursued by central banks globally in response to the financial crisis. Several players in the annuity reinsurance market were established during this period of low interest rates and credit spread compression, primarily in order to provide yield enhancement solutions to annuity writers. With strong capabilities in asset-liability management and asset sourcing, these reinsurers have helped cedants manage legacy portfolios and offer attractive pricing on new business despite suppressed investment yields.

Over the same period, equity markets have rebounded to all-time highs, leading to strong performance for traditionally equity-backed liabilities, such as pensions and structured settlements.

Turning to the current economic environment, and looking ahead to the future, we note that the quantitative easing era has ended and rates have been steadily rising in recent years. This has been particularly pronounced in the last two years. As a consequence, we can expect credit spreads to revert closer to historical norms. In this new environment, the same reinsurance capabilities will be required to respond to higher crediting rates on new annuity business and help de-risk equity-heavy portfolios as credit opportunities become more attractive.

Consumer Shift

In the past, guaranteed withdrawal benefit features were added to annuities in order to compensate for the low crediting and/or participation rates being offered. Given the increase in interest rates and market returns, we have seen a shift from

income-driven products to accumulation products. This, in combination with the increased need for retirement solutions, will entice life insurers to enter the annuity market, if they haven't already, and those already in the market will need to keep up with higher crediting rates.

Through a combination of annuity writers de-risking variable annuity product features coming out of the financial crisis and fierce competition pushing up crediting rates on fixed annuity products, fixed annuity sales have increased substantially over the last few years, surpassing variable annuity sales.

Fixed annuity sales in the U.S. have approached and exceeded \$100 billion annually for the last five years, according to LIMRA statistics. Through the third quarter of 2018, year-over-year sales have grown by more than 10 percent, with deferred annuities and indexed annuities leading the charge. As of this writing, many industry observers expect 2018 to be a record sales year, with the fourth quarter being among the largest of all time. Indeed, this trend is expected to continue into 2019, during which many observers predict yet another record sales year.

Turning again to long-dated bulk annuities, we have observed impressive growth in the demand for pension risk transfer (PRT) solutions globally. The value proposition for pursuing a PRT transaction continues to become more attractive in the rising rate environment, particularly as plans' funding statuses are restored to healthy levels coming out of a bull equity market. PRT in the U.S. has the potential to be a \$3 trillion market, and we are only scratching the surface, with a little more than \$300 billion transacted to date.

Supply of Capital

In response to this growing demand, we have observed an influx of capital sources seeking to provide capacity in this market. As we discussed, several specialist reinsurers with strong capabilities in asset-liability management and yield enhancement have emerged in the past decade to provide much-needed solutions during the quantitative easing era. Now, with rising interest rates and the prospect for increasing investment yields, traditional onshore reinsurers have become more active in the annuity reinsurance market as well.

The market also continues to attract interest from nontraditional capital sources, including hedge funds and other private equity. For these investors, the asset-intensive insurance space represents a cheap and sticky source of leverage, enabling them to deploy their asset management capabilities at scale. We have also observed interest from property and casualty reinsurers in diversifying into the life and annuity markets, due in part to saturation in their core markets and a prolonged soft underwriting environment.

This new environment has led to a very competitive process for reinsurance quotes and thus an upward trend in ceding commission, ultimately benefiting the cedants.

A combination of these trends brings us to the current trillion-dollar opportunity. Interest rates are rising, credit spreads are widening, and equity markets may have reached the peak of the current cycle. Demand for annuity products is at an all-time high. The reinsurance market is awash with capital. How is the market evolving to address this new environment? Let's find out in the next section.

TOP SOLUTIONS

Block Reinsurance

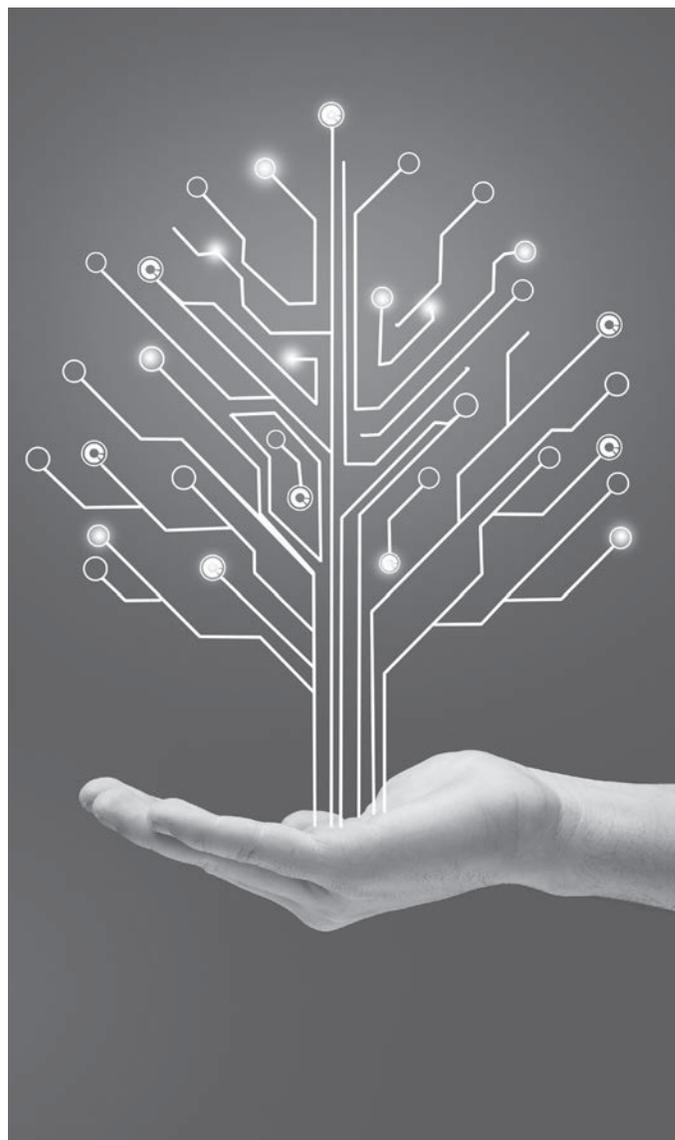
Annuity reserves held by U.S. life insurers are estimated to be \$1 trillion. A substantial proportion of those annuities were written more than 10 years ago with much higher guaranteed rates than would otherwise be credited in the current market. Given the extended period of low returns on assets backing the legacy annuity blocks, insurers have encountered spread compression and an increased pressure on their ability to achieve original return targets. This has resulted in direct writers seeking reinsurance solutions to assist in meeting profit objectives and alleviating capital strain. Insurers can use annuity reinsurance to exit legacy blocks, releasing capital and allowing for redeployment to newer and more profitable lines of business. Legacy annuity blocks that were not put out to reinsurers in the past are now emerging due to the competitive pricing available in the current market.

Reinsuring annuity reserves can help manage risk-based capital and a company's risk appetite. For a company that already has a high C3 component, ceding the reserves under coinsurance will reduce retained C3 reserves and thus the overall required capital. This can also help a company exit existing business if new opportunities better align with its risk appetite and/or strategic goals.

Product Development

We have seen an increase in the number of cedants looking for product development support for their new business initiatives (more commonly referred to as flow business). Direct writers look to utilize the expertise of the reinsurance companies so that their new products are competitive, profitable and ultimately sustainable. This solution is unique in that the direct writer and reinsurer have aligned partnership interests during both the development stage and the full life cycle of the product.

On the liability side, the direct writer and reinsurer work closely to design and price a competitive product, while the reinsurer also provides support in the preparation and review of contracts and marketing materials. On the asset side, a model portfolio is developed based on projected volume, duration and risk profile characteristics of the underlying reserves. Analyzing both sides



of the balance sheet ensures that the annuity product meets return objectives and risk constraints for both the cedant and the reinsurer.

Reinsuring flow business can limit strain and committed capital associated with increased sales volume. Direct writers can continue sales without the concern of reaching a maximum concentration or allocating too much capital to one project. The reinsurer typically pays the cedant an upfront allowance that can help offset first-year strain.

The efficiency of the direct writer's administrative resources can be maximized by reinsuring flow business, as the cedant is typically responsible for the administration of the new business. Distribution channels can also be retained even though the risk is reduced.

Innovative Structuring

Coinsurance is the most common and straightforward type of reinsurance structure used for annuity reinsurance. Under this approach, the assets are transferred from the cedant to the reinsurer. The reinsurer establishes its quota share of the reserves, and the cedant takes reserve credit for the same amount. For the credit to be recognized by the domiciliary regulator, the reinsurer must be authorized by the state. Many offshore reinsurance companies are classified by the National Association of Insurance Commissioners (NAIC) as unauthorized reinsurers, with reinsurers from certain NAIC-qualified jurisdictions able to apply for certified reinsurer status on a state-by-state basis.

When a reinsurer is unauthorized, the reserve credit must be fully collateralized by either letters of credit or assets in trust (all of which must meet regulatory requirements laid out by the NAIC). The trust structure guarantees the cedant access to the supporting assets for reimbursement of amounts due or in the event of reinsurer insolvency. The offshore reinsurer typically must fully collateralize its obligations on a market value basis (which is not required or commonly offered by authorized domestic reinsurers). This can and should be seen as a positive differentiating aspect of a transaction with an offshore reinsurance company. As an additional safeguard to the cedant, it is common for the reinsurance agreement to define a negotiated level of overcollateralization in excess of the market value of the assets supporting the reserves.

When choosing a reinsurance partner, it is important for cedants to perform adequate due diligence and understand the reinsurer's yield enhancement strategies. This is particularly relevant if a recapture event were ever to occur. In this scenario, the cedant would need to take control and potentially trade out of supporting assets. Cedants do not want to be faced with assets that have limited liquidity and lower-than-expected credit quality. The cedant should also be comfortable with the negotiated investment guidelines as they relate to permitted assets, limits by asset class and issuer, and duration limits relative to the liabilities.

Under variants of coinsurance, such as funds withheld coinsurance or modified coinsurance, the cedant retains ownership of the assets (recognized on the cedant's balance sheet). Some prefer this approach, as it can provide greater visibility to the underlying investments. The assets are typically retained in a segregated custody account and managed by an investment adviser agreed upon by both the reinsurer and the cedant. There is generally more transparency on investment strategies and the underwriting process performed by the investment manager. We are seeing a renewed emphasis on credit quality and collateral liquidity, as well as pushing for greater levels of overcollateralization.

The cedant should review all methods described and evaluate the structure that will best meet its needs.

CONCLUSIONS

There is good reason to be excited about the current annuity reinsurance market and what we can expect in the future. As annuity writers ramp up production on new business offerings to keep up with the growing demand, reinsurance solutions will continue to be essential for providing balance sheet capacity, product expertise and yield enhancement.

Block reinsurance of legacy portfolios, as well as capacity for bulk annuity transactions, will continue to be an essential tool for balance sheet optimization as cedants seek de-risking opportunities on noncore lines and solutions to redeploy capital and resources toward new business.

The turn in the economic cycle will have positive effects on new business sales as well as an opportunity to review asset allocations. We expect cedants to benefit as their existing and potential reinsurance partners leverage their capabilities to source attractive credit opportunities in this changing investment environment.

Despite the unprecedented success of annuity reinsurance over the past decade, the untapped potential remains impressive, with underserved liabilities totaling in the trillions of dollars. As the market continues to innovate and provide cedants with a variety of solutions, we believe the best is yet to come. ■



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A Look at Two New (Surprising) Drivers in Catastrophic Exposures

Hemophilia and hereditary angioedema have turned into key drivers of the large medical claim trend in U.S. health care insurance.

By Yang Hu

The increasing frequency of catastrophic exposures greatly challenges today’s managed-care reinsurance market. Catastrophic-claim “horror stories” now refer to exposures in excess of \$5 million to \$10 million, whereas only a few years ago, this threshold used to be “only” \$2 million. That latter amount now instead seems to be a working layer. This trend is driven by the rapid progression in health care technology and new specialty drugs that can relieve human suffering.

To that end, according to the Swiss Re’s large-claim study on U.S. commercial health plan costs, historical large claim (more than \$1 million) frequency experienced a near doubling in growth from 2012 to 2016.

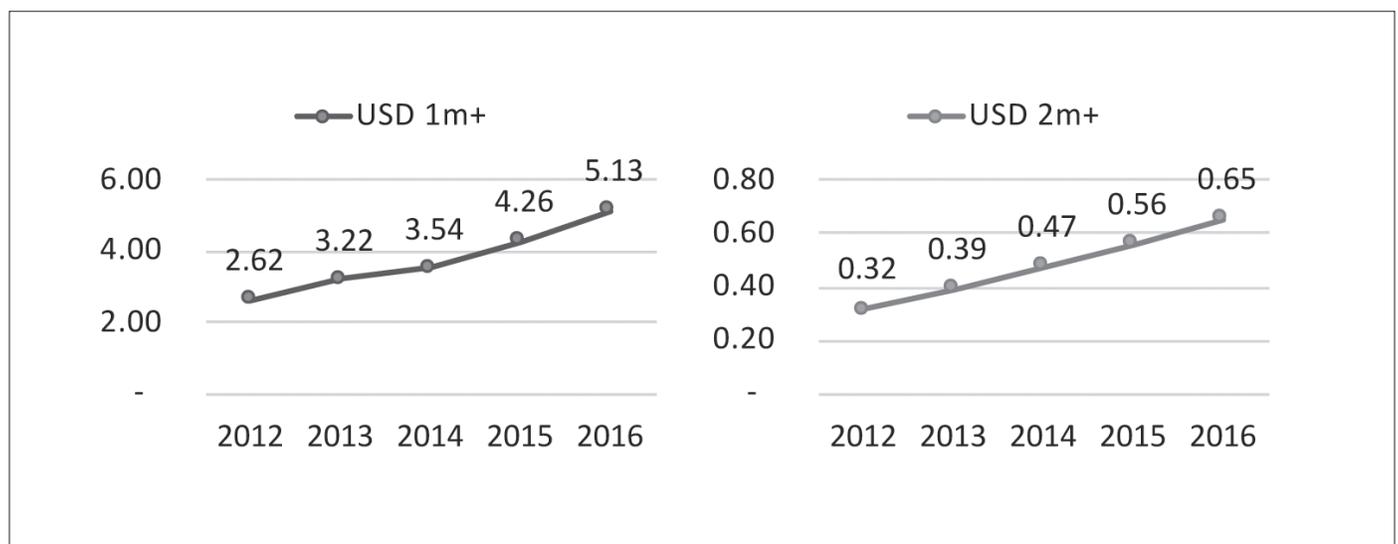
Among the key driving medical conditions behind this trend, two emerging conditions stood out clearly: hemophilia and hereditary angioedema (HAE).

LARGE-CLAIM FACTS

According to the Swiss Re large-claim study¹ on commercial health plan costs, during 2016, the average frequency of claims in excess of \$1 million and \$2 million were 5.13 and 0.65 per 100,000 members, respectively. These two numbers were the result of a near-doubling frequency trend from 2012 to 2016, which is expected to continue. According to Swiss Re’s projection, the two frequency numbers for 2018 are expected to be 6.39 and 0.91 per 100,000 members for claims of more than \$1 million and \$2 million. This suggests that for any commercial health plan (self-funded by an employer group or fully insured) that has enrollment of more than 100,000 members, there is a high chance that the plan will experience a claim of more than \$2 million in 2018.

Behind these large claims, the top three drivers, or the “large-claim conditions” by total ground-up claims cost, were 1) neonatal (usually preterm infants), 2) malignant neoplasm (cancer, including leukemia), and 3) cardiovascular disease. However, not far from these three and still among the top 10 are two emerging catastrophic drivers with astounding growth in severity and frequency during the last few years: HAE and hemophilia.

Figure 1
Historical Large-Claim Frequency (per 100,000 Members) for Claims of More Than \$1 Million and \$2 Million



ALL ABOUT HAE

Hereditary angioedema² is a rare and potentially life-threatening genetic disorder where the patient experiences recurrent episodes of severe edema (swelling) in various parts of the body. The most common areas of the body to develop swelling include the hands, feet, face and airway (throat). Patients often suffer excruciating abdominal pain, nausea and vomiting caused by swelling in the intestinal wall. Swelling of the airway or throat is particularly dangerous, because it can cause death by asphyxiation. HAE is caused by a defect in the gene that controls a blood protein called the C1-inhibitor. This defect causes a biochemical imbalance that produces swelling. HAE is also known as C1-inhibitor deficiency, with type I and type II. According to the US Hereditary Angioedema Association, the frequency of this condition is one in 10,000 to 50,000 people, with a death rate of 15 to 33 percent for patients suffering from the disease. In the U.S., HAE causes 15,000 to 30,000 emergency department visits every year.

HAE is very difficult to diagnose accurately due to the wide variability in disease expression and the unpredictable and diverse course of the disease. The treatment relies on specialty drugs that are used as a C1-inhibitor at an average cost of roughly \$350,000 per year to maintain patients. To add to the complexity, each HAE patient is different, requiring various amounts of the drug depending on the patient's specific needs. It is not uncommon for a patient to go from being stable with a relatively limited use of drugs to frequent use of drugs costing millions of dollars.

The drugs listed below may be required to relieve the swelling that a patient is experiencing. Prior to the development of these drugs (less than a decade ago), a patient who had a severe swelling episode could have died. The rapid increase in price for these drugs has also added to the exposure.

Figure 2
Five Drugs to Treat HAE

PROPRIETARY NAME	COST/INJECTION
Cinryze	\$5,000–\$11,000
Firazyr	\$7,000–\$8,000
Ruconest	\$6,000
Berinert	\$6,200
Kalibitor	\$4,000–\$5,000

ALL ABOUT HEMOPHILIA

Hemophilia³ is an inherited genetic disorder where the blood's ability to form a clot at the site of blood-vessel injury is impaired. It is characterized by extended bleeding after injury, surgery,



trauma or menstruation. Sometimes the bleeding is spontaneous, without a known or identifiable cause. Improper clotting can be caused by defects in blood components, such as platelets and/or clotting proteins, also called clotting factors. The body produces 13 clotting factors. If any of them are defective or deficient, then blood clotting is affected. There are many different types of bleeding disorders. The most well-known types are hemophilia A (factor VIII deficiency), hemophilia B (factor IX deficiency) and von Willebrand disease. There are also other relatively rare factor deficiencies, including I, II, V, VII, X, XI, XII and XIII.

According to the National Hemophilia Foundation and the U.S. Centers for Disease Control and Prevention, the frequency of hemophilia is approximately one in 5,000 live births and there are about 20,000 people with hemophilia in the U.S.

Hemophilia patients can present a large exposure (from birth) due to the factor VIII drugs required to maintain clotting capabilities and reduce the prevalence of bleeding. Experience shows that maintenance costs can average up to \$100,000 per

month, or even higher depending on which drug is used, the volume of the drug, and the setting where it is administered. In addition, once a spontaneous bleed happens, the inpatient stay in ICU can be extremely costly as they use additional factor drugs to stop the bleeding. Hemophilia can be classified as mild, moderate or severe, depending on the number of units of factor required to maintain clotting. Some of the claimants have costs of between \$3 million and \$5 million per year when there is a spontaneous bleed requiring hospitalization. This uncontrolled variable presents a difficult underwriting dilemma.

ACTUAL COST IMPACT OF THE TWO CONDITIONS IN CATASTROPHIC CASES

Due to the nature of cause and treatment of the two diseases, the majority of the cost of care is billed as specialty drugs. The Swiss Re large claim study shows that based upon data in 2014–16, roughly 20 percent of all claims of \$2 million or more (summation of the annual inpatient/outpatient/physician/prescription drug costs for any individual) are due to either hemophilia or HAE, counting by the total number of claims. The distribution of this percentage between hemophilia and HAE is fairly even. For HAE in particular, there has been a spike from 2014 to 2015–16. (See Figure 3)

At the same time, counting by the total ground-up claim costs, the total of all claims of more than \$2 million due to HAE/

hemophilia is roughly 25 percent. The HAE cost spike between 2014 and 2015–16 is also obvious. (See Figure 4)

In the Swiss Re large-claim study, the highest annual claim in 2016 (\$8.5 million), the second-highest claim in 2015 (\$6.4 million), and the fifth-highest claim in 2014 (\$7.3 million) were all due to HAE.

IMPLICATIONS TO EXCESS OF LOSS REINSURANCE

Next, we turn to the excess per-member per-month claim costs, which are important metrics for insurers and reinsurers involved in excess of loss protections (usually with \$1 million or higher deductibles). Excess of loss protection is a nonproportional reinsurance coverage designed to protect against the severity or frequency of catastrophic claims. These protections are usually priced at a small percentage of the total premium of the underlying health plan but can effectively eliminate the volatility from catastrophic claims.

Regarding the excess of loss coverage costs, it is commonly understood that the claim cost above retention tends to grow much faster than the normal ground-up claim cost trend, due to the mathematical effect called “leveraging.” The impact of this leveraging effect increases with the magnitude of the retention.

Figure 3
Frequency of Catastrophic (More Than \$2 Million) HAE/Hemophilia Claims

YEAR	NUMBER OF CLAIMS OF MORE THAN \$2 MILLION	NUMBER OF CLAIMS OF MORE THAN \$2 MILLION DUE TO HAE	NUMBER OF CLAIMS OF MORE THAN \$2 MILLION DUE TO HEMOPHILIA	PERCENTAGE OF CLAIMS OF MORE THAN \$2 MILLION DUE TO HAE	PERCENTAGE OF CLAIMS OF MORE THAN \$2 MILLION DUE TO HEMOPHILIA	PERCENTAGE OF CLAIMS OF MORE THAN \$2 MILLION DUE TO EITHER HAE OR HEMOPHILIA
2014	82	5	8	6.1%	9.8%	15.9%
2015	74	8	7	10.8%	9.5%	20.3%
2016	84	9	9	10.7%	10.7%	21.4%

Figure 4
Total Ground-Up (GU) Costs Impact of Catastrophic (More than \$2 Million) HAE/Hemophilia Claims

YEAR	PERCENTAGE OF CLAIMS OF MORE THAN \$2 MILLION (TOTAL GU AMOUNT) DUE TO HAE	PERCENTAGE OF CLAIMS OF MORE THAN \$2 MILLION (TOTAL GU AMOUNT) DUE TO HEMOPHILIA	PERCENTAGE OF CLAIMS OF MORE THAN \$2 MILLION (TOTAL GU AMOUNT) DUE TO EITHER HAE OR HEMOPHILIA
2014	7.7%	11.1%	18.8%
2015	13.2%	11.7%	24.9%
2016	14.1%	11.9%	26.0%

Figure 5
Impact on Excess Claim Costs

YEAR	RETENTION	PERCENTAGE OF EXCESS COST DUE TO HAE	PERCENTAGE OF EXCESS COST DUE TO HEMOPHILIA	PERCENTAGE OF EXCESS COST DUE TO EITHER HAE OR HEMOPHILIA
2014	1,000,000	5.5%	8.3%	13.8%
	2,000,000	10.8%	13.6%	24.4%
	3,000,000	13.6%	14.2%	27.8%
2015	1,000,000	8.4%	9.8%	18.1%
	2,000,000	17.8%	16.1%	33.9%
	3,000,000	21.5%	16.5%	38.0%
2016	1,000,000	7.6%	9.1%	16.6%
	2,000,000	17.5%	16.2%	33.6%
	3,000,000	23.4%	20.5%	43.9%

Leveraging applies not only to trend. We can anticipate that the impact on the claim costs of HAE and hemophilia are also “leveraged.”

The actual findings from the study, however, still amaze us. Based on 2015–16, at a \$1 million retention, more than 15 percent of the excess claim costs are due to either of these two conditions. At a \$2 million retention, this number is further leveraged and is higher than 30 percent. At a \$3 million retention, the number increases to more than 40 percent. (See Figure 5)

Unlike some of the traditional drivers of large claims (e.g., transplants) that don’t usually recur in subsequent years due to death or recovery, the large claims due to HAE and hemophilia tend to continue for multiple years, as the patient needs to receive injections on a continuous basis. This has caused higher and higher financial pressure on health care insurers and reinsurers, especially when a “no new laser” commitment is made.

CONCLUSION

As the large-claim trends continue to accelerate in the current health care environment, it is very important to recognize some of the main drivers behind catastrophic claims. Specifically, during the past couple of years, HAE and hemophilia were the two new emerging, and increasingly frequent, causes of “jumbo claims.” This frequency and severity is on the radar of the stakeholders in the health insurance market. These conditions now represent a significant portion of the high excess risk (especially excess of \$2 million) and therefore need to be carefully considered and monitored. Insurers will need to understand the magnitude and trend of the catastrophic risk and consider excess of loss reinsurance not only for the protection at the high layer

but also for obtaining access to the reinsurer’s care-management vendor program which may help significantly reduce the cost through specialty case management. Reinsurers will need to adequately model risk in the excess coverage rating, provide care management services to their clients to help them contain the costs, and consider innovative reinsurance solutions. That may include carve-out coverage for these types of special and extremely expensive conditions. ■



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ENDNOTES

1 The Swiss Re large claim study was based on Truven MarketScan Research Database 2012-16 commercial data.

The underlying data of the study includes more than \$383 billion in ground-up claims, representing comprehensive benefits including inpatient, outpatient, physician and prescription drug services costs, and covers more than 1 billion member months of exposure during the years 2012 to 2016 from various fully insured and self-funded health plans across the U.S.

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2 The US Hereditary Angioedema Association website, <https://www.haea.org>, source for the definition, symptoms and frequency of the disease.

3 National Hemophilia Foundation website, <https://www.hemophilia.org>, source for the definition, symptoms and frequency of the disease.

Enterprise Risk Management and Reinsurance for Property and Casualty Insurers

By Dave Ingram

Insurers are in the business of aggregating risk. This makes enterprise risk management (ERM) particularly important to insurers.

In addition, property and casualty (P&C) insurers have an incredibly flexible and powerful tool available for sculpting their risks: reinsurance.

ERM is a very new approach to risk that has been embraced by insurers just in the past 15 years. Reinsurance, on the other hand, has been around for almost as long as insurance. Do they work together? Can the new ERM process learn from the mature reinsurance approach?

The answers are yes and yes.

INSURER'S PERSPECTIVE

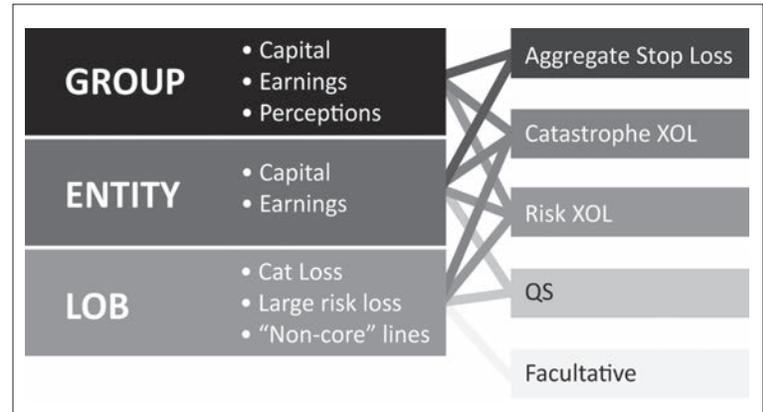
ERM can be thought of as having three stages that build on each other. The first stage is "individual risk management." In this stage, insurers will concentrate on making sure that they are addressing each of their key risks appropriately. In this stage, insurers will concentrate on making sure that they are consistently addressing all of their key risks—and addressing those risks in a transparent and disciplined manner.

The risk profile of a P&C insurer is much different from that of a life insurer. Often the majority of risk exposure comes from the insurance risks, while the majority of the risk profile of life insurers often comes from investment risks. So in the individual risk management stage, P&C insurers can use reinsurance to carefully mold their retention.

An insurer's ERM process looks very much like the process of designing a reinsurance program. Both start with the articulation of risk appetite and tolerance—how much and what kind of risk the insurer wants to have (retain) at the end of the process (though the reinsurance world may not have used those particular terms

until recently). Figure 1 shows how insurers look at risk from a variety of perspectives and choose from a variety of reinsurance tools¹ to achieve their desired outcomes.

Figure 1
Risk Determines Reinsurance Tool



Source: Alice Underwood, FCAS

The second stage of ERM is called aggregate risk management. In this stage, ERM is focused upon achieving a predetermined relationship between risk and risk-bearing capital. This stage is usually associated with the concept of risk appetite and tolerance.

Because reinsurance purchasing is a familiar process, insurers seeking to establish an ERM framework can draw upon this experience to inform their ERM risk appetite and tolerance. Management choices about reinsurance protection illustrate how much insurance risk a company is willing to retain from individual insureds, single events, lines of business and annual underwriting results. ERM-related risk tolerances can be developed by extending the reinsurance thinking to other risks.

If, for a variety of reasons, an insurer finds that its aggregate risk does exceed its risk tolerance, the insurer has a number of options, several of which are tied to reinsurance:

1. Change investment strategy.
2. Raise capital.
3. Change underwriting policies.
4. Modify reinsurance program:
 - Buy additional reinsurance cover through reinsuring an additional part of the business.
 - Reduce attachment and/or increase limit.
 - Increase percentage placed.

In many cases, insurers will find that the reinsurance options are the least disruptive of company operations and often the most economical as well.

The third stage of ERM is risk reward management. Under this stage, a corporate group will look at the risk-adjusted returns of all of the insurer's major activities and help steer decision-making toward achieving a good risk adjusted for the entire group.

In this stage, ERM thinking may also influence reinsurance decisions. For insurers with significant reinsurance purchases and developing ERM programs, the ERM thinking often spurs an evolution of reinsurance philosophy. Taking an enterprise-wide view of the risk profile, companies often choose to consolidate historically separate purchases on similar risks, thereby taking advantage of diversification benefits and efficiencies of scale. As they develop greater confidence in their selected risk appetites, insurers may decide to calibrate reinsurance structures to achieve better alignment with corporate strategy. And they may adjust the balance of retained risk among lines of business in light of temporary or longer-term differences in risk-adjusted returns.

PERSPECTIVE OF RATING AGENCIES AND REGULATORS

At the same time, outside bodies such as rating agencies and regulators have been urging that insurers take up ERM. They all agree that reinsurance is a crucial risk management tool and will want to learn how well the reinsurance program fits with ERM goals.

Starting in 2005 at Standard & Poor's and in 2008 at AM Best, the rating agencies have considered risk management an important aspect of their ratings of insurers. They look for insurers to apply a not-too-hot, not-too-cold approach to reinsurance. Insurers are expected to transfer out a significant part of the high-end, "catastrophic" risks in their insurance portfolios to reinsurers. An insurer that retains too much of its extreme tail risk is seen to have a poor risk management approach. But insurers can also be judged for buying too much reinsurance. Those insurers are seen by the rating agencies as being overly dependent upon reinsurance and unable to continue their business strategy without that support. When a catastrophic event does occur, such as a hurricane, the rating agencies will look to see that insurers have in fact purchased the right amount and form of reinsurance by reporting losses that parallel the bulk of the industry.

In the U.S. and Canada, insurance regulators have adopted requirements for an "Own Risk and Solvency Assessment" (ORSA). As a part of the ORSA process, insurers will do advance stress testing of the exact sorts of events that are discussed above. The regulators will not have to wait until after a catastrophic event to see if insurers have purchased sufficient reinsurance.

The ORSA process involves creating a series of stress tests that are related to all the key risks of the insurer and then determining the impact on the insurer's earnings, surplus and risk tolerance of the stress scenario. Unique to the ORSA process,

insurers are encouraged to look at the scenarios where the loss causes them to breach their risk tolerance and to devise pro forma actions that might be taken after one of those severe stress events. Key among the potential courses of action in those situations is reinsurance. With reinsurance, insurers can drastically alter their retained risk and therefore shrink their retained risk to conform to their remaining capital.

REINSURER'S PERSPECTIVE

The investment and insurance losses that major reinsurers experienced in 2001 served as a wake-up call to the industry. Since that time, reinsurers have increasingly sought to coordinate their risk acceptance and retrocession strategies through the lens of ERM.

For many reinsurers formed following 2001, ERM has been a fundamental part of their business strategy. While the 2008 financial crisis was an unprecedented shock to world markets, reinsurers have for the most part weathered that storm—and the ensuing economic challenges.

In recent years, prudent risk management is increasingly seen as a differentiator. For example, since 2013, Partner Re had disclosed in its annual report risk limits for a dozen major risks along with its actual risk acceptance. Other international reinsurers have followed suit.

It's hard to know to what extent ERM drives reinsurer behavior, but as ERM has become further ingrained over the last several years, reinsurers have shown some different behaviors, even in the face of an extremely competitive marketplace as compared with prior decades. Catastrophic events have not created major dislocations in the market or, in general, threatened reinsurer solvency. Capacity has been generally available, and reinsurers are showing more discipline in avoiding overconcentration.

And, despite competitive pressure from alternative capital and the hardship of persistently low investment returns, analyst consensus places reinsurer return on equity expectations in a respectable range in the current economic environment, even in years with moderate levels of catastrophes. ■



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ENDNOTE

1 P&C Reinsurance Landscape article, *Reinsurance News*, July 2018.

DI for Dinner

Measuring Disability Income Insurance Volatility Using Survival Models

By Kai Kaufhold

A year ago, we started our SOA *Reinsurance News* series on predictive modeling using survival models with a casual introduction to survival models over lunch. In the second article, for afternoon tea, so to speak, we saw survival models being successfully applied to persistency within a book of life insurance business and discovered that this method also lends itself well to illustrating the drivers behind differences in persistency or mortality. In this third and final article of the series, we will wrap it up with a wholesome five-decrement dinner. My aim is to demonstrate that survival models are useful for predicting the outcomes of insurance business under multiple decrements (five, no less!) and then take it even one step further and show that we can use the method to quantify the volatility of a portfolio.

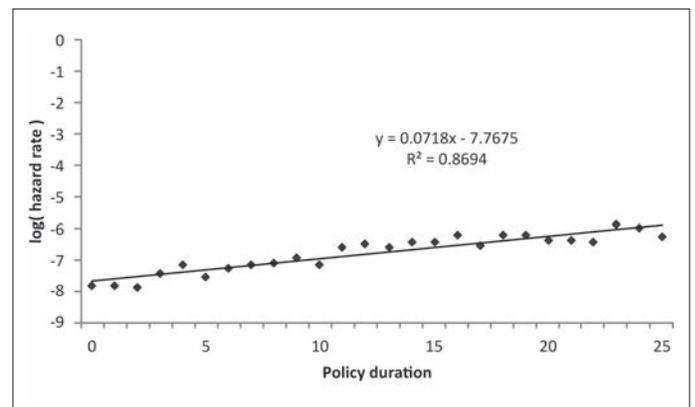
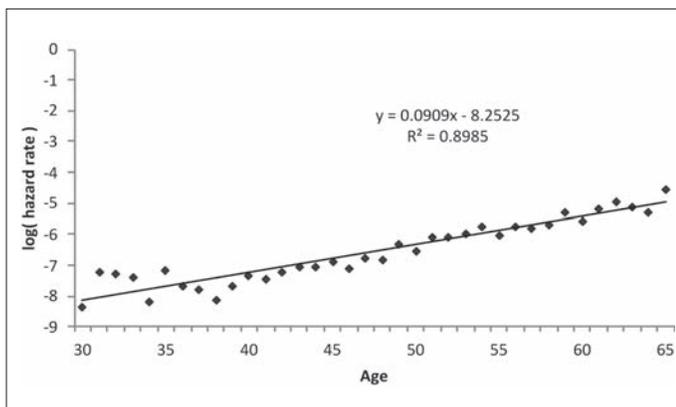
Most life insurance products combine multiple competing risks, such as death and lapse, or death, disability and lapse. For traditional actuarial models, this poses substantial challenges, because the actuary must make assumptions about the distribution of events during discrete time periods. By contrast, parametric survival models in continuous time entirely avoid



that difficulty, because in each instance, each risk is acting simultaneously to all others.

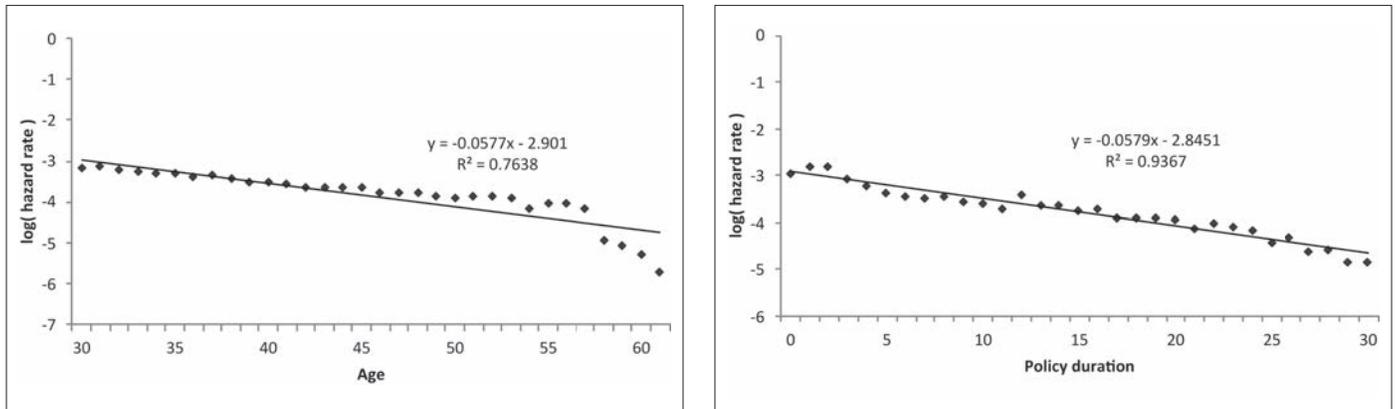
Let's look at a case study of disability income risk. The challenge was not just to predict disability claims but to measure their volatility, to quantify by how much the predicted best estimate was likely to be wrong. To do this, I teamed up with a reinsurer, created a statistical model that described disability income insurance risk, and then used that model within a

Figure 1
Crude Hazard Rates for Active Death Against Attained Age and Policy Duration



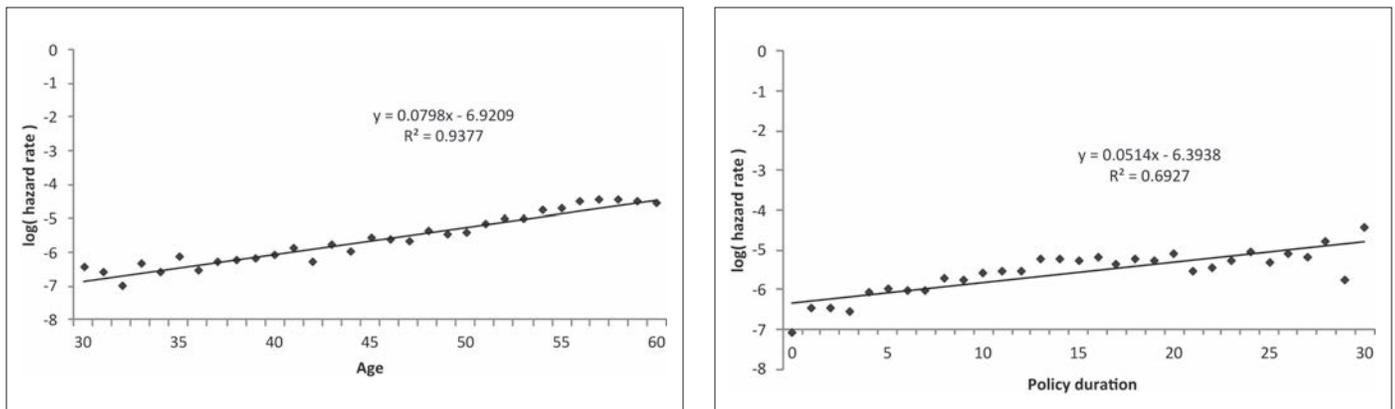
Source: Own calculations of time exposed to risk by age group and policy duration since inception.

Figure 2
Crude Hazard Rates for Lapse Against Age and Policy Year



Source: Own calculations of time exposed to risk by age group and policy duration since inception.

Figure 3
Crude Hazard Rates for Incidence of Disability Against Age and Policy Year



Source: Own calculations of time exposed to risk by age group and policy duration since inception.

Monte-Carlo simulation to measure volatility. We applied our method first to German disability income business (Berufsunfähigkeitsversicherung) and then to Australian individual disability income business.

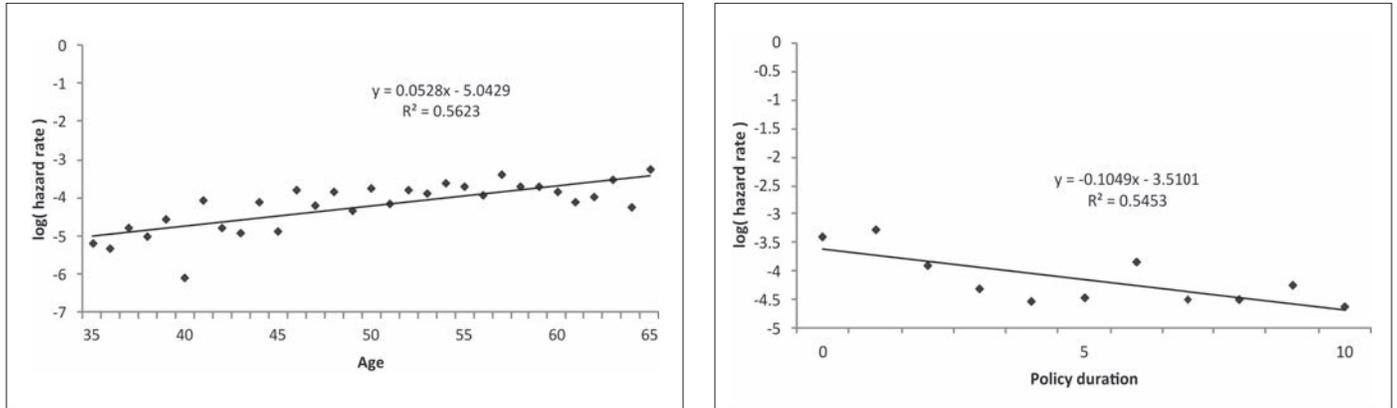
Before designing the parametric survival models that we used for our predictive analysis, we reviewed the raw data to get an idea of the basic shape of the crude hazard rates. An active policyholder can die, lapse the policy or become disabled. Figures 1–5 include two charts—the left chart showing the age dependence of the respective hazard and the right-hand chart showing the hazard rates against policy duration. Note that in all cases, we have taken the logarithm of the crude hazard rates. I have included trend lines to indicate that on a logarithmic scale, a linear model should reasonably reflect the risk.

Naturally, the most important decrement is the incidence of disability, shown for the German case study in Figure 3, which increases with age and policy duration.

Switching to disabled lives, there are two ways benefit payments can terminate, except reaching the end of the benefit period, of course: by the disabled person either dying or going back to work. Mortality increases more moderately by age for disabled lives than for active lives. We also see in the right-hand chart of Figure 4 that disabled mortality is highest just after the disability occurs and decreases over time.

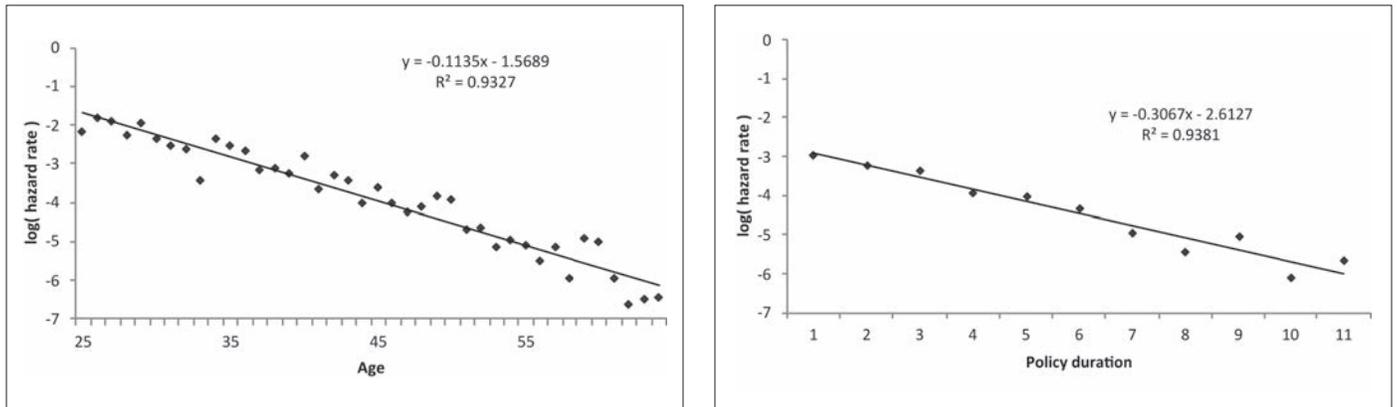
And finally, the chance that disabled people return to work declines both with age and with time since the disability occurred, as can be seen in Figure 5.

Figure 4
Crude Hazard Rates for Disabled Deaths Against Age and Duration of Disability



Source: Own calculations of time exposed to risk by age group and time since the date of disability.

Figure 5
Crude Hazard Rates for Reactivation Against Age and Duration of Disability



Source: Own calculations of time exposed to risk by age group and time since the date of disability.

An important feature of the disabled life models is that we have much fewer data, because we are limited to disabled lives. This explains the greater variability of results and relatively low scores for the R^2 statistic on disabled deaths. By contrast, the reactivation rates are much more tightly bunched around the log-linear trend line.

Having identified the basic shape for our parametric hazard rate function as a simple linear exponential function, equivalent to the Gompertz law of mortality, we can now use the maximum likelihood method to fit parameters and identify additional risk factors that might have an impact on the respective hazards, just as we saw in the previous article on survival models in the July issue of *Reinsurance News*. In our

case study for the German disability portfolio, we limited the models to include only age, duration and gender as risk factors and thereby graduated a set of assumptions that was directly comparable to the German industry tables for disability risk.

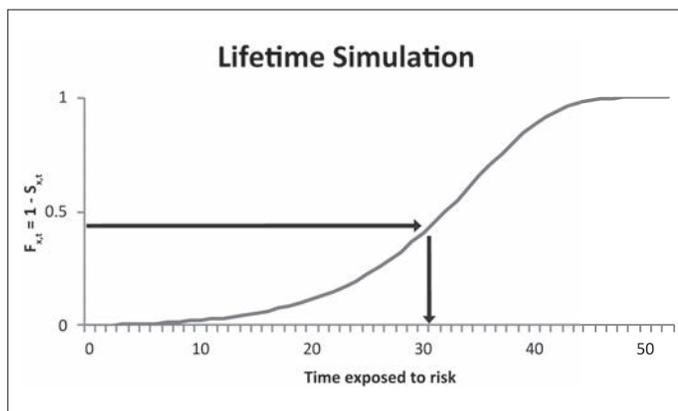
We now use the five hazard rate functions for the five different decrements to predict the financial outcome of a disability income insurance portfolio and then run a Monte Carlo simulation, in which we go through the entire portfolio and simulate the outcome for each person. First, we “roll three dice”¹ to find out when each person lapses, dies or becomes disabled. All we need to do is check which happened first. If the first event predicted to happen is disability,

If we acknowledge that incidence rates, lapse, death and termination rates are not deterministic, then we have to accept that the overall risk is 50 times higher.

we roll two more dice to decide whether the disabled person dies, goes back to work or remains disabled to the end of the benefit period.

The reason we can do this so easily is that we have analytical (continuous) expressions for the different hazard rates and thus the survival curves, which give us the cumulative probability of an event. By inverting the survival curves, we can use a randomly picked probability of, say, becoming disabled to calculate exactly when that event will take place, as illustrated in Figure 6.

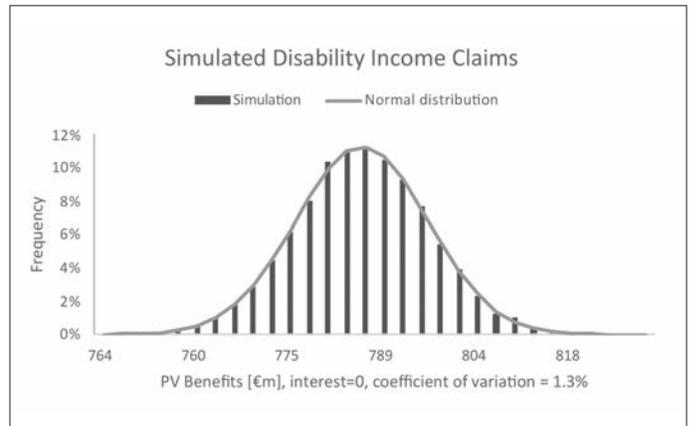
Figure 6
Illustration of Disability Risk Simulation—Idiosyncratic Risk



Source: Own calculations of cumulative risk of becoming disabled.

If we go through this process of rolling the dice for each life in the portfolio many times, we will get a distribution of disability claims that reflects idiosyncratic risk (i.e., the fact that disability, death, lapse and reactivation are all random events that will affect different individuals differently). This risk is often also referred to as process risk. An example of such a distribution generated for our German book of disability income risks is given in Figure 7.

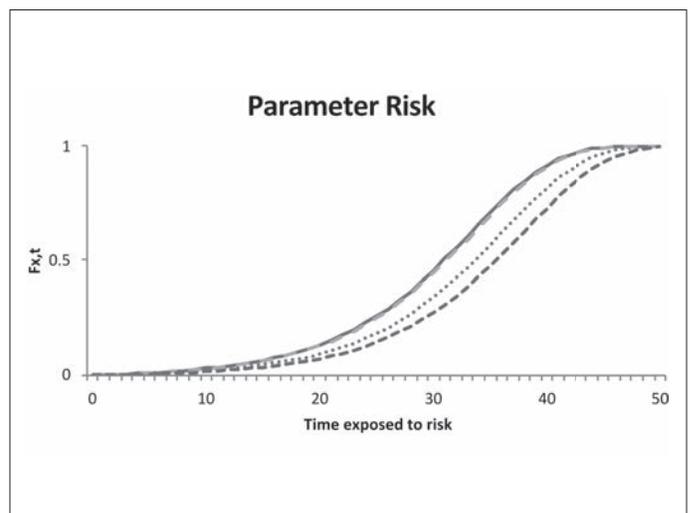
Figure 7
Simulated Distribution of Disability Benefits—Idiosyncratic Risk



Source: Own calculations of random time of disability and contingent duration of disability claim for a portfolio of 140,000 lives. Monte-Carlo simulation with 50,000 runs. Coefficient of variation: 1.3 percent.

Within this same simulation framework, we can also incorporate estimation error by replacing the fitted parameters with a set of random parameters. Let's say a parameter has a maximum likelihood estimate that comes with a high standard error. Then the randomly "perturbed" new parameter should be farther away from the best-estimate parameter than for a parameter with a small standard error.² Figure 8 illustrates misestimation risk influencing the simulated survival curves.

Figure 8
Illustration of Disability Risk Simulation—Misestimation Risk

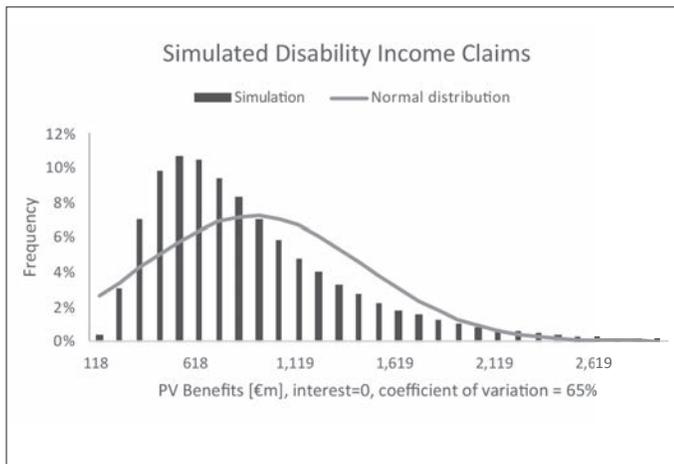


Source: Own calculations of cumulative risk of becoming disabled. Different cumulative distribution functions correspond to different sets of parameters, which have been randomly displaced from the best estimate in a way consistent with the experience data.



Rerunning the simulation 50,000 times, including misestimation risk, gives us a distribution as shown in Figure 9. To put it mildly, this distribution no longer has anything to do with a nicely behaved normal distribution. The simulated disability claims are heavily left-skewed, and volatility is 50 times higher than for the simulation without misestimation risk.

Figure 9
Simulated Distribution of German Disability Benefits—
Idiosyncratic and Misestimation Risk

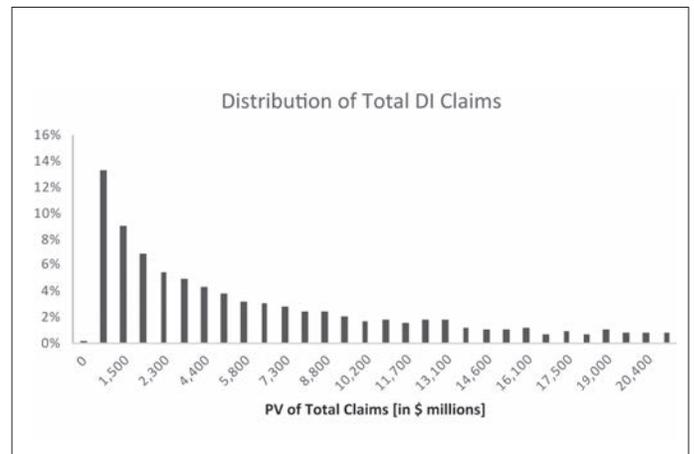


Source: Own calculations of random time of disability and contingent duration of disability claim for a portfolio of 140,000 lives. Monte-Carlo simulation with 50,000 runs. Coefficient of variation: 65 percent.

What does this mean? In simple terms, disability income risk is perfectly well-behaved as long as we can assume that we know the disability incidence rates as well as all other decrements exactly. Then the law of large numbers applies, and it is possible to predict disability claims quite accurately (standard deviation < 2 percent of mean). If we acknowledge that incidence rates, lapse, death and termination rates are not deterministic, then we have to accept that the overall risk is 50 times higher.

My reinsurance colleagues and I wondered whether this phenomenon applied only to German disability business (say it with me: “*Berufsunfähigkeitsversicherung*,” aka “BU”) or whether disability income risk showed the same profile in other countries. We carried out the same analysis for a portfolio of Australian individual disability income insurance business and were able to confirm that the distribution of claims shows the same pattern, if not worse.

Figure 10
Simulated Distribution of Australian Disability Benefits—
Idiosyncratic and Misestimation Risk



Source: Own calculations of random time of disability and contingent duration of disability claim for a portfolio of 111,000 lives. Monte-Carlo simulation with 5,000 runs. Coefficient of variation: 143 percent.

The total claims distribution for Australian disability income risks shown in Figure 10 is even more left-skewed than the German BU results and has a coefficient of variation that is twice as high. There are several reasons things would be worse for the Australian portfolio that we analyzed. For example, the Australian portfolio showed greater heterogeneity between short-term and long-term disability benefits and different occupational classes. We were also able to measure annual lapse spikes in the Australian DI portfolio that may have led to anti-selective lapses, which would not be present in the German-level premium disability business to this extent.

From a reinsurer's perspective, all this shocking news about the riskiness of disability income insurance business is, of course, scary but at the same time is the best-possible sales argument. A single life insurance company has no way of handling a large portfolio of disability income risk on its own. It needs the support of a well-diversified, financially strong reinsurance partner who can withstand the potentially catastrophic results of disability income business. Our results prove that disability risk in and of itself is frightfully difficult to get right, even if you make no mistakes.

See you in Las Vegas³—if you are interested in rolling some dice or discussing DI over dinner. ■



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ENDNOTES

- 1 In this example, rolling the dice symbolizes drawing uniformly distributed random numbers between zero and one.
- 2 For the interested practitioner, S.J. Richards gives an in-depth introduction to mis-estimation risk in his paper: Mis-estimation risk: measurement and impact, *British Actuarial Journal*, 21(3), pages 429–475 (including discussion).
- 3 ReFocus 2019 will take place March 10–13, 2019, in Las Vegas and is jointly sponsored by ACLI and SOA.

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Industry 4.0— Implications for the Insurance Industry

By Leo Ronken

The topic of Industry 4.0 has been discussed at many conferences in recent times. When you talk to participants and colleagues, you quickly realize that different people associate this buzzword with different things. To make matters worse, the term is now used in almost every industry as a synonym for the digitized, automated and interconnected world known as the “smart factory.”

This article discusses the term Industry 4.0 and examines its impact on property insurance.

Industry 4.0 is a new level of organization and control over the entire value chain of a product—from idea and design to flexible production of customized products and delivery to the customer. Customers and business partners are directly involved in the processes.

Industry 4.0 is a new level of organization and control over the entire value chain of a product.

The term Industry 4.0 is synonymous with a range of available automation, data exchange and manufacturing technologies to increase production flexibility and efficiency/profitability and to advance the value chain conceptually in industrial production and manufacturing. The basic principle is the intelligent networking of machines, workpieces and systems, as well as all other business processes along the entire value chain, in which everything is regulated and controlled independently.

The ultimate vision of Industry 4.0 is to create an intelligent factory in which all production and business units, machines and devices communicate with each other—as much as possible without human intervention but involving both employees and external suppliers.

It should not be forgotten that the term Industry 4.0 is used synonymously for digitized production, with the ultimate goal of increasing production at significantly lower costs.

DESIGN PRINCIPLES

The design principles of Industry 4.0 can be summarized as follows:

- **Networking/interaction**
Machines, devices, sensors and people can network with each other and communicate via the “internet of things” or the “internet of people.”
- **Information transparency**
Sensor data extend information systems of digital factory models to create a virtual image of the real world.
- **Decentralization**
Cyber-physical systems are able to make independent decisions.
- **Real-time decisions**
Cyber-physical systems are able to collect and evaluate information and translate it directly into decisions.
- **Service orientation**
Products and services (of cyber-physical systems, people or smart factories) are offered via the internet.
- **Modularity**
Smart factories adapt flexibly to changing requirements by exchanging or extending individual modules.

CHALLENGES FOR INDUSTRY 4.0

Although the goals of Industry 4.0 sound promising, a number of challenges remain to be resolved, including:

- Availability of relevant information in real time through connectivity of all entities involved in the value chain.
- Reliability and stability for critical machine-to-machine (M2M) communication, including very short and stable latency (real time).
- Progress in network technology toward real-time actions.
- The need to maintain the integrity of production processes.
- Increased vulnerability of the supply chain.
- IT security problems.
- Data, network, cyber and device security, etc.
- The need to avoid unexpected IT errors that can lead to production downtime.

DEFINITION

Industry 4.0 represents the intelligent networking of product development, production, logistics and customers. It describes a network of autonomous, self-controlling, self-configuring, knowledge-based, sensor-supported, spatially distributed production resources (production machines, robots, conveyor and storage systems, and operating resources), including their planning and control systems.¹ The historical evolution of Industry 4.0 can be summarized as follows:

PHASE	CHARACTERIZED BY	PRODUCTION SIZE	PLACE OF ACTIVITY
Manufacture	Handcraft	Individual manufacture	Workshop
Industry 1.0	Mechanization	Serial individual production	Factory
Industry 2.0	Mass production/ electrification	Mass production	Factory
Industry 3.0	Automation/ digitization	Flexible mass production	Alliance of factories
Industry 4.0	Cyber-based production/ information	Individual mass production	Virtual factory

- Protection of industrial know-how.
- Lack of adequate skills to drive the Industry 4.0 revolution.
- Threat of redundancy problems in the IT department.
- Ethical and social impact on society (what would be the impact if a machine were to override the human decision?).

CHALLENGES FOR THE INSURANCE INDUSTRY

The insurance industry will continue its interest in collecting data and information for underwriting as well as preparing and evaluating it by linking new algorithms and artificial intelligence principles. For example, information collected at the operating and machine levels could help identify certain patterns and predict when maintenance work or servicing is required or when a machine is nearing the end of its life. This allows a more detailed assessment of the actual exposure, which in turn can have an impact on all business areas of the insurance industry, so that the insurance principles might have to be redefined accordingly.

In the future, a claim will affect several lines of business simultaneously, which will often make it difficult to identify a person liable for a loss and to assign the loss to a line of business; this in turn will ultimately complicate claims settlements. The probability of business interruption losses—caused by fire or natural catastrophe, for example—will increase due to the virtualized value chain that is the result of the optimization of systems and their dependency on the environment or on suppliers, customers, energy supply, etc. Ultimately, this could lead to a significant extension of the recovery period following a loss event, which will, in particular, be a consequence of

the search for causes, the substitution of destroyed machines, plants, networks and communication channels.

As a further consequence, the complexity of the linked systems and technologies will also result in exposures not yet known, with serious but also unexpected outcomes. For example, a cyberattack or security failure could lead to an interruption of production/supply, whereby cascade effects can ultimately even lead to a complete collapse of the entire value chain. For the insurance industry, the outcome of such an event could be comparable to current losses from natural catastrophes or a pandemic event.

The problem is that industry and insurers generally have little, if any, experience with the real, but intangible and difficult-to-quantify, risks arising from the networking and automation of business processes.

OPTIONS FOR INSURERS

The economy is doing everything it can to make Industry 4.0 a reality as quickly as possible. One example is the Mindsphere initiative launched by Siemens, a cloud-based open internet of things operating system that can already be used today by the companies involved. It was developed for three purposes:²

- To simulate plant and machine behavior before conversion and modernization.
- To monitor machines set up at customers' businesses.
- To compare production, quality and maintenance data with other machines and thus increase efficiency and the ability to identify problems—for example, imminent

defects—so that repairs can be carried out early and a prolonged production downtime can be prevented.

Currently under discussion is the extent to which the insurance products available today in the property and liability lines of business offer sufficient cover for this concept. As Industry 4.0 is controlled via networks and data streams, protection against cyberattacks will certainly be taken increasingly into account in the current coverage concepts.

In addition, however, new risks will arise with integrative and automated production, and new insurance solutions will have to be developed to cover these risks. The use of the new technologies will result in new and different liability scenarios for all market participants. One of the difficulties will be to determine, for example, what caused the damage and who could be held liable. In other words, is there insurance cover for a specific loss and, if so, under which insurance policy?

In this respect, it is necessary for the insurance and reinsurance industries to address the topic of Industry 4.0 at an early stage and to support policyholders in the implementation of their Industry 4.0 concepts—in order to recognize the associated changes in risks and their implications for the liability and property insurance cover. In order to establish the insurance industry as an important know-how carrier and partner for the respective policyholders, a discussion with policyholders must be conducted as a matter of urgency regarding potential risk scenarios and possible protective measures.

Furthermore, insurers should proactively support the industry from the outset in the development of necessary protection and prevention measures—such as predictive maintenance, defense against cyberattacks, drawing up business continuity plans, measures against the failure of critical infrastructures—in order to identify and avert potential risks before their manifestation so that a possible loss can be avoided (i.e., preventive risk management).

In addition, the insurance industry should promote the development of its own concepts for the analysis and assessment of new risks, including:

- Turning away from burning cost toward risk models.
- Developing new loss-prevention measures.
- Developing artificial intelligence.
- Introducing more extensive data analyses and forecast models in order to mitigate losses before they occur.

The use of big data/internet of things technologies can, for example, help insurers identify new risks and, if necessary, develop appropriate insurance solutions. This will include the development of new insurance products that meet both the challenges and exposures as well as the loss-prevention and mitigation measures of policyholders (e.g., model terms and conditions for an

Industry 4.0 all risks policy). Ultimately, the decisive element will be development of new ways to cope with accumulation scenarios by Industry 4.0 loss events, with the focus on major losses.

In addition, the internal and external business processes of insurance companies (keyword: digitization) will be affected, for instance, in the areas of communication, transparency, claims handling, preparation of proposals, etc.

CONCLUSION

If Industry 4.0 is implemented as planned, it will lead to a revolution in existing business processes that will also affect the insurance industry, which will need to adapt both its processes and its current insurance products.

In accordance with the promoted goals, Industry 4.0 can create an enormous added value, especially for industrial companies and not the least for our global economy and society. It will be accompanied by the generation of enormous data streams that can be evaluated and used for resource-efficient and high-quality production. Ultimately, it will affect our well-known world of manufacturing and selling products and finally our whole lives.

However, this concept will also entail new risks, such as cyber, data protection, failure of critical infrastructure and uncorrelated effects.

Industry 4.0 will change the insurance industry as a whole and our currently well-known and widely used strategies for defining risks, insurance, underwriting exposures and insurance products. This means that the Industry 4.0 concept will also be a revolution for the insurance sector.

This requires those in the insurance industry to follow developments and inherent changes in the industry as closely as possible and to adapt current insurance products to the new realities. In this respect, one can ultimately speak of today's insurance industry as moving toward an Insurance Industry 4.0. ■



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ENDNOTES

- 1 <https://www.fraunhofer.de/de/forschung/forschungsfelder/produktion-dienstleistung/industrie-4-0.html>.
- 2 *Mindsphere*, <https://www.siemens.com/global/de/home/produkte/software/mindsphere.html>.

The Bulletin Board

Updates on important events related to the Reinsurance Section

BEST ARTICLE OF 2018

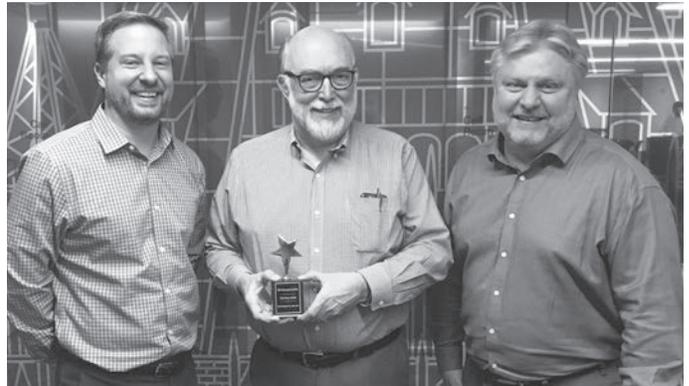
The 2018 *Reinsurance News* best article prize was awarded to Dave Ingram, executive vice president for Willis Re, for his article “The P&C Reinsurance Landscape.” The article appeared in the July 2018 issue. It provides a brief but unique tour of the property and casualty (P&C) reinsurance landscape as seen through the eyes of an actuary with long-standing experience in both life and P&C reinsurance. The winning article was voted upon by two sitting members of the Reinsurance Section Council and the editors of *Reinsurance News*. The prize was handed over on the occasion of the meeting of the Reinsurance Section Council in December 2018.

Why the prizes? Just a small token of appreciation to recognize the tremendous effort of our volunteer authors, who share their experiences and knowledge, whether professionally or personally. It would be impossible to publish three information-packed editions per year without their contribution.

Please feel free to contact Ronald Poon-Affat at rpoonaffat@rgare.com and/or Dirk Nieder at nieder@genre.com if you are interested in submitting an article for 2019. We are always looking for interesting articles. You might even win a prize!

THE REINSURANCE SECTION COUNCIL

The Reinsurance Section Council and friends prepare for 2019 during their annual face-to-face meeting held in New York City in December 2018. ■



Dave Ingram (middle) is pictured with Dave Vnenchak (left) and Mike Kaster (right).



Top row (left to right): Jim Miles, Laura Muse, Emily Roman, Jeremy Lane, Jean-Marc Fix. Bottom row (left to right): Xueli Zhang, Laurie Kolb, Kyle Bauer, David Vnenchak, Mike Kaster.



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