

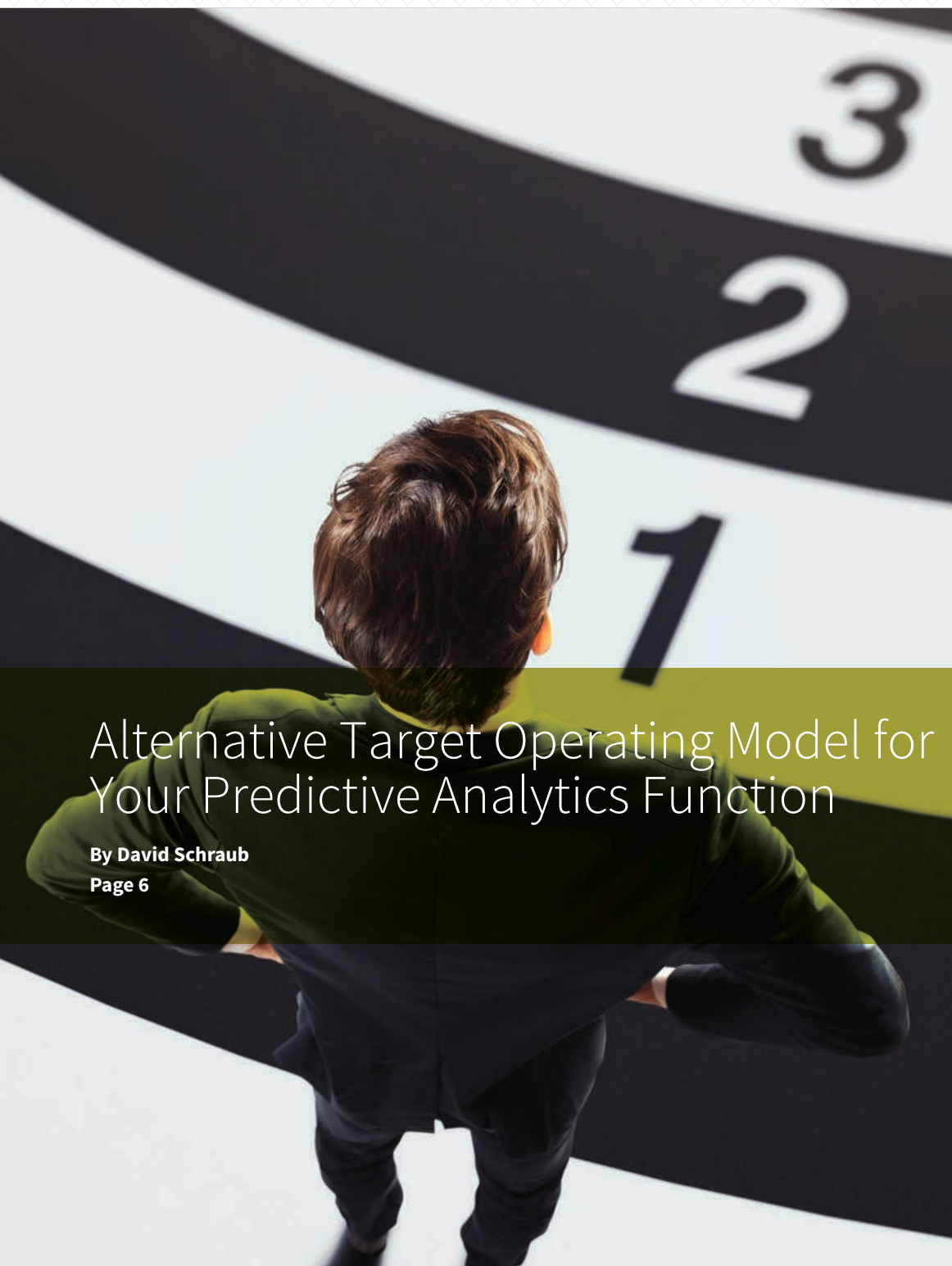


SOCIETY OF
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TECHNOLOGY
SECTION

CompAct

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Letter From the Editors

By Ravi Bhagat and Hugh Lakshman

Welcome to the fall edition of *CompAct*! First and foremost, we want to extend a heart-felt thank you to those who provided feedback on the spring edition of *CompAct*. We appreciate the feedback and use it to motivate self-reflection and the continual improvement of the newsletter. Moreover, we recognize the feedback as a sign that our readers are genuinely engaged and interested in the published newsletter content that strongly guides the direction of future editions.

With that said, the latest edition of *CompAct* continues to include a diverse set of topics that have central (and occasionally peripheral) technology elements, and more importantly, to showcase a set of topics which aim to pique the interest of readers and ultimately spur additional dialogue and continued self-development. In addition to diversifying the spectrum of content, it has been our primary focus to ensure we have a good mix of topics that cover multiple dimensions such as practical vs. theoretical considerations, introductory vs. advanced subject matter, and legacy vs. disruptive themes.

The latest edition of *CompAct* continues to include a diverse set of topics that have central (and occasionally peripheral) technology elements.

Lastly, in the continued spirit by which we collaboratively shape this newsletter, we encourage you to submit articles for publication, topics that are of interest to you, and your feedback. We truly appreciate everyone's contributions as they directly correlate to the worth and insightfulness of the newsletter. For thoughts, questions and feedback, we can be reached at ravibhagat@kpmg.com and hugh.lakshman@ibx.com.

In this edition of *CompAct*, we have seven articles that span a broad spectrum of topics.



ALTERNATIVE TARGET OPERATING MODEL FOR YOUR PREDICTIVE ANALYTICS FUNCTION

Building upon the industry momentum surrounding data analytics, companies are increasingly looking to use predictive analytics in various elements of their operating model, but their implementation often involves the investment of significant resources. David Schraub from the SOA contributed an exploratory article that touches on incorporating a data robot to help reduce overall costs and realign resource time to more impactful focus areas.

DEVOPS: A JOURNEY TO AN EFFICIENT REGULATORY COMPLIANCE PRACTICE

The successful relationship between IT and business is critical to the long-term success of an organization. Exploring aspects of IT and business collaboration, Soumava Dey introduces the intriguing topic of “DevOps” (i.e., combination of development and operations). As coordination between cross-functional groups becomes more critical to the smooth, successful and compliant-focused operations of an organization, this article provides a thought-provoking introduction into a unique operating model (and mindset).

PROTECTING OUR MOST VALUABLE ASSET

Organizations of all sizes and within virtually all business sectors consider data and information to be one of their most valuable assets. These assets offer great opportunities to expand business potential, solution capabilities and strategic positions, but expose organizations to unique challenges and risks. Alex Zaidlin, Ben Farnsworth and Natalie Huang of KPMG provide a practical article that outlines considerations for actuarial data governance.

MACHINE LEARNING, SKYNET OR THE FUTURE OF ACTUARIAL SOFTWARE?

Sean Hayward from FIS (and vice-chair of the SOA technology Section Council) contributed an insightful article that provides a look into the potential of machine learning in an actuarial setting. In a sign of exciting times, the author notes that machine learning has the potential to become another tool on the actuary's tool belt for solving problems yet to be defined.

LOSS RESERVING IN THE FUTURE

To provide our readers with real-world insight and to showcase technology enablement in today's world, we included an article on reserve modernization using technology innovation that is readily available now. In this article, Chris Nyce and Drew Golfen from KPMG discuss how reserving and reporting enhancements are achievable with reasonable effort, existing technologies and moderate cost outside of extended transformational programs.

IOT BENEFITS BUILD ON EXISTING INFRASTRUCTURE

Wearables and sensors used to monitor and track data are now considered commonplace in nearly everyone's lifestyle and are becoming more and more interconnected. Being able to constructively leverage this data and the increasing connectivity has the potential to improve an organization's ability to identify risks, manage ultimate outcomes, and mitigate certain

types of risk exposures. Nick Leimer from Microsoft provides an informative article that describes some of the relevant benefits that can be achieved by utilizing the Internet of Things (IoT) on existing infrastructures.

FOR NEW LIFE CUSTOMERS, IT'S ALL ABOUT THE EXPERIENCE

Lastly, to round out this edition of *CompAct*, Samir Ahmed from X by 2 contributed a well-articulated article that delves into the customer experience for new life insurance customers. Life insurers are continually looking to enhance the customer experience of their existing policyholders and increase the potential sales base of new customers and this article provides meaningful insight in a highly relatable context. ■



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Letter From the Chair

By Mark Africa

Welcome to the October issue of *CompAct*! We are excited about the continued diversity of technology topics as you will note in this issue and always look forward to your feedback on same, good or bad. Our mix of articles includes an interesting blend of real world implementation related subjects as well as some leading-edge offerings. As we close in on the conclusion of another section cycle, we will highlight our accomplishments/work in progress, discuss our vision with regard to our role within the InsurTech space, and discuss some of the other emerging technology issues that our council and membership have been researching on your behalf.

First, in keeping with the diversity of topics theme of our newsletter, we also recognize the value of the historical inventory of intellectual capital and reference material in past issues of *CompAct*, and due to our current hardcopy format, not all of our history is readily available online. In order to ensure that much of our historical article material is easily referenced, we have begun an effort to assign and/or refresh metadata for each historical article by topic, keywords and competency. We have assigned articles for the past five years of issues and will go back further if our membership agrees to the value of the effort. We also have a similar effort in flight for applications listed in our Apps for Actuaries and the metadata defined for the same. Special thanks to Richard Junker for his leadership and initiative for both of the aforementioned efforts.

Second, we continue to stay close to the InsurTech subject. Our vision as a section is to participate from a proactive perspective in the InsurTech discussion as opposed to reacting to current events. In keeping with the theme of proactive discussion, the Technology Section will co-sponsor an InsurTech Innovation Networking Event Session 142M on Tuesday, Oct. 16, 7–9 p.m. in conjunction with the 2018 SOA Annual Meeting & Exhibit in Nashville. The session is open to section members and non-members, we hope to see you there!

Next, we have our “ear to the ground” on many other emerging topics including, but not limited to, cloud computing, block chain, artificial intelligence, robotics and machine learning. The last two topics are represented in the current issue of *CompAct* along with several other pragmatic offerings. The aforementioned research is in keeping with our mission to be



a resource to access the expertise on a breadth of technology topics of interest to our members. We remain inclusive and include vendor/consultant feedback, as well as carriers, in all Technology Section activities.

Finally, I remain honored to serve on this section with so many talented and energetic council members and friends of the section. We are grateful for the contributions of article authors, and the webcast and meeting presenters and coordinators. If you are interested in participating in the activities of our section, please take advantage of one of these options. For more information, please contact me or Jane Lesch (jlesch@soa.org), our SOA section specialist.

We always look forward to your feedback, thank you for your continued support. ■



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Alternative Target Operating Model for Your Predictive Analytics Function

By David Schraub

The use of predictive analytics to drive the sales and marketing strategies of insurance companies is a trend on the rise. Predictive analytics models used to determine measures such as propensity to buy, etc., is a common way in which predictive analytics is used to inform the sales and marketing strategies of insurers.

The starting point for any predictive analytics initiative is to clearly identify the business need or problem. This will, amongst other things, drive the choice of the model used.

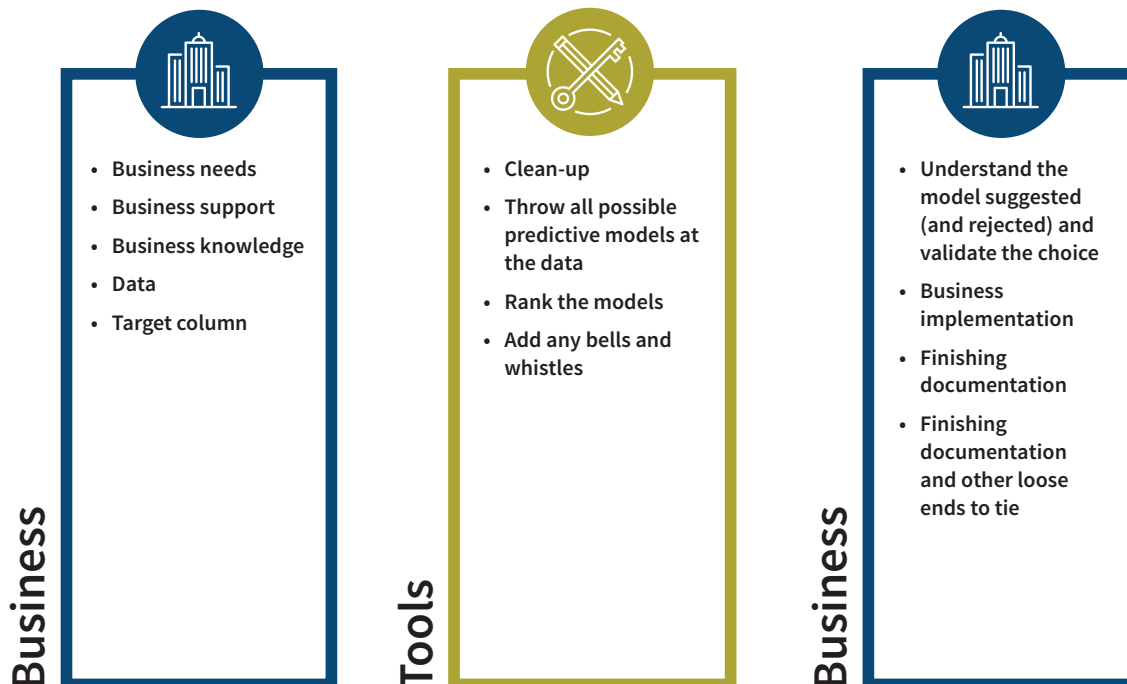
Below is a list of the common steps to be followed for any predictive analytics task:

1. Integrate this predictive analytic endeavor in a business context¹
2. Define the data needed
3. Clean the data
4. Choose model type and build the model
5. Test Model
6. Implement

The usual target operating model for the predictive analytics function is to build a full predictive analytics team. One alternative would be to leverage some tools that can automate some of the time consuming processes. Examples of such software platforms are DataRobot, Alteryx and RapidMiner (and WTW Emblem for property and casualty (P&C) pricing). The goal of such a tool is to lighten² the need for quants on the predictive analytics team by facilitating the model building process.

This tool will not help you with business problems³ and get data for you. This will not replace business knowledge or data dictionary and will not solve the garbage-in-garbage-out issue. You are on your own here.

What the tool does is to help automate simple cleaning (recording null values, creating manageable numbers of buckets if there are too many possible discrete values, using the word cloud function to turn text into variables, detecting outliers, etc.),



build all possible models on a subset of the data (GLM, random forest, gradient boosted trees classifier with early stopping, etc.), test and validate on another subset of the data, and rank all the models by their predictive powers. It adds all the possible bells and whistles for you: Open code visible, technical documentation in Microsoft Word, graphical representation of the predictive force of each variable (with dependence analysis) and many more that I didn't list here.⁴

From there, the business needs to pick it back up. Using the documentation, individual scenarios and other graphs, you need to open the black box and understand the model chosen to fully own it. You can leverage this to more easily explain your model to other stakeholders and get buy-in. You still need to clean up a few loose ends on the documentation and on other areas in order to get to the implementation.

CONCLUSION

No, this tool doesn't bring you coffee. But it could help reduce costs and banish the fear of the investment involved in building a full predictive analytics function with full-time employees. ■



David Schraub, FSA, CERA, AQ, MAAA, is a staff actuary for the SOA. He can be contacted at dschraub@soa.org.

ENDNOTES

- 1 The predictive analytic component exists to solve a business question (e.g. optimize possible prospect, detect potential fraud, or retain customers) in a business context (project funding, timeline...)
- 2 You still need predictive analytics quants on your team, in order to understand what the black box just did. Pressing a magic button without deep knowledge could be potentially problematic.
- 3 I attended a presentation from a provider of such tool. One of the examples they use on their site and in a live demo is about loan performance. Their choice of target column is a Yes/No column representing the loan default, instead of capturing a profitability metric. The speaker acknowledged off-line that this misses all the high-yield profitable loans that default and wrongly includes the low yield performing loans ... but makes the inner working of the tool easier to explain.
- 4 I also admit didn't grasp the usage of all the bells and whistles that were presented during the tool provider session I attended.



Listen at Your Own Risk

The SOA's new podcast series explores thought-provoking, forward-thinking topics across the spectrum of risk and actuarial practice. Listen as host Andy Ferris, FSA, FCA, MAAA, leads his guests through lively discussions on the latest actuarial trends and challenges.

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DevOps: A Journey to an Efficient Regulatory Compliance Practice

By Soumava Dey

Regulatory compliance became more prominent for a variety of big organizations within the last decade and a few occurrences of audit compliance violations were experienced which lead to legal punishment in the form of huge federal fines. Being a part of an insurance company, I did find myself dealing with a lot of audit compliance and various IT regulations on several occasions.

It is obvious that when we manage customer's financial data we do have to comply with all regulations aligned with either business or IT functionalities. The Insurance sector has always been strictly regulated and it is more reluctant to change when it comes to its core functionalities like underwriting, risk assessment, risk projection, etc.; and the Actuarial department is not an exception to that. During my last few years with the Actuarial department I came to the realization that actuaries analyze financial risk and uncertainty using mathematics, statistics and financial theory. Their work is essential to the insurance industry as the actuarial models help businesses to mitigate the cost of a potential risk. So, all IT processes that support actuarial functionalities are subject to financial risk because any drawbacks in the process could cause a substantial impact on a company's actuarial reserve value. Sometimes it reminds me of a famous quote: "With great power comes great responsibility." Hence, it is deemed necessary to implement a continuous scrutiny and compliance review process to ensure the effectiveness of actuarial IT functionalities.

But how do we showcase our credibility to regulate the actuarial IT function so that it can adhere to the different audit compliances, for example, Sarbanes-Oxley Act (SOX), Health Insurance Portability and Accountability Act of 1996 (HIPAA), Financial Control Unit (FCU) and guidelines specific to its business? Fortunately, there is a software engineering practice popularly known as DevOps (combination of development and operation) which can be our best answer to the regulatory compliance issues.

WHAT IS DEVOPS?

The term DevOps became quite popular in the IT industry in 2008. DevOps brings a culture containing a set of practices that could help companies to comply with different IT and business regulations. This technology not only brings automation to the development world, but it also makes sure that any IT functionalities like development and deployment practices should be reliable, traceable and repeatable.

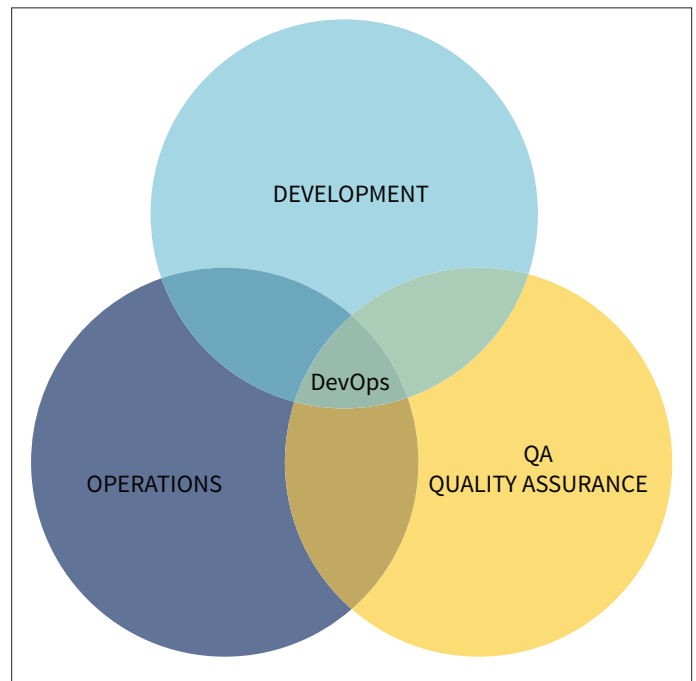
The term "reliable" means bringing transparency into the workplace by getting all the stakeholders (developers, testers, operation staffs, etc.) on the same page in terms of software development progress.

The term "traceable" introduces us to the practice of keeping all the project artifacts in a single repository where everyone has access to it. Eventually this practice leads us to implementing a secure version control solution in a software development world.

The term "repeatable" depicts the significance of a reusable process which supports the continuous integration of a software development practice in an autonomous environment.

Within an organization it helps employees to collaborate using the scientifically automated approach that combines software integration, continuous development and quality testing along with a proper monitoring activity. (Fig. 1)

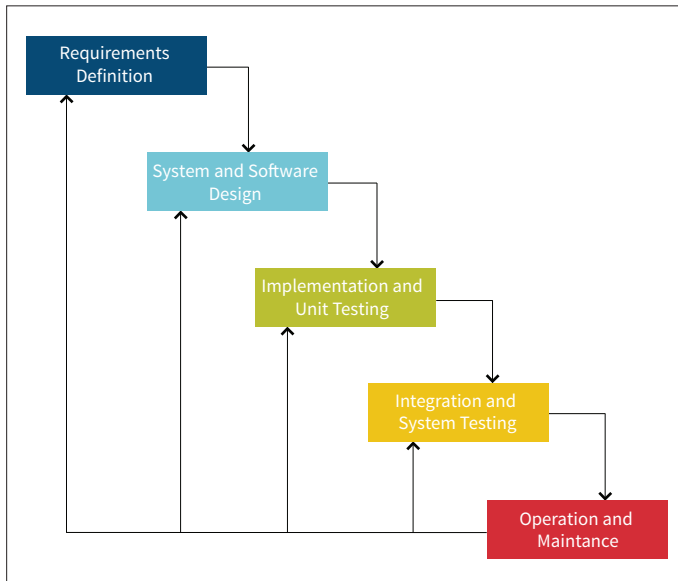
Figure 1
The Elements of DevOps



HOW IS IT DIFFERENT THAN THE TRADITIONAL WATERFALL MODEL AND AGILE?

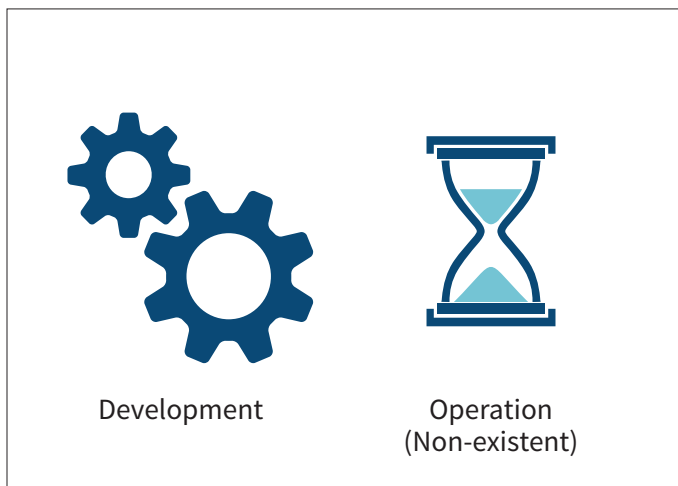
The traditional software development life cycle (SDLC) has mostly depended upon the Waterfall model (Fig. 2) since its inception.

Figure 2
Waterfall Model



The Waterfall model is considered to be the linear approach in software development where results of each phase need to be signed-off before moving to the next one. That means all types of requirements need to be documented in detail before a project starts. Therefore, the scope of radical changes to the

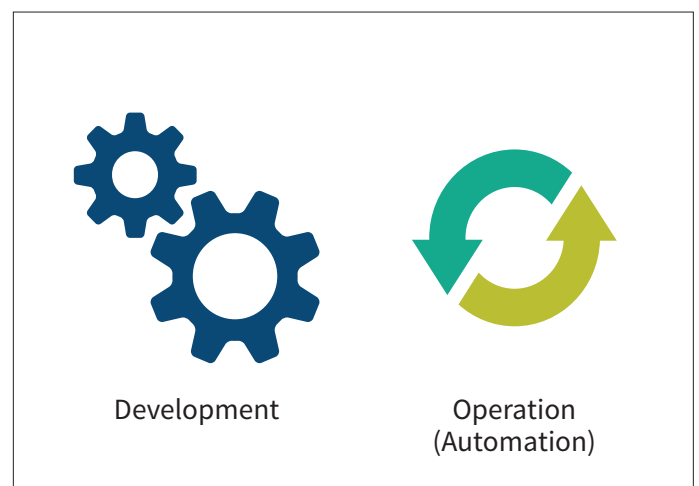
Figure 3
Agile vs. DevOps



requirements during development time should be minimal. So, eventually the success of this development approach totally relies on well-defined plans and detailed documentation. But what if the customer will be dissatisfied with the end-product after the completion of the development project? It is most likely that rollback is not an option at that moment because it is very costly to repeat the development process. This is recognized as one of the biggest drawbacks of the Waterfall model.

But technology found a response to the waterfall approach which could make the development process more transparent, iterative and agile. The Agile process was the best approach that software developers found out at the beginning of the last decade in order to eradicate the limitations of the traditional model. There is no concept like “end product” in Agile because this approach eliminates the stereotypical concept of development and makes the software development process more incremental and flexible. The customer has frequent and early opportunities to see the work being delivered, and to make decisions and changes throughout the development project.

But although Agile came as a savior to the software development world, sometimes it crumbled due to the lack of communication between separate departments within the IT organization. This issue led to a movement called DevOps which eradicated the communication problem between developers and IT operations. It builds on a concept based on continuous communication between the developer, operation and configuration management team. Usually DevOps introduces an operations person who can help build communication between cross-functional teams leading toward a smooth transition from software development to deployment. (Fig. 3)





WHY DEVOPS IS AN ESSENTIAL PROCESS FOR THE ORGANIZATION NOW?

DevOps is a mindset to break the barrier between the Dev and Ops. Building a culture of collaboration, transparency and faster communication is the basic foundation of any DevOps team. Often, it is difficult to communicate between various IT departments within the same organization. And that lack of communication could lead to a blame game when project deliverables go wrong. The introduction of DevOps builds a more trusting relationship and a more sustainable model of development process, run by the development and operation team.

As an example, DevOps tools like TFS, Atlassian JIRA, Basecamp, etc., are helpful in letting the teams collaborate and work together during each phase of a software development life cycle.

This is not just a concept used in the Silicon Valley Tech companies; it is a process being implemented across major organizations around the world. From financial services to health care, retail to manufacture, you can see the digital footprint of DevOps everywhere now.

Let's talk about some of the key aspects of DevOps that made it superior to any other development process models being used by the IT departments in past few decades.

Culture of Collaboration

DevOps builds a culture which stands on "cross-functional collaboration" in every organization. All the development projects are meaningless unless the software developers, IT/Operation professionals and infrastructure put up a cumulative effort to deliver a quality product. In my experience, it is the best culture which can put the Agile process to better use in any circumstance. Most successful companies are on board with the DevOps culture based of a series of communications on a

periodic basis, keep focusing on customer's requirements and adjust project timeline if it is deemed necessary.

Continuous Automation

Automation brings flexibility to DevOps. It brings more agility to the operations along with other important features, which are beneficial for audit compliance, as mentioned below:

- **Version control:** DevOps adopts source code tracking feature using the latest versioning tool available in the market. It means that developers can keep source code in a secure repository that is being offered by various version control tools like git, svn, tfs, etc.
- **Audit trail:** Implement an automation process to keep logging build, deploy and test results.
- **Security:** DevOps brings the concept of repository manager that can only allow certain people to make changes in the code repository and no one has permission to make changes in production unless they are from the IT Operations department.
- **Failover and recovery:** Automatically rolling back a deployment gone badly is way less error-prone than doing it by hand. And it's traceable, and it's faster, which helps you meet your service level agreements (SLAs).

When the IT department follows these four key aspects of automation logics in a repetitive manner, it not only prevents failure in the development project, it also keeps the auditor away.

Documentation

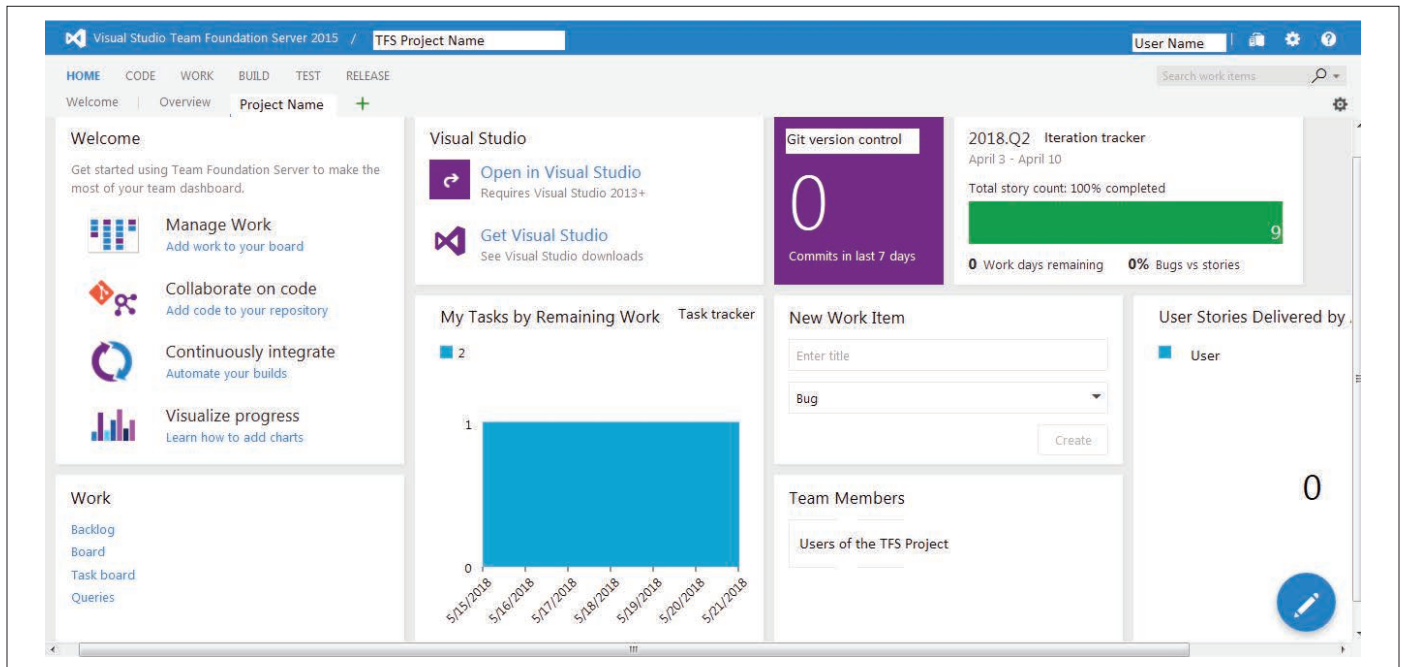
Unlike the Waterfall model, this process allows a customer to review documentation at each phase/iteration of the project. This approach always reduces the chances of delivering an end-product which is not aligned with the project requirement. So, by all means, documentation is required to make customers, stakeholders and team members aware of the project status, requirement change, and final deliverables at each phase, etc. Most DevOps enabling tools like Team Foundation Server (TFS) (Fig. 4), JIRA also introduced dashboard, team portal concept which provides a graphical display of project management work. A TFS dashboard looks like Figure 4.

Measurement

When it comes to following a path of continuous improvement you need to set a benchmark at every starting point. There are different parameters to measure the improvement of a DevOps process. When it comes to process improvement we often asked these questions:

How long does it take to go from development to deployment phase?

Figure 4
Sample TFS Dashboard



How many iterations do we need to complete a development project?

How long does it take for team members to complete a certain task?

DevOps often creates a good foundation that could easily capture the performance metrics and help us find answers to the above mentioned questions. That information comes in handy to help make team decisions, to create the future road map and to go for the next big move.

IT'S A JOURNEY, SO MAKE IT A HABIT

I hope you have a notion about the DevOps concept by now. DevOps technique is more like a mindset than a process or a model, so any actuarial IT function needs to be more adaptive to include the DevOps practices to its development model. DevOps enables IT departments to achieve speed without risking stability and governance.

Any data project, data analysis or continuous development work could easily be monitored by the DevOps in the actuarial world. Main DevOps features like documentation, continuous integration and automation technique are becoming less intimidating to the auditors. In reality, we all know that the work priority changes frequently in a big insurance organization and it can be a cumbersome process for the managers to reallocate resources based on certain prioritization. DevOps is super-efficient to

help the actuarial managers who sometimes find it difficult to transition and prioritize the unplanned work.

Based on my own experience, I would like to emphasize the fact that DevOps plays a key role in transforming some key actuarial IT functionalities from a clumsy state to an agile state within a very short time span. Most of those IT functionalities include activities like managing vendor software, automating the production deployment process, handling SOX and FCU audit control practices, etc. The bottom line is DevOps brings the automation that helps organizations stay in compliance and reduces the overhead cost of extensive audit control process in every year. We all could foresee a future when DevOps will introduce a fully automated audit compliance process and eliminate most of the audit oversight processes that actuarial IT departments go through every year. Eventually that will give internal auditors more opportunities to engage in other compliance activities that happen every year in an insurance company.

In my humble opinion, DevOps is a journey which we all should embark on; trust me, in the future, you won't regret doing that! ■



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Protecting our Most Valuable Asset: Reinventing Actuarial Data Governance

By Alex Zaidlin, Ben Farnsworth and Natalie Huang

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From collection and transformation to application and analysis, actuarial data in life insurance companies is used by various functions for their unique needs. Throughout its lifetime, actuarial data must be carefully monitored to ensure its accuracy and completeness. Incorrect, missing, or inconsistent data, or data misinterpretation and misuse, can lead to significant errors.

Data issues in actuarial modeling and analysis processes can go unnoticed and may result in misstatement in company financial reports. Management of this data should be consistent, transparent, and controlled. Policies and standards around actuarial data management and controls are collectively referred to as actuarial data governance.

WHY DO WE NEED ACTUARIAL DATA GOVERNANCE?

Life insurance companies collect, store, manage, and analyze vast amounts of data, such as confidential policyholder information, actuarial assumptions, and product information.

- Policyholder information includes policy attributes, risk factors, account value and balances, financial transactions, underwriting information, reinsurance information, and other support data.
- Actuarial assumption data includes both economic and noneconomic assumptions plus market and demographic assumptions.
- Product information includes product features and riders, historic sales and policyholder behavioral data, historic financial results, competitive intelligence, and financial and insurance market data.

Actuarial operations rely on data for experience analysis, modeling, reserving, pricing, underwriting, and product development as well as marketing and financial reporting.

Unfortunately, this critical information is error prone due to its breadth and complexity. Described in Figure 1 are common pitfalls that can result in misused, misinterpreted, and incorrectly modified data.

Figure 1
Pitfalls in Actuarial Data Management



In addition to wasting time and resources on resolving data issues, these pitfalls can result in error-prone transformation processes, storage wasted from multiple copies of the same information, numerous unvalidated spreadsheets with overlapping functionalities, and process errors resulting in misstatements and delays in reporting. Implementation of an actuarial data governance framework can mitigate these risks and define protocols and policies to be applied if these errors occur.

Components of Actuarial Data Governance

The actuarial data governance framework is a conglomerate of policies, processes, and controls put in place to manage availability, usability, accessibility, integrity, and security of data. A sound actuarial data governance framework would include

a data governance committee, a defined set of policies, and a roadmap to execute and manage those policies through day-to-day operations. The drivers of initial and continuous success for a sound actuarial data governance framework include:

- Seniority and influence of the governance committee members
- Clarity and ease of adaptability of the actuarial data governance policies
- Periodic critical review, communication, and updates to the governance policies and compliance monitoring
- Establishment and periodic critical reevaluation of effectiveness of controls
- Timely update and implementation of function and current data management software and hardware.

There are many approaches in the insurance and other industries for defining and implementing data governance frameworks. We offer an approach that breaks the actuarial data governance into seven independent components that together constitute a sound governance framework.

While each component and its purpose is individually defined, all seven are to be developed and implemented in tandem

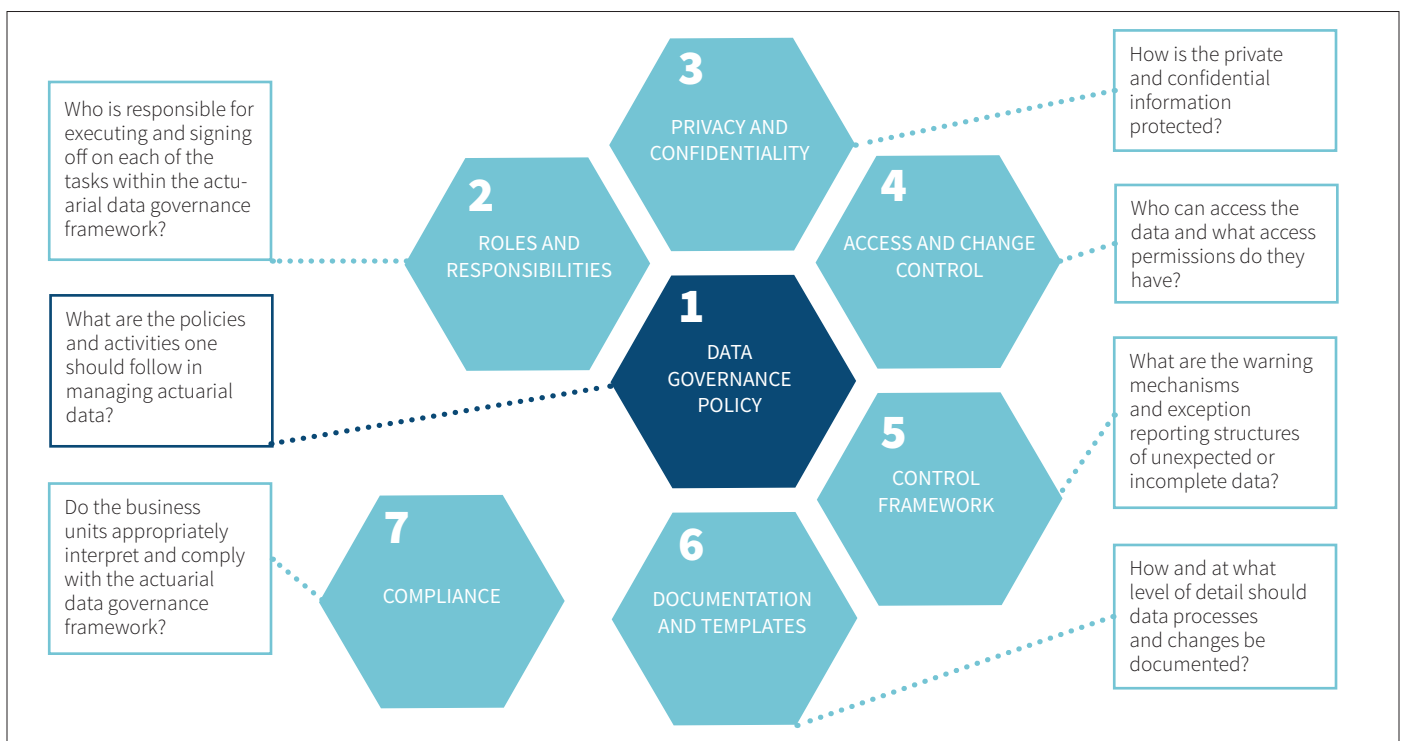
in order to establish a functional and cohesive governance framework. Figure 2 shows the components of actuarial data governance.

1. DATA GOVERNANCE POLICY

The data governance policy is the foundation of any governance framework. It is not meant to be used as process documentation, but rather as guiding principles that are periodically reviewed, updated, and communicated to the impacted groups within the organization.

The actuarial data governance policy consists of a set of standards around retrieving, managing, transforming, preparing, and archiving data. It also contains guidance around data validation, controls, and documentation processes. The policy is typically generalized to be inclusive of multiple areas within the organization. It should include an appendix or supplemental materials that interpret and customize the policy to include standards that are made specific to the application of various groups within business units. These standards encompass internal and external data sourcing to identify quality controlled data sources, data dictionaries, and naming conventions for consistency in data elements across actuarial functions. There are data quality standards to improve data usability, issue management standards to provide standard approaches to manage data-related issues, change management standards

Figure 2
Components of Actuarial Data Governance



over business case implementation, and testing and data management standards over the data life cycle.

Actuaries do not need to “reinvent the wheel” when it comes to data governance policies. Most organizations have IT or risk groups that produce and manage technology and data related policies for the organization. Teaming with these groups in developing actuarial data governance policies, would ensure consistency in spirit and approach to the more general policies within your company.

2. ROLES AND RESPONSIBILITIES

Clearly defining roles and corresponding responsibilities within the company and its business units is critical to successful actuarial data governance framework implementation. However, embedding a governance structure within the actuarial data domain is often not sufficient or sustainable. Life insurers should aim to build a strong foundation for their enterprise-level data governance framework and have actuarial data governance embedded in the overall policy as one of the segments.

Buy-in and oversight from senior management has proven to be critical for sound actuarial data governance framework structures. The company’s senior management program oversight committee should include C-suite executives or their second-in-commands from the Chief Data Office, Chief

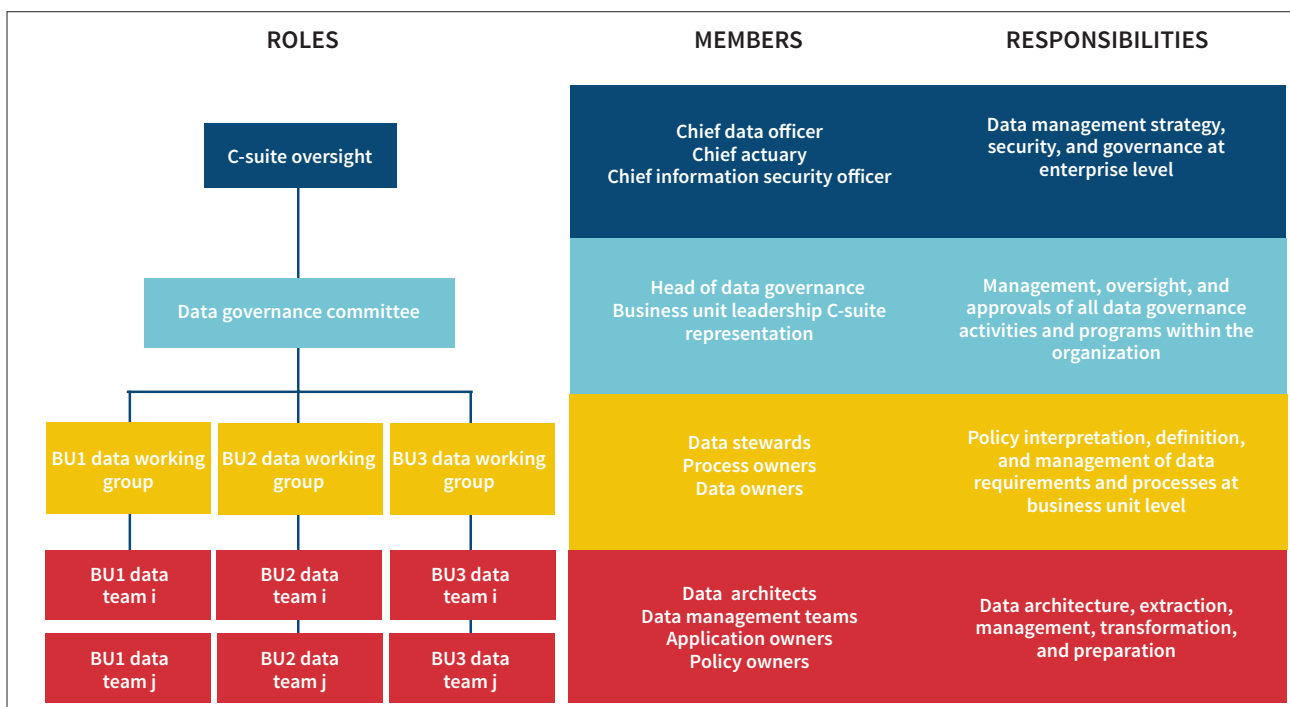
Actuary Office, and Chief Information Security Office. This group is tasked with overseeing the data management strategy, security, and governance at the enterprise level.

Each representative may have veto power in the decision-making process as various considerations of the actuarial data governance framework are developed. At the next level down, a data governance committee should be formed consisting of business unit leadership, the head of data governance, and potentially C-suite representatives. This committee is typically responsible for the management, policy oversight, and approvals of all data governance activities and initiatives within the organization.

Data working groups and business unit focused data teams should be identified for each business unit within the company. These data working groups, consisting of data stewards, process owners, and data owners, are typically responsible for the business unit’s policy interpretation and personalization, definition and management of data requirements, and processes. Data teams will then be responsible for data architecture, extraction, management, transformation and preparation.

Actuaries should be working closely with their IT counterparts to assign roles and responsibilities within the governance structure based on the “right skill for the right job” principle. It is not uncommon to see two individuals, an actuarial business

Figure 3
Data Roles and Responsibilities





owner and an IT technology/data owner, teaming up to fill in a role as they bring different, yet complimentary, skills and institutional knowledge to these roles. An illustrative breakdown of a company's data-oriented committees is depicted in Figure 3.

3. PRIVACY AND CONFIDENTIALITY POLICY

This policy is supplemented by access and change controls and is in place to protect private and confidential data from being viewed, used, or removed by an unauthorized party. The office of the chief information security officer is traditionally responsible for strategy and oversight of this policy. Various data classifications exist within the organization, from policyholders' personally identifiable information (often referred to as PII) to proprietary actuarial assumptions.

Implementation of this policy begins with classifying the levels of confidentiality of all actuarial data sets and identifying the abilities of technological components to read, maintain and output data. Once the policy describing the treatment of confidential data is rolled out and embedded within the organization, it should be periodically reviewed and updated for new data processes and data sets. Periodic mandatory data

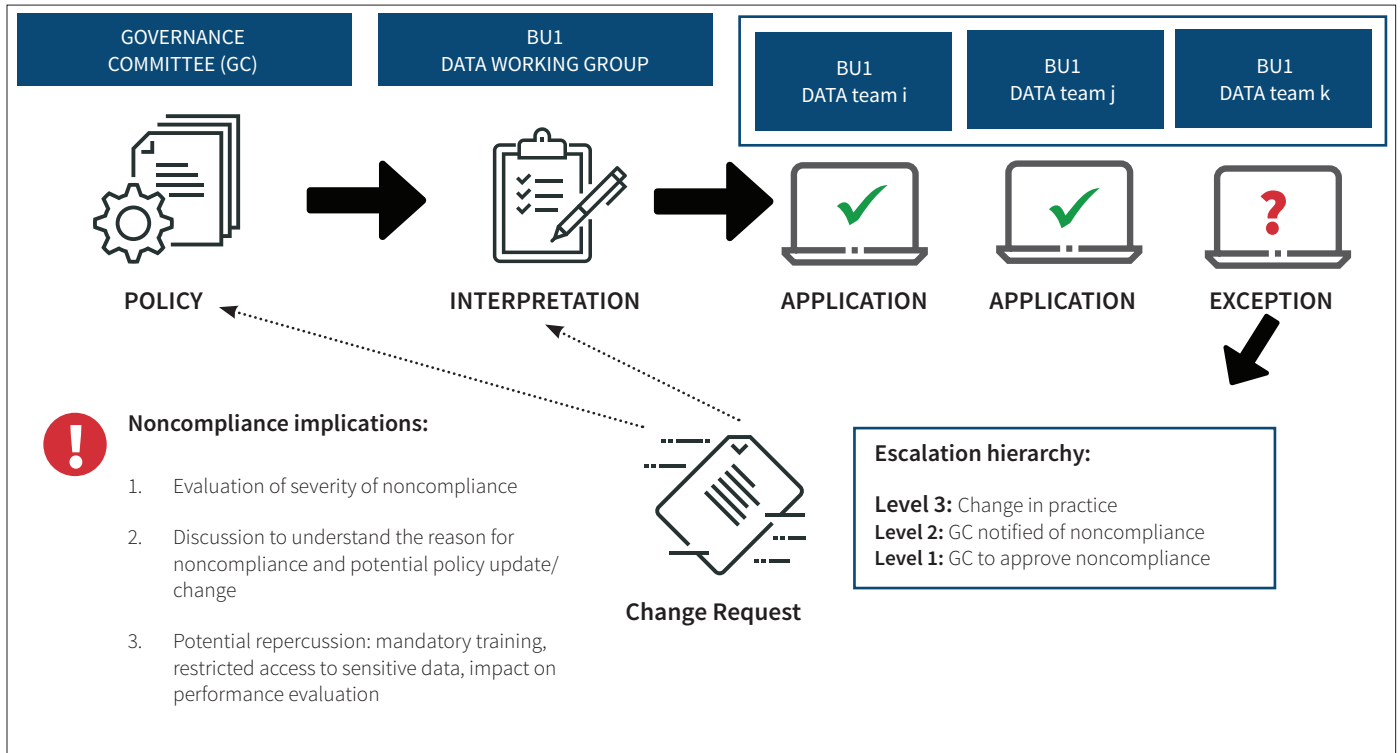
privacy and security trainings should be conducted for all relevant groups within the organization to communicate policy changes and keep pulse on policy compliance and data access protocols.

4. ACCESS AND CHANGE CONTROL

Access and change controls are designed to guard against unauthorized access to actuarial data sets within the organization. These controls are also used as safeguards against the misinterpretation or misuse of this complex data that may lead to incorrect analysis conclusions. The ability to access and change actuarial data should be limited to qualified individuals who understand the data and are familiar with how to interpret each of its elements.

Many insurers are moving away from spreadsheets and independent databases as data repositories. These have become cumbersome to manage and do not lend themselves well to be integrated into a sound governance framework. Companies are moving towards enterprise-level data solutions with embedded controls where access and change management are easier to implement. They automate their production processes to

Figure 4
Illustrative Compliance and Remediation Cycle



minimize the need for human access to and interaction with the data.

5. CONTROL FRAMEWORK

The data control framework should be developed, embedded, and automated into the actuarial production processes to track and report the timeliness, accuracy, and completeness of the data as it travels through various production processes. Since controls are integral to a sound actuarial data governance framework, they should be built into every stage of the actuarial data life cycle and be viewed as a vital components of actuarial production processes.

Depending on the criticality of data, both active and passive controls should be implemented into the data processes. Active controls are developed to try and remediate any data errors that occur throughout the process (populate a default value if one is missing, for example), while passive controls are merely there to report on the “health” of the data as it travels through the process. These should be periodically evaluated for adequacy, effectiveness, and implications of failure.

Historically, controls over technology and data have been owned by risk groups within IT departments. However, in the recent years, we have observed close collaboration within many organizations of actuaries designing, implementing and

monitoring controls over actuarial processes. Typically, actuaries are responsible for business and actuarially focused controls (for example, reserve trending from quarter to quarter, or logical DAC amortization pattern), while IT teams remain responsible for the technical controls over data accuracy and completeness.

6. DOCUMENTATION AND TEMPLATES

Documentation is key from the very technical comments in the transformation code to change requests and approvals for a sound governance framework. Templates are often created to ensure all the required information is populated to expedite and streamline the documentation process. There are multiple levels of documentation and templates that are typically prescribed as part of an actuarial data governance framework including data dictionaries and technical specifications, data set user guides, issue logs, and change requests.

Change request documentation templates are specifically important for a sound governance framework since all data and data transformation changes need to be traceable throughout data sets and over time. These should include a unique sequential ID so that change impacts can be assessed in the correct order, description of impacted data elements, change description, testing documentation, and impact

analysis. Data change testing processes should not only focus on showing that the change impacted the data in a reasonable manner, but also that other data elements were not unintentionally impacted by the change.

7. COMPLIANCE

The last of the seven components of an actuarial data governance framework is compliance with the actuarial data governance framework. Since actuarial data governance policies standards are typically written to encompass all the actuarial data processes within an organization, they are to be interpreted for validity and applicability by the data working groups of each of the corresponding business units.

Actuarial data governance policies may unintentionally restrict or complicate certain data processes. Therefore, these policies should be periodically updated and should define a process to submit requests for updates or exceptions to the data governance committee. Compliance with actuarial data governance and other company policies should be mandatory and is sometimes directly linked to data users' performance evaluation and variable compensation structures. Figure 4 depicts an illustrative compliance and remediation cycle for an actuarial data governance policy.

IMPLEMENTATION OF ACTUARIAL DATA GOVERNANCE

There are three main phases in the implementation of actuarial data governance: initialize, develop, and embed. Each of the seven components of an actuarial data governance framework can be broken down into these three phases.

Phase 1: Initialize

The initialize phase is characterized by identification, classification, and inventory. During this phase, activities such as inventorying all existing data documentation, dictionaries, controls, and data sets and actuarial models occur to evaluate the current state and structure of the company. From there, any gaps in data documentation and procedure and inefficiencies in the data life cycle can be identified to be addressed in the development stage.

Phase 2: Develop

The develop phase addresses the erroneous procedures and data inefficiencies identified in phase one. The actuarial data governance framework must be built to cater to each company's needs, customized for each company's data life cycle from collection of data sources to analysis of outputs. Here, the first draft of actuarial data governance policies is written and circulated for comments from management and data teams. With the development of the data governance policy, the critical actuarial roles are to be established and their responsibilities in the company are to be defined. This stage includes the drafting and

development of the privacy and confidentiality policy, access and change controls, the control framework, documentation policies and templates, and compliance protocols.

Phase 3: Embed

The embed phase is defined by the full establishment and finalization of all actuarial data governance policies, standards, and controls. In this stage, all seven components are finalized and put in place to form the big picture of actuarial data governance. The vision and strategy of the governance bodies and end users are aligned. The result of embedding actuarial data governance is a coherent and efficient data life cycle facilitated and integrated by each of the seven components of the actuarial data governance framework.

From conception to implementation, a sound actuarial data governance framework should address the accuracy and completeness of actuarial data and efficiency of data management processes.

Discussion and development of policies and standards by governing bodies should not be isolated from the data managers and end users. Rather, the vision and expectations of the governing bodies must align with the capabilities of the data working groups and teams. For these entities to connect, an effective data governance policy, roles and responsibilities, privacy and confidentiality policy, access and change controls, control framework, documentation, and compliance policies must be initialized, developed, and embedded throughout the company's data life cycle. An implementation of a sound actuarial data governance framework has proven to reduce erroneous conduct and mitigate inefficient, inconsistent, or misguided data use. ■



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Machine Learning, Skynet or the Future of Actuarial Software?

By Sean Hayward

As an actuary who has spent his career focused on actuarial software, my ears perk up at every new buzzword that shows up on the tech blogs. Some, like cloud computing, SaaS and GPUs have become ingrained parts of the actuarial software landscape. Others, like blockchain and bitcoin, seem promising, but are still too abstract for me to be able to tell when, or if, they will become part of my day-to-day work. Machine learning falls in between these two ends of the spectrum.

As a discipline, machine learning has been around a long time and is relatively easy to understand.

As a discipline, machine learning has been around a long time and is relatively easy to understand. Regardless of what is happening under the hood, the idea that computers can analyze data, infer patterns and apply those patterns to new data is a pretty easy concept to understand. Actually implementing a machine learning algorithm, on the other hand, required a Ph.D. in CS! Because of this, actuarial software has been slower to incorporate machine learning. Actuaries have had enough problems to solve over the past decade, that figuring out how to implement a machine learning algorithm just so we could find a problem to solve with it hasn't been a top priority. This has changed significantly in the past year, as major software players have begun making machine learning tools available to regular developers. Both Microsoft (<https://azure.microsoft.com/en-us/services/machine-learning-studio/>) and Google (<https://ai.google/research/teams/brain>) have easy to use tools that take the logistics out of using machine learning and allowed developers to get creative and start coming up with problems for machine learning to solve.

While the obvious applications, like predicting economic data or modeling investment behavior, will likely be the headliners, one under the radar application that will impact many actuaries is using machine learning to write better code. This feels a bit like Skynet in the Terminator, the machines learning to program themselves to be better machines, but it is actually a very logical application of machine learning. Coding has become such an integral part of an actuary's day job that many schools have included some computer science in their actuarial curriculum. As more people in the profession are writing code, it is important that the tools provided to them improve as well.

So, how exactly can machine learning be used to improve code? A computer program is simply a series of instructions that are executed with varying degrees of efficiency. This efficiency can be measured a number of ways, but the primary ones are compute time and memory usage. Without getting into the details of all the different types of machine learning algorithms, most require two main things, a set of data and some measure of "better." The algorithms can then analyze the set of data, and extract drivers of which factors make things "better" and which make things "worse." The set of data is typically randomly broken down into two subsets, one of which is used to train the model, and the other used to evaluate the model. Once a model is calibrated to the developer's satisfaction, it can then be applied to new data to predict outcomes. With respect to coding, the measure of "better" was described above, so what is the set of data? This is the series of instructions noted above. Breaking code down into meaningful subsets is called tokenization, a topic which sounds easier than it is, and could be the subject of an article of its own. Once the code is tokenized, it just becomes a standard machine learning problem, analyzing tokens to see which improve the model, and which make things worse, and using those findings to analyze new code, and ultimately recommend "better" code. For example, this analysis would show that raising numbers to an exponent has a negative impact on performance, compared to addition.

We are still far from the days where machines are writing all our code for us (hopefully, at least, until I'm ready to retire), but machine learning is no longer an abstract subject that requires a Ph.D. to understand. Machine learning will soon become just another tool in the actuary's toolbelt, available to be applied to problems that we aren't even thinking about trying to solve right now. ■



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Loss Reserving in the Future: Innovation in a Rapidly Changing World

By Chris Nyce and Drew Golfin

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Insurers who see the promise of technology can modernize their reserving approach to realize insights and efficiencies, making it a true asset to business leadership.

The insurance world is changing rapidly. Call centers are being automated. Insurance pricing, underwriting, and claims triage have been revolutionized by predictive analytics. Cars are driving themselves on our roadways today and, together with new ridesharing apps, are changing the automobile liability regime and insurance structure. Detailed analytics around catastrophe modeling have led to a strongly competitive property insurance market even in areas that are hurricane and earthquake zones.

Yet if you examine loss-reserving techniques commonly used today, they are very similar to those described in a seminal paper in 1972, over 44 years ago.¹ Ironically, in that paper the authors observed that reserve methods at that time were mainly described in a 1934 paper, and the authors concluded it was “a serious indictment...that those particular skills have not been sharpened in almost 40 years.” Forty-four years later, we could draw the same conclusion. Since 1972, the main advance in reserving techniques has been that the methods described back then have been adopted to software packages to automate what used to be done on paper spreadsheets.

A lot has happened in recent decades that change the potential reserving landscape. Detailed data is readily available to replace the aggregate “triangles” widely used today. Insurers have used analytic models in other processes predicting individual outcomes, such as claim frequency for individual personal autos, severities by individual claims, and even the likelihood a life insurance policyholder will borrow against a policy when interest rates change. Using modern computing, statistics, and data capabilities, a whole new field of data analytics methods, such as machine learning techniques, has been created that was simply not possible 25 years ago. But

the use of these advanced techniques in property and casualty reserve processes is minimal in today's world.

THE PROMISE OF NEW TECHNOLOGY

Against the backdrop of methods invented in a computing power environment of 50 years ago is the promise of computing power and advanced analytics methods of today. The fields of machine learning techniques, powerful computing, and robotic process automation create enormous potential to achieve leaps in effectiveness and accuracy, efficiency, frequency of review, and greater control over the reporting environment. And visualization tools give us the power to quickly assimilate and act on the advances.

STEPPING STONES

Practical approaches to an improved and modern reserving process can be achieved by using established technologies of today. The goal is to take maximum advantage of existing technologies that are used already in most organizations, without creating impractical or unwieldy projects. These tools include:

1. **Advanced analytics tools**—These include machine learning techniques, statistical methods, and other advanced analytics. Many techniques are available in common software packages used today, such as SAS, Python, and R. In fact, reserving analysts may already use these tools for data manipulation.
2. **Data warehouses and data lakes**—The quintessential challenge with advanced analytics is often data. However, this can be overcome through sharing data with other analytics projects, being careful not to over-specify the data need, in combination with using innovative structures such as data lakes to streamline the acquisition of data. These can be accomplished consistent, of course, with sound financial control processes.
3. **Robotic process automation**—Using widely available, yet innovative tools for systems integration, instances of “bots” can replicate the repetitive tasks of human users. For example “bots” can get the data, run the update, display the results, and feed downstream systems with the outcomes, allowing human analysts to review and validate outcomes and selections and then to interpret and communicate the insights.
4. **Data visualization**—Claim and policy and coverage-level reserving techniques can produce detailed data files including IBNR that are ready-made to be analyzed for insights immediately using visualization tools. This analysis can start with probing the root causes for reserve changes and be rapidly adapted to profitability analysis across any dimension without further steps.

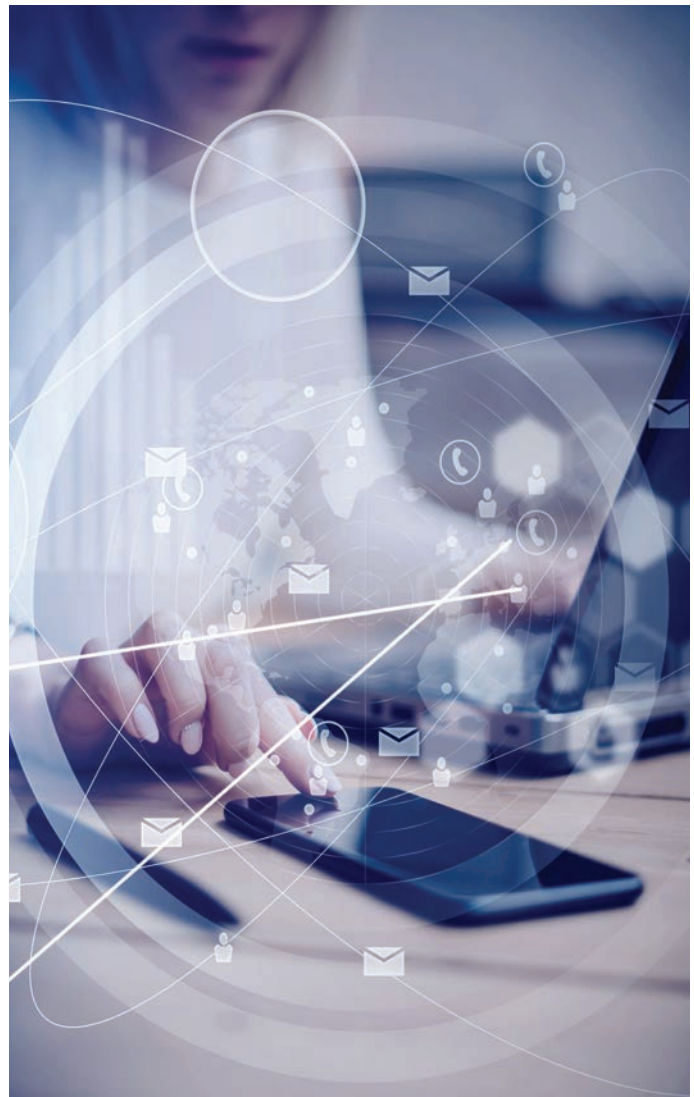
It takes only a little imagination to envision a modern reserving process that includes these elements. Modern analytics techniques, like machine learning techniques, can be used to update reserving models and run them to produce reserve outputs with whatever frequency management wishes to digest them. Robotic process automation can help to make this smooth and efficient. Data can be drawn from data lakes or other such structures that are routinely reconciled and available frequently or in real time, again assisted by robotics. The results can be provided to users in easily accessible files, with significant movements in the outputs already identified. The users can quickly access and analyze the data with a visualization tool and act quickly on the information. All this innovation is within grasp using existing technologies. It simply awaits the vision to make it real.

While not widely used in the reserving process, the use of these technologies is not unknown in the insurance industry. Predictive modeling has revolutionized pricing and underwriting in personal lines starting 20 years ago, and the revolution in commercial and specialty lines is well underway today. Claim prioritization models are in use in many claims departments. In fact, the promise of using existing underwriting and claims severity models as stepping-stones to the broader reserving model holds great promise to bring synergies in all the disciplines.

CHALLENGES

That the use of these technologies has not become well rooted in reserve-setting processes perhaps lies in the need to overcome challenges that are unique to reserving, including:

1. **Control environments**—Financial reporting considerations such that well-controlled and repeated processes may actually hinder innovation.
2. **Efficiency challenges**—As organizations are challenged to increase efficiency, investment in reserving infrastructure is difficult to prioritize.
3. **Lack of vision**—The failure to articulate the benefits of the insights that new approaches can achieve lead to underinvestment in innovation.
4. **Difficulty in acceptance**—A more precise reserve-setting process has potential to disrupt an organization. As valuable insights are discovered that might shift organizations to de-emphasize or increase emphasis on business segments, constructive business decisions can create winners and losers.
5. **Transition**—Moving in a well-controlled environment from static approaches through an innovation cycle creates



challenges in keeping constituents, management, investors, and auditors comfortable with the change. Both a focus on testing and a period of parallel process are key to addressing the challenge.

THE POTENTIAL BENEFITS OF ACTION

But a focus on the challenges takes away from the promise of what innovation can bring to the reserving process. These include:

1. **Increased insights**—A more precise reserve-setting process holds the promise to dramatically increase the business insights from that process. Imagine a process that sets reserves based on detailed characteristics of innate risk and claims characteristics. “Allocation” of the reserves is no longer an issue, as reserves are calculated ground up and actually reflect the detailed risks.

- 2. Faster reaction**—Management is able to realize changes in the environment more quickly and react. For example, many companies blame the slow recognition of the deteriorating auto environment starting earlier in the decade on slowly adapting “triangle” approaches. Imagine reserving techniques that respond as claims are reported and are reparameterized regularly using machine learning techniques.
- 3. Frequency of review**—Once the models are parameterized, they can be run with any valuation date for which data is available. For example, an analysis could easily be run a few weeks before close, allowing that extra time to digest projected changes in ultimate losses and reserves and to prepare discussion for earnings calls as an example.
- 4. Increased efficiency**—Robotic process automation can be introduced, leading to increased speed to close, as repetitive processes can be replaced by “bots”. And as machine learning techniques can quickly identify trends and the root causes behind them, actuaries are freed up from routine tasks to digest the trends and communicate them to the organization for timely actions.
- 5. Coordinated communication**—A by-product of a modern reserving process is an output ready-made for deriving insights using visualization tools. It is simple to mine the output and save views to communicate to constituents. Others can be given views of the data appropriate to their access requirements to derive their own insights for their business segments.

CONCLUSIONS

A leap forward in reserving and reporting processes is achievable with reasonable effort, existing technologies, and moderate

cost without long-term or large projects. With proper design, this innovation can be implemented within well-controlled financial reporting processes. Not only can these innovations provide significantly more insight, but can do so within more efficient cost structures. A company acting on these more timely insights holds significant competitive advantage while peers who are left behind strive to catch up to the innovation.

It is likely that if the authors of the 1972 paper discussed previously were starting their careers today, they would be on the forefront of these innovations and once again assert the time is ripe to cast aside the approaches of the last century and modernize the reserving process. ■



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ENDNOTE

- 1 “The Actuary and IBNR,” by Ron Ferguson, and Ron Bornhuetter. Casualty Actuarial Society Proceedings, 1972.

For New Life Customers, It's All About the Experience

By Samir Ahmed

The life insurance industry has been abuzz with improving customer experience for the past few years, particularly in the new business and underwriting processes. It might seem like a tired topic to revisit in 2018, but the number of carriers that have yet to (fully) implement capabilities such as end-to-end electronic application, end-to-end eSignature, straight-through policy issuance, and eDelivery of policy, just to name a few, indicates otherwise. What is behind the low adoption rates for such capabilities? And more importantly, what can be done to drive higher adoption?

CURRENT APPLICANT EXPERIENCE

Increasingly new life insurance applicants are likely to be a Gen X or Millennial—and will soon be a Post-Millennial. Their buying experience often leaves them angry, frustrated and dissatisfied. As younger people do whenever they are faced with any new purchase, they start by doing their research on the Internet. They quickly find a website that offers life insurance quotes. More often than not, this is where the experience first starts to deviate from their expectations. Instead of providing a quote, the website facilitates a phone call with an agent. Disappointed, the applicant provides a phone number and indicates a convenient call time. The agent calls, and after a preliminary discussion, offers to visit the applicant at their home and walk them through everything. The applicant is a bit taken aback. They weren't expecting to have to meet with someone to get a life insurance quote, let alone invite that person into their home, or go to an agent's office. In their view of the world, this is not how things get done.

When the agent arrives at the home, the process starts by asking the applicant to fill out an insurance "needs assessment" questionnaire that is seven pages long. It all looks simple and straightforward, yet, as the applicant begins filling it out, they can't help but notice that the questions become progressively more intrusive. It starts with demographic information, such as name, address and occupation. That is followed by detailed questions about the monthly budget, including all income and

expenses broken down by category. The assessment concludes by asking about assets, liabilities, financial goals and expectations for final expenses, debts and income replacement. Using the collected information, the agent prepares a few proposals, walks the applicant through them while answering any questions along the way. The agent also provides a 41-page packet containing the insurance application and several associated forms. The agent asks the applicant to review the proposals, and to fill out the application packet based on the preferred proposal. The agent offers to return in a few days to take care of signatures and payment, and to collect the paperwork for submission to the carrier.

The whole experience continues in this manner, inclusive of documentation follow ups, family medical histories of which the applicant knows little, an in-home visit from a nurse, and it culminates with the agent telling the applicant that the 41-page application packet is ready for evaluation by the insurance company, and that they can expect to hear back in the next 90 days or so. To the applicant, the 21st century this is not.

THE DISCONNECT

To say that the applicant is left with unmet expectations disconnected from their reality is understating the issue. In this example, the applicant believes that they have already left their comfort zone to get through all the trouble required to get a quote—filling out a detailed needs assessment questionnaire and providing additional detailed personal and medical information in the application packet—only to find out that they may or may not be able to buy insurance. And if they are able to buy it, not knowing exactly what coverage and benefits they'll be buying, and not knowing what the final cost will be—all of this despite the applicant having a detailed quote from the agent. The new applicant wonders where else they have had such a buying experience, but can't think of anywhere. They can't imagine going online to buy a smart phone or a laptop, being given a price estimate, being asked details about how they were going to use the device, paying for it, and, in return getting a device with limited functionality and being told that, in the next 90 days, the website might refund the money and ask for the device back because they determined that the applicant was not the type of customer they wanted using their device. The applicant describes all of this to the agent as rather absurd. The agent nods, and clarifies that buying insurance is different—it's not buying a good or a service, it's buying a promise. The applicant isn't convinced, but not seeing any other choice, they hand over their credit card just to make the whole thing go away. Adding insult to injury, the agent explains that the carrier doesn't accept credit cards and he'll need cash or check.



THE NEXT-GEN EXPERIENCE

These sentiments held by the biggest pool of potential life insurance buyers are well known in the life insurance industry; it's not a surprise to anyone. It's equally well-known that what these applicants desire instead is: a) 24/7 self-service on devices of their choosing with seamless transition from one (e.g., mobile app) to another (e.g., desktop web browser); b) interactive questionnaires presenting a few questions at a time and tailored based on answers already provided; c) being asked the breadth of information needed during the application process (not as follow-ups during the evaluation process); d) comparison of products, coverage, premiums, etc.; e) review of the final application packet before signing it; f) electronic

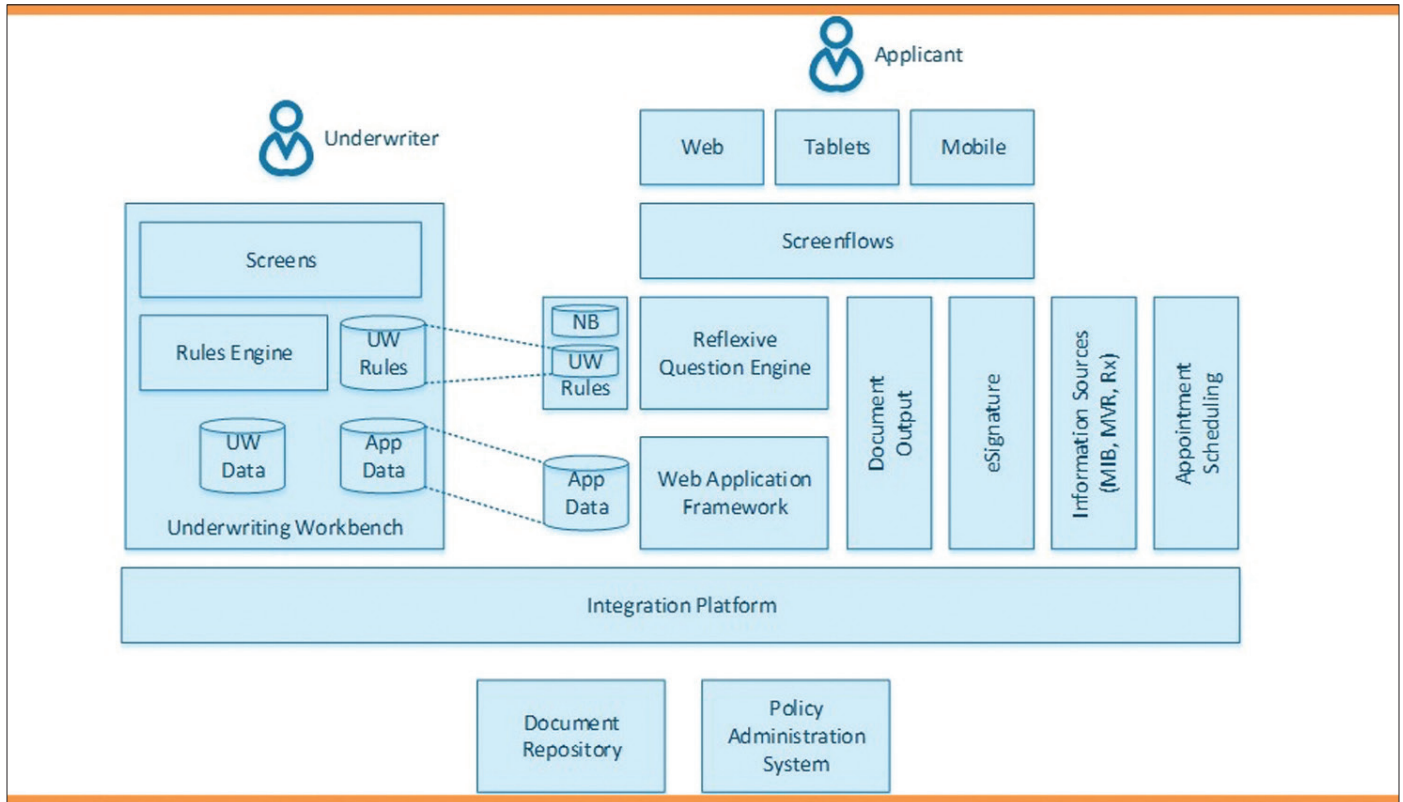
signature; g) electronic payment at the time of signature; h) an immediate decision, with an explanation in cases when the application requires further evaluation, followed by regular notification of its status; and i) electronically delivered documents, including the issued policy!

When both the source of frustration and the pathway to delight are known, why the low adoption rate on capabilities that matter most to this newest generation of consumers? The short answer is that while there is a simple-to-understand-and-implement technology solution for each element of the desired experience, delivering the complete experience requires assembling simple technology building blocks into a complex and well-engineered solution. And while that might sound simple, it is not always easy for life insurers to do, and that is what bedevils the industry.

The technology components that need to be assembled consist of the following:

- A modern user interface development framework that supports web, tablet and mobile access.
- A reflexive question engine that can determine what questions to ask based on answers already provided.
 - Using it effectively requires codification of all application evaluation rules, including new business, compliance and underwriting.
- A document generation system, to present electronically completed application packets for review.
- Esignature and epayment.
- A system integration platform that facilitates,
 - real-time communication with information sources, e.g., MIB, Rx history registries, MVR providers, etc. and
 - real-time appointment scheduling with providers of evidence, e.g., paramedical exam, labs, tele-interview, etc.
- An underwriting rules engine, to codify underwriting rules, and provide real-time risk assessment with stratification by statistical confidence intervals.
- Epolicy and edelivery.
- A policyholder portal for receiving application status, viewing the issued policy, and securely communicating with the agent and the insurer.
- An agent portal to see the status of submitted applications, and securely communicate with applicants and the insurer.

Figure 1
Conceptual Solution



CONCEPTUAL SOLUTION

Figure 1 illustrates a logical assembly of the necessary technology components into a conceptual future state for a typical life insurer.

Such a conceptual solution might seem daunting. Fortunately, the software architecture discipline provides a proven approach for accomplishing all of the above and more, which is to conceptualize the target state, acknowledge the current state, identify gaps between the two, outline a roadmap for closing the gaps, and then chip away at the solution one capability at a time. Care must be taken to ensure that each building block that adds functionality and capability on the back-end also enhances the front-end experience of next-generation

customers. Given proper prioritization of resources and budgets, all of this can be accomplished in two to three years.

Think big, start small and move fast is the call of the hour. It's not rocket science, but it does take considerable focus and persistence—something the industry has been demanding of its applicants for decades. ■



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IoT Benefits Build on Existing Infrastructure

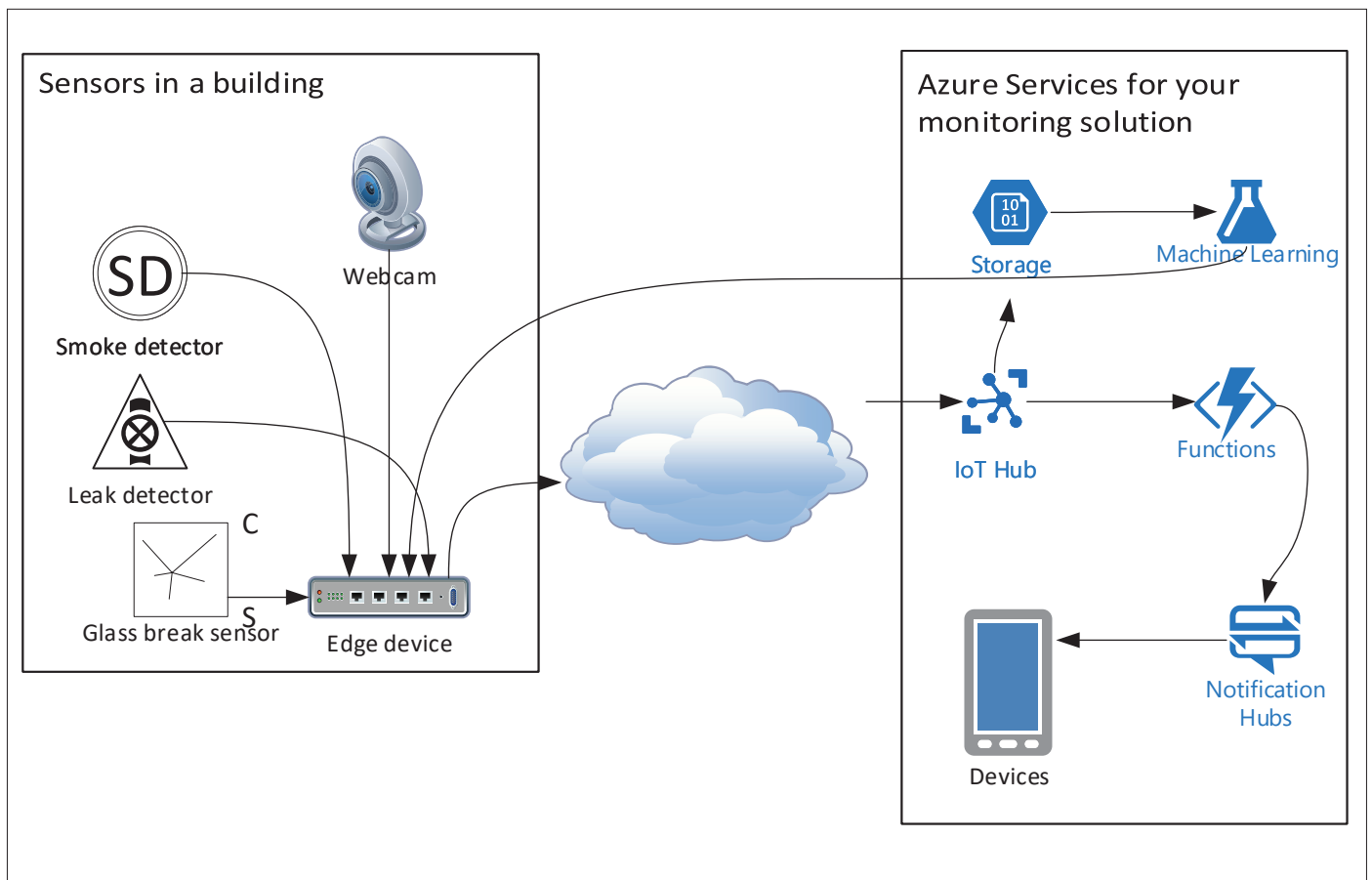
By Nick Leimer

No one would live in a house or apartment without a smoke detector. No one would work in an office or stay in a hotel without a sprinkler system. No one would feel completely safe in a mid-western town that did not have a tornado siren. Basic safety and risk mitigation equipment are not new. They have been with us for decades. The next step is to connect sensors and warning devices to systems that can act based on the instrument readings. To this end, we can couple

the Internet of Things (IoT) with infrastructure to capture and process a wide range of sensor data. We are now set to transform the data into operations and actions that changes outcomes.

For instance, home smoke detectors, located throughout the house and connected to each other, can report the presence of smoke and identify where the smoke is. To report this information outside of the building, we would use an “edge” device—a computer or other smart machine that receives the sensor data, and processes it through an AI program loaded on the device. In this example, when smoke is detected, the data first arrives on the edge device. Then the device processes data from all inputs (other sensors) using the loaded AI application to rule out false alarms. Finally, the device generates alerts that are sent to all interested parties: all residents of the home, the insurance agent and the local fire department. This can mitigate the possibility of total loss of property and life. In an extension of this example, other forms of catastrophic risk can be mitigated with a localized notification. Residents’ phones

Figure 1
Components of Home Security



start ringing, while speakers loudly begin evacuation warnings or other emergency alerts for the household.

Less dramatic events can impact personal safety and property, and IoT sensors can help mitigate these as well. For property and casualty insurers, water damage is the second most expensive cause of loss behind fire damage. Connected water detection sensors could notify the homeowner or maintenance company of a leak, and its location. When paired with an auto water shut-off valve, the sensor can trigger automation to turn the water off and prevent further water damage. For personal safety, IoT sensors mean home security devices. Such systems, with cameras and entry point detectors, mitigate burglary attempts by identifying the exact point of entry, turning on lights inside the home, and informing the homeowner and home monitoring company of the intrusion with texts and/or calls.

The technology to make these integrated systems real exists today. Figure 1 is an illustration of the components that can go into a home setting: smoke, water, and intrusion sensors all talk to an IoT edge device. This device then analyzes data locally and transmits information to a cloud provider like Azure. Within Azure, the system sends notifications as needed, stores data, and builds new models to better learn behavior patterns for the house.

In life insurance, we see companies using wearable devices to encourage healthier behavior and enhancing risk selection. Insurance industry, John Hancock, uses wearable devices connected to an application called Vitality. John Hancock then offers discounts on life insurance policies based on the policy holder's activity which is tracked by a Fitbit or Apple Watch. Vitality is also part of a health and wellness program with information on nutrition and active lifestyle choices. It is used by all John Hancock employees to promote the benefits of increased physical activity which includes things like net increases in productivity, employee satisfaction and improved general health (with fewer sick days!). The use of products like Vitality is quickly becoming the norm for major employers as they offer incentives to policy holders based on healthful activity—from cash rewards to special recognition.

Another benefit comes from processing the data from the devices with additional data sources, to build better risk models. Better models lead to a greater understanding of customer risk profile, and more accurately priced solutions. The increased understanding also helps spot gaps in coverage and to identify upsell opportunities. Artificial intelligence (AI) and big data are the technologies that drive this new model creation.

The number of IoT devices is now exceeding the number of cellphones. Insurance companies need to move forward and leverage existing sensors and data. The first step is to collect

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and process data as close to the source as possible, pushing only the preprocessed data to the cloud. Edge devices can be programmed with machine learning algorithms to understand and act on the data coming from a wide range of IoT devices. The device uses the intelligence (supplied by the algorithm) to determine what should be shared to the cloud. This division of duties is a work saver and it ultimately saves the time and bandwidth of moving unnecessary data back and forth from the cloud. From a data security standpoint, it also provides a security layer to encrypt all data.

Non-connected warning devices and sensors have been part of our lives for decades, and the natural evolution to connected devices reduces overall risk and mitigation claim events. The addition of a wide range of new sensors, combined with edge devices, further expands the benefits. P&C companies are seeing the benefits in commercial property and with homeowners that have adopted IoT devices. Life insurance companies are refining their models and seeing benefits from self-selection as healthier customers are more likely to actively use Fitbits and other devices. With more data from a wider range of customers, better models can be built, benefiting more groups in the industry.

Many insurance companies are making progress or have already started to realize the benefits of IoT being built on their existing infrastructures. Below are the two explicit examples noted earlier.

- State Farm has implemented water leak detectors into home owner's products (State Farm).
- John Hancock, Vitality: Life insurance that saves you money and rewards healthy living. (Vitality)

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