North American CRO Council

Risk Implications of Data and Analytics to the Insurance Industry

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This paper also includes reference to specific companies, products, and services in an attempt to illustrate and support key themes with real world examples. These references are intended for illustrative purposes only and do not constitute an endorsement by the North American CRO Council of any company, product, or service. These examples are not, and are not intended to be, a comprehensive list of innovation within the industry.

> *"The capability to conduct Advanced Analytics will no longer be viewed as a competitive advantage. It will become a necessity for survival and a requirement to stay competitive in the marketplace."*
>
> *- 2016 Big Data Survey Respondent*

Introduction

This paper provides the perspective of Chief Risk Officers on the future risk management implications of the Big Data and Advanced Analytics paradigm shift underway in the insurance industry. The new paradigm will afford unparalleled opportunities for new product design, risk selection, distribution, and modernizing the customer experience. At the same time, insurers will face a radically different competitive landscape in areas of product and distribution, pressure to change business, operating and expense models, and regulatory interest in the areas of data privacy and consumer protection. The future generation of successful insurance carriers will have embraced Big Data and Advanced Analytics while at the same time have navigated the risk management challenges from such innovation.

For the purposes of this paper, "Big Data" refers to a broad range of new, massive, and complex data types that have emerged since the early 21st Century that can be analyzed to produce actionable insights within the insurance marketplace. Further, "Advanced Analytics" is defined broadly to consider an array of tools and techniques that interpret and transform Big Data datasets in predictive and other advanced ways with speeds hitherto not seen by the insurance industry. Increasingly, advances in cognitive learning and artificial intelligence have the potential to radically alter how businesses act upon data compared with traditional descriptive and diagnostic approaches (e.g., business intelligence (BI), management information systems (MIS)). For the remainder of this paper we use the shorthand of Data and Analytics to refer to Big Data and Advanced Analytics.

In this paper, we begin by providing an overview of the Data and Analytics which includes findings from the North American CRO Council member survey and a perspective on why Data and Analytics is likely to have such a profound impact on the insurance industry. Some of the potential risk management implications from these changes are relatively intuitive and likely addressed by existing ERM initiatives (for example, security considerations of cloud computing, model risk from use of predictive models). In the remainder of the paper we choose to explore some broader, more strategic risk management questions that the subject of Data and Analytics raises: culture, talent, consumer behavior, consumer protection, and regulation.

Executive Summary

The key conclusions from this paper are summarized as follows:

1. The **insurance purchaser should be the ultimate beneficiary** as Data and Analytics provide insurers the actionable insights and technical capability to deliver product more closely matched to insured interests and circumstance (e.g., single day travel policy, smart home, etc.). Customers may further benefit as carriers use new technology to lower operating cost structures and transform the customer service experience at the points of sale and claim. This change will be driven by the combined impact of scale, access, and automation afforded by Data and Analytics;

2. Data and Analytics **will impact most aspects of an insurer's operating model**; the use of data to underwrite new risk cohorts with new coverages, the technical ability to store mass data in a secure yet accessible manner, the skills to analyze large datasets and build new risk models, and the controls needed to protect data according to relevant regulation and other interests;

3. Workforce **culture will likely change** as carriers seek newer, more dynamic ways to conduct business with accelerated product development cycle times. This will require **a more technical and flexible work-force** with the skills required to apply Data and Analytics and management structures that can readily adapt to market needs and opportunities;

4. **The search for analytical talent will challenge insurers** as they compete with other industries, other insurers, and within their own organization to attract and retain employees. The risks are magnified by a significant part of the workforce rapidly approaching retirement age;

5. **Customers have changed their buying habits and behaviors in non-insurance sectors in response to technology innovation and will similarly demand from insurers' new products, customized services, and cross-channel experiences**. Insurers must work to address this consumer demand or risk replacement by new entrants seeking to disrupt market conventions of product offering, channel / distribution, and expense. Distribution models will change as data and technology allow new ways for those seeking to shed risk to find those with risk bearing capital and vice versa. On the other hand, the ability to identify and access alternative pools of capital will give rise to new risk bearers and/or risk transfer mechanisms such as risk securitization;

6. Carriers will also **need to engage with regulators across several fronts to ensure existing regulatory frameworks are appropriate and responsive to the evolving landscape**. The privacy and protection of data should be assured but in a consistent and proportionate manner. The overall benefits to customer, society, and the economy of new products should be widely communicated and understood by regulators. Finally, the public-private sector should collaborate to ensure that any major residual risk segments are adequately addressed in a manner similar to prior insurance industry solutions (e.g., residual hurricane pools or HIV-life products); and

7. Clearly, **the impact of Data and Analytics to an insurance carrier's external and internal stakeholders will be profound**. Chief Risk Officers can play a valuable leadership role to dimension, assess and manage the risks and help their company manage the road ahead.

2016 Big Data Survey

As a precursor to this paper, the North American CRO Council conducted a survey of its members to explore the implications of emerging technology and analytical capabilities across the value chain of insurance. The survey's respondents consistently identified that the ability of an insurer to drive insights from Big Data through the use of Advanced Analytics will have a profound impact to the industry in the short and medium term. Such insights were viewed as the critical driver of the customer experience, product development and risk management underpinned by transformational changes in product distribution and company operating models. P&C companies identified a greater current and expected impact across the value chain to their industry segment, and, accordingly, assessed their current and future analytical capabilities higher than their Life insurance peers. However, it can be expected that all sectors, whether Life, P&C, or Health, will be significantly impacted over the next 3-5 years.

Council members believe that Advanced Analytics will result in benefits to both the insurer and the policyholder. The consumer should benefit through new and innovative products, more efficient pricing, and better claims handling. Insurers will likely realize organizational benefits through improved risk management practices, higher operational efficiency, and more effective business development. The survey indicates that these benefits should result in a more dynamic, competitive, and innovative industry.

Traditional Uses of Analytics in Insurance

The fact that society is on the cusp of a new technology revolution driven by Data and Analytics is not a new phenomenon. As early as 3800 BCE, censuses were used to gather and analyze data to collect taxes[1], an approach also taken by William the Conqueror after conquering Britain in 1066. Such early data gathering techniques served as a lynchpin for modern societies, and were arguably the first use of Big Data. The advent of computers in the mid-20th Century was a further transformational step in which data could be analyzed in "real-time". Such capabilities allowed the Allied powers to crack Nazi code during World War II and place a man on the Moon.

> *The 17th century philosopher Francis Bacon is widely considered to have coined the phrase "scientia potentia est" – knowledge is power.*

From its earliest moments, the modern insurance industry utilized data and analytic methods to inform decision-making. Relying on the Law of Large Numbers early underwriters were able to reduce idiosyncratic risk by pooling individual risks into insurance pools[2]. This principle made possible a rudimentary type of marine insurance described in the Ancient Babylonian text "The Code of Hammurabi", which appeared c. 1800 BCE. The text devotes 282 clauses to the subject of "bottomry", which was a form of maritime financing wherein the loan would only need to be repaid if the ship returned safely[3]. Further, the concept of aggregating and pooling risk enabled the citizens of London to rebuild following the Great Fire of London in 1666, when Dr. Nicholas Barbon formed the world's

[1] Capponi, Livia, "Classical World Series: Roman Egypt", Bristol Classic Press, 2011

[2] Richard Routledge, Encyclopedia Britannica, Law of Large Numbers. www.britannica.com/science/law-of-large-numbers (accessed on August 18, 2016)

[3] Bernstein, Peter, "Against the Gods: The Remarkable Story of Risk", John Wiley & Sons, Inc., pp 92-93, 1996

first insurance company "The Insurance Office[4]" to pool and transfer the risk of future fires. The pooled insurance groups benefited the insurer by making losses less variable and easier to predict, and benefited the individuals as they were no longer subject to financial ruin in the event of loss.

Over time, the simple actuarial aggregation of data (e.g., mortality tables, Table M, annuities) has morphed into a broad range of Data and Analytics that today support a carrier's operations. Notwithstanding these advances, the prevalent foundation of the analytics has been retrospective in nature, relying on descriptive information collected through the insurer's interaction with the agent or customer (e.g., quote data, insurance applications, medical tests, and claim files) or aggregated sets of industry loss experience. While helpful, descriptive analytics capture what has happened in the past and are not necessarily explanatory. Further their use requires management judgment and assumptions about how historical trends and circumstances might be relevant to the future.

Some of the above shortfalls are increasingly being addressed by insurers with the use of predictive analytics in which statistical models are created to identify variables that are explanatory in nature and help explain drivers of targeted outcomes. Increasingly, the digital age has the potential to provide broader and deeper datasets with the prospect of alternative variables that are more explanatory of a customer's risk profile and/or behavior. Consequently, insurance companies have begun to further the pace and extent of information collected from their customers, public sources, and data vendors. This is a phenomenon further accelerated by advances in the sheer processing speed of computers and more complex analytical algorithms such as machine learning and storage capability.

What Will Be Different?

The increasing prominence of analytics within insurance, and the transformation of other sectors, such as travel, retail, and banking, suggests the industry is on the cusp of a revolution. The advantage will accrue to those companies able to harness their data and analytical capabilities into insights that are readily actionable. Pivotal in this transformation will be the integration of analytical methods into technology solutions, resulting in digital labor, machine learning, and cognitive technologies that monitor and adapt to outcomes in real time. The result of these technologies will be a much more dynamic marketplace as smaller insurers and new-entrants will have the tools and capability to compete against the scale, cost structure, and distribution of larger legacy insurers. The ultimate beneficiary will be the customer as insurers are able to increase product availability, shrink cost structures, and modernize service.

The ability of an organization to capture and interpret data is the cornerstone of its analytical franchise. That data is abundant in this Age of Information is without question. Researchers estimate that 2.5 quintillion bytes of data are created *every day*, and the growth in data volume is increasing exponentially as consumers adopt new and creative uses for technologies such as wearables, social media, sensors, digital devices, etc.[5] Within this mountain of information lie critical insights that, when extracted, could help insurers understand

[4] Klein, Barry, "The World's First Insurance Company", International Risk Management Institute, July 2001.

[5] IBM Infographics & Animation, "The Four V's of Big Data", http://www.ibmbigdatahub.com/infographic/four-vs-big-data (Accessed August 20, 2016)

their customers, markets, or their products in ways that were not possible in the past. As a result, customers will benefit with new and unique products or better, more customized buying experiences.

The fundamental challenge is the volume of information required to be mined and interpreted. The term *Big Data* possibly understates the enormity of data sets to be mined – literally billions of transactions detailing hundreds of millions of consumers. Amplifying the potential and complexity is the mix of structured numerical fields, unstructured text, and even voice and video recordings that, if properly analyzed, can provide valuable insights to businesses. Fortunately, the decreasing cost of computing power together with Big Data software tools make it realistic for insurers to gather such volumes of data, internal and external, and generate new insights. These insights, in turn, can lead to further innovation and change when deployed throughout the organization.

Trends in innovation have challenged the paradigm by which analytics are deployed into the business, resulting in faster development times and infrastructure that is able to learn and adapt on its own in real-time. Under a traditional paradigm, effectively deploying innovative solutions, such as analytics based technology, requires a full development cycle to introduce and improve tools and solutions to the end user. New innovation frameworks such as LEAN Startup and Design Thinking emphasize continuous improvement through iteration to accelerate the development cycle from months or years to days or weeks. Clothing retailer H&M, for example, has implemented continuous improvement design processes that enable it to analyze fashion trends and turn out new design styles every two weeks. Its competitors, in contrast, require as much as six month to go from concept to design[6].

In addition to process improvements, companies are looking to self-learning analytics to improve workflow and productivity. IBM's Watson technology was made famous by defeating its competitors on the game show Jeopardy. The application of Watson technology is revolutionizing the way people work by integrating technology that has the ability to self-learn into the workplace. In 2011, IBM announced a partnership with the healthcare provider Wellpoint to utilize Watson for evidence-based medical decisions. While not completely dislocating its human counterparts, Waston augments human intelligence and enables better, faster decisions by making probabilistic treatment recommendations based on a corpus of cutting-edge medical research. The aggregation and consumption of such research would require a team of highly trained oncological doctors[7].

> *"Machine learning will allow computers to perform many of the work processes normally given to a 4 year University Graduate which will transform how work is done in an insurance firm."*
>
> *- 2016 Big Data Survey Respondent*

Whatever the future state of the insurance industry, it is becoming clear that capabilities in Data and Analytics will be integral to competing in the market. Risks to

[6] Peterson, Hayley, "How H&M Churns out New Styles every 2 Weeks", Business Insider, September 20, 2014

[7] *Friedman, Laura F. "*IBM's Watson Supercomputer May Soon Be The Best Doctor In The World", Business Insider, April 22, 2014

least-innovative insurers are growing as gaps in efficacy and capability between legacy and technology-driven business models continue to widen.

Risks of Utilizing Data and Analytics Will Evolve

As we look to the future, Data and Analytics is expected to bring meaningful change to the traditional insurance risk landscape (e.g., market risk, credit risk, insurance risk, operational risk, etc.) The application of Data and Analytics will create new dimensions to these risks. As an example, the credibility of third-party data, the relevance to certain lines of business, and availability to aggregate data when and where it is needed will also pose significant challenges to both modelers and coders. Some of the implications are already likely addressed in existing risk management programs such as the security of cloud computing, data privacy, and model risk. This section focuses on a several other strategic questions that should be of interest to any risk manager thinking about the implications of Data and Analytics to their company.

Cultural Shift

A 2009 study by the London Business School found that corporate culture was a much more important driver of radical innovation than labor, capital, government, or national culture.[8] The importance of culture cannot be understated. If a company wishes to realize the benefits of Data and Analytics, then its culture must adapt. Compared with other sectors, the insurance industry is often perceived as slow to embrace change. However, change will be required as insurers grapple with their own innovation strategies and face new and emerging competitive forces. Fundamental to the cultural shift will be a new, younger, more technologically savvy generation of employees who have different work and life-styles than their elders. Further, the pace and extent of technology innovation is exponential which will shorten development cycles and narrow the windows to make decisions. Insurers will need a culture that can nimbly react and execute to keep pace with innovation and avoid its disruption in the marketplace. Such flexibility will be important as the full effect of Data and Analytics is yet to be determined.

As an industry with perhaps more traditional instincts, insurers have sometimes lagged in the adoption of emerging technologies. For example, the development of catastrophe (CAT) models in the late 1980s was met with skepticism as modeled projections often far exceeded prior industry loss experience and underwriting "gut". After a number of significant events occurred in the early 1990s (i.e., Hurricane Andrew and the Northridge Earthquake), the limitations of historical data were realized and the potential value of CAT models was demonstrated. In reaction to market conditions, and fully embracing CAT models, a handful of reinsurance companies were quickly set up after Hurricane Andrew and were able to capitalize while the rest of the market was on its heels. Despite this, much of the industry kept CAT models on the periphery of their underwriting process for the next decade. It was not until after Hurricane Katrina in 2005 that, under pressure from rating agencies, the industry adopted the technology.

The industry broadly relies on historical loss experience to set rates and premiums. Such an approach requires significant business judgment as to how this historical data is relevant to the product

[8] G.J. Tellis, J.C. Prabhu and R.K. Chandy, "Radical Innovation Across Nations: The Preeminence of Corporate Culture," Journal of Marketing 73, no. 1 (January 2009): 3-23

today. The industry's hesitation to embrace "imperfect" CAT models in the early 1980s is a marker of the future challenge to traditional decision making that will become more common as Data and Analytics is deployed throughout the industry. A combination of real-time exposure data and sensors will supplement, or may ultimately replace, loss experience data with new variables that are more exposure based and indicative of current risk behavior. While these variables may be more representative of today's risk environment, less data will be available for calibration and validation. As with the adoption of CAT models, management and organizational behavioral cultural biases will serve as a brake on the adoption of new information. Senior management will need to become more comfortable with the use of such new data, maintaining an awareness of both the opportunities afforded by such information and its limitations, and ensuring that their decision-making culture adapts.

Whilst the insights drawn from Data and Analytics may challenge traditional biases, such insights are also limited by the inability of an algorithm – even a very sophisticated one – and user preferences to capture the infinite nuance of the real world. On November 9, 2016 many woke to learn of the stunning upset of the U.S. presidential election. Donald Trump had defeated Hilary Clinton despite major voter forecasts indicating a Clinton victory. The results left many asking "Why were the forecasts wrong?" The answer is complex and yet to be written. Under scrutiny will likely be the possible shortcomings of data and algorithms to contextualize voter sentiment during a highly contested election and whether the pre-election polling sample was biased or incomplete. However, at the same time, the interpretation and application of the models will need examination to identify whether user bias or "anchor" preferences played a role in ignoring signals that were evident in the forecast models. The election example illustrates that the extensive amount of data can be harnessed for sophisticated analytics, but successful application will be constrained by the imperfection of models and human interpretation.

Traditional insurance culture is also being challenged by new entrants. "InsurTech" companies are attempting to disrupt the insurance market by embracing innovation. InsurTech companies are characterized by open and flexible corporate cultures – similar to those made popular by Silicon Valley giants – that enable them to thrive in environments of rapid innovation and constant change. This culture model is absent any bias and entrenchment present in traditional insurers, leaving it more adept at quickly embracing innovation. Success in the future may require insurers to adapt to the pace of innovation driven by Data and Analytics in a similar way[9]. To illustrate this need, a 2016 Big Data Survey Respondent noted that the traditional technology development cycle within the insurance industry is measured in years. As a result, it is probable that a selected technology is obsolete before ever being put into production[10].

Cultural change begins with the "tone at the top" and leadership's ability to embrace innovation, set a strategic vision, and motivate and inspire people to be their best. It was this driving quality that catapulted Steve Jobs into the corporate ethos, and established Apple's corporate culture as a case study for MBA programs the world around. Jobs was a relentless

[9] PWC, Opportunities await: How InsurTech is reshaping insurance, June 2016

[10] 2016 North American CRO Council Big Data Survey

perfectionist who was driven to develop products that "made more sense to people". But it was his ability to offer meaning to his employees, to impart a vision, a sense of purpose that made Apple unique[11]. Through inspiration and meaning, Jobs revolutionized the world of technology and disrupted established music and animation industries.

The ability to find leaders who inspire will be increasingly important as the industry looks to back-fill an aging workforce with new talent. A 2010 study by the consulting firm McKinsey and Company estimates that the number of insurance industry workers aged 55 or older increased 74% between 2000 and 2010. Further, McKinsey estimated that by 2018 one quarter of the industry workforce will be nearing retirement age[12]. The challenge for insurers will be to recruit and retain a younger generation of insurance professionals who think and act very differently than their predecessors. This generation of employees wants to be engaged both emotionally and behaviorally in their work. They also value collaboration, flexible work schedules, and work-life integration[13]. In response, employers from across industries have begun to offer flexible work arrangements and tailor employee benefits to fit the millennial values. A recent survey of employee benefits, for example, indicated that 6% of employers offer in-office nap rooms including audit firm PwC and on-line shoe retailer Zappos[14]. Conglomerate General Electric and accounting firm Grant Thornton have started offering employees unlimited vacation days[15]. Insurers will be competing for the same talent, and will need to adopt cultures that attract a younger generation.

Cultural shift may also be shaped by technology and the physical workplace environment. A survey on digital strategy cited a senior executive from the manufacturing industry who noted "[companies] don't ask questions about what behaviors a new technology might foster and what behaviors it might actually inhibit[16]." As an example, she cites the replacement of desktop computers with laptop computers that allow people to move around the office and enabled more productive and collaborative teaming. While the conclusion may not be to replace conference tables with Ping-Pong tables, this reinforces the need that insurers ought to be exploring more flexible work environments to attract high-quality talent and promote a culture that values and enables innovation through collaboration.

The Talent Challenge

The successful insurance carriers of tomorrow will be highly dependent on the recruitment and retention of a talent pool with skills suited to the use and implementation of Data and Analytics. Today, the high demand for data analysis and interpretation skills are creating sourcing challenges. In 2016, Data Scientist was ranked as the top job in the US with an average salary of over $116,000 according to Glassdoor.com. The President's Council of Advisors on Science and Technology identified in 2012, based on economic

[11] Verganti, Robert, "Steve Jobs and Management by Meaning", Harvard Business Review October 7, 2011
[12] McKinsey & Company, "Building a Talent Magnet: How the Property and Casualty Industry Can Solve Its People Needs", 2010
[13] Business.com, "How Companies Are Changing Their Culture to Attract (And Retain) Millennials", August 19, 2015
[14] Henry, Zoe, "6 Companies (Including Uber) where it's OK to Nap", Inc.com. (Accessed November 22, 2016)
[15] Frohlich, Thomas C. "7 Companies with unlimited Vacation" USA Today, December 19, 2015.
[16] Kane, Gerald C.,; Palmer, Doug; Phillips, Anh Nguyen; Kiron, David; and Buckley, Natasha; "Strategy, not Technology, Drives Digital Transformation"; MIT Sloan Management Review; July, 2015.

projections, a shortfall of 1 million science, technology, engineering, and mathematics (STEM) professionals over the following decade[17]. While that gap has closed for many STEM disciplines within government and academia, there remains a high demand in the private sector for professionals in areas such as software development and data science[18]. The magnitude of the demand can be observed in the exponential increase in H-1B visa filings for data scientists over the past 5 years as U.S. employers have expanded their search for analytical talent to foreign labor markets. In 2012 only a dozen visas were filed for Data Scientists, whereas by 2016 almost 700 visa petitions were filed[19]. In December 2016, IBM announced that it would make significant investments in its workforce hiring as many as 25,000 employees and investing $1 billion in training over the next four years[20]. Such change comes as IBM focuses its strategy on advancing development of its Watson platform. As analytical solutions are further integrated into business processes, employee profiles will continue to shift to focus on skills to interpret and apply analytical output. Further, digital labor technologies will change the relationship between people and machine which will fundamentally change the talent profile within insurance companies – emphasizing more cerebral "thinking" tasks rather than manual intensive "process" tasks. This shift will require significant revision to the way companies currently source, train, and retain employees, and will create significant challenges in managing intellectual property.

> "How do I convince top tier talent to come work [in insurance] instead of Google? It's a problem. Insurance isn't considered a [desirable] industry."
>
> *- 2016 Big Data Survey Respondent*

The challenge for insurers is the ability to attract and retain scarce talent into an industry that has traditionally been considered slow to innovate. There has been a notable trend over the past decade of graduates from top MBA programs increasingly choosing technology companies over financial services companies, sometimes even eschewing higher pay for a better culture and the perception of more meaningful work. Derrick Bolton, former assistant dean and director of M.B.A. admissions at Stanford's business school, noted that students are asking, "Where's the place that I can drive innovation? Where's the place that I can have the most impact?"[21] Further, a 2015 survey on Digital Strategy co-authored by MIT and Deloitte Consulting observed that digitally mature companies are almost four times as likely to build the necessary skills to capitalize on digital trends[22]. Increased adoption of Data and Analytics will also likely create a knock-on effect within insurance industry service organizations – such as auditors, consultancies, rating agencies, and regulators – who will need talent capable of understanding increasingly analytically focused business models to continue to provide independent advisory and oversight services. The competition for analytical talent will not be

[17] Holden, John P. and Lander, Eric, "Engage to Excel", The President's Council of Advisors on Science and Technology, February 2012

[18] Larson, Richard C. and Xue, Yi, "STEM Crisis or STEM surplus? Yes and Yes", Bureau of Labor Statistics, May 2015

[19] h1bdata.info "Labor Condition Application ("LCA") disclosure data" United States Department of Labor, March 2016

[20] Balakrishnan, Anita. "IBM offers to hire 25,000 US workers next year." December 13, 2016. CNBC.

[21] Korn, Melissa, "Elite Grads in Business Flock to Tech", The Wall Street Journal, November 5, 2013

[22] Kane, Gerald C.,; Palmer, Doug; Phillips, Anh Nguyen; Kiron, David; and Buckley, Natasha; "Strategy, not Technology, Drives Digital Transformation"; MIT Sloan Management Review; July, 2015.

isolated to external competition. As with any scarce resource, analytical talent will need to be allocated within an organization in an economically efficient way. This may become increasingly difficult to do as analytical advancements create lower margin products, benefitting consumers but also lowering insurers cost structure. This may conflict with organization's ability to invest in further analytical talent and infrastructure.

The shifting talent profile is an implication of Data and Analytics for which insurers should start to plan. Growing more common will be job functions that require employees to understand and apply analytical output to the business. Adoption of digital labor technologies will put further emphasis on critical thinking skills by automating the manual tasks and freeing capacity for employees to focus on value added activities. In addition to the sourcing challenges described above, these trends will force insurers to rethink traditional training and development programs, and make protection of intellectual property a key consideration in workforce management. A 2015 MIT Sloan Management Review survey found that 63% of companies are providing employee training on analytics to help overcome the shortage of data scientists. Companies will need to balance training employees on analytical techniques, considering the added benefit of already possessing an understanding of the business, against hiring new resources that possess greater analytical expertise but require time to develop the business knowledge.[23] Insurers are already starting to see this evolution. In a white paper, EY points to analytical development within the underwriting function, and suggests that the granularity of predictive modeling requires a mastery of statistical models and heuristic underwriting rules that will expand the role of the underwriter to include sales, prospecting, account retention, and account servicing[24].

Consumer Behavior and Expectations

The emergence of digital computing since the late 1970s has led to a dramatic shift in consumer behavior. Data and Analytics have enabled retailers to customize products, services, and interactions to meet individual buying patterns, and the new generation of consumers has become accustomed to these types of tailored buying experiences. As insurers look to leverage Data and Analytics to understand and segment risk there may be both positive and negative implications to consumers. The industry, therefore, will need to determine its responsibility to address the potential for consumer dislocation, privacy concerns, and lack of consumer acceptance.

> *"Consumers have already responded to [companies using Big Data and Advanced Analytics], and they want more. The consumer is further ahead than companies in many instances."*
>
> *- 2016 Big Data Survey Respondent*

In 2011 Netflix was considering whether to make its first foray into original programing. An opportunity arose to purchase the rights to a remake of the BBC hit House of Cards. The remake would be directed by David Fincher and star Kevin Spacey. In analyzing the opportunity Netflix turned to its massive storehouse of data to understand consumer tastes. Analysis indicated that viewers of the original BBC show were

[23] Press, Gil, "The Supply And Demand Of Data Scientists: What The Surveys Say", Forbes, April 30, 2015

[24] EY, "The Future of Underwriting: A transformation driven by talent and technology", 2015

also likely to watch movies directed by David Fincher and starring Kevin Spacey. To Netflix the analysis was clear. It purchased the rights to the show, and as its first original series House of Cards went on to achieve both critical and financial success and will be releasing its fifth season in 2017[25]. The Netflix case study illustrates the power of Data and Analytics to create products and services specifically tailored to meet or create consumer demands.

> *"There are 33 million different versions of Netflix."*
>
> *– Joris Evers, Director of Global Communications, Netflix*

In response to such customized products and experiences, consumers have come to expect customized interactions from the companies with which they do business, and are willing to trade private information if there is value to the services they get back. Retailers like Amazon regularly track buying patterns and target advertisements for other products the customer is likely to purchase. Smart technologies, such as those offered by the company Nest, allow consumers to literally invite technology companies into their homes by enabling the consumer to operate lights, thermosets, security cameras, smoke detectors, etc. from their mobile device. While willing consumers may experience an extraordinary level of service and convenience, these devices accumulate data regarding living habits such as energy use that can be analyzed to make improvements to product and service. The aggregated data collected by this type of technology could bring substantial change to the energy industry by enabling energy companies to better predict demand allowing for more efficiency utilization of backup capacities[26]. Similarly, insurers may be able to design products and services from the information provided by the rapidly expanding ecosystem of sensors in homes, cars, and elsewhere.

These bespoke customer experiences are made possible by mining customer information generated by technologies unavailable twenty years ago. Smart devices, social media, internet/mobile shopping are all technologies that have become mainstream, and the delivery and consumption of these services will likely evolve further away from traditional distribution channels and consumption patterns. Ranging in age from mid-teens to mid-thirties, it is estimated that 87% of millennials are using their smartphones to transact business. It is likely that upcoming generations will not understand another way of transacting[27]. The challenge for the insurance industry will be to leverage Data and Analytics and digital technology platforms to develop new products, educate and engage consumers, and evolve distribution channels that enhance customer experiences.

Already the industry is starting to see shifting strategies to address changes in policyholder behavior. Consider the example of insurance start-up Cuvva. Cuvva was launched in October of 2015, and offers customers the option of buying comprehensive auto insurance coverage on an as-needed basis in time increments as short as one hour. The product is offered entirely through a mobile app, and requires no interaction with the company. Cuvva's strategy is to

[25] Kyle Vanhermert, Fast Company Magazine, The Secret Sauce Behind Netflix's Hit, "House Of Cards": Big Data, http://www.fastcodesign.com/1671893/the-secret-sauce-behind-netflixs-hit-house-of-cards-big-data (Accessed August 24, 2016)

[26] Berdoff, Jason. "How Big Data Changes the Economics of Renewable Energy" Wall Street Journal. September 23, 2016.

[27] KPMG. People and Social Trends in Insurance. February 19, 2016

address a growing consumer base that prefers to rent and borrow rather than own and prefers to interact through mobile channels.

Data and Analytics also helps insurers better understand the nature of the risks they assume, adjusting the organization's risk appetite and allowing it to offer new products that were once deemed unviable. In December 2015, Prudential Financial announced that it would start offering life insurance protection for individuals diagnosed as HIV-positive. Prior to Prudential's announcement, HIV-positive consumers had limited life insurance options, typically limited to group term policies available through their employer. Advances in HIV treatment and analytical insights demonstrated that HIV positive patients were living longer, healthier lives[28]. The insight provided an economically viable product that benefitted both the consumer and Prudential.

Customer service is another area under change as insurers implement Data and Analytics to improve loss prevention. Insurers are possibly in a unique position to inform policyholders of risky behavior prior to loss. Leveraging the smartphone's built-in accelerometer, State Farm's Driver Feedback™ App measures and scores drivers along three factors – acceleration, braking, and cornering. At the end of a trip the app will score drivers' performance and recommends tips to drive more safely in the future[29]. In the life insurance industry, it is becoming more common for insurers to "reward" customers for living healthy lifestyles. John Hancock's Vitality program, for example, rewards its customers for activities like going to the gym, getting annual health screenings, and staying tobacco free. Customers can then use these rewards to earn lower premiums and/or discounts at various retailers. Solutions such as State Farm's Driver Feedback™ App and John Hancock's Vitality program can help to proactively shape policyholder behavior by informing consumers when they engage in risky behavior and encouraging healthy lifestyles to prevent losses before they occur.

> "We don't have to passive[ly accept changes in policyholder behavior]. Can we help them help themselves? What insights can we provide to consumers that proactively shapes behavior?"
>
> *- 2016 Big Data Survey Respondent*

While the adoption of Data and Analytics by carriers should result in positive progress for customers, the insurance industry must also determine its responsibility to offer products across the spectrum of consumer segments. For example, refinement in pricing segments could result in dislocation to policyholders deemed to be higher risks, and, at the extreme, may result in an insurer deeming a risk uninsurable. Historically, uninsurable risks have had to enter residual risk pools. Labeled "the insurer of last resort" these residual markets are public/private pooling mechanisms that provide coverage for high risk policyholders. Through these mechanisms the industry has been able to provide homeowners insurance to homes vulnerable to coastal flooding, auto insurance to high risk or non-standard drivers, and workers' compensation coverage to hazardous

[28] John Hilton, Insurance News Net, Prudential Offers Life Insurance to HIV Patients, December 5, 2015. http://insurancenewsnet.com/innarticle/prudential-offers-life-insurance-to-hiv-patients (Accessed August 26, 2016)

[29] Chris Matyszczyk, CNET, iPhone app tells you if you drive like a jerk, April 28, 2011, http://www.cnet.com/news/iphone-app-tells-you-if-you-drive-like-a-jerk/ (Accessed August 26, 2016)

occupations. The Massachusetts Workers' Compensation Assigned Risk Pool (MWCARP) is an example of such a public/private partnership. All Workers Compensation carriers within the state are required to share in the loss experience from the MWCARP. The mechanism ensures that workers compensation insurance is available to any employer within the state[30].

As an alternative to residual risk pools, the insurance industry may look to non-traditional markets to access alternative pools of capital with which to transfer high risk policies. In 2015 the Florida Hurricane Cat Fund, a state mandated reinsurance fund, placed nearly 25% of its own $1 billion reinsurance program in Insurance Linked Securities (ILS) and third-party capital vehicles[31]. Attracted to an investment that is not correlated to market risks, investors may play a larger role in the industry as analytics continues to inform insurers and investors on the nature of risk. Throughout this change the insurance industry should continue to collaborate with regulators and create public-private partnerships that address market needs.

Regulation and Consumer Protection

The role of an insurance regulator is to protect the consumer while at the same time enabling a marketplace to make insurance available to the public[32]. Sound regulation enacted and enforced by the regulator, which protects consumers while at the same time allowing companies to succeed and fail, is a critical component to a well-functioning marketplace.

As insurers explore the potential of Data and Analytics, the industry should continue to collaborate with regulators to ensure that new products and services are structured in a manner consistent with those objectives of a fair and efficient marketplace. Specifically, insurers should work with regulators to address potential concerns that might arise as analytical models increasingly incorporate data sets that contain new or different variables (e.g., home sensors, telematics, etc.) Proactive collaboration will protect consumers while also providing insurers the room to innovate, succeed, or fail.

> *"When you are modeling things other than the risk that will be transferred from the policyholder to the insurer, we have concerns."*
>
> - *Lee Barclay, Washington Office of the Insurance Commissioner*

A clear focus for regulators is to protect customers from unfair price discrimination. This oversight is not new for the insurance industry, but regulators have sometimes been reluctant to endorse new data and analytical methods used to price insurance. E.U. regulators, for example, ruled in 2012 that insurers could not use gender to set insurance premiums despite the clear correlation to risk[33]. When insurers began using credit scores to underwrite and rate personal lines auto insurance, regulators and consumer advocacy groups argued that the practice unfairly discriminated against certain policyholders. In response, insurers engaged in industry wide research to demonstrate the benefit of using credit scores

[30] The Workers Compensation Rating and Inspection Bureau of Massachusetts (www.wcribma.org)
[31] "Collateralised & ILS plays role in FHCF's $1bn reinsurance purchase", Artemis.bm, June 16, 2015.
[32] "State Insurance Regulation: History, Purpose, Structure", National Association of Insurance Commissioners. (Accessed December 14, 2016)
[33] BBC News, Insurance gender ruling and you, December 21, 2012, http://www.bbc.com/news/business-12608777 (Accessed August 26, 2016)

within the underwriting process, and in 2007 the U.S. Federal Trade Commission released a study confirming that credit scores "are effective predictors of the risk…[and] therefore likely to make the price of insurance better match the risk of loss posed by the customer.[34]" Notwithstanding these findings, there are some that continue to advocate for restrictions on the method and manner in which an insurer can use credit scores to price insurance.

Another clear focus for regulators is data privacy and permissible usage. As insurers' use of data sets broaden, regulators will likely look closer to ensure that insurers (and other organizations) fulfill their duty to protect private consumer information. Longstanding regulation such as the U.S. Fair Credit Reporting Act (FCRA), Electronic Communications Privacy Act (ECPA), and Health Insurance Portability and Accountability Act (HIPAA) are supplemented with additional regulation at the local level to protect consumers. For example, the National Association of Insurance Commissioners (NAIC) is working on a Cybersecurity Model Law. If adopted, the NAIC Model Law would establish standards for data security, investigation, and notification of a breach of data security applicable to insurance providers. Similar examples of data privacy regulations are emerging around the world as countries enact laws and regulations that prevent the cross-border flow of personally identifiable information (PII). The complexity of the regulatory environment creates tactical challenges for companies operating across multiple jurisdictions. A 2011 study by the Ponemon Institute estimated the cost to multi-national organizations to comply with data privacy laws and regulations and address non-compliance related problems to be almost $1,050 per employee. For an insurer with 50,000 employees the cost would be over $52 million per year[35]. Clearly these costs are likely to increase as the complexity of data privacy regulation increases.

Future developments in Data and Analytics may also expose the insurance industry to the influence of a broader set of regulators. Technology and data that crosses industries may open the door for cross-industry regulation regarding the permissible use of data. For example, the trend toward autonomous vehicles may bring disruption to the private auto market by raising questions on liability when autonomous technology fails. The Department of Transportation (DOT), National Transportation Safety Board (NTSB), National Highway Traffic Safety Administration (NHTSA), the courts, or other governing bodies may ultimately determine that auto liability lies with the manufacturer[36]. In another example, the telecommunications regulator Federal Communications Commission (FCC) may review and exert limitations on the permissible use of data collected from mobile phones.

In response, insurers should continue to collaborate with regulators. This will allow insurers to have a voice in the necessary design and modernization of regulations covering the application and interpretation

[34] Federal Trade Commission Report to Congress, "Credit-based Insurance Scores: Impacts on Consumers of Automobile Insurance", July 2007

[35] Ponemon Institute, LLC, "The True Cost of Compliance: A Benchmark Study of Multinational Organizations", January 2011

[36] "Government autonomous car regulations are out", Autoweek, September 20, 2016

of analytics across all insurance products and services. Additionally, open dialogue provides insurers the opportunity to demonstrate the benefits of analytical insights (e.g., Prudential's HIV Life products) that provide new options to underserved markets. Finally, collaboration with regulators will define the industry's obligation to service "uninsurable" risks through public/private partnerships and residual market mechanisms.

Role of the Risk Manager

Risk managers will play a critical role in the development of Data and Analytics by helping the organization to weigh the risks and benefits of innovation at both the strategic and operational levels. In their broadest role, risk managers are asked to examine the risk landscape and draw attention to broad strategic questions, such as those discussed above, and facilitate a dialogue with key decision makers on these issues. At the operational level, risk managers are tasked with promoting an atmosphere of intelligent risk taking through the institution of a risk framework that enables the business to identify, mitigate or escalate risks as they emerge.

> *"Our job is to prod. We have to keep prodding until we are convinced that the organization is aware of and discussing the [strategic and operational] opportunities and risks posed by Big Data and Advanced Analytics."*
>
> *- 2016 Big Data Survey Respondent*

At a strategic level, Risk Managers are well positioned to identify and address strategic risks and opportunities presented by Data and Analytics. Sitting outside the business, risk managers can independently assess the position of the organization relative to emerging trends and reach across the organization to ensure that relevant stakeholders are brought to the table to discuss these strategic issues. Whilst not the risk manager's responsibility to determine how the business ultimately builds analytical solutions, it is incumbent on risk managers to facilitate a discussion and promote awareness.

> *"Insurance hasn't integrated [Big Data and Advanced Analytic technologies] as quickly as other industries. But, there is going to be an inflection point not too far into the future, and we better be prepared for it."*
>
> *- 2016 Big Data Survey Respondent*

Calling attention to the opportunities and challenges of Data and Analytics is especially important given the early state of technology adoption within the insurance industry. This early stage provides risk managers with a short but critical window in which to assess and prepare for future disruption. Further, insurance industry risk managers have the benefit of key learnings from other industries that experienced similar disruption from these or similar technologies. Manufacturing, retail, travel, etc. have all experienced "creative destruction" and been forced to make profound changes to business models. Risk managers can learn from these examples to provide context and inform business units looking to leverage technology.

A key risk priority should be the bridging of communication gaps that may arise as business units innovate in new technology and analytical methods independently across the enterprise. Innovation often happens within the business, making it difficult for organizations to manage the risk and leverage key

learnings across the enterprise. In that case, risk managers can promote awareness of innovation and facilitate the cross pollination of ideas throughout the firm. Further awareness allows risk managers the opportunity to bring together parties that ought to be consulted for a regulatory or control risk perspective. For example, a business unit seeking to innovate using a sensor-based consumer product (e.g., personal fitness or telematics) will need to involve input from IT, Compliance, Legal, and other control functions. Overall awareness will ultimately build confidence that the organization has set itself on a cultural foundation that is prepared to innovate and meet its strategic challenges.

> *"Awareness is critical. As we roll out [products and processes built on Advanced Analytics] it is important to have awareness and confidence that the organization has ground rules in place."*
>
> *- 2016 Big Data Survey Respondent*

Finally, risk managers should look to improve their own risk processes using Data and Analytics capabilities. The vast amounts of data on operational and compliance risk coupled with advancements in natural language processing and artificial intelligence allow for the development of models and technologies that support everyday decision making for the risk professional.

Conclusion

The insurance industry has long used sophisticated analytical techniques within many of its core functions; however, the emergence of Data and Analytics enables the industry to understand and respond to customer demands. Consumers are benefiting from these insights and have come to expect more from the businesses with which they do business. Further, consumers have demonstrated a willingness to trade private information for customized products or services, and the challenge to insurers is to deliver on that value proposition.

The Data and Analytics revolution will require insurers to challenge traditional insurance culture to meet evolving consumer expectations and the threats posed by new entrants unencumbered by traditional biases. Cultural change begins with a "tone at the top" and will be dependent on an insurer's ability to recruit and retain new talent to back-fill for an aging workforce. Companies will be competing for talent against other industries, other insurers, and other departments within their organization.

Crucial to the adoption of Data and Analytics is the regulatory environment that acts to protect consumers and their data. Insurers should continue to diligently monitor data, algorithms, products, etc. to help identify and manage potential dislocation of segments. Insurers also have a duty to safeguard private consumer data, which will become more challenging as data sets grow and become more connected. The complexity of regulatory compliance will likely increase as regulators outside of the insurance industry may exert influence on data and its use.

Throughout this change, risk managers are responsible for helping the organization address strategic risks and navigate the regulatory environment. Sitting outside the business, risk managers are uniquely positioned to independently assess business operations and identify opportunities to cross-pollinate innovative ideas or rein in innovation that has outpaced good governance. ■

APPENDIX

A Brief History of the Development of Data and Analytics

The 17th century philosopher Francis Bacon is widely considered to have coined the phrase *scientia potentia est* – knowledge is power. As the father of the scientific method, Bacon understood that a critical limitation to scientific understanding was the possession of the observations necessary to analyze and draw conclusions. The idea that knowledge provided power to the possessor was not novel to the English Renaissance. For millennia, civilizations have sought to store and collect knowledge and data.

Some of the earliest large scale examples of data collection and storage can be attributed to the Ancient Egyptians. In 300 BC, understanding the value of knowledge, King Ptolemy I directed that the first universal library be created, the Library of Alexandria. Historical accounts reveal that great effort and expense were taken to collect, if possible, all the books in the world[37]. While existing prior, libraries had previously been limited in focus to the collection of regional works and ideas. Ancient Egyptian and Babylonian civilizations also sought to collect data on its citizens through censuses, the earliest known date to the 4th millennium BCE. Censuses continued to be conducted by civilizations throughout the ancient world and middle ages to determine taxes and military muster[38]. One of the most famous examples was the *Domesday Book*, undertaken by William the Conqueror in England in 1086 for the purpose of tax assessment. To execute the survey, teams of royal officers visited each county collecting responses from regional representatives, after which the results were then transcribed by a single individual into what became known as the *Domesday Book*[39]. Understandably, given the method of data collection and large number of records to be manually captured, the *Domesday Book* has proved to be far from accurate.

Throughout history censuses have continued to be a primary administrative data source and were conducted regularly. As the volume of census data grew, traditional methods of tabulation and analysis were quickly overwhelmed. The 1880 US Census took 8 years to be tabulated, and for the 1890 US Census, it was estimated that the manual tabulation of the data collected would take more than 10 years to complete – after the next census was scheduled to occur. In response to this, a young census bureau engineer named Herman Hollerith created a punch card automated tabulation system, reducing the time required to tabulate the census to 3 months[40].

Machines to assist in calculations or to carry-out automated tasks have been used for millennia. Tools such as the abacus were first developed in Mesopotamia during the 3rd millennium BCE, and the first known analogue computer, the Antikythera Mechanism which was used in astrological

[37] R.H. Charles, "The Letters of Aristeas," *Oxford: The Clarendon Press*, 1913, http://www.ccel.org/c/charles/otpseudepig/aristeas.htm

[38] New World Encyclopedia contributors, "Census," *New World Encyclopedia*, http://www.newworldencyclopedia.org/p/index.php?title=Census&oldid=968850

[39] New World Encyclopedia contributors, "Domesday Book," *New World Encyclopedia*, http://www.newworldencyclopedia.org/p/index.php?title=Domesday_Book&oldid=973015

[40] Frank da Cruz, "Columbia University Computing History - Herman Hollerith," *Columbia University*, 2011, http://www.columbia.edu/cu/computinghistory/hollerith.html

calculations, dates to the 1st century BCE[41]. In the early 19th century, the Jacquard loom utilized punched cards to control a sequence of actions that wove complex patterns, improving the speed and efficiency of manufacturing textiles[42]. Hollerith's tabulation machine, however, expanded upon the concept of using punch cards to transfer data to a readable medium. With this advance, Hollerith made possible a new era of accelerating innovation in the 20th century.

A further leap in big data technology came in 1936 when Alan Turing conceived of a conceptual computer that could read and write binary code on magnetic tape and an internal memory. The Turing Machine consisted of a means of input and output, memory, and a central processor, providing the evolutionary foundation for modern computing[43]. The critical departure from past technology like the Hollerith Machine was that the Turing Machine was programmable and not created for a single purpose. Turing's concept of representing data and code in the same way is fundamental to modern computing and the rapid advancement of technology behind them[44].

The same concepts Turing used to create the Turing Machine were also applied - to no small impact - during World War II. During the war Turing and his team of code breakers were tasked with deciphering encoded German naval messages, which prevailing sentiment deemed to be unbreakable. Turing quickly ruled out manual methods of deciphering the encrypted messages due to the complexity and volume of the required calculations. Instead, Turing and his team devised a machine called the *Bombe,* capable of simulating the operation of German cipher machines and allowing British intelligence to learn of German war plans and thwart them.[45]

Through the 20th century and into the 21st century, processing power has accelerated exponentially. Technological innovations meant that computer processors developed from using electrical relays to vacuum tubes to transistors to integrated circuits used in current technology. Moore's law refers to an observation made by Gordon Moore of Intel in 1965 where he predicted that the number of transistors in a silicon chip would double each year. Through the end of the 20th century Moore's prediction has remained fairly accurate with the number of transistors doubling closer to every 18 months[46].

After nearly a century of computing advancement, the processing power economically available and the ease of applying in the 21st century has allowed for new and exciting innovations in ways to utilize data. Modern medicine has embraced this power to optimize matching organ donors with recipients. Given the critical nature and potential for complications in organ transplantation, a large set of donors and recipients presents a challenging optimization problem. To help

[41] Encyclopedia Britannica Online, "Antikythera Mechanism," *Encyclopedia Britannica*, 2016, https://www.britannica.com/topic/Antikythera-mechanism
[42] Encyclopedia Britannica Online, "Jacquard Loom," *Encyclopedia Britannica*, 2016, https://www.britannica.com/technology/Jacquard-loom
[43] Encyclopedia Britannica Online, "Turing Machine," *Encyclopedia Britannica*, 2016, https://www.britannica.com/topic/Turing-machine
[44] Simson Garfinkel, "Turing's Enduring Importance," *Technology Review*, 2012, https://www.technologyreview.com/s/426834/turings-enduring-importance/
[45] Lee A. Gladwin, Alan Turing, Enigma, and the Breaking of the German Machine Ciphers in World War II, Quarterly of the National Archives and Records Administration, Washington D.C. 202-217, 1997
[46] Michael Aaron Dennis, "Gordon E. Moore," *Encyclopedia Britannica*, 2016 https://www.britannica.com/biography/Gordon-E-Moore

address the problem, algorithms have been developed to help maximize the likelihood of a successful transplant[47]. In 2012, the Democratic Party embraced analytical techniques to help secure President Obama's reelection. Using data collected from the 2010 mid-term elections and leading into the presidential election, Obama's campaign was able to micro-target donors and voters, maximizing efficiency in fundraising and ad spending[48]. Similarly, the campaign was able to utilize its database of voter data to explore trends on issues in various regions and demographics throughout the campaign, and ultimately increase voter turnout[49].

Looking further into the 21st century, innovations around Data and Analytics will continue to rapidly develop. Driverless cars continue to be tested and are expected to become readily available over the next decade. Contrasting the ability of this technology to collect, process, and react to its environment in real-time to computers a half-century ago demonstrates the rapid pace of innovation. Continued developments of artificial intelligence will provide another potential innovation spring-board for this century. The concepts behind innovations in analytics are also being applied to the insurance industry. They present an opportunity to radically transform the insurance business model and change the way insurers price products, engage customers, process claims, and conduct back office operations. ■

[47] John Timmer, "The math of organ donation: Kidneys are an NP-hard problem," *Arstechnica*, 2015, http://arstechnica.com/science/2015/01/the-math-of-organ-donation-kidneys-are-an-np-hard-problem/

[48] Gretchen Gavett, "Electing a President in a Microtargeted World," *Harvard Business Review*, 2012, https://hbr.org/2012/11/electing-a-president-in-a-micr

[49] Michael Scherer, "Inside the Secret World of the Data Crunchers Who Helped Obama Win," *Time Magazine*, 2012, http://swampland.time.com/2012/11/07/inside-the-secret-world-of-quants-and-data-crunchers-who-helped-obama-win/2/