INSTITUTE OF INTERNATIONAL FINANCE

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INNOVATION IN INSURANCE: HOW TECHNOLOGY IS CHANGING THE INDUSTRY

INTRODUCTION

A variety of breakthrough technologies are set to spur a fundamental transformation of the insurance industry. Cloud computing, the Internet of Things (IoT), advanced analytics, telematics, the global positioning system (GPS), mobile phones, digital platforms, drones, blockchain, smart contracts, and artificial intelligence (AI) are providing new ways to measure, control, and price risk, engage with customers, reduce cost, improve efficiency, and expand insurability. These technologies are also enabling the creation of new insurance products, services, and business models. And while emerging technology provides opportunities for traditional insurers to modernize and reinvent themselves, it also forces them to respond to new sources of competition from increasingly well-funded and nimble software-based companies that are beginning to make inroads in the market by focusing on unmet consumer demand, bringing down cost, and providing new services. This paper examines how technology is beginning to reshape the insurance landscape and the potential challenges and opportunities facing the industry.

UNDERLYING DRIVERS OF CHANGE

Technology

In addition to innovations in data and mobile, which impact every company in financial services, insurance is also being disrupted by rapid innovation around advanced sensors.

Customer Expectations

Insurance is traditionally an industry with low customer touch and slow tech adoption. Shaped by their experiences with other industries, insurance customers, particularly millennials, now expect on-demand, high-touch, and rapidly innovating services focused on user experience.

Digital Disruptors

Digital disruptors in insurance are taking a narrow focus on a portion of the value chain or leveraging a specific new technology to meet customer needs. This is accelerating competition, innovation and change in insurance.

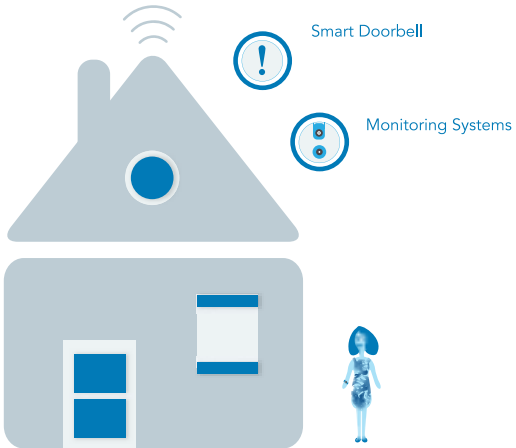
INNOVATION & INSURANCE

On-Demand Insurance

New digital platforms support micro-duration and atomization of insurance by item.

Smart Homes and Property Insurance

Sensors and monitoring systems give homeowners and insurers data on, and control over, major risks.

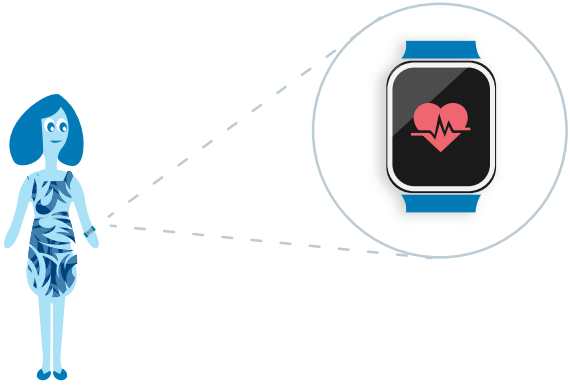


Telematics, Driverless Cars and Car Insurance

Telematics monitor customers' driving habits for more accurate risk profiles and pricing, while driverless cars redefine the kind of motor insurance required, limit accidents, and reduce the overall need for insurance.

Wearables, AI and Health Insurance

New biometric sensors and smartwatches monitor heart rate, blood pressure, oxygen, glucose levels, etc., while providing real-time data, coaching, and incentives.



Cognitive computers and big data help researchers make new discoveries, doctors diagnose illnesses, and individuals monitor and treat chronic conditions, such as diabetes, through personalized education and coaching.

TECHNOLOGY

Until recently, insurance has been a virtual island in a sea of technological change. While new players worked to disrupt banking and wealth management—after entirely transforming music, publishing, travel, taxis and booking—insurance seemed to be operating much as it had for decades. That era of relative stability has ended with the increasing deployment of advanced sensor technologies and related services. Insurance is now, like other major industries, grappling with the risks and opportunities of new technologies as we will see below.

The main body of this paper is organized around different breakthrough technologies. Two major impressions emerge: technology is changing the nature of risk and is enabling new products, services and channels. One of the most exciting implications resulting from these developments is expanded insurability for low-income populations, which we will cover in our upcoming companion report, "Insurance Inclusion."

INSURANCE FACING AN ON-DEMAND MARKETPLACE

Insurance has been an industry with low customer engagement. A 2014 survey by Morgan Stanley and Boston Consulting Group found that consumers interacted less with insurers than with any other industry in the study. Many insurers have limited interaction with a significant portion of the end-consumers because a considerable amount of their business is intermediated—brokers, for instance, amass an impressive $45 billion in annual compensation from insurers around the world. Furthermore, the slow digitization of the industry has hindered a high frequency of interaction between insurers and insureds. The lack of more customer touchpoints has meant that insurers have fewer opportunities to gain insight into customer needs and to use insights to customize products. A desire to become more consumer-centric and enhance personalized services is shared throughout the industry. As AXA's new CEO Thomas Buberl said, "Insurance suffers traditionally from a lack of contact with customers. We want to do more." According to Christof Mascher, COO, Allianz, "How to get to a higher frequency of interaction with customers was always a big challenge for insurers. The digital age has brought us countless opportunities and frequent touch points."

CHANGING CUSTOMERS

Major shifts in client demographics, behaviors, and expectations are underway and will have important ramifications for the insurance landscape. This shift has been led by millennials, individuals born roughly between 1980 and 2000. This generation will constitute half of the global workforce by the end of the decade. In the United States, they already comprise the largest share of the overall population as well as the employed population—at 26% and 34%, respectively. Millennials, whose exposure to digital technology and innovative platforms from an early age have made them the first generation of "digital natives," are beginning to move into their peak earning and spending years and have become an influential segment of the population. Their high expectations for technology-based services, convenience, transparency, speed, regular engagement, and a personalized experience that reflects their needs are defining how products and services are delivered. Their preferences and expectations are a particular challenge for the insurance industry.

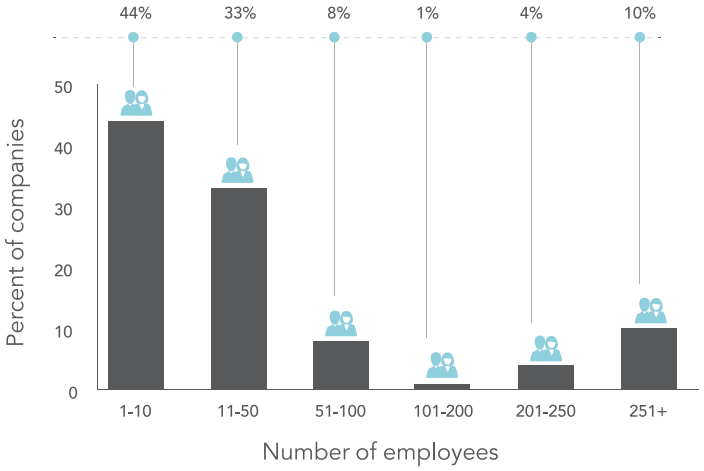
DIGITAL DISRUPTORS

Though still only a tiny share of the overall $4.5 trillion insurance market, new digital players pose a potential competitive challenge as their low-cost technology platforms and different business models help them compete asymmetrically by targeting areas of the insurance value chain. They also face fewer legacy costs and benefit from greater specialization, risk tolerance and agility—44% of insurance tech companies have fewer than 10 employees (**Chart 1, Pg. 5**).

Startups are using technology to reduce operational costs and help enhance the client's user experience by improving convenience, transparency, timeliness, simplicity, personalization, and customer engagement. As we

Chart 1

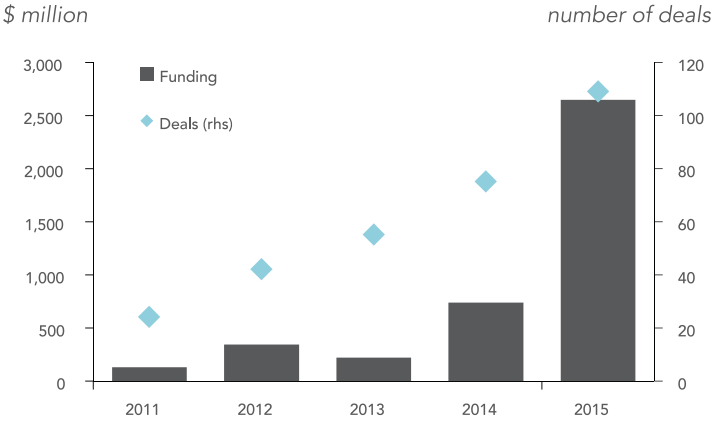
Insurtech Company Headcount Distribution



Source: Venture Scanner.

Chart 2

Global Financing Activity in Insurance Tech

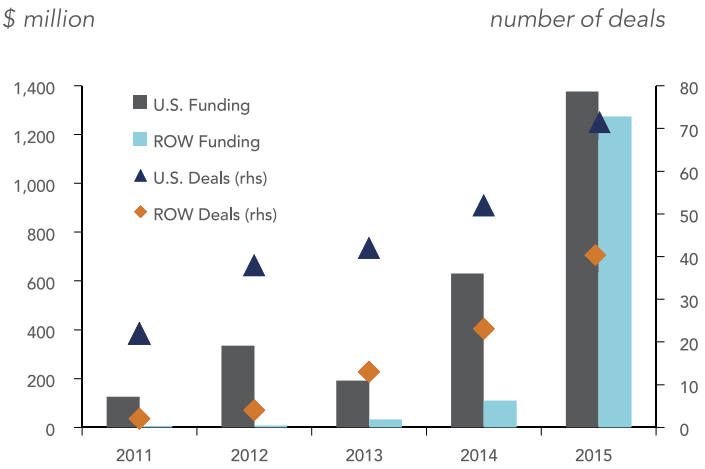


Source: CB Insights, IIF.

will see throughout the following sections of the paper, from mobile insurance policy management platforms to usage-based automobile insurance, the insurance technology (insurtech) industry is expanding quickly. Investment in insurtech startups more than tripled last year, rising from $740 million in 2014 to above $2.6 billion in 2015, according to data from CB Insights, a U.S.-based research firm (**Chart 2**). The strong inflow of capital has continued in 2016, with CB Insights reporting that the first three months of the year experienced the second largest quarter for financing ever in the space with more than 45 deals raising $650 million. And while the U.S. remains the most active country for insurtech, the momentum is growing globally (**Chart 3**) and (**Chart 4**). This growing momentum has been an important catalyst for a number of incumbents to begin modernizing and improving their services through the adoption of breakthrough technologies in order to remain competitive.

Chart 3

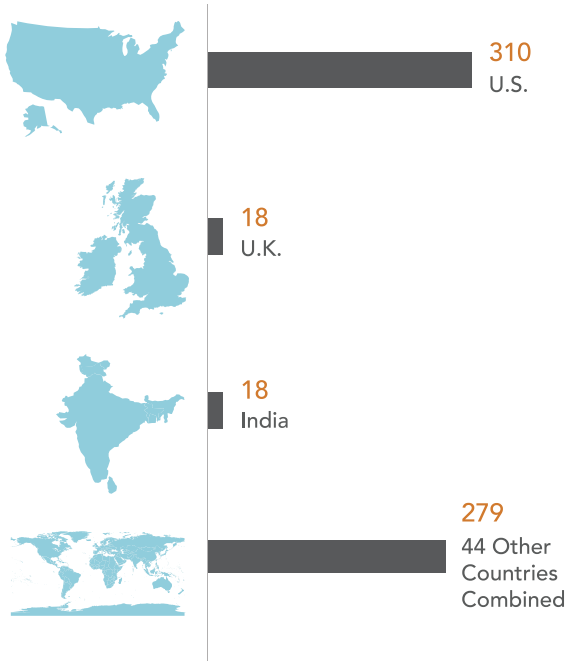
U.S. vs. Rest of the World Insurtech Financing Activity



Source: CB Insights, IIF.

Chart 4

Insurence Tech Startups by Select Country



Source: Venture Scanner, IIF.

BREAKTHROUGH TECHNOLOGIES TODAY: INDUSTRY IMPLICATIONS AND ACTIVITY

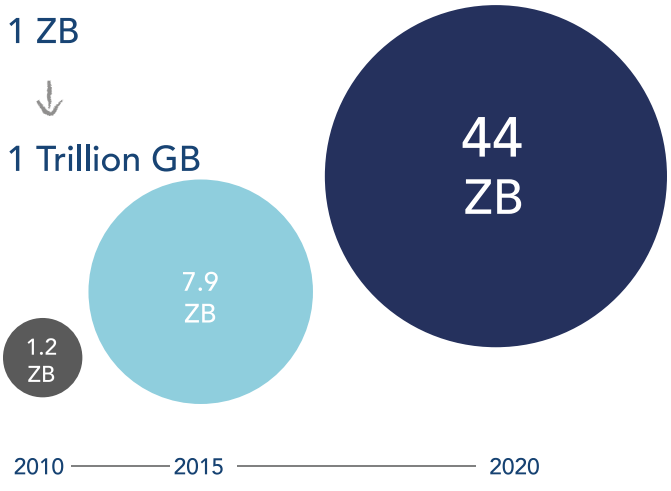
DEEPENING DATA

Data technology is transforming the very nature of risk—the core element of the industry's business model—by enabling new ways to create, capture, and analyze data valuable to insurance firms. Today, there are countless new sources to automatically and non-intrusively acquire consumer data in real time, thereby helping insurers better calculate and manage risk. This is providing opportunities for insurers to underwrite policies that could not have been covered profitably in the past.

Chart 5

Active Growth of Global Data

zettabyte



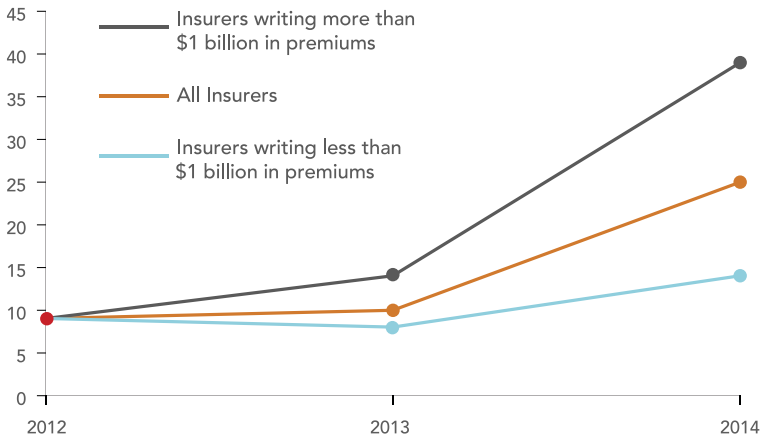
Source: CSC, IDC.

According to International Data Corporation, a technology market-intelligence firm, the digital universe is doubling in size roughly every two years. This dramatic growth (**Chart 5**) is attributable to a variety of factors, including new and cheaper solutions to store, manage, and process data (i.e. the cloud), a substantial rise in computing power, a decline in related costs, the ubiquity of the Internet, and the proliferation of online devices. Insurers are increasingly leveraging the explosion of data (**Chart 6**) and advanced analytics to help boost risk transparency, reduce the number of unknowns within risk models, curtail everyday accidents, mitigate damage, decrease underwriting risk, offer personalized premiums, expand insurability, and create novel insurance products and services.

Chart 6

Share of North American Insurers Investing in Big Data

percent



Source: SMA Research, Swiss Re.

For instance, by obtaining valuable real-time and personalized customer data through IoT devices such as biometric wearables and cars and homes with embedded sensors, insurers can measure risk more accurately. Data can also help insurers better manage risk and mitigate dangers and losses by providing them with important information they can use to alert or remind their policyholders in real time via mobile technology to take action—for example, avoid driving into a storm or remotely shut a home's water supply off because of a leaking pipe. This results in fewer claims and improved customer satisfaction. Moreover, as risk assessment moves toward a more data-dependent model, insurers will be able to price risk at a more granular level and offer dynamic personalized coverage. A policyholder's location feature on their smartphone, for example, could inform an insurer that their customer is abroad, at which point travel coverage is activated while their car insurance premium simultaneously declines. Insurers will also be able to counter fraud more effectively as verification becomes simpler.

Moving forward, customization will become easier as data capture and analysis improves and becomes more affordable. However, at the same time, addressing issues surrounding comprehensive data regulation will grow

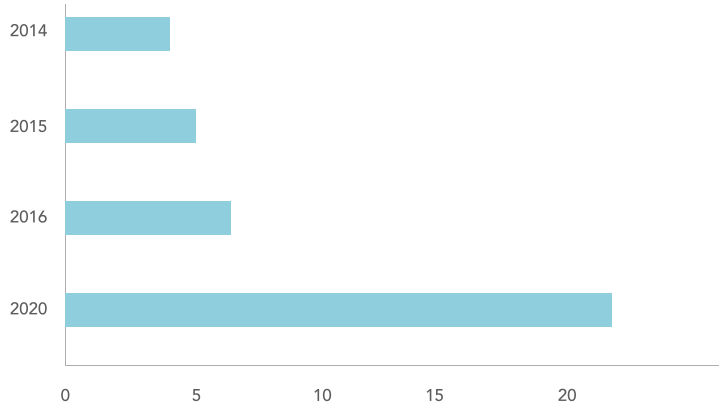
in importance. According to a report by Moody's, "regulators will have to weigh in on which data can be used in pricing decisions and to what extent. Prime considerations include safeguarding customer privacy, and ethical use of data, including prevention of unfair discrimination." Thus, insurance regulators and data privacy rules will play a significant role in determining how insurers will be able to use data and also influence the level of product customization available to customers (please see page17 for more information on regulation).

Internet of Things, Advanced Sensors, and New Data Sources

The IoT provides a prime example of how new data sources, better data, and ongoing data reporting are laying the foundation for the industry's transformation by enabling insurers to more effectively model risk and underwrite policies. The IoT is a network of nodes, or devices, that collect, monitor, and share data through the Internet. These connected devices, or "smart" devices, can include everything from automobiles, home security systems, wearable health monitoring units, kitchen appliances, and energy and transport infrastructure. Moving forward, as the cost of sensors, microchips, and cloud computing declines, and as global online connectivity and computer processing expands, the number of IoT devices is expected to multiply. According to Gartner, a global IT research and advisory firm based in the U.S., 2016 will see 5.5 million new "things" become connected to the Internet daily, and by year's end the world will have 6.4 billion connected devices—up 30% from the previous year. By 2020, that number is forecast to reach 20.8 billion (**Chart 7**). This trend will have far-reaching implications for home, health, and car insurance.

Chart 7

Internet-Connected Devices
installed units, billions



Source: Gartner.

Smart Homes and Property Insurance

Smart house monitoring systems will give homeowners and their insurers data on, and control over, major risks. This is expected to lower premiums as claims and losses are minimized. For example, Ring, a startup based in Los Angeles, builds HD video doorbells that help deter break-ins. The Internet-connected doorbell allows users to see and speak with visitors at their door using their mobile phone from anywhere in the world. These smart doorbells also feature night vision, motion detection and the ability to video record activity detected near someone's front door, which can be shared with others through the cloud. According to Ring's CEO Jamie Siminoff, company data shows that using an Internet-connected doorbell "dramatically reduces the likelihood of home break-ins." American Family Insurance, an investor in Ring, incentivizes its home insurance policyholders to install the device by offering a $30 discount on the product as well as the possibility of qualifying for a 5% savings on their policy. Other insurers that offer their policyholders discounts for installing qualified home monitoring systems are State Farm and PURE. State Farm policyholders receive premium discounts for installing ADT Pulse, a home security system, as it helps, among other things, to limit damage from a leaking water pipe before it becomes a major expense by receiving alerts from embedded sensors that detect plumbing issues, and enabling users to remotely shut their water off with a smartphone. PURE, a U.S.-based insurer specializing in high net worth homes, offers insurance discounts to customers who install temperature monitoring systems like Google's Nest thermostats, which can help avoid damages from frozen pipes and other extreme temperature-related issues. As homes become smarter there will likely be a reduction in the severity and frequency of claims, the risk to underwrite policies, and premiums.

Wearables and Health and Life Insurance

Health and life insurance will also be transformed as wearable biometric sensors, such as FitBits, provide insurance firms with unprecedented data on the health of their clients. With more and more sensors providing ever-increasing valuable data on people's exercise habits, and vital signs, including their heart rate and blood pressure, the way health risk is assessed and underwritten will change. According to a report by PwC, wearables and similar technologies will help make health care "predictive, preventive and personalized," and this will be reflected in insurance plans going forward. Insurers are already leveraging wearable biometric sensors to incentivize policyholders to adopt healthy habits. One of the leaders in the space is Vitality Group, a member of South Africa-based Discovery, an insurer and the creator of the Vitality wellness program. The company has partnered with other insurance firms around the world, including Prudential in the UK, Ping An in China, AIA in Singapore, and John Hancock, one of the largest life insurers in the U.S. According to the company's website, as part of the program with John Hancock, "policyholders receive personalized health goals and can easily log their activities using online and automated tools, which are integrated with personal health technology…The healthier their lifestyle, the more points they can accumulate to earn valuable travel, shopping and entertainment-related rewards and discounts from leading retailers. Additionally, depending on the type of product they purchase, a policyholder could save as much as 15 percent off their annual premium." U.S.-based Oscar Health, an insurance startup valued at $2.7 billion, is another example of a company offering policyholders rewards in exchange for exhibiting healthy habits. In 2014, the insurer partnered with Misfit, a company producing wrist-worn sensors, and now encourages participating policyholders to reach daily step goals. If they meet those goals 20 times per month they are rewarded with a $20 gift card every month they complete the challenge. The rewards ultimately save Oscar money because it leads to healthier policyholders with fewer medical bills. Programs such as these are mutually beneficial: they improve health and potentially extend the lives of policyholders while also reducing risks and claims for insurers.

More advanced biometric sensors are currently under development or have just recently come to the market. For example, Google is working with Novartis, a global healthcare provided based in Switzerland, to create a smart contact lens that corrects vision as well as monitors blood sugar levels, which is potentially life-saving for individuals with diabetes. Furthermore, Proteus Digital Health, a California-based company, has developed the world's first digital medicine service. According to the company's website, "Proteus Discover is comprised of ingestible sensors, a small wearable sensor patch, an application on a mobile device and a provider portal. Once activated, Proteus Discover unlocks never-before-seen insight into patient health patterns and medication treatment effectiveness, leading to more informed healthcare decisions for everyone involved." Information obtained through ingestible sensors could help doctors customize drug treatment for patients and also help insurers establish optimal pricing and coverage for particular policies.

Telematics and Car Insurance

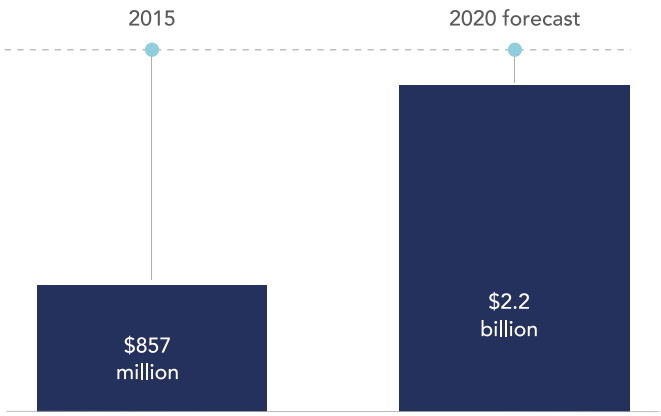
Car insurance is yet another area that will be transformed by connected devices as telematics can transmit valuable data for assessing an individual's risk profile. Instead of relying simply on basic information like age and gender, the type of car someone drives, and their history of accidents or offenses, insurers today can obtain real-time data on their policyholders' driving habits—for instance, whether they make hard turns or abrupt stops, how fast they drive, how frequently, what time of day, and location. Having this information available enables insurance firms to make more informed underwriting decisions and provide policies accordingly.

According to a report by Markets and Markets, a market research firm, "insurance and automotive companies are rapidly deploying insurance telematics solutions to monitor driver behavior, simplify roadside assistance, effectively manage claims, improve their security of insurance data, and achieve competitive advantage." The report explains that thanks to the growth of IoT technology and consumer enthusiasm for in-car connectivity, the telematics insurance market is projected to expand quickly over the remainder of the decade, from $857 million in 2015 to $2.2 billion in 2020 (**Chart 8, Pg.9**).

Examples of companies active in the space include Metromile, Octo, Zubie, and MyDrive Solutions. Metromile, a U.S.-based car insurance startup offering pay-per-mile insurance, claims it saves low-mileage customers an average of $500 per year compared to their traditional plans. The company, the only one of its kind in the U.S., currently operates in seven states but is planning to expand to others in the near future. Customers receive a small wireless device to plug into their car's diagnostic port, which tracks mileage and transmits it to the company as well as to the user's mobile app.

Chart 8

Global Telematics Insurance Market



Source: Markets and Markets.

Octo, an Italian company, provides telematics to the car insurance industry and helps make insurance pricing more fair and transparent. According to the company's website, it has "grown into the leading global insurance telematics provider, with more than 60 insurance partners and four million active end users." In addition to monitoring mileage, the company's technology allows insurers to collect data on customers' driving habits and behaviors—for instance, how they accelerate and how they brake—and charge them premiums according to their risk profiles. The company has collected over 100 billion miles of driving data and absorbs new information at a rate of 60,000 miles every minute. Octo's website states that their technology enables drivers to "benefit from savings of up to 30%, as well as increased safety and security features, while insurers benefit from better risk assessment and claims management, which improves financial performance."

U.S.-based Zubie also provides a device that connects cars to the Internet and tracks driving habits. The company has partnered with Progressive to offer users customized premiums after the insurer tracks the driver's driving data over a six-month period. Finally, MyDrive Solutions, a London-based telematics startup acquired in 2015 by Italian insurer, Generali, uses data analytics and software engineering to assess driver risk at the granular level for the benefit of insurance companies.

Telematics technology is still evolving. It is likely to become increasingly prevalent and sophisticated moving forward, enabling insurers to more accurately assess individual risk profiles, facilitating more equitable premiums for drivers, and incentivizing people to drive more safely. Telematics-based car insurance could also potentially help reduce emissions, theft, and repair costs. Even more transformational for both the auto and insurance industries, however, will be self-driving cars, which we will examine in the artificial intelligence section (page 14) of this paper.

A MOBILE WORLD

Another key innovation contributing to the reshaping of the insurance industry today has been the spread of—and advances in—mobile phone technology. Increasingly powerful smartphones—the fastest selling devices in history—are forecasted to reach a global penetration rate of 50% this year and 75% by 2020 (**Chart 9, pg. 10**). Penetration rates are even more impressive when basic mobile phones are included in calculations.

In addition to capturing valuable data, the growing prevalence of mobile phones provides new methods for insurance firms to communicate with and provide products and services seamlessly at all hours to their customers, encouraging greater engagement and brand allegiance. With advances in mobile technology, smartphones are playing an increasingly important role in company-consumer connections. For example, insurers can send text reminders to policyholders to update account details to ensure continued protection or push personalized communications to customers when they are more likely to need a plan, such as during travel.

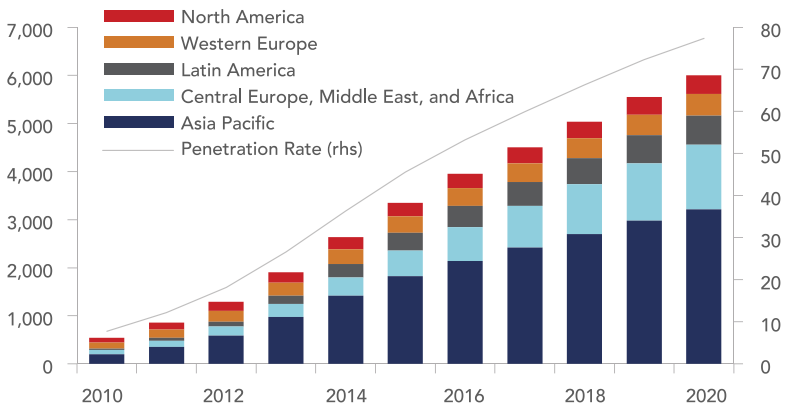
Moreover, the unprecedented access afforded by mobile phones provides insurers the opportunity to spot customer trends and evolving needs more quickly than before. Through more frequent interactions and better engagement, insurers can build stronger relationships with policyholders and increase customer satisfaction and retention rates.

Mobiles are also reducing the need for brick and mortar offices and employees, and makes physical barriers and distances less of an obstacle to servicing customers—resulting in lower operational costs, improved scalability, faster service, and ultimately more affordable and accessible products for customers.

Chart 9

Global Smartphone Subscriptions and Penetration Rate

$ million *percentage*



Source: United Nations, Ericsson, GSMA Intelligence, IIF.

Mobile technology is enabling the spread of on-demand tailored insurance as well. Individuals can now purchase personalized coverage for specific durations and items in real time. Customers cover what they want, when they want, for however long they want. This makes insurability more convenient and accessible to a larger segment of the population as it allows people who could not afford traditional blanket and long-duration policies to benefit from more affordable and customized insurance products that are delivered in real time to their phone.

DIGITAL PLATFORMS

Proliferation of smartphones and new software development tools have facilitated the emergence of innovative digital insurance platforms that provide better information, user experience, transparency, convenience, rates, and customization than traditional channels. Thanks to lower startup costs enabled by software and the business opportunities in the industry, many of the innovative insurance platforms that have emerged are operated by new market entrants, who are looking to address new trends such as the sharing economy and customer needs such as transparency and simplicity.

On-Demand Usage-Based Platforms

The rise of the sharing economy, as exhibited by the growing popularity of Uber, Airbnb, and others, as well as the increasing demand for personalized insurance solutions, has led to a preference for on-demand usage-based insurance platforms. Traditional policies are not ideal in the new landscape as assets are increasingly shared. The current model of insuring individuals as owners of assets over long periods is outdated; instead a shift toward insuring individuals as users of assets over short periods will become increasingly common.

Leading the way in the space is Trōv, a California-based insurtech startup, which has raised $39 million in funding. The firm's software allows users to instantly obtain on-demand micro-duration insurance policies for individual items. Unlike blanket policies that cover everything at once—for instance, a whole houseful of goods—Trōv's atomization of items enables coverage at a granular level. Customers use a mobile app to photograph, catalogue, and value items like laptops, cameras, and bicycles. Users can then insure their possessions—for example, their bicycle during a weekend excursion in the mountains—with a simple swipe on their phone. Claims are submitted simply by sending a couple of text messages. The company, which according to its website is the world's first on-demand insurance for single items, recently launched in Australia after partnering with Suncorp, the country's leading insurer. Trōv is planning to expand to the UK—where it has partnered with

AXA—later this year—and to the U.S. and beyond in 2017. According to Scott Walchek, founder and CEO, "On-demand is the expectation of the connected generations. From purchasing and policies to pricing and claims, we've rebuilt insurance from the ground up by creating a truly on-demand experience." The company, he says, "enables people to protect just the things they want, when they want, for whatever duration, with a single swipe." As of the end of May, over 940,000 items worth $8.5 billion have been added to the platform.

Other examples of mobile on-demand insurance platforms include U.S.-based Sure and UK-based Cuvva. Sure offers coverage for travel, life, property, pet, and baggage. The company's app is powered by artificial intelligence and allows customers to purchase the category of insurance they need for precisely the length of time they need it—for instance, the duration of a flight. According to Wayne Slavin, co-founder and CEO, "With our new Robo-Broker technology we've created the first AI-powered insurance platform in the world, bringing an unprecedented level of service and personalization to customers globally—empowering them to make smart life decisions about their insurance needs." Cuvva, a startup, allows drivers to purchase car insurance by the hour rather than obtaining traditional annual coverage, making it safer and cost-effective to lend or borrow a car. The process to obtain insurance takes under a minute, according to the company's website. Users simply enter the license plate of the car they wish to insure and the duration of coverage, snap a photo of the front of the vehicle, and pay.

Moving forward, on-demand usage-based mobile insurance will likely grow in importance. Airbnb hosts could purchase coverage by the night, Uber drivers by the hour, and TaskRabbit "Taskers" by the day. Furthermore, with micro-duration and atomization insurance, customers will benefit from more customized coverage and accurate premiums reflecting the individual's risk profile at a particular point in time. This will help expand insurability to individuals that may not have been able to afford, or considered to purchase, traditional plans.

Peer-to-Peer Platforms

As in other areas such as consumer lending and music, advances in technology are facilitating the rise of innovative online peer-to-peer (P2P) platforms in insurance. While such platforms do not fundamentally change the core of insurance, they provide new and more efficient ways of servicing and attracting customers, which could threaten incumbent profits. Peer-to-peer insurance (P2PI) firms can be roughly split into two camps—brokers and carriers. The majority act as brokers and aim to lower the cost of insurance for their consumers by pooling policyholders together online and leveraging their buying power. Policyholders pay a portion of their premiums into a mutual pool and the remainder goes to a standard insurance firm. The mutual pool covers minor losses and if a smaller-than-expected amount of claims are filed over the course of a year, the remaining funds are returned to the group in the form of cash or lower policy renewal rates for the following year. If claims exceed the coverage provided by the group, a traditional insurance company covers the difference. Guevara and Friendsurance are two examples of software-based P2PI brokers. The former is an auto insurance network based in the UK that can save groups upwards of 50% on their premiums when claims are kept low. Similarly, Germany-based Friendsurance, "rewards small groups of users with a cash-back bonus at the end of each year they remain claimless," according to the company's website. Friendsurance asserts that its property insurance policyholders insured for the full year receive an average cashback of one third of paid premiums. Both companies have achieved impressive metrics with Guevara selling over £100,000 in premiums within two days of launching in 2014 and Friendsurance expanding at a monthly rate of 20% the same year.

Unlike P2PI brokers, P2PI carriers do the actual underwriting and offer their policies directly to consumers online. The business model allows investors to participate in the process and contribute money toward the capital reserves for the various insurance pools. Once the required period of time has elapsed, and after all claims have been paid, the investors and the carrier firm divide the outstanding balance remaining in the premium pool. U.S.-based Lemonade and Uvamo are two examples of online P2PI carriers. Lemonade, which focuses on property and casualty insurance, is the first company to formally announce its plans to operate as a

P2P insurance carrier. Uvamo, which was founded by former Lending Club employees, is reportedly planning to launch by the end of 2016.

Other P2PI startups that have recently emerged in various markets around the world include Bought By Many (UK), Darwinsurance (Italy), Inspeer (France), PeerCover (New Zealand), and PeersMutual Protection (China). We are likely to see more of these online P2PI models pop up in the future as they enable insurance firms to pool capital more cost-effectively, investors to diversify in an asset class that should move independently of securities markets, and policyholders to save significantly by keeping claims low.

Insurance Management Platforms

Thanks to new software solutions, innovative insurance management and comparison platforms are appearing. For example, San Francisco-based Embroker provides a free platform for small and medium-sized companies to manage and buy business insurance. According to the startup's founder and CEO, Matt Miller, Embroker is "building the world's first commercial insurance management system." He says the company's aim is to "reinvent the industry by giving CFOs, business owners, and managers tools to understand their insurance spending and improve their risk management program." Embroker's software has several useful features, including the ability to aggregate and compare various policies, summarize documents, and track certificates of insurance and claims all on one platform. The software is currently in beta. UK-based Brolly also offers a free insurance management platform but for individuals rather than businesses. The company's platform—which is powered by artificial intelligence—enables individuals to oversee all of their policies and identify areas of coverage that are missing or duplicative, and whether they can obtain coverage at a better price. Brolly is also currently in beta and will launch later this year. Other companies providing similar digitally-focused services with the aim of simplifying, personalizing, and increasing transparency of insurance policies for their customers are Swiss-based Knip, California-based Next Insurance, and New York City-based PolicyGenius. These aggregated systems help prevent customers from having to navigate countless websites as information is available on one intuitive platform.

DRONES: AERIAL ASSESSORS

Drones, small unmanned aerial vehicles, are increasingly piquing the interest of insurance companies as they provide useful ways for insurers to improve business functions, including claims management and underwriting.

The technology allows easy access to isolated and dangerous areas after man-made or natural disasters occur to effectively collect aerial data and assess loss through cutting-edge imagery analytics. Munich Re has been experimenting with the technology and has partnered with U.S.-based PrecisionHawk, a drone company, to augment insurance evaluations of areas affected by natural disasters by delivering improved reporting precision and quicker response times. The two companies worked together in the aftermath of the April earthquake in Ecuador. Within days of the devastation all of the affected areas were captured by drone imagery. The valuable data was delivered to Munich Re after being analyzed in DataMapper, a drone-based mapping and analytics platform. The technology allowed one of the world's leading reinsurers to respond to the catastrophe very quickly and effectively, and could play an increasingly important role moving forward by speeding up post-disaster relief and rebuilding through faster claims processing and payment. According to Tobias Büttner, head of claims at Munich Re, "Drone techniques may become standard in loss adjustment and claims management." Allianz has also been experimenting with the technology for similar purposes. Earlier this year, the company used drones to obtain high-level assessments of flooded parts of the southern region of Germany.

American insurers are eagerly exploring the potential uses of the technology as well. In 2015, over 10 insurance firms—among them AIG, Liberty Mutual, and State Farm—received approval from the Federal Aviation Administration in the U.S. to test and research the commercial use of drones for a variety of purposes, including assessing property claims after disasters and collecting advanced aerial data to enhance databases that predict risk factors and help with the underwriting process.

THE NEXT WAVE: TECHNOLOGIES WITH ENORMOUS FUTURE POTENTIAL

Blockchain and artificial intelligence are set to have a significant influence on the future of the industry; however, their impact will take longer to materialize.

BLOCKCHAIN AND BLOCKCHAIN-ENABLED SMART CONTRACTS

Blockchain—the underlying technology first used in Bitcoin—is a new type of distributed consensus system that enables transactions to be quickly validated and securely maintained through cryptography, computational power, and network users, removing the need for a trusted centralized authority. The blockchain provides an immutable record and audit trail of transactions and agreements that are replicated on computers around the world, thereby eliminating a single point of failure. Because virtually any type of information can be digitized, codified and placed onto a blockchain, a distributed ledger or database that is tamper-proof and permanent, the technology's potential to impact various industries is significant. A 2015 study by the World Economic Forum found that 58% of surveyed executives and experts from the information and communication technology sector believe 10% of global GDP will be stored on blockchain technology by the mid-2020s. Insurance industry observers, for their part, believe that the innovative distributed ledger could introduce a variety of improvements and efficiencies to the insurance landscape, including establishing a level of accountability and transparency that hitherto was impossible, mitigating risk and fraud, streamlining back-office operations, introducing new products, lowering costs, and providing easier and improved data access to parties.

According to a recent report on insurance by Ernst and Young, blockchain technology could "eliminate error, negligence, and detect fraud by providing a decentralized digital repository to independently verify the veracity of customers, policies, and claims." By mutualizing infrastructure and creating a common record of truth, firms could save significant time and money and improve operational efficiencies. Moreover, because all transactions on a blockchain are time-stamped and immutable, identities are secure, and data is trustworthy, insurance fraud would be more easily detected and minimized. This would be of incredible value to the industry as it is estimated that 65% of all fraudulent claims go unnoticed and that in the U.S. and Europe alone, fraud costs insurers approximately $60 billion in annual losses.

The innovation's ability to authenticate assets would also be beneficial to the industry. For example, a diamond's entire commercial history could be tracked on a blockchain, therefore making it easier to insure and premiums more accurate. Everledger, a London-based startup seeking to enhance transparency for diamond certification, has added records for over 850,000 of the precious gemstones to its blockchain database. Other assets that carry a unique identifier, which is difficult to destroy or replicate, could also be combined with the technology. According to the company's website, Everledger's permanent and immutable ledger benefits insurance firms, owners, claimants, and law enforcement.

Another specific area the technology could help ameliorate is title insurance. Individuals purchasing or refinancing homes face high transactions costs and a title search process that is difficult and expensive. By registering real estate records on distributed ledgers, title insurers could more easily obtain information required to clear a title. This would help lower fees during a transfer of ownership. According to a report by Goldman Sachs, blockchain technology could generate $2 to $4 billion in cost savings in the U.S. title insurance market alone by reducing errors and manual effort.

One of the most intriguing applications blockchain technology enables is smart contracts. A smart contract is a contract captured in code which self-executes the obligations the parties have committed to in an agreement. The term was coined in the mid-1990s though existed largely as a theoretical concept until the development of blockchain technology, which has provided the necessary elements for smart contracts to function effectively, including cryptographic security and immutability. Once two or more parties consent to all of the terms within a smart contract, they cryptographically sign and deploy it to a distributed ledger. When a condition specified

in the code is met, the program automatically triggers a corresponding action. By removing the need for direct human involvement once a smart contract has been deployed onto a distributed ledger, the computer program could, in theory, help automate various procedures, including claims processing, and make contractual insurance relationships more efficient and economical with potentially fewer opportunities for error, misunderstanding, delay, fraud or dispute. For instance, upon verification of a policyholder's passing, a life insurance smart contract could immediately release funds to the chosen beneficiary. The coded contract would establish the moment of disbursement by scanning online death registries in real time. Another example could include a smart insurance product linked to a real-time weather data source that triggers a crop insurance payout if rainfall amounts drop below a particular level in a certain area. In addition to supporting automation, this process of linking coded contracts with online devices may also provide product customization. For example, travel insurance plans could collect premiums only when a smart contract is notified via the policyholder's smartphone location feature that the person is indeed travelling. Similarly, smart insurance contracts could be linked to vehicles and collect premiums based on the driving habits of the owners.

In addition, smart contracts could impact the industry through peer-to-peer (P2P) solutions. Dynamis, a P2P insurance company, is developing a framework that uses smart contracts on the Ethereum blockchain to disintermediate traditional insurance firms by allowing policyholders to pool their funds and in the event of any claim, support one another financially. The company is focusing initially on unemployment insurance. According to the company's website, Dynamis "provides supplementary unemployment insurance by using the LinkedIn social network as a reputation system. Applicants for a new policy can use LinkedIn to verify their identity and employment status. Claimants can use their LinkedIn connections to validate that they are looking for work. The exercise of one's social capital within one's social network enables participants to obtain a new policy or open a new claim." The system, which is still in the development phase, could one day help reduce the costs of insurance.

While blockchain technology is still nascent, several established insurance firms have begun exploring the space. Hong Kong-based AIA and Shenzhen-based Ping An recently joined R3, the rapidly growing blockchain consortium based out of New York City, to see how it could help them improve their operations. Allianz, along with Nephila, a leading investment manager specializing in reinsurance and weather risk, "successfully piloted the use of blockchain smart contract technology for transacting a natural catastrophe swap." And finally, France-based Caisse des Dépôts, launched the blockchain market initiative in March with 17 partners, among them four insurers and mutual insurers—Aviva, AXA, CNP Assurances, and MAIF. The consortium's objective is to identify and promote blockchain solutions in the insurance, banking and finance industries. Insurers are expected to continue exploring and experimenting in the space moving forward as the technology improves.

ARTIFICIAL INTELLIGENCE

Artificial intelligence enables software to exhibit human-like intelligence, including learning, planning, reasoning, problem-solving, and decision-making.[1] AI is quickly becoming increasingly proficient at performing tasks that have historically been difficult for computers to execute, including recognizing images, identifying spoken word, and using unstructured, or unlabeled, data. While currently further along its development cycle than blockchain, AI is still far from its expected potential; the examples below provide just some of the technology's promising applications. Moving forward, the technology could help insurers enhance automation, reduce risk and expense, increase productivity, and facilitate better and faster decision-making. It could also enable both large and small insurance firms to offer services at a level of sophistication, customization, and scale never previously possible. Finally, it is expected that the technology will impact insurers indirectly through its widespread usage in various fields such as medicine and transportation in the future.

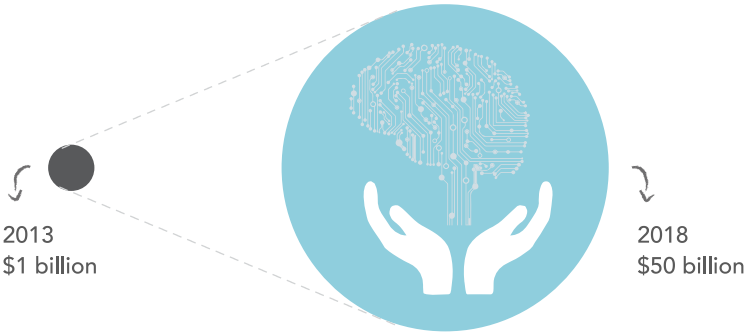
In light of these potential benefits and developments, it comes as little surprise that in 2013 Deloitte forecast

1 Artificial intelligence is a broad field with many sub-fields and related fields, including "machine learning" and "cognitive computing." For purposes of the paper, we refer to these terms without distinction. For more explanation, please click here, here and here.

the cognitive computing market in the U.S. alone to expand from $1 billion to $50 billion by 2018 (**Chart 10**). This forecast is in line with what Neal Cross—managing director and chief innovation officer of DBS—told the IIF earlier this year, "We'll see significant impact of machine learning and cognitive computing in the next five years. It has the potential to be more impactful than blockchain."

Chart 10

U.S. Cognitive Computing Market



Source: Deloitte.

With cognitive agents, insurers will be able to collect enormous amounts of real-time data through software-client interactions, which will allow them to gain deep insights into each of their clients' unique needs, and provide customized products and services accordingly. Moreover, because cognitive agents are scalable, firms utilizing them will be able to simultaneously increase their capacity to serve a larger number of customers while also reducing operational costs as the need for employees performing similar tasks gradually vanishes. AI software could, for example, automatically collect data from biometric sensors and medical files to obtain valuable and up-to-date information on the health of customers and then make near-instantaneous decisions on policy applications and set personalized premiums based on an individual's risk profile. Similarly, AI could facilitate claims processing automation and in doing so reduce the time it takes to process a claim from weeks, or even months, to just a couple of minutes. This could all help bring greater consistency to decision-making within the industry and make processes more cost-effective, efficient, and faster with less human involvement.

While the technology—like blockchain—is still developing, AI is beginning to infiltrate the insurance industry. According to research conducted by Accenture, "82% of insurers agree AI-driven automation will be seamlessly embedded into every aspect of business over the next five years." As mentioned earlier, startups such as Sure and Brolly are using AI to power their digital platforms. In 2014, USAA trialed IBM Watson's cognitive computing platform to help advise its clients on a variety of finance-related topics, including insurance, job search, and home purchasing. Another similar example of a virtual advisor or assistant infiltrating insurance is Amelia, the "learning cognitive agent" created by IPsoft, a global tech firm headquartered in New York City. The tech company's chief cognitive officer, Edwin Van Bommel, told the IIF that "she" is able to resolve issues 50% faster than a human in a similar customer service situation. Amelia, which can help automate various processes such as claims, is currently being deployed or tested by several multinational insurance firms.

Furthermore, Allianz has partnered with Baidu, China's leading search engine, and Hillhouse Capital Group, a leading investment management firm in Asia, to launch Bai'an, an online insurance company in China that plans to leverage artificial intelligence to boost innovation in the insurance industry. According to comments made by Ya-Qin Zhang, president of Baidu, at an AI panel at the World Economic Forum in Davos, Switzerland earlier this year, the Internet giant is already using the technology for insurance underwriting and there is huge potential for companies to deploy AI technology to better assess risk. "In insurance and consumer loans, AI and machine learning can help you identify all the patterns to help you reduce risk," he said.

Meticulous Medicine and Autonomous Automobiles

The impact of AI on the insurance landscape will also be felt indirectly. For example, the expected widespread adoption of artificial intelligence by the healthcare and transportation industries will likely have large ripple effects on insurance as a result of healthier individuals and safer roadways.

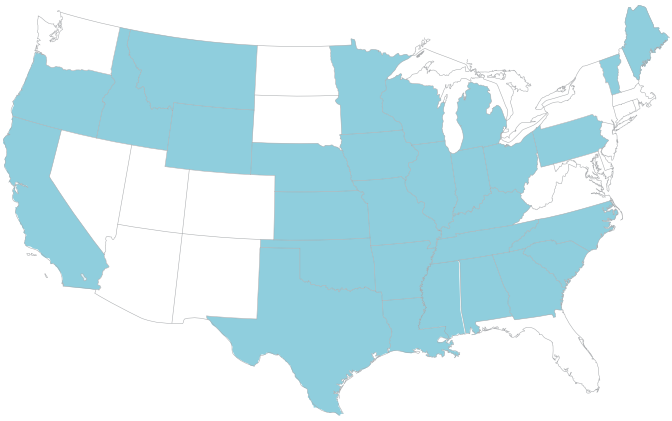
Cognitive computers could help doctors diagnose illnesses by examining mountains of patient data—including their entire medical history, notes from previous exams, medical images, and risk factors such as age, genetic makeup, and pre-existing conditions—to determine a short list of potential diagnoses with a confidence score for each. The technology could also be used by individuals to help monitor and treat chronic conditions, such as diabetes, through personalized education and coaching.

Because the technology can massively increase the capacity to collect and analyze both structured and unstructured data to find valuable patterns and connections, AI will play a crucial role in an industry that is expected to see medical data double every 73 days by 2020, according to IBM. A 2015 report by Frost & Sullivan, a consultancy, estimates that the AI market for healthcare applications will reach over $6.6 billion in 2021, up from $634 million in 2014. Moreover, the report claims that the technology "has the potential to improve outcomes by 30 to 40 percent while cutting treatment costs by as much as 50 percent."

AI is already beginning to make a difference in healthcare. Several institutions, including the Cleveland Clinic and Yale Cancer Center, have recently begun working with Watson Health to diagnose and treat cancer patients. And more and more companies that leverage AI for medical purposes are emerging, including San Diego-based Pathway Genomics and New Jersey-based Hindsait. Moving forward, the insurance industry will be reshaped by the shift toward cognitive health. As prevention, diagnoses, and treatment improve, individuals are expected to become healthier and visit hospitals less frequently and for shorter durations, minimizing claim costs for insurers.

Chart 11

U.S. States where Truck/Tractor/Delivery Driver is the Most Common Job*



*Data for 2014. For more information on the methodology, please click **here.**

Source: IPUMS-CPS/University of Minnesota, NPR.

Similarly transformative will be the blending of artificial intelligence with technologies such as advanced car sensors, GPS, computer vision, radar, and lidar to help make self-driving vehicles a reality. According to the Boston Consulting Group, partially and fully autonomous automobiles are expected to create a $42 billion market in 2025 and could constitute 25% of new car sales globally by 2035. This will have enormous implications for the transportation industry, but also, indirectly, on insurers as well as the economy at large (**Chart 11**). While real-world widespread usage on public roads is at least a decade or two away according to various experts, fully autonomous driving cars are making significant technological progress thanks to noteworthy research and development initiatives by companies such as Google, NuTonomy, Tesla, and Uber.[2] The once unimaginable innovation will likely redefine the kind of motor insurance people will require, how the coverage will function, and also reduce the need for it overall.

Studies indicate that human error is the number one cause for car accidents. According to a 2015 paper by the U.S. Department of Transportation, 94% of crashes in the country were attributable to errors made by the driver. By removing humans from the driving equation, autonomous cars are expected to eliminate the vast majority of accidents and make transportation significantly safer. Preliminary testing—both on and off public roads—is already exhibiting promising results. Observers see the severity and frequency of auto claims dropping precipitously and premiums following suit. This will have an enormous impact on the global motor insurance market, which was worth over $670 billion in gross written premiums in 2014, according to UK-based Finaccord, a leading market research, publishing, and consulting company specializing in insurance.

2 In September, Uber began field-testing the transportation of passengers around Pittsburg in self-driving cars.

The shift toward autonomous vehicles will be a long and gradual process but already car manufacturers—including Tesla, with its autopilot mode, Subaru, with its automatic braking, and Volvo, with its staying alert, lane-keeping, and safe-distance systems—are deploying semi-autonomous vehicles on public roads. Liberty Mutual has begun offering discounted premiums on cars with assistive features that enhance safety and others are sure to follow as the technology improves.

Driver-free roads will raise new issues around insurance that will need to be addressed. First, while fully autonomous vehicles are expected to drastically improve safety overall, new risks could arise, including self-driving software failure and cyber hacking of the system. Insurers may increasingly need to provide coverage for these risks. Second, as the technology evolves, questions around liability will emerge. Will liability for an accident shift from the owner of the car to the manufacturer and/or the software provider? Will individuals using the vehicles be responsible for purchasing coverage themselves or will car manufacturers be required to obtain insurance for each of the cars they sell? Finally, in the medium term, insurance issues may initially turn out to be more complex as cars become increasingly semi-autonomous but still would require driver intervention in the case of an emergency. This middle ground would make it extremely difficult to determine liability as both software and the driver play a role in the maneuvering of the vehicle.

REGULATORY IMPLICATIONS

As the nature of the insurance business changes due to technological innovation, the regulatory framework will change with it to address potential new risks and existing gaps in supervision. First, innovations will lead insurers to gain and store ever more granular and sensitive information about their customers and their behavior, resulting in increased operational risks. In response, the resilience of automated systems needs to be guaranteed as insurers become increasingly reliant on them. Recent high profile data breaches have shown the importance of businesses securing their data. Indeed, regulators are increasingly requiring insurers to strengthen their defenses against attacks. The International Association of Insurance Supervisors (IAIS) recently published an issues paper on cyber risk, providing best practices to national regulators on how to approach cyber risk, and it is likely that national supervisors will move to increase supervision.

Insurers will also face challenges with regard to restrictions on their ability to use new data sources. According to Helena Kingsley-Tomkins, assistant vice president, Moody's, "While insurers will have a new trove of information on policyholders to help assess and price risk, they will also have to navigate a growing number of rules around how they use and protect the information."

National and international regulations on the sharing of data and data privacy will have a large impact on how global insurers will be able to effectively use consumer information. New data technologies work best to generate insights when data can be stored and accessed in centralized, consistent, and structured ways; however, restrictions on the ability to share, store, and access data across national borders, such as the EU's safe harbor ruling, are complicating this. It will be important for insurers to engage with officials and encourage standard-setting bodies around the world to develop regulatory guidance that addresses cross-border inconsistencies and fragmentation related to innovations in the insurance industry in order to ensure that insurers can effectively use technology across jurisdictions.

Yet regulatory implications go beyond those immediately linked to the use of data and computer systems, as new innovations will have a direct impact on the insurance market. As insurers gain more granular insights about consumer behavior, they may be better able to offer products and prices tailored ever more specifically to individuals. Some critics have objected that this may lead to unfair practices advantaging some individuals over others. As a result, regulators are moving to investigate the practice of "price optimization," including the National Association of Insurance Commissioners (NAIC) in the U.S.

Lastly, if new firms enter the insurance market based on peer-to-peer insurance models, such as Lemonade in the U.S., there is a question as to how these should be regulated and supervised. Regulators so far have taken the stance that similar risks should be regulated in similar ways, and as such, new entrants like peer-to-peer insurance firms should, according to NAIC, "be regulated like any other insurance company within the existing regulatory framework." At the same time, regulators are studying new business models to find out any risks specific to them, such as operational risks from increased reliance on technology, and other differences with traditional insurers which might impact their risk profile.

To conclude, regulators are moving with the market, and are currently exploring potential risks and ways to address them through new supervision in "new" areas.

CHALLENGES AND OPPORTUNITIES FOR INCUMBENT FIRMS MOVING FORWARD

Insurance executives are well aware that the technology revolution currently underway is a threat as well as an opportunity for the traditional industry. During an insurance panel at our IIF Spring Membership Meetings in Madrid earlier this year, Tom de Swaan, chairman, Zurich Insurance Group, stated, "Technology is going to affect our industry tremendously." He explained that the whole value chain will be impacted and how various innovations, including self-driving cars and drones, will lead to "a very, very fundamental rethinking of how we do business." With the pace of technology adoption accelerating (**Chart 12**), innovation cycles contracting, and distribution rates rising across the world, insurance firms will need to quickly adapt to the changing landscape. A recent report by McKinsey forecasts that up to a quarter of full-time positions in the industry in Western Europe will become consolidated or replaced as a net aggregate by 2025 thanks to advances in various technologies (**Chart 13, pg.19**).

Chart 12

Time Taken to Reach 50 Million Users

Source: KPMG.

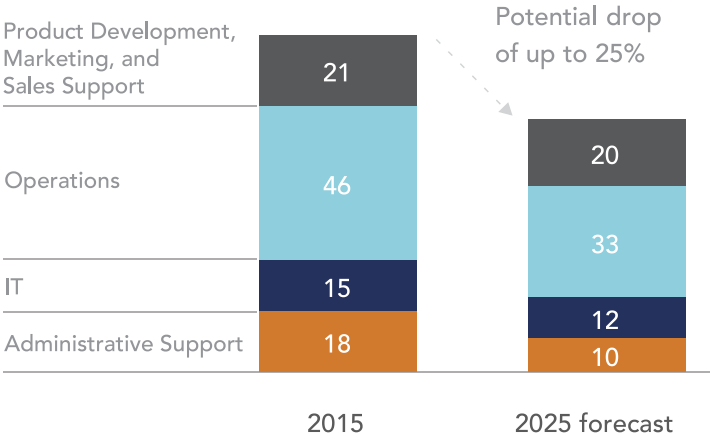
Incumbent firms unwilling or unable to adapt to new technologies, learn from new market entrants, and adjust business models will likely face persistent low growth and declining profits resulting from the inability to compete at a high level with tech-savvy incumbents and digital startups. For instance, technology laggards would be less efficient at performing a number of important tasks, including measuring and managing risk, handling claims, selling policies, and recognizing consumer demands.

The race to innovate vis-à-vis new market entrants with business models enabled by digital technology will be one of the greatest challenges facing incumbents as these new players could threaten the most profitable areas of the value chain and wrestle policyholders away from established insurers. As Solmaz Altin, chief digital officer, Allianz, told the IIF, "There is a huge gap between what startups can do in terms of service renewal and reacting to changing customer needs and what incumbents are typically able to do. I think we need to be quicker as an industry overall. This can only work if we allocate resources faster and more boldly to the new profit pools that are emerging and also more resources to understanding what startups are currently working on, as well as positioning ourselves to successfully partner with them. We would also need to significantly invest in

Chart 13

Insurance Workforce in W Europe: Share of Full-Time Positions

index, 2015 = 100



Source: McKinsey.

building state-of-the-art IT architectures that are secure, customer-friendly, and—from the privacy perspective—safe for the customer to use."

Another big challenge facing incumbents during the transition to a more modern, data-dependent, and digital industry relates to attracting employees with appropriate skill sets. The ability to recruit, develop, and retain workers with proficiencies in fields related to computer programming and data engineering is increasingly vital to the ultimate success of an insurance firm. Moving forward, the industry will be forced to pay more attention to devising effective strategies outlining how to entice top technical talent. Finally, as outlined in the previous section, navigating the evolving regulatory landscape and addressing issues related to data privacy, sharing, and security will also prove challenging for insurers moving forward.

While the challenges listed above are not inconsequential, the industry has an opportunity to reinvent itself and become more modern and efficient thanks to various technological advancements as well as through mutually beneficial partnerships with new market entrants. Firms that proactively embrace technology and incorporate innovative and integrated platforms into their business will be better positioned to provide customized and high-quality products and services seamlessly to their increasingly informed and price-sensitive clients, allocate resources more efficiently, reduce errors and operational costs, automate complicated tasks, improve decision-making and the standardization of process workflow, overtake the competition, capitalize on emerging market opportunities, and increase market share.

In light of these benefits and with the rapid growth in financial technology investment and the increasingly significant impact of technological advancements on the financial industry, many insurers are beginning to proactively seek ways to stay ahead of the curve. Generali, for example, announced last year that it would allocate €1.25 billion for reinvesting in technology, data analytics, and more flexible operating platforms. Moreover, several of the world's largest incumbents, including AIG, Aviva, AXA, MetLife, and Ping An, have created specialized venture capital funds, and insurers have already earmarked more than $1 billion to investing in startups in a push to discover new approaches to achieving growth and a competitive advantage. Many firms have also created dedicated teams at innovation labs, participate in accelerator programs, and hold hackathon events focusing on insurance-specific issues. For instance, Aviva opened a "digital garage" in London in 2014 and one in Singapore the following year to explore and develop digital technology. Global incumbents, including Allianz and Swiss Re, have joined Startupbootcamp InsurTech, a recently launched accelerator of startups focusing exclusively on insurance. The objective of the London-based accelerator program is to foster startups and collaborate with them to bring improvements to the market.

Going forward, a growing number of partnerships between traditional insurance firms and insurtech startups will likely materialize so as to help facilitate innovation. By partnering with inventive startups, incumbents can bolster their competitive position and reduce the time required to develop, test, and launch original products, while startups can capitalize on incumbents' deep pockets, large base of clients and their data, and robust infrastructure. Consequently, startups will not only raise challenges for incumbents in the form of additional competition but will also present opportunities in the form of partnerships.

It is also likely that the number of acquisitions will rise given how much capital insurers have and the industry's history of mergers and acquisitions. In fact, 43% of insurers that responded to a 2014 Accenture survey indicated that their company was planning or had "completed the acquisition of startups or innovative competitors to help them extend their value chains and better position themselves in the digital world."

CONCLUSION

Emerging technologies and innovations are beginning to transform the insurance landscape as they enable new ways to measure, control, and price risk, engage with customers, reduce cost, improve efficiency, and expand insurability. This has produced enormous opportunities for established insurers to modernize, create new insurance products and services, and shake up their business models. It has also led to the emergence of many new innovative startups seeking to significantly enhance the way insurance has traditionally been assembled, purchased, and experienced. Increasingly, incumbents are compelled to strategize about ways to routinely innovate and establish superior digital experiences in response to disruptors who have made notable inroads in the market by focusing on unmet consumer demands, lowering costs, and providing innovative new services. Going forward, both competition and partnerships between tech-savvy incumbents and increasingly well-funded and nimble new market entrants are expected to rise. This will likely fuel further innovation and transformation within the industry. At the same time, addressing issues surrounding comprehensive data regulation will grow in importance, and insurance regulators and data privacy rules will play a significant role in determining how insurers will be able to use data and also influence the level of product customization available to customers.

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