

RISK MANAGEMENT IMPLICATIONS OF AI IN INSURANCE INDUSTRY

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ABSTRACT

Artificial Intelligence (AI) has been rolled out with spectacular speed in an increasing number of areas, such as medicine, the auto industry, finance, manufacturing, agriculture and marketing. This expansion lies at the crossroads of three major technological developments: the emergence of big data, the normalization of the interconnection between humans and machines, and advances in machine learning (technology that enables machines to learn from experience). AI is progressively transforming the way in which the economy and society operate. The insurance industry is concerned by these changes on two fronts. Firstly, new risks associated with AI must be assessed, quantified, insured and mitigated against. The increasing use of AI raises numerous risk questions. For example, in an accident caused by an autonomous vehicle, who is liable – the user, the manufacturer or the creator of the algorithm behind the technology? What would be the insurance consequences of an AI bug or AI cyber-attack? Or, how can the insurer manage the shift in its risk profile due to impact of AI on biometric, property, casualty, financial, operational and strategic risks. Secondly, how can the insurance industry leverage off the potential of AI? For example, how can it be used to improve competitiveness, improve customer experience, reduce risk exposures and improve profits through greater use of automation, efficiency, refined underwriting and segmented pricing? In this paper we committed to incorporate new technology into its business to check the impact of Artificial intelligence in insurance sector.

Keywords: Artificial intelligence, Risk modeling, strategic risks

I INTRODUCTION

The term Artificial Intelligence (AI) was first coined in 1956 by the scientist John McCarthy as “the science and engineering of making intelligent machines”. Today AI is still the simulation of human intelligence in machines and includes processes such as learning, reasoning and self correction. AI is used as an umbrella term for everything from process automation, to robotics and to machine learning, a form of AI where the machine is trained using past data, it can

learn from this data and make predictions without having to be explicitly programmed. AI is being applied in all fields and sectors, examples include healthcare, agriculture, mining, manufacturing, transportation, education and financial services. AI has become a critical tool for business, particularly insurance. It is helping to shape the Fourth Industrial Revolution which involves “new technologies that are fusing the physical, digital and biological worlds, impacting all disciplines, economies and

industries, and even challenging ideas about what it means to be human³". AI is driving a lot of these new technologies and Bloomberg predicts that in the next few years AI could be a feature in all software. AI is expected to change society. It could especially impact social and ethical risks. AI will create new behaviors, new ways of living and different interactions between people and machines. Human and AI interactions may prove a challenge in the short to medium term as new and evolving roles and responsibilities are established. AI will impact society in areas such as people's ability to find employment. Secondary effects of AI could be social unrest, for example if people believe AI has created greater inequality between the rich and poor. For now, it is difficult to predict exactly how AI will impact the insurance industry. AI may redefine the insurance basics, such as reducing information asymmetry between Insurers and insured due [1][2]to enhanced data and allowing better predictability and monitoring of risks. As a second order effect, AI will improve efficiencies and product innovation but also create new intrinsic AI risks.

In June 2017, consulting company Accenture published a paper on how AI boosts industry profits and innovation. In its report, it is noted that financial service companies' profits⁴ could increase by 31% by 2035 due to AI technologies. Most (re)insurance companies are not at a stage where they can harness the benefits of AI within their business models. To get to this point, many Insurers have embarked on ambitious projects to digitalize their business, improve their data management

and partner with technology experts to leverage off advanced analysis tools and technologies. Currently AI in insurance is mainly used in the areas of claims management, risk selection, pricing, fraud detection and intelligent chatbots for customer advice. However, some Insurers are expanding into some transformative AI technologies to improve their operations and risk management.

In this paper we assesses the implications and applications of AI for risk management with a focus on the (re)insurance industry. The paper looks at how AI is changing the business model and risk landscape for (re)insurance along with how AI is impacting the modeling and management of risk by Chief Risk Officers (CROs), risk managers and supervisors.

II PROPOSED BUSINESS MODEL

In the past, insurance has mainly been an "after the fact" business model where Insurers pay the client after the event has happened and after providing some effort in risk prevention advice. AI is changing this "after the fact" characterization. In the future Insurers could be helping its clients avoid some of the events altogether. The Internet of Things (IoT) and increased use of sensors means that massive amounts of data now exist. With the use of [3][4][5]Big Data technologies such as MapReduce, these larger datasets can be better managed and interpreted. AI will improve the efficiency of insurance prevention activities. Insurers with the use of AI technologies can help clients collect, analyze and make sense of their data to prevent accidents or illnesses. The insurance business model may evolve where Insurers could play a larger role in

risk management advice and services instead of risk transfer, under this new role they could also be competing against risk management advisers from non-insurance backgrounds. Insurers may have to reassess their underwriting based on how the nature of risks left to insure will have changed due to AI.

Technology in the insurance sector (InsurTech) is being used to create savings and efficiency in the insurance value chain. InsurTechs are using [6]AI technologies to exploit areas such as claims processing, customer service and compliance. InsurTechs are also using new streams of data from internet-enabled devices to improve areas such as pricing and underwriting and offering ultra-customized policies. A well-known example of an InsurTech's successful use of AI is Lemonade, a New York based start-up launched in 2016. Lemonade uses AI in chatbots, cognitive automation and robotics to provide a streamlined, automated and quick insurance experience for its customers. A well-publicized achievement for the company was its ability to settle a claim in three seconds using its claims bot "AI Jim".

AI Jim reviewed the claims details, checked the policy documentation, ran eighteen anti-fraud algorithms and then approved the claim. Not only was this a plus from a customer satisfaction standpoint but also from the [9][10]insurer's perspective in terms of cost efficiency. InsurTechs are having a profound impact on the insurance market with their innovation and drive to improve customer experience. Some Insurers are partnering with InsurTechs and

tech start-ups as a quick and easy way to enhance technological capabilities. However, Insurers must be conscious of operational risk (e.g. outsourcing risks, data risks, legal risks) in terms of its third-party partnerships. Re(Insurers) may also use[7] InsurTechs as service providers or brokers, with Insurers providing the capacity. AI is being used to improve customers' experience with insurance companies and make it easier for them to take out a policy (e.g. by using chatbot advisors). Customers are now also better informed about their insurance needs through the use of health sensor data, face mapping tools, AI enabled genetic predictors and AI personal assistants. All of this could lead to potentially reducing the insurance gap. AI has also had an impact on corporate organizations in terms of employee collaboration, task automation and the creation of new data-related jobs. Companies can now use AI software to help them identify and select candidates for roles and to assess job satisfaction within their organization. Companies are[8] also creating more data related positions within their organizations so that they can better utilize their data and harness the opportunities provided by AI. However, AI is also a threat to employment.

The Japanese insurer Fukoku Mutual Life hit international headlines in January 2017 when it announced that it would be replacing 34 employees with IBM's Watson AI system. Insurance is built on the principal of pooling risks and Insurers ability to band together large groups of similar people or risks. At any given time, the insurer will have to pay out on claims in

that pool but should have enough money in the pool from the premium collected. However, AI and the use of big data breaks down this principal of pooled risks and cross-subsidization especially for certain lines of business. Insurers are now able to provide much more specific pricing and policies for clients [12][13] particular needs meaning that the need to pool broad groups disappears. In other words, people with safer risks pay less, people with higher risks pay more, and insurance could become a luxury affordable only for the very well off. Regulations or government may intervene to prevent such a shift in insurance practices and to ensure minimum insurance levels.

III THE THREATS AND OPPORTUNITIES OF AI ON PARTICULAR RISKS

AI is changing the risk landscape for Insurers and will impact some of the life, property, and casualty, strategic, financial and operational risks of insurers.

3.1 Life risks

Much has been published on health and lifestyle sensory technologies that provide data on numerous indicators that can be analyzed and interpreted into insurance need predictions. Consumers may be more self-aware of their health and what insurance they need. For example, consumers can access genetic predictive tools (such as face mapping mobile applications) which use machine learning AI technologies to predict potential future illnesses. The use of such applications greatly increases the anti-selection risk for Insurers especially where Insurers are prohibited from accessing genetic testing results for underwriting purposes. In some regions, Insurers are

already increasing their pricing to reflect the cost of this increased anti-selection risk in the market.

However, on the flip side, the increased data available from lifestyle type sensors provides the opportunity for Insurers to better price risks. The IoT means that there is abundant [14]medical data available to better price and underwrite risks. Deep learning technologies allow Insurers to better identify data connections and forecast results. Insurers are also providing smart sensor services as part of their products with the aim of improving customers' health monitoring and encouraging a healthier lifestyle while at the same time, providing the (re)insurer with access to a larger data pool for health statistics. For example, Gen Re announced in October 2017 that it would be partnering with Track Active a digital health management provider (incorporating AI technologies) to help deliver innovative solutions to its life and health clients.

These improved technologies are also changing the profile of biometric risks. Take for example the ageing Baby Boomers generation. Older people are now more able to live at home independently while being monitored remotely by a caregiver. (Re)Insurers' future medical expenses, long term care and longevity profiles will change because of these smart sensor technologies improving older people's quality of lives, reducing hospital stays and costs and improving older age mortality rates.

3.2 Property risks

Autonomous machines such as self-driving cars, autonomous equipment for medical care, manufacturing, farming, mining, telematics and warfare may have profound

implications for property insurance. As human error is the main cause of accidents, a wider use of autonomous machines might lead to a transition from loss frequency to severity, and property losses may accumulate in new ways. Defining and assigning liability will be more challenging for Insurers due to grey areas on who is liable when a technology fails and an accident occurs. As manufacturing becomes more technologically and intelligently advanced, challenges will arise on assessing liabilities, D&O covers and policy wording. For example, claims may be filed against not just manufacturers but also the companies providing their manufacturing technologies. Insurers will also need to assess their risks in the medium and long term especially in the context of transition periods when human and autonomous machines coexist.

Autonomous machines also include lethal autonomous weapons (LAWs) and military drones which have potentially negative impacts for property lines of business in relation to terrorism risk, geopolitical risk and war risk. However, autonomous machines will also provide many opportunities for Insurers in terms of improved risk management, especially in the context of risk prevention and disaster mitigation. Drone aerial intelligence ('Aerobotics') enables Insurers to assess geospatial information to improve the granularity of underwriting for farming crop insurance. Aerobotics also allow easy access to isolated and dangerous areas after man-made or natural disasters occur. After US hurricane Harvey (August – September 2017), two US insurance companies (Allstate and Farmers Insurance) launched

drones to assess property insurance damage. Farmers Insurance noted that the drone technology allowed their claims adjusters to process three houses an hour as opposed to three houses a day.

In addition to drone technologies, AI-enabled image recognition APIs (application programme interfaces) are also helping Insurers to speed up claims assessments. For example, a policyholder can now take a photo of their car after a crash and pass it onto the insurer to start the claims process and access any of the insurer's crash support services. Ageas UK Ltd is working on providing AI-enabled visual appraisals to its policyholders to speed up the claims process, reduce claims costs and improve the policyholder's claim experience.

3.3 Casualty risks

Multiple aspects of the workers compensation insurance and related medical markets could dramatically change in the future due to AI technological advancements employed across underwriting and claims spectrums. In underwriting, AI could directly influence risk selection and pricing accuracy in two regards. First with respect to deployment of AI monitoring tools, dynamically capable of proactive controls in dangerous or accident-prone environments (e.g., refineries, ateliers), and second through loss and pricing data processing improvements carriers use to define sub-market strategies and client targeting. With no clear vanguards, multiple insurance and new-market entrants are working to supplement underwriting's abilities to reduce losses, and more accurately price

risks commensurate to more granular sub-profiles.

In claims, AI could materially change the nature of claims avoidance and processing. Today, carriers have already begun incentivizing employers to incorporate AI as worker wearables to monitor both macro-(workplace wide) and micro-(individual workspace) environments to alert of worker fatigue or machinery overheating. With respect to processing, AI improvements could markedly improve medical services injured workers require and the subsequent coordination and steering of workers to the proper medical facilities and required scale. As an example, in October 2017 Aon Benfield announced a partnership with Clara Analytics, a company providing AI tools to help employees get back into the workforce. These technologies would help ensure employees are quickly matched to the most appropriate treatments to help speed up their recovery times.

3.4 Strategic risk

AI technologies are impacting the strategic risk of Insurers in terms of the changing demand for insurance (e.g. increased insurance on demand), new distribution channels, alternative pricing and increased competition (e.g. from InsurTechs). A 2017 MIT Sloan Management Review survey of 3,000 business executives, managers and analysts from global organizations noted that almost 85% of those surveyed believe AI will provide their companies with a competitive advantage. These competitive and strategic advantages could include greater operational efficiency and improved insights from data. Yet, even though respondents acknowledge the strategic

advantages of AI, less than 39% of respondents have an AI strategy in place. Within the (re)insurance industry the difference between the different AI strategies is striking. For example, the Chinese insurer Ping An Insurance (Group) Co invested over USD\$1bn in technological research in 2017, with AI being the focus of this R&D. Many other Insurers AI capabilities are only focusing on chatbots.

3.5 Financial risk

Insurers business activities include asset management and many companies have in-house investment managers. AI technologies may help in the liquidity and credit risk management of Insurers investment activities. To date, investment managers have mainly used bid/offer spreads to calculate liquidity costs. Now information on transaction costs and volumes, how likely large fund flows are expected to be and how long it takes to liquidate such positions can be collected to help better understand potential liquidation costs in extreme events. Non-parametric neural networks can incorporate hundreds of factors to improve probability assessments of large flow redemptions. Asset managers are developing their machine learning capabilities to harness the benefits of AI in combining market risk and liquidity risk analysis to support fund managers' investment, risk management and regulatory duties (e.g. to meet the new Securities and Exchange Commission (SEC) risk management rules (Dec 2018)).

Deep learning techniques are being used in asset management to make better use of Big Data for quantitative trading techniques such as high frequency trading

and algorithmic trading. Enhanced data analytics has improved the timing and cost of trading but does pose additional challenges such as the inability of deep learning to think over the long term and factor in external factors, e.g. central bank and competitor decisions. There is also the increased risk of a systemic crash as investors may all be using similar AI tools or because these AI tools could rapidly destabilize the market creating a liquidity crisis similar to the 2010 flash crash in the US market.

Insurers could also use AI to better manage credit risk. AI is being successfully used in credit risk management by FinTech lenders such as Kabbage who use machine learning algorithms together with data from public online profiles and other data factors to rate small businesses online before lending them money. Machine learning enables companies to leverage off non-traditional data sources (e.g. social media, news reports, ATM usage) to build more complete credit risk profiles of business and individuals. In addition to machine learning, credit risk management is being improved by the use of cognitive technologies to process unstructured data in due diligence exercises more quickly, thoroughly and cost efficiently. Such technology could help a (re)insurer assessing credit risks as part of financial transactions with large amounts of underlying contracts, treaties and addenda to review. When a due diligence exercise is limited by budget, deadlines and resources, it might not be possible to review all documents. Instead only a sample may be tested meaning that a credit risk assessment may be incomplete or inaccurate. If AI

technologies were used in the same due diligence, all materials could have been reviewed, mitigating the risk of missing something vital.

IV CHALLENGES OF AI IN RISK MODELLING

The risk manager is experiencing a shift in the way modeling is used. Most current models are based on thoroughly selected variables, using economic theories or statistical methods such as [8] as Principal Component Analysis. The use of AI in risk modeling is changing this. One of the most common applications of AI in modeling is the use of machine learning. Machine learning algorithms automatically select variables of interest for building predictive models, without a-priori on the variables to use. The two main classes of machine learning algorithms are: Supervised learning: The algorithm tries to predict a certain variable (the y) based on a set of existing variables (the observations x_1, \dots, x_n). Algorithms such as decision trees, artificial neural networks or even linear regressions are different examples of supervised learning.

Unsupervised learning: In that case, the algorithm does not predict a variable but tries to use observations in order to find the hidden structure in the data. Clustering algorithms are the main example of unsupervised learning. Other classes exist such as reinforcement learning or transfer learning but they are far less used in (re)insurance.

V OPPORTUNITIES OF AI IN RISK MODELLING

Traditional risk models have become increasingly incapable of processing the new

vast amounts of data available. By using AI tools, Insurers can better clean and process their data and identify indicators for known and unknown risks. This way AI can improve the output from risk models by providing additional layers of granular results and identifying additional predictive factors or dependencies that cannot be captured by traditional techniques (e.g. copulas).

AI can also be used to help in the model validation process. Model validation is typically a long and labor intensive process done once a year but with AI algorithms, model validation may be ran on a continuous basis throughout the year, at least for particular parts of the model. Machine learning algorithms could be thought to test repetitive parts of a model, freeing up time for risk managers and model validators to assess more complex model validation issues.

VI IMPACT OF AI IN INSURANCE INDUSTRY

AI is being applied in areas with existing governance regimes meaning that most new AI technologies are falling under pre-existing rules and regulations. For example, US bankers using AI as part of their models need to demonstrate to the Federal Reserve that they are complying with SR 11-7 Guidance on Model Risk Management. The Insurance Distribution Directive (IDD) assumes that most insurance is sold to policyholders based on advice from brokers meeting face to face with customers. With AI, the boundaries of IDD rules on treating customers fairly are being pushed with technologies like chatbot's advising on insurance products.

Under IDD rules, are AI generated decisions fair to customers if they cannot be easily explained by the Insurers management to customers? The new General Data Protection Regulation (GDPR) also brings about additional challenges for Insurers using AI for data analysis and data management. Many of the AI technologies available for Insurers have been developed in the US and abide by US data rules but may not be allowable under the new GDPR rules. One such practice, data scraping using machine learning algorithms is common in the US but would be difficult to translate to Europe within GDPR regulations. From an insurer's perspective, AI may be beneficial in meeting compliance requirements on sanctions and embargos. Cognitive computing and machine learning algorithms can review millions of historical 'Know Your Customer' (KYC) files and use this data to make a probabilistic judgment on a new policyholder or client being compliant. Insurers can now run more accurate and efficient KYC checks and improve their monitoring against sanctions and embargo lists. These technologies can also be used for enhanced fraud detection and money laundering checks across numerous jurisdictions making regulatory compliance easier for (re)Insurers. However, on the flip side, supervisors may not fully approve of (re)insurance companies using such black box technologies if they struggle to explain their model outputs.

Regulators generally follow the common supervisory principles of technological neutrality and proportionality while considering consumer protection and market integrity. Within these principles

regulators are embracing the following approaches to AI and other technological developments: Regulatory Sandboxes, a controlled financial testing environment for new technologies to be tested within an existing regulatory framework which ensures protection to all those participating. Innovation hubs, regulators aiding technological developers who may not be familiar with specific financial regulations. Public-private partnerships, providing support and encouraging sharing resources, experiences and cooperating in funding of innovative developments.

Governing AI is complex, overly onerous restrictions will delay innovation but too lax an approach may result in irresponsible uses of AI. Often regulations may be slow to react to technological advancements, however AI is not an area where regulation should lag. Instead regulations should be more proactive and a driver of controls. In fact, in the 2016 World Economic Forum Global Risks Perception Survey 46% of respondents stated that they felt AI and robotics needed better governance. Governance is especially crucial in specific fields of AI such as automated weapons. In August 2017, 116 founders of AI and robotic companies wrote a letter to the UN calling for the ban of “killer robots”. Supervisors are engaging developing technologies to help in their day to day operations. The Bank of England (BoE) launched its FinTech Accelerator program in June 2016, which is a partnership with technology firms to explore innovations such as Big Data analytics and AI for the BoE’s supervisory duties. European Insurance and Occupational

Pensions Authority (EIOPA) has engaged with stakeholders from the insurance industry in roundtable sessions on InsurTech with specific breakout sessions on AI. It was noted during the EIOPA round table discussions that supervision of P&C Insurers may be less challenging than Health and Life Insurers due to the social and ethical complications associated with AI in life and health insurance and the sensitivity of medical data for consumers.

VII CONCLUSION

It is becoming clearer and clearer that AI will become a geopolitical stake in the future. There is a risk that some regions or companies dominate in terms of AI technologies meaning that those slow to adopt or lagging behind suffer in terms of potential economical and personal growth. The expectations of AI and how it can impact the insurance industry are high and very much hyped. At least for now, limitations of AI can be clearly seen (an AI cannot have feelings about something and cannot actually think at all). AI has been around since the late 1950s with many peaks and troughs in its advancement since then. Those peaks and troughs were mainly driven by the availability of hardware and financial investment.

Today AI technologies have the critical mass in terms of computing power, low cost of storage, data availability, breakthroughs in data science and investment to make an impact. There is greater public awareness about AI, AI technologies are becoming a part of day-to-day life such as Google Translate, Apple’s Siri assistant and self-driving car technology. Currently the main benefits and

uses of AI are from machine learning capabilities. However, it can be expected that AI becomes more and more powerful, eventually improving itself in exponential time (The Law of Accelerating Returns by Ray Kurzweil). It has yet to be seen if AI will be a threat and the “biggest risk we face as a civilization” (Elon Musk, Tesla and SpaceX CEO), or something that will considerably improve the lives of everyone.

What can be seen is that AI will be a game changer for all parties involved in insurance. Customers purchasing insurance will have greater access to data to make more informed decisions and will benefit from a more efficient and streamlined insurance process. Insurers will have more data available to make more informed decisions, offer improved risk management services to complement the transfer of risk, reduce manual processes within their organizations and enhance their risk management capabilities.

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