



RESEARCH ARTICLE

Evaluating the impact of AI on insurance: The four emerging AI- and data-driven business models [version 1; peer review: awaiting peer review]

Alex Zarifis , Christopher P. Holland, Alistair Milne

Loughborough University, Loughborough, UK

v1 First published: 01 Oct 2019, 1:15 (<https://doi.org/10.35241/emeraldopenres.13249.1>)Latest published: 01 Oct 2019, 1:15 (<https://doi.org/10.35241/emeraldopenres.13249.1>)

Abstract

The increasing capabilities of artificial intelligence (AI) are changing the way organizations operate and interact with users both internally and externally. The insurance sector is currently using AI in several ways but its potential to disrupt insurance is not clear. This research evaluated the implementation of AI-led automation in 20 insurance companies. The findings indicate four business models (BM) emerging: In the first model the insurer takes a smaller part of the value chain allowing others with superior AI and data to take a larger part. In the second model the insurer keeps the same model and value chain but uses AI to improve effectiveness. In the third model the insurer adapts their model to fully utilize AI and seek new sources of data and customers. Lastly in the fourth model a technology focused company uses their existing AI prowess, superior data and extensive customer base, and adds insurance provision.

Keywords

Artificial Intelligence, Business Model, Insurance, Value Chain, Machine Learning



This article is included in the [Digital World gateway](#).

Open Peer Review

Reviewer Status *AWAITING PEER REVIEW*

Any reports and responses or comments on the article can be found at the end of the article.

Corresponding author: Alex Zarifis (a.zarifis@lboro.ac.uk)

Author roles: **Zarifis A:** Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Resources, Validation, Writing – Original Draft Preparation, Writing – Review & Editing; **Holland CP:** Conceptualization, Funding Acquisition, Investigation, Writing – Review & Editing; **Milne A:** Conceptualization, Funding Acquisition, Investigation

Competing interests: No competing interests were disclosed.

Grant information: This research is part of the TECHNGI project (Technology Driven Change and Next Generation Insurance Value Chains) that is funded by the Economic and Social Research Council (ESRC) in the UK, grant number ES/S010416/1.

Copyright: © 2019 Zarifis A *et al.* This is an open access article distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

How to cite this article: Zarifis A, Holland CP and Milne A. **Evaluating the impact of AI on insurance: The four emerging AI- and data-driven business models [version 1; peer review: awaiting peer review]** Emerald Open Research 2019, 1:15 (<https://doi.org/10.35241/emeraldopenres.13249.1>)

First published: 01 Oct 2019, 1:15 (<https://doi.org/10.35241/emeraldopenres.13249.1>)

Introduction

Insurance is changing and sources from inside the sector¹ and outside² expect around a third of insurers and their models to disappear within a decade. The sector faces several challenges such as more unpredictable weather and fierce competition, and opportunities offered by technology such as artificial intelligence (AI), the internet of things (IoT), big data and blockchain. AI-led automation has the potential to mitigate many of the challenges and be a catalyst to harnessing the opportunities. The journey and destination of AI led automation however is unclear. This research focuses primarily on business-to-consumer (B2C) insurance. The move of B2C insurance online separated parts of the value chain differently. AI is now separating and re-arranging the value chain again.

AI is already used in several ways in the insurance sector^{3,4}. Examples are fraud detection⁴, virtual assistants (chatbots)⁵ and calculating insurance risk⁶. These applications of AI are having some influence on the business processes. As these islands of AI innovation start merging the influence will be greater, possibly transformative. AI is a broad term that refers to a technology that has the ability to learn. Machine learning and deep learning, where learning can be supervised or unsupervised^{7,8}, are making AI more capable and more accessible to organizations. There is a spectrum of capabilities of AI and there is a spectrum of degrees of implementation of AI. As more capable AI is implemented across the value chain more data is required, and more processes are changed. Some organizations cannot make this step because they do not have the necessary data or willingness to change their processes. This suggests that some organizations can be propelled to new BM by AI while others need to implement new BM to utilize AI.

Along with the insurers and AI a third factor in the diffusion of AI in the insurance sector is the consumer. Purchasing insurance and making claims are part of a relationship between the consumer and the insurer. Most current applications of AI are used to strengthen the capabilities and knowledge of the insurer and not the consumer. As the information asymmetry increases, the insurer can provide lower quality services at lower prices. The higher quality more expensive services may stop being offered as they can no longer compete on price. More information relating to how the decisions are made can be concealed by the insurer increasing the moral hazard.

This raises the question how the user will react to their weaker position and how they should be 'compensated'. One approach is to avoid increasing the information asymmetry. Other approaches are to offer lower prices or a better service. Lastly, the fourth option is to also use AI to strengthen the consumers knowledge on the insurance they will be using.

The insurers certainly have a role in shaping AI in this sector. The consumers have their role as does the government that needs to develop and adapt laws and regulation. It is unclear if there should be a fourth stakeholder along the three obvious ones. In many areas, including e-commerce, there are additional institutions like third party certifications that fill in

the gap between the retailer and the government in building trust. They are more unbiased than the retailer and more specialized than the government. Who will these third parties be and what will their role be in AI in insurance? Will technology companies be the fourth stakeholder and provide the reassurance that their AI is trustworthy? Alternatively, will the additional trust building come from within the insurance industry with self-regulation and standards? These issues that emerge from the use of AI in insurance are, potentially, sufficiently transformational to change B2C insurance BMs. Therefore, the research questions of this exploratory research are:

- 1) What are the applications of AI in the insurance sector?
- 2) What is the effect of AI on insurance value chains and business models? Is it improving existing models or disrupting them?

The next section reviews the literature. This is followed by the methodology section that explain how the cases studies and focus group were implemented. The analysis identifies the new AI and data driven value chain and four AI driven BMs for B2C insurance. The last two sections discuss the implications of these models and sets an agenda for future research.

Literature review

The review is divided into two sections, AI as a technology and the challenges it faces to become a catalyst for new BMs and the existing BMs and value chain in insurance.

AI and AI driven automation

The challenges to AI in insurance come from several sources including the insurance organizations themselves, regulation and the consumer. The unpredictability and difficulty to explain decisions is at the center of many challenges⁹. The general increase of data is also a challenge exacerbated by AI.

The sociotechnical challenges to AI from within the organization include the data, the people and the processes. The data is not enough in volume or quality in some cases to train AI sufficiently or for AI to use to make decisions. This is one reason why insurers are seeking out collaborations with organizations that can bring more data or use the existing data more intelligently.

In relation to the people, there are not always enough skills and expertise in AI. Furthermore, the insurance sector is historically risk averse and traditional. It is unclear how the user would react to extensive use of AI but the current backdrop of privacy concerns and challenges to trust are an indication that there may be some resistance¹⁰. Efforts to regulate AI intend to avoid misuse but also aid its adoption and center on respect of human autonomy, prevention of harm, fairness and explicability¹¹.

In addition to these broader challenges, from the user's perspective, there are also challenges more specific to insurance. As insurers link their services to offer a 'one stop shop'

they often penalize loyal users. The information asymmetry is tipped towards the insurer and this can lead to worse contracts for the user. While this is not the way all insurers use technology, this is a user concern that should be considered. It is an example of a recurring theme of how new technology, like AI, changes the relationship between the user and the insurer.

In addition to the increasing role of technology, there is also the increasing role of the technology providers. The knowledge shifts from the insurance professionals to the systems. From the insurers perspective new skills and training are needed to implement AI.

Insurance business models

BMs cover an organization, what it does, how it captures and creates value. While the focus is the organization, a BM can include the partners of that organization¹². One important distinction between insurers is those that attempt to cover all the insurance needs of the consumer and act as a ‘one stop shop’ and those that focus primarily on one type of insurance. Another distinction is incumbent, traditional insurers, in contrast to new entrants. Incumbents insurers often cover a broad range of services while new entrants often focus on one service such as car insurance. New entrants often rely on technology to provide a fully digital stand-alone service which is integrated with other fully digital services like mobile payments. Insurers regularly rethink and change their BMs to overcome the typical challenges of too much complexity and weak efficiency, usually measured by cost to income ratio.

There are several ways of explaining insurance BMs including by mapping the value chains¹³. As we are in a data driven economy, data, its sources and how it is utilized is another way to explain a BM¹⁴. Another influence on BMs is the prevalence of powerful platforms such as Google and Alibaba. These platforms fulfil several functions traditional insurer’s BMs used to, like payment processing and data storage.

Before we can identify the new BMs we must step back and ask ourselves what the new value chain is. It can be argued that the impact of AI and other technologies like IoT and blockchain are of such importance that the sociotechnical capability to utilize them is significant enough that it should be included as part of the value chain. Technology has been included in insurance value chain models as a supporting function along with human resources and the legal department and not as a primary function¹³.

Methodology

An exploratory approach was chosen because the impact of AI is potentially far-reaching and can create a new environment in insurance, where some current theories are no longer valid. This exploratory research analyzed case studies of insurance companies using AI and carried out a focus group with experts. The data sources included academic literature, practitioner-focused sources, insurer websites, websites of organizations that support the insurer’s supply chain, parent companies of insurers and employees of organizations in the insurance value chain.

Case study research was used to build theory^{15,16}. In total, 20 cases were selected for this inductive approach. The selection was based on how theoretically useful they were, and it was not random. The cases were chosen because they covered different geographic regions, incumbents and disruptors and different levels of technology focus. More cases were not explored because there was a repetition and a saturation of the themes and it was unlikely that more cases would bring new insights. From the 20 cases, seven are UK insurers, three are from other European countries, six are from north-America and four are from Asia.

The cases were analyzed across six constructs identified in the literature. The constructs were refined and verified in an iterative process¹⁵. The constructs were used for within case analysis and across case analysis. To enhance the validity one of the researchers with a background in finance and insurance acted as a ‘resident devil’s advocate’ on the analysis of the cases and the theory that was built¹⁷.

Lastly a focus group was held with 12 experts from six large organizations involved in InsurTech. All the experts had experience in implementing AI in the insurance sector. Their roles are senior manager in the IT department of insurers and insurance comparison websites, insurance technology providers and consultants on implementing technology in insurance. They all had over five years of experience. The selected experts were recruited with an email that explained the project and the purpose of the focus group. The discussion was moderated by one of the researchers. To ensure privacy and anonymity no voice recording was taken. One of the researchers took notes. The issues identified in the case studies were put forward for discussion, but the experts were also encouraged to introduce their own topics. The issues put forward for discussion covered the roles of AI, how their organizations currently implemented AI, future plans for implementing AI and the influence on their BM. The workshop lasted two and a half hours. The notes taken during this focus group are available as *Underlying data*¹⁸.

The research received ethical approval by Loughborough University as part of the TECHNGI project (Technology Driven Change and Next Generation Insurance Value Chains) that is funded by the Economic and Social Research Council (ESRC) in the UK. Informed consent was given through the email invitation and subsequent email exchange, reaffirmed by attending and further reaffirmed in an informed way when the purpose of the focus group and how the data would be used was explained before the focus group started.

Case study analysis

The first step was to get a rich understanding of each insurance company using AI and make a within case analysis. This was followed by the cross-case analysis.

The 20 cases selected are currently utilizing AI in insurance. Some, like Lloyd’s of London, are incumbents with a broad range of insurance activities and AI applications. Others, like FRI:DAY

are new entrants with a narrower focus in their operations and systems. Beyond some basic descriptive analysis done in the following section the rest of the analysis avoids identifying specific organizations. The purpose of the research is to identify the overarching BMs and not to produce findings on a specific organization. The case studies are available as *Underlying data*¹⁹.

Within-case analysis

All the organization evaluated were currently using AI. Most current implementations of AI replaced specific processes that had specific challenges. One of the earliest implementations was using AI to evaluate damage to cars such as cracked windshields. [Table 1](#) lists the 20 cases, the position of these organizations in the insurance sector and some examples of how

Table 1. The 20 cases of AI in insurance.

	Case	Position in insurance	Examples of AI applications
1	Lloyd's of London	Large incumbent, B2B, multichannel	Data entry quality control: AI analyses contracts to ensure regulatory compliance.
2	Willis Towers Watson	Large incumbent, B2B, multichannel	When processing a claim or evaluating a business customer AI can identify the right expert and bring in their expertise at the right point.
3	AVIVA	Large incumbent, B2C multichannel	A virtual assistant can be asked questions with natural language and reply.
4	Compare the market.com	Incumbent, tech-focused B2C, company offering a platform	Digital Voice: Full or semi-automatic interaction with the consumer using natural language processing and big data are supported by AI.
5	Bupa	Incumbent, health insurance and healthcare provider	AI is used for illness and disability claim prediction.
6	Confused.com	Online, tech-focused, B2C, low cost focused on car insurance	AI supporter virtual assistants (chatbots) support the customer with sentiment analysis and automation of time-consuming and repetitive tasks.
7	CUVVA	Small start-up, online, B2C, offers innovative services	AI supports underwriting, claims processing and fraud detection.
8	AXA	Large incumbent, B2C, multichannel	AI supports underwriting, customization, claims processing and fraud detection.
9	Zurich Insurance	Large incumbent, B2C, multichannel	Fraud detection and reduction. AI also supports underwriting and claims processing.
10	Tokio Marine	Large incumbent, B2C, multichannel	Claim documentation, AI 'reads' hand-written documents.
11	Manulife	Large incumbent, B2C, multichannel	AI can underwrite insurance independently.
12	Allstate	Large incumbent, B2C, multichannel	AI supports underwriting, customization with a virtual assistant, claims processing and fraud detection.
13	GEICO	Large incumbent, technology focused, B2C, specialized in car insurance	Recruitment, AI carries out interview and matches the applicant's skills to the right roles.
14	Progressive	Large incumbent, technology focused	AI is used to improve efficiency across a complete process so that humans are not needed.
15	Lemonade Insurance	Online, no physical stores, relatively new, technology focused, B2C, offers innovative services	Their virtual assistant called 'AI Jim'. 'AI Jim' can interact with the consumer during the buying a policy, switching from another insurer, claims process. AI supports behavioral analysis.
16	FRI:DAY	Small start-up, online, technology focused B2C, offers innovative services	The Guidewire system used are achieved by AI that is trained specifically to identify patterns that indicate fraud in insurance.
17	Ping An Insurance	Large incumbent, B2C, multichannel, offers innovative services	Innovative services utilize AI to be proactive and shape behavior like improving health.
18	Alibaba	Tech and e-commerce giant, with large user base entering the insurance sector with innovative services	Alibaba uses AI heavily in healthcare and this is being integrated with new insurance products.
19	Tencent	Tech and e-commerce giant, large user base entering insurance with innovative services	AI is used across this technology giant's e-commerce and social media for analysis, facial recognition, natural language processing, fraud detection and security.
20	TESLA	Tech company influencing insurance sector	There are new opportunities and challenges for insurance created by AI in self-driving cars.

they utilize AI. An analysis of the AI used, follows. It is important to understand each organization's present state but also their journey as an insurer and their relationship to technology in general and AI specifically. The insight gained in the within-case analysis is developed further in the cross-case analysis. First there is an overview of the large incumbent, multichannel insurers, then the small new entrants that only operate online and, lastly, the technology companies that have a role in insurance.

Large incumbent, multichannel insurers. Lloyd's of London is a large incumbent, B2B, multichannel insurer that focuses primarily on re-insurance. They have several approaches to adopting AI such as developing solutions in their labs, supporting startups and purchasing solutions from leading vendors like Expert System. They are currently turning their physical market place to a digital one.

Willis Towers Watson is primarily a B2B, insurer. They use AI and machine learning to enhance their analysis and predict future risks more effectively. AI is used to develop and optimize behavioral models.

Bupa is a health insurance and healthcare provider. They utilize technology extensively to aid cross selling and sharing of intelligence. They also use an app from Babylon Health that allows virtual consultations with doctors and the prescriptions are provided within the app. The app uses AI to replicate the process a doctor goes through, interpret symptoms and give prescriptions. The data also enables AI to predict disability claims more accurately. Like Bupa, Ping An Insurance offer innovative services that utilize AI to be proactive and shape behavior like improving health.

AVIVA, AXA and Zurich Insurance are primarily B2C insurers. AVIVA engages with AI in several ways including collaborating with TESLA to create new insurance services for AI supported self-driving cars.

AXA employees use an AI enabled virtual assistant by Veezo for easier access to relevant information. Zurich Insurance uses AI to help detect fraud cases that are less obvious and can be missed by a rules-based system.

Manulife uses AIDA, an AI underwriting tool that was trained with machine learning and is allowed to underwrite life insurance without a human making the final decision.

Allstate, GEICO and Progressive use virtual assistant that utilize AI. They have different names 'ABIE', 'Kate' and 'Flo' respectively, but they have similar capabilities. They can answer general questions around insurance and specific questions on the user's claims and deductibles. They can also set up payments. The virtual assistant can interact with consumers by voice or text.

In addition to the more common uses of AI seen above Tokio Marine applies AI to identify complex handwriting in claim documentation.

Small new, online only insurers. Lemonade Insurance is online and mobile app. based without physical stores. It is a relatively new disruptor that is technology focused and offers innovative B2C services. The whole interaction with the consumer can be carried out with an AI enabled virtual assistant.

FRI:DAY is a small start-up that is mobile app. based without physical stores. It offers innovative services like paying for insurance by the kilometer travelled. Despite the innovative services provided they use a popular insurance enterprise solution. This enterprise solution currently uses some AI for behavioral analysis. CUVVA is similar to FRI:DAY. It also offers innovative B2C services like paying for insurance per hour, in an automated interaction online supported by AI.

E-commerce and tech companies in insurance. Comparethemarket.com, of the BGL Group, is an incumbent, tech-focused B2C, company offering a platform to the user with several insurance providers. Unlike most implementations of AI in the insurance sector, that enhance the knowledge of the insurer, AI is implemented here to enhance the knowledge of the user so they can make the best choice for themselves. This reduces the information asymmetry as opposed to increasing it.

Confused.com offers similar services to Comparethemarket.com. They use AI solutions provided by Microsoft, including virtual assistants for customer support that can analyze sentiment.

Alibaba is a tech and e-commerce giant that offers several insurance services directly and through several partnerships. It has a large user base that purchase from its marketplace and it has entered the insurance sector with innovative services. Alibaba uses AI heavily in healthcare and it is being integrated with new insurance products. As this technology giant uses AI extensively and the several partners it has in insurance also use AI extensively it can be challenging to have a transparent image of how AI and data is used across the many actors involved in providing the insurance. Achieving auditable 'explainability' is harder with AI and complex partnerships.

Tencent, like Alibaba, is also a tech and e-commerce giant that offers several insurance services. It has a large user base from its social media platforms like WeChat. It is entering the insurance sector with innovative services. Tencent has extensive AI capabilities including a leading AI lab that integrates the use of AI, blockchain and other technologies across their services.

TESLA is a technology company and car producer that is influencing the insurance sector primarily through its Insure MyTesla program. Tesla use AI for their current cars and are developing self-driving cars that use AI more extensively. There are new opportunities and challenges for insurance by AI in both current cars that can drive independently, but even more so for self-driving cars. Therefore, TESLA takes a proactive approach in shaping the insurance their cars need and partnering with traditional insurers to deliver it in different countries.

Cross-case analysis

The cross-case analysis offers further insight on each insurance company's use of AI but also on the potential of AI as a whole to disrupt this sector. The analysis of the current implementations of AI and the plans for further implementing AI, indicate that AI is driving automation and is enabling the insurer to be more proactive rather than reactive. The analysis is separated into six areas: User-facing and back office applications of AI in insurance, sources of data and users, new insurance and technology ecosystems and lastly the capability to implement AI driven automation.

User-facing applications of AI in insurance. The current processes that are enhanced by AI are presented in [Table 2](#) for the user-facing applications and [Table 3](#) for the back-office

Table 2. Applications of AI in insurance (user-facing).

	AI application
1	Proactive processes and active loss prevention
2	Virtual assistants, chatbots and robo-advisor
3	Fast initial offers and underwriting
4	Faster and more accurate claims processing
5	Improving process flow with clients
6	Enabling new more flexible services
7	Direct marketing and customer retention
8	Tailored insurance advice
9	Understanding the user's emotions
10	Identify legal parameters across countries
11	AI insuring AI such as driverless cars

Table 3. Applications of AI in insurance (back-office).

	AI application
1	Automating simple, low-value tasks
2	Processing large volumes of data
3	Populating and improving data sets
4	Processing structured, semi-structured or unstructured datasets
5	Claims processing and adapting to new risks
6	New insights on current clients
7	Utilizing the data from the IoT
8	Virtual assistants for analysts
9	Fraud detection
10	Faster risk detection for automated services
11	Improved risk analysis
12	Identifying and analyzing new data
13	Audit

operations. While the distinction between the two is not always clear it is a useful way to group the many current AI applications. The hundreds of applications of AI supporting the interaction with the user, across the 20 cases, fall into 11 applications. While this number could be further reduced with larger groups, these 11 applications represent sufficiently distinct and useful applications to be separate.

(1) Proactive processes and active loss prevention: Several capabilities of AI, such as the speed of analysis and the volume of data that can be analyzed, support tailored proactive processes. Utilizing the data from sensors and IoT further enhances this. AI can identify emerging threats, warn customers and support active loss prevention. It can also encourage and monitor better behavior.

(2) Virtual assistants, chatbots and robo-advisors: They use natural language comprehension and recognize facial expressions and feelings. They are intuitive and keep a consistent state throughout a conversation. In other words, they remember the previous questions made by a user and answer subsequent questions accordingly. Chatbots and robo-advisors on websites or apps can interact with the user with spoken language or text.

(3) Fast initial offers and underwriting: The AI led automation can speed up the evaluation of the request, calculate a price in 60–90 seconds and underwrite it.

(4) Faster and more accurate claims processing: IBM Watson and similar AI are used for calculating the claim payout amount and making the payment automatically. In some implementations a reimbursement is triggered by a sensor on an IoT before a claim is even made. Furthermore, AI can process unstructured data, including pictures. For example, a picture of cracked windshield can be evaluated for a claim.

(5) Improving process flow with clients: Beyond the insight, the order and timing of the engagements with the customer across multiple channels is coordinated and optimized.

(6) Enabling and supporting new more flexible services. New services like paying car insurance per KM or per hour require more data to be collected and processed. The AI led automation also leads to paperless processes.

(7) Direct marketing and customer retention: These existing processes, can be optimized and tailored to each user and their current circumstances.

(8) Tailored insurance advice: AI can harness information from disparate sources like social media, IoT sensors and big data for more accurately tailored advice.

(9) Understanding the user's emotions: Natural language processing and facial expression processing can identify user's emotions, feelings perspectives and attitudes towards risk.

(10) Identify legal parameters across countries: While some insurers want to standardize their operations, different countries and regions have different laws, regulations and norms. This is a problem that AI can help with by analyzing local data and localizing the services offered.

(11) AI insuring AI such as driverless cars: AI has a bigger influence in cases where humans are still in the loop and makes more decisions without humans in the loop. In many cases the decision making of AI is not predictable, explainable or transparent. The unpredictable nature of some AI and the large volumes of data it can use, make evaluating its decision challenging in some cases. The scale and complexity can be challenging for humans, so AI can support the process of insuring AI.

Back-office applications of AI in insurance. The 13 primary uses of AI that were identified are listed in [Table 3](#).

(1) Automating simple, low-value tasks: Automating simple, low-value tasks such as simple analysis or rearranging data. AI can replace the simplest administrative tasks.

(2) Processing large volumes of data: The ability of AI to process different types of data enable it to process large volumes of data such as multiple policies and information from IoT devices and social media.

(3) Populating and improving data sets: AI can populate and enhance the quality of a data sets that will be used later to make decisions.

(4) Processing structured, semi-structured or unstructured datasets: Several sources of information are used, such as engineers reports and geological information, which is not always in the ideal form for what it will be used for.

(5) Claims processing and adapting to new risks: New risks, such as the recent increase of thefts of cars with keyless entry due to a vulnerability in that technology, influence the overall risk to an insurer. As the overall risk is influenced the way specific claims are processed is also influenced. AI can support evaluating and adapting to new risks.

(6) New insights on current clients: Analyzing current users to avoid premium leakage can be enhanced. The risks current users face change over time. The quicker their cover adapts the better it will cover new and evolving risks.

(7) Utilizing the data from the IoT: The number of IoT devices will continue to expand both for individuals, for example with smart homes, and organizations, for example with connected sensors on freight containers. Furthermore, some insurers sell devices like health trackers and use their own devices like telematic 'black boxes' in cars. A large proportion of the data the insurer will use in the future will come from IoT devices and AI can support analyzing it. This enables behavioral insurance, where the terms of the insurance change dynamically with behavior.

(8) Virtual assistants for analysts: These assistants for analysts use AI to keep a consistent state throughout a conversation. In other words, they remember the previous analysis requests made by an analyst and answer subsequent questions accordingly.

(9) Fraud detection: Expert systems that use a rules-based approach do not capture all frauds, particularly new types of fraud. The capabilities of AI can reduce subrogation, multiple unlawful claims and scams, such as written off cars that are later sold second hand.

(10) Faster risk detection for automated services: As AI can analyze risks quickly and 24 hours a day, seven days a week, risks can be identified instantly. Therefore, automated services and humans can respond quicker. This fast reaction can also support a more proactive approach and less reactive approach.

(11) Improved risk analysis: AI can process large amounts of disperse data which is beneficial in risk analysis. This improves risk analysis by analyzing the customer and other risks, such as natural disasters more effectively.

(12) Identifying and analyzing new data: Unlike most rules-based systems, machine learning and deep learning can identify new data that is useful. As more data is generated in many ways like social media and IoT devices, identifying which of this data is relevant is beneficial.

(13) Audit: AI can support an insurer to audit its processes in several ways. AI can prepare deeper insight for the human analyst by drawing on more data. Cases of special interest can be identified for a human to review. Potential fraud within the organization can also be identified that is too innovative or subtle, for rule-based systems to detect.

Sources of data. Based on the case studies of the insurers, the volume of data is important but so is the quality. If AI uses inaccurate insurance data, it will not perform effectively. The data needs to be checked and cleansed of inaccuracies. While AI can process unstructured data, it is more effective with data sets that offer the relevant information.

Sources of customers. In B2C insurance, AI driven automation using only online channels creates a large capacity. The only limitation is the amount of risk the insurer wants to take on. Furthermore, these users are new sources of data. Therefore, gaining access to new uses is important. This can be achieved through collaborations with partners from other sectors and cross selling insurance products to them or by the insurer moving into other areas.

While new sources of users should be pursued, it is equally important to avoid and mitigate the risks to losing users. From the user's perspective some risks increase with AI driven automation: The capability of AI increases the information asymmetry between the user and the insurer. A larger volume of data that is collected from an expanding number of sources is processed. This amplifies privacy concerns. Lack of transparency may reduce trust and raise ethical concerns.

Insurance and technology ecosystem. Fully utilizing AI requires several sociotechnical capabilities across the value chain that one organization may not possess. Furthermore, there are new opportunities that AI offers beyond the traditional insurance value chain. Therefore, an ecosystem with other partners insurance and the technology sector may be necessary. One example is that insurers can combine their data so that AI can be trained better and have more data to make decisions. A second example is that it may be easier for one member of an ecosystem that already has data and a relationship with the user, to ask for more data and access, than another member of the ecosystem. Therefore, all members of the ecosystem can benefit from the data and access that they would not otherwise have.

Capability to implement AI driven automation. The changes necessary to fully utilize the capabilities of AI require new BMs, knowledge and skills. This requires a willingness to change from the employees who are technology users within the organization and the customer who are a technology user outside the organization. Based on the analysis of the case studies, the transition to new models may take several years. The transition includes sociotechnical challenges that go beyond the organization including the users. The users concerns over the increasing information asymmetry, and privacy concerns will require trust to be built. Some smaller organizations may make this transition more quickly while some large organizations may separate specific services, such as car insurance, and prioritize moving them towards the new AI and data driven model.

Focus group

The participants to the focus group raised five main interconnected themes. Firstly, this was the journey of AI in insurance, where we are now and where the final destination is. Secondly the challenges in implementing AI within the organization were emphasizes. These included the lack of skills related to AI and the importance of effective change management. Furthermore, the immaturity of both the ethics and regulation on AI where discussed.

The fourth topic was the current implementations of AI. There was some agreement that most current implementations of AI solved specific problems for specific processes. These specific applications stopped short of being enterprise systems or linking beyond one organization.

The fifth topic was the threat to the incumbent insurers from AI as it can be an enabler to new entrants and disruptors. The sixth topic was the importance of data and the increase in data from IoT. Overall the focus group supported the findings of the case study analysis although the importance of having enough, high quality data to support the training of AI but also support its decision making, came out more strongly. Most participants agreed that AI and an increase in the quantity and quality of data, could revolutionize BMs in the future but that this may be a gradual process over several years.

Discussion

Insurance value chain with AI

Traditional B2C insurance value chains need to be adapted to accurately capture the impact of AI and AI driven automation. The six areas that are important to AI driven automation identified in the 20 case studies form the AI and data driven insurance value chain are illustrated in figure 1. Figure 1 illustrates the first order themes of the value chain. Second order themes can also be developed to offer greater granularity.

Firstly, as AI, and the data it needs, cover more of the value chain a more data-centric value chain would represent the new B2C insurer better. A data driven model can have data central to the value chain, not in a supporting role, and can include internal and external data sources¹⁴.

Sources of consumers should be included in the new value chain as it should not be assumed that the consumer will come to the insurer directly. For example, tech-companies like UBER, TESLA, Alibaba and Tencent bring their consumers to be insured. Many value chains include marketing and distribution but there are also some that include the consumer²⁰.

The four insurance business models for AI driven automation

From the 20 case studies four AI and data driven BMs emerged as illustrated in Figure 2. AI is the catalyst in creating this new taxonomy for insurance companies. These four models cover all of the case studies. Some insurers had a hybrid model using one model for some services and another model for others. These hybrid models could remain hybrids in the future, or when more AI is absorbed, they may transition into one uniform AI and data driven model.

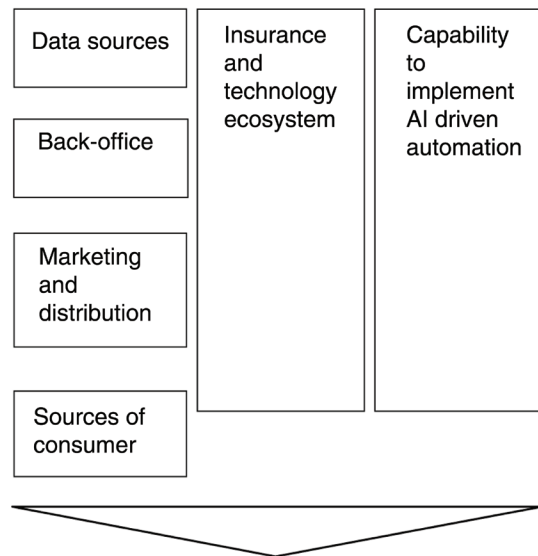


Figure 1. AI and data driven insurance value chain.

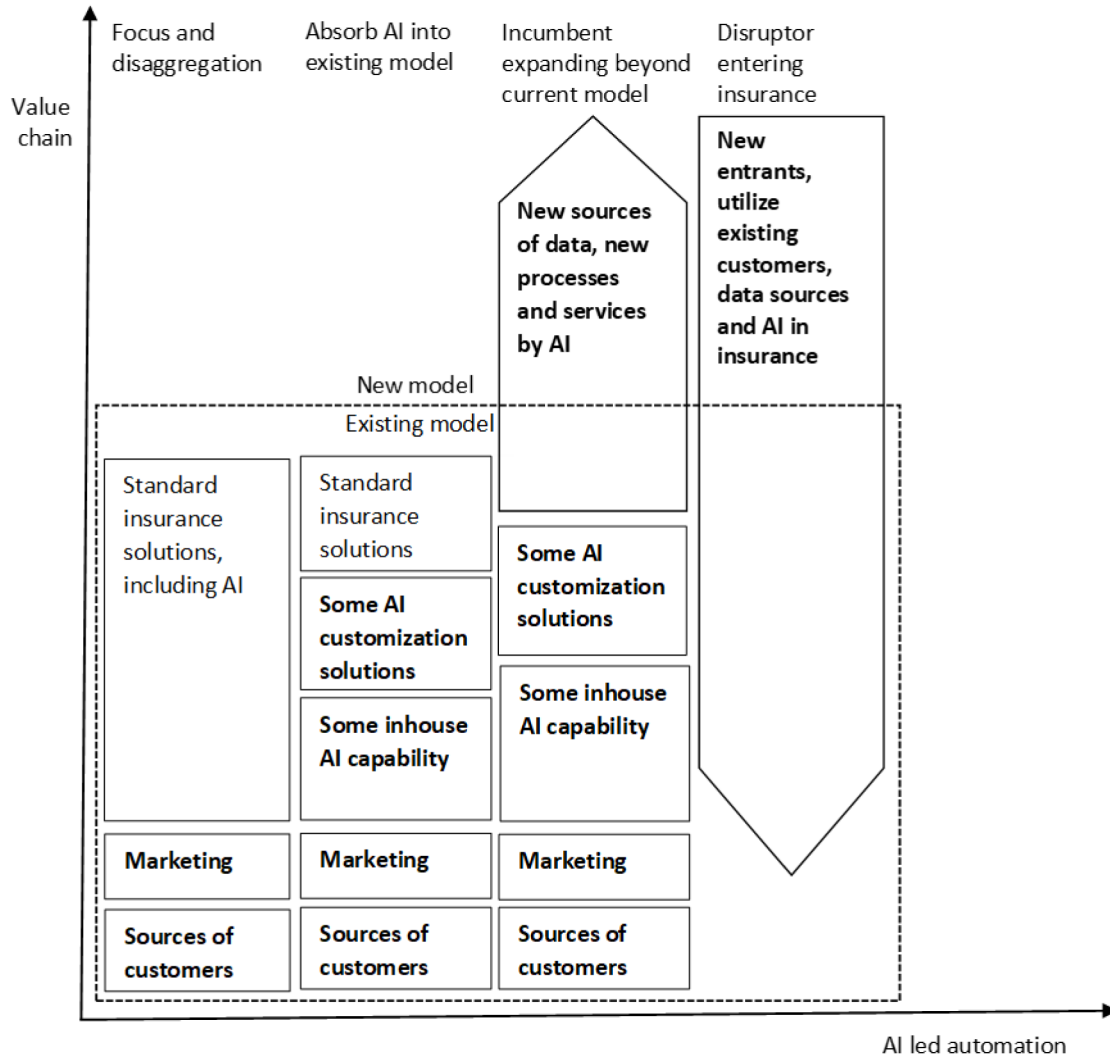


Figure 2. AI and data-driven business models.

Focus strategy and disaggregation. In this model the insurer implements a smaller part of the value chain, has a larger ecosystem and may join a platform. In this strategy ‘less is more’. The insurer has a reduced part of the value chain either by choice or because other organizations, such as tech companies, adopt processes they used to do. The insurer focuses on their existing core competencies and disaggregates others. A tech company or e-commerce platform can implement other parts of the value chain. Examples of tech companies taking a larger part of the value chain are TESLA and UBER. UBER agreed with insurers such as AVIVA and AXA to insure the passenger for one trip.

The ‘streaming generation’, may make more subscriptions for cars than purchases, so these collaborations will be helpful to insurers to access these temporary users.

Another example is where the insurer focuses on the marketing and distribution. In this model the insurer accepts that

other organizations are better positioned to benefit from many of the changes AI brings. Other organizations may be better positioned because of better in-house AI capabilities, applying external AI better, having more, and better-quality data for AI to use, or a larger customer base to apply AI to. Becoming smaller across the value chain can be seen as an effective way to become part of a larger ecosystem.

Same model and value chain but improved by AI. In the second BM the insurer utilizes AI across their value chain but does not change their BM to fully utilize the opportunities AI led automation can bring. AI-driven automation may be implemented in some processes and services but not at enterprise level, across the BM, so that risk is reduced. AI is mostly absorbed into current processes. An advantage of the insurer applying the AI themselves, ‘in-house’, with their data, is that the industry specific knowledge is not lost or given to partners in the AI implementation. Therefore, the insurer has control over their data, their industry specific knowledge and how

they use them to shape their competitive advantage. A traditional insurance company that is risk averse with technology and processes would be in this category.

Expanding beyond the insurance value chain, seeking more data, becoming the platform. An example of an insurer in the 'go big or go home' model is selling IoT hardware or using the data from it. There are examples of this in health, such as Bupa, and transport. In health people are tracked by IoT sensors and in transport containers and goods. New forms of big data create new opportunities. Some traditional risk averse insurers may use startups they own to test these new opportunities.

Tech company expanding into the insurance value chain. The case studies illustrated the increasing role AI and data will have in the future. This is also reflected in the value chain proposed. This prominent role of technology across user-facing and back office processes, accessing data and implementing AI means technology companies and e-commerce platforms are in a strong position. Furthermore, companies like Tencent and Alibaba have access to customers. As these tech companies do not have a long legacy in insurance, they are arranging their processes to deliver insurance with a focus on AI and data from the start. While tech companies and e-commerce platforms are in a strong position to implement the new value chain effectively, there may also be other innovative companies or startups coming from outside insurance that can harness AI, data and users sufficiently. New incumbents, with no reputation to lose, can accept a higher risk and use technology in new untested ways.

Conclusions and further research

This research gained insight at industry and company level. The 20 case studies and the focus group indicate the

disruptive potential of AI and reinforce other research that suggested this²¹. Some processes change in a specific and fundamental way, while in other cases AI drives a broader automation in a similar way to the Internet. In a similar way to the disruptive impact of the Internet the transition is a journey for the insurance sector.

This research makes three primary contributions: Firstly, the current applications of AI in the insurance sector were identified. Secondly, a new AI and data driven value chain for B2C insurance was developed. Thirdly, four AI and data-driven BMs for insurance emerged. The choice of model and value chain influences the approach to implementing AI. In the focus and disaggregation strategy more off the shelf solutions are used with less customization. In the second model where AI is absorbed into the existing model some customization is implemented. In the third and fourth model extensive new capabilities of AI are developed and implemented.

Further research can explore how the transition to new AI and data focused models can be implemented and how the users inside and outside the organization can be encouraged to support this change.

Data availability

Underlying data

Figshare: 20 case studies on AI evaluating the impact of AI on insurance. <https://doi.org/10.6084/m9.figshare.9845015.v2>¹⁹.

Figshare: Notes from workshop on AI evaluating the impact of AI on insurance. <https://doi.org/10.6084/m9.figshare.9845048.v1>¹⁸.

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0).

References

- Bauer A, Gröninger Y: **Dying, Surviving or Thriving - Strategic analysis of the future Swiss insurance market.** 2017. [Reference Source](#)
- Microsoft chief warns companies to act now to maximise AI opportunity. 2018. [Reference Source](#)
- Hall S: **How Artificial Intelligence is changing the insurance industry.** *The Center for Insurance Policy & Research.* 2017; **22**: 1–8. [Reference Source](#)
- Wang Y, Xu W: **Leveraging deep learning with LDA-based text analytics to detect automobile insurance fraud.** *Decis Support Syst.* 2018; **105**: 87–95. [Publisher Full Text](#)
- Riikinen M, Saarijärvi H, Sarlin P, et al.: **Using artificial intelligence to create value in insurance.** *International Journal of Bank Marketing.* 2018; **36**(6): 1145–1168. [Publisher Full Text](#)
- Vassiljeva K, Tepljakov A, Pellenkov E, et al.: **Computational intelligence approach for estimation of vehicle insurance risk level.** *Proceedings of the International Joint Conference on Neural Networks.* 2017; **2017**: 4073–4078. [Publisher Full Text](#)
- Ghahramani Z: **Probabilistic machine learning and artificial intelligence.** *Nature.* 2015; **521**(7553): 452–459. [PubMed Abstract](#) | [Publisher Full Text](#)
- LeCun Y, Bengio Y, Hinton G: **Deep learning.** *Nature.* 2015; **521**(7553): 436–444. [PubMed Abstract](#) | [Publisher Full Text](#)
- Langley P, Meadows B, Sridharan M, et al.: **Explainable Agency for Intelligent Autonomous Systems.** *31st Conference on Artificial Intelligence (AAAI 2017), Proceedings.* 2017; 4762–4763. [Reference Source](#)
- Saffarizadeh K, Boodraj M, Alashoor TM, et al.: **Conversational Assistants: Investigating Privacy Concerns, Trust, and Self-Disclosure.** *Proceedings of the International Conference on Information Systems (ICIS).* 2017; 0–12. [Reference Source](#)
- European Commission: **Ethics Guidelines for Trustworthy AI.** 2019. [Reference Source](#)
- Zott C, Amit R, Massa L: **The Business Model: Recent Developments and Future Research.** *J Manage.* 2011; **37**(4): 1019–1042. [Publisher Full Text](#)
- Eling M, Lehmann M: **The Impact of Digitalization on the Insurance Value Chain and the Insurability of Risks.** *Geneva Papers on Risk and Insurance: Issues and Practice.* 2018; **43**(3): 359–396. [Publisher Full Text](#)
- Hartmann PM, Zaki M, Feldmann N, et al.: **Capturing Value from Big Data – A Taxonomy of Data-Driven Business Models Used by Start-Up Firms.** *International Journal of Operations and Production Management.* 2017; **022**: 1–14.

15. Eisenhardt KM: **Building Theories from Case Study Research.** *Acad Manage Rev.* 1989; **14**(4): 532–550.
[Publisher Full Text](#)
16. Miles MB, Huberman AM: **Qualitative data analysis.** Sage Publications. 2018.
17. Sutton RI, Callahan AL: **The Stigma of Bankruptcy: Spoiled Organizational Image and Its Management.** *Academic of Management Journal.* 1987; **30**(3): 405–436.
[Publisher Full Text](#)
18. Zarifis A: **Notes from workshop on AI evaluating the impact of AI on insurance.** *figshare.* Dataset. 2019.
<http://www.doi.org/10.6084/m9.figshare.9845048.v1>
19. Zarifis A: **20 case studies on AI evaluating the impact of AI on insurance.** *figshare.* Dataset. 2019.
<http://www.doi.org/10.6084/m9.figshare.9845015.v2>
20. Bonaccorsi A, Giannangeli S, Rossi C: **Entry Strategies Under Competing Standards: Hybrid Business Models in the Open Source Software Industry.** *Manage Sci.* 2006; **52**(7): 1085–1098.
[Publisher Full Text](#)
21. Maull R, Collomosse J, Brewer S, *et al.*: **Taking control: Artificial intelligence and insurance.** 2019.
[Reference Source](#)