Contextual Need Assessment and Policy Matching Intelligence: Machine Learning Frameworks for Enhanced Insurance Policy Recommendation Systems

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1. Introduction

Although insurance has evolved into a proactive platform, the essence of risk relaying is yet to be encompassed in insurance frameworks. These traditional models fall short of influencing customer choices based on personalized suggestions. Subsequently, they emanate from all available products instead of a strategic attempt to leverage futuristic insights. Recognizing and learning from past experiences, while established data must be catalyzed using advanced methodologies prevalent in diversified domains, this rationale has led to the incipience of this study. To this end, prevalent literature propagates the transformative potential of AI in augmenting suggestions on routine behaviors and lifestyles. Nevertheless, researchers have not highlighted the potential of AI in expanding and improvising upon standard insurance policy frameworks. The sole exceptions are in the resolution of claims, repudiation of fraudulent demands, or in risk prevention.

The crux of this study is devoted to this aforementioned lacuna. To introduce, this research primarily reports the rationale for utilizing AI in formulating inclusive and dynamic policy suggestions, thereby presenting two primary frameworks through which the current study can formulate recommendations. The study then identifies the scope and limitations. This analysis forms the vanguard for the discussion on AI, insurance, and the scope for quantitative research in the insurance sector.

1.1. Background and Significance

The work on recommendation systems for insurance products started in the late 1960s and early 1970s. At the time, data were limited, and recommendation systems were

manual rather than computational. They were highly talented experts who would make the types of recommendations, and they were driven by their knowledge. However, manual methods are slow and inconsistent as they depend on the quality of the people involved and long experience in the field. It was impractical and took a shorter timeframe to provide enough accurate recommendations to meet market needs. The information collected by the insurance broker was static. It is the same today as it was yesterday. Modern technology and AI give every insurance company the possibility to provide ad-hoc recommendations for all policies to any customer at any time, which retains more customers for a longer period. The modern technique was introduced earlier this year. Statistics show that there is a need for a very deep study in this field, which results in more satisfied customers and helps insurance companies achieve trouble-free customer retention. It has been observed in other organizations that if customers receive ad-hoc and better services, they will remain loyal for the long term. Customers always prefer to have personalized services rather than the normal ones. The static approach will not fulfill the needs of the customers. In today's dynamic world, it is necessary to provide customers with a product that exactly meets their requirements. In the given work, the problem of providing static products to customers that never change behaviors for a specific time will be resolved. The main aim is to propose an AI-based system that provides insurance recommendations.

1.2. Objectives of the Study

Objectives of the Study. The objective of this work is to investigate and develop the potential for AI in the insurance industry to provide the right solutions for robust and personalized policies tailored to customer individual needs. We will also look into some of the challenges and future developments in this area. The main focus of this paper is "how to recommend an effective insurance policy to the right customer at the right time?" At the same time, we will work on policy structure, the context of helpful techniques, and the diverse machine learning models for bias-free recommendations of precise insurances to customers. In recent years, large adoption has been noticed in the research domain for personalized recommendations across diverse platforms with the use of ML techniques. In this direction, insurance policy can also be used for personalized and effective output in the insurance field. At the same time, the installed machine learning models need to be strong and efficient to offer the necessary results and outputs. In this field, there are limited results. The goal of our policy is to provide a

framework for relevant and timely recommendations of accurate insurance policies to create more customer engagement. We also recognize the AI-based future shifts and strategies in this domain. There are a few challenges found as part of this study based on AI in insurance strategies. Our major contribution and research focus, after summarizing the earlier contributions in a short and straightforward manner, are to offer the following outcomes: 1. Understand how to suggest relevant insurance policies and services to the right consumers at the right time. 2. Provide a short outline and basic thoughts about insurance and automated insurance suggestion techniques. 3. Perform a systematic literature review on insurance suggestions with existing machine learning techniques. 4. A short summary of the machine learning models used in research is also provided. 5. Recognize future trends and insurance strategies that use AI. 6. Identify some barriers and outlines to which a few AI solutions might contribute.

2. Understanding Insurance Policy Recommendations

Insurance policy recommendations entail identifying suitable insurance products based on consumers' needs. While traditional recommendation methods rely on significant input from users, artificial intelligence enables the automatic identification of individual customers' needs, risk profiles, and corresponding coverage options. AI provides the opportunity to automate these processes in real time using structured and unstructured data from diverse sources and analyze this data particular to the circumstances of individual consumers. In doing so, AI can introduce a new paradigm for insurance policy recommendations, enabling truly discrete and data-driven advice for consumers that is not only feasible on a large scale, but also relevant and more respectful of the consumer's individual circumstances as well. Traditional insurance policy recommendations are typically based either on a manual journey through user input and historical data or on a pre-structured process supported by a rule-based system. This approach generally results in recommendations that tend either to be only as good as the data available or as exhaustive as users' support and time permit. However, the insurance sector is a late adopter of new technologies, and recommendations remain mainly data-driven. Among the hardest challenges for insurers to overcome is tailoring the coverage to individuals, and as a result, selecting the coverage is not generally included in the process. The potential for true innovation in insurance lies in discovering new business models that offer greater added value to policyholders than conventional insurance packages, and the combined use of smart and IoT devices is key in achieving

this transformation. Failure to adopt knowledge and technology for strong personalization and integration between the traditional value represented by the consortium and technological value at a time when clients increasingly expect individualized advice could lead companies to face higher churn and lower customer satisfaction.

2.1. Traditional Methods vs. AI Approaches

Traditional methods for insurance policy recommendation mainly rely on data analysis based on historical records. Some recommendation processes establish criteria relying on predefined information from clients and policy documents without considering real customer behavior. AI as a method for policy recommendation could provide a more comprehensive product and customer suitability fit. It benefits from suitable machine learning algorithms, where the best-suited algorithm may depend on the amount and quality of given data, and the use of automated decision support systems. The most important benefit of machine learning algorithms is their ability to provide a real-time delivery model and customer-driven feedback loop. They achieve a more accurate, personalized way of lifestyle fitting. They improve personalized advice accuracy when it comes to minimizing insurance coverage lacking or even reducing potentially negative biases that are learned from restricted personal data. An insurance placement system empowered by AI technologies enables the consumer to be the best possible policyholder qualifier and provide continuous feedback on how good the insurance product's fit is for them as individuals. It is now possible to buy satisfaction with relatively quick online processes. This makes the application for personalized insurance policy consulting more comprehensive with the support of AI technologies than traditional insurance consulting processes consisting of one-to-one consultation sessions incorporating various test methods. For both the consumer and the company, transformation provides advantages. In operational risk management, exploiting AI-based technology can lead to improved risk coverage, more accurate modeling, and early detection of adverse trends.

2.2. Challenges in Tailoring Coverage Options

The ability to create coverage recommendations that are tightly tailored to the needs of individual policyholders presents several challenges. As the use of technology to gather and analyze more data about people grows, so does concern about privacy and the

sharing of data among different companies. Further, the nuances and interconnections of numerous leading-edge digital technologies make data ingestion, integration, analysis, and application a complex endeavor. Additionally, for most of their history, insurance companies have worked mainly with actuarial data and employed conventional means to identify and understand customer behavior and preferences. It has only been recently that artificial intelligence technology has enabled insurers to bring in and analyze not just increasingly diverse and larger volumes of data, but also to capture subtler patterns that allow for a more accurate understanding of customers and potential policyholders. Ultimately, this gap makes the insurance system unwieldy and delayed in responding to the customer, resulting in a potential mismatch of policies between the potential risk and actual consumption profile between the customer and company.

Regulatory compliance may also be an area of concern. Since policy recommenders use big data and AI technologies, the relevant outputs must also comply with relevant legal, engineering, and professional standards and their associated regulations, standards, and guidelines. Both consumers and regulators want to ensure that the processes, recommendation outcomes, and product options are ethical, compliant, and implemented in a way that has no biased outcomes that discriminate against certain groups. Furthermore, both practitioners and further research studies have highlighted potential challenges of policy recommenders. Indeed, as stakeholders, including consumers, businesses, and regulators, continue to understand, evaluate, and learn from policy recommendation systems, it is likely that these systems will be guided by new regulations and guidelines. The use of AI can change many aspects of an insurance company's practices, operations, and culture. Changing every part of a company this way is a challenge. Many firms don't have the right skills and teams in place. Some of the remaining obstacles are to bring clarity and organizational alignment around AI adoption. It's also key to ensure that the customer's AI use is transparent, rational, and easy to understand in order to do something. This is particularly important for insurance, where transparency increases customer trust and expertise. Some of the fundamental rules of AI are the same for insurance and risk assessment. It is important to ensure that AI choices are explainable to customers in accordance with good practices and regulations. Overall, the insurance industry needs to be more involved in AI and organizational management to highlight the power of AI technologies in improving customer and working experience to inform choice and attract future AI capabilities.

3. Machine Learning Techniques in Insurance

Machine learning techniques have been proven to be efficient in various industries. Especially in the area of insurance, numerous machine learning techniques are applied to enhance the insurance policy recommendation. Currently, machine learning insurance techniques can be analyzed from two points of view. First, machine learning techniques are used to recommend policy options. Two types of machine learning techniques can be used for it, namely supervised learning and unsupervised learning. In the area of recommendation systems, the key used for consideration is built upon supervised learning. Recommendation is particularly important for companies since it can affect how the companies advise certain policies to specific clients. The use of machine learning recommendation systems could help the companies in achieving their goals as it is capable of processing a huge amount and diverse set of collected data, analyzing more information, and providing a better risk estimation divided by characteristics. In addition, supervised learning recommendation systems are widely used to assist insurance companies in their risk assessment and try to match policy and policyholder in a better way than ever possible before by reducing the subjectivity in the risk assessment process. Second, machine learning techniques can be applied to segment customers. This will help the insurance companies in targeting their client group and in providing the proper service and marketing strategy for the particular segment. The segmentation can also be useful from a risk assessment point of view, as it is possible to assess the risk of a homogeneous portfolio. In a practical setting, this segment can serve as a separate entity in pricing or to see the adequacy and proper distribution of an assessment insurance provision.

Supervised learning is particularly effective when used to develop recommendation systems. In fact, different supervised learning approaches are proposed to best perform policy personalization. Random Decision Forest models were developed to predict the bundling of auto and home insurance policies. A gradient boost model has been developed to predict the optimal priced policy and the total customer purchase. Five different learning-to-rank algorithms were implemented to develop multiple recommendation systems to personalize insurance offerings according to customers' risk attitudes and preferences using the same labeled data source. When considering the previous work, a combination of approaches was used to develop an expert system considering the level of uncertainty and paying attention to the assessment of human

evaluators dealing with the label attribution. Unsupervised learning techniques can be employed to identify subgroups of customers on the basis of their inherent data patterns, without requiring a labeled data set. Indeed, clustering algorithms build customer segments on the basis of their data. Customer segmentation on the basis of data is fundamental for the actuarial evaluation and operational management, marketing strategies, and continuously needs adjustments according to the development of the market and the company proposals. An additional advantage of clustering is that it can deal with large data sets. In general, the asset of all the machine learning techniques for business is the ability to process a large amount of data, which is a crucial aspect in the presence of Big Data. Being able to leverage a small amount of labeled data to align distant decisions is a game-changer in terms of expanding the value of machine learning to business, for both classification and regression settings. In brief, machine learning techniques can be the solution for large-scale risk assessment accurately considering Big Data with cost-effective approaches.

3.1. Supervised Learning for Recommendation Systems

One of the fundamental concepts in recommendation systems is the use of machine learning models, namely supervised learning algorithms, that are trained on labeled data in order to determine the best-recommended insurance policy for the user. Unlike unsupervised learning algorithms that identify patterns, relationships, and anomalies in the input data without human intervention through structured inputs, they work with labeled datasets, using paired questions and answers or inputs and correct outputs to complete the requested task, which are provided during the training phase. This prior labeling can be considered an inference hazard. While users may not have correct answers to the requested queries, they can respond directly, aiding the training process. One of the most pivotal advantages of using supervised learning algorithms to create recommendation models over other algorithms is their extremely high predictive accuracy. Users expect recommendations that best match their preferences and align with their individual needs. In cases where supervised learning algorithms cannot be trained on users, they can be trained on similar user data since identifying encroachments on data is quite challenging for businesses. Such algorithms can improve because recommendation systems tend to continually train or retrain the model every week, day, or hour to enhance its precision according to the results it receives.

In the insurance domain, these algorithms are widely used and take the form of classifications, followed by predicting the price of different insurance schemes into various buckets or using different factors for clustering with techniques like logistic regression to build classification models or linear regression to build a prediction model. Decision trees are supervised learning algorithms that use classification policies to yield quicker and more accurate outcomes. In providing top recommended policies, decision trees can perform different rules or segments based on given conditions, predicting specific insurance policies to offer automatically. These predictions include providing the top three most recommended policies as a feature in a product recommendation engine. Overall, a high-level data infrastructure like data pipelines and storage, having different data as a use case of various data structures in a runtime environment to be attached to the training algorithms, and the ultimate workload that will consume the underlying infrastructure is required, depending on what you are performing at a higher data level.

3.2. Unsupervised Learning for Customer Segmentation

Unsupervised learning is another powerful method of machine learning in which data is examined without predefined labels. This approach in AI could be relevant in the insurance sector where insurers have to analyze not only customers' insurance risks but also the behavior of different customer segments. For example, clustering could be used to identify segments that are less prone to insurance products with coverages that are easier to measure from segments that actively buy insurance against risks that are difficult to measure. Furthermore, unsupervised learning would allow insurers to identify segment behaviors and preferences that may be taken into account before offering insurance covers and fraud detection solutions. Insurers do not only look at existing practices to understand customers but also make exploratory analyses to identify new patterns. There is also the possibility of discovering emerging signals that fall outside standard technical risk assessments. An insurer that serves both large SMEs in commercial insurance could use clustering in customer segmentation. In unsupervised learning, labeled data is not available. The insurer can use whether the customer is insured by the company. This can lead to meaningful presentations of high potential. In addition, insurers are less likely to use non-mainstream business insurance, but there are some small and medium-sized businesses that insure. This segment is not interested in buying goods against risks that insurers can measure more easily.

4. AI Applications in Insurance Industry

Artificial intelligence is a disruptive technology with great potential. Numerous industries are budgeting for AI deployments and investments, and incumbents are moving forward with integrations of AI. The banking, finance, and insurance industries have reported or realized numerous use cases where AI has been helping or could potentially help. We explore and discuss the various applications of AI in the insurance sector, including claim processing, fraud detection, personalized recommendations and advice, robo-advisors, etc.

The insurance industry is one of the domains that can benefit from AI. Research studies have indicated how AI can enable more efficient insurance providers, attract new clients, enhance customer experience, process claims more quickly, and increase fraud detection accuracy. More particularly, in the customer service domain, chatbots have attracted public interest and can provide improvements in the customer experience. Features of AI such as machine learning, natural language processing, and predictive analytics have been learning to determine various aspects. For instance, AI could be employed to examine a driver's driving patterns to make decisions on insurance levels, discounts, or service improvements.

It has been indicated that AI can create a greater shift in creating value for the customer than merely providing a digital facade layer to existing services. For instance, with AI, a new and truly personalized insurance recommendation could be generated, taking into account the individual's financial position, risk tolerance, happenings in the world, and something very particular also happening at the customer's location, such as a flood, all resulting in a new tailored insurance package that can be offered based on a unique need. This is but one example of how AI can be used in the insurance domain, capable of changing operating models. The next question makes us ask what businesses can be made here and what these AI capabilities would be – how much value is there?

4.1. Personalized Recommendations

Insurers try to shift to needs-based service models in various sectors. Due to the increasing number of competitors that provide customers with hassle-free and always valid policies with a seamless and smooth interface, the insurers are in need of providing more personalized offerings. AI is one of the key factors that assist in personalizing recommendations. AI algorithms help to provide customized offerings

and promotions based upon user preferences, behaviors, and profiles. Personalization goes a step beyond recommendation and influences customer relationship management strategies. The use of AI for making personalized insurance offerings is already being implemented in various insurance areas, and more possibilities for implementation are yet to come. In the narrow sense, the term "recommendations" usually refers to a specific item offered to customers, based on, for example, user behavior and the similarity of recommendations to the profile created. Insurance technology applications use advanced algorithms and customer data to create policies based on individual needs and behaviors. These policies are offered through a tech-enabled distribution model that delivers insurance advice through personalized storytelling. When done well, personalized recommendations improve customer satisfaction and increase customer retention by getting the best policy match for the best quote. However, there are technical and ethical concerns around data privacy and algorithm bias. Moreover, producing personalized policies requires a lot of financial and human resources. Currently, only a small number of companies offer personalized advice based on the use of AI. Combining internal and multiple data sources to achieve a more accurate and nuanced level of personalization is likely to be the next stage in the evolution of personalized coverage. In some areas of the insurance industry, providing such accurate recommendations will be essential over the coming years. It is time for insurance companies to take note of these innovative approaches and invest in machine learning and computation to become future-ready.

4.2. Risk Assessment and Management

At its heart, the business of insurance is one of putting a price on risk. Traditionally, risks were assessed on the basis of available historical data and often generalized measures such as average fire or flooding probabilities. Insurtech companies aim to fundamentally reinvent the insurance business by incorporating diverse real-time data into insurance risk assessments to produce risk profiles that are much more accurate and comprehensive, thereby predicting probabilities of potential losses. To this end, machine learning can help identify related patterns and make better predictions of future claims frequencies and individual claim amounts. Risk assessment also plays a crucial role in the underwriting process. Inaccurate or insufficiently attractive pricing may force insurers to take on a significant amount of capacity constraint or risk, i.e., limit the

amount of cover provided in some way where the exposure to loss is perceived as unacceptably high, or avoid certain risks.

The availability of insurance coverage, thus, ultimately depends on widespread accessibility at the individual level. Improving the ability of existing and new policyholders to obtain the right amount of cover at a fair price based on AI-powered risk assessments, therefore, has the potential to serve increasingly broad social goals. A major challenge of AI-based insurance risk assessment is the ability to find and collect appropriate data. Furthermore, data collection processes must adhere to various existing regulations to ensure that personal, sensitive, and proprietary information is protected. As always in data science applications, the predictive performance of algorithms depends significantly on the quality of data used for training the algorithms. Insurers also need to ensure that their algorithms are sufficiently transparent and can be used to provide explanations to customers to meet various explainability requirements. These challenges and considerations have been reflected in several recent studies. Rather than focusing on the issues around discrimination and risk pricing, we are looking for a better understanding of machine learning and AI-based risk assessments' potential at the level of practical applications. Based on our literature review and managerial experience, we see several ways in which AI can help insurers in their quest for better risk management.

5. Case Studies and Success Stories

Case studies and success stories: AI-enhanced policy recommendations, tailored for the needs of individual customers, are successfully breaking into different sections within insurers. One prominent example, closely intertwined with operational excellence, is AI-enabled claims handling, which is particularly relevant when claims handling scales persistently upwards. Case studies exemplify the successful implementation of this kind of technology. One company improved customer satisfaction and retention rates; their services were especially helpful in onboarding new customers, while another insurance company reduced the time to make a buyback quotation from one day to just three minutes.

Insurers are not inadvertently enhancing their sales opportunities with AI-enhanced policy sales. Research suggests that the majority of customers would be appreciative of personalized insurance offers, and studies have indeed proven the benefits of this

approach in pet insurance policies, where a significant percentage of customers became new to insurance. In life insurance, a customer might invest an average of a substantial amount into a lifetime insurance policy. By utilizing AI, insurance carriers were able, on average, to upsell by a notable percentage more in new business premiums. Cutting through the noise of flashy success stories to the examples that are actually transferable and impactful to other insurers, this article delves into existing case studies of AI-enhanced insurance policy recommendations. They span use cases from sales, retention, and claims and range across several different sectors. It is clear that concrete and evidence-based success can lead to strategic decisions and breakthroughs in AI usage.

5.1. Real-world Implementations of AI in Insurance

Real-world Use Cases for AI in Insurance In recent years, numerous organizations have started integrating AI into the insurance business. In this section, we explore several examples. We delve into how they built their competitive advantage using AI and what strategies they employed. Competitive advantage through building trauma models with an AI-based partner offers win-win solutions to clients. AI Strategy: One organization only recently started to focus on the property/casualty branch—an accidental entry that paid off in their being bought for an undisclosed sum. Building up around 500 data capacity models for every line of business in that field helped them track patterns and make good predictions based on loss history. This organization became a win-win. The business-in-a-box model offers one-stop, efficient shopping for all manner of middlemen, reducing the quotations process from a week to around two hours. Operational and Organizational Challenges: One concern might be that trauma models are still a somewhat experimental enterprise, not yet entirely figured out. Additionally, breaking into a market with established customer relationships like property/casualty means plenty of business professionals have favorite platforms to which they might not be inclined to defect. Sector-Specific Regulatory Hurdles: Strict regulations and reliability sought from insurance companies and medical professionals by both parties in the litigation realm likely mean the adoption of AI-based analyses would be slower in the medicolegal niche. "AI 2.0" is where this organization's business plans center. Expanding from looking back at data loss, the company is now hoping to more fully embody the initial, idealized concept of AI seeing into the future based on a hybrid of historical, current, social, and other concordant data.

6. Future Directions and Ethical Considerations

The directives presented in this chapter only represent the tip of the proverbial iceberg. The insurance industry is in the process of liquefying not only the traditional forms of insurance but also classic business models. The easy handling of AI-based services for this purpose is increasingly shaping the competitive conditions as well as the expectations of insurance customers.

Emerging trends in AI and predictive analytics, as well as automation, indicate the transformative potential of the function of an insurance company. Through the increasingly data-based capture of individual behavior, as is the case with regard to wearables, current health trackers, and fitness gadgets, or navigation assistance services, there is a high potential to take out insurance in micro-segments. Thus, the individual becomes the target group. In addition to offer creation, fully automatic claims settlements can be implemented via an autopilot, as fraudulent or pseudo-malicious claims patterns can be fully automated using pattern recognition. Appropriately designed insurance companies naturally expect a high growth in customer interest and thus a new source of sales in their new business segment.

Ethical considerations arise in the context of data-driven insurance regarding data accuracy, transparency, consumer acceptance and its consequences, data and algorithmic accountability, data protection and data privacy, fair pricing, and how the development, use, and effects of new services can be anticipated. An increasing dichotomy in society is to be expected with regard to access to certain AI applications and thus to a lower limit of such technology in proprietary companies. Is there a responsibility to amplify this? What AI applications should remain expensive? In hindsight, it is necessary that the opportunities and destinies of AI applications for insurance have far-reaching repercussions for society and thus fall under the category of corporate social responsibility.

6.1. Potential Innovations and Trends

Advances in predictive modeling and data analytics have already resulted in a redefinition of risk management and insurance pricing models. The integration of big data has also been an important trend within the insurance industry. The data collected by insurers and brokers, such as a customer's driving behavior, location, or browsing history, among others, has been increasingly used for the development of new products,

such as on-demand insurance. Thus, as insurers are expected to have access to a growing volume of new data, it is possible that they will also be increasingly involved with the development of new offerings in the IoT space. The technology has been cited as a potential tool for insurers to assess property and risk conditions, information which can be used to provide more precise and accurate underwriting and pricing. A driving force of these and other innovations has been determined as emerging from customer demand. Innovations and AI applications in the insurance industry are in line with shifts in customer preferences and the demand for seamless omnichannel experiences. These expectations have officially transferred over to the insurance industry, bringing it to attention in the digital arena.

The advanced AI use scenarios are not simply suggested for internal operational efficiency purposes; rather, they are a representation of changes in the businesses themselves. Larger insurance companies have been found to increasingly engage in all aspects of innovation, of which digital is an invaluable asset. They have either developed new insurance products that can cope with the altered customer demands from technology—such as smart home and usage-based policies—or have introduced internal innovation strategies to increase operational efficiency, in particular cost reduction. Recently, quite a few have renewed their business models to include a tech-focused strategy, while others have undertaken strategic investments and collaborations with tech startups whose leading technologies give them a competitive edge. Smaller insurance companies strive to capitalize on any tech edge they can obtain, usually through partnering with larger insurers and tech companies. The reason behind the focus on technology is to supply customers with cutting-edge solutions and services that will keep them competitive, while increasing the attractiveness of the industry as a career prospect. Among the adoption barriers identified are regulatory restrictions, the lack of investment/robust infrastructure for leading-edge digital developments, administrative capabilities and knowledge, and incompatibility of technological solutions due to disparities between insurers. However, it has been noted that AI can be useful in the dynamic response to market change.

6.2. Ethical Implications of AI in Insurance

6.2. Ethical Implications of AI in Insurance

The enhanced utility of AI technologies has been raised in this document as potentially driving professional processes in an ethical direction, but there are also serious ethical concerns relating to their use in insurance. People share increasing amounts of sensitive personal data every day, both willingly and unwillingly. As a result, there is an urgent need to account for the privacy of all data subjects and the consent of data providers. Despite such a critical understanding, there is little consideration as to the level of data provided to insurance companies and to what purpose. Yet, concern has been raised that in the case of insurance, a system in which consumers are unable to provide informed consent is already in place. In this view, the value of covering risk for the individual provides legitimate grounds for an insurance company to demand and collect the details of the proposal.

Ethical discussions in financial services often heavily focus on the potential for machine-learned insights to be influential without any need for them to be transparent or verifiable. The principle of accountability increases where the data in question is sensitive and the companies are regulated to protect the most vulnerable stakeholders. Although the increased personalization is often heralded as a benefit, insurers similarly have a duty to ensure the fair and equitable treatment of each of their customers. One of the key criticisms of a data-driven insurance industry from an ethical perspective is how this is at risk of perpetuating and normalizing unfairness in premium pricing and underwriting. Risks automatically priced into a certain group based on their physical or mental characteristics are bound to be less affordable to that group, and should the risk happen, will pay back less as a percentage of their income or wealth. There is also the danger that introducing an algorithmic approach to such underwriting will prevent an insurer from learning from its own human errors, as there is no incentive to go back and assess performance. Existing statistical techniques do not provide a mechanism for providing individual explanations. While this lack of transparency is common to many insurance products, at a societal level, perception of transparency and faith in processes are critical for the insurance product to function. Regulatory bodies intervene with action to protect and ensure market fairness for individual data for that same reason. It is in the best interest of insurance researchers and practitioners to promote best practices and foster such dialogues and research, as it plays into the narrative of using tools as an extension of existing insurance practice rather than a radical break imposed by technology.

7. Conclusion

Insurers' business is at the risk of being disrupted by the new insurtech companies that use digital technologies and AI to provide personalized insurance products. The large volumes of data created on a daily basis have made personalization a priority in insurance risk assessment, policy pricing and risk management solutions. AI and IoT expand insurers' capabilities to assess, cover and manage the ever-rising uninsured risks of their retail and corporate customers by removing the human error from the processes as a much higher volume of data sources than before are used. Transformative AI technologies of external data stewardship, real-time personalized insurance claims compensation and real-time continuous adjustment of insurance policies are developed and their benefits in customer retention and satisfaction as well as increased operational efficiency are substantiated. Claims ratio control is important for pricing the personalized insurance products. The main research challenge that must be addressed is to develop an efficient data governance framework or networks where the ethical issues are addressed and the partnerships in sharing data are based on agreed principles.

AI can make other risk management solutions useful, effective, and operational by adjusting its operations and capabilities based on continuous learning process targeting operational excellence and key performance indicators. AI capabilities must help achieve the corporate objectives in which the products and services are determined based on the analysis of the external and internal information using strategic objectives towards profitable long term operation. Thus the practice of our study has deep implications for the insurance industry. It is crucial for the companies in the field to realize the potential benefits of embracing AI and to acknowledge the potential sources of resistance and address the ethical issues. The sector-wise impacts of strategic objectives and the systemic drivers as new risks must be further explored in all areas including life insurance, pensions, savings, as well as in insuring typical industries like renewables as well as banks and any new financial products and services that are on the horizon. We hope that our study encourages new research in these exciting topic areas.