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Artificial Intelligent Architecture Analysis in Life Insurance Company

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Abstract
The life insurance industry faces increasing challenges due to complex processes, growing customer expectations, and competitive pressures. This research explores the transformative potential of Artificial Intelligence (AI) in revolutionizing end-to-end processes within the life insurance sector. By leveraging AI technologies such as machine learning, predictive analytics, and natural language processing, insurers can address inefficiencies in underwriting, claims processing, policy changes, and renewals—improving both speed and accuracy while ensuring regulatory compliance. The study adopts a comprehensive research methodology using TOGAF, beginning with a literature review and user interviews to identify existing challenges and inefficiencies in life insurance processes. A detailed architecture vision was developed using fishbone analysis and solution concept diagrams. Business and technology architectures were designed to address gaps, leveraging AI-driven tools to enhance risk assessment, fraud detection, and customer engagement. Expert validation was incorporated to ensure the practical applicability of the proposed solutions. The research presents an AI architecture tailored to various life insurance processes, including proposal creation, new business/underwriting, renewal, policy changes, claims management, agent commission, financial report, premium reserve, and reinsurance. Key innovations include predictive models for risk scoring, fraud detection algorithms, and churn prediction models to enhance customer retention. The study highlights the significance of AI-driven personalization, operational efficiency, and decision-making in optimizing these processes. The findings emphasize the importance of aligning AI integration with organizational goals and compliance standards. AI not only expedites processing but also enhances customer satisfaction and competitiveness in a rapidly evolving market.

Keywords: Artificial Intelligence (AI); Life Insurance; Predictive Analytics

INTRODUCTION

The life insurance industry serves a crucial function by offering financial protection and risk mitigation for individuals and businesses. Among the key aspects of this industry, claim processing stands out as policyholders seek reimbursement for covered losses. The efficiency and accuracy of the life insurance process are integral to customer satisfaction, regulatory compliance, and the overall success of life insurance companies (Lakhangaonkar, 2021). The insurance industry has long been characterized by complex processes and extensive documentation, often leading to delays and inaccuracies in underwriting, claim processing, and customer service. While current methods are reliable, they are increasingly seen as inefficient in the face of growing customer expectations and competitive pressures (Kaushik et al., 2024).

In recent years, the advent of Artificial Intelligence (AI) has presented transformative opportunities across various sectors, including insurance (Glozman, 2020; Hirz et al., 2023; Holland, 2022). AI technologies, such as machine learning, natural language processing, and predictive analytics, offer the potential to revolutionize the insurance industry by automating routine tasks, enhancing decision-making, and improving overall operational efficiency (Putra, 2023). AI has emerged as a transformative force in various industries, and the insurance sector is no exception (Birlasoft, 2021). AI technologies, including machine learning, natural language processing, and image recognition, offer the potential to revolutionize claim processing by automating repetitive tasks, improving accuracy, and enhancing the overall efficiency of the process. These technologies can analyze large datasets quickly, identify patterns, and make

data-driven decisions, thereby reducing the time and resources required for processing (Hajraoui, 2024).

Previous studies have shown that AI has significant potential to improve different aspects of insurance operations. Eling, Nuessle, and Staubli (2022) explain that AI can generate a substantial impact along the insurance value chain by improving efficiency, decision quality, and customer interaction. Dhieb et al. (2020) demonstrate that AI-driven architectures can strengthen fraud detection and risk measurement in automated insurance systems. Chancel et al. (2022) also highlight the relevance of machine learning in life insurance, particularly in enhancing risk assessment and supporting more accurate decision-making. Additionally, Groll, Wasserfuhr, and Zeldin (2022) show that statistical and machine learning methods can improve churn modeling for life insurance policies, while Cai, Abdallah, and Jeganathan (2024) emphasize the value of advanced neural network approaches in reserve analysis and risk capital evaluation. These studies collectively confirm that AI can provide significant operational and strategic benefits in the insurance industry (Fernandez-Arjona, 2021).

However, most previous studies tend to focus on specific functions, such as underwriting, fraud detection, reserve modeling, or customer retention, rather than examining how AI can be architecturally integrated across end-to-end life insurance processes (Fursov et al., 2022). Existing research often highlights technical models or isolated use cases but pays less attention to the design of a comprehensive enterprise architecture that aligns AI implementation with business objectives, operational workflows, and organizational readiness. In other words, the literature has not sufficiently addressed how life insurance companies can systematically structure AI adoption across interconnected business processes within a unified architectural framework. This gap is particularly important because fragmented implementation may reduce the effectiveness of AI and create integration challenges with existing systems and organizational practices.

Based on this gap, the novelty of this study lies in its effort to develop a comprehensive AI architecture for life insurance companies by integrating AI capabilities into multiple core business processes rather than limiting the analysis to a single operational function. This research adopts TOGAF as an enterprise architecture framework to map business needs, identify process inefficiencies, design future business and technology architectures, and formulate implementable AI-based solutions (Ibrohim & Girsang, 2019). Through this approach, the study provides not only a technological perspective but also a strategic and architectural view of how AI can be embedded in proposal creation, underwriting, renewal, policy changes, claims, commission management, financial reporting, premium reserve processes, and reinsurance operations.

METHOD

The research method will outline the stages involved in developing this research. It begins with understanding the business and compiling a requirement catalogue, followed by defining the architecture vision, business architecture, and technology architecture. Next, it explores opportunities and solutions. Finally, the methodology includes validation from experts in the fields of insurance and AI technology. Research framework shown at figure 1.

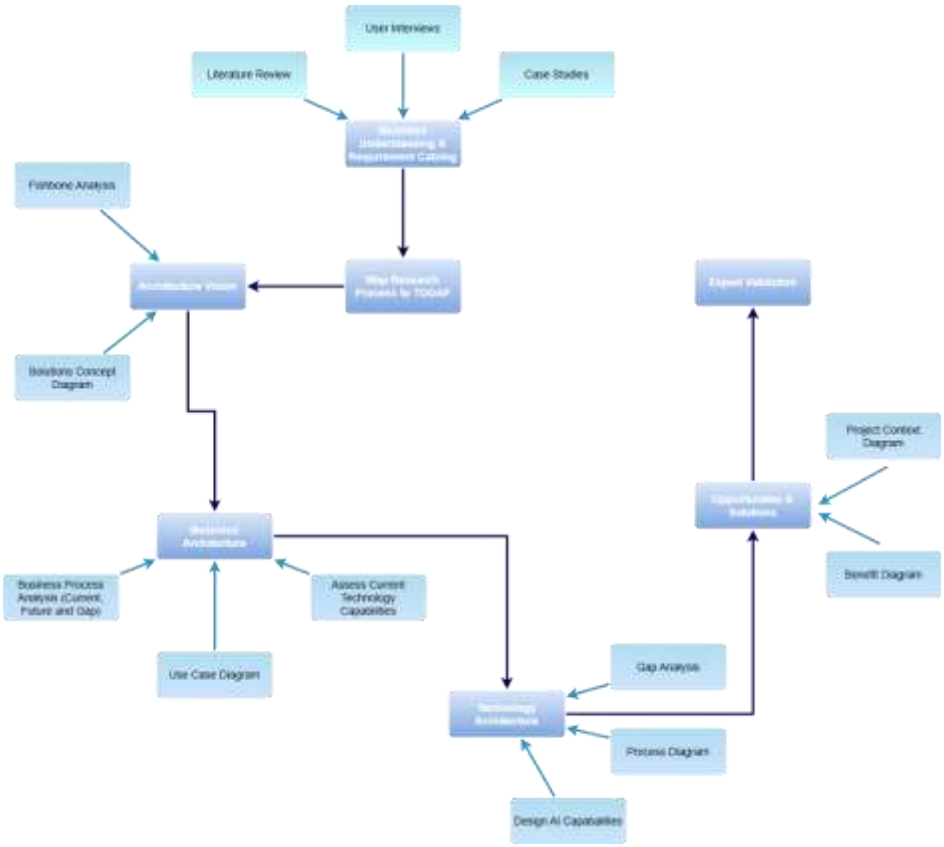

Figure 1. Research framework
Source: Author's elaboration (2026)

Business Understanding & Requirement Catalog

1. Literature review
   The literature review used as a reference is about the application of AI in life insurance companies.
2. User interview
   Interviews were conducted with users to understand how they currently manage these processes. This initial stage is crucial, as it reveals the number of steps users take to complete their tasks. Only from this analysis can we determine which processes can be enhanced with AI technology.
3. Case studies
   Case studies in research on AI applications in the field of life insurance are needed to see how far AI technology can be implemented in the field of life insurance.
4. Fishbone analysis
   Is a visual tool used to systematically identify and analyze the root causes of a problem in life insurance company
5. Solution concept diagram
   Is a high-level visualization used to outline the intended solution for an architecture engagement. It serves as an initial sketch that provides orientation for stakeholders involved in the change initiative.

Business Architecture

a. Business process analysis
b. Current
c. Future
d. Gap
e. Assess current technology capabilities

Assessing current technology capabilities involves evaluating an organizations technology infrastructure, applications, people, and processes to identify strengths, weaknesses, and gaps. This comprehensive assessment provides a clear picture of the current state of technology and helps in planning for future improvements

1. Use case diagram

   Is a visual representation used in the Unified Modelling Language (UML) to illustrate how users (actors) interact with a system to achieve specific goals. It helps in understanding the functional requirements of a system by showing the various use cases and the relationships between actors and these use cases. This diagram helps stakeholders understand the interactions and functionalities of the system at a high level.

2. Technology Architecture
   a. Design AI capabilities
      Designing AI capabilities involves creating systems that can perform tasks typically requiring human intelligence. These capabilities can be applied across various domains, including design, product development, and business processes.
   b. Process diagram
      Is a visual representation that outlines the steps involved in completing a task or process. It helps to identify, analyse, and improve workflows by providing a clear and concise overview of the process. This diagram helps visualize the entire process, making it easier to identify areas for improvement.
   c. Gap analysis
      To compare current technology with future technology using AI.

3. Opportunities and Solutions
   a. Benefit diagram
      Used to illustrate the advantages or benefits associated with an AI implementation, initiative, or decision. It helps stakeholders understand the value and impact of the proposed changes or investments
   b. Project context diagram
      Is a high-level visual representation that outlines the scope and boundaries of a project, showing how it interacts with external entities such as stakeholders, systems, and processes. It provides a clear overview of the project' s environment and helps in understanding the relationships and dependencies between the project and its external factors.

Expert Validation

Validation from experts is needed to prove that the research in this thesis can be used in the life insurance industry.

1. Expert Criteria
   Life Insurance Experts

Roles and Responsibilities

2. Senior-level professionals in life insurance, such as:
3. Underwriting managers or senior underwriters.
4. Claims managers or claims process specialists.
5. Policy administration experts.
6. Financial controllers or actuaries.
7. Reinsurance managers or treaty analysts.
8. Professionals involved in AI or technology implementation in their organizations.

Industry Experience

1. At least 5– 10 years of experience in the life insurance sector.
2. Experience with technology-driven transformation initiatives in life insurance, such as digital claims processing, predictive underwriting, or automated policy management.

Knowledge Areas:

1. Deep understanding of life insurance workflows, including underwriting, claims, reinsurance, and policy renewals.
2. Familiarity with industry regulations, compliance standards, and customer engagement strategies.

Data Analytics Experts

Roles and Responsibilities

1. Data scientists, data analysts, or data engineers working in the insurance domain.
2. Professionals involved in developing or implementing AI solutions for insurance operations.
3. Academics or researchers specializing in data analytics, artificial intelligence, or machine learning applications in insurance.

Industry Experience

1. At least 5 years of experience in applying data analytics to real-world problems, preferably in financial services or insurance.
2. Experience in building or managing predictive models, automation systems, or big data solutions for operational optimization (Che, 2024).

Knowledge Areas

1. Expertise in machine learning, predictive analytics, and data modelling.
2. Familiarity with tools and platforms like Python, TensorFlow, Power BI, and cloud-based analytics solutions (e.g., AWS, Azure).
3. Understanding of insurance-specific datasets, such as claims history, policyholder demographics, and actuarial models.

RESULTS AND DISCUSSION

Proposal in Life Insurance is a document, which outlines in detail the terms and conditions of the proposed insurance policy. This proposal is presented to prospective clients so that they can make an informed decision before purchasing the policy. Usually, the proposal is made by the insurance agent or also by the prospective customer himself in the proposal application provided by life insurance.

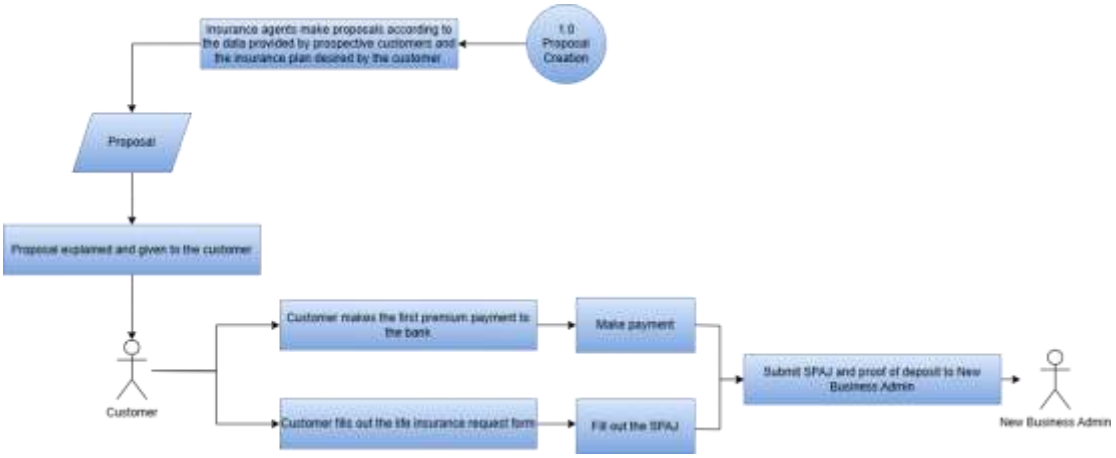

Figure 2. Life Insurance Proposal Process

Source: Author's elaboration (2026)

Underwriting and Risk Selection Process

Underwriting is the process of identifying and selecting risks from prospective insureds who wish to insure themselves with a company. A thorough understanding of the underwriting process is crucial for accurately and precisely identifying risks. The primary responsibility of an underwriter in risk selection is to ensure that no risks are taken on that could pose significant problems or financial burdens for the company in the future. Consequently, the risk selection process conducted by the underwriter directly correlates with the company's objective of maximizing profits.

Renewal Process

Renewal is the process of extending existing insurance policy beyond its expiration date, allowing to maintain uninterrupted protection against potential risks and financial losses. In the renewal process, the customer will pay a premium amount that has been set at the beginning when buying insurance. The amount of premium to be paid will change every year, depending on the age of the insured. Insurance renewal is a crucial concept that every policyholder should be familiar with, as it plays a significant role in ensuring continuous insurance coverage.

Policy Changes

Policy changes is a process to change a customer's policy section. It could be changing the way premiums are paid or adding/dropping insurance riders etc.

AI has the potential to revolutionize the policy change process by automating routine tasks, providing predictive insights, and empowering customers with clear, data-driven decision support. The processes identified in Table 4.4 impact evaluation, scenario analysis, workflow automation, and predictive modelling are not only feasible but also align with business goals of improving efficiency, customer satisfaction, and revenue growth.

Claim Process

Claim process is the process of applying for the benefits requested by the customer. It can be a living benefit or a death benefit. Living benefits, for example, when an accident occurs to a customer, then he has the right to submit a claim to the insurance company (Alnuaimi et al., 2022). Or maybe when the customer is sick, he also has the right to submit a claim according to the coverage he has. The death benefit is certain, namely when an insured dies, then he has the right to file a claim.

In submitting a claim, a customer is required to attach several documents required by the insurance company. And there are times when a claim is accepted or rejected by the insurance company depending on the assessment by the claim officer.

The claim process is an important process in the insurance company, the company's profit depends on how much claim is paid. There are many cases of claiming by customers. Then insurance companies must be observant and selective in processing claims submitted by customers.

AI has the potential to revolutionize the agent commission process by automating complex calculations, predicting performance trends, preventing fraud, and optimizing incentive structures (Kaushik et al., 2024). The processes identified in Table 4.6 align with organizational goals of improving efficiency, reducing errors, and enhancing agent satisfaction. Proper implementation of AI solutions will provide measurable benefits in both operational efficiency and strategic alignment with business goals.

Functionality: AI flags unusual patterns in commission payouts that could indicate fraud or errors, ensuring compliance and financial integrity.

Financial Report Process

Financial statements are made specifically for the purpose of providing guidance and supervision of insurance business (OJK, 2012). Thus, the form, content, and structure of financial statements are prepared in accordance with prevailing regulations in insurance business (OJK, 2012). In Indonesia stipulated in the Ministerial Regulation of Minister of Finance No. 53 of 2012 and its implementing regulations (OJK, 2012). The main financial statements for insurance companies are the same as most other companies:

1. Balance sheet
2. Income statement
3. Cash flow statement.

Premium Reserve Process

Premium reserve is accounting process allocating the premium paid for an insurance policy over the life of the policy (IRMI, 2024). The concept of premium reserve holds immense importance in the realm of financial management, as it plays a crucial role in ensuring the financial stability and resilience of organizations. Premium reserve, also known as surplus reserve, refers to the excess funds that an insurance company or a financial institution maintains over and above its required minimum capital or regulatory requirements. This additional buffer serves as a safeguard against potential financial risks, such as unexpected losses, market fluctuations, or unforeseen events that could threaten the organization's solvency.

One of the key aspects of premium reserve is its ability to mitigate operational risks. Operational risks, such as fraudulent activities, system failures, or human errors, can have a

significant impact on a financial institution's profitability and liquidity. By maintaining a robust premium reserve, organizations can allocate funds to cover these operational risks, ensuring the continuity of their operations and protecting the interests of their stakeholders.nal and external stakeholders of an insurance company.

AI has the potential to revolutionize the premium reserve process by enhancing accuracy and efficiency. Processes such as predictive reserve calculation, automated allocation and forecasting are not only feasible but also align with organizational goals of financial stability and operational efficiency. Proper implementation of these AI-driven processes can deliver significant value to insurance companies, enabling them to remain competitive and compliant in a dynamic industry.

Reinsurance Process

Reinsurance process is the process of transferring part of the risk from the insurance company. A contract is entered into between a reinsurance company and an insurance company. In this contract, the insurance company - the cedent - transfers risk to the reinsurance company, and the reinsurance company assumes all or part of one or more insurance policies issued by the cedent. The amount of risk transferred varies, depending on the agreement between the insurance and reinsurance company. It could be 70-30, or 60-40.

Suppose there is a claim from a customer amounting to 10 million rupiah, and the reinsurance contract is set at a 70-30 split. In this case, 7 million rupiah of the claim payment is covered by the insurance company, while the remaining 3 million rupiah is paid by the reinsurer.

Results Against Research Objectives

1. Evaluation of Existing Processes

   Research Objective: Evaluate the current challenges and inefficiencies in life insurance processes.

   Chapter 4 identifies manual processes such as underwriting, claims processing, and renewals as key pain points, which are prone to errors, delays, and high operational costs.

   For example, the proposal creation processes highlighted inefficiencies in personalization and turnaround times. AI models like customer segmentation and behavioral analysis directly address these inefficiencies by improving proposal accuracy and customer satisfaction.

   Claims processing results demonstrated how current methods struggle with fraud detection and require substantial manual verification, leading to financial losses. AI-driven fraud detection models using supervised machine learning reduce this burden by identifying fraudulent claims in real-time.

2. Integration of AI in Workflows

   Research Objective: Assess the integration of AI technologies into life insurance workflows.

   Chapter 4 demonstrates the successful integration of AI across various processes:

   Underwriting and risk assessment: Risk scoring models improve decision-making accuracy while reducing processing time.

   Renewals: Predictive churn models proactively engage at-risk customers, increasing retention rates and reducing policy lapse rates.

Policy changes: AI-driven impact analysis ensures that adjustments to premiums and benefits are transparent and accurate, enhancing customer satisfaction.

The case studies and AI-driven processes proposed in Chapter 4 show that integration is not only feasible but yields tangible benefits in terms of efficiency and accuracy.

Challenges Addressed:

Chapter 4 also highlights challenges, such as data quality issues and the need for seamless integration with legacy systems, emphasizing the importance of strategic planning for AI implementation.

Conclusion: The results provide strong evidence that AI can be effectively integrated into insurance workflows, aligning with the objective to assess AI integration and its operational impact.

3. TOGAF Principles for AI Implementation

Research Objective: Explore the applicability of TOGAF principles in designing and implementing AI solutions.

Chapter 4 illustrates the application of TOGAF principles in AI architecture development:

Business Architecture: AI enhances business processes, such as claims processing and agent commission, by aligning technology solutions with organizational objectives like efficiency and transparency.

Technology Architecture: AI systems for fraud detection, predictive analytics, and real-time financial reporting showcase modularity and scalability, core principles of TOGAF's technology architecture.

Opportunities and Solutions: The benefit diagrams and process gap analyses presented in Chapter 4 highlight how AI implementations align with TOGAF's focus on identifying actionable improvements.

The research framework in Chapter 4 reflects TOGAF’ s phased approach, ensuring that AI architecture is adaptable, scalable, and aligned with business goals.

Conclusion: The results demonstrate that TOGAF principles provide a robust framework for integrating AI into insurance operations, supporting the objective of aligning AI implementation with organizational goals and enterprise architecture.

Engaging stakeholders from multiple departments, such as IT, actuarial teams, underwriting, and risk management, ensured that the proposal addressed cross-functional needs. This collaborative approach not only helped in gathering diverse perspectives but also in aligning the AI solution with business priorities.

Acquiring medical records can be challenging due to privacy concerns. It is essential to explore alternative methods to access this data while respecting privacy regulations.

Despite its potential, AI implementation in underwriting is not without challenges. Data quality issues, legacy system integration, and resistance to change within the organization can hinder progress. Additionally, balancing automation with human judgment is crucial for handling complex cases that require contextual understanding and empathy.

External fraud databases will also be difficult to obtain, requiring support from regulators to gain access to these fraud databases.

Implementing AI in the renewal process presents challenges such as data integration issues, legacy system compatibility, and ensuring customer trust in AI-driven decisions. Regulatory compliance and data privacy also require careful management to avoid legal risks.

Policy changes often involve sensitive customer data and complex regulatory requirements. AI models must be designed to adhere to these regulations while maintaining transparency in decision-making. Explainable AI (XAI) is essential in this context to ensure that automated decisions are understandable and justifiable.

Customers may prefer human interaction for significant policy modifications due to the financial implications and personal nature of these changes. Insurers must balance AI-driven automation with human oversight to maintain customer trust and ensure ethical decision-making.

Despite the significant potential benefits, implementing AI in the claims process comes with challenges. Data quality and integration with legacy systems are critical hurdles. Additionally, ensuring that AI decisions are transparent and explainable is vital for maintaining customer trust and meeting regulatory requirements. Human oversight is still necessary for complex claims that require contextual understanding.

External fraud databases will also be difficult to obtain, requiring support from regulators to access these fraud databases.

There are challenges related to data quality, integration with existing commission management systems, and ensuring fairness in automated decisions. While AI can significantly improve the financial reporting process, its implementation poses challenges, such as data quality issues, integration with legacy financial systems, and the need for skilled personnel to manage and interpret AI-generated insights. Human oversight remains critical for validating AI-driven forecasts and ensuring that financial decisions align with business objectives.

Implementing AI-driven premium reserve models poses challenges, including data quality issues, integration complexities with legacy actuarial systems, and the need for skilled professionals to interpret AI-generated insights. Ensuring transparency and explainability in AI-driven reserve calculations is also critical for regulatory approval.

Integrating AI-driven reinsurance processes comes with challenges. These include the need for high-quality, standardized data across multiple entities, regulatory compliance issues, and ensuring transparency in AI decision-making. Additionally, legacy reinsurance systems may require extensive modifications to accommodate AI-driven automation.

CONCLUSION

AI technologies, including machine learning, predictive analytics, and automation, offer significant opportunities to streamline insurance workflows. Key processes such as proposal creation, underwriting and risk assessment, policy renewals, claims processing, agent commissions, financial reporting, premium reserves, and reinsurance can all be enhanced with AI, resulting in tangible benefits like reduced processing times, improved accuracy, and better resource allocation. However, implementing policy changes in insurance presents several challenges for AI. These include the wide range of changes involved, such as premium adjustments, coverage modifications, and the addition or removal of riders, which can be difficult for AI to process without human oversight. Additionally, policy modifications often require an understanding of customer-specific contexts, regulatory nuances, and real-time

scenarios, which AI may struggle to fully comprehend. Incorrect processing of policy changes can also result in financial losses or customer dissatisfaction, potentially harming trust and reputation.

Current insurance processes face several inefficiencies and challenges. Many workflows still rely on manual tasks, such as underwriting and claims assessment, leading to errors, delays, and high operational costs. Traditional fraud detection methods are often time-consuming and limited in scope, making them less effective in identifying sophisticated fraud schemes. Furthermore, integrating AI into existing processes is hindered by poor data quality, fragmented datasets, and legacy systems. Additionally, policy renewals suffer from a lack of proactive engagement, contributing to higher lapse rates.

AI, however, offers substantial improvements in accuracy and fraud detection. In underwriting, risk assessment models leverage historical data, customer demographics, and claims history to provide accurate risk classifications. Predictive analytics also enhances the accuracy of financial reporting, including reserve calculations. AI-powered fraud detection models in claims processing use supervised machine learning algorithms to identify anomalies, reducing false positives and preventing financial losses. Similarly, anomaly detection models help flag suspicious agent commission payouts, ensuring compliance and financial integrity.

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