# Automated Claims Adjudication and Resolution Pathway Intelligence: Machine Learning Frameworks for Insurance Settlement Process Optimisation

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## 1. Introduction

Today, insurance is a rapidly developing area that is constantly adapting to technological innovations and the changing requirements of end users. Relevant changes are also associated with significant development in the field of AI. This is why the subject of this publication is a presentation of the possibilities of applying AI solutions to the optimization of operations connected with the insurance process. The insurance sector deals with a significant number of customers. That is why it is so important to improve the process of handling client requests. The tendency to improve focuses on the possibility of a quick and objective decision, especially in the event of a claim. A long period of work monthly is a result of many cases requiring a lot of time to clarify. It is also a response to the constantly growing insurance market, where the number of clients needing help in settling their claims is growing day by day. The continuous growth of the insurance market means that it is necessary to hire employees who can effectively calculate, among others, benefits.

The exchange of existing costly human resources with AI solutions is necessary to ensure high quality of services despite the constantly increasing customer demand. Artificial intelligence is a combination of two sciences: computer and information technology, and cognitive studies. This term is defined as an interdisciplinary research area into one narrow field: simulating human abilities to think logically and solve problems on the computer. The paper concerns the issue of using artificial intelligence solutions to optimize insurance operations: claims handling. The aim of this paper is to evaluate the chosen methods of complaint adjustment used by insurance representatives.

### 1.1. Background and Significance

Insurance has historically been based on demographic averages; that is, premiums for different levels of insurance are based on statically assigned risk classes. However, it is not only the data of the respective policyholder that enable the insurance company to determine an exact risk class, but also the data of the insurance network. AI makes possible an accurate assessment of these risks. Technological advancements in the insurance industry make possible a more precise calculation of risk assessments. Above all, the innovation pressure of start-ups in the sector often escapes the traditional sales channel and the established infrastructure of the insurance industry. This forces the insurance industry to innovate technologically, above all in order to adapt to the digital changes in society and customer behavior. Claims processing has a long tradition within the insurance industry and has undergone radical changes in recent years. Originally, the primary goal of claims processing consisted of the digital implementation of internal processing processes. Up to the present, however, processing claims has been gaining significant importance due to increasing complexity and the requirement for digital support from policies. Complex claims are defined as claims where a case takes longer to be processed and is associated with significantly higher costs. Today, the application possibilities of AI are vast and include fraud detection and assessment of the damage as part of the internal claims process, as well as the clarification of the causal network or data analysis in the context of wholesale insurance. In this way, the use of AI in the claims process can significantly increase both the efficiency and accuracy of processing claims in the insurance process, lower the cost of claims processing, increase the accuracy and amount of potential claims detected, and thus also enhance the customer experience.

### 1.2. Research Objectives

The overall research objective is to assess the opportunities for incorporating AI in insurance claims settlement, assessing from a customer and insurance stakeholder perspective the role, the perceived value, and the outcome of AI. Accordingly, the purpose of this study is threefold: First, we aim to identify the main requirements and the obstacles of a more user-centered claim settlement process driven by AI. Second, we seek to identify the most valuable potential applications involved in an AI-featured claim settlement process, from the customer's and the insurance stakeholder's point of view. Third, we aim to develop an AI-driven model to improve the accuracy and

increase the efficiency in the injury estimation and the claim allocation. The research along the identification of the main goals and the qualitative approaches to analyze the different stakeholders' strategies should be complemented with the quantification of these potential economic value results, taking into account that empirical case studies are currently missing, revealing if these AI systems are able to replace the different experts' tasks in the claim management process.

The overall claim process is still applicable, but the potential to increase accuracy and efficiency would help the industry increase the level of automation from 40% today to 100% in the next decade. The final users of these innovative technologies will only accept them if they have benefits in the insurance value proposition for all the stakeholders involved in the process. The purpose of this chapter is to explore the potential role of AI in the modern system of claim settlements, confining the scope of the analysis to insurance contracts concluded for the coverage of people injured in vehicle accidents. In line with this objective, by resorting to a set of qualitative approaches, we identify the Quadruple Aims of AI in MV CTS from the perspective of the MA.

**2. AI in Insurance Industry**

As robo-advisors enter the markets for the provision of safe and efficient insurance solutions, artificial intelligence is also being incorporated to surface insights into complex risks. For the insurance sector, several challenges are posed, which, if resolved, could result in the sector’s transformation. Insurance is a sector where copious amounts of data are available to insurers, who are now capitalizing on several AI and robotic process automation technologies to improve their performance. The adoption of technology is being considered to leverage data-driven decisions and establish a more incisive estimate of the various risks. Moreover, various AI technologies have also been applied in decision-making contexts for internal and external prevalent issues. Similarly, chatbots and algorithms are being incorporated in other industries, including financial institutions, to improve the claims process by assisting the parties in understanding the terms and conditions of their policies, identifying fraudulent activities, and making the claims process more efficient.

Global market intelligence forecasts that AI spending would reach over 6.8 billion in revenue, predicting a significant CAGR through to 2022 in the area. It is predicted that AI will become a mainstream customer experience investment in marketing and

servicing by 2023, and further predictions indicate that by 2026, a large percentage of all insurance policy sales will occur online directly or through an agent using automated insurance quote platforms. However, a significant percentage of insurers remain neutral in embedding AI and ML models into the development of their products and services. It is crucial that insurance service providers keep up with market changes to avoid falling behind. These statistics denote that technology is becoming a more integral part of the financial services and insurance providers' makeup, even more so than the initial forays into design thinking, customer journey mapping, agile, and DevOps. The adoption of the same by the industry only serves to reiterate the need to understand the implications of their embeddedness. The biggest challenges companies are facing right now are having too much data on their customers and not being able to analyze, make sense of, or act on this data in the most efficient way to benefit their work provided.

### 2.1. Current Trends and Challenges

In the insurance domain, the adoption of AI is growing rapidly. More insurance processes are thought to be fundamentally changed by AI than by other technological developments. New data analytics techniques, based on improved machine learning, enable the industry, especially in connected settings, to progress in the formula for settling claims, which has moved only slightly in the last few decades. The most cited examples of disruptive potential are predictive analytics and customer service automation. AI models are implemented in different functions, adding value across the insurance value chain.

Regardless of these exciting opportunities, insurance companies are confronted with certain challenges in implementing AI. Legal restrictions in many countries cover a wide array of areas, including data use by insurers, data management, vendor management, use of external experts, internal staff training, and insurance product compliance. The first problem is that insurers are required to adhere to privacy legislation when they use AI and machine learning techniques in big data to target specific customer bases. This limits the way in which AI can be used to target and underwrite certain consumer classes. Second, legacy systems are not generally designed for efficient data integration and can overcomplicate data collection efforts. Third, integration with old systems can be hard and time-consuming in traditional security software used in previous procedural processes.

### 2.2. Benefits of AI Implementation

Recent literature presents an array of advantages stemming from the introduction of AI technologies in the claims settlement process. Operational efficiency is improved through the streamlining of claims management processes. Automating manual workflows in this way minimizes time-intensive, repetitive tasks, ultimately reducing the time spent on claims processing. Furthermore, automating FNOL and document scanning processes enhances data induction capabilities, improving outcome accuracy. This contributes to an overall decrease in processing time and an associated reduction in personnel, service, and facilities costs for claims management. Not only does automating claims management contribute to quicker case resolution, but it also increases the accuracy of data analysis. By investigating policyholders and corresponding claims with more specificity, AI can learn to identify patterns in historical data and select cases that should require further inspection.

Furthermore, insurers are more likely to identify fraudulent and inflated claims, thus leading to direct cost savings. In the bigger picture, thought leaders studied in this area expect a cascading effect on customer satisfaction, retention, and cross-selling. Such improvements are expected to occur as a result of assisting a consumer at a time of need and providing proactive services based on advice from AI. Considering the potential for such competitive advancements, it is not surprising that studies also determine the ongoing AI revolution will lead to the restructuring of existing systems and processes. Over time, as more specific data-driven decision-making models are combined with advanced deep learning, a strong customer-vendor bond will develop and yield long-term profits. This suggests that the advantages of AI are not only immediate. By continually creating new insights and competencies, AI becomes an integrated element of the firm and not merely an asset.

## 3. Insurance Claims Settlement Processes

Insurance claims processes are crucial components of an insurer's relationship with its clients. Claims management represents an opportunity to build client perceptions of an insurer's values. These co-produced perceptions affirm a continuous alignment between an insurance company's capability to innovate and to understand the connected client experience. Claims processes initiate as the first notice of loss. This is a notification made by a client to their insurer that harm has occurred which may be covered by the

insurance policy. The first notice of loss is the first required step and is the start of the claims handling process.

Therefore, it is essential for an insurer to centralize the various tasks from receipt of a claim through to its conclusion. Having additional system capability can flag red flags, indicative of possibly fraudulent or exaggerated claims. The aim of the claims management process is to settle claims quickly and reduce costs associated with the management of claims. It is for this reason that claims management information systems have been developed. Traditionally, the claims department in an organization could be viewed as a pure expense function. However, advances in technology, including hardware and software, will help an insurance company provide better service to their clients regarding their most valuable asset. In other words, advances in technology and business processes will allow a claims department to be seen as a way of adding value to an organization. Unfortunately, each of the three aforementioned stages is fraught with its own unique challenges. In one example, a percentage of claims that were ceded from an intermediary for approval challenge the decision of the experienced claims assessor. Each of these challenges, and the constituent stages, are opportunities for optimization. In any of the aforementioned scenarios, delay adversely affects a company's clients in that they expect prompt service, i.e., appropriate service at an appropriate time. Furthermore, any manual process can and generally does involve human error; if not now, then eventually. Failed settlements reflect adversely on the acceptant. Failed settlements also manifest as legal costs for any individual or corporation wishing to contest the decision. In short, claims handling is a primary factor in a client's adjudication of an insurance company. The longer it takes to settle a claim, the more it will cost. Delays in servicing clients also affect customer retention. With real-time computing having raised client expectations, clients expect quick and efficient service, and any lack thereof is quickly shared on social media. All of these are just a few of the reasons to optimize the claims handling process. Moreover, insurance companies work - or should work - towards preventing substantial delays in the satisfaction margin of clients. More importantly, client preferences are changing. With the rise of new technologies, no room exists for a status quo. The insurance industry is not immune from challenges such as the rise of new market entrants, and these challenges ultimately necessitate reinventing the client experience. These digital challenges have implications for several parts of the service value chain, and one such value chain is claims

management. A changing landscape is a clear indication that value chain components such as claims management could benefit from accelerated digitization.

### 3.1. Overview of the Process

The basic process of insurance claim settlement follows a set of stages that lead from the moment the claim becomes known to the insurance company, due to a notification from a customer or the company identifying the claim by itself, to the moment in which the company processes the claim and decides about its approval, either partially or completely. If approved, the claim will then lead to the indemnity being paid by the insurance company to the insured party. This overall process follows the stages detailed next for a better understanding. The insurance company receives a notification containing the necessary data to assess the circumstances of the claim and to check for its veracity in light of the valid insurance policy. Once the claim is made and its registration is completed, the insurance company must then take care of a set of additional operations including claim assessment and claim approval or denial. The customer is often called upon to provide additional data, also through possible fraud investigations carried out on both the party claiming indemnity and the third parties involved, where applicable. Eventually, the claim settlement, including the possible negotiations with the involved parties, leads to the final approval or denial of the claim, reflecting the value of the claims to be eventually denied and thus kept as unpaid. Insurance is a business in which several manual tasks still affect the claim settlement process or where the final decision might be delayed due to concurrent processes within the insurance company. A deep insight into the overall process of claim handling allows us to better understand which practices of the insurance company can seriously affect the process in terms of time and could be optimized by implementing technologies.

### 3.2. Key Stakeholders

2. Background 3. Key Stakeholders Key stakeholders within the insurance claims settlement process include: • Policyholders: These are the purchasers of the insurance policies. In non-liability claims, which are not dependent on someone else's actions to be paid, the policyholder is the claimant. In liability claims, the claimant would be the wronged party, a non-contractual individual who had damages caused by the insured of another company. • Insurance adjusters: These are insurance professionals who investigate the claims for an insurance carrier. In larger organizations, employees in

these positions are sometimes called 'claims handlers.' Adjusters can be internal or external. • Loss adjusters/independent adjusters: These are firms or individuals who are hired by the insurance carrier to handle a particular claim. In many instances, the losses caused by weather-related or natural disasters or riots will be handled by adjusters. • Investigative teams: These are usually internal or external special investigative units who investigate the validity of a claim, i.e., they may dig out absenteeism reports from the employer to check whether an employee was capable of work and whether 'their back was really broken.' Incorrect payments made to scammers are often due to inadequate investigation. What is clear from this is the complexity of the settlement process, with claims handlers frequently having to juggle and disseminate large, diverse amounts of data from various stakeholders. These stakeholders could include internal sales agents, independent brokers, loss adjusters, and, in some cases, external assistance providers. In addition, multiple and complex interconnections exist between the various stakeholders. Cognizance of the above, some of the concerns raised by various stakeholders include the ability to shape the business practices of adjusters or the manner of the responses to questions asked; agents and claimants have been known to attempt to change adjuster, especially if obtainable on the scene; and the fact that claimants often contact the adjuster before agents or the company themselves. Furthermore, poor communication between the policyholder, their insurance company, the adjusters, and the third-party providers is an issue, leading to a poor and unsatisfactory claims experience. For example, while a claims handler may be requesting documents or photographs from the policyholder, proof of ownership or the total loss valuation from the loss adjuster may have already been requested, thus causing a duplication of effort. As only through collaborative working will an accurate total loss valuation be marketable, this poor communication also often leads to delays in settling claims.

**4. Machine Learning Models for Claims Settlements**

There are several machine learning techniques that could potentially be used in designing optimization models for the insurance sector. One of the possibilities is machine learning models that are specifically designed to make optimized and balanced decisions related to the claims settlements in insurance for each individual claim. Different algorithms can be used to develop a predictive model for the outcomes in claims cases based on the data of previous claims settlements. Machine learning models

are capable of analyzing large amounts of data, which allows for more accurate claim assessments. Furthermore, different algorithms can be used to create an unsupervised model on the basis of previous claims settlements, which could be used to detect a specific type of fraud claim or suspicious transactions that have a high probability of being fraudulent. Several procedures take place over the course of the claims settlement cycle. Two of the most important steps are feature selection, where the relevant features that impact the goal prediction are chosen, and model development, where the predictive model is developed using the specific learning algorithm. The development of models using machine learning algorithms should involve a model update after a period of learning and observation, assuming that the model accuracy declines steadily over a period of time. Claims settlement is one of the most important processes in the insurance sector, as it allows the insurer to manage the risk associated with potential losses as part of their contracts with their clients. This process is already transforming into a more data- and information-driven procedure, where the information about the customers, as well as the data regarding the events and claims, have become essential in order to effectively assess and manage the risk in order to determine the insurance premium and potentially develop some custom products or services to reduce and perhaps avoid the losses.

### 4.1. Types of Machine Learning Algorithms

There are two different types of machine learning algorithms: supervised learning and unsupervised learning. Supervised learning involves learning a function that maps an input to an output based on input-output pairs. A historical example of how a supervised learning algorithm can be used includes using a decision tree to determine the amount for which an insurance claim will be paid. By doing this, the output is the claim amount, and the input could be the class of the driver, whether the driver was injured in the accident, the cost of the car repair, etc. Unsupervised learning involves learning the structure of the input data. Types of Algorithms. Choosing a machine learning algorithm that can accommodate a segmented dataset based on the type of loss could be beneficial because various algorithms have different strengths and weaknesses. Commonly used decision tree algorithms recategorize the dependent variable to minimize mean squared error. Artificial Neural Network algorithms can stretch over datasets that involve independent or dependent variables that are not precise or are not easily categorizable. For instance, they can predict the immediate outcome and the long-

term outcome, but they can only access one set of a patient's records. After categorizing the claim process, the type of dataset and the dependent variable can be considered when deciding the type of machine learning algorithms to use. The following information can help guide the choice of machine learning algorithm. Furthermore, deep learning, a subfield of machine learning, is becoming an increasingly popular technique for supervised learning algorithms because of its ability to approximate functions with high degrees of dimensionality.

### 4.2. Data Collection and Preprocessing

Data collection and preprocessing are key stages in many machine learning application domains. Insurance in general, and especially the AI-based optimization of claims processes, are no exceptions. High data quality is essential in order to generate reliable, stable, and explainable outcomes using statistical analyses. Various ways regarding how such training data could be collected have been presented. Possible sources of operational and claims data that could be used for our scenario include corporate databases with historical claims records, call center notes of relevant customer interactions, and company-augmenting commercial external databases with additional input features such as claims duration or amount. As non-structured data travels across multiple organizational interfaces, it would require a considerable amount of preprocessing. Modern ETL and data mining tools are required to clean the data and perform normalization and transformation of the attributes of interest, such as incident date, operation location, and the customers involved in the case of customer harm. Variable creation, selection, and reduction, as well as the exploration of internal and external predictive techniques, are also time-critical steps to which the data set has to be prepared accordingly. At the same time, each of the mentioned steps may potentially have a great effect on the performance of the overall AI solution, and the utilization of relevant yet representative data is, therefore, the key to the success of the algorithm.

## 5. Case Studies and Applications

Some insurance companies have directly realized the efficiency and effectiveness improvements promised by optimization using big data and AI. Since optimization is now standard for most uses in insurance systems that incorporate AI, many insurance companies appreciate the tangible results it provides. Online or 'direct' insurers have led the way in integrating AI solutions into their processes. This means that many insurers

are now considering their strategic approach to AI so that they remain competitive. Some may opt to undertake a large multi-year project to completely replace their legacy systems, while others may integrate an external AI solution that complements their existing setup.

In the field of claims, two insurance companies are using AI to great effect to improve claims outcomes. Both companies depreciate the value of a claim before pursuing subrogation in real time. One company is based in the UK and they use their AI capabilities to fully automate the resolution of fast-track, automotive straight-through claims, such as dents and scratches. The solution uses both structured and unstructured data, such as images, to predict the cost of repair and identify appropriate parts to be replaced, if required. Experimental results suggest significant operational success with the deployment of the unstructured data-driven part identification tool. Logs of activity generated by the system show that both cost of repair estimation and part swapping have largely been validated by body shops, with a claimant-shop negotiation rate of 94% and 88% success respectively. The savings on third-party claims are already understood to be many millions of pounds per annum.

Another company has invested in a number of new technologies to improve efficiency across their group. Key among these has been the development of an AI tool that helps claims handlers to automatically assess complexity, recovery probability, financial impact, and track court case progress. As well as reducing manual effort in claims assessment by 80%, it claims that their handlers are now managing 32% more recovery cases, have improved recovery accuracy by 25%, have 40% more indemnity-only cases with decreased closure time, and have recorded improved customer satisfaction. The complexity of the claims is calculated by the system, based on a very wide set of pattern features. This includes an analysis of responses from the claimants and witnesses, and these quantified responses are weighted against supportive or opposing evidence.

### 5.1. Real-World Examples of AI in Claims Settlements

This subsection examines real-world illustrations of the potential for AI to revolutionize claims settlements. Each insurer profiled has deployed an AI-based solution and, in some cases, has either successfully completed a proof of concept or won accolades for their system's success. This inclusion aims to provide industry stakeholders and firms valuable insights into how AI can be deployed, as well as the positive outcomes it has to

offer. Linking the theoretical with the practical in this way aims to overcome the skepticism and apprehension about AI that have contributed to its slow broad adoption in the Industry 4.0 landscape. Profiled use cases illustrate different facets of the claims settlement process and rely mainly on structured data. This is not surprising as insurers can be expected to leverage their operational data to prove AI efficiency, and they usually use structured data. This, however, is likely to change in the future as more and more unstructured data created by customers, insurers, loss adjusters, police, and third-party data aggregators is formed, stored, and, most significantly, linked, and as AI solutions based on this data are rolled out, tested, and improved. Each AI claim settlement system is described along with details of its application technique, including what type of AI is being used. This is complemented by text describing the impact of the solution. These real-world profiles showcase the types of AI systems that can be deployed in the insurance sector, their value, and the industry's early movers for deploying them, increasing stakeholder confidence in the abilities of both AI solutions and those who have developed them.

**6. Future Direction**

While current systems are already based on AI technology, future enlargements will engage with an even broader range of AI approaches complementing the developing solutions of other industries. Among others, stated techniques are generative adversarial networks, enabling the simulation of different fraud scenarios. Since the entire insurance industry is undergoing a disruptive convergence of trends such as an increasing focus on customer centricity and an overwhelming shift towards digitization and advanced data usage, we identify emerging high-impact areas which could merge with issues not covered in the industry survey. Emerging trends consist of dynamic risk assessment, hyper-personalized products, higher levels of customer engagement, intelligent automation, ecosystems, and distributed ledgers. Though these trends might have the potential to create other, new types of claims, the basic problems surrounding claims settlement processes, such as inconsistency in knowledge and a significant loss-increasing fraud exposure, will remain the same. As such, we expect the AI-based optimization of insurance claims settlement processes to remain a cornerstone solution helping insurance to differentiate in these areas.

A rule of thumb to decide whether to apply the general optimization should be: is there a possibility to differentiate the portfolio by applying such technology, and would this amount to any significant financial gain or loss? While it has proven to be valuable in a number of projects and industry sectors when labor-intensively automating processes, it will not differentiate the public transport operator in which one-fifth of the public car park should be used for shared cars, regardless of the answer to that question. Which new features AI will have in some years cannot be predicted with certainty, of course. Visions in insurance express that, by 2025, a chatbot will serve as the gateway to obtaining personalized advice from the insurer's data lake during periods of time when life is uncluttered by events or needs worthy of cover, supporting customers in lowering any future loss rather than dealing with claims just ex post. Regulatory bodies will also push their AI evolution guidelines: we must, therefore, expect that ethics and transparency, in a data-driven environment, will form the foundation of successful adaptations of these developments. As data is becoming a major pillar of AI models too, to maintain the lead on exploiting new developments in insurance, AI in the next decades will have to evolve in response. These timescales are in line with the industry fueling survey which found that pattern recognition and data science will be of increasing strategic importance well into the next decade.

**7. Conclusion**

Businesses are recognizing the potential of artificial intelligence to augment their operations and align with the skyrocketing customer expectations. Insurers are no exception to this. It is in the best interest of insurers to employ predictive modeling using AI technologies. Through employing AI and predictive modeling, insurers can enhance their capability of claims assessment—the foundational function of an insurer. Historically, insurance claims assessment relies on a series of human-performed actions. However, recent advancements in AI allow for this process to become automated, and claimants accurately identified, within a fraction of the time otherwise required. Processing times for claims would also significantly reduce. Automatic fraud detection, along with a high level of coverage, would ensure the best interest of the insurer is being managed. A thorough investigation of AI and classification models is conducted to analyze their impact, focusing on fraud detection and claims assessment.

In summary, the introduction of AI, through predictive modeling, into the claims settlement process has the potential to create significant operational efficiencies, with accuracy rates far exceeding that of a solely human-performed process. Such operational improvements enable the insurer to be in a more competitive position, through reduced economic loss. Nevertheless, challenges still remain, with ongoing research the key in aligning the service offered to a changing business landscape. Insurers must work to proactively adopt AI, ensuring their solutions present value against future expectations —a rapidly moving target as technology continues to evolve. Ultimately, only through the introduction of AI can the concept of assurance offered by an insurer remain relevant to modern society. A robust foundation has been established with this research. From this, future research can be developed to extend the real-world suitability of the classification models developed. Moreover, insight into the potential of AI integration can be examined at all levels of the insurance value chain. The identification is a step toward structuring the AI ecosystem within the insurance industry.