ΕΘΝΙΚΟ ΜΕΤΣΟΒΙΟ ΠΟΛΥΤΕΧΝΕΙΟ
ΣΧΟΛΗ ΗΛΕΚΤΡΟΛΟΓΩΝ ΜΗΧΑΝΙΚΩΝ ΚΑΙ Μ/Υ
ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ
ΣΧΟΛΗ ΝΑΥΤΙΛΙΑΣ ΚΑΙ ΒΙΟΜΗΧΑΝΙΑΣ
ΤΜΗΜΑΤΟΣ ΒΙΟΜΗΧΑΝΙΚΗΣ ΔΙΟΙΚΗΣΗΣ & ΤΕΧΝΟΛΟΓΙΑΣ
ΔΙΑΠΑΝΕΠΙΣΤΗΜΙΑΚΟ ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ
«ΤΕΧΝΟ-ΟΙΚΟΝΟΜΙΚΑ ΣΥΣΤΗΜΑΤΑ»

ΔΙΕΠΙΣΤΗΜΟΝΙΚΟ – ΔΙΑΠΑΝΕΠΙΣΤΗΜΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ
«ΤΕΧΝΟ-ΟΙΚΟΝΟΜΙΚΑ ΣΥΣΤΗΜΑΤΑ»

The Reshaping of the Greek Insurance Sector Through Artificial Intelligence Technologies

Η Αναδιαμόρφωση του Ελληνικού Ασφαλιστικού Κλάδου Μέσω Τεχνολογιών Τεχνητής Νοημοσύνης

ΜΕΤΑΠΤΥΧΙΑΚΗ ΔΙΠΛΩΜΑΤΙΚΗ ΕΡΓΑΣΙΑ

Βασιλική, Δ., Κελαϊδή

Επιβλέπων: Νικόλαος Δουλάμης
Καθηγητής Ε.Μ.Π.

Αθήνα, Φεβρουάριος 2025

ΕΘΝΙΚΟ ΜΕΤΣΟΒΙΟ ΠΟΛΥΤΕΧΝΕΙΟ
ΣΧΟΛΗ ΗΛΕΚΤΡΟΛΟΓΩΝ ΜΗΧΑΝΙΚΩΝ ΚΑΙ Μ/Υ
ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ
ΣΧΟΛΗ ΝΑΥΤΙΛΙΑΣ ΚΑΙ ΒΙΟΜΗΧΑΝΙΑΣ
ΤΜΗΜΑΤΟΣ ΒΙΟΜΗΧΑΝΙΚΗΣ ΔΙΟΙΚΗΣΗΣ & ΤΕΧΝΟΛΟΓΙΑΣ
ΔΙΑΠΑΝΕΠΙΣΤΗΜΙΑΚΟ ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ
«ΤΕΧΝΟ-ΟΙΚΟΝΟΜΙΚΑ ΣΥΣΤΗΜΑΤΑ»

ΔΙΕΠΙΣΤΗΜΟΝΙΚΟ – ΔΙΑΠΑΝΕΠΙΣΤΗΜΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ
«ΤΕΧΝΟ-ΟΙΚΟΝΟΜΙΚΑ ΣΥΣΤΗΜΑΤΑ»

The Reshaping of the Greek Insurance Sector Through Artificial Intelligence Technologies

ΜΕΤΑΠΤΥΧΙΑΚΗ ΔΙΠΛΩΜΑΤΙΚΗ ΕΡΓΑΣΙΑ

Βασιλική, Δ., Κελαϊδή

Επιβλέπων: Νικόλαος Δουλάμης
Καθηγητής Ε.Μ.Π.

Εγκρίθηκε από την τριμελή εξεταστική επιτροπή την 20η Φεβρουαρίου 2025

Νικόλαος Δουλάμης	Αναστάσιος Δουλάμης	Θεοδώρα Βαρβαρίγου
Καθηγητής Ε.Μ.Π.	Καθηγητής Ε.Μ.Π.	Καθηγήτρια Ε.Μ.Π.

Αθήνα, Φεβρουάριος 2025

.....

Βασιλική Κελαϊδή

Διπλωματούχος Μεταπτυχιακού Προγράμματος Τεχνο-Οικονομικά Συστήματα της

Σχολής Ηλεκτρολόγων Μηχανικών και Μηχανικών Υπολογιστών Ε.Μ.Π.

Copyright © Βασιλική, Κελαϊδή, 2025

Με επιφύλαξη παντός δικαιώματος. All rights reserved.

Απαγορεύεται η αντιγραφή, αποθήκευση και διανομή της παρούσας εργασίας, εξ ολοκλήρου ή τμήματος αυτής, για εμπορικό σκοπό. Επιτρέπεται η ανατύπωση, αποθήκευση και διανομή για σκοπό μη κερδοσκοπικό, εκπαιδευτικής ή ερευνητικής φύσης, υπό την προϋπόθεση να αναφέρεται η πηγή προέλευσης και να διατηρείται το παρόν μήνυμα. Ερωτήματα που αφορούν τη χρήση της εργασίας για κερδοσκοπικό σκοπό πρέπει να απευθύνονται προς τον συγγραφέα.

Οι απόψεις και τα συμπεράσματα που περιέχονται σε αυτό το έγγραφο εκφράζουν τον συγγραφέα και δεν πρέπει να ερμηνευθεί ότι αντιπροσωπεύουν τις επίσημες θέσεις του Εθνικού Μετσόβιου Πολυτεχνείου.

Συνοπτική Περίληψη

Η ραγδαία ανάπτυξη της Τεχνητής Νοημοσύνης αποτελεί μια από τις πλέον καθοριστικές τεχνολογικές εξελίξεις του 21ου αιώνα, επηρεάζοντας ουσιαστικά τον τρόπο λειτουργίας πολλών τομέων της οικονομίας παγκοσμίως.

Η παρούσα διπλωματική εργασία στόχο έχει να εξετάσει πώς η εφαρμογή τεχνολογιών Τεχνητής Νοημοσύνης θα μετασχηματίσει την Ελληνική ασφαλιστική αγορά. Αρχικώς, αναλύονται οι βασικές έννοιες της Τεχνητής Νοημοσύνης και γίνεται μια ανασκόπηση της ιστορικής εξέλιξής της στον παγκόσμιο ασφαλιστικό κλάδο. Μέσω της μελέτης διεθνώς επιτυχημένων πρακτικών από κορυφαίους ασφαλιστικούς οργανισμούς στην Ευρώπη, τις ΗΠΑ και την Ασία, αναδεικνύονται στρατηγικές και πρακτικές που μπορούν να προσαρμοστούν με επιτυχία στο Ελληνικό ασφαλιστικό περιβάλλον.

Παρά τα προφανή οφέλη, αναδεικνύονται προκλήσεις όπως οι κανονιστικές απαιτήσεις, οι ανησυχίες για την ιδιωτικότητα των δεδομένων, η ανάγκη προσαρμογής του εργατικού δυναμικού και οι τεχνολογικές υποδομές. Επιπλέον, δίνεται έμφαση στην ηθική χρήση της Τεχνητής Νοημοσύνης, υπογραμμίζοντας τη σημασία της διαφάνειας, της δικαιοσύνης και της λογοδοσίας. Η ευθυγράμμιση με τις εξελισσόμενες κανονιστικές απαιτήσεις αποτελεί επίσης κρίσιμο βήμα για τη διασφάλιση της βιώσιμης υιοθέτησης της Τεχνητής Νοημοσύνης.

Συνολικά, η μελέτη παρέχει πολύτιμες κατευθύνσεις για τη μετάβαση σε ένα ψηφιακό και τεχνολογικά προηγμένο μέλλον, όπου η τεχνολογία της Τεχνητής Νοημοσύνης θα είναι κεντρικό εργαλείο για την αναβάθμιση της λειτουργίας και της ανταγωνιστικότητας του ασφαλιστικού τομέα στην Ελλάδα.

Λέξεις Κλειδιά: Τεχνητή Νοημοσύνη, Μηχανική Μάθηση, Ασφαλιστικός Κλάδος, Ηθική, Ελληνική Ασφαλιστική Αγορά, Ψηφιακός Μετασχηματισμός

Abstract

The rapid evolution of Artificial Intelligence is fundamentally reshaping industries across the globe, and the insurance sector is no exception. This master thesis examines how AI-driven innovations are transforming the Greek insurance industry, analyzing the associated challenges, emerging opportunities, and strategic pathways for effective adoption. By harnessing AI capabilities such as machine learning, natural language processing, and predictive analytics, insurers can streamline operations, enhance claims automation, refine risk assessment, and deliver tailored customer experiences.

The research begins by exploring the core principles of AI and tracing its historical integration into the global insurance landscape. It then delves into specific AI applications, including underwriting optimization, fraud detection, claims automation, and customer engagement. By incorporating case studies from international markets, the study highlights successful implementations and provides a comparative analysis of AI strategies adopted by leading insurers in Europe, the USA, and Asia, offering valuable insights applicable to the Greek market.

Despite AI's vast potential, its integration into the Greek insurance sector presents several hurdles. Regulatory complexities, concerns over data privacy, workforce adaptation, and technological infrastructure gaps are among the primary challenges. This thesis identifies these obstacles and proposes a structured framework to facilitate AI adoption while ensuring compliance with ethical standards. Additionally, it examines the broader societal implications, emphasizing the need for transparency, fairness, and accountability.

To enable a seamless AI-driven transformation, this research outlines strategic recommendations for Greek insurers. These include investing in AI-powered ecosystems, forging partnerships with technology firms, upskilling employees, and aligning with evolving regulatory policies. By adopting a proactive and innovative approach, the Greek insurance industry can unlock AI's full potential, fostering competitiveness, driving innovation, and enhancing customer satisfaction in an increasingly digitalized world.

Keywords: Artificial Intelligence, Machine Learning, Insurance Industry, Ethics, Ethical AI

Περίληψη

Η ραγδαία ανάπτυξη της Τεχνητής Νοημοσύνης έχει αναδειχθεί ως μια από τις πιο σημαντικές τεχνολογικές εξελίξεις του 21ου αιώνα, αναδιαμορφώνοντας τον τρόπο λειτουργίας διαφόρων κλάδων της οικονομίας σε παγκόσμιο επίπεδο. Ο ασφαλιστικός κλάδος, στηριζόμενος στην ανάλυση δεδομένων, στην εκτίμηση κινδύνων, καθώς και στην εξυπηρέτηση πελατών, αποτελεί έναν από τους κλάδους που επηρεάζονται περισσότερο από αυτή την τεχνολογική επανάσταση.

Η παρούσα διπλωματική εργασία διερευνά την αναδιαμόρφωση της Ελληνικής Ασφαλιστικής αγοράς μέσω της χρήσης τεχνολογιών που βασίζονται στην Τεχνητή Νοημοσύνη, εστιάζοντας στις προκλήσεις, τις ευκαιρίες που προκύπτουν, καθώς και στις στρατηγικές συστάσεις για την αποτελεσματική υιοθέτηση της τεχνολογίας αυτής, ώστε να μπορέσουν να επιβιώσουν.

Στο πρώτο μέρος της εργασίας πραγματοποιείται μια εξέταση των βασικών εννοιών της Τεχνητής Νοημοσύνης καθώς και της ιστορικής της εξέλιξης στον παγκόσμιο ασφαλιστικό κλάδο. Μέσα από την ανάλυση και την ανάδειξη επιτυχημένων περιπτώσεων χρήσης της σε διεθνές επίπεδο, η μελέτη συγκρίνει στρατηγικές Τεχνητής Νοημοσύνης από κορυφαίους ασφαλιστικούς οργανισμούς στην Ευρώπη, τις ΗΠΑ και την Ασία, παρέχοντας πολύτιμες πρακτικές που μπορούν να υιοθετηθούν και να προσαρμοστούν στην Ελληνική ασφαλιστική πραγματικότητα.

Παρά τα υποσχόμενα οφέλη που προσφέρει η Τεχνητή Νοημοσύνη, η ενσωμάτωση της στον Ελληνικό ασφαλιστικό τομέα παρουσιάζει μοναδικές προκλήσεις, συμπεριλαμβανομένων των κανονιστικών περιορισμών, των ανησυχιών περί ιδιωτικότητας των δεδομένων των πελατών, της προσαρμογής του εργατικού δυναμικού και των τεχνολογικών υποδομών. Η παρούσα μελέτη προσδιορίζει τους κρίσιμους παράγοντες που δυσχεραίνουν την υιοθέτηση της Τεχνητή Νοημοσύνη και προτείνει ένα δομημένο πλαίσιο για την αποτελεσματική ενσωμάτωσή της. Παράλληλα, εξετάζονται σημαντικά ηθικά ζητήματα που απορρέουν από τη χρήση των συγκεκριμένων τεχνολογιών, καθώς και ο κοινωνικός αντίκτυπος της χρήσης της, υπογραμμίζοντας τη σημασία της διαφάνειας, της δικαιοσύνης και της λογοδοσίας στη διαδικασία λήψης αποφάσεων που βασίζονται στην Τεχνητή Νοημοσύνη.

Μέσα από την εν λόγω εργασία, δίνεται Ιδιαίτερη έμφαση δίνεται στη σημασία της ηθικής εφαρμογής της Τεχνητής Νοημοσύνης, όπου η χρήση αλγορίθμων πρέπει να

είναι αμερόληπτη, διαφανής και δίκαιη. Οι ασφαλιστικές εταιρείες καλούνται, πλέον, να υιοθετήσουν πρακτικές που να διασφαλίζουν τη συνεχή συμμόρφωση τους με κανονισμούς περί προστασίας δεδομένων, την αποφυγή αλγοριθμικών προκαταλήψεων και την ενίσχυση της εμπιστοσύνης των πελατών. Η ανάλυση παρουσιάζει επίσης στρατηγικές για την αντιμετώπιση των ηθικών προκλήσεων, προτείνοντας κανονιστικά πλαίσια και μηχανισμούς ελέγχου που μπορούν να διασφαλίσουν τη δίκαιη χρήση της AI στον ασφαλιστικό τομέα.

Τέλος, η εργασία διατυπώνει στρατηγικές συστάσεις για την επιτυχή πορεία των Ελληνικών ασφαλιστικών εταιρειών στον μετασχηματισμό μέσω της χρήσης τεχνολογιών Τεχνητής Νοημοσύνης. Αυτές περιλαμβάνουν επενδύσεις σε οικοσυστήματα Τεχνητής Νοημοσύνης, ανάπτυξη συνεργασιών με τεχνολογικούς παρόχους, συνεχής αναβάθμιση των δεξιοτήτων του ανθρώπινου δυναμικού – ώστε να μπορούν ανταπεξέλθουν αποτελεσματικά - και εναρμόνιση με τις εξελισσόμενες κανονιστικές απαιτήσεις. Μέσα από μια προοδευτική στρατηγική, η Ελληνική ασφαλιστική βιομηχανία μπορεί να αξιοποιήσει στο έπακρο τις δυνατότητες της Τεχνητής Νοημοσύνης, οδηγώντας την καινοτομία, βελτιώνοντας την ανταγωνιστικότητα και ενισχύοντας την ικανοποίηση των πελατών σε ένα ταχύτατα εξελισσόμενο ψηφιακό περιβάλλον.

Page intentionally left blank.

Acronyms

AIA	Artificial Intelligence Act
AI	Artificial Intelligence
AGI	Artificial General Intelligence
ANI	Artificial Narrow Intelligence
APAC	Asia-Pacific
ASEAN	Association of Southeast Asian Nations
ASI	Artificial Superintelligence
CAGR	Compound Annual Growth Rate
CCPA	California Consumer Privacy Act
DL	Deep Learning
DORA	Digital Operational Resilience Act
DTB	Digital Transformation Bible
EIOPA	European Insurance and Occupational Pensions Authority
ESG	Environmental, Social, and Governance
EU	European Union
FCA	Financial Conduct Authority
FSA	Financial Services Agency
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
GenAI	Generative AI
GFC	Global Financial Crisis
IAIS	International Association of Insurance Supervisors
ICO	Information Commissioner ‘s Office

ICT	Information and Communication Technology
IDD	Insurance Distribution Directive
IoT	Internet of Things
IP	Intellectual Property
IT	Information Technology
LLM	Large Language Model
MDG	Ministry of Digital Governance
ML	Machine Learning
NAIC	National Association of Insurance Commissioners
NLP	Natural Language Processing
OECD	Organization for Economic Co-operation and Development
PRA	Prudential Regulation Authority
PLD	Product Liability Directive
RML	Reinforcement Machine Learning
RPA	Robotic Process Automation
SHAP	Shapley Additive Explanations
UBI	Usage-based Insurance
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
XAI	Explainable AI
XML	Extensible Markup Language

Contents

Συνοπτική Περίληψη **5**
Abstract **7**
Περίληψη **8**
Acronyms **11**
Contents **13**
Introduction **15**
Thesis Objectives **16**
Chapter 1: Foundations and Applications of Artificial Intelligence **18**
1.1. Introduction to Artificial Intelligence 18
1.2. History and Evolution of AI 21
1.3. Types of Artificial Intelligence 23
1.3.1. Types of AI Based on Capabilities 23
1.3.2. Types of AI Based on Functionalities 24
1.4. Core Concepts and Technologies in AI 26
1.4.1. Artificial Intelligence Categories 29
1.4.2. How Artificial Intelligence Operates 29
1.5. Challenges in Artificial Intelligence 30
1.6. The role of AI in the Insurance Industry 33
1.6.1. Applications of AI in the Insurance Industry 33
1.6.2. Potential Risks of AI in the Insurance Industry 35
Chapter 2: The Evolution of The Global Insurance Industry Towards Artificial Intelligence **37**
2.1. Brief Historical Context and Evolution of the Global Insurance Industry 38
2.2. Growth, Trends, and the Transformative Role of AI 39
2.2.1. Key Trends and Practices 41
2.2.2. Key Characteristics of AI Tools and Services 46
2.3. AI Strategies of Leading Insurance Players Across Regions 47
Chapter 3: Adopting Artificial Intelligence in the Greek Insurance Industry: Challenges and Opportunities **50**
3.1. Current Landscape of AI in the Greek Insurance Industry 51

3.1.1. National Strategy on Artificial Intelligence....52
3.1.2. Key Trends and Practices 54
3.2. Challenges and Opportunities in AI Adoption 56
3.2.1. Challenges 56
3.2.2. Opportunities....58
3.3. Strategic Recommendations of AI Adoption Gap 60
Chapter 4: The Ethical and Societal Dimensions of AI in the Insurance Industry 64
4.1. Balancing the Ethical Purposes of AI 65
4.2. Core Ethical Principles.... 67
4.3. The Difference Between “Ethics of AI” and “Ethical AI” 68
4.4. Ethical Concerns and Risks in AI Applications in the Insurance Industry.. 70
4.5. The Transformative Impact of AI on the Insurance Workforce and Global Economy 72
4.6. The Interplay Between Ethics and Law in AI Regulation 73
4.6.1. European Union 74
4.6.2. United Kingdom....76
4.6.3. United States....77
4.6.4. Asian Pacific Region 77
4.6.5. International Community....78
4.7. Comparative Analysis & Recommendations 80
4.7.1. Comparative Governance Approaches to AI Regulation....80
4.7.2. Ethical Considerations in AI-Driven Insurance....81
4.7.3. Recommendations 82
Chapter 5: Building the Future of AI in Greece’s Insurance Industry.... 84
5.1. Proposals for Adoption.... 85
5.1.1. A Practical Framework for AI Integration in Greek Insurance Industry 85
5.1.2. Strategic Infrastructure Investments 89
5.1.3. Training Initiatives to Prepare Employees for Technological Change 92
Bibliography 94

Introduction

“The measure of intelligence is the ability to change" - Albert Einstein

Thesis Objectives

The main thesis objectives, as outlined in this document, focus on exploring the role of Artificial Intelligence (AI) in transforming the Greek Insurance Sector. The key objectives include:

1. Assessing AI's Influence on the Insurance Industry
2. Identifying Challenges and Opportunities in AI Adoption
3. Evaluating Ethical and Regulatory Implications
4. Comparing Greek AI Adoption with Global Trends
5. Developing a Strategic Framework for AI Integration

Page intentionally left blank.

Chapter 1: Foundations and Applications of Artificial Intelligence

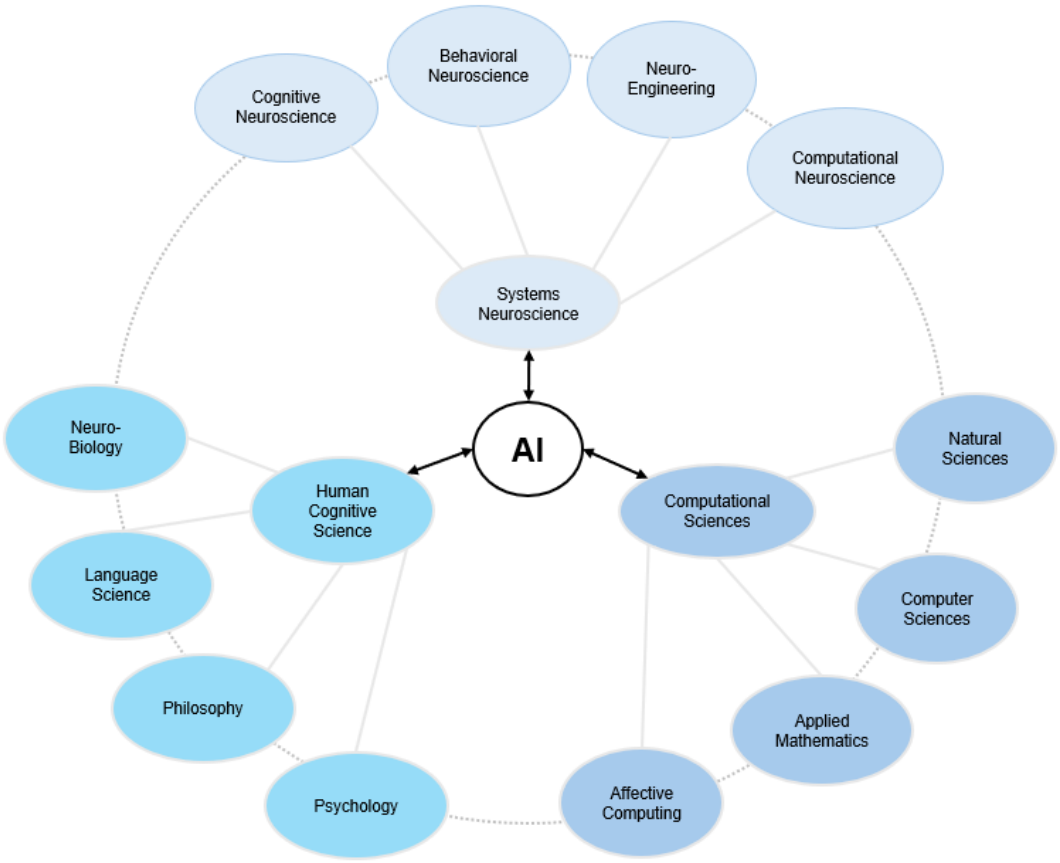
This chapter presents an introduction to artificial intelligence (AI) and the remarkable impacts that it will bring to present civilization. It traces the evolution of artificial intelligence from a theoretical idea to practical applications. It also covers things like natural language processing, deep learning, and machine learning that are the tools that attempt to replicate human intellect to solve difficult problems. By the chapter's final section, they will understand the basic concepts and wide-ranging applications behind artificial intelligence, priming them to explore how artificial intelligence can transform the insurance industry.

1.1. Introduction to Artificial Intelligence

Since then, AI has shifted from an academic field about theoretical exploration, the stuff of Philip K. Dick novels, to a transformative force with practical uses that touch nearly every aspect of everyday life. An as of yet very abstract concept in the area of computer science is now by far the most important driver of technological progress. Beyond voice assistants like Siri and Alexa, AI is revolutionizing critical sectors like disaster management, with predictive models forecasting natural calamities to improve emergency responses. AI is now an integral part of modern life. This quick transformation has sparked a deep-seated evolution inside a wide variety of industries, including but not limited to healthcare, finance, transportation, and entertainment.

What is AI? At its essence, artificial intelligence involves crafting systems and machines capable of performing tasks traditionally requiring human intelligence [1, pp. 1-5]. Among those categories are logical reasoning, problem-solving, pattern recognition, language understanding, and at times even decision-making. Artificial Intelligence is a very broad interdisciplinary field consisting of elements of computer science, mathematics, neuroscience, and engineering. The diversity of AI applications ranges from optimizing supply chains to enabling remote surgical procedures, illustrating its potential to reshape not only industries but also societal. [2, pp. 27-60]

Table 1 - AI is multidisciplinary [2, p. 35]



While rapid AI advancements enable innovation, they also amplify critical challenges. The enabling tools and technologies behind AI, such as machine learning, deep learning, and natural language processing, are advancing at an extraordinary speed, enabling machines to sift through large datasets, learn from them, and make more and more accurate decisions. At the same time, AI systems are increasingly autonomous systems, raising fundamental questions of transparency, fairness, and accountability of their use and how to use such systems ethically.

AI is poised to reshape the future of industries and the world we live in - so understanding the principles and practical applications of AI and its inevitable use case implications is fundamental for all, from individuals and organizations to policymakers. Understanding AI on a substantive level is vital not just to capitalize on its promise, but to responsibly mitigate its risks and complexities. This analysis is designed as a primer on all things AI, covering its historical roots, underlying technologies, general

applications, and ethical implications, concluding with some thoughts about what the future holds for this game-changing technology. [3, pp. 1-4]

Here multiple definitions of AI are provided:

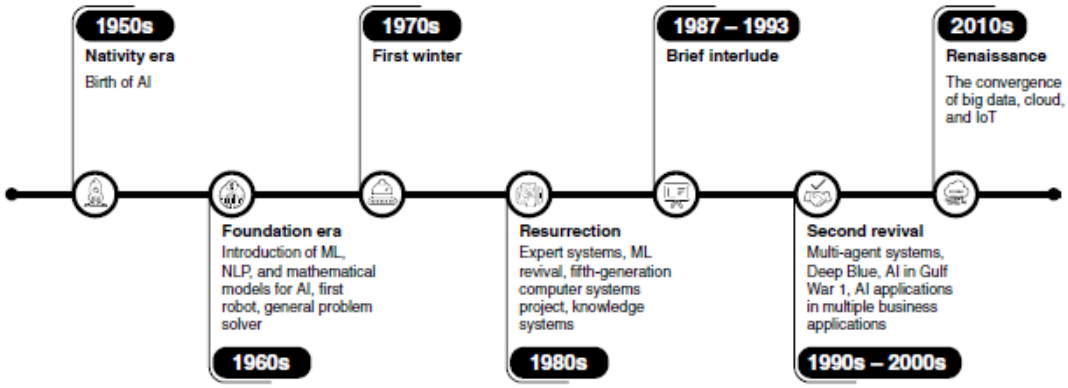
Table 2 – Various definitions of AI [4, p. 20]

- *«The use of algorithms. The term "algorithm" refers to a specific instruction for solving a problem or performing a calculation. »*
- *«The imitation of all human intellectual abilities by computers »*
- *«The imitation of various complex human skills by machines »*
- *«Technology that can function appropriately and with foresight in its environment »*
- *«Systems that display intelligent behaviour by analyzing their environment and taking actions –with some degree of autonomy – to achieve specific goals. »*

1.2. History and Evolution of AI

The concept of artificial intelligence has its roots in ancient tales and philosophies, where thinkers speculated about creating non-human entities capable of thought and intelligence, long before Alan Turing ever asked: *"Can machines think?".* Early definitions of "non-human intelligence" had already been touched upon by ancient Greek philosophers. Ideas of mechanical men, much like modern robots, go back to the Renaissance. As a discipline, though, AI research began in the mid-20th century when the idea of machines being able to perform tasks as humans did first emerged.

Table 3 – History Timeline (Key Milestones)



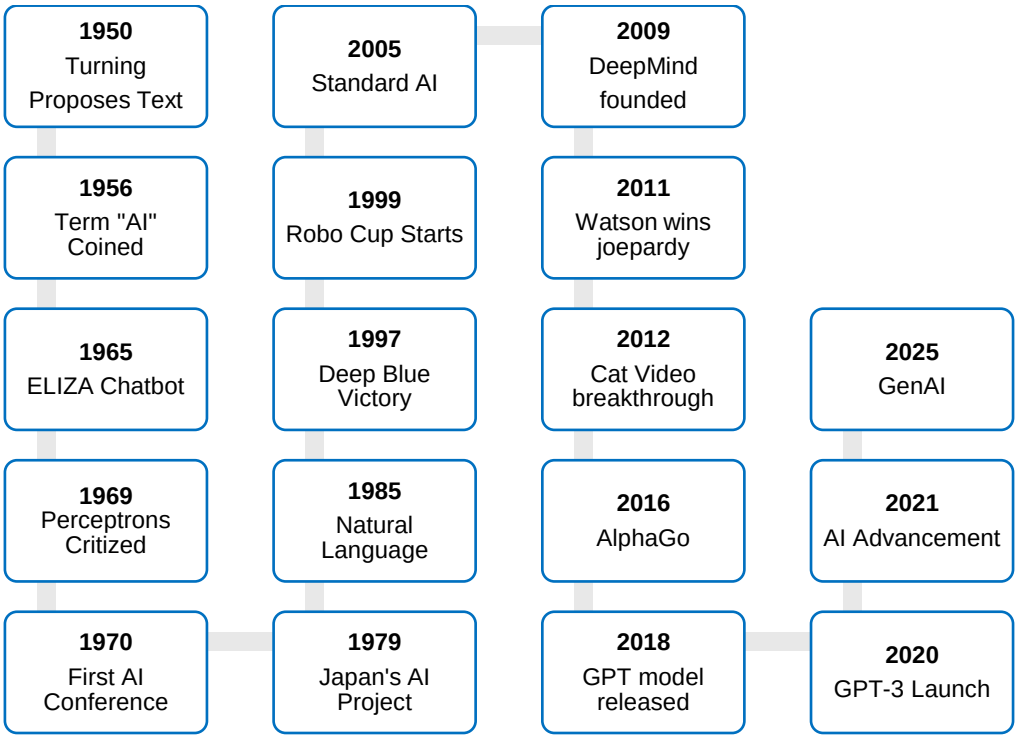
More specifically:

- **1950s (Nativity Era)**: In his 1950 paper *Computing Machinery and Intelligence*, Alan Turing laid the groundwork for machine intelligence. In it, he proposed what would become known as the Imitation Game, later dubbed the Turing Test, which measures a machine's ability to exhibit humanlike intelligence. A machine is intelligent if its responses are indistinguishable enough from a human that a human evaluator cannot tell it from a person. This philosophy became fundamental to the progress that followed in AI.
- **1956**: John McCarthy introduced the term "Artificial Intelligence" during the Dartmouth Conference, where multidisciplinary experts laid the groundwork for exploring how machines could emulate human thinking. McCarthy's vision was shaped by his work on LISP, one of the earliest programming languages designed for AI research.

- **1960s-1970s (Foundation & First Winter Era)**: Early AI programs like ELIZA, a chatbot intended to simulate a therapist, and DENDRAL, an expert system for chemical analysis, proved AI was possible in limited domains. However, a lack of computer power and funding caused progress to slow during this period, often referred to as the First AI Winter.
- **1980s (Resurrection Era)**: A renewed interest in AI emerged due to developments in neural networks. The backpropagation algorithms developed during this time were instrumental in training deep learning models, paving the way for the eventual breakthroughs to come.
- **2000s-Present (Second Revival & Renaissance Era)**: The revolution in both big data and computational processing power, combined with significant improvements in machine learning algorithms, has led to an unprecedented proliferation of AI applications. Today, AI leads to innovations in multiple domains including healthcare, finance, transportation, and entertainment, marking the start of a transformative time.

[5] [6, pp. 13-21] [7, pp. 4-8] [8, pp. 1-2] [9, pp. 15-39] [10, pp. 7-8]

Table 4 – Evolution of AI



1.3. Types of Artificial Intelligence

As previously stated, Artificial Intelligence refers to human-engineered systems designed to simulate cognitive processes such as reasoning, learning, and problem-solving. It's not an isolated thing; It plays a vital role in enhancing the efficiency of numerous systems in various industries. Different forms of AI, from simple data labeling to advanced autonomous driving technologies, demonstrate unique strengths and limitations. By leveraging iterative algorithms, AI identifies patterns within datasets, enabling predictive analytics that guide decision-making processes. Categorically, AI systems are defined based on their operational capabilities or the functions they perform.

Table 5 – Types of AI

Based **on Capabilities**	Based **on Functionalities**
Narrow AI (Weak)	Reactive Machines
General AI (Strong)	Limit Memory
Super AI (Superintelligence)	Theory of Mind
	Self Aware AI

1.3.1. Types of AI Based on Capabilities

- **Narrow AI (or Weak AI):** Narrow AI systems specialize in limited tasks, excelling at specific objectives such as image recognition, language translation, or game playing. Artificial Narrow Intelligence (ANI) systems are purpose-built to perform specific tasks, excelling within their designated scope, such as autonomous navigation or natural language processing. However, ANI lacks the ability to generalize knowledge, functioning strictly within predefined boundaries.

- **General AI (or Strong AI)**: represents a level of artificial intelligence that mirrors human cognitive abilities. Unlike Narrow AI, AGI can apply its learning across

diverse contexts, adapting and problem-solving in ways akin to human intuition. This milestone remains theoretical, requiring machines to achieve self-awareness and independent reasoning.

- **Super AI:** The term artificial superintelligence (ASI) envisions systems surpassing human intellect in every domain, from emotional intelligence to creative problem-solving. While purely hypothetical today, ASI has the potential to revolutionize industries and tackle complex global challenges. However, such advancements would demand rigorous ethical oversight and global collaboration to mitigate existential risks.

1.3.2. Types of AI Based on Functionalities

- **Reactive Machines:** Reactive Machines are foundational AI systems that base their decisions exclusively on immediate input data. They lack memory storage capabilities and the ability to learn from past experiences. While their responses can appear intelligent, they are inherently limited to pre-programmed knowledge and cannot adapt over time. An example includes IBM's Deep Blue, which defeated a chess grandmaster by evaluating current board positions without relying on past games.

- **Limited Memory AI:** Limited Memory AI goes beyond Reactive Machines by incorporating temporary memory of past interactions to inform future decisions. This type of AI is commonly seen in applications like autonomous vehicles, which process recent sensor data to navigate dynamic environments. Although effective, Limited Memory AI cannot store long-term historical data, keeping its scope confined to recent observations.

- **Theory of Mind:** Theory of Mind AI aims to bridge the gap between human and machine interaction by enabling systems to interpret emotions, intentions, and beliefs. Though still conceptual, advancements in Emotion AI are progressing toward this goal, with current technologies capable of analyzing facial expressions and voice tones to estimate emotional states. Future applications could revolutionize areas like mental health therapy and personalized education.

- **Self-Aware AI:** Self-Aware AI represents the ultimate frontier, envisioning systems with consciousness akin to human self-awareness. These systems could theoretically experience emotions and make independent judgments. However, achieving such an advanced state raises ethical and philosophical questions about AI autonomy and accountability, making it a speculative pursuit for now.

  [7, p. 9] [11, pp. 34-41]

1.4. Core Concepts and Technologies in AI

Consider a world in which computers can learn, make decisions, and adapt to their environment seamlessly. Artificial Intelligence has the potential to make machines behave and think like humans. Critical components that enable this interest include:

I. Data

At the heart of artificial intelligence lies data, fueling its ability to recognize patterns, generate insights, and make predictions. High-quality, diverse datasets are critical for effective model training, spanning applications from customer behavior analysis to advanced healthcare diagnostics. By leveraging both structured and unstructured data, AI systems emulate and often surpass human decision-making capabilities, transforming industries. [12, pp. 15-35] [13, pp. 2-3]

II. Machine Learning (ML)

Machine learning, a pivotal subset of artificial intelligence, empowers systems to improve performance by learning from data without explicit programming. Some of the areas where machine learning is being used are recommendation engines, fraud detection, speech recognition, etc.

There are three main categories of ML:

- **Supervised Machine Learning:** This is a type of ML that uses fully labelled datasets to perform accurate predictions or classifications. Labelled data is the data that has tags that reveal some of the details related to the data. In a supervised machine learning model, the more labeled data is fed into it, the better it becomes at performing accurate classifications and predictions. Regression, decision trees, nearest neighbor, and support vector machines are the most common algorithms for supervised learning.

- **Unsupervised Machine Learning:** In this type of ML, the machine detects all data using algorithms. The algorithms derive models by finding hidden patterns and relationships between attributes because, unlike Supervised ML, the data is not well-labeled. This discovery-

based approach is also useful for market segmentation tasks. Unsupervised learning typically involves clustering, anomaly detection, and neural network algorithms.

- **Semi-supervised Machine Learning:** Semi-supervised ML is a mix of supervised and unsupervised learning. The model is first trained on a small dataset labeled by humans. Then, it learns by extracting features from a large amount of unlabeled data, which it does on its own. When the labeled dataset is small, this approach helps us train the model using an external set.

Advanced Models:

- **Reinforcement Machine Learning (RML):** In Reinforcement ML, a model is used that learns through a methodology described as trial and error, in specific terms, through interaction with its environment; its actions are adjusted according to the feedback obtained. The system is positively reinforced when its actions are aligned with desired results and faces negative consequences when it does not meet such expectations. This way, the system can internalize behavioral reinforcement, learning through adaptation. [7, pp. 9-10] [14, pp. 242-255]

III. Neural Networks

Neural networks form the foundation of deep learning, consisting of layers of interconnected nodes inspired by biological neurons. These systems, which range from convolutional networks for image recognition to recurrent networks for sequential data, enable machines to analyze patterns and derive insights from complex datasets. In general, a basic neural network should have at least an input layer, an output layer, and one or more hidden layers.

IV. Deep Learning (DL)

Deep learning is a key branch of ML that leverages multi-layered neural networks to process vast datasets and identify intricate patterns. Recent breakthroughs, such as the development of transformers for NLP tasks and

convolutional neural networks for computer vision, have revolutionized fields like autonomous driving, medical diagnostics, and virtual assistants.

V. Natural Language Processing (NLP)

Natural Language Processing enables machines to interpret and respond to human language. Recent advancements like GPT-3 and BERT have significantly enhanced capabilities in machine translation, sentiment analysis, and conversational AI, pushing the boundaries of human-computer interaction.

VI. Machine Vision

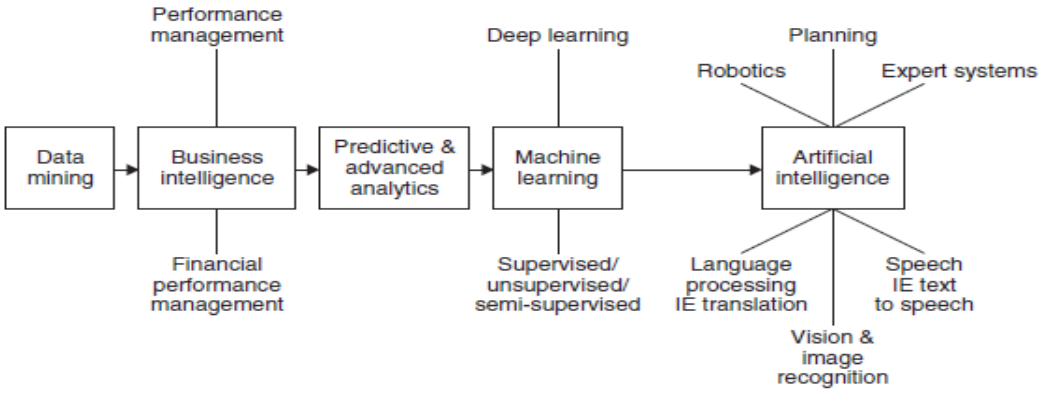
NLP deals with communication, while Machine Vision focuses on interpreting static and moving visual images.

VII. Robotics

The integration of AI into robotics is transforming industries, from collaborative robots in manufacturing to AI-driven autonomous delivery systems. Innovations like surgical robots and AI-powered drones are expanding the horizons of automation.

[3, pp. 4-11] [15, pp. 49-59]

Table 6 – The road to Artificial Intelligence [12, p. 27]



1.4.1. Artificial Intelligence Categories

Artificial Intelligence (AI) can be broadly categorized into two main categories based on the role it plays in decision-making processes:

a. Soft AI (Assisted Decision-Making)

Soft AI refers to technologies designed to support, rather than replace, human decision-making processes. By offering insights, predictions, or recommendations, these systems enable users to make more informed decisions. For example, predictive analytics in business or clinical decision support systems in healthcare fall under this category, emphasizing collaboration between humans and machines.

b. Hard AI (Autonomous Decision-Making)

Hard AI describes systems that operate independently, making decisions and executing actions without human intervention. Autonomous vehicles, for instance, analyze their environment and make driving decisions in real time. While offering efficiency, these systems also raise critical questions about accountability and transparency in AI-driven processes.

This distinction highlights the degree of human involvement in AI-driven processes, ranging from collaborative assistance to complete autonomy. [13, p. 4]

1.4.2. How Artificial Intelligence Operates

Machines are given the power to analyze information and carry out tasks in a highly proficient manner because of artificial intelligence. Data and algorithms are interlinked because as much as algorithms are a crucial part of making decisions, AI technologies make the most of the algorithms by integrating them into data to gain valuable insights. Algorithms are simply tools, while data is AI power.

All AI systems, regardless of application, work in five steps:

1. **Starting Point:** Data is collected from numerous sources and then classified.

2. **Executing:** The AI accesses and analyzes the information a structure that it was created to recognize, repeating the process until similar structures are detected in the provided information.
3. **Results:** Based on the models, the AI works out what the most probable outcome is.
4. **Modifications:** If the datasets fail to reach the target, the AI understands the mistake and goes back to attempting it but this time round under different circumstances.
5. **Evaluation:** By using this method, the AI is able to continuously change and improve performance.

1.5. Challenges in Artificial Intelligence

There are significant advantages and drawbacks that come with the use of AI, much like with any other modern technological facility. Rendering service with the aid of artificial intelligence to human beings can provide an abundance of possibilities, but applying such technology is not so easy in reality. For now, let us explore the primary adversities that come with the practicality of AI in work. These adversities have many dimensions: they include utilizing the psychology aspects of artificial intelligence, the changing requirements for highly skilled personnel, the presence of gaps in the security network, and the need to keep the data secure and trustworthy, among other things. The factors presented above pose specific challenges that need to be addressed to benefit from the innovative features of AI technology.

1. **Loss of Independent Thinking**

AI-based productivity tools are rooted in the knowledge and expertise of the person behind them. While they equip machines to carry out intelligent tasks according to the limits of their coding, they do not, at their core, augment the users' ability to think independently. In fact, dependence on machine intelligence that is intentionally created and coded might be detrimental. A machine, for example, that is programmed to accept certain responses, may lead users to a point where they will not question the machine’s outputs, even when human reasoning has the opportunity to provide better solutions.

2. Bias in Artificial Intelligence Design

One of the concerns that AI developers have is gauging whether a model that is derived from a single person or a set of individuals can be considered as a universal gauge of sorts. This single concern highlights the bigger picture reality or problem of “bias” in the design of the artificial intelligence. All machines created using human intelligence and algorithms are designed by someone, hence the model is biased even before its deployment. Therefore, developed AI is constrained and does not consider other possibilities in terms of knowledge.

Also, this dependence enables developers to remain the only ones who are capable of controlling and/or modulating the intelligence of the incorporated systems, designed models with outcomes that are not suited or beneficial to all users. Such biases can have profound consequences for society by normalizing the use of models that do not meet the needs of all users. For instance, facial recognition technologies have demonstrated disparities in accuracy across different demographic groups, underscoring the importance of diverse training datasets and inclusive development practices. This shows that preventing biases when building AI systems is crucial to ensure fairness and the way technology is used.

3. Limitation in Data Utilization

Data availability and quality bear significantly on the performance and reliability of AI systems, but developers face persistent challenges in ensuring that data is not missing or incomplete and that it is authentic. Some common techniques that could be applied to estimate these missing values, which often greatly affect the outcomes of an AI model, are interpolation, regression, and correlation. Besides, the criteria for choosing or rejecting the data points generate variability. The criteria used may give quite different outputs of models and different interpretations. Such is the case, for example, with the clustering of data when the ways of inclusion and exclusion of certain points yield completely different models, each modeled after the selection initially made. These limitations, therefore, underpin the acute need for robust and unbiased data preparation methods so that AI models can generate reliable and equitable results. For example, missing data in healthcare records may skew predictive models, leading to inequitable outcomes in patient care.

4. Impact on Employment Opportunities

Artificial intelligence is designed to reduce human-generated errors by utilizing machine intelligence; however, this very development reduces employment opportunities since most AI-based systems operate independently of human intervention. The indirect effects of AI on the world economy, through a decrease in job availability, can be very strong. Given the unabated growth of the human population across the world, humanless technologies have posed an increasingly serious challenge to the sustainability of both the workforce and human livelihood around the world. However, this shift also creates demand for new skill sets, emphasizing the need for reskilling initiatives to support displaced workers.

5. Lifestyle Transformations

The way we live today has changed dramatically compared to traditional lifestyles, primarily due to the widespread influence of technology. Although these advancements have made life more convenient, they have also brought about shifts that affect human health. Increasing reliance on virtual environments has created challenges, particularly for younger generations, who often struggle with stress and find it difficult to disconnect from these immersive digital experiences.

6. Security Concerns

Artificial intelligence has become a vital driver of global innovation, enabling the creation of advanced smart products and fostering an interconnected digital ecosystem. While this interconnectedness allows for easy access to AI-driven tools from almost anywhere, it also introduces critical security vulnerabilities. Hackers can exploit these weak points to gain unauthorized access, potentially compromising or manipulating the functionality of AI systems.

[10, pp. 14-19]

1.6. The role of AI in the Insurance Industry

For years, the insurance sector has been recognized as fertile ground for transformative technological advancements. More precisely, the insurance industry, historically reliant on data-driven decisions, is increasingly embracing advanced technologies to enhance its processes. This transformation, while gradual, has significantly improved efficiency and service quality, even though cost reductions remain elusive. For insurers, adopting technology has shifted from a competitive advantage to a necessity for survival in a rapidly evolving market.

AI, in particular, has reshaped traditional notions of technological value. Unlike general-purpose tools, AI systems are built to address specific business challenges from the outset. For instance, in the insurance sector, AI-driven algorithms have revolutionized claims fraud detection by analyzing patterns across large datasets to identify anomalies with unparalleled accuracy.

In 2023, the widespread adoption of AI across industries marked a critical juncture, with insurers leveraging its capabilities to streamline operations, improve customer satisfaction, and reduce risk. These developments underscore the integral role of AI in shaping the future trajectory of the insurance industry, bridging the gap between innovation and business impact.

1.6.1. Applications of AI in the Insurance Industry

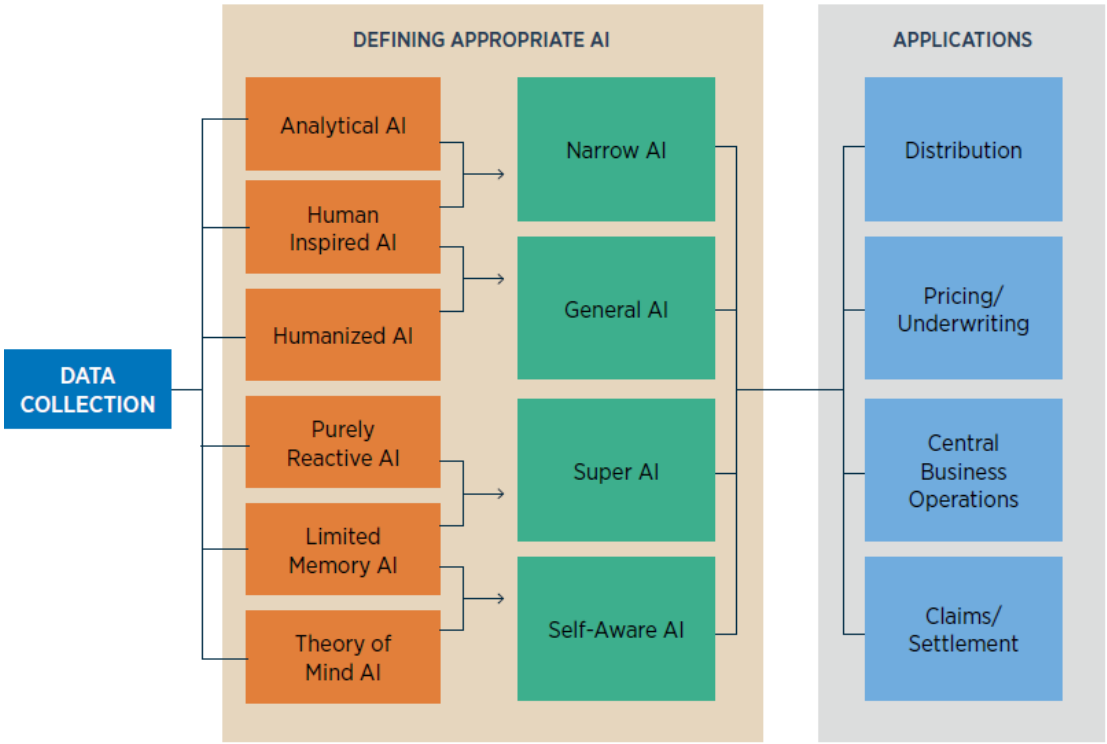
Across industries, artificial intelligence has driven innovation by automating complex tasks, streamlining decision-making processes, and unlocking opportunities for data-driven strategies. [16, p. 17] In the insurance industry artificial intelligence has emerged as a transformative force, reshaping core operations and enhancing efficiency across the board. By leveraging advanced algorithms and vast datasets, AI enables optimized decision-making and introduces tailored solutions that meet the unique needs of insurers.

The process begins with analyzing data, selecting the desired output type - whether analytical, human, humanized, reactive, limited memory, or theory of mind - and determining the level of complexity, ranging from basic to advanced AI tools. These

tools enhance key functions across critical business areas for property, casualty, and life insurers. These areas are vital for assessing risks, determining premiums, and ensuring financial stability and long-term success.

To maximize the potential of AI, it's essential to recognize its limitations early and establish clear criteria for measuring success.

Type 7 – A framework for selecting AI tools in Insurance [17, p. 23]



AI excels in automating underwriting, detecting fraud, and enhancing customer service. Key applications of AI in the insurance industry include:

- **Claims Management:** Tools like Tractable automate claims assessment by analyzing images and documentation, drastically reducing processing times and enhancing accuracy.
- **Fraud Detection and Prevention**: Advanced algorithms detect anomalies in underwriting and claims data, enabling insurers to address fraudulent activities proactively. For example, Shift Technology has helped insurers save millions in fraud-related costs.

- **Telematics and Usage-Based Insurance**: By monitoring driving behaviors, AI-powered telematics systems allow insurers to offer customized premiums, promoting safer driving habits and fair pricing.
- **Risk Assessment and Underwriting**: AI models evaluate extensive datasets, integrating historical and external data to produce more precise risk analyses. This reduces underwriting errors and enhances policyholder satisfaction.
- **Predictive Analytics**: AI forecasts emerging trends and customer behaviors, helping insurers stay ahead of market dynamics and optimize resource allocation.
- **Personalized Marketing and Sales**: AI tailors communication strategies and product offerings to align with individual customer preferences, driving higher engagement and loyalty.

These applications showcase the transformative potential of AI in the insurance sector, driving greater efficiency, customer satisfaction, and profitability.

1.6.2. Potential Risks of AI in the Insurance Industry

AI adoption in the insurance industry resents vast potential for innovation and efficiency. However, it also introduces notable risks and challenges that demand careful management to ensure ethical and sustainable use. Below is an analysis of the primary areas of concern associated with AI implementation in the insurance sector.

〉 Data Quality and Accuracy

One of the main challenges in applying AI in the insurance industry is the variability in data quality and accuracy. AI systems depend on various types of data, such as customer-provided information and synthetic datasets. While these data sources fuel AI models, challenges like incomplete records or biased training sets can compromise outcomes. For instance, inaccuracies in telematics data used for usage-based insurance could lead to unfair premium pricing. Moreover, large-scale data collection raises several critical, such as **Data Privacy** (ensuring compliance with privacy laws and protecting individuals' rights over their personal data), **Data Ownership** (clarifying legal rights to collected and processed data) and **Bias** (identifying and addressing

embedded biases within datasets to prevent skewed results). Addressing these risks requires robust data validation methods and compliance with privacy regulations like GDPR.

〉 Lack of Transparency

The complexity of machine learning algorithms often renders them opaque, posing challenges in understanding their decision-making processes. This "*black box*" nature raises concerns about algorithmic fairness and accountability. Explainable AI (XAI) approaches, such as Shapley Additive Explanations (SHAP), offer promising solutions by breaking down AI decisions into interpretable components. [18] This lack of transparency raises questions about accountability and trustworthiness, making it difficult for regulators and stakeholders to validate the fairness and accuracy of AI-driven insurance processes.

〉 Bias

Bias in AI systems remains a significant challenge, particularly in underwriting and claims assessment. For example, historical datasets reflecting societal inequalities may lead to discriminatory outcomes, disadvantaging certain groups. Unchecked bias can lead to reputational damage, regulatory scrutiny, and erosion of trust. Regular bias audits and inclusive dataset curation are essential to mitigate these risks.

〉 Uninsurable Customers

AI's granular risk assessment capabilities risk excluding high-risk individuals from coverage altogether. This trend undermines the solidarity principle central to insurance. Developing regulatory frameworks to cap premium hikes or mandate basic coverage options can help balance efficiency with equity.

To conclude, AI adoption in the insurance industry offers transformative opportunities to enhance efficiency, improve decision-making, and deliver personalized services. However, its implementation must address critical issues related to data quality, transparency, bias, and accessibility to avoid ethical pitfalls and maintain stakeholder trust. A balanced approach that combines robust regulatory oversight with ethical AI practices will be essential for unlocking AI's full potential while ensuring sustainable growth in the industry.

[19, p. 13]

Chapter 2: The Evolution of The Global Insurance Industry Towards Artificial Intelligence

Thirty years ago, the insurance industry was a very different place - much simpler and slower-paced than the fast-moving, complex world it operates in today. Back then, profit margins were wide, technology advanced at a leisurely pace, and decisions like underwriting were guided more by gut instinct than by hard data. Regulations were basic, and the industry wasn't under the same level of scrutiny it is today. While the core idea of pooling premiums from many to cover the losses of a few still stands, nearly everything else about the industry has changed - and at a breathtaking speed - driven by competition and the constant demand for innovation.

The digital revolution in the mid-1990s completely reshaped the way the industry worked. The introduction of the internet, email, digital records, and e-commerce made everything faster and more connected. Collaboration also changed, with companies forming partnerships and ecosystems to innovate together and improve customer experiences.

Major global events, like the 2008 financial crisis (GFC), the COVID-19 pandemic, have further accelerated change, compelling insurers to rethink their risk assessment models and adapt to unprecedented challenges. Meanwhile, climate change and geopolitical events, such as the war in Ukraine, have introduced new complexities in underwriting and claims management. On top of this, artificial intelligence is now poised to transform everything - from predicting risks to serving customers - pushing insurers to embrace cutting-edge technology. But with all this potential, AI also brings a new set of challenges and risks that need to be managed carefully.

Even with all these advancements, the insurance industry has been slow to innovate in certain areas. Beyond improving how products are distributed, the core offerings of insurance have remained largely the same for centuries. Part of this reluctance to change comes from the heavy regulations that require every step forward to be taken cautiously.

That said, the potential for transformation is still there. To navigate this rapidly changing world, the industry must lean into innovation - it's the key to staying relevant and meeting the challenges of the future.

2.1. Brief Historical Context and Evolution of the Global Insurance Industry

Insurance, rooted in the principle of mutuality - a simple yet profound way of addressing the uncertainties of the future. By pooling resources from individuals who face similar risks, insurance offers protection against potential losses, even those that are rare but highly impactful. This collective approach not only helps reduce individual burdens but also fosters a sense of shared responsibility and solidarity. Beyond its practical utility, insurance plays a crucial role in ensuring societal stability and economic resilience, enabling communities to recover from unexpected events while promoting trust and cooperation among participants.

Throughout history, the insurance industry has evolved in tandem with technological advancements:

- **Insurance 1.0**

The first industrial revolution introduced steam engines, revolutionizing transportation and production. This era saw the emergence of accident insurance, particularly as railway companies began offering coverage as part of travel packages, laying the groundwork for integrating insurance with consumer services.

- **Insurance 2.0**

The second industrial revolution expanded societal safety nets through groundbreaking social insurance programs, such as those pioneered by Germany under Otto von Bismarck. These programs, addressing risks like illness and old age, inspired similar initiatives globally, including the UK's National Insurance Act of 1911.

- **Insurance 3.0**

The advent of computers during the third industrial revolution transformed insurance operations. This era, known as "Insurance 3.0", introduced automation to processes that once relied on time-consuming manual work. Actuarial calculations, data analysis, and administrative tasks became faster and more efficient. By the 1980s and 1990s, independent insurance agents were using computer-based systems to streamline their operations, cut costs, and improve service.

Organizations like ACORD also played a big role during this time, standardizing forms and introducing new technologies like Electronic Data Interchange and XML. These innovations made it easier to share information and work across borders, paving the way for a globally connected insurance industry.

- **Insurance 4.0**

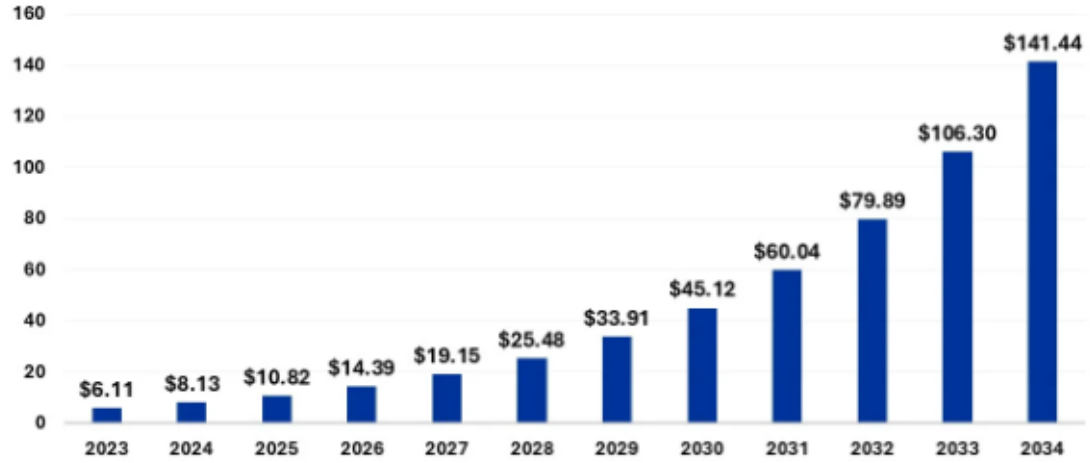
Today, we're in the middle of the fourth industrial revolution - what many call "Insurance 4.0". This era brings together cutting-edge technologies like Internet of Things (IoT), AI, and automation, enabling smart insurance solutions. These tools are transforming insurance into ways we could only dream of before, enabling real-time interactions between machines, people, and systems. For example, wearable devices in health insurance track real-time data to offer personalized premiums, while AI-powered chatbots enhance customer engagement. These advancements drive flexibility, efficiency, and customer-centricity, redefining the insurance landscape. "Smart insurance" is the big focus now. [20, pp. 11 - 40]

2.2. Growth, Trends, and the Transformative Role of AI

In 2022, the global insurance market reached an estimated valuation of $6 trillion, with the United States accounting for 44.2% of the total market share [21]. This sector witnessed remarkable growth in 2023, achieving a +7.5% expansion - the fastest rate since 2006 - outpacing its decade-long average of +4.9%. Premium collections exceeded €6 trillion, with life insurance contributing €2.62 trillion, followed by property and casualty (€2.15 trillion) and health insurance (€1.43 trillion) [22].

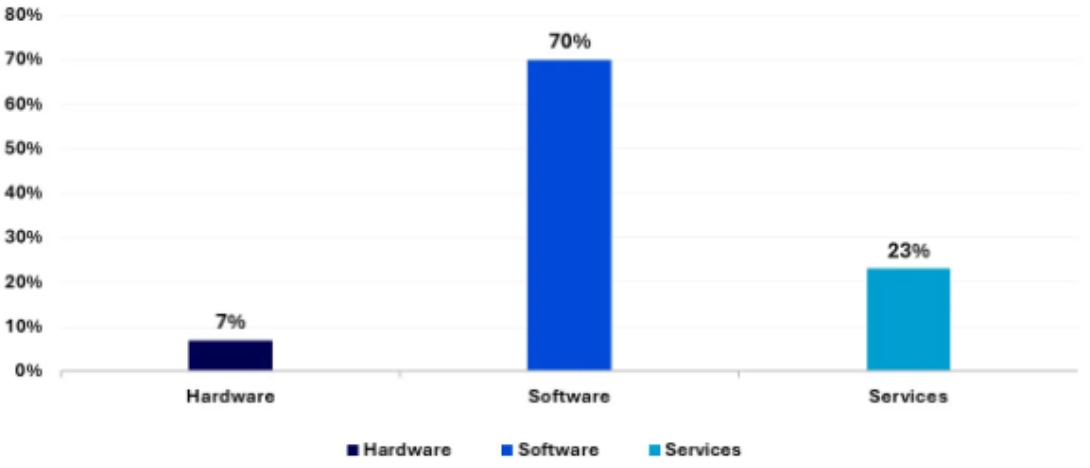
Looking ahead, the adoption of artificial intelligence in the insurance industry is expected to accelerate. The global AI insurance market is projected to grow from $8.13 billion in 2024 to a staggering $141.44 billion by 2034, reflecting a compound annual growth rate (CAGR) of 33.06%. This growth highlights the increasing reliance on AI-driven innovations to streamline processes, enhance risk assessment, and deliver personalized customer experiences.

Table 8 – AI in Insurance Market Size 2023 to 2024 (USD Billion) [23]



Market research divides the global AI insurance industry into three core categories: hardware, software, and services. Among these, the software segment is projected to dominate during the forecast period, driven by advancements in AI-powered analytics, fraud detection, and customer engagement tools. The increasing adoption of cloud-based solutions and AI software-as-a-service (SaaS) platforms further solidifies the software segment's market leadership. Key contributors include predictive analytics platforms for underwriting and customer service applications, such as chatbots powered by natural language processing.

Table 9 – AI in Insurance Market Share, By Offering, 2023 (%) [23]



AI is already proving its worth in many ways. It's being used for predictive analytics to create personalized marketing campaigns, real-time data analysis to develop innovative products, and automation to streamline claims management and detect fraud. Mastering AI isn't just a nice-to-have anymore - it's becoming a critical competitive advantage. Insurers that embrace it can deliver cost-effective, personalized solutions while driving growth and staying ahead of the curve.

In 2023 alone, global insurance companies made significant investments in AI, spending $1.4 billion on predictive analytics, $950 million on tools to help agents work smarter, and $560 million on better data management. While these investments are paying off by cutting costs and improving access to insurance, scaling AI across board is still a challenge.

Early results are promising, adopting AI has led to a 15 - 20% boost in efficiency in areas like handling documents, back-office work, and customer interactions. These improvements could translate into a 3% revenue increase for the industry. Even though insurers are some of the biggest investors in AI, adoption rates remain surprisingly low.

The insurance industry is going through a time of big changes, with some key trends shaping its future. Rising costs from natural disasters and cybercrime are pushing people to look for more customized insurance options, while emerging markets in Asia and Latin America are creating exciting growth opportunities. Amid all this, AI is stepping in as a game-changer, helping the industry become more efficient, productive, and customer-friendly.

Of course, there are hurdles to overcome, like meeting regulatory requirements and integrating new technologies. But the potential of AI is too big to ignore. With the right approach, the insurance industry can use AI to completely transform itself, becoming more customer-focused and future-ready than ever before. [24] [25]

2.2.1. Key Trends and Practices

The insurance industry is undergoing a profound transformation driven by AI technologies, which are redefining operational processes, improving customer experiences, and fostering innovation. Below are some of the key trends and practices shaping the global insurance landscape:

〉 Predictive Analytics for Customer Behavior

Trend: AI-powered predictive analytics help insurers understand customer behavior, anticipate needs, and offer proactive service. It can predict actions like policy renewals, cross-selling opportunities, or even which customers might be at risk of leaving. By understanding risks more accurately, insurers can also set premiums with greater precision.

For example, State Farm Insurance (USA) uses AI to identify when customers might switch policies or file claims. They use this data to proactively offer retention incentives or adjust coverage, boosting loyalty and satisfaction. [26]

〉 Automation of Claims Processing

Trend: AI is revolutionizing claims handling by automating processes, reducing errors, and cutting down processing time.

For example, Lemonade Insurance (USA) uses an AI-powered bot named “Jim” to instantly approve claims. The system analyzes submitted claims, validates them using algorithms, and accelerates the entire process without much human intervention. [27]

〉 Fraud Detection and Prevention

Trend: AI systems identify patterns and anomalies in data to detect and prevent fraud.

For example,

- Allstate Insurance (Spain) uses AI to flag suspicious claims for investigation, reducing losses from fraud. [28]
- AXA Insurance (France) leverages AI to detect fraudulent claims by analyzing historical data and spotting suspicious patterns. Using predictive modeling, AXA can identify fraudulent behavior before it becomes a financial risk. [29]
- Cigna Insurance (USA) uses AI to review health insurance claims, identifying inconsistencies in medical data and billing patterns to prevent fraud. [30]

〉 Customer Service Enhancement (Chatbots and Virtual Assistants)

Trend: AI chatbots and virtual assistants provide 24/7 support, answering routine questions and simplifying complex processes.

For example:

- GEICO's Insurance (Spain) has a virtual assistant, “Kate”, that helps customers with billing questions, policy details, and more. [31]
- Allianz Insurance (Germany) uses the Allianz Chatbot, which employs natural language processing (NLP) to provide personalized responses to customer queries. [32]
- Ping An Insurance (China) developed the “*Ping An Good Doctor*”, an AI-driven health assistant that that guides users through insurance claims and offers personalized medical advice. [33]

〉 Personalized Insurance Products

Trend: AI enables the customization of policies based on individual behaviors and preferences.

For example:

- MetLife Insurance analyzes customer data to match life insurance products with individual financial needs. [34]
- Progressive Insurance’s (USA) Snapshot program uses telematics to adjust motor insurance premiums based on real-time driving behavior. [35]
- Vitality Health Insurance (UK) integrates wearable technology to monitor health metrics, rewarding customers with personalized premiums for healthy lifestyles. [36]

〉 Risk Assessment and Underwriting

Trend: AI transforming underwriting by providing the accuracy of risk assessments.

For example:

- Swiss Re (Switzerland) uses AI to analyze data like satellite images and weather patterns to refine risk models. [37]
- Zebra Insurance (USA) uses AI to assess risks by analyzing social media behavior and historical data, enabling more accurate pricing and tailored coverage. [38]

〉 Generative AI (GenAI)

Trend: GenAI is being used to improve business processes and generate insights that enhance decision-making.

For example, AXA Insurance uses GenAI to analyze customer interactions, improving service strategies and boosting customer satisfaction. [39]

〉 Integration with Emerging Technologies

Trend: Combining AI with technologies like IoT and blockchain is creating smarter and more innovative solutions.

For example:

- John Hancock Life Insurance integrates AI with wearable devices in its Vitality program, encouraging healthy habits by offering rewards. [40]
- Allianz Insurance (Germany) and Munich Re (Germany) use telematics to gather real-time driving data, offering personalized auto insurance. [41] [42]
- MetLife Insurance (USA) leverages wearables to personalize health insurance based on activity data. [43]

〉 AI-Driven Ecosystems

Trend: Insurers are building AI-driven ecosystems to offer more comprehensive services beyond traditional products.

For example:

- Ping An Insurance (China) developed a digital ecosystem that spans healthcare, financial services, and smart city solutions. [44] [45] [46]
- Lloyd's of London (UK) uses AI tools for underwriting and claims analysis, improving efficiency and risk pricing.

〉 Robotic Process Automation (RPA)

Trend: RPA increases efficiency by automating repetitive tasks like claims processing, policy management, and underwriting.

For example:

- Generali Insurance (Italy) uses RPA bots to handle routine administrative tasks, reducing errors and freeing up employees for complex work. [47]
- AXA Insurance (France) also uses RPA to automate tasks like policy renewals and document management, enhancing efficiency and lowering costs. [48]
- Ethniki, Hellenic General Insurance, utilizes RPA to automate repetitive processes and manage the automated payment of experts in P&C [1] Claims.

〉 Natural Language Processing (NLP)

Trend: NLP improves operational efficiency and customer experience by automating processes and delivering personalized interactions.

For example:

- Tractable (UK) uses NLP to automate claims in motor insurance by scanning images of vehicle damage and generating repair estimates. [49]
- Zurich Insurance (Switzerland) analyzes customer sentiment from e-mails and surveys to enhance service quality. [25]

One standout example of AI in the reinsurance space is Munich Re (Germany). The company uses AI to tackle some of the most complex challenges in the industry, such as catastrophe risk modeling and pricing strategies. By analyzing vast data sets, including information from natural disasters, historical events, and climate change projections - Munich Re is improving how it assesses risks and optimizes its pricing models. This cutting-edge approach allows them to better predict and manage risks in an ever-changing environment. [50]

These trends and practices, along with many others, show how AI is doing more than just increasing efficiency and accuracy in the global insurance industry. It's driving innovation, reshaping processes, and creating better experiences for customers. AI is helping insurers and reinsurers alike step into the future, redefining what's possible and setting new standards for the entire industry.

[1] Property & Casualty

2.2.2. Key Characteristics of AI Tools and Services

As the insurance industry increasingly integrates AI tools and services, several key characteristics define their functionality and impact:

1. Data Processing and Predictive Capabilities

AI excels at processing massive amounts of structured data to identify patterns and correlations. These insights are then used to predict future scenarios, making AI an incredibly powerful tool for decision-making. A great example is AI-powered chatbots, which use this capability to hold natural, human-like conversations by recognizing and learning from patterns in customer interactions.

2. Accuracy Depends on Data Quality

The accuracy of AI's predictions is only as good as the data it processes. Both the quantity and quality of the data play crucial roles in determining how precise the outputs are. On top of that, the algorithm behind the AI model significantly influences its predictive power and reliability, making careful selection of tools and approaches essential for success.

3. Human-like, Yet Distinct

AI systems, like large language models (LLMs), are designed to mimic human reasoning by predicting the next word or phrase in a sequence - similar to how predictive text works. While this makes them seem human-like, they don't truly understand what they're saying. Instead, they function as highly sophisticated "*stochastic parrots*", generating outputs based on patterns without actual comprehension.

4. Technological Impact

With the rise of big data, insurers now access unprecedented volumes of information. AI accelerates decision-making by processing IoT-generated data, such as telematics for usage-based insurance, within seconds. This technological shift has redefined efficiency in risk management and operational workflows.

These key characteristics illustrate just how transformative AI has become for the global insurance market. [51]

2.3. AI Strategies of Leading Insurance Players Across Regions

The approaches to AI adoption in the insurance industry vary across regions, reflecting local priorities and market dynamics. Here's a closer look at how insurers in the USA, Europe, and Asia are leveraging AI to reshape the industry:

More precisely:

- **USA**

AI is reshaping the USA insurance industry, and companies are embracing it to work smarter and serve customers better. By fully integrating AI into their operations, adopting cutting-edge technologies, and committing to ethical practices. US insurers are leading the way in innovation and building a stronger, more competitive future. Here are the key strategies driving AI adoption in the US:

- **Comprehensive AI Integration**

In the US, insurers are integrating AI into every corner of their business. From automating underwriting and claims processing to improving customer service, AI helps streamline processes, cut costs, and deliver faster, more accurate results. This holistic approach isn't just about efficiency - it's about creating better experiences for customers. By fully embracing AI, insurers are keeping up with the demands of a competitive market where staying innovative is the key to success.

- **Generative AI Adoption**

Generative AI is quickly becoming a game-changer in the US insurance sector. This technology helps companies personalize customer interactions, automate repetitive tasks, and make sense of huge amounts of data. Whether it's crafting tailored recommendations or speeding up operations, Gen-AI allows insurers to innovate faster and stay ahead of the curve. It's clear that customer-centricity and efficiency are top priorities, and generative AI is helping insurers deliver on both fronts.

- **AI Governance and Compliance**

Given the highly regulated nature of the US insurance industry, companies prioritize building robust governance frameworks to ensure ethical AI deployment. For instance, insurers adhere to standards like the California Consumer Privacy Act (CCPA) to

maintain transparency and accountability. By fostering trust with customers and regulators, these frameworks are essential for long-term success. [52]

❖ EUROPE

Europe's approach to AI in insurance reflects its values: ethical use, strong consumer protection, and customer-centric innovation. By focusing on building trust, aligning with regulations, and understanding customer needs, European insurers are carving a path that balances responsibility with progress - setting a standard for sustainable and impactful AI adoption. Here's a closer look at the key approaches shaping the use of AI in the European Insurance Industry:

- **Ethical and Trustworthy AI**

European insurers are placing a big emphasis on using AI ethically. This means prioritizing transparency, fairness, and data privacy in all AI applications. With strict regulations in place and a strong focus on consumer protection, companies aim to ensure that their AI systems are trustworthy and non-discriminatory. By committing to these values, insurers can build stronger customer relationships, enhance their reputation, and align with Europe's broader commitment to fairness and social responsibility.

- **Regulatory Alignment**

Adapting AI strategies to meet the requirements of the European Union's regulatory frameworks, such as the AI Act, is a top priority. These regulations focus on ensuring AI systems are safe, transparent, and accountable. While complying with these rules might slow down the pace of innovation, it creates a structured and secure environment for deploying AI technologies responsibly. This careful balance between innovation and regulation reflects Europe's dedication to safeguarding society and consumers from potential risks while still fostering technological progress.

- **AI-Driven Customer Insights**

European insurers are using AI to get a better understanding of their customers' needs and preferences. By analyzing data, they can create more personalized and relevant products, boosting customer satisfaction and loyalty. This approach not only helps insurers tailor their offerings but also enables them to spot emerging trends and stay ahead of the competition. In a market where consumer expectations are always evolving, having a customer-focused strategy powered by AI is essential for success. [53] [54] [55]

❖ ASIAN

Asian insurers are setting the pace in AI adoption by focusing on holistic integration, personalized services, and significant investments in technology. These strategies not only reflect the dynamic growth of the region's insurance markets but also highlight how AI is transforming the industry to better meet the needs of customers in a rapidly changing world.

- **Holistic AI Integration**

Asian insurers are weaving AI into every aspect of their business, from engaging with customers to managing risks. This seamless integration helps optimize operations, cut costs, and deliver innovative services. By leveraging AI across the board, insurers can not only improve efficiency but also offer better, faster experiences to their customers. In Asia's rapidly growing insurance markets, where staying competitive means staying innovative, this comprehensive approach is essential.

- **Focus on Personalization**

Personalization is at the heart of AI strategies in Asia. Insurers are using AI-powered tools to create customized products and services tailored to the diverse needs of their customers. This not only enhances customer satisfaction but also builds loyalty by offering solutions that feel relevant and unique. In such a competitive market, personalization is a powerful way for insurers to stand out and differentiate themselves.

- **Investment in AI Infrastructure**

To support their AI ambitions, Asian insurers are making substantial investments in technology and talent. By developing advanced AI infrastructure and hiring skilled professionals, they are ensuring they have the resources needed to innovate and improve operational efficiency. These investments enable insurers to stay ahead of the curve, deploy cutting-edge AI solutions, and maintain a strong competitive edge in a fast-evolving industry. [56] [57]

While the strategies differ across regions, they all share a common goal: harnessing the power of AI to enhance operational efficiency, improve customer satisfaction, and secure a competitive edge. Together, these efforts highlight the transformative role AI plays in reshaping the global insurance industry, paving the way for a smarter and more customer-centric future.

Chapter 3: Adopting Artificial Intelligence in the Greek Insurance Industry: Challenges and Opportunities

The global insurance industry is undergoing a significant transformation, with artificial intelligence leading the way. In Greece, insurance companies are prioritizing digital transformation alongside Environmental, Social, and Governance (ESG) initiatives, which are expected to attract increased investor interest in the near future. Similar to other markets, technology is set to reshape how insurance organizations operate and compete.

While global industry leaders have already embraced AI to enhance efficiency, improve customer experiences, and optimize risk management, the Greek insurance sector is still in the early stages of adopting these innovations. The pace of this transition has been shaped by factors such as economic recovery, regulatory developments, and the unique dynamics of the Greek market. Despite these challenges, AI presents significant opportunities to address long-standing inefficiencies, including issues related to fraud detection, low customer engagement, and outdated operational methods.

AI is increasingly recognized as a powerful tool for improving insurance pricing, ensuring more accurate underwriting, and automating claims processing. In Greece, insurers are beginning to deploy AI-driven solutions to detect fraudulent claims and offer more tailored policy recommendations. However, several challenges must be addressed, including a shortage of skilled professionals, concerns over data privacy, and difficulties in integrating AI with legacy systems. To ensure that AI adoption is ethical, secure, and effective, there is a growing focus on implementing strong governance frameworks that align with evolving regulatory requirements.

This chapter examines how AI can help Greece’s insurance sector bridge the gap with global industry leaders. By analyzing the current state of the industry, the obstacles it faces, and the opportunities available, it underscores the transformative potential of AI. From improving operational efficiency to delivering exceptional customer experiences, AI offers endless possibilities for Greek insurers willing to innovate and adapt to the changing landscape of the future.

3.1. Current Landscape of AI in the Greek Insurance Industry

The Greek insurance sector has been recovering alongside the broader economy after a decade of economic contraction. Challenges stemming from the financial crisis - such as GDP contraction, climate change, investment restrictions, and bond losses - were compounded by pre-existing issues like high guaranteed interest rates and outdated distribution systems. The implementation of Solvency II introduced technical complexities but improved risk management practices, positioning the sector for a more resilient future.

The adoption of artificial intelligence in Greece's insurance sector is a relatively new and underexplored area. Although direct studies are scarce, valuable information can be drawn from related research and the contributions of Greek experts specializing in AI applications for insurance.

Professor Evangelos Tsoukatos from the Hellenic Mediterranean University has made noteworthy contributions through his research on service quality and customer satisfaction within the Greek insurance industry. His work, such as the study titled *"Path analysis of perceived service quality, satisfaction and loyalty in Greek insurance,"* underscores the critical role of service quality in retaining customers. While this research does not specifically focus on AI, it highlights areas where AI technologies could be used to improve service delivery and enhance customer experience. [58]

On a broader scale, the study *"Using artificial intelligence to create value in insurance"* by Riikkinen et al. delves into the ways AI can generate value in the insurance industry. Although this study is not tailored to the Greek context, its findings offer insights into how AI could be applied in Greece to address similar challenges and opportunities. [59]

Additionally, the paper *"Algorithmic Insurance"* by Bertsimas and Orfanoudaki introduces a quantitative framework for assessing risk in machine-driven liability scenarios, offering the concept of algorithmic insurance. This framework could prove highly beneficial for Greek insurers looking to adopt AI-driven decision-making strategies. [60]

In summary, while research on AI integration in Greece's insurance sector is currently limited, existing studies highlight significant potential for AI to enhance service quality, improve risk assessment, and boost operational efficiency. By fostering collaboration between AI specialists and insurance professionals, the Greek industry could unlock new opportunities for innovation and strengthen its competitive edge. This potential is further supported by recent improvements, including market consolidation, the modernization of distribution networks, and the restructuring of legacy products, which have driven strong financial results for key players such as Eurolife ERB and Ethniki. With insurance penetration in Greece at just 2.3% of GDP - well below the EU average of 6.8% - there is substantial room for growth, particularly as state-provided benefits decline and private insurance becomes increasingly attractive. [61]

3.1.1. National Strategy on Artificial Intelligence

AI is a key pillar in Greece's Digital Transformation Bible (DTB), the country's comprehensive strategy for advancing digital transformation. The DTB highlights AI's critical role in fostering innovation, addressing societal challenges, and driving economic growth. It sets actionable goals, such as developing ethical and trust frameworks for AI, implementing data policies, and launching pilot projects across sectors.

Greece is also making significant progress in formulating its National Strategy on AI, aligning closely with the European Union's regulatory framework, including the AI Act. Spearheaded by the Hellenic Ministry of Digital Governance (MDG), this initiative involves collaboration with key stakeholders and experts from Greece and the EU. The strategy emphasizes foundational elements for AI growth, such as skill development, robust data policies, and ethical frameworks, ensuring safe and trustworthy deployment of AI across multiple sectors. [62]

Key updates include:

I. **Alignment with the EU AI Act**: Greece has identified national authorities, such as the Hellenic Data Protection Authority and the National Commission for Human Rights, to monitor and enforce compliance with high-risk AI

applications, including biometrics, law enforcement, and education. Full enforcement powers will take effect in 2026.

II. **Governance Framework Expansion**: Steps have been taken to establish national "notifying" and "market surveillance" authorities by 2025. These bodies will assess and certify high-risk AI systems to ensure compliance with EU and national standards.

III. **Data Regulation and Intellectual Property**: AI applications in Greece are subject to evolving laws on data usage and intellectual property. For instance, databases with machine-generated data may face limitations under the EU Data Act, impacting AI system development.

In November 2023, the Greek government established the High-Level Advisory Committee on Artificial Intelligence under the Prime Minister's office. This committee was tasked with formulating policy recommendations and outlining guidelines for the long-term development of a national AI strategy. Their comprehensive study, *"A Blueprint for Greece's AI Transformation,"* analyzes principles guiding the national strategy and proposes six flagship projects aimed at transforming Greece into a leader in AI applications. [63]

The six proposed flagship projects include:

1. **Positioning Greece as a model in data collection and governance:** Establishing robust data governance practices to create a strong foundation for AI development.
2. **Creating an AI Center of Excellence:** Developing a world-class research and educational hub to drive innovation and entrepreneurship in AI.
3. **Launching a central AI educational platform:** Enhancing AI literacy through resources for teaching, learning, and online collaboration.
4. **Fostering AI ecosystems:** Encouraging the development of AI ecosystems through investments, computational resources, and initiatives like competing to host a European AI Factory.
5. **Developing a data space for the Greek language:** Promoting the inclusion of Greek texts and cultural materials in AI models to preserve and integrate the Greek language in AI technologies.

6. **Establishing a global AI ethics forum and observatory:** Creating a platform to advocate for ethical AI practices and protect democratic principles in the age of AI.

These initiatives reflect Greece's commitment to leveraging AI for economic growth, societal benefit, and the preservation of democratic principles. By focusing on data governance, education, innovation, and ethical considerations, Greece aims to position itself as a leader in the AI landscape. [64] [65] [66] [67]

3.1.2. Key Trends and Practices

The Greek insurance sector is undergoing a steady transformation, fueled by the adoption of AI technologies that are reshaping customer experiences and improving operational efficiency. This shift marks a major transition, as the industry moves away from traditional practices to embrace innovation. In its early stages, AI adoption primarily focused on enhancing customer-facing applications - such as personalized support and seamless service delivery - while optimizing internal processes for greater efficiency.

A notable example of this transformation is ERGO Hellas, which has made significant strides in digital innovation by introducing an AI-powered chatbot called *"Chara."* Launched in January 2023, this virtual assistant operates 24/7, using advanced Natural Language Processing (NLP) to handle customer inquiries in real time. By providing tailored support and achieving high customer satisfaction, *"Chara"* has streamlined the company’s customer service operations and improved the overall user experience. This initiative not only aligns with ERGO Hellas's broader digital transformation goals but also sets a standard for using AI to enhance customer engagement within Greece's insurance industry. [68]

The launch of *"Chara,"* however, is just the beginning of a larger trend sweeping the sector. Soon, many traditional insurance providers in Greece are expected to roll out similar AI-driven solutions for their customers. These advancements will likely include sophisticated chatbots, predictive analytics for risk evaluation, and AI tools for claims processing and fraud detection. Collectively, these innovations are poised to transform

the industry, enabling companies to deliver faster, more personalized, and efficient services.

This wave of AI integration reflects a strategic response to global trends and growing competitive pressures. By focusing on customer-centric technologies and optimizing operations, Greek insurers aim to stay relevant and drive growth in an increasingly digital world. This evolution emphasizes the need for thoughtful planning, regulatory adherence, and ethical responsibility to shape a sustainable future for Greece's insurance sector.

3.2. Challenges and Opportunities in AI Adoption

The Greek insurance industry has traditionally been cautious about adopting new technologies, often waiting to see how innovations succeed in other fields before making a move. While this approach is conservative, it allows Greek insurers to benefit from the lessons learned in sectors like banking, where tools like artificial intelligence (AI) have already made a big impact. Early efforts to integrate AI into Greece's insurance market show promise in boosting efficiency and improving customer service. However, widespread adoption is still held back by challenges such as complex regulations, limited data infrastructure, and resistance to change within organizations. By addressing these obstacles strategically, Greek insurers have the opportunity to embrace AI, evolve into more agile and customer-focused businesses, and gain a competitive edge in an increasingly digital world.

This analysis explores the key challenges and opportunities tied to AI adoption in Greece's insurance industry. It offers a balanced view of the factors driving this transformation while highlighting the critical need to address obstacles to unlock AI's full potential. By tackling these issues strategically, Greek insurers can position themselves for long-term growth and sustainability in an increasingly digital global market. [69]

3.2.1. Challenges

〉 Regulatory and Compliance Concerns

One of the biggest challenges in adopting AI is navigating the regulatory landscape. The European Union's General Data Protection Regulation (GDPR) enforces strict rules on data protection, which directly influence how insurance companies gather, store, and use customer data for AI-driven solutions. On top of GDPR, Greek insurers must adhere to local regulations and industry-specific standards set by organizations like the Bank of Greece (BoG) and the European Insurance and Occupational Pensions Authority (EIOPA).

AI systems often function as "black boxes," making it hard to understand how they make decisions. This lack of transparency raises questions about accountability and

can clash with regulations that demand fairness and explainability, especially in critical areas like policy pricing and claims processing. To overcome these hurdles, insurers need to focus on building interpretable AI models and working closely with regulators to create clear, practical guidelines for using AI in the insurance sector.

〉 Data Quality and Privacy

AI depends on high-quality, comprehensive data to work effectively. Unfortunately, many Greek insurance companies still rely on outdated, fragmented systems, leading to incomplete or inconsistent data. This limits what AI systems can do and increases the chances of inaccurate predictions and recommendations.

Data privacy is another major concern. To encourage customers to share sensitive personal and financial information, insurers need to implement strong data security measures and be transparent about how the data will be used. Building trust is crucial to addressing this challenge and unlocking the full potential of AI in the industry.

〉 High Implementation Costs

The cost of adopting AI technologies can be a significant barrier, especially for smaller or mid-sized Greek insurance companies. The upfront investments in infrastructure, software, and skilled personnel are considerable, and the ongoing expenses for maintaining and upgrading AI systems add further financial pressure.

For many insurers, the lack of in-house expertise means they have to depend on external vendors or consultants. This not only drives up costs but can also limit their ability to customize AI solutions to fit their specific needs.

〉 Talent Shortages

The lack of skilled AI professionals in Greece is a significant challenge. Building, deploying, and managing AI systems require expertise in areas like data science, machine learning, and cybersecurity—skills that are in high demand but not widely available. This talent shortage often pushes insurers to rely on external partners, which can delay implementation and drive-up costs.

〉 Cultural Resistance to Change

Cultural resistance is another obstacle to AI adoption in Greece's insurance sector. Employees used to traditional workflows may see AI as a threat to their job security,

making them hesitant to embrace new technologies. At the same time, customers may distrust AI-driven decisions, especially in sensitive areas like claims and pricing, fearing they might lack fairness or the human touch. [13, p. 5]

3.2.2. Opportunities

〉 Enhanced Customer Experiences

AI has the power to transform customer experiences in meaningful ways. By using advanced machine learning and natural language processing (NLP), insurers can deliver personalized services that cater to each customer's unique needs. AI-driven tools also enable insurers to anticipate customer requirements, offering customized policy recommendations and proactive communication. This approach helps build stronger relationships, fostering loyalty and improving customer retention.

〉 Operational Efficiency

AI has the potential to greatly improve operational efficiency by automating time-consuming tasks and reducing costs. For example, claims processing, which is often a lengthy and resource-heavy process, can be streamlined using AI systems that analyze claims data, spot anomalies, and provide real-time recommendations. AI also shines in fraud detection. Machine learning algorithms can identify patterns that suggest fraudulent behavior, helping insurers minimize risks and cut financial losses.

〉 Competitive Advantage

Greek insurers who adopt AI early have the opportunity to position themselves as market leaders. By offering innovative, technology-based solutions, they can stand out from competitors both locally and internationally. This is especially important for appealing to younger, tech-savvy customers who value convenience and efficiency. In addition, AI-driven insights enable insurers to make smarter, data-informed decisions, whether it's refining pricing strategies or developing new products. This proactive approach helps them stay ahead of market trends and maintain a competitive edge.

〉 Cost Reduction

Although the upfront investment in AI implementation is significant, the long-term cost savings can be substantial. Automating routine tasks like document processing and

risk assessment not only reduces operational expenses but also frees up human resources for more strategic, high-value activities, ultimately boosting efficiency and profitability. AI-driven predictive analytics further cuts costs by improving risk assessment accuracy, leading to better underwriting decisions and fewer claims disputes.

〉 Creation of New Revenue Streams

AI enables the development of innovative insurance products that align with changing customer needs. For instance, usage-based insurance (UBI), powered by telematics and IoT devices, allows insurers to offer flexible, real-time policies. These dynamic offerings appeal to customers seeking personalized solutions, while also creating new revenue opportunities for insurers.

〉 Enhanced Compliance and Risk Management

AI plays a key role in simplifying compliance by automating regulatory reporting and ensuring adherence to complex policies like Solvency II. Additionally, advanced AI tools for risk assessment help insurers identify and address vulnerabilities proactively, strengthening their overall resilience and operational stability. [13, p. 4]

3.3. Strategic Recommendations of AI Adoption Gap

As analyzed in the previous chapter, leading markets like the United States, Europe, and parts of Asia are at the forefront of AI adoption in the insurance industry. Insurers in these regions have made significant investments in AI technologies to enable personalized underwriting, dynamic pricing, fraud detection, and improved customer service. Global markets have adopted different strategies to tackle regulatory challenges:

- **European Union:** Focuses on strict compliance with frameworks like GDPR, emphasizing data privacy, ethical AI use, and transparency.
- **United States:** Takes a market-driven approach, prioritizing innovation and flexibility with fewer centralized regulations.
- **Asia:** Follows a mixed model, with countries like China balancing government-led AI advancements and new privacy laws.

A common trend across these regions is the growing demand from younger, tech-savvy customers for personalized, digital-first insurance experiences. In response, insurers are integrating AI into omnichannel platforms to boost customer engagement and retention.

In Greece, AI adoption in the insurance industry is progressing but at a slower pace compared to global leaders. Greek insurers have concentrated on customer-facing applications like chatbots and automated claims processing. While these initial efforts reflect an awareness of AI's potential, they also underscore the challenges slowing broader adoption:

- Complex regulatory requirements influenced by both EU and national policies.
- Limited resources and fragmented data infrastructures.
- Cultural resistance to change within organizations.

To bridge the gap with global trends, Greek insurers must strategically address these challenges while seizing opportunities for innovation and growth.

More specifically,

1. Investment in AI Infrastructure

For effective AI adoption, Greek insurance companies must prioritize upgrading their technology. This includes:

- **Modernizing Legacy Systems:** Transitioning from outdated IT systems to cloud-based platforms is crucial for scalability and real-time data processing. Platforms like AWS, Microsoft Azure, and Google Cloud offer tools for integrating machine learning models and big data analytics.
- **Strengthening Cybersecurity:** With insurers handling sensitive personal and financial data, robust cybersecurity measures are essential. This includes multi-layered defenses like data encryption, secure APIs, and AI-driven intrusion detection systems to minimize cyber risks.
- **Leveraging Strategic Partnerships:** Collaborating with fintech and insurtech startups can speed up AI adoption by providing pre-built solutions for underwriting, fraud detection, and customer service, saving time and reducing development costs.

2. Scaling AI Adoption Incrementally

Start with small-scale AI deployments in areas such as automated claims processing or fraud detection to showcase return on investment (ROI) and optimize processes. Gradually expand successful pilots, using the returns to fund broader AI adoption. U.S. insurers frequently adopt phased implementation strategies, focusing on measurable results before scaling up, which can serve as a valuable model.

3. Implementation of Robust Data Governance Frameworks

High-quality data is the foundation of effective AI systems. To tackle fragmented data systems, insurers should:

- **Establish Centralized Data Repositories:** Building unified data lakes or warehouses enables seamless access to structured and unstructured data, improving AI reliability.
- **Ensure GDPR Compliance:** Greek insurers should create in-house compliance teams specializing to AI-related regulations. Working closely with EU bodies and local regulators will help clarify the requirements for new AI applications. To align

with GDPR, insurers must secure explicit customer consent for data usage, anonymize sensitive data to protect privacy, and conduct regular audits of data management processes to ensure compliance.

- **Enhance Data Quality Management:** Using AI tools to clean and preprocess legacy data ensures historical records are usable. NLP can digitize and analyze unstructured documents, such as handwritten claim forms, improving data readiness for AI applications.

4. Development of Human Capital and Workforce Skills

A skilled workforce is essential. More specifically,

- **Invest in Employee Training:** Organize workshops and training sessions to help employees understand AI technologies and their potential. Emphasize that AI serves as a tool to enhance their roles, not replace them, fostering a positive mindset and encouraging adoption within the organization.
- **Recruit AI Specialists:** Hiring data scientists, AI engineers, and cybersecurity experts is critical. Competitive salaries and partnerships with universities can attract top talent.
- **Create Cross-Functional Teams:** Combining AI professionals with insurance experts ensures that AI solutions align with business objectives and address customer needs effectively.

5. Promotion of Transparency and Ethical AI

Building trust in AI systems is vital for customer acceptance and compliance.

- **Adopt Explainable AI (XAI):** Using interpretable AI models allows stakeholders to understand the reasoning behind automated decisions. For example, XAI can clarify risk factors in claim denials, fostering transparency.
- **Establish Ethical AI Guidelines:** Developing ethical standards ensures fairness and prevents discrimination in areas like pricing and underwriting. Regular audits can identify and mitigate biases.
- **Communicate AI Benefits to Customers:** Educate customers about how AI enhances services, such as speeding up claims or improving fraud detection. Sharing success stories can further build confidence in AI-driven solutions.

6. Alignment of AI Strategies with Business Objectives

For successful AI integration, insurers must align AI initiatives with their business goals.

- **Focusing on Customer-Centric AI Applications:** AI tools should enhance customer experience, such as through 24/7 chatbot support or predictive analytics for personalized policy recommendations.
- **Optimizing Operational Processes:** Automating tasks like claims processing and policy renewals can cut costs and improve efficiency. Robotic Process Automation (RPA) can streamline workflows, reducing manual errors and delays.
- **Establishing Key Performance Indicators (KPIs):** Metrics such as customer satisfaction, claim processing times, and fraud detection rates should be monitored to measure AI's impact and guide future investments.

The strategic recommendations outlined above offer a clear roadmap for Greek insurance companies to successfully embrace AI technologies. By focusing on upgrading infrastructure, enhancing workforce skills, ensuring transparency, fostering collaboration, and aligning AI initiatives with business goals, insurers can overcome the challenges of AI integration and harness its transformative potential. Adopting these strategies will not only boost operational efficiency and customer satisfaction but also position Greek insurers as strong competitors in the global insurance market.

[70] [71]

Chapter 4: The Ethical and Societal Dimensions of AI in the Insurance Industry

Ethics involves the study of moral principles that define right and wrong behavior. However, ethical reasoning is rarely black and white - it's a complex and nuanced field that explores the principles behind moral and immoral actions. Different ethical theories provide structured ways to evaluate decisions, helping us understand why some choices may be more justifiable than others. Among the most well-known approaches are consequentialism and deontology, each offering a unique perspective on moral decision-making.

Consequentialism determines whether an action is ethical based on its outcomes. One of its most influential branches, utilitarianism - championed by philosophers Jeremy Bentham and John Stuart Mill - argues that the best course of action is the one that creates the greatest overall benefit while minimizing harm. This idea plays a major role in AI, where ethical decision-making often revolves around maximizing positive societal impact. For example, AI-driven advancements in healthcare, automation, and efficiency reflect utilitarian thinking by focusing on the bigger picture - saving lives with predictive diagnostics or streamlining processes to reduce waste. However, this approach also raises concerns, as prioritizing the greater good can sometimes lead to job losses, biases, or privacy risks, all of which must be carefully addressed.

Deontology, on the other hand, focuses on following moral rules and duties rather than just looking at the consequences of an action. Immanuel Kant’s concept of the categorical imperative highlights the importance of universal moral principles (rules that should be upheld no matter the potential benefits). In AI ethics, a deontological approach emphasizes values like privacy, fairness, autonomy, and informed consent, even if ignoring these principles could result in significant advantages. For example, AI-powered surveillance might improve security, but from a deontological standpoint, protecting individual privacy and preventing unnecessary monitoring are non-negotiable ethical priorities.

While consequentialism and deontology provide clear ethical frameworks, they are not the only ways to think about morality - especially when it comes to AI and technology. Other perspectives add even more depth to ethical discussions. Virtue ethics, rooted

in Aristotle's philosophy, focuses on developing moral character rather than strictly following rules or assessing consequences. Feminist ethics of care, introduced by scholars like Carol Gilligan, emphasizes relationships, compassion, and the moral significance of human connection. Additionally, religious traditions, interdisciplinary fields like computer ethics, and emerging discussions in technology ethics all contribute to this ongoing conversation.

At its heart, ethics is a deep human experience. It reflects our ability to empathize, build connections, and critically examine how our actions shape society. Addressing the ethical challenges of AI requires more than just following rigid rules or making calculations based purely on outcomes. Instead, it calls for a well-rounded approach - one that brings together different ethical perspectives to promote well-being, empathy, and our shared humanity. As technology continues to reshape our world, adopting this broader ethical mindset is crucial for navigating its far-reaching impact responsibly.

[72, pp. 19-22] [73] [74] [75]

4.1. Balancing the Ethical Purposes of AI

Understanding AI ethics requires a deep exploration of its intended purposes, applications, and unintended consequences. One of AI's most distinctive features is its adaptability, which allows it to be used in ways its creators never anticipated. This adaptability has fueled incredible innovations, but it also raises serious ethical questions. AI has the power to drive positive changes, from revolutionizing healthcare to transforming education, but it can also be misused - threatening privacy, reinforcing discrimination, or valuing efficiency over human dignity.

When examining AI's role in society, researchers have identified three key priorities that shape its development and use: efficiency, social governance, and human well-being. These priorities are deeply connected, and while they sometimes seem to be in conflict, they don't have to be. The challenge is to strike a balance - ensuring AI serves society without undermining fundamental human rights and values.

Efficiency is about making things quicker, cheaper, and more productive. It fuels economic growth and drives new possibilities, but an overemphasis on efficiency can come at a cost. Ethical concerns and social impact can get sidelined, leading to

unintended harm. Take workplace surveillance, for instance, some companies use AI to track employee activity, arguing that it boosts productivity. But critics warn that constant monitoring can create stressful, dehumanizing environments that prioritize efficiency over worker well-being. Similarly, AI-powered hiring tools may speed up recruitment, but if they're not carefully designed, they can reinforce existing biases, disproportionately disadvantaging certain groups.

Social governance, on the other hand, relies on AI's ability to process vast amounts of data to guide or regulate human behavior. In some cases, this can be beneficial - helping governments run effective public health campaigns or encouraging ethical business practices. But if mismanaged, it can become a tool for excessive surveillance and restriction of personal freedoms, raising urgent questions about how to balance governance with individual rights.

Of all AI's potential uses, the most ethical and forward-thinking goal is its ability to enhance human well-being. Unlike efficiency or social governance, this approach prioritizes values like empathy, fairness, and sustainability. Research from the University of Twente highlights how AI, when developed with these principles in mind, can empower communities and foster a more just and equitable society. The conversation is no longer just about what AI can do, it's about what AI should do. If we want AI to work for people rather than for corporate profits or government agendas, we need to build systems that reflect our highest ethical standards. [76]

Thoughtfully designed AI can balance these objectives, driving both economic progress and social good. The real challenge is preventing any one goal from dominating at the expense of the others. AI is more than just a tool; it's a reflection of the values we embed in it. To ensure it serves all of humanity, we need collaboration across fields, bringing together ethicists, technologists, policymakers, and communities to shape AI systems that align with our shared human values.

[72, pp. 23-27] [77]

4.2. Core Ethical Principles

To balance efficiency, social control and human flourishing, AI must be built on six key ethical principles:

1. Respect for Human Autonomy

AI should empower individuals by ensuring they have full control over their data and decision-making. This means prioritizing informed consent - giving people the choice to opt in or out of AI-driven processes. Ethical user engagement is key, and AI systems must avoid manipulative tactics that could undermine personal autonomy.

2. Prevention of Harm

AI should be built with safety in mind, protecting both individuals and society. This includes reducing biases, strengthening cybersecurity, and addressing vulnerabilities that could expose AI to malicious attacks.

3. Fairness and Non-Discrimination

AI must be designed to treat everyone fairly, without reinforcing biases or discrimination. Developers need to actively identify and correct both obvious and hidden biases, especially in high-stakes areas like healthcare, finance, and insurance. In insurance specifically, AI should ensure fairness in underwriting, pricing, and claims processing, so that all users receive equitable treatment.

4. Transparency and Explainability

AI decision-making should be clear and understandable, allowing people to see how conclusions are reached. Explainability builds trust by enabling users, regulators, and affected parties to scrutinize AI-driven decisions. This is particularly crucial in industries like insurance, where accountability and consumer confidence are essential.

5. Accountability

Those who create, deploy, and regulate AI must take responsibility for its impact. Clear accountability frameworks should be in place so that if an AI system malfunctions, causes harm, or produces unintended consequences, responsibility can be traced. This is especially important in insurance, where AI errors can have serious financial and personal effects.

6. Sustainability and Environmental Impact

AI should be developed with sustainability in mind, focusing on energy efficiency and reducing resource consumption. As technology advances, it's essential to ensure that AI contributes positively to society without harming the environment.

[72, pp. 28-29] [78, pp. 27-37] [79] [80] [81]

4.3. The Difference Between "Ethics of AI" and "Ethical AI"

AI ethics revolves around the moral principles that guide the development, deployment, and use of intelligent systems. It encompasses two key areas: roboethics, which examines how human actions impact AI and its role in society, and machine ethics, which focuses on ensuring AI systems behave in morally responsible ways.

Some of the biggest ethical concerns in AI include data bias, privacy issues, transparency, job displacement, wealth inequality, and even the question of robot rights as AI technology advances.

Machine ethics plays a critical role in shaping AI behavior to align with human values. One of the earliest frameworks, Isaac Asimov's "*Three Laws of Robotics,*" offers a starting point for governing AI, though they may need updates to address the complexities of modern intelligent systems and their interactions with one another.

By fostering a deeper understanding of AI ethics and applying responsible development practices, we can ensure that AI technologies serve humanity in a positive way, operate with integrity, and minimize potential risks to individuals, society, and future intelligent systems.

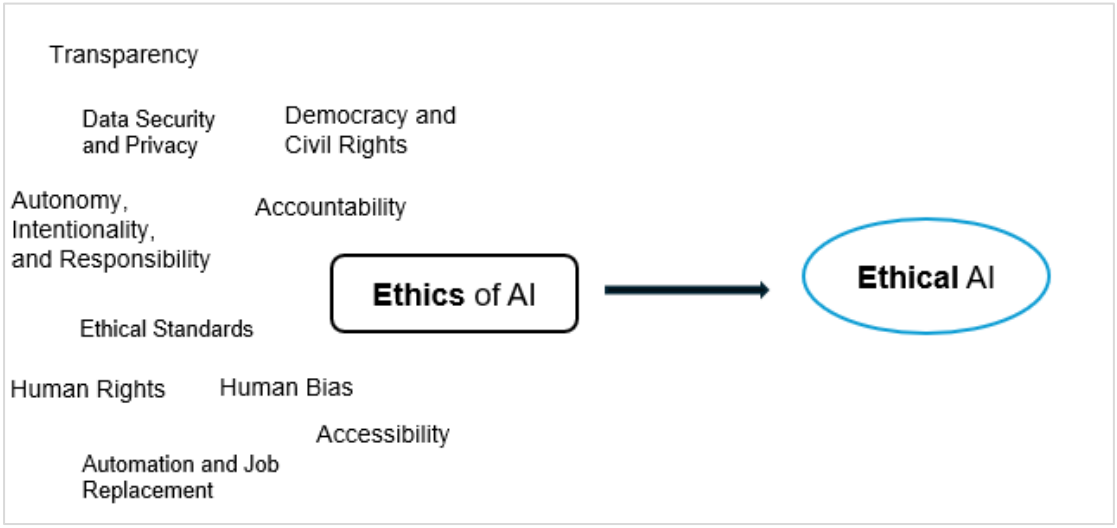
Table 10 – Understanding the Difference [81, p. 74]

	AI	Human	Society
Ethics of AI	Principles of developing AI to interact with other AIs ethically.	Principles of developing AI to interact with human ethically.	Principles of developing AI to function ethically in society.
Ethical AI	How should AI interact with other AIs ethically?	How should AI interact with humans ethically?	How AI should operate ethically in society?

Defining and implementing AI ethics in the insurance industry is a complex, multi-layered challenge. While ethical AI should prioritize "doing no harm," this raises deeper questions about fairness in underwriting, claims processing, and risk assessment. Ensuring AI-driven insurance decisions uphold human rights and avoid unintended harm requires long-term commitment, ethical awareness, and collaboration across stakeholders.

To build trust and accountability in AI-powered insurance systems, strong governance frameworks, regulatory compliance, and industry self-regulation are essential. Laws such as anti-discrimination policies and data privacy regulations play a key role in protecting policyholders. However, these legal safeguards must be reinforced by industry-driven efforts, including transparent communication, explainable AI models, and public education on AI-driven insurance processes. By prioritizing ethical AI, insurers can enhance customer trust, mitigate risks, and create a more equitable and inclusive insurance landscape. [81, pp. 82-83]

Table 11 - Fostering Ethical AI [81, p. 83]

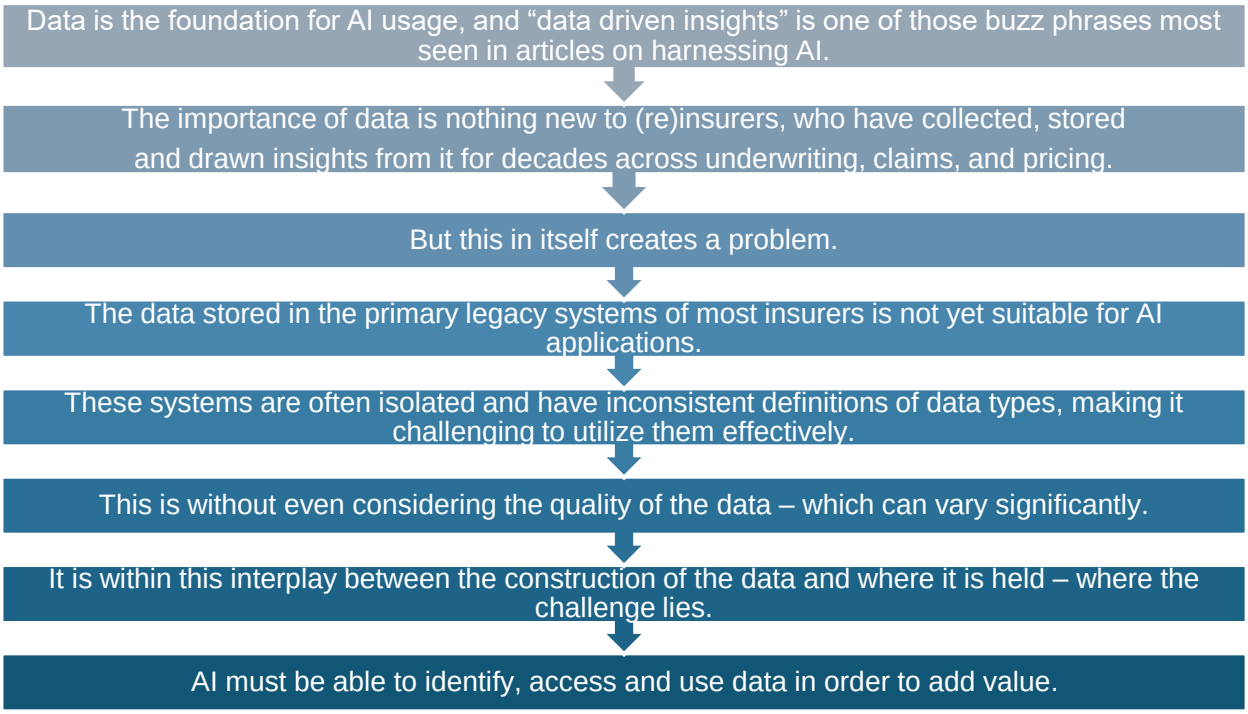


4.4. Ethical Concerns and Risks in AI Applications in the Insurance Industry

At this stage, it is essential to address several critical ethical concerns and risks associated with the application of AI technologies in the insurance sector. These concerns are pivotal in ensuring AI is used responsibly and do not undermine fundamental ethical principles.

1. **Data Quality and Privacy**: One of the most significant issues lies in the quality, accuracy, and integrity of the data used by AI systems. AI relies on various data types - provided, observed, derived, inferred, and synthetic - each with different levels of reliability that can significantly impact outcomes. The large-scale collection and processing of data for insights and predictions raise serious ethical concerns regarding privacy, ownership, and consent. Individuals may not fully understand how their personal data is being used, increasing the risk of misuse and non-consensual processing. Additionally, bias embedded in datasets can reinforce societal inequalities, leading to unfair treatment of certain groups in underwriting, pricing, or claims decisions.

Table 12 – The data challenge for insurers [17, p. 12]



2. **Transparency Challenge:** AI systems, particularly ML models, are often criticized for their lack of transparency, commonly referred as the *"black boxes"* problem. The complexity of these algorithms makes it difficult to understand how they generate decisions, creating ethical and regulatory challenges. Without transparency, it becomes nearly impossible to assess whether AI-driven outcomes are fair, unbiased, and aligned with ethical standards. This opacity raises concerns about discrimination, accountability, and the potential for unjust outcomes, especially in underwriting, claims processing, and pricing models.

3. **Excluding Customers:** AI's ability to analyze risk in extreme detail is transforming traditional risk-sharing models in insurance. Instead of grouping people into broad categories, AI allows insurers to price policies at an individual level. While this can mean lower premiums for some, it also creates a major ethical dilemma - what happens to those deemed high-risk? Some individuals may face higher costs or even become uninsurable, making access to coverage more unequal.

4. **Bias:** One of the biggest ethical challenges with AI is bias, particularly when it leads to unfair treatment based on gender, race, ethnicity, or income. In insurance, AI models rely on historical data, which may already contain deep-rooted societal biases. If these biases go unchecked, AI could end up reinforcing discrimination, resulting in unjust pricing, denied coverage, or unfair risk assessments for certain groups.

These concerns underscore the importance of responsible AI implementation in the insurance sector. Ensuring data integrity, transparency, and inclusivity is essential for AI to have a positive impact, while also upholding fairness, protecting individual rights, and maintaining consumer trust. [17] [82, p. 4]

4.5. The Transformative Impact of AI on the Insurance Workforce and Global Economy

AI is fundamentally transforming the insurance industry worldwide, altering the nature of work, employee roles, and economic structures. While AI increases efficiency, it also raises concerns about job displacement, workforce polarization, and ethical risks.

AI-driven automation is streamlining repetitive tasks like data processing, underwriting, and customer service, allowing employees to focus on higher-value roles. However, this shift brings job displacement anxiety, particularly for workers in routine-based positions. While AI can improve job satisfaction by eliminating mundane tasks, successful role transitions require upskilling and adaptation.

The rise of AI is also leading to workforce polarization, where high-skilled roles in AI and data analytics are growing, while low-skilled jobs are shrinking. Younger employees often adapt more quickly, while older workers may struggle with reskilling, widening the generational skills gap. Companies must invest in AI training to ensure an inclusive and adaptable workforce.

Economically, AI enhances cost efficiency and productivity, enabling dynamic pricing, fraud detection, and predictive analytics. However, it also exacerbates wage disparities, with high-skilled professionals benefiting from wage premiums while routine-based workers face stagnant wages. Additionally, AI fosters global job redistribution, benefiting emerging economies while posing job security risks in developed nations.

Despite its advantages, AI introduces ethical and regulatory concerns, including algorithmic bias, data privacy risks, and transparency issues. AI-driven decisions must be fair, explainable, and compliant with global regulations to maintain public trust.

Ultimately, striking a balance between technology and human expertise will be key to a sustainable workforce transformation. Rather than replacing employees, AI should be leveraged to enhance decision-making, drive innovation, and create new opportunities, ensuring a balanced, ethical, and future-ready workforce.

[12, pp. 1-14] [81, pp. 77-82] [83, pp. 205-241] [84] [85, pp. 45-53] [86] [87] [88] [89]

4.6. The Interplay Between Ethics and Law in AI Regulation

The relationship between ethics and law is often seen as complex, with the two traditionally viewed as distinct - sometimes even conflicting - domains. Ethics is frequently considered a complement to legal frameworks, extending beyond formal regulations. Under this perspective, individuals and organizations may find themselves navigating separate legal and ethical responsibilities that do not always align. However, this distinction is increasingly being reconsidered, particularly in the evolving landscape of artificial intelligence governance.

Legal frameworks frequently incorporate ethical principles, as seen in regulations such as anti-discrimination laws and data protection policies, which reflect essential societal values. Additionally, ethics can function as a form of *"soft law,"* influencing industry standards even in the absence of formal legal requirements. Many businesses, for example, adopt ethical AI principles to align with global best practices, even in areas where specific regulations remain underdeveloped.

The convergence of ethics and law is particularly evident in AI governance. The widespread adoption of AI technologies presents profound ethical and societal concerns that existing legal frameworks may not yet comprehensively address. Recognizing and managing this interplay is essential for establishing reliable and ethically responsible AI systems, especially in heavily regulated sectors such as insurance. [90]

This section explores ethical standards and regulatory frameworks shaping AI's role in the insurance industry. As AI continues to advance, regulators and policymakers have introduced guidelines to ensure its responsible and fair use, particularly in areas where ethical considerations intersect with compliance requirements. Central to these frameworks is the principle of fairness, which mandates transparency and equitable AI applications to prevent inadvertent discrimination.

For the insurance industry, these ethical and regulatory frameworks provide a foundation for internal policies that go beyond legal compliance, fostering responsible AI adoption. Insurers must align their AI initiatives with regulatory requirements while integrating ethical principles that reflect the expectations of both policymakers and

consumers. By doing so, the industry can mitigate risks, foster consumer trust, and drive innovation within a framework of ethical accountability.

4.6.1. European Union

The European Union (EU) has taken a leading role in shaping ethical AI regulation, introducing comprehensive legislative measures to ensure transparency, fairness, accountability, and resilience in AI applications. Key regulations such as the Artificial Intelligence Act (AIA), General Data Protection Regulation (GDPR), Digital Operational Resilience Act (DORA), and sector-specific directives (e.g. Solvency II and Insurance Distribution Directive) provide clear guidelines for how AI should be integrated into the insurance industry. Insurers must align their AI applications with these standards to avoid penalties and maintain customer trust.

The AIA is the world's first comprehensive AI law, classifying AI applications into four risk levels based on their potential impact on human rights, privacy, and safety. By applying this approach, it ensures that AI-driven insurance applications do not reinforce discrimination or create opaque decision-making processes. For example, AI models used to assess personal characteristics or behaviors for insurance risk must follow strict ethical guidelines to prevent unjust discrimination. This legislation is part of the EU's broader digital strategy, which seeks to align AI technologies with European values, including fundamental rights, social inclusion, and ethical business practices. This legislation officially took effect on August 1, 2023. [91]

However, the AIA does not replace existing EU laws, so insurers must also comply with other key regulations. For instance, the Product Liability Directive (PLD) holds companies accountable for any damage caused by AI-driven products, reinforcing consumer protection. Similarly, the General Data Protection Regulation (GDPR), governs the use of personal data in AI models, ensuring privacy and granting consumers the right to know how their data is processed.

In addition to these frameworks, the Digital Operational Resilience Act (DORA), coming into effect in January 2025, aims to strengthen cybersecurity in financial services, including insurance. As a result, AI vendors and technology providers may

also fall under DORA's requirements. To ensure compliance with Article 30 of the regulation, insurers must establish contractual agreements with these providers.

Beyond general AI regulations, insurers must also navigate sector-specific directives, including:

- **Solvency II:** This directive governs insurance and reinsurance firms within the EU, requiring them to maintain financial stability and implement effective risk management strategies. With AI playing an increasing role in automated risk assessment and actuarial modeling, insurers must ensure that AI-driven financial decisions align with regulatory governance.

- **Insurance Distribution Directive (IDD):** IDD sets standards for insurance product design, distribution, and consumer protection. As AI-driven insurance recommendations become more prevalent, it ensures that insurers remain accountable for ethical and fair AI usage, maintaining transparency in how AI-driven advice is provided to customers.

[82, pp. 5-6] [92]

4.6.2. United Kingdom

The United Kingdom (UK) is shaping a regulatory framework to encourage innovation while ensuring ethical use, particularly in industries like insurance. In March 2023, the UK government introduced a white paper, *"A Pro-Innovation Approach to AI Regulation,"* outlining five key principles:

5. **Safety, robustness and security:** Ensuring AI systems operate reliably and securely.
6. **Transparency and explainability:** Providing clear insights into AI decision-making processes.
7. **Fairness:** Preventing discrimination and bias in AI applications.
8. **Accountability and Governance:** Establishing clear responsibility for AI-driven outcomes.
9. **Contestability and Redress:** Allowing challenges to AI decisions and providing mechanisms for redress. [82, p. 6]

Instead of introducing immediate AI-specific laws, the government empowers existing regulators to apply these principles across industries.

Key regulators, such as the Information Commissioner's Office (ICO) and the Financial Conduct Authority (FCA), oversee AI compliance in insurance underwriting, claims, and risk assessment. The FCA warns against AI-driven hyper-personalization, which could make some individuals uninsurable or lead to unfair pricing models. Insurers must actively monitor and mitigate AI biases to protect consumers.

In September 2024, the UK became the first country to sign an international AI treaty drafted by the Council of Europe [93]. This legally binding agreement enforces human rights protections, mandates AI impact assessments, and promotes ethical AI use in both public and private sectors.

[94] [95]

4.6.3. United States

AI regulation in the United States (US) insurance industry is rapidly evolving, shaped by federal guidance, state initiatives, and industry self-regulation. Unlike the European Union's centralized approach, the U.S. lacks a single federal AI law governing insurance.

The National Association of Insurance Commissioners (NAIC) has introduced foundational AI principles emphasizing fairness, transparency, accountability, compliance, and security, providing a framework for state regulators and insurers to adopt responsible AI practices. [96]

Some states have taken proactive steps to regulate AI in insurance. Colorado's AI Insurance Regulations, effective November 2023, require life insurers to prevent AI-driven discrimination against protected groups. Additionally, Colorado plans to introduce a broader AI governance framework in 2026, though insurers remain exempt due to existing state laws.

Several other states have begun adopting NAIC's AI guidelines or similar policies in early 2024, signaling a nationwide shift toward aligning AI with consumer protection laws. This evolving regulatory landscape reflects a growing effort to balance AI innovation with ethical and legal safeguards in the insurance industry. [82, p. 6] [97]

4.6.4. Asian Pacific Region

The Asia-Pacific (APAC) region is rapidly advancing AI regulations, with various countries adopting unique approaches to ensure ethical and responsible AI deployment, particularly in insurance. As of August 2024, [98] at least 16 jurisdictions across APAC have introduced AI-related guidelines or regulatory frameworks.

More specifically,

China: As one of the leading nations in AI governance, China has introduced national laws like the *"Regulations on the Management of Deep Synthesis Technology," which prioritize* consumer protection, data privacy, and responsible AI deployment.

Japan: AI regulations in Japan emphasize ethical AI and consumer rights, particularly in financial sector. The Financial Services Agency (FSA) is developing frameworks to align AI with existing laws, including those on data privacy.

South Korea: The “AI Industry Fostering Act” in 2023, aims to build a trustworthy AI ecosystem, with a focus on high-risk AI applications that impact human lives, including those used in insurance.

Vietnam: The Vietnamese government promoting AI adoption in insurance, especially in product distribution. However, specific AI regulations for the insurance sector are still under development.

India and Southeast Asia: While India is advancing AI governance frameworks, its regulatory development is still early stages compared to other regions. Countries like Malaysia have implemented the “National AI Roadmap,” which outlines seven responsible AI principles, while Thailand is developing its national AI strategy to shape future policies on ethical AI use.

Despite variations in AI regulations across APAC, there is a clear trend toward ensuring transparency, fairness, and accountability in AI applications. The Association of Southeast Asian Nations (ASEAN) is working to standardize AI governance among its member states, aiming for regulatory consistency while considering each country’s socio-economic context. [99] [100]

4.6.5. International Community

The international community is increasingly recognizing the importance of cohesive AI governance to ensure ethical deployment, particularly in sectors like insurance. This has led to major initiatives, including the *Framework Convention on Artificial Intelligence*, signed in September 2024 by the US, UK, EU, and other nations, marking the first legally binding AI treaty to uphold human rights, democracy, and the rule of law.

In the insurance sector, the International Association of Insurance Supervisors (IAIS) is developing guidelines to ensure AI-driven operations meet high standards of governance, risk management, fairness, and transparency. Proper oversight, including human intervention and continuous monitoring, is essential to mitigate risks such as

bias and opaque decision-making. While regulatory approaches vary across jurisdictions, there is a collective effort to create a globally coordinated AI framework that ensures compliance, consumer protection, and innovation.

Beyond national regulations, organizations like the Organization for Economic Co-operation and Development (OECD) and United Nations Educational, Scientific and Cultural Organization (UNESCO) are shaping global AI ethics. The OECD's AI Principles (FACTS) promote fairness, accountability, transparency, and security, while UNESCO's AI ethics framework emphasizes data protection, transparency, and bias mitigation. These global initiatives complement national efforts, ensuring AI development remains ethical, transparent, and beneficial to society while addressing emerging risks in insurance and beyond. [82, p. 6] [101]

4.7. Comparative Analysis & Recommendations

As AI becomes increasingly embedded in insurance operations, issues surrounding governance, ethics, and regulation have become critical focal points. Ensuring that AI systems operate fairly, transparently, and accountably requires a comparative analysis of global regulatory frameworks, a thorough examination of ethical risks, and the development of best practices for responsible implementation.

4.7.1. Comparative Governance Approaches to AI Regulation

As AI becomes a crucial part of the insurance industry and other sectors, the different global regions, as previous mentioned, have adopted distinct governance models to balance innovation, ethical oversight, and regulatory compliance. While some emphasize strict legal frameworks, others rely on industry-driven self-regulation or state-led innovation. Below is a comparison of AI governance approaches in the EU, the U.S., and Asia.

Table 13 - Comparative Governance Approaches

	Strengths	Gaps
EU	Robust Legal Frameworks: Regulations like the GDPR ensure ethical AI use, enforcing data privacy, informed consent, and non-discrimination.	Strict compliance requirements can slow innovation, making it harder for smaller firms to keep up with regulatory demands.
	Stakeholder Engagement: allows diverse perspectives in policymaking, aligning insurance regulations with societal needs.	A rigid regulatory approach may hinder AI adoption, especially in industries that need flexibility and rapid technological progress.
US	Companies can experiment and implement AI quickly.	Inconsistent Regulations – With AI laws varying by state, insurers face complex compliance challenges, making it harder to operate seamlessly across different regions.
	Tech giants set global AI standards.	The lack of a unified national AI framework leaves room for bias, unfair decision-making, and accountability concerns, especially in insurance pricing and claims processing.
ASIA	Significant state funding in AI infrastructure has accelerated technological innovation, ensuring rapid deployment of advanced AI systems with built-in ethical safeguards.	A lack of public oversight and regulatory openness can weaken trust, especially in cross-border insurance, where concerns over data privacy and fairness are more pronounced.
	Countries in Asia are actively working together to align AI regulations, promoting consistency and interoperability, particularly in sectors like insurance and finance.	In some cases, economic and political goals take precedence over individual rights and fairness, raising concerns about bias, discrimination, and consumer protection in AI-driven decision-making.

[72] [80] [88] [102] [103, pp. 53-84]

4.7.2. Ethical Considerations in AI-Driven Insurance

The integration of AI in insurance offers significant benefits, but it also raises ethical concerns that must be carefully managed. Ensuring fairness, transparency, and accountability is essential to guarantee that AI-driven processes are applied responsibly and equitably, minimizing risks such as bias, lack of explainability, and unclear accountability. By proactively addressing these challenges, insurers can harness AI's potential while maintaining trust, compliance, and ethical integrity in their operations.

One of the most pressing challenges is **fairness**. Although insurers may attempt to eliminate bias by removing sensitive variables like gender or ethnicity, AI models can still rely on correlated factors, leading to indirect discrimination in risk assessments. Additionally, the concept of fairness varies across different regions - while Europe emphasizes group equity, the United States focuses more on individual rights, making global implementation complex. To address these concerns, insurers must develop fairness-aware algorithms that can detect and correct proxy discrimination using advanced statistical methods. Furthermore, multi-objective optimization techniques should be employed to balance fairness, accuracy, and profitability, ensuring equitable outcomes without compromising competitiveness.

Another key issue is **transparency and explainability**. Many AI-driven pricing and claims models operate as "black boxes", making it difficult for insurers, regulators, and consumers to understand how decisions are made. While regulators and customers demand explainability, insurers must also protect proprietary algorithms that give them a competitive edge. To strike this balance, insurers can use explainable AI (XAI) techniques, such as visualizations or plain-language explanations, to make AI-driven decisions more understandable. Additionally, standardized policy frameworks should be established to ensure that AI models across the industry remain transparent, trustworthy, and compliant with regulatory expectations.

Accountability is another critical concern, as multiple stakeholders - including developers, insurers, and data providers - are often involved in AI systems, making it difficult to determine who is responsible when things go wrong. Moreover, risks such as bias amplification and adversarial attacks can lead to unfair outcomes, often with limited recourse for affected customers. To address these risks, insurers must

implement clear accountability structures, including audits, regulatory reporting, and third-party oversight, to uphold ethical standards. Additionally, real-time monitoring systems should be in place to detect and correct algorithmic failures before they negatively impact consumers.

[80] [102] [103, pp. 35-84] [104] [105] [106, pp. 15-32]

4.7.3. Recommendations

To ensure the ethical integration of AI, the following recommendations are proposed:

- **Ethics by Design**

Integrate ethical considerations at every stage, from data collection and model development to deployment and monitoring.

This includes conducting proactive audits to identify and mitigate potential ethical risks early in the AI development process.

- **Global Collaboration**

As AI regulations vary across jurisdictions. Aligning international standards through cross-regional dialogue helps define common principles of fairness, accountability, and transparency, ensuring consistency in AI governance while supporting innovation.

- **Stakeholder Engagement**

To enhance stakeholder engagement, it is crucial to involve regulators, consumer advocates, and technical experts in policy development. Customer education programs can further improve transparency by helping consumers understand how AI-driven decisions impact their insurance policies.

- **Dynamic Regulation**

Given the rapid evolution of AI, dynamic regulation is necessary to adapt to emerging challenges. Regulatory sandboxes provide controlled environments where insurers can test and refine AI applications before full-scale deployment, ensuring ethical compliance while encouraging technological advancement.

- **Cultural Sensitivity**

Additionally, cultural sensitivity should be considered when developing AI governance frameworks. Recognizing regional differences in legal norms, societal values, and customer expectations allows insurers to tailor ethical guidelines to local markets, ensuring both relevance and acceptance.

By implementing these strategies, the insurance industry can effectively leverage AI's potential while upholding ethical integrity, regulatory compliance, and consumer trust, creating a more equitable and transparent global insurance landscape.

[80] [92] [102] [103] [107]

Chapter 5: Building the Future of AI in Greece's Insurance Industry

The rapid rise of AI is transforming industries worldwide, and insurance in Greece is no exception. The Greek insurance industry is undergoing a profound transformation, driven by the integration of AI technologies. AI presents unparalleled opportunities to streamline operations, improve risk assessment, enhance customer experiences, and detect fraud. However, alongside these exciting opportunities come significant challenges, particularly regarding regulatory frameworks that govern AI's development and use within the EU.

One of the biggest hurdles facing AI adoption is the perception that EU regulations create unnecessary bureaucracy. While these rules are designed to promote safety, accountability, and human oversight, they can also slow down AI implementation, increase development costs, and limit scalability. Strict regulatory compliance, though well-intended, sometimes makes it harder for businesses to fully embrace AI's transformative power, particularly in countries like Greece, where the insurance industry is still evolving within this digital shift.

Despite these challenges, Europe's commitment to ethical and responsible AI is widely respected. For Greece to fully capitalize on AI's potential, it must find ways to navigate regulatory barriers without compromising innovation. By refining existing frameworks and fostering a supportive environment for AI development, Greece can take a leading role in shaping the future of AI-driven insurance within Europe.

To make the most of AI, Greece's insurance industry must strike a careful balance - leveraging AI to improve efficiency, personalization, and decision-making, while adhering to evolving regulations. Establishing strict safeguards and following Responsible AI principles will ensure that technological advancements enhance the sector without compromising ethical standards.

This chapter explores how AI can reshape the future of the Greek insurance industry, detailing strategies for adoption, investment priorities, and solutions to ethical challenges. Through responsible and well-structured AI integration, Greece can enhance its insurance sector's competitiveness, sustainability, and trustworthiness. [84] [108] [109]

5.1. Proposals for Adoption

The Greek insurance industry is at a pivotal moment in its digital transformation, but several challenges stand in the way of fully embracing Artificial A). Outdated IT systems, disconnected data sources, regulatory uncertainties, and a shortage of AI-trained professionals create obstacles that must be addressed to ensure a smooth and effective transition to AI-driven operations.

To overcome these barriers, strategic investments in both technology and workforce development are essential. By modernizing infrastructure and equipping employees with the right skills, Greece's insurance sector can harness AI to enhance efficiency, improve decision-making, and deliver better customer experiences.

The following sections outline a comprehensive roadmap for AI adoption in Greece's insurance industry. First, a practical framework will provide insurers with clear guidelines for responsible AI implementation, ensuring compliance with EU regulations and ethical standards. Next, we will explore the critical investments in infrastructure and human capital needed to build a sustainable, competitive, and technologically advanced insurance sector that is ready for the future.

5.1.1. A Practical Framework for AI Integration in Greek Insurance Industry

To ensure sustainable, responsible, and competitive AI adoption, Greek insurers must implement a structured framework tailored to the country's regulatory landscape, EU directives, and industry best practices. This section outlines a five-step approach, providing a clear roadmap for integrating AI while prioritizing transparency, security, data accuracy, accountability, and workforce readiness.

1. Transparency: Building Customer Trust Through Clarity

For AI to be widely accepted, customers must trust how it is used in their insurance policies. Transparency is not just a regulatory requirement – it is essential for maintaining consumer confidence. This involves:

- **Clearly disclose AI usage** in customer interactions. For example, disclaimers in policy documents and chatbots should notify customers when AI-driven tools assist them.
- **Explain AI-driven decisions** in underwriting, claims processing, and pricing. If an AI system increases a customer's premium, the insurer must provide a detailed, understandable explanation following EU transparency standards.
- **Ensure regulatory compliance** with GDPR and the EU AI Act, which mandate that customers be informed of automated decision-making processes. The Greek government could introduce AI transparency requirements for insurers to align with EU standards and build public trust in digital insurance services.

2. Intellectual Property and Data Security: Protecting Policyholders and Insurers

AI is only as reliable as the data it processes, making data security and intellectual property (IP) protection critical for both insurers and policyholders. Greek insurers should:

- **Safeguard data ownership and privacy** by ensuring policyholders maintain control over their personal information, even when AI services involve third-party vendors. Privacy-preserving AI models using data anonymization techniques should be adopted to comply with GDPR.
- **Define clear contractual terms** with AI vendors, specifying who owns AI-generated outputs, how data is handled, and what happens in case of security breaches. Legal teams should carefully review agreements before adopting AI-powered solutions.
- **Conduct routine security audits** to prevent cyber threats and unauthorized access. A potential solution could be the introduction of an AI Data Security Certification, developed in collaboration with the Bank of Greece and the Hellenic Data Protection Authority, to ensure AI models meet strict security and compliance standards.

3. Ensuring Data Accuracy: A Foundation for Reliable AI Decision-Making

AI thrives on high-quality, accurate, and unbiased data. If the data is flawed, the AI-generated outcomes will be flawed as well. To maintain decision reliability, insurers must prioritize:

- **Standardize data integrity practices** by training AI models on diverse and reliable datasets to ensure fair risk assessments. Historical data that reinforces gender, age, or geographic biases in premium pricing should be avoided. Greek insurers should avoid using historical datasets that reinforce gender or age biases in premium pricing.
- **Enable real-time validation** of AI models to adapt to changing economic, climate, and demographic conditions. For instance, if wildfire risks in Greece increase due to climate change, AI-driven risk models must integrate updated probability data for accurate underwriting.
- **Continuously refine** AI models by regularly updating datasets to reflect shifts in market conditions, customer behavior, and regulations. Static AI models become outdated and prone to inaccurate predictions, leading to unfair policy pricing and poor risk assessment.

4. Comprehensive Documentation: Strengthening Accountability and Compliance

AI is powerful, but without proper documentation and oversight, insurers risk losing control over its decision-making processes. To ensure accountability, regulatory compliance, and consumer protection, Greek insurers should:

- **Track data usage** by documenting every dataset used in AI systems, noting origin, ownership, and purpose, to prevent copyright disputes and compliance breaches.
- **Maintain AI audit trails** by recording how AI-driven decisions are made, particularly in policy pricing, claims approvals, and fraud detection. If an AI model denies a medical claim, insurers must keep detailed logs of the factors influencing that decision.
- **Align documentation with regulatory requirements** to meet Greek and EU compliance standards, ensuring AI systems remain transparent and defensible in audits.
- **Regularly review** AI models to correct errors and biases, preventing systemic issues that could unfairly impact policyholders.

A proposed solution could be the introduction of an AI Compliance Reporting System, requiring insurers to submit AI decision logs to Greek regulators for oversight.

5. Skill Development and Oversight: Fostering an AI-Ready Workforce

AI doesn't replace humans - it enhances human expertise. To ensure successful AI integration, Greek insurers must train employees to work effectively alongside AI. This includes:

- **AI education and training** for employees at all levels, from claims analysts to executives, to improve understanding of AI technologies, ethics, and compliance requirements.
- **Creating new AI-related roles**, such as AI ethics officers, prompt engineers, and AI auditors, to monitor AI outputs, detect biases, and address ethical concerns.
- **Maintaining human in the loop** in high-stakes decision-making areas such as claims approval and fraud detection, ensuring AI-generated decisions are validated by human experts before being finalized.

A valuable initiative for Greek insurers could be partnerships with universities and AI research centers to establish specialized AI training programs for insurance professionals, equipping them with the skills needed to navigate the AI-driven transformation of the industry.

[110]

5.1.2. Strategic Infrastructure Investments

The integration of AI into Greece's insurance sector necessitates substantial investments in infrastructure. This strategic transformation aims to enhance operational efficiency, improve customer experience, and strengthen market competitiveness in an era of rapid digital evolution.

Currently, the Greek insurance sector relies heavily on manual processes and legacy systems, resulting inefficiencies in underwriting, slow claims processing, and suboptimal customer service. Additionally, the lack of standardized data-sharing frameworks and digitized systems has limited innovation, preventing insurers from fully leveraging AI-driven advancements. Several challenges continue to hinder adoption of AI, including:

- **Low Digital Maturity:** Outdated IT systems that are incompatible with AI tools.
- **Fragmented Data Ecosystems:** Disjointed data storage across multiple systems, making it difficult to perform comprehensive analytics.
- **Talent Shortages**: Limited local expertise in AI and data science, creating skill gaps in AI implementation.
- **Regulatory Gaps:** Unclear guidelines on AI usage, creating uncertainty for insurance companies.

To overcome these challenges, and fully embrace AI, targeted investments in digital infrastructure, AI-powered platforms, cybersecurity, and research development are crucial.

〉 Digital Infrastructure

To support AI-driven decision-making, insurers need robust data management and processing capabilities:

- **Data Warehousing and Analytics Platforms:** Centralized systems to aggregate and analyze customer information, claims history, and market trends, integrated with AI tools for predictive modeling and machine learning.
- **Cloud Computing:** Transitioning legacy systems to scalable cloud-based platforms improves scalability and enables secure, large-scale AI deployments. Studies, such as those from Boston Consulting Group, highlight that cloud platforms are generally safer than on-premise infrastructure, even for

companies handling highly confidential data, such as banks and insurance companies. [111]

- **High-Speed Connectivity:** Advanced network infrastructure will facilitate real-time data sharing, particularly for Internet of Things (IoT) - enabled insurance applications.

[112] [113]

〉 AI-Powered Platforms

Modernizing insurance operations with AI-driven tools will significantly enhance efficiency, fraud detection, and policy customization:

- **Claims Management Systems**: AI-driven platforms to automate claims assessments, detect fraudulent claims, and accelerate approval processes.
- **Underwriting Tools:** Advanced risk assessment models powered by AI for dynamic pricing and personalized policy recommendations.
- **Fraud Detection Systems**: Machine learning algorithms capable of identifying patterns indicating fraudulent activities, significantly reducing financial losses.

[108] [109] [114]

〉 Cybersecurity and Data Governance

With AI relying on large volumes of customer data, ensuring robust cybersecurity and regulatory compliance is paramount:

- **Establish robust protocols** to protect sensitive customer data and ensure compliance with data protection laws such as the EU's General Data Protection Regulation (GDPR).
- **Implement Explainable AI (XAI)[2] frameworks** to enhance transparency in decision-making processes, building trust among regulators and customers.

[115]

〉 Research Development

To drive continuous innovation, Greece must establish dedicated AI research centers:

- **AI Innovation Hubs:** Creation of dedicated research centers focused on developing AI applications tailored to the insurance industry.

[109] [113]

[2] Explainable Artificial Intelligence (XAI) models foster greater transparency and clarity in the interaction between humans and machines.

5.1.3. Training Initiatives to Prepare Employees for Technological Change

Successfully integrating AI into the insurance sector requires more than just technological advancements, it demands a well-prepared workforce capable of leveraging AI tools effectively. To ensure a smooth transition, insurers must invest in comprehensive training programs that equip employees with the skills, knowledge, and confidence needed to adapt to AI-driven processes.

〉 Upskilling and Reskilling Programs

- **AI Training Programs:** Courses tailored to insurance professionals, teaching them how to apply AI solutions in real-world scenarios. For instance, NobleProg offers hands-on AI training in Athens, providing practical demonstrations of AI's role on insurance operations. [116]
- **Specialized Training for Key Roles:** AI integration impacts underwriters, claims adjusters, and fraud investigators differently. Targeted training will help these professionals use AI tools effectively in their workflows.
- **Cross-Functional Training:** Promote collaboration by training employees across departments on AI integration, ensuring consistency and understanding of AI-driven processes.

〉 Partnerships with Educational Institutions

Collaboration with universities and academic institutions can strengthen AI expertise in the insurance workforce.

- **University Collaborations:** Collaborate with local Greek universities to develop curricula that align with industry needs and establish regional innovation hubs. The National and Kapodistrian University of Athens, for example, offers an online course on Machine Learning and Deep Learning tailored to finance and insurance applications. [117]
- **Industry Certifications:** Encourage employees to pursue certifications in AI and data science from recognized global institutions.

〉 On-the-Job Learning Opportunities

Hands-on experience with AI technologies is crucial for building confidence and practical expertise.

- **Mentorship Programs:** Pair employees with AI specialists to facilitate knowledge transfer and hands-on experience with AI tools.
- **AI Labs:** Establish innovation labs where employees can experiment with AI technologies and co-develop solutions for real-world challenges.

〉 Cultural Adaptation and Change Management

AI adoption can cause uncertainty among employees, making change management strategies essential.

- **Workshops on Change Management:** Organize sessions to address employee concerns about AI adoption and emphasize its benefits for career growth.
- **Communication Campaigns:** Launch internal communication initiatives to build awareness and enthusiasm for AI technologies.

[108] [113] [118]

Bibliography

[1] M. Miller, "Welcome to the AI Revolution," in *AI for Educators*, Ditch That Textbook, 2023.

[2] D. J. E. Mehan, "A very brief history of AI - and perceptions of AI," in *Artificial Intellignece - Ethical, social and security impacts for the present and the future*, ITGP, 2024.

[3] E. Luger, "Introduction," in *What Do We Know and What Should We Do About AI?*, London, SAGE Publications Limited, 2022.

[4] C. P. E. S. Haroon Sheikh, "Artificial Intelligence: Definition and Background," in *Mission AI, The New System Technology*, Springer, 2023.

[5] Coursera, "The History of AI: A Timeline of Artificial Intelligence," 25 October 2024. [Online]. Available: http://www.coursera.org/articles/history-of-ai.

[6] E. Luger, "A Brief history of Artificial Intelligence," in *What Do We Know and What Should We Do About AI?*, London, SAGE Publications Limited, 2023.

[7] S. a. H. K. A. Sinha, "Introduction," in *Reimagining Businesses with AI*, John Wiley & Sons, 2020.

[8] C. P. E. S. Harroon Sheikh, "Introduction," in *Mission AI, The New System Technology*, Springer, 2023.

[9] C. P. E. S. Haroon Sheikh, "Artificial Intelligence: Definition and Background," in *Mission AI, The New System Technology*, Springer, 2023.

[10] P. K. a. T. Devi, "Artificial Intelligence: A Complete Insight," in *Artificial Intelligence Theory, Models, and Applications*, CRC Press, 2022.

[11] D. J. Mehan, "What exactly is AI?," in *Artificial Intelligence - Ethical, social, and security implacts for the present and the future*, ITGP, 2024.

[12] T. Boobier, "Introduction to Analytics," in *Advanced analytics and AI : Impact, implementation, and the future of work*, John Wiley & Sons, 2018.

[13] T. Boobier, "Understanding the Key Building," in *AI and the Future of the Public Sector : The Creation of Public Sector 4.0*, John Wiley & Sons, 2022.

[14] P. K. a. T. Devi, "Machine Learning," in *Artificial Intelligence Theory, Models, and Applications*, CRC Press, 2022.

[15] C. P. E. S. Haroon Sheikh, "The Practical Application of AI," in *Mission AI, The New System Technology*, Springer, 2023.

[16] P. K. a. T. Davi, "Application Domains of AI," in *Artificial Intelligence Theory, Models, and Applications*, CRC Press, 2022.

[17] Arthur J. Gallagher & Co., "2024 The role of AI in the (re)insurance industry," Arthur J. Gallagher & Co., UK, 2024.

[18] B. S. M. M. M. C. J. R. a. G. C. Emer Owens, "Explainable Artificial Intelligence (XAI) in Insurance," MDPI, 2022.

[19] Arthur J. Gallagher & Co., "Global InsurTech Report, The role of AI in the (re) insurance industry [Q2 2024]," Arthur J. Gallagher & Co. |, UK, 2024.

[20] B. Nicoletti, "Industry 4.0 and Insurance 4.0," in *Insurance 4.0, Benefits and Challenges of Digital Transformation*, Palgrave Macmillan, 2021.

[21] J. Rudden, "Statista," 19 12 2023. [Online]. Available: https://www.statista.com. [Accessed 07 December 2024].

[22] T. Gangcuangco, "Insurance Business," 24 05 2024. [Online]. Available: https://www.insurancebusinessmag.com/. [Accessed 13 01 2025].

[23] Precedence Research, "Precedence Research," 17 10 2024. [Online]. Available: https://www.precedenceresearch.com. [Accessed 08 12 2024].

[24] Allianz SE, "Allianz Global Insurance Report 2024: Transformative years ahead for the insurance sector," Allianz SE, Munich, 2024.

[25] KPMG, "Advancing AI across insurance," KPMG, 2024.

[26] Emerj, "Artificial Intelligence at State Farm," 8 12 2023. [Online]. Available: https://emerj.com. [Accessed 07 12 2024].

[27] Harvard Business School, "Lemonade reinvents the insurance industry with machine learning," 15 13 2018. [Online]. Available: https://d3.harvard.edu. [Accessed 07 12 2024].

[28] PYMNTS, "Allstate On Using AI To Fight Insurance Claims Fraud," 21 04 2020. [Online]. Available: https://www.pymnts.com. [Accessed 07 11 2024].

[29] EMERJ, "Artificial Intelligence-Based Fraud Detection in Insurance," 13 12 2019. [Online]. Available: https://emerj.com. [Accessed 07 12 2024].

[30] J. Bendix, "Cigna using AI to reject claims, lawsuit charges," *Medical Economics,* 07 08 2023.

[31] GEICO, "GEICO," 07 12 2024. [Online]. Available: https://www.geico.com. [Accessed 07 12 2024].

[32] Informa TechTarget, "Customer service chatbots gain ground," 01 08 2018. [Online]. Available: https://www.techtarget.com. [Accessed 07 12 2024].

[33] Financial Times, "Bridges to health for China's people," 14 12 2021. [Online]. Available: https://www.ft.com. [Accessed 07 12 2024].

[34] EMERJ, "EMERJ, Artificial Intelligence at MetLife – Three Use Cases," 10 05 2024. [Online]. Available: https://emerj.com/artificial-intelligence-at-metlife/. [Accessed 07 12 2024].

[35] CIO, "CIO, How Progressive Uses Telematics and Analytics to Price Car Insurance," 26 07 2013. [Online]. Available: https://www.cio.com. [Accessed 07 12 2024].

[36] J. England, "InsurTech Digital, Vitality's ActiveLife tracks health data from Apple watches," 19 01 2023. [Online]. Available: https://insurtechdigital.com. [Accessed 07 12 2024].

[37] P. L. a. A. Grasso, "Benefits and use cases of AI in insurance," Swiss Re, 2024.

[38] ZEBRA, "ZEBRA," 07 12 2024. [Online]. Available: https://www.zebra.com. [Accessed 07 12 2024].

[39] BearingPoint, "BearingPoint, Predictive Uncertainty: Generative AI in insurance," [Online]. Available: https://www.bearingpoint.com. [Accessed 07 12 2024].

[40] Larry Dignan, "How John Hancock Life Insurance gamifies wearables to bolster longevity," ZDNET, 2020.

[41] Allianz SE, "Allianz, Doorway to a new era in automotive insurance," 17 10 2023. [Online]. Available: https://www.allianz.com. [Accessed 14 01 2024].

[42] Munich Re, "Munich Re, Munich Re's cutting-edge telematics solution," 2024. [Online]. Available: https://www.munichre.com. [Accessed 14 01 2024].

[43] MetLife, "Sustainability Report, Supporting Wellness," MetLife, 2023.

[44] P. A. Group, "Pig An - Ecosystem for a health China," Financial Times, 14 05 2021. [Online]. Available: https://group.pingan.com. [Accessed 15 12 2024].

[45] Digital Transformation Academy, "Ping An from the insurance business to the world's No. 1 FinTech and Healthcare platform leader," Digital Transformation Academy, 2020.

[46] Pig An Group, "Pig An - Ping An Unveils First Smart City Integrated Platform and Solutions in China to Empower Development with Technology," 21 08 2021. [Online]. Available: https://group.pingan.com. [Accessed 14 01 2025].

[47] Generali, "Generali, Automation and artificial intelligence, what's new with the latest generation of robots," 2022. [Online]. Available: https://www.generali.com. [Accessed 14 01 2025].

[48] AXA Partners, AXA Partners, 2024. [Online]. Available: https://www.axapartners.com. [Accessed 14 01 2025].

[49] Tractable, "Tractable, Put applied AI at the heart of your claims cycle," [Online]. Available: https://tractable.ai. [Accessed 14 01 2025].

[50] L. Sarkin, "Next-generation AI-powered digital risk assessment," Munich Re, 2021.

[51] K. Iaroshenko, "AI at the Helm of Insurance: Automating Data Processing and Risk Management," CEO Today, 2024.

[52] HAI Stanford University, "Artificial Intelligence Index Report 2024," HAI Stanford University, 2024.

[53] Forbes, "Forbes, The State Of AI In Europe: Balancing Responsibility With Progress," 27 11 2024. [Online]. Available: https://www.forbes.com. [Accessed 07 12 2024].

[54] Insurance Europe, "Artificial Intelligence, Views of the European insurance industry," Insurance Europe, 2020.

[55] Insurance Europe, "AI in the insurance sector," Insurance Europe, 2021.

[56] P. J. a. K. P. Violet Chung, "Insurer of the future: Are Asian insurers keeping up with AI advances ?," McKinsey & Company, 2023.

[57] M. &. Company, "Unlocking the potential of AI adoption in Asian insurance," McKinsey & Company, 2023.

[58] G. K. R. Evangelos Tsoukatos, "Path analysis of perceived service quality, satisfaction and loyalty in Greek insurance," *Managing Service Quality: An International Journal,* pp. 1-23, 2006.

[59] H. S. P. S. I. L. Mikko Riikkinen, "Using artificial intelligence to create value in insurance," *International Journal of Bank Marketing,* 01 06 2018.

[60] A. O. Dimitris Bertsimas, "Algorithmic Insurance," 2022.

[61] Milliman, "The Greek insurance sector: Recovering like the rest of the economy but with its own challenges," Milliman, 2019.

[62] European Commission, "Greece AI Strategy Report," 01 09 2021. [Online]. Available: https://ai-watch.ec.europa.eu/.

[63] H. -. L. A. C. o. A. Intelligence, "A Blueprint for Greece' s AI Transformation," Hellenic Republic, Athens, 2024.

[64] ΠΡΩΤΟ ΘΕΜΑ, "Six flagship projects for AI in Greece," *ΠΡΩΤΟ ΘΕΜΑ,* 2024.

[65] KG Law Firm, "Data, Privacy, Cybersecurity & Technology Law - Greece makes the first step in implementation of the AI Act," Kyriakides Georgopoulos, Athens, 2024.

[66] G. p. Experts, "AI, Machine Learning & Big Data Laws and Regulations 2024 – Greece," Global Legal Insights, 2024.

[67] OECD, "National strategies on Artificial Intelligence, A European perspective," OECD, Luxembourg, 2021.

[68] ERGO, "ERGO," [Online]. Available: https://www.ergo.com. [Accessed 08 12 2024].

[69] S. A. a. S. L. Maria Albani, "How Do Digital Technologies Drive Greece's Economic Growth ? Opportunities and Challenges," Bank of Greece, Athens, 2019.

[70] F. J. Z. B. Marvin S. L. van Bekkum, "AI, insurance, discrimination and unfair differentiation. An overview and research agenda," iHub, Radboud University, Nijmegen, The Netherlands, 2022.

[71] M. C. a. R. K. Elisa Luciano, "Adversarial AI in Insurance: Pervasiveness and Resilience," Cornell University, 2023.

[72] B. C. Stahl, Artificial Intelligence for a Better Future, UK: Springer, 2021.

[73] Open Access, "Neuroethics and AI ethics: a proposal for collaboration," Springer, 2024.

[74] Z. Z. B. M. a. X. Y. Changwu Huang, "An Overview of Artificial Intelligence Ethics," *IEEE Transactions on Artificial Intelligence,* 08 2023.

[75] J. Z. A. H. K. R. F. a. S. S. Fang Chen, "Artificial Intelligence Ethics and Trust: From Principles to Practice," *IEEE Intelligent Systems,* 11/12 2023.

[76] A. A. P. B. ,. T. H. A. K. K. M. S. L. S. A. P. M. R. D. W. B.C. Stahl, "Artificial intelligence for human flourishing – Beyond principles for ML," *Journal of Business Research ,* 2021.

[77] SHERPA Project, "SHERPA," 2025. [Online]. Available: https://www.project-sherpa.eu. [Accessed 15 12 2025].

[78] C. L. A. W. a. S. W. Christoph Bartneck, "Ethical Principles for Trustworthy and Fair AI," in *An Introduction to Ethics in Robotics and AI*, Switzerland, Springer, 2021.

[79] T. Boobier, "The Impact of AI on Leading-Edge Industries," in *Advanced Analytics and AI : Impact, Implementation, and the Future of Work*, John Wiley & Sons, 2018.

[80] AI HLEG, "Ethics Guidelines for Trustworthy AI," European Commission, Brussels, 2019.

[81] K. S. a. W. Wang, "Artificial Intelligence Ethics: Ethics of AI and Ethical AI," *Journal of Database Management,* 06 2020.

[82] Arthur J. Gallagher & Co, "Finding the Guardrails - What (re)insurers need to know about AI regulation," Arthur J. Gallagher & Co, UK, 2024.

[83] N. D. a. S. J. Eling M., "The impact of artificial intelligence along the insurance value chain and on the insurability of risks," Springer, 2021.

[84] A. L. a. D. M. Ramnath Balasubramanian, "Insurance 2030 - The impact of AI on the future of the insurance," McKinsey & Company, 2018.

[85] C. L. A. W. a. S. W. Christoph Bartneck, "Risks in the Business of AI," in *An Introduction to Ethics in Robotics and AI*, Springer, 2021.

[86] C. P. H. M. C. Martin Mullins, "Creating ethics guidelines for artificial intelligence and big data analytics customers: The case of the consumer European insurance market," *CellPress,* p. 15, 08 10 2021.

[87] A. F. a. S. Duffy, "AI, Ethics and Life Insurance: Balancing Innovation With Access," The American College, 630 Allendale Road, Suite 400, King of Prussia, PA 19406, 2021.

[88] EIOPA, "Artificial Intelligence Governance Principles: Towards Ethical And Trustworthy Artificial Intelligence In The European Insurance Sector," Luxembourg: Publications Office of the European Union, Luxembourg, 2021.

[89] C. L. A. W. a. S. W. Christoph Bartneck, "Privacy Issues of AI," in *An Introduction to Ethics in Robotics and AI*, Springer, 2021.

[90] C. L. A. W. a. S. W. Christoph Bartneck, "What Is Ethics?," in *An Introduction to Ethics in Robotics and AI*, Switzerland, Springer, 2021, p. 22.

[91] Commission, European, "EU AI Act," European Commission, 2024.

[92] EIOPA, "AI Governance Principles: Towards Ethical and Trustworthy AI in the European Insurance Sector," EIOPA, Germany, 2021.

[93] The Guardian, "UK signs first international treaty to implement AI safeguards," *The Guardian,* 10 2024.

[94] ABI, "AI Guide," ABI, 2024.

[95] Deloitte, "The UK’s framework for AI regulation," Deloitte, 2024.

[96] National Association of Insurance Commissioners, "National Association of Insurance Commissioners Principles on AI," National Association of Insurance Commissioners, 2020.

[97] E. R. C. Gregory R. Mitchell, "State Regulators Address Insurer's Use of AI: 11 States Adopt NAIC Model Bulletin," McDermott Will & Emery, 2024.

[98] Sidley, "Asia-Pacific Regulations Keep Pace With Rapid Evolution of AI Technology," Sidley, 2024.

[99] Deloitte, "Generative AI: Application and Regulation in Asia Pacific," Deloitte, Asia Pacific, 2024.

[100] Association of Southeast Asian Nations, "ASEAN Guide on AI Governance and Ethics," ASEAN, 2024.

[101] IAIS, "Regulation and supervision of AI / ML in insurance: a thematic review," IAIS, 2023.

[102] T. H. K. M. M. R. A. K. Andrew Patel, "Security Issues, Dangers and Implications of Smart Information Systems," European Union, 2019.

[103] T. Boobier, "The Impact of AI on Leading-Edge Industries," in *Advanced Analytics and AI : Impact, Implementation, and the Future of Work*, John Wiley & Sons, 2018.

[104] A. C. A. L. Marguerite Saucé, "AI and Ethics in Insurance: A New Solution To Mitigate Proxy Discrimination In Risk Modeling," 2023.

[105] T. Hagendorff, "The Ethics of AI Ethics: An Evaluation of Guidelines," Springer, 2020.

[106] S. a. H. K. A. Sinha, "Building a Framework for Applying AI," in *Reimagining Businesses with AI*, John Wiley & Sons, Incorporated, 2020.

[107] B. G. R. P. E. F. M. P. Simona Tiribelli, "Embedding AI ethics into the design and use of computer vision technology for consumer’s behaviour understanding," *Computer Vision and Image Understanding,* 2024.

[108] J. Mcckendrick, "How artificial intelligence is transforming insurance: AI is giving insurance new ways to enage with their customers, process claims and adjust risk," *Digital Insurance,* 26 08 2024.

[109] J. Wargin, "Harnessing the Power of AI: Revolutionizing Insurance," *Insurance Journal,* 30 07 2024.

[110] D. Marquis, "How Insurance Industry Can Use AI Safely and Ethically," *Insurance Journal,* 07 10 2024.

[111] M. G. E. K. Chryssos Kavounides, "Harnessing the Power of AI in Greece," Boston Consulting Group, 2020.

[112] B. Pieroni, "From Productivity to Prevention: AI and the Future of Insurance," *Best's Review,* 008 2024.

[113] J. a. D. Kyriazis, Big Data and Artificial Intelligence in Digital Finance, UK: Springer, 2022.

[114] N. Sabharwal, "4 Ways AI Can Benefit the Insurance Industry," *Insurance Journal,* 15 05 2023.

[115] B. S. M. M. M. C. J. R. G. C. Emer Owens, "Explainable Artificial Intelligence (XAI) in Insurance," MDPI, 2022.

[116] NobleProg, "NobleProg," 15 01 2025. [Online]. Available: https://www.nobleprog.gr. [Accessed 15 01 2025].

[117] National and Kapodistrian University of Athens, "National and Kapodistrian University of Athens," 15 01 2025. [Online]. Available: https://elearninguoa.org. [Accessed 15 01 2025].

[118] C. P. H. a. A. M. Alex Zarifis, "Evaluating the impact of AI on insurance: The four emerging AI and data-driven business models," Emerald Open Research, 2019.

[119] T. Boobier, "Introduction to Analytics," in *Advanced analytics and ai : Impact, implementation, and the future of work.*, John Wiley & Sons, 2018, p. 27.

[120] Precedence Research, "Precedence Research," 10 2024. [Online]. Available: https://www.precedenceresearch.com/artificial-intelligence-in-insurance-market. [Accessed 08 12 2024].

[121] KPMG International Limited, "Advancing AI across insurance," KPMG, 2024.

[122] KPMG International Limited, "Advancing AI across insurance," KPMG International Limited, 2024.

[123] Stanford University, "Artificial Intelligence Index Report 2024," Stanford University, HAI , 2024.

[124] Arthur J. Gallagher & Co., "Finding the Guardrails - What (re)insurers need to know about AI regulation," Arthur J. Gallagher & Co., UK, 2024.

[125] Arthur J. Gallagher & Co., "Finding the Guardrails - What (re)insurers need to know about AI regulation," Arthur J. Gallagher & Co., UK, 2024.

[126] Arthur J. Gallagher & Co., "Finding the Guardrails - What (re)insurers need to know about AI regulation," Arthur J. Gallagher & Co., UK, 2024.

[127] Arthur J. Gallagher & Co., "Finding the Guardrails - What (re)insurers need to know about AI regulation," Arthur J. Gallagher & Co., UK, 2024.

[128] European Commission, "EU AI Act," European Commission, 2024.

[129] Arthur J. Gallagher & Co., "2024 The role of AI in the (re) insurance industry," Arthur J. Gallagher & Co., UK, 2024.

[130] Arthur J. Gallagher & Co. |, "2024 The role of AI in the (re)insurance industry," Arthur J. Gallagher & Co. |, UK, 2024.

[131] P. K. &. T.Devi, Artificial Intelligence Theory, Models, and Applications, CRC Press, 2022.

[132] T. Boobier, Advanced analytics and ai : Impact, implementation, and the future of work, John Wiley & Sons, 2018.

[133] T. Boobier, AI and the Future of the Public Sector : The Creation of Public Sector 4.0, John Wiley & Sons, 2022.

[134] T. Boobier, AI and the Future of the Public Sector : The Creation of Public Sector 4.0, John Wiley & Sons, 2022.

[135] B. C. Stahl, Artificial Intelligence for a Better Future, UK: Springer, 2021.

[136] B. C. Stahl, Artificial Intelligence for a Better Future, Springer, 2021.

[137] A. C. a. A. L. Marguerite Saucé, "AI and Ethics in Insurance: A New Solution to Mitigate Proxy Discrimination in Risk Modeling," 2023.

[138] K. S. a. W. Wang, "Artificial Intelligence (AI) Ethics: Ethics of AI and Ethical AI," *Journal of Database Management,* 06 2020.

[139] McKinsey & Company, "Insurance 2030—The impact of AI on the future of insurance," McKinsey & Company, 2018.

[140] S. a. H. K. A. Sinha, "Introduction," in *Reimagining Businesses with AI*, John Wiley & Sons, 2020.

[141] S. a. H. K. A. Sinha, "Introduction," in *Reimagining Businesses with AI*, John Wiley & Sons, 2020.

[142] E. Luger, "Introduction," in *What Do We Know and What Should We Do About AI?*, London, SAGE Publications Limited, 2023.

[143] T. Boobier, "Understanding the Key Building," in *AI and the Future of the Public Sector : The Creation of Public Sector 4.0*, John Wiley & Sons, 2022.