Artificial Intelligence: A Case Study on the Estimation of CO2-Emission due to the Claim Management of a Non-Life Insurance Company

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About the speaker

- **Rocco Roberto Cerchiara** – PhD, Actuary (IOA)

- *MSc in Statistical and Actuarial Sciences - PhD in Actuarial Sciences at University of Rome "La Sapienza"*
- *He is External Advisor at Oliver Wyman Actuarial with consultancy for several European insurance companies*
- *Since 1999 to 2003 he has been serving at Arthur Andersen (then Deloitte) and then Assistant Professor of Risk Theory and Non-Life Insurance Mathematics at University of Calabria in Italy. From 2007 to 2017 he was Senior Consultant at Willis Towers Watson. He was Head of NL Underwriting Risk at the headquarters of Generali Group (2021-2022).*

- ***Mediolanum Assicurazioni*** *was founded in 1974 and since 2013 it has been part of the Mediolanum Group. Through Family Bankers, it offers insurance solutions in a simple and easily accessible way that take care of the safety of each customer, protecting the person and his or her assets in the event of unforeseen circumstances. It has always focused on the quality of the service in symbiosis with the most needs of policyholders. The speed and care with which it manages claims guarantee customers a high quality standard in the satisfaction of the commitments undertaken.*
- ***All Consulting Group*** *(www.gruppoallconsulting.com) is a leading loss adjusting company, operating mainly in Italy, offering the insurance sector a wide range of services and activities. All Consulting Group carries out its activities by operating in a young and dynamic environment, where experienced professionals work, including engineers, lawyers, architects and economics graduates with an educational background and many years of experience in all insurance-related fields.*

Agenda

- Executive Summary
- Framework for describing the effects of claim assessment on GHG emissions
- How can AI improve claim management and limit CO2 emission?
- Impact assessment and scenario analysis
- Final Remarks
- References

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Executive Summary

- At the UN Climate Change Conference (COP21) in Paris, on 12 December 2015, Parties to the United Nations Framework Convention on Climate Change (UNFCCC) reached a **landmark agreement to combat climate change** and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement builds upon the Convention and – for the first time – brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the **global climate effort**.

- The **transport sector** is responsible for about **a quarter of Europe's total CO_2 emissions**, **71.7% of which come from road transport**, according to the European Environment Agency. In an effort to limit CO_2 emissions, the EU has set a **target** of reducing transport emissions by 60% from 1990 levels by 2030.

- The EU aims to achieve a 90% reduction in **GreenHouse Gas** (GHG) emissions from transport by 2050 compared to 1990 levels. This forms part of efforts to reduce CO_2 emissions and **achieve climate neutrality** by 2050 under the European Green Deal roadmap.

Executive Summary

- **Mediolanum Assicurazioni**, in its path of environmental sustainability, intends to **provide its Loss Adjusters operating in "non-motor" segments (Italian market) with a tool for measuring the carbon footprint** produced in the performance of their assignments
- The goal of this joint project (work in progress) with **All Consulting** is twofold:
  - **Quantify CO_2 emissions in claims management and define a scoring system of Loss Adjusters**
  - **Introduce Traditional AI, Operational AI and Generative AI in this process** in order to improve the sustainability framework of the Company as a starting point of a wider project
- The data were provided by All Consulting

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Carbon Footprint (CF)

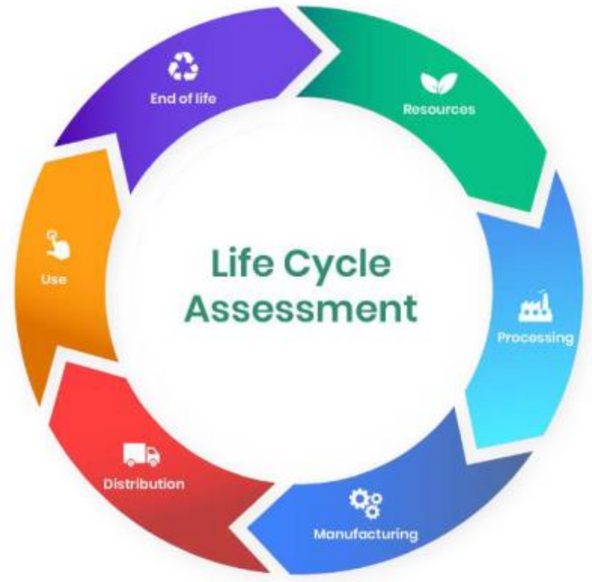
- Definition (Wright et al., 2011): "*A measure of the total amount of carbon dioxide (**CO_2**) and methane (**CH_4**) emissions of a defined population, system or activity, considering all relevant sources, sinks and storage within the spatial and temporal boundary of the population, system or activity of interest. Calculated as carbon dioxide equivalent using the relevant 100-year Global Warming Potential (**GWP100**)*".
- To date, the CF is the parameter that makes it possible to determine the environmental impacts that anthropogenic activities have on **climate change** and, therefore, on **global warming**: its unit of measurement is the ton of CO_2 equivalent (per year, per km travelled, etc.), **which makes it possible to compare the different GHGs** by relating them to a unit of CO_2 through the use of an appropriate **correction factor**, i.e. **Global Warming Potential – GWP.**
- A substance's **GWP depends on the number of years** over which the potential is calculated (**100 years as standard approach**). *A gas which is quickly removed from the atmosphere may initially have a large effect, but for longer time periods, as it has been removed, it becomes less important* (Intergovernmental Panel on Climate Change - IPCC *Third Assessment Report*). **The GWP value depends on how the gas concentration decays over time in the atmosphere**.
- The **calculation** of the CF of a product, service or sector **requires expert knowledge** and careful examination of what is to be included. **Several free online carbon footprint calculators** exist

Life Cycle Analysis

- We focus on the ***carbon footprint* of of claims assessment** by a **Life Cycle Analysis (LCA)**: The full life cycle includes a production chain (comprising supply chains, manufacture, and transport), the energy supply chain, the use phase, and the end of life (disposal, recycle) stage. See Alvarez et al. (2016) for further details.

- Doing so, **claims assessment** is split in different phases and the LCA estimates the level of CO_2.

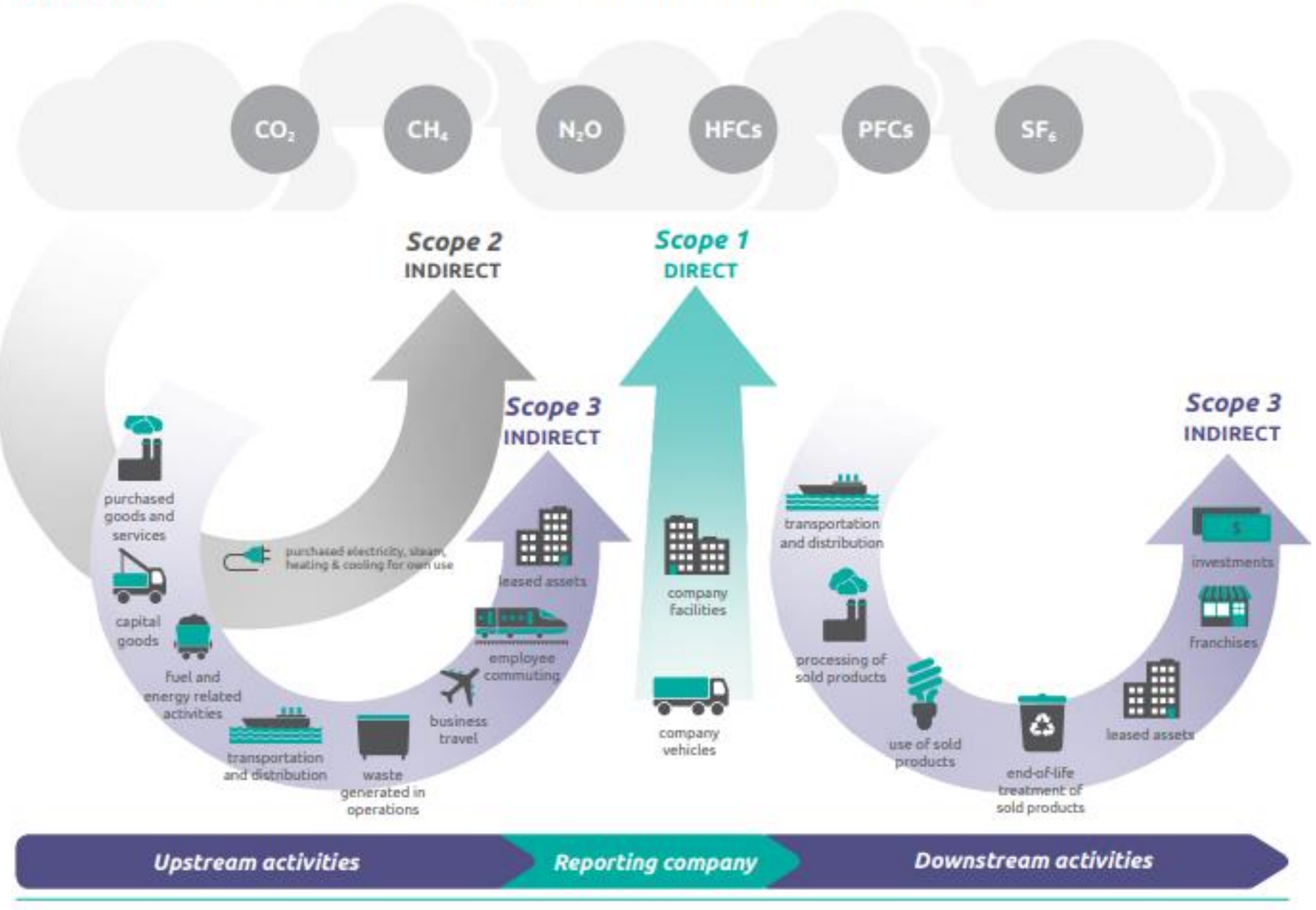
- **LCA is a methodology for assessing all environmental impacts associated with the life cycle of a** commercial product, **process**, or service. GHG product life cycle **assessments** can also comply with specifications such as Publicly Available Specification (PAS) 2050 and the **GHG Protocol** Life Cycle Accounting and Reporting Standard.



GHG protocol is a set of standards for tracking GHG emissions.

- The standards divide emissions into three scopes (Scope 1, 2 and 3) within the value chain.
  - Scope 1: GHG emissions caused **directly** by the organization such as by burning fossil fuels
  - Scope 2: Emissions caused **indirectly** by an organization, such as by purchasing secondary energy sources (electricity, etc.)
  - Scope 3: **indirect** emissions associated with upstream (transport, waste, etc.) or downstream processes (transport, investments, etc.)

Figure [1.1] Overview of GHG Protocol scopes and emissions across the value chain



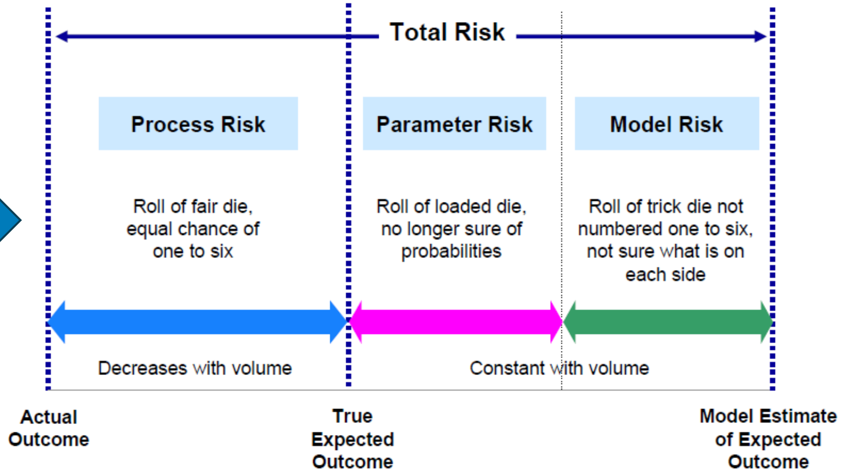
Corporate Value Chain (Scope 3) Accounting and Reporting Standard • *e-reader version* [05]

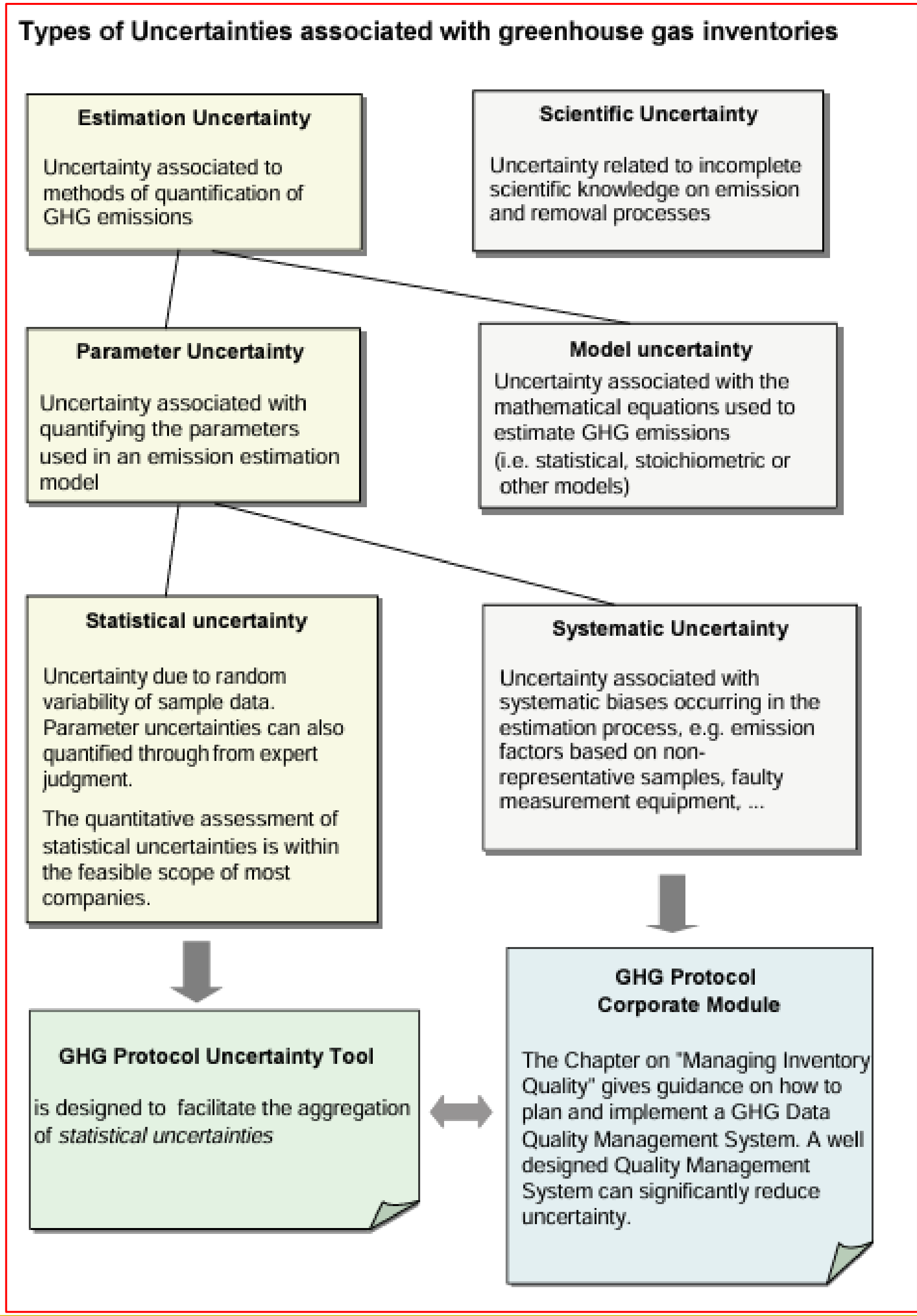
Uncertainty assessment and Prediction Error

- Software such as the "Scope 3 Evaluator" automates **the aggregation steps** involved in developing a basic uncertainty assessment for GHG inventory data.

  Uncertainties associated with GHG inventories can be broadly categorized into:
  - **Scientific uncertainty** arises when the science of the actual emission and/or removal process is not sufficiently understood. For example, many of the direct and indirect emissions factors associated with **GWP values** that are used to combine emission estimates of different GHG involve significant scientific uncertainty.
  - **Estimation uncertainty arises any time GHG are quantified**. Therefore all emission or removal estimates are associated with **estimation uncertainty**. Estimation uncertainty can be further classified into two types: ***model uncertainty and parameter uncertainty***

Common approach in actuarial practice: estimation of Prediction Error!





GHG Protocol and aggregation of statistical parameter uncertainty

GHG Protocol: "***Measurement uncertainty is usually presented as an uncertainty range***, *i.e. an interval expressed in +/- percent of the mean value reported. Once sufficient information on the parameter uncertainty ranges has been collected and a company wishes* ***to combine its parameter uncertainty information using a fully quantitative approach****, it has two main choices of mathematical techniques:*

- *The first order error propagation Method (Gaussian Method)*
- *Methods based on a Monte Carlo Simulation"*

The tool proposed in the Guidance for the aggregation and ranking of statistical parameter uncertainties uses the **first order propagation (Gaussian) method**. "*This requires that that the distribution of measurement data converges to a normal distribution and that the individual uncertainties are smaller than 60% of the expected mean. This method should however only be applied if the following assumptions are fulfilled:*

- *The errors in each parameter must be* ***normally distributed*** *(i.e. Gaussian),*
- *There must be no biases in the estimator function (i.e. that* ***the estimated value is the mean value****)*
- *The estimated parameters must be uncorrelated (i.e.* ***all parameters are fully independent****).*
- *Individual uncertainties in each parameter* ***must be less than 60% of the mean****"*

"Standard" uncertainties if the collection of data is not possible

Uncertainties due to emission Factors and Activity Data				
1	2	3	4	5
Gas	**Source category**	**Emission factor**	**Activity data**	**Overall uncertainty**
CO_2	Energy	7%	7%	10%
CO_2	Industrial Processes	7%	7%	10%
CO_2	Land Use Change and Forrestry	33%	50%	60%
CH_4	Biomass Burning	50%	50%	100%
CH_4	Oil and Nat. Gas Activities	55%	20%	60%
CH_4	Rice cultivation	$\frac{3}{4}$	$\frac{1}{4}$	1
CH_4	Waste	$\frac{2}{3}$	$\frac{1}{3}$	1
CH_4	Animals	25%	10%	20%
CH_4	Animal waste	20%	10%	20%
N_20	Industrial Processes	35%	35%	50%
N_20	Agricultural Soils			2 orders of magnitude
N_20	Biomass Burning			100%
Note: Individual uncertainties that appear to be greater than ± 60% are not shown. Instead judgement as to the relative importance of emissions factor and activity data uncertainties are shown as fractions which sum to one				

Source:
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reporting Instructions

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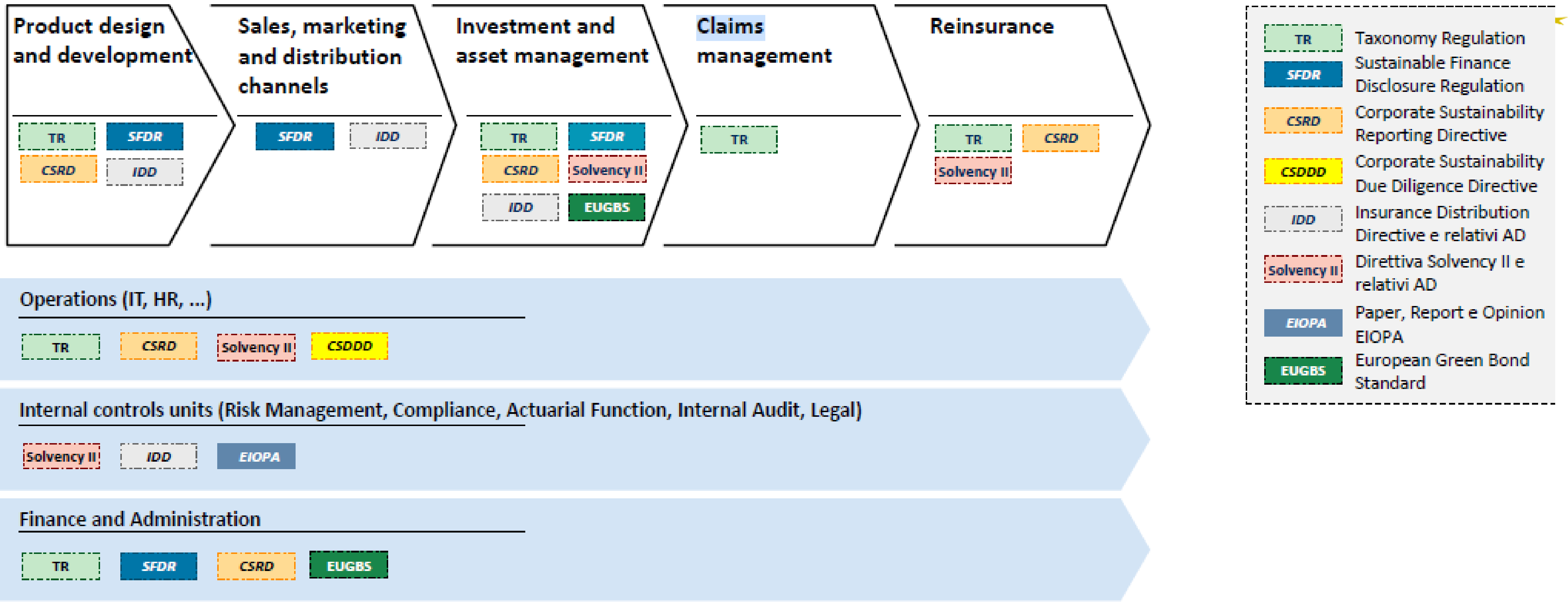
Regulation overview



Source: Oliver Wyman (2023)

INTEGRATION OF ESG FACTORS IMPACTS THE WHOLE ORGANIZATION, ALL AREAS ARE INVOLVED, ALTHOUGH ON DIFFERENT LEVELS

Italian Market overview

Survey on the use of Machine Learning algorithms and Traditional AI by insurance companies in their relations with policyholders - IVASS (Italian Insurance Supervisor) 2023

Executive Summary

- Insurance companies report that they are **at an early knowledge-gathering stage** regarding the use of ML algorithms, adopted mainly for the optimization of internal processes and, **only in limited cases**, in the relations with policyholders.
- 27% of companies use at least one ML algorithm in processes with direct impact on customers, for a market share of
  - 78% in non-life and
  - 25% in life business.
- The **main areas** of use of ML algorithms, mainly in **motor liability**, relate to
  - fraud prevention and
  - claims management,

  and to the identification of customer intention to churn (churn patterns), including for pricing purposes at policy renewal.

Italian Market overview

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Executive Summary

- As regards the **governance of new ML tools** - crucial for their informed and responsible use –
  - only one company indicates that it has defined a specific policy;
  - other 19 companies are defining it;
  - 5 state that they have not yet addressed this issue.

- It should be noted, however, that 56% of undertakings using ML algorithms say they have internal mechanisms in place to assess fairness to policyholders and detect unwanted exclusions or discrimination of customers.

Italian Market overview

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Executive Summary

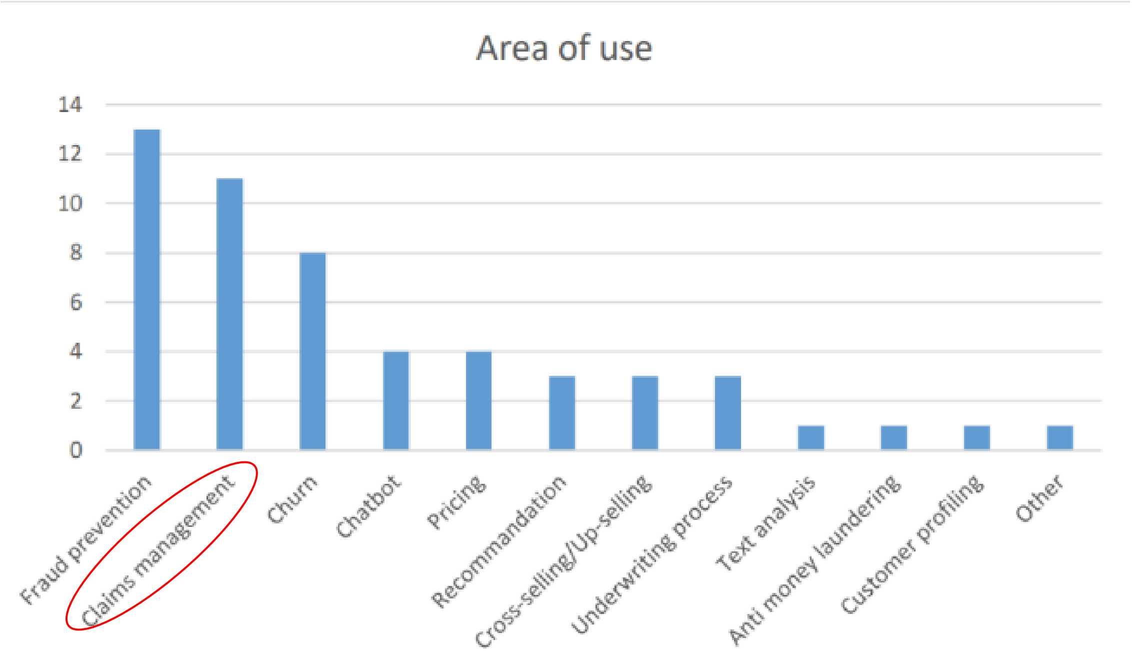
- 43% (In a Europe-wide sample survey conducted by EIOPA in 2019, it was found that 31% of European insurance companies were using ML algorithms and 24% had ongoing trials) of surveyed undertakings use some form of AI;
- 27% use at least one ML algorithm in processes with direct impact on customer, for a market share of 78% in non-life and 25% in life business

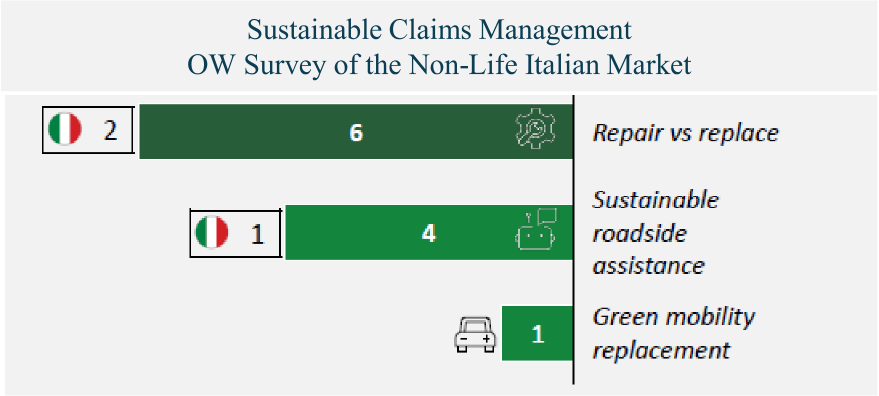
Italian Market overview

Survey on the use of Machine Learning algorithms and Traditional AI by insurance companies in their relations with policyholders - IVASS (Italian Insurance Supervisor) 2023

Executive Summary

- The main areas of use of ML algorithms (some undertakings use the same algorithm for multiple areas of use) in retail processes relate to fraud prevention and claims management, mainly in motor liability, and the identification of customer intention to churn (churn patterns)





Source: Oliver Wyman 2023

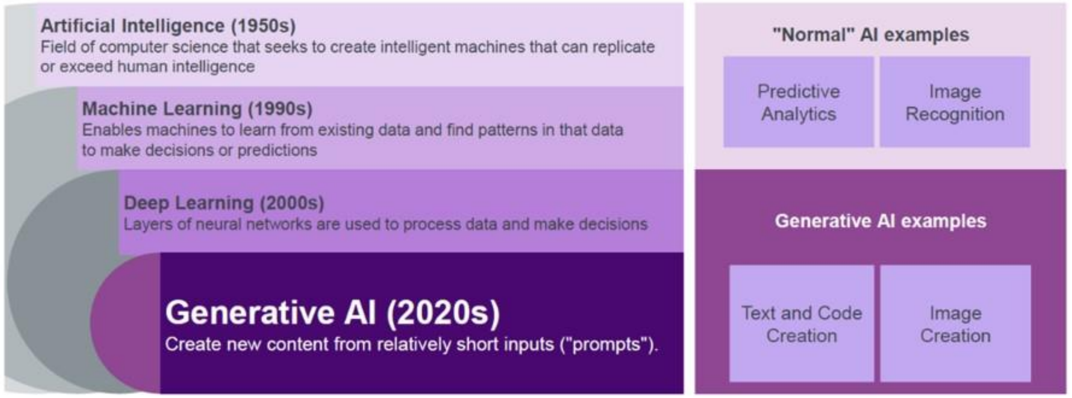
Source: https://www.ivass.it/normativa/nazionale/secondaria-ivass/lettere/2022/lm-06-06/index.html

International Ovierview
From "Traditional"AI to Generative AI

- **Generative AI** (GenAI) operates through deep learning models and advanced algorithms, often without the need for highly structured data input (coding, data validation, automated reconciliation, etc.)

- Future iterations of GenAI are expected to include **prescriptive technology** that not only predicts outcomes, but also suggests the actions to be taken based on the data it analyzes➔*Another trend that may be supported by GenAI is the **move** for insurers from "**paying claims**" to "**preventing claims**". This has been aimed for decades, but GenAI may actually be the missing link to achieve this. Sensors with real-time alerts will enter the average household / company, and GenAI will understand the context, interpret the signals of the sensors, and assist the customers in preventing losses* (Delm, 2024)

Walk along the "Actuarial Data Science" timeline



Source: Edwards et al. 2023

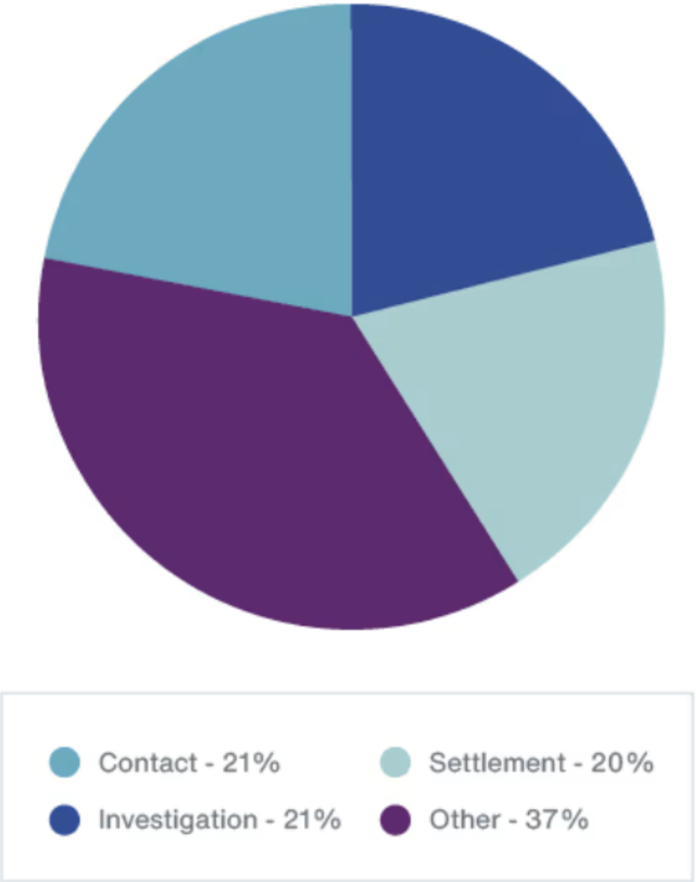
- Proven use cases of traditional AI have already been adopted by many (re)insurers, while generative AI is just starting to take its foot hold with **limited application within the claims process**.

- GenAI can be a catalyst for redesigning end-to-end operating models by creating new content based on past inputs. Although AI risks can be significant, implementing **structured governance** will help mitigate these threats. See also EIOPA (2019, 2021)

- Widespread adoption of AI raises some concerns about transparency, interpretability, and regulatory compliance. **Expainable AI (XAI)** can address them. See Meyer et al. (2023) – SHAP for actuaries - and Rivas and Senatore (2024)

International Ovierview
Claim Process and the contribution of Artificial Intelligence

Top Claims Process Phases and Root Causes Driving Poor Claims Outcomes



Source: AON Report (2023)

Contact

- Initial contacts with pertinent parties not proper
- Subsequent contact with applicable parties not made

Investigation

- Loss facts investigation not properly completed
- Investigative action plan not proper

Settlement

- Negotiation not properly managed
- Settlement not handled properly

Workforce and Predictive analytics (U.S. Chamber of Commerce "The America Works Report: Industry Perspectives," June 1, 2021)

- The impending retirement of a substantial portion of the insurance workforce, coupled with a **lack of younger talent** entering the field, intensifies the scarcity of skilled professionals. **Within the next 15 years, half of the insurance workforce will retire, resulting in over 400,000 vacant positions**
- Despite the potential of predictive analytics and workflow automation to revolutionize claims management, the industry lags in its widespread adoption. Currently, **only 42% of organizations utilize predictive analytics for insurance claims.**

International Ovierview
Claim Process and the contribution of Artificial Intelligence

- **AS IS**: work involved in managing the areas of the claims process requires
  - extensive human resources,
  - manual and repetitive tasks that are prone to duplication and error.
- **To Be**: AI will help close the skill gaps due to
  - an ageing insurance workforce
  - less skilled claims handlers involved in the claims process
  - **Operational AI:** Triage of messages, automatic responding, Entity Recognition, …

Milliman "Industry survey: Tackling claims department challenges with AI," March 19, 2024: *the top 5% to 10% of claims often account for 80% of total costs, emphasizing the significance of early identification and intervention. For large enterprises,* ***AI-driven cost reductions can add up to millions annually. In fact, AI-enabled claims triage can reduce claim severity 3% to 10%.***

Benefits:

- IOT/telematics capabilities in order to alert insurers via smart phones, home assistants or smart cars when a potential claim has occurred and to **get initial information**
- Investigation by AI **reducing cycle times** (computer vision, etc.) and improve **Data Quality**
- Using GenAI in combination with LLM for claim adjustment, **automating largely the claims process for certain types of claims**
- Classification of similar claims and determing claim's value by ML (e.g. **CART**) creating **automatic estimates and KPIs/Benchmarking**
- **Improvement of settlement rates and reduction in average costs** (and potentially claim reserves/premium rates)
- **reduction in CO_2 emission** (see next slides)

Adopting AI in insurance's value chain ensures consistency in decision-making

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The loss adjusting process and the tool developed by Mediolanum Assicurazioni

A) Measurement/Assessment

- **LCA** of the Loss Adjuster’s work:
  1. assignment of the claim management by the Insurance Company
  2. activities to be carry out (data download, policy analysis, damage inspection, agreement of the loss compensation, etc.) using
     - Traditional assessment (e.g. on-site inspection) and/or
     - Sustainable assessment (e.g. video appraisal)
  3. preparation and sending the report to the Insurance company
- For each claim managed, the **tool** requires the entry of: a) **recurring data** (e.g. LA’s car, etc.), b) **specific data** of the assigned claim, c) **other sources** by the model (survey and analysis by regulators, etc.), d) **assumption**/Expert Judgement when data are not available
- The total result, in terms of CO_2 per claim, will lead **to a numerical index consistent with the rating system** chosen by MA, representing **an emission performance**

Measurement → Management → Audit

The loss adjusting process and the tool developed by Mediolanum Assicurazioni

B) Mitigation/Management

- **The total result will be disaggregated into different components**: the analysis of the impact of each component on the overall value will allow the construction of **management actions and strategies** capable of orienting the Loss Adjusting company towards the sustainability target set by MA
- The **specific reduction measures** (limitation of pages printed, use of environmentally sustainable means of transport where possible, utilization of vegetable-derived inks, etc.) may be integrated with **interventions for the carbon neutrality** that the company will eventually put in place through activities aimed at offsetting emissions themselves with economically efficient actions
- This is to enable **to fall within the limits imposed by MA, with adequate carbon management**.

C) Carbon Audit

- The system also makes it possible to customize the reporting tools, so as **to allow MA to provide check-points** and any other moments of discussion with its Loss Adjusters.

Case study: Data, sources and assumptions

In order to calculate the total impact of a claim assessment, firstly it is necessary to calculate the CO_2 emission for each step: phone calls, energy consumed by desktop, laptop, monitor, pages printed, transport, etc. :

- Calculation of emissions for **transport** → Data obtained as an average of the best-selling cars in the country with emission data found from sources such as https://www.terraup.it/ and "Ministero dell'Ambiente e della Sicurezza Energetica"
- Calculation of emissions for **Personal Computer** → Data obtained as an average of hourly energy consumption among the best-selling laptops, desktops, and monitors, multiplying by ISPRA's 2022 consumption/emission conversion factor
- Calculation of emissions for **papers printed**→ see Arroja and Dias (2012)
- Calculation of emissions for **emails** → Data based on BBC research "*Why your internet habits are not as clean as you think*"
- Calculation of emissions for **phone calls** → Data based on Mike Berners-Lee (2022) "*What's the carbon footprint of... using a mobile phone?*"
- **Computer usage time** to handle the entire claim file: 3 hours (assumption)

Case study: Draft Results – 5 claims and 5 LAs

- Five different practices with comparable distance assigned to five Loss Adjusters (LAs)
- Common parameter => 25 km to get to the claim assessment location
- CO_2 emissions for each LA/Claim were then calculated
- The results were compared to show the best and worst performance in terms of sustainability (gCO_2)

gCO_2	Claim 1	Claim 2	Claim 3	Claim 4	Claim 5	Total
Loss adjuster A	**570.17**	**3495.30**	**3539.03**	2197.95	2847.15	**12649.60**
Loss adjuster B	3090.00	1918.55	3027.33	3308.55	4103.30	**15447.73**
Loss adjuster C	3082.35	1469.00	2765.31	4168.13	4181.15	**15665.94**
Loss adjuster D	5969.00	1833.86	2632.25	3442.03	2121.25	**15998.39**
Loss adjuster E	**3493.30**	2687.55	2340.68	4595.56	5622.90	**18739.99**

- LA A had the lowest total environmental impact: the video call tool for viewing and assessing damages limits the emissions
- Claims number 2 and 3: LA A turns out to be the worst from the environmental impact. We can infer that video assessment can be said to be sustainable for long distances, but the shorter the distance between the starting point and the event location, the less beneficial the effect of video assessment will be

Case study: Focus on Claim 1 and Final Score

Loss Adjuster A - INPUT				OUTPUT	
*Parameter (**LCA**)*	*Quantity*	*UoM*	*gCO2*	**570.17**	**gCO2 Total**
Desktop	0	n	0.00	0,00	gCO2 Transport
Monitor	1	n	15.12	3113.00	gCO2 Saved
Laptop	1	n	18.05	2.00	Bonus points
Email	10	n	40.00	**4.20**	Final score **
Pages Printed	50	n	225.00		
Phone Call time	25	min	75.00		
Video assessment (AI)	Yes	(Yes/No)	-		
Video ass. duration	20	min	147.00		
Distance	25	km	3260.00		

LA A used video assessment, scoring a 4.2 with 2 bonus points due to emission savings (no use of car)

Loss Adjuster E - INPUT				OUTPUT	
*Parameter (**LCA**)*	*Quantity*	*UoM*	*gCO2*	**3493.30**	**gCO2 Total**
Desktop	0	n	0.00	3260.00	gCO2 Transport
Monitor	2	n	30.24	0.00	gCO2 Saved
Laptop	1	n	18.05	0.00	Bonus points
Email	5	n	20.00	**4.00**	Final score *
Pages Printed	20	n	90.00		
Phone Call time	15	min	75,00		
Video assessment (AI)	No	(Yes/No)	-		
Video ass. duration	0	min	0.00		
Distance	25	km	3260.00		

LA E didn't use video assessment, scoring 4.0 due to sustainable behaviours such as fewer printed pages, etc. without getting bonus points for video assessment

* Final score depends on bonus points and other parameters (distance, desktop, etc.)

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Final Remarks

- The goal of this work in progress is twofold:
  - Quantify and manage CO_2 emission in claims management
  - Introduce traditional AI, Operational AI and Gen AI in this process in order to improve the sustainability framework of the company
- First steps have made:
  - Data and sources collections
  - Use in day by day in claim management process:
    - Measurement of CO_2 emission for each claim assessment
    - Average of CO_2 emission per month and per Loss Adjuster
    - Monitoring and Rating system according Mediolanum Assicurazioni KPIs
    - Awards for Loss Adjusters who have average of CO_2 emission under a KPI threshold
  - Sustainability awareness of people involved in claims management

Further investigations and next steps

- More **features** and other GHGs in order to adopt GWP correction factors (the GHG Protocol includes all of the most important GHGs - **carbon dioxide (CO_2),** methane (CH_4), nitrous oxide (N_2O), etc.)
- Investigate **different aggregation techniques and probability distributions**
- **Uncertainties estimation** associated with GHG inventories (prediction error)
- Inbound **Scoring System** and **implement policy** (for AI as well)
- Using TradAI to select legal trustees measuring their performance (and consider claims with court decisions as well)
- Using GenAI in combination with LLM for claim adjustment, **automating largely the claims process for certain types of claims**
- Classification of similar claims and determing claim's value by ML (e.g. **CART**) creating automatic estimates and KPIs (**predictive modelling)**
- Improvement of settlement rates and reduction in average costs (and potentially claim reserves/premium rates)➔ **Individual Claim Reserving/ML**

AI type	Symbol*	Examples	Main use
StatM		• Risk pricing • Demand modelling	Predictions
ML		• Fraud modelling • Sophisticated pricing	
TradAI		• Estimate loss using picture of a claim • Customer sentiment	Recognise patterns
LLM		• Summarise and compare RI contracts • Summarise customer calls	Create / generate
GenAI		• Creative design • Inbound AI	

Source: Delm (2024)

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Q&A

Thank you

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