# From TMX data to motor insurance relevant scoring

## How to leverage data science

Actuarial data science (Après-Midi workshop)
October 6th, 2021

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Swiss

## Swiss Re's modular end-to-end telematics solution consists of several pillars

Comprehensive solution with internal support from a reinsurer to insurers

**Telematics solution**

**Coloride app** (white-label or SDK) for behavioural and contextual data collection
Coloride **hardware tag** for trip, crash, fraud, and acceleration detection
Device-agnostic **IoT** telematics **platform** (MS Azure) to store and enhance data
**Automotive portal** with portfolio analytic functionalities for insurers

**Swiss Re support**

**Scoring & analytics** support to analyse driver and contextual data
**Actuarial** support to translate the data in insurance metrics
**Behavioural economic** support to develop a solution that suits the customers needs

**Reinsurance**

Swiss Re offers to share the risk of implementing a telematics solution in return for **reinsurance**
Alternatively, the solution is offered on a **fee**-based model

## Swiss Re Scoring is built by an insurer for insurance partners

Dynamic, machine-learning based platform to turn data into effective risk segmentation

**Speeding**
e.g., accelerometer, speed limit

**Distraction**
Phone distraction duration and level

**Maneuvers**
e.g., harsh acceleration, braking, roundabout, intersection, lane change

**Context**
e.g., time of day, area, km driven, proximity to school, pedestrian crossing

**My Scores**
post-drive coaching: comparisons to myself/others

**ADAS risk score**
scoring of impact of advanced driver assistance system (ADAS) features

- Swiss Re **scores** can be used for **behavioural** (usage-based insurance (UBI): pay-how-you-drive (PHYD) and/or pay-as-you-drive (PAYD)) and/or **vehicle risk scoring models**
- Swiss Re´s team of **scoring, analytics and actuary experts** support you in turning telematics and ADAS **data into risk-relevant insights for insurance pricing**

# Accurate trip recording

Automatic start/stop and transport-mode recognition


- It is impossible to control the operating system
- Trip-recording results vary depending on the smartphone (e.g., sensor quality, memory, and utilized capacity)
- A minimum amount of sensors are required
- The GPS quality is crucial for trip recording
- We have invested a lot in low battery usage, trade off between battery consumption and trip recording precision

| Start criteria | Trip recording | Transport-mode recognition | End criteria | Upload trip |
|---|---|---|---|---|
| • Different triggers | • Speed<br>• Maneuver recognition<br>• Distraction analysis | • Pattern recognition | • Different triggers | • Upload trip data<br>• Possibility to upload only via WLAN |

# TMR performance

Model trained giving priority to the recall of the car transport mode, and the precision of the secondary ones.
Performance on European pilots, may be retrained with trip mode corrections supplied by the client


| Transport Mode | Support | Recall | Precision |
|---|---|---|---|
| boat | 12 | 100,00% | 100,00% |
| car | 12710 | 98,68% | 94,98% |
| cycling | 407 | 71,74% | 91,54% |
| motorcycle | 851 | 53,94% | 88,78% |
| other | 13 | 30,77% | 2,60% |
| plane | 115 | 77,39% | 88,12% |
| public | 1000 | 77,90% | 92,63% |
| skiing | 349 | 93,70% | 92,90% |
| train | 316 | 82,59% | 95,96% |

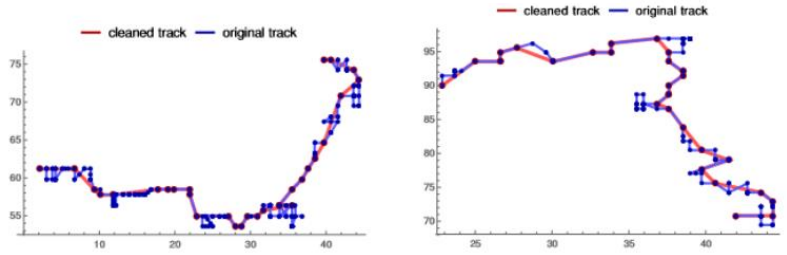
# Event Detection: Data collection and processing

From raw data to event

## Raw data collection

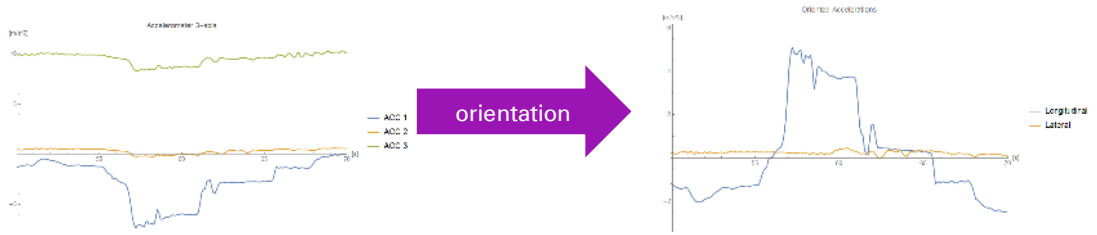
| Date | Time | Latitude | Longitude | X | Y | Z |
|---|---|---|---|---|---|---|
| 18.09.2016 | 13:25:04 | 44.904975 | 8.874011 | 0.060 | -0.100 | 0.010 |
| 18.09.2016 | 13:25:05 | 44.904977 | 8.874008 | 0.070 | -0.030 | 0.000 |
| 18.09.2016 | 13:25:05 | 44.904978 | 8.874005 | 0.072 | -0.033 | 0.007 |
| 18.09.2016 | 13:25:06 | 44.904978 | 8.874006 | -0.040 | -0.100 | 0.002 |
| 18.09.2016 | 13:25:06 | 44.904979 | 8.874004 | 0.039 | 0.052 | 0.004 |
| 18.09.2016 | 13:25:06 | 44.904982 | 8.874003 | 0.057 | -0.067 | 0.011 |
| 18.09.2016 | 13:25:07 | 44.904983 | 8.874001 | 0.060 | -0.081 | 0.009 |

## Cleaning of data & interpolation




GPS coordinate are cleaned and interpolated

## Mobile Phone Axis orientation




Accelerometer axes are orientated on the vehicle frame in order to have longitudinal, lateral and vertical acceleration of the vehicle.

## Feature extraction & Maneuver/Event classification

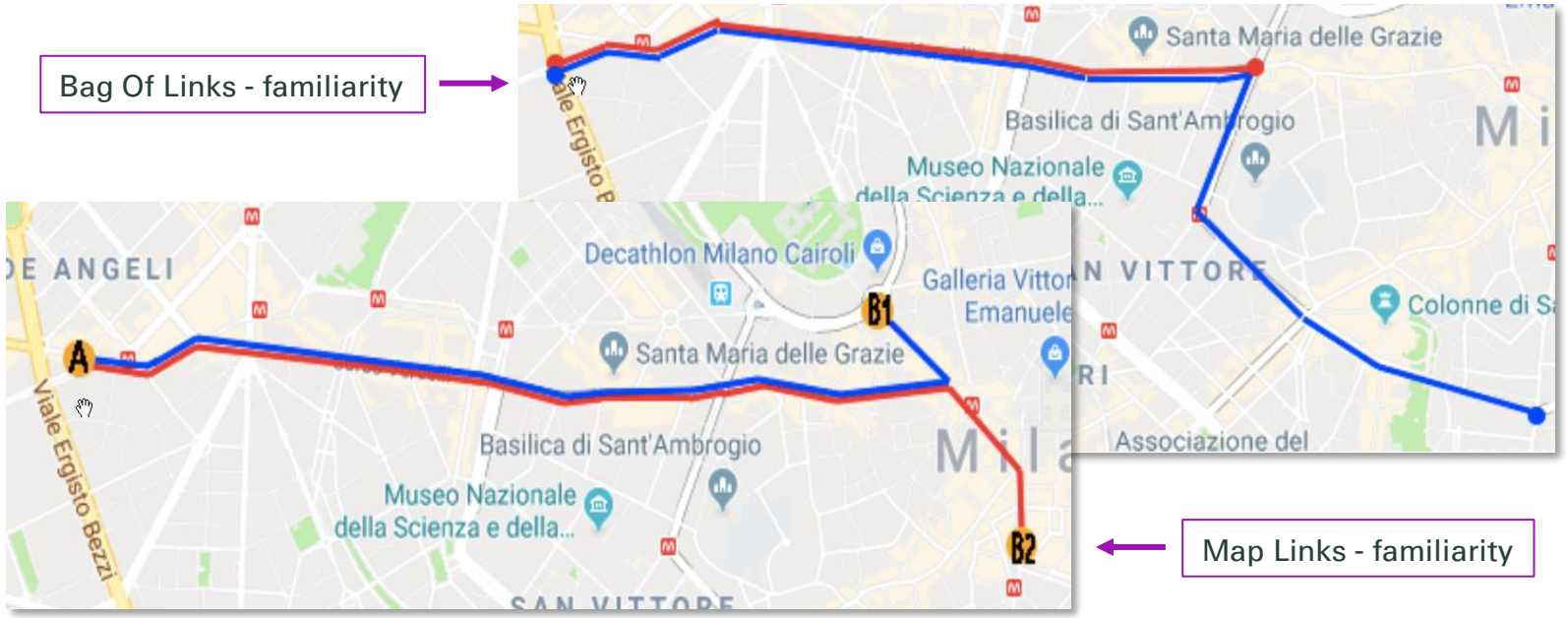
| Maneuver detected – Sensor based | Maneuver detected – Context + Sensor based | Phone distraction |
|---|---|---|
| Acceleration | U-turn | Level 1 |
| Braking | Harsh Intersection | Level 2 |
| Cornering | Roundabout | |
| Harsh Steering | | |

# Our scoring starts with an intimate understanding of the in-situ risk

- During our **'track days'**, we perform maneuvers with a dedicated fleet including regular passenger cars as well as BMW M2 & M3 und Tesla Model X
- We use **machine learning** methods to train decision trees with the recorded maneuvers
- To maximize maneuver-recognition accuracy, we use an **articulated parameter set** to enable identification and repeatability
- Unlike our competitors, we rely on **'photographic blueprints'** of maneuvers rather than kinematic thresholds

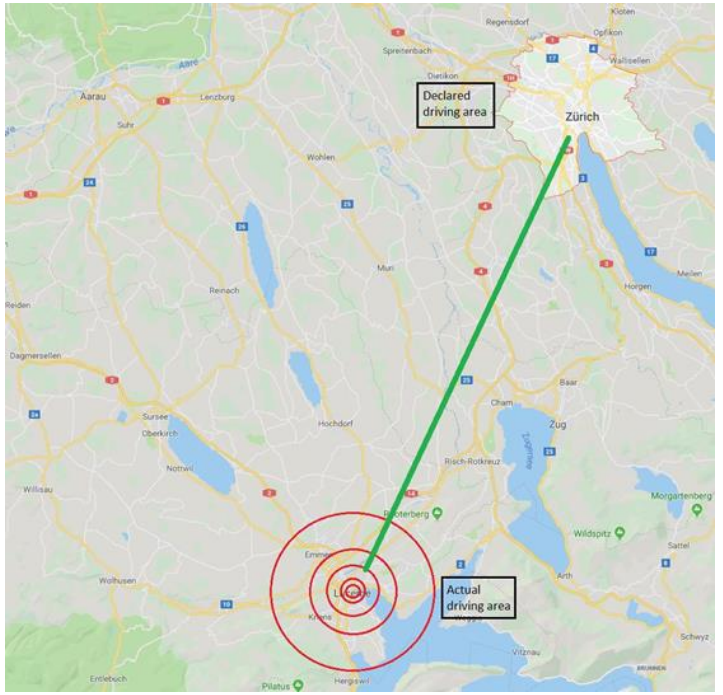
# Familiarity

Bag Of Links - familiarity




Map Links - familiarity

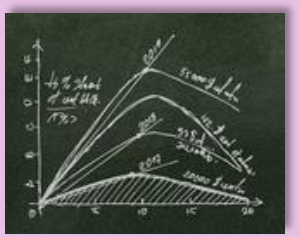
## Radius



# From driver scoring to scoring for insurance

**Increasing scoring complexity**

| Basic telematics features (e.g., distance driven) | Contextual factors (e.g., road type, time of the day) | Maneuvers (e.g., frequency of harsh braking) | Extended driver analytics (e.g., maneuver's level, distraction events) | Comprehensive behavior in context (e.g., braking in proximity of different traffic signs) |
|---|---|---|---|---|



**Data volume**

## Driver scoring

- **Purpose** is to give drivers **timely feedback**
  - Good driving behaviour is positively reinforced
  - Earned vouchers and rewards constitute an additional service (rather than premium differentiation)
- **Focus** is on **motivation** rather than precision
  - No rewards for clearly bad driving and risk-affecting behaviour
- Rough convergence to a coherent risk classification

## Insurance scoring

- **Purpose** is to work out a **telematics personalization**
  - Identify new, highly predictive factors
  - Improve the predictive power of existing pricing models and redistribute it to telematics parameters
  - Achieve a competitive advantage in the market
- **Focus** is on **precision**
- Applications beyond premium differentiation possible

# Swiss Re Driver Score

Four elements comprise the points earned from each trip driven. This is the trip score:

**Attentive driving** +

Takes into account how many times the driver is distracted (pick-up and unlock) by his/her phone

**Conscious driving** +

Considers the portion of the trip where the driver exceeds the speed limit and by how much the speed limit is exceeded

**Contextual** +

There are two contextual components:

1. Time of Day – night driving and rush hour driving are considered to be more risky
2. Inner urban area: % of time spent on urban roads where the speed limit <= 50km/h

**Smooth driving**

Applies how many times harsh manoeuvres are performed

$$Overall\ Score_n = \sum_{i=1}^{n} Trip\ Score_i * Trip\ Weight_i \qquad Final\ Score = Overall\ Score\ * Distance\ Multiplier$$

$$Trip\ Weight_i = \frac{Trip\ Length_i}{\sum_{k=1}^{n} Trip\ Length_k}$$

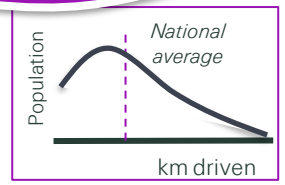
# A deep dive in cycle modelling

Producing a score

Telemetry trip data

*Data requirements ideally 10hz accel, 1hz gps*

SR telematics features

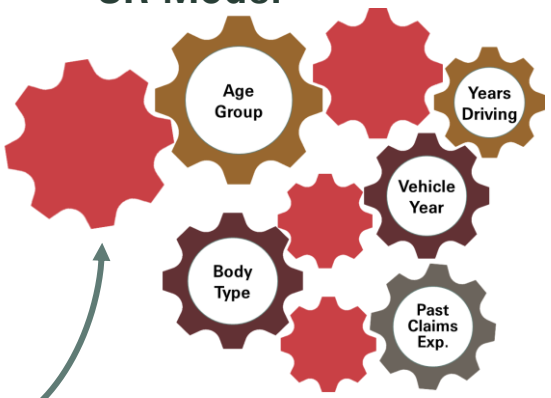



SR Driver Score

Historical trip data

Policyholder/claims information

SR Model




SR Risk Score

| Client ID | Scoring Segmentation $S_i$ | Additional variables: KM driven | % Night Driving | Duration trips performed (in hours) | % Driving in Address area | Phone usage detection on trip |
|---|---|---|---|---|---|---|
| *1* | $S_1$ | 4.020 | 32% | 10 | 25% | 2 |
| *2* | $S_2$ | 5.230 | 26% | 12 | 85% | 0 |
| *3* | $S_3$ | 3.460 | 55% | 30 | 90% | 0 |
| *4* | $S_3$ | 2.001 | 80% | 2 | 80% | 3 |
| .... | | | | | | |
| *101* | $S_3$ | 1.580 | 10% | 8 | 75% | 0 |
| .... | | | | | | |
| *n* | $S_4$ | 4.566 | 5% | 11 | 82% | 4 |

Scoring modelling and output matrix are designed to be device agnostic

# Model approach comparison

GLM vs. other ML-methods

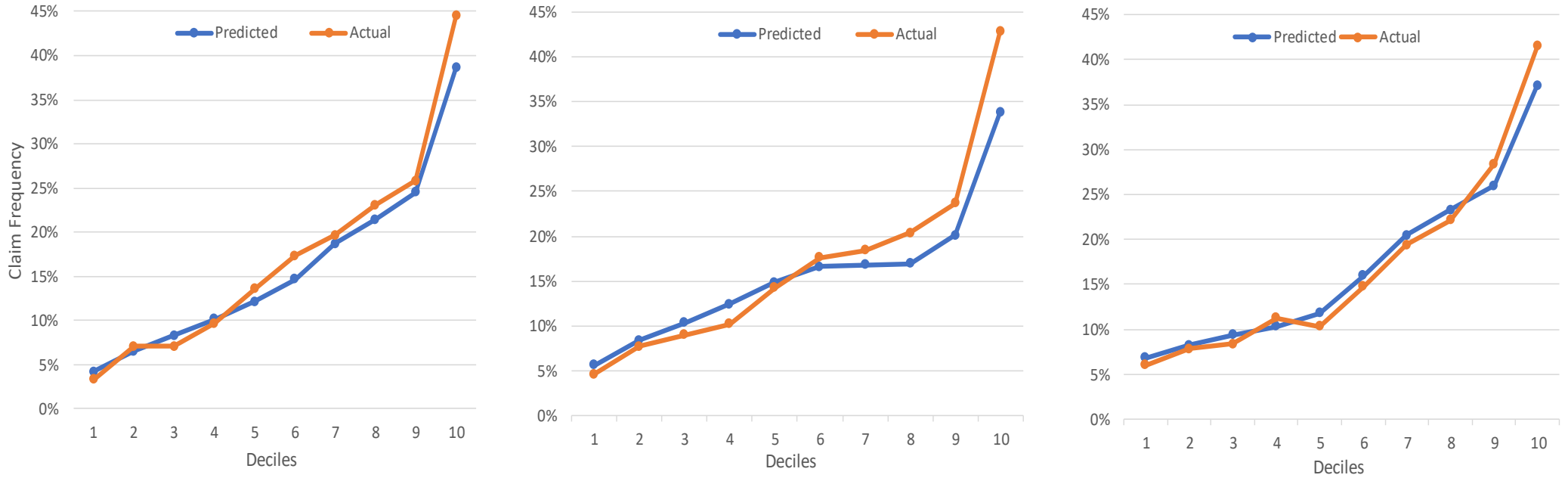
| | XGBoost | Random Forest | GLM |
|---|---|---|---|
| Automatic Feature selection | ✓ | ✓ | X |
| Model Runtime | Longer | Medium | Short |
| Performance (AUC) | High | Medium | Medium |
| Interpretable results | X | X | ✓ |

- Different modelling techniques display different performance along key measurement criteria
- Setting clear expectations a priori helps to select the preferred one

# Model performance merging different data sources

How to predict claim frequency per year

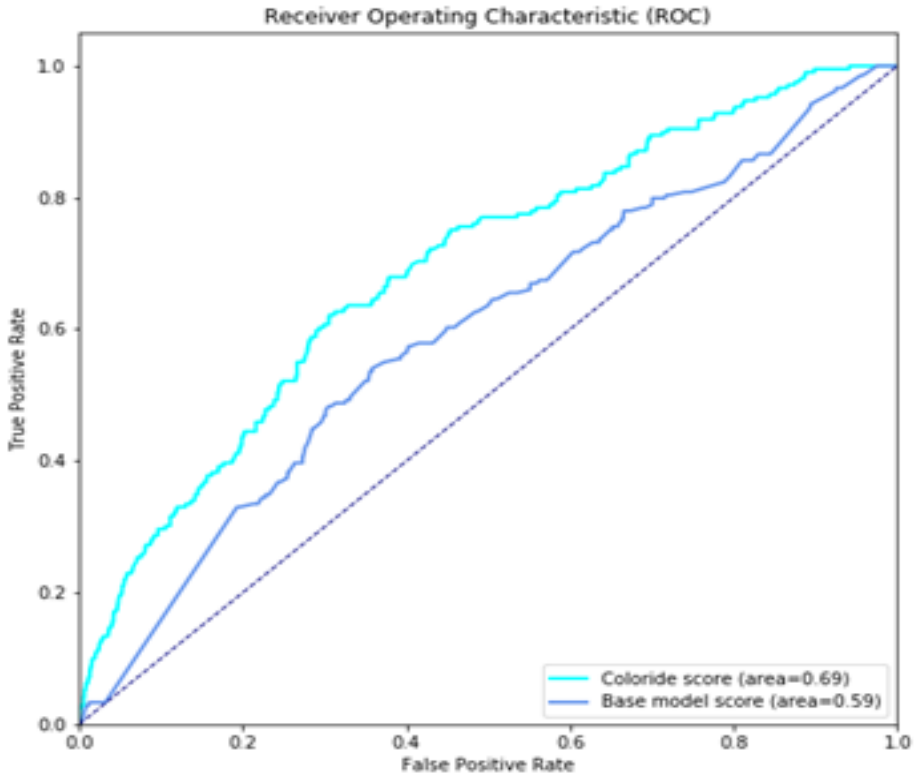
| Compulsory Third Party Liability | | | |
|---|---|---|---|
| **Features** | Traditional + Telematics | Telematics | Traditional |
| **Lift** | 12~13 | 9~10 | 6~8 |




- Training and comparing an Xgboost on a different set of features allowed to measure distinctive predictive power
- It's clear that a mixture of telematics + traditional insurance factors brings the most effective measurement of the insurance risk (measured as lift ratio on decile)

# Model performance measured on Coloride app

How to assess model accuracy augmentation




## Improvement of our TMX app solution with respect to a "traditional" telematics product

- Results presented are drawn from Xgboost computed on the entire dataset using a *cross-validation* approach
- Using ROC curve as accuracy metric, it's almost evident that a model built including peculiar telematics features retrieved from Coloride (as phone distraction, speeding ….) represents an improvement compared with a more basic model of telematics + traditional insurance

# Pricing is only one of the options!

In our experience and in our clients' experience, pricing and motor telematics product development is only one way to use the TMX collected information

Other options include:

- differentiation element for policy payment terms
- differentiated coverages to better clients
- incentive scheme for agencies
- VAS (value added services) proposition
- Rewarding mechanic

...and more

# Questions?

Swiss Re

# Thank you!

## Contact us

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## Our vision

# We make the world more **resilient**

## Our mission

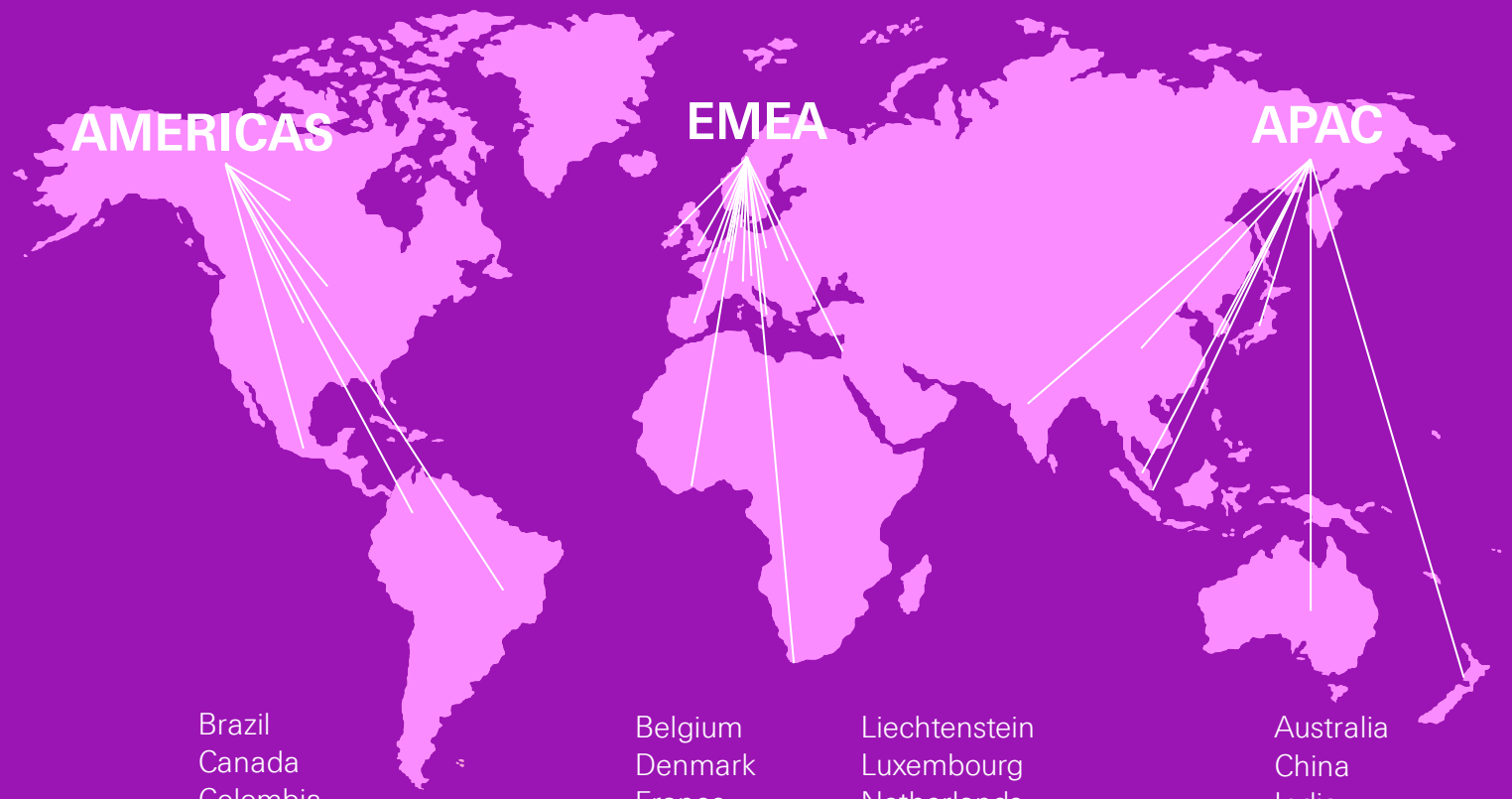
**#1** Provide **fresh** and **innovative perspectives**

**#2** Apply **knowledge**, **expertise** and **capital**

**#3** Anticipate, analyze and manage **risks**

**#4** Create smart **data-** and **technology**-driven **solutions**

# Our global business

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**We-re a leading, diversified global reinsurer, providing expertise and services to clients throughout the world, since 1863.**

**13,189** employees

**121** nationalities

**81** offices in **29** countries

**USD 40.8b** earned premium and fees (FY 2020)

# Holistic and integrated solutions

to address evolving mobility trends

**Telematics/UBI solution**
End-to-end, modular solution for assessment of driving behaviour, context and services around crash for personal and commercial vehicles in certain territories

**Swiss Re ADAS Risk Score**
Assessment of ADAS' impact on insurance pricing

**Swiss Re Vehicle Feature Score (R&D)**
Assessing the vehicle in each meaningful part: all makes, all models, global coverage and unmatched granularity

**Mobility**
Swiss Re Box: multi-country, end-to-end solution for multi-line insurance

**EVs**
Accurate insurance pricing of EVs and (extended) warranty insurance (EWI) for charging infrastructure (R&D) and batteries

01 Connected

02 Automated

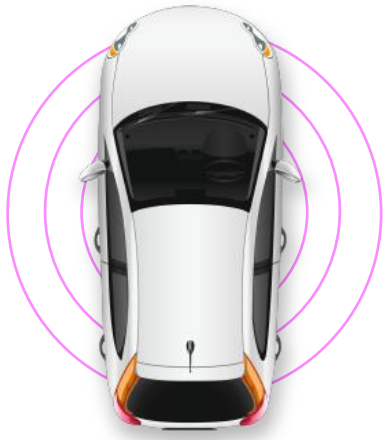
03 Shared

04 Electric

**Swiss Re Connected Cars solution (R&D)**
Holistic scoring approach unifying vehicle characteristics and features usage, driver behavior and context

**Swiss Re Smart Claims**
AI-driven digital end-to-end claims management platform – consists of modular solutions for insurers, repair shops & policyholder

**AV Risk Assessment Framework (R&D)**
Identifying and pricing the risk associated to highly automatized vehicles



**Commercial fleet (R&D)**
A comprehensive risk assessment toolkit based on technology and partnerships with fleet management providers

**Motor analytics**
Harvest data insights to navigate today's complex risk landscape