Swiss Re

Moving Beyond History - A forward looking modeling approach for casualty exposures
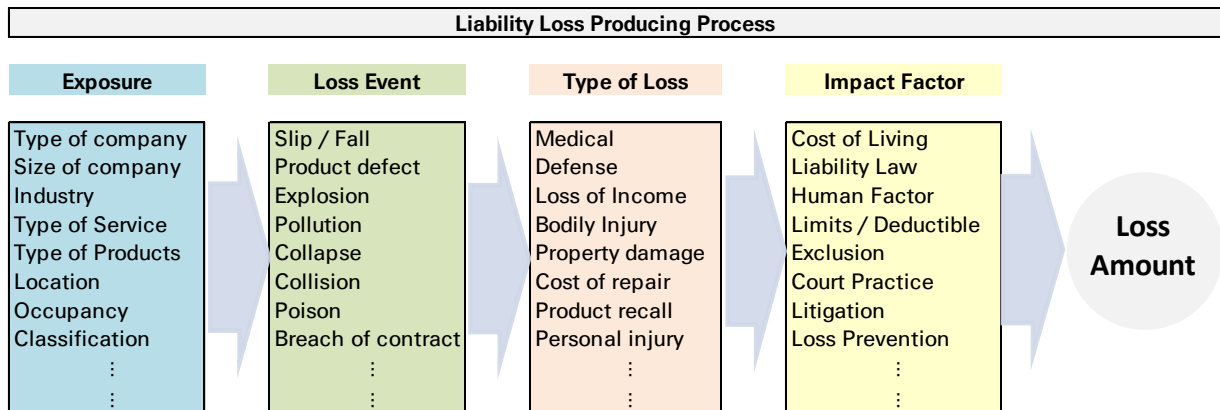
A Comparison of Two Complementary Modelling Options in Commercial Liability Insurance

Why do we need a forward looking approach in Liability?

- Liability risk is characterized by extremely inhomogeneous exposures, high uncertainty and a vast amount of risk drivers.

- Liability is highly exposed to economic, societal, legal trends and changes (risk of change)

    - Entering **new markets** and responding to **market changes** requires an exposure based approach

    - Understanding sensitivity of losses to key factors allows us to better **manage our portfolios**

    - Existing approaches are not able to **anticipate changes** adequately and consistently

- Liability accumulation is only partially known

    - We want to be able to **identify liability catastrophes (L-cat)** early on in order to

        - **Understand impact** on market, own portfolio and clients portfolios and

        - **Manage** own accumulation and **steer** risk appetite

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Challenges in Liability Insurance

Liability Loss Producing Process			
Exposure	**Loss Event**	**Type of Loss**	**Impact Factor**
Type of company Size of company Industry Type of Service Type of Products Location Occupancy Classification ⋮	Slip / Fall Product defect Explosion Pollution Collapse Collision Poison Breach of contract ⋮	Medical Defense Loss of Income Bodily Injury Property damage Cost of repair Product recall Personal injury ⋮	Cost of Living Liability Law Human Factor Limits / Deductible Exclusion Court Practice Litigation Loss Prevention ⋮

Leads to **Loss Amount**

- Challenges with existing methods

    - Traditional actuarial and predictive modelling methods using exposure to predict the loss directly without fully utilizing the information of the loss generating process

    - Lack of understanding on cause-effective chain from exposure to loss

    - Slow to reflect changes in market place

    - Insufficient data size with patterns are often masked by noises.

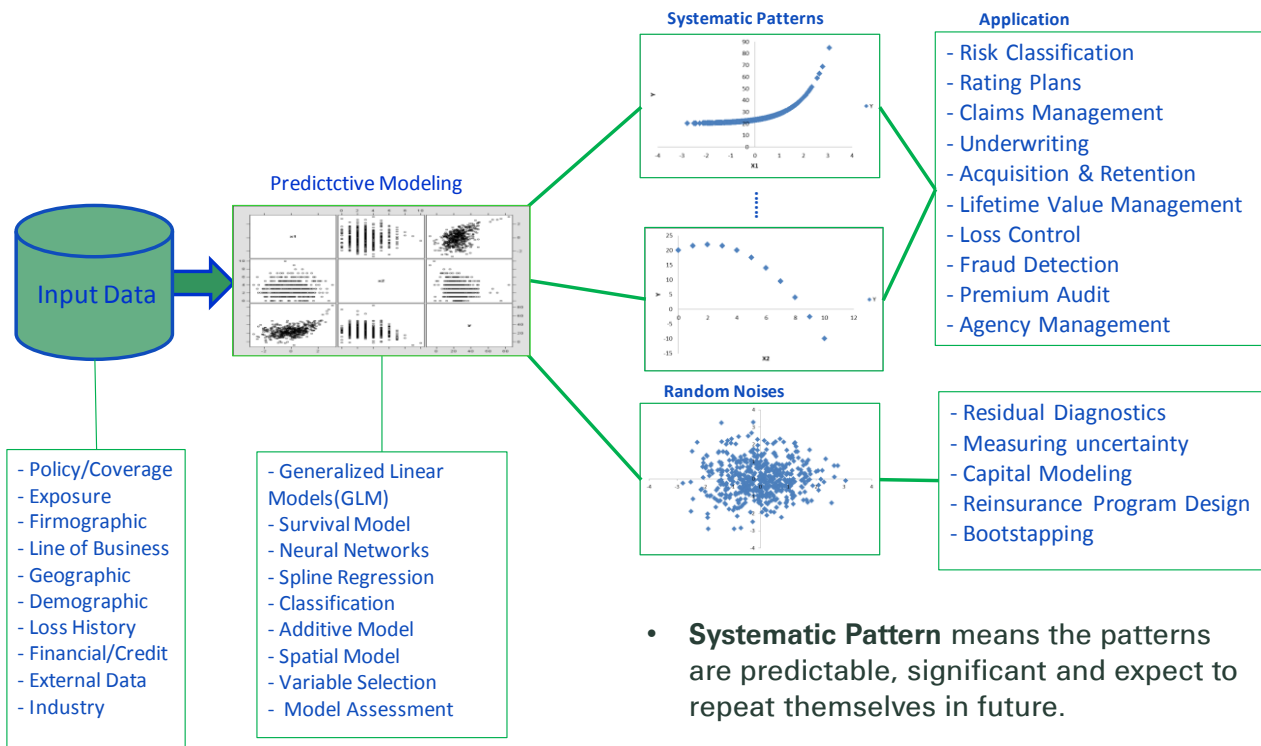   - Difficult to incorporate data from different resources with different format

➜ Call for innovative methods to quantify liability exposures

Comparison of Predictive Modelling and Forward-looking Modelling in Liability Insurance

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What is Predictive Modelling?

- **Predictive Modelling (PM)** is the process of applying techniques from statistics, data mining and mathematics to extract systematic patterns from data to predict future events or behaviours.

  − In insurance, predictive models are used to predict the policyholders' future loss and expenses. The models have been broadly used for price setting, risk selection and claims management.

  − Generalized linear models (GLMs) has become the industry standard for pricing segmentation for personal lines.

  − Outside of insurance industry, predictive modelling has been widely used in

    o Database marketing, customer acquisition, retention and relationship management.

    o Fraud detection, credit scoring

    o Spam filtering, internet streaming analysis

    o Medical research, drug development

Predictive Modelling and Its application in P&C Industry

Systematic Patterns

Predictctive Modeling

Input Data

Random Noises

Application
- Risk Classification
- Rating Plans
- Claims Management
- Underwriting
- Acquisition & Retention
- Lifetime Value Management
- Loss Control
- Fraud Detection
- Premium Audit
- Agency Management

- Residual Diagnostics
- Measuring uncertainty
- Capital Modeling
- Reinsurance Program Design
- Bootstapping

- Policy/Coverage
- Exposure
- Firmographic
- Line of Business
- Geographic
- Demographic
- Loss History
- Financial/Credit
- External Data
- Industry

- Generalized Linear Models(GLM)
- Survival Model
- Neural Networks
- Spline Regression
- Classification
- Additive Model
- Spatial Model
- Variable Selection
- Model Assessment

- **Systematic Pattern** means the patterns are predictable, significant and expect to repeat themselves in future.

How Predictive Modelling Work?

- The historical data are compiled to form multidimensional datasets(training data) which include targeting and explanatory variables.

- Statistical and data mining methods were applied on the training data to extract systematic patterns and transform them into structured mathematical algorithms.

- The models are tested and validated on testing data, the repeatable patterns are used to predict the future events/outcomes.

- The model algorithms are combined with business knowledge and expert opinions and apply to real-world dataset.

Characteristics of Predictive Modelling

- Essentially a data-driven approach, relies on historical data to provide basis for pattern extraction.

- Using exposure factors to predict the final loss amount without considering the loss generation process.

- Most of predictive models are based on structured data, that means dependent and predictive variables are needed to be in one modelling dataset and they are appropriately matched together.

- PM applies statistical methods and/or data mining techniques to extract patterns without preconceived theoretical structures.

- Factors that correlated to the loss events not necessary to be the causes of the effects.

- Data quality is the key for successful predictive modelling:
  - Homogeneity
  - Data is consistent from historical to current periods
  - Sufficient with systematic patterns exist in data
 - Personal lines are

What is Forward Looking Modelling?

- **Forward-Looking Modelling(FLM)** is a scenario based modelling approach which models cause-effect chain of potential losses, thus anticipating future outcomes of business for the (re)insurance industry in the light of economic, societal, and legal dynamics.

- **Liability Risk Drivers (LRD)** is Swiss Re's own patented FLM for Liability business. Developed in Swiss re since 2007 with purpose to address the issues and challenges in Casualty Modelling.

Characteristics of Forward Looking Modelling

- LRD models the cause-effect chain of liability losses through a **scenario-based** approach.

- The loss scenarios/events are based on company's industry classification, products and activities(exposures).

- The effects of internal and external factors on loss frequency and severity are quantified and validated.

- Incorporates validated experts' insights.

- The model is calibrated and validated against reliable in-house and external exposure and loss data.

- Open and flexible modelling structure allows to incorporate new information and data from different sources.

Short vs. Long Tail: Risk Factors

Example Earthquake   >>   Accurate "hard" risk factors based on science, statistics, observations

Hazard + Vulnerability + Values + Conditions
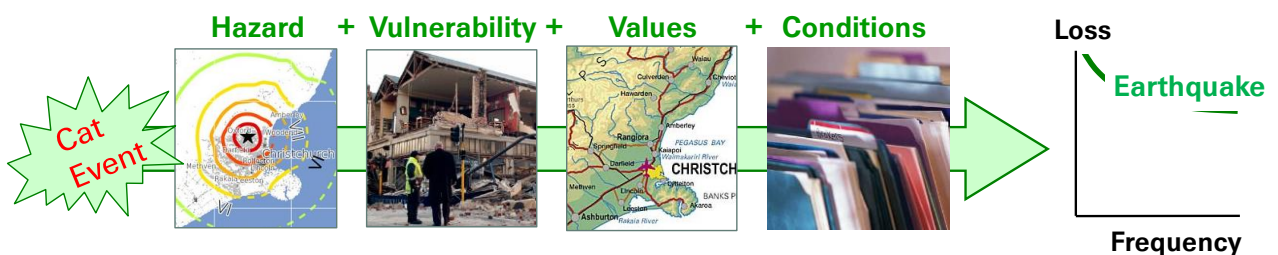
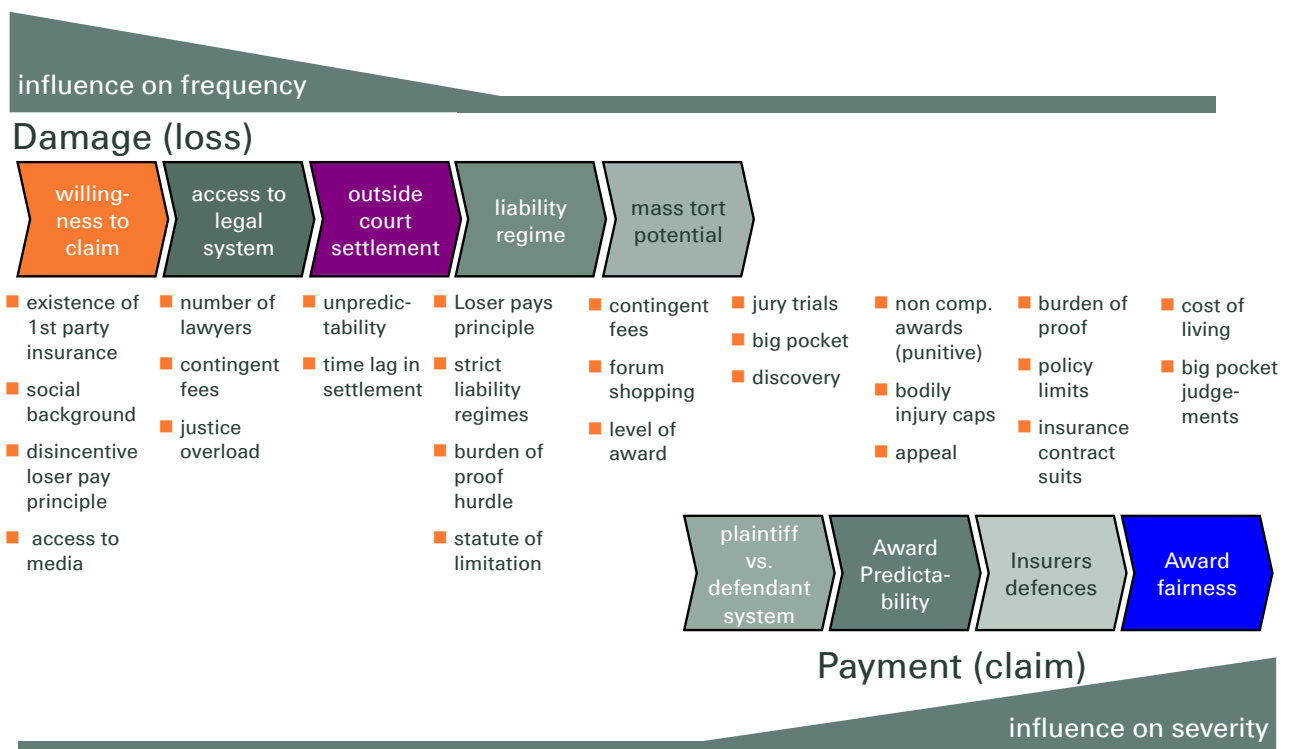Example Liability Event   >>   Some "soft" experience and statistics, but what exactly "drives" the risk?

➡ Understanding what drives risk in Liability is key to improve UW quality

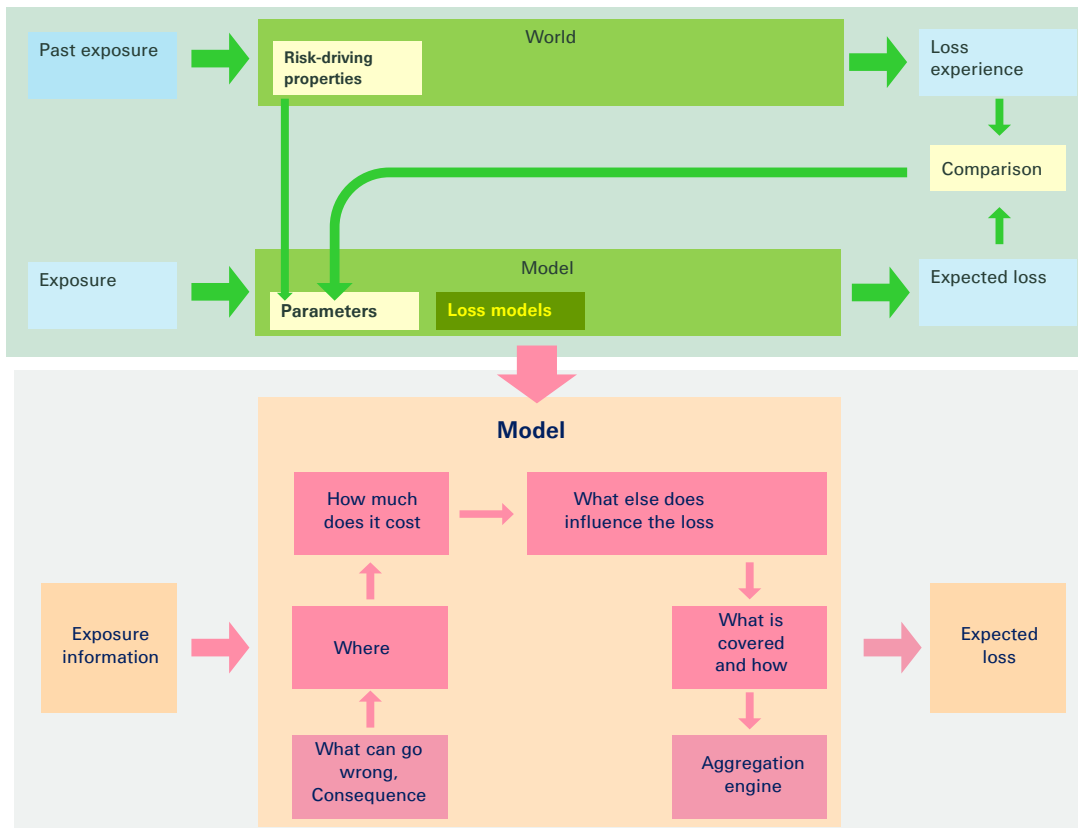# What are the risk drivers in liability?

Industry Sector	Revenues Size	Exports	Cultural background	Legal system	Cost of living	...	Insurance conditions
Activities? What is produced?	How big is the company?	Geographic spread of products?	Likelihood that people sue?	Mass litigation?	What do courts award for bodily injuries?	...	What proportion of the loss is insured?

Liability Risk Drivers Model

Expected Annual Loss

Liability Laws
Details of Chain

influence on frequency

Damage (loss)

willing-ness to claim | access to legal system | outside court settlement | liability regime | mass tort potential

- existence of 1st party insurance
- social background
- disincentive loser pay principle
- access to media

- number of lawyers
- contingent fees
- justice overload

- unpredic-tability
- time lag in settlement

- Loser pays principle
- strict liability regimes
- burden of proof hurdle
- statute of limitation

- contingent fees
- forum shopping
- level of award

- jury trials
- big pocket
- discovery

- non comp. awards (punitive)
- bodily injury caps
- appeal

- burden of proof
- policy limits
- insurance contract suits

- cost of living
- big pocket judge-ments

plaintiff vs. defendant system | Award Predicta-bility | Insurers defences | Award fairness

Payment (claim)

influence on severity

Liability Risk Drivers™ (LRD) Model

PM vs. FLM in Liability Risk Modelling

Predictive Modelling	Forward Looking Modelling
- Using predictors for loss without knowing their real loss mechanism. - As environment changes, variables that explain the past may no longer applicable to the future.	- Focus on modelling the loss mechanism/loss generating process, clear cause-effective chain from exposure to loss. - Quantifies the impact of key external (environment) and internal (risk specific) risk factors in a transparent way.
- Require structured data. Exposure and loss information needed to be in one modelling dataset which limits the using unstructured information outside of the portfolio(e.g. scenarios occurred in other companies) - One carrier's portfolio is often not sufficient in size to build predictive models.	- Flexible modelling structure allows to use unstructured external data sources or loss information that can not be matched to the modelling dataset. - Taking advantage of big data by combining information from different resources.
- Backward looking and therefore inadequate for liability, which is long tail. - Take time for the changes to be reflected in data which results significant in delay to reflect changes in market place	- Forward looking the future outcomes of the business in the light of economic, societal, and legal dynamics. - The new information and expected changes in future can be reflected in model
	- FLM can incorporate PM as modelling option in its modules when data is rich. - Robust PM findings can be transferred into the situation where experience is sparse such as a low frequency-high severity range (incl. liability catastrophes).

➜ **FLM and PM are two complementary methods in Liability Modelling**

Integration and Transfer of Predictive Models by Forward-Looking Models
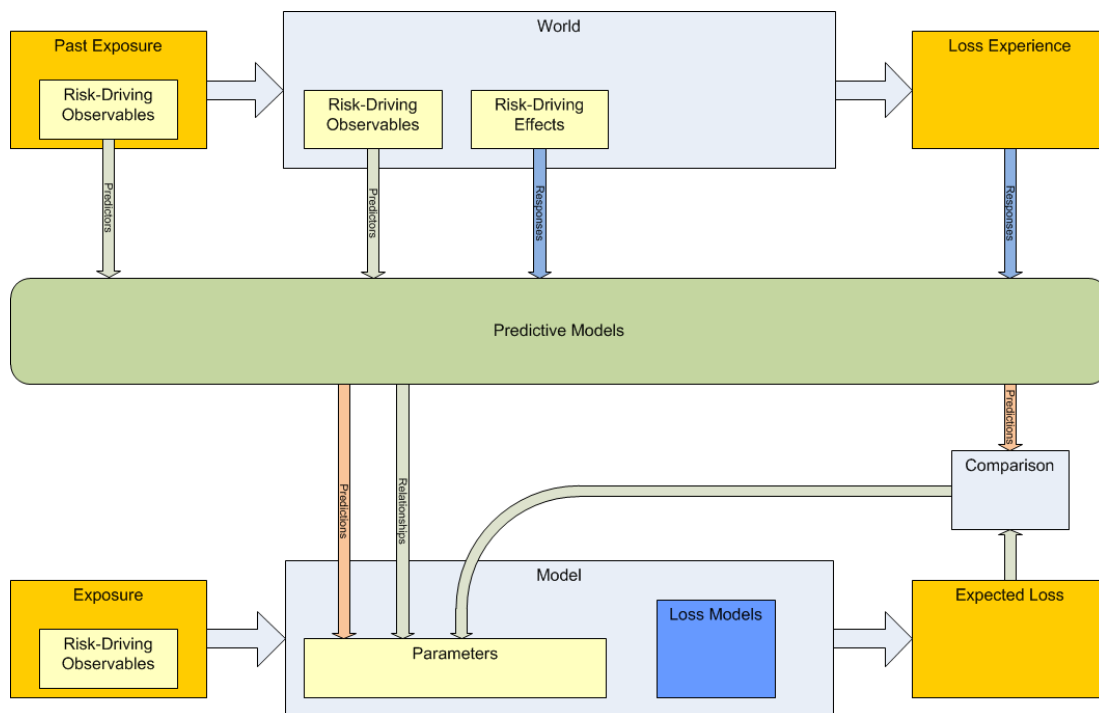
PM and FLM are complementary to each other

- FLM incorporates PM in its modules when data is sufficient
  - Quantifying the effects of risk drivers.
  - The PM can identify if there are residual patterns left in the data after the "known effects" of the risks drivers are fixed/off-setted.

- FLM provides deep insights and valuable guidance into the risk assessment of a portfolio when PM has limited value
  - New and growth market
  - Portfolios with limited historical data and/or too much noises
  - Evaluation the impact of changing environments/conditions
  - Risk aggregation
  - Incorporating big data and information from different sources

➜ The combination of FLM and PM providing state-of-the art analytical solutions and unparalleled understanding of the commercial liability risks

Enhance FLM Through Collaboration

- With its open and flexible structure, FLM incorporates robust predictive modelling findings and apply them in situations where experience/data is sparse or non representative.

- FLM combined with insurer's wealth of knowledge and data, enables to confidently grow in emerging markets and improve risk selection via increased business transparency and risk understanding.

- We work with strategic clients and partners to quantify the risks of both today and tomorrow, offering services in the area of:
  - Portfolio Risk Analysis
  - Tariff Indicator for Emerging Markets
  - Scenario Analysis
  - Casualty Cat Modelling (under development)

LRD Model – Usage

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