Swiss Re

Forward-Looking Modelling

Agenda

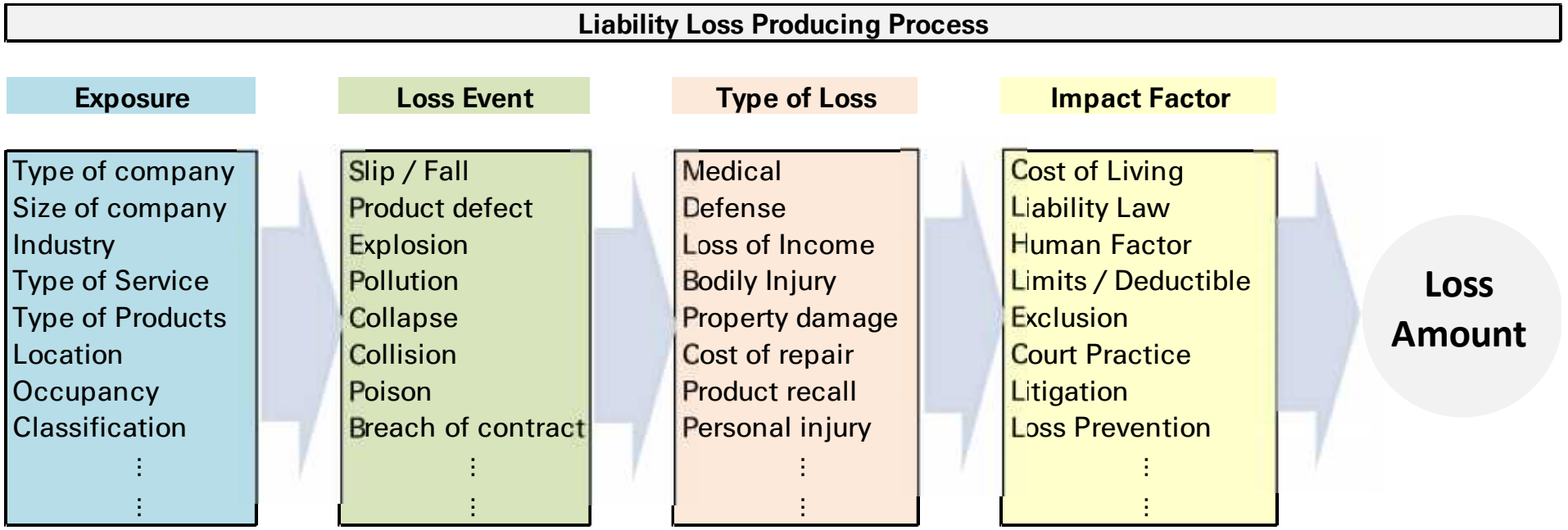
- Why do we need a new approach
- Comparison of Predictive Modelling and Forward-Looking Modelling in Liability

Why do we need a new approach

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

Challenges in Liability Insurance



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

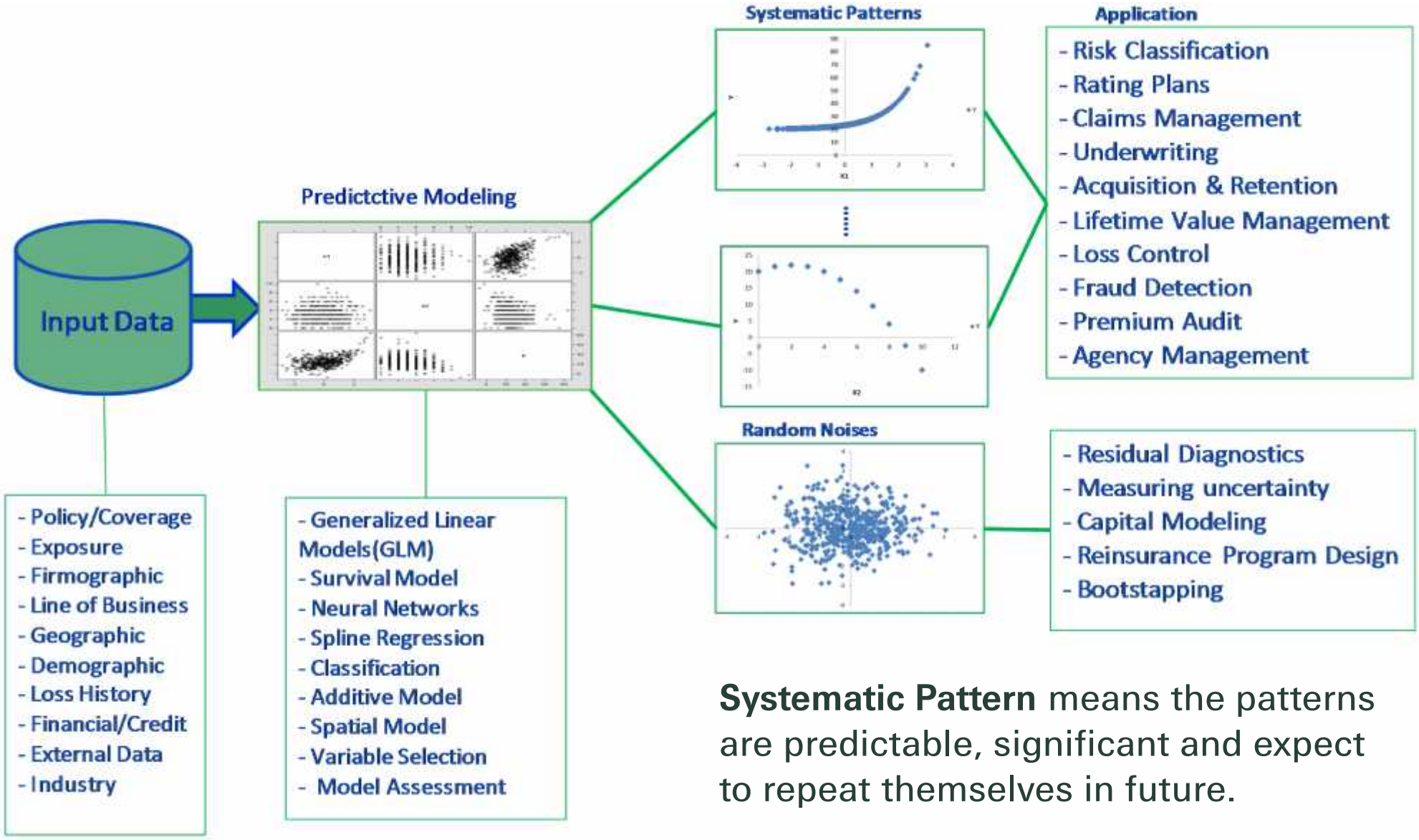
Comparison of Predictive Modelling and Forward-Looking Modelling in Liability

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
  - Customer acquisition, retention and relationship management
  - Fraud detection, credit scoring
  - Spam filtering, internet streaming analysis
  - Medical research, drug development

Predictive Modelling and Its application in P&C Industry



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

How does 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 correlate to the loss events are not necessary the causes of the effects.
- Data quality is the key for successful predictive modelling:
  - Homogeneity
  - Data is consistent from historical to current periods
  - Sufficient systematic patterns exist in data

Suggested Practice on Predictive Modelling

- PM is a powerful tool in quantifying the inter-relationships between losses and exposure factors and should be used when data is sufficient.
- PM should be used with caution. Common pitfalls should be avoided, e.g.
  - assuming that all significant patterns are predictable to the future
  - incomplete understanding of the biasness of the data and its limitations
- PM practice should focus on quantifying external factors (economic, societal, legal, judicial) from "big data" and derive patterns from industry wide loss statistics where data is strong. For example:
  - The relationship between external factors and the loss frequency and severity trends
  - Optimal industry segmentation for loss frequency based on e.g. ISO data
  - Quantifying the relationship between frequency and company size using economic data
  - Prediction of ALAE distribution for losses with/without indemnity for Med Mal

What is Forward-Looking Modelling?

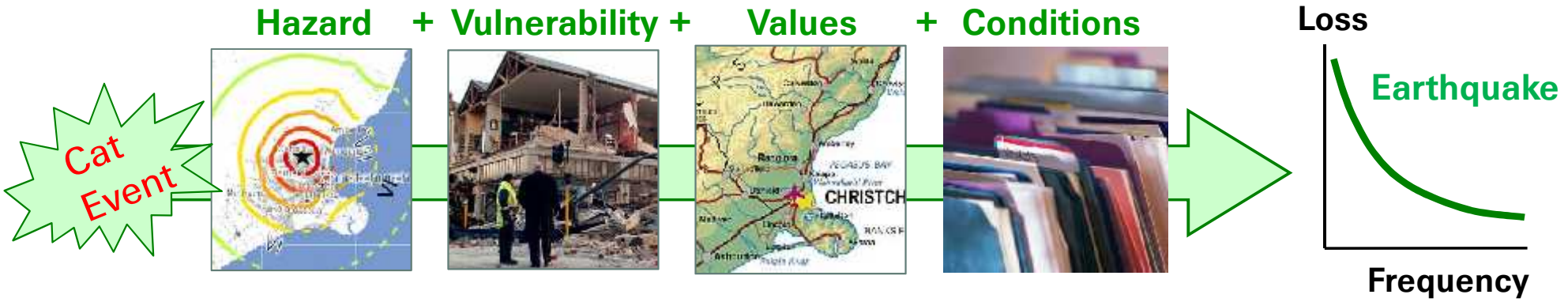
- **Forward-Looking Modelling(FLM)** is a scenario based modelling approach which models cause-effect chain of potential losses, thus anticipating future outcomes of business for the (re)insurance industry in the light of economic, societal, and legal dynamics.
- Forward-Looking Modelling examples:
  - NatCat models used in Property insurance for e.g. costing, risk management, accumulation control.
  - The Liability Risk Drivers™ model used in Casualty with the aim to replicate the NatCat success story.

Characteristics of Forward-Looking Modelling

- FLM 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 exposure and loss data.
- Ideally, an 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



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?



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Limit

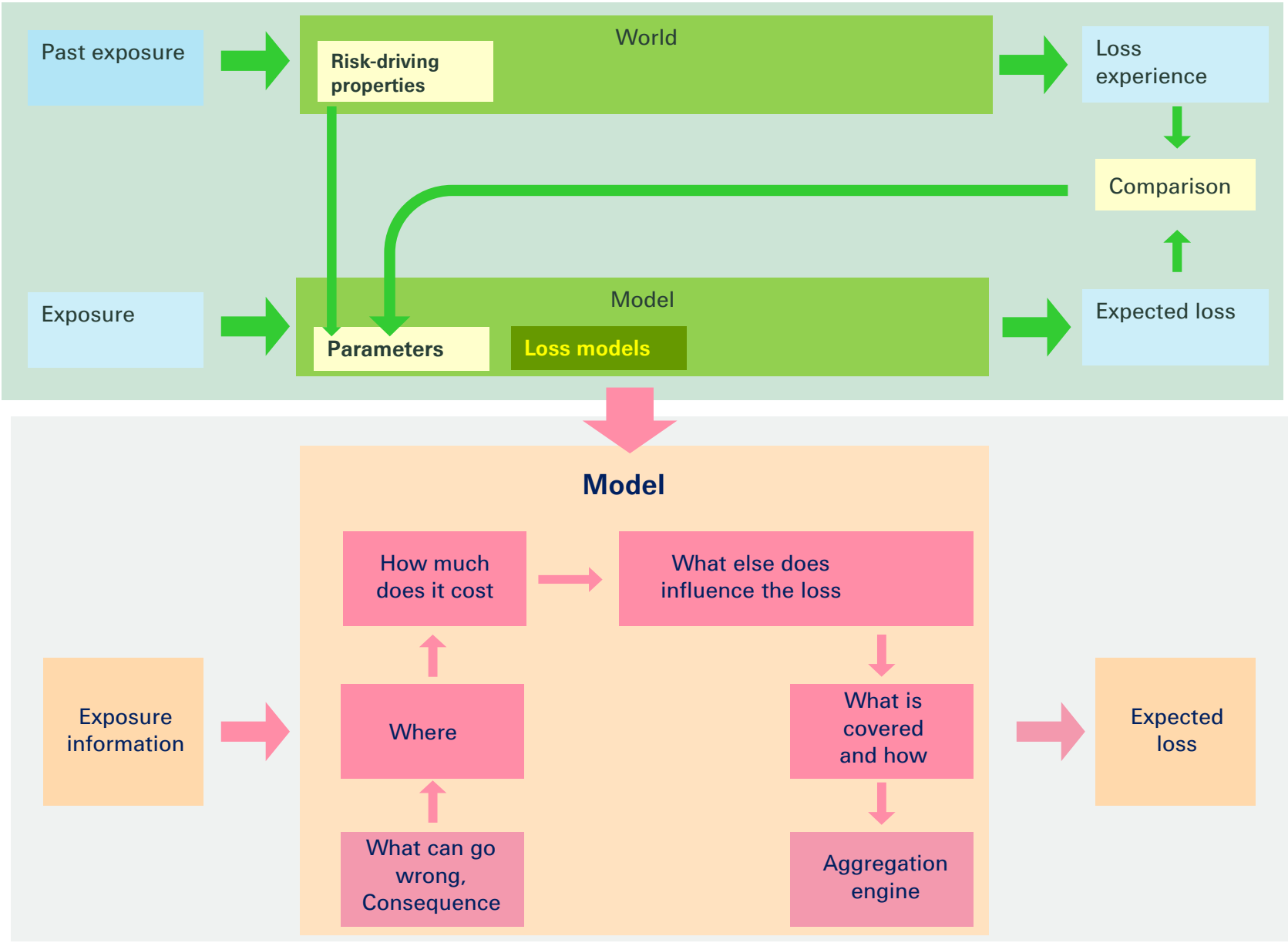
Deductible

Type of Products	Size of Company	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

FLM Example: The Liability Risk Drivers™ (LRD) Model

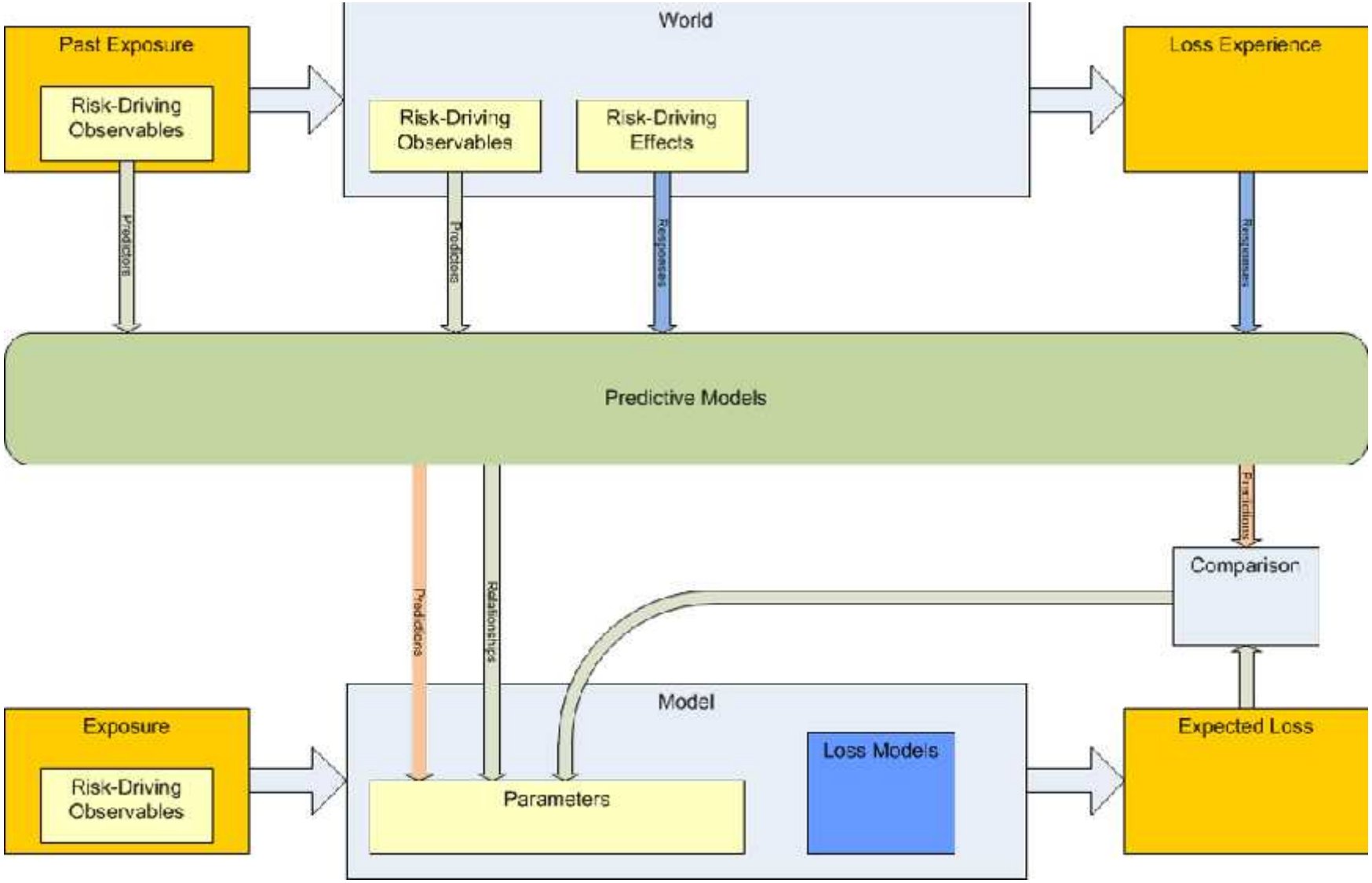


PM vs. FLM in Liability Risk Modelling

Predictive Modelling	Forward Looking Modelling
- Using predictors for losses 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 generation 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.
- Requires structured data. Exposure and loss information needs to be in one modelling dataset which limits the usage of unstructured information outside of the portfolio - 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 cannot be matched to the modelling dataset. - Takes advantage of big data by combining information from different resources.
- Backward looking and therefore inadequate for liability, which is long tail. - Takes time for the changes to be reflected in data which results in significant delay to reflect changes in the market place	- Forward looking in the light of economic, societal, and legal dynamics. - New information and expected future changes can be reflected in the 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
  - Quantification of 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 in the risk assessment of a portfolio when PM has limited value, e.g.
  - in new and growing markets
  - for portfolios with limited historical data and/or too much noises
  - in the evaluation of the impact of changing environments/conditions
  - in risk aggregation
  - in incorporating big data and information from different sources

→ The combination of FLM and PM provides state-of-the-art analytical solutions and an unparalleled understanding of the commercial liability risks

Application Examples of FLM

- Portfolio risk analysis by decomposing of an insurance portfolio into key risk drivers
- Tariff indicator for emerging markets by calculating the expected loss and identifying major risk drivers in different high growth countries
- Scenario analysis by a portfolio impact analysis based on legal and societal developments
- Casualty cat and accumulation modelling by calculating the impact of various casualty cat scenarios
- ...

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