

## DRAFT WORKING PAPER FOR SEADRIF WEBINAR

# SEADRIF Knowledge Series: Financial Protection of Public Assets Fact Sheet 3: Information Requirements for Public Asset Disaster Risk Financing and Insurance



**Disaster Risk Financing  
& Insurance Program**



TAKE CRISIS OUT  
OF DISASTER

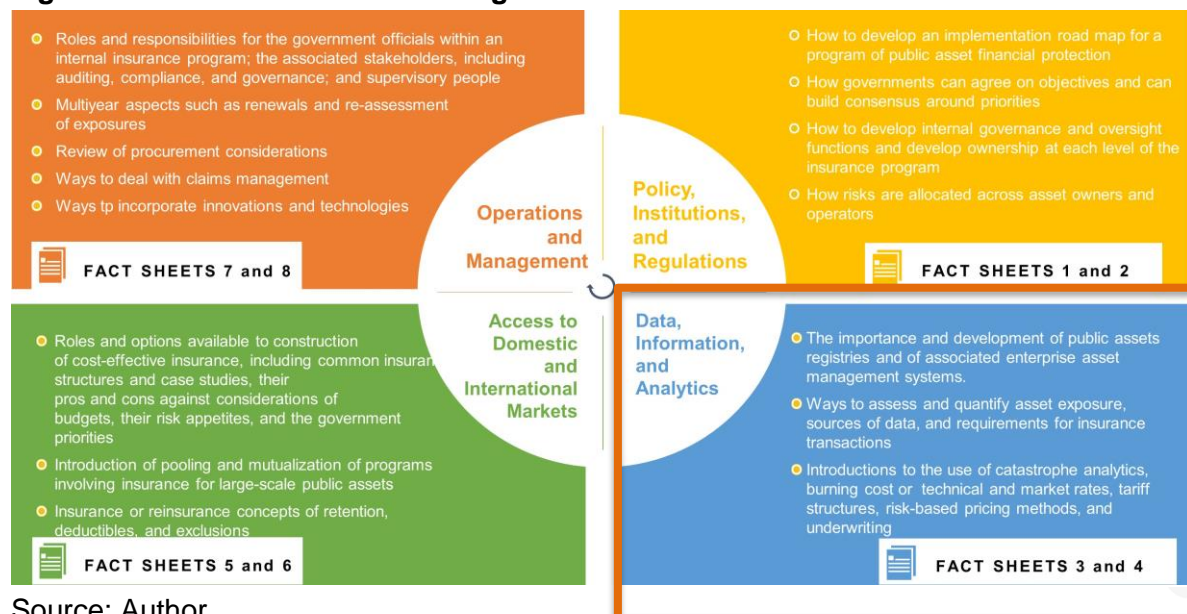
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## The SEADRIF Knowledge Series: Financial Protection of Public Assets

This third fact sheet<sup>1</sup> is part of a Knowledge Series that supports government officials as they develop their understanding of the steps needed to design, develop, deliver, and operate effective financial protection of public assets, particularly through risk transfer and insurance. The Knowledge Series encompasses an end-to-end development of public asset financial protection and insurance, as shown in figure 1. See previous fact sheets in this series for a more detailed introduction.

Each fact sheet will cover a major element of the process and will highlight considerations to assist government officials and other stakeholders responsible for developing solutions. New terminologies are highlighted in italics and defined in the glossary.

**Figure 1. Overview of the Knowledge Series**



Source: Author

<sup>1</sup> Drafted by Matthew Foote, Greg Fowler, Nicola Ranger, Lit Ping Low and James Allchorne of the Disaster Risk Financing and Insurance Program at the World Bank. Benedikt Signer also contributed input. The draft will be refined and finalized after presentation of the series of SEADRIF webinars about public asset financial protection, and it will incorporate feedback from SEADRIF members and other webinar participants. The findings, interpretations, and conclusions expressed in this fact sheet do not necessarily reflect the views of the World Bank, its board of executive directors, or the governments they represent. The World Bank does not guarantee the accuracy of the data included in this work.

## Introduction

This fact sheet addresses some of the common information and data requirements to develop a robust financial protection program, with a focus on the data needs for insurance, including specific insurance instruments such as parametric insurance.

Every stage of the process to operationalize financial protection, and specifically risk financing and insurance, for public assets requires information. It provides the evidence base needed to support decision-making throughout the design, development, delivery, and renewal stages of a public asset risk-financing process.

Obtaining and using the right data and information for a risk-financing program are often challenging and costly steps. Moreover, data capture often requires sophisticated analytical platforms, and information is usually hard to gather in a consistent and effective way to meet insurer needs.

This analysis means that it is difficult to create a single definition of data quality. Such definitions can change according to the degree of risk a financing program may represent, as well as the importance of decisions made using it. Rather than “quality”, a more suitable term to use when considering the appropriateness of data for risk assessment is “adequacy.”

This fact sheet is structured as follows:

- **The use of data and information throughout the four stages of public asset financial protection programs.** This section identifies what data are required, as well as why and how they can be used across the four stages introduced in previous fact sheets dealing with design, development, delivery, and renewal. This section gives an overview of how risk modelers and underwriters use the data provided.
- **The types of public asset data required.** This section focuses on the types of data that government officials will need to collate, with a special discussion on exposure data.
- **Fitness for the purposes of the data.** This section discusses how to prioritize data collection efforts in an environment of scarce collection resources and data gaps.

Two cases studies are used throughout the fact sheet and are provided in the full in the Annexes: Mexico (Annex A) and New Zealand (Annex C).

## The Use of Data and Information throughout the Stages of Public Asset Financial Protection Programs

### Introduction

Structuring and implementing the most appropriate disaster risk-financing instrument depend on obtaining data that adequately represents the risks being addressed. Information derived

from data underpins each stage of the road map (fact sheet 1), enabling effective decisions about strategic alignment, collective agreement of objectives, and the optimal balance between risk retention and risk transfer. Stakeholders have varying degrees of responsibility for collecting data during the risk-financing process, but they also gain corresponding benefits from the information provided by themselves and others.

The collection of data for risk financing and insurance contributes to and can draw from wider efforts to strengthen public assets data management and delivers benefits beyond contributing to financial protection, for example, for wider financial management of public assets and for informing disaster risk management investments and systems. This wider view on public assets data is outlined in the next fact sheet (fact sheet 4).

## Design Stage

From fact sheet 1, the objective of the design stage is to agree on the overall purpose, principles and objectives of a public assets financial protection program with key stakeholders. As such, for the design stage, the level of detail required will be low relative to other stages; however, the supplied data should accomplish the following:

- Provide a suitable indication of the overall risk profile.
- Be adequate to enable structured engagement with stakeholders.
- Reflect the scale and character of the risks under consideration.

An example of the use of data during the design stage is given in Annex A for the Fondo de Desastres Naturales (FONDEN). FONDEN is a financial vehicle through which the Federal Government of Mexico allocates budget ex ante for post-disaster relief, rehabilitation, and reconstruction of public infrastructure such as roads, hospitals, and schools. Annex A describes how data on historical damages to public assets, and government expenditure at federal and state level was used to give an initial picture of the financial needs for FONDEN and an indicative risk profile.

<b>What data?</b>	<p>An overview with general insights includes the following:</p> <ul style="list-style-type: none"> <li>• Historical effects of natural disasters on public assets analyzed through academic research or hazard reports or both</li> <li>• Financial or budgetary effects of those events described in government financial statements and donor aid reports</li> <li>• Other significant social and economic effects laid out in post-disaster needs assessments and academic research</li> <li>• Current contingent funding arrangements that use existing funded and unfunded reserves</li> <li>• Existing legislative or regulatory constraints or dependencies such as fiscal management and procurement legislation</li> <li>• Approaches adopted by other jurisdictions as a benchmark</li> </ul>
<b>For what purpose?</b>	<p>Building a case for change must include the following:</p> <ul style="list-style-type: none"> <li>• Develop a general understanding of the scale of natural disaster risk exposures.</li> </ul>

	<ul style="list-style-type: none"> <li>• Identify the potential scale of financial effects on government and the economy from disaster events, as well as the benefits of financial protection.</li> <li>• Provide an early benchmark of the adequacy of existing funding arrangements.</li> <li>• Facilitate structured stakeholder engagement.</li> </ul>
<b>How is it used?</b>	<ul style="list-style-type: none"> <li>• Data are often collected and collated by government officials to develop a “problem or opportunity definition” for consideration by senior leadership.</li> <li>• Better information leads to an improved understanding by senior leaders of arrangements for public asset financial protection and helps impel governments to issue risk appetite statements discussing the likely nature and extent of such arrangements.</li> </ul>
<b>What is the benefit?</b>	<ul style="list-style-type: none"> <li>• Support informed discussion.</li> <li>• Support agreement on strategic priorities, objectives, and benefits.</li> <li>• Support a tailored approach to solution development exceedance probability.</li> </ul>

## Development Stage

The development stage is where a financial protection strategy is structured, including for example appraising options for the balance of risk retention vs. risk transfer, and where roles and responsibilities and budgets are agreed, and delivery options clarified. More detailed data are required to inform these decisions. The quality of data needed will vary, though, depending on the approach used to assess the level of risk, the type of assets, the type of financial protection strategy and risk transfer instrument that will be adopted, and the ability of insurers to incorporate the data into underwriting and analytical models to derive adequately accurate outputs.

At this stage, designers can use analytics-driven approaches to assess the materiality (Box 1) and scale of financial risk relative to various hazards. Analytics can include historical loss or damage data (often termed “experience” data) and can use loss estimation models, most particularly “catastrophe” models, for analyzing one or more of the most material hazards (Box 2). Annex A describes the process of developing a customised catastrophe risk model “R-FONDEN” in Mexico and how this was used for decision making alongside other data.

<b>What data?</b>	<ul style="list-style-type: none"> <li>• A detailed public assets register (see next section and Fact Sheet 4)</li> <li>• Catastrophe modeling analysis showing the physical and financial effects on public assets in different disaster scenarios</li> <li>• Analysis of government’s explicit and implicit natural disaster contingent liabilities (funding obligations entrenched in legislation and non-entrenched moral obligations)</li> <li>• Analysis of legislative and regulatory constraints or dependencies</li> <li>• Analysis of approaches adopted by other jurisdictions, including lessons learned</li> </ul>
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<b>For what purpose?</b>	<p>Data modeling and information are used for the following tasks:</p> <ul style="list-style-type: none"> <li>• Develop a detailed risk profile.</li> <li>• Identify and estimate the financial gap expected between the modeled impacts of disaster events and currently available funding.</li> <li>• Assess the appropriate retention-transfer options available.</li> <li>• Assess the costs and risk allocations most appropriate to each asset risk owner.</li> <li>• Identify which hazards are most material to the loss potential (see box 1).</li> </ul>
<b>How is it used?</b>	<ul style="list-style-type: none"> <li>• The public asset register is provided to catastrophe loss modelers to enable them to run computer simulations of natural disasters of varying severity so they can assess the financial impact on the asset portfolio (see box 2).</li> <li>• Government officials can use the outcomes of those simulations to             <ul style="list-style-type: none"> <li>○ Assess risk appetite (the desire to retain a proportion of the risk).</li> <li>○ Assess risk tolerance (how much risk to retain).</li> <li>○ Identify the scale of risk-transfer requirements.</li> <li>○ Account or plan for the design of solution-specific legislation or regulation.</li> </ul> </li> </ul>
<b>What is the benefit?</b>	<ul style="list-style-type: none"> <li>• Establish a well-informed basis to develop options that are more likely to be relevant and viable.</li> <li>• Provide a greater degree of certainty for senior leaders, thereby enabling a more defensible and transparent explanation of the preferred option.</li> </ul>

### **Box 1. Materiality and Its Application**

Materiality relates the relevance or significance of an aspect of data or information in influencing the true representation of risk. It is a measure of the estimated effect that the presence or absence of an item of information may have on the accuracy or validity of a result. The degree of materiality determines how much data detail is required when making risk-based decisions. For example, the exact location of a building may have a high degree of materiality for flood insurance, e.g. where the building is in relation to a river, but less so for earthquake. This concept can also apply to hazard data. For example, if a building is not located in a flood zone and covered by a multi-peril policy, then earthquake or wind damage may be the most material hazards to assess using a catastrophe model.

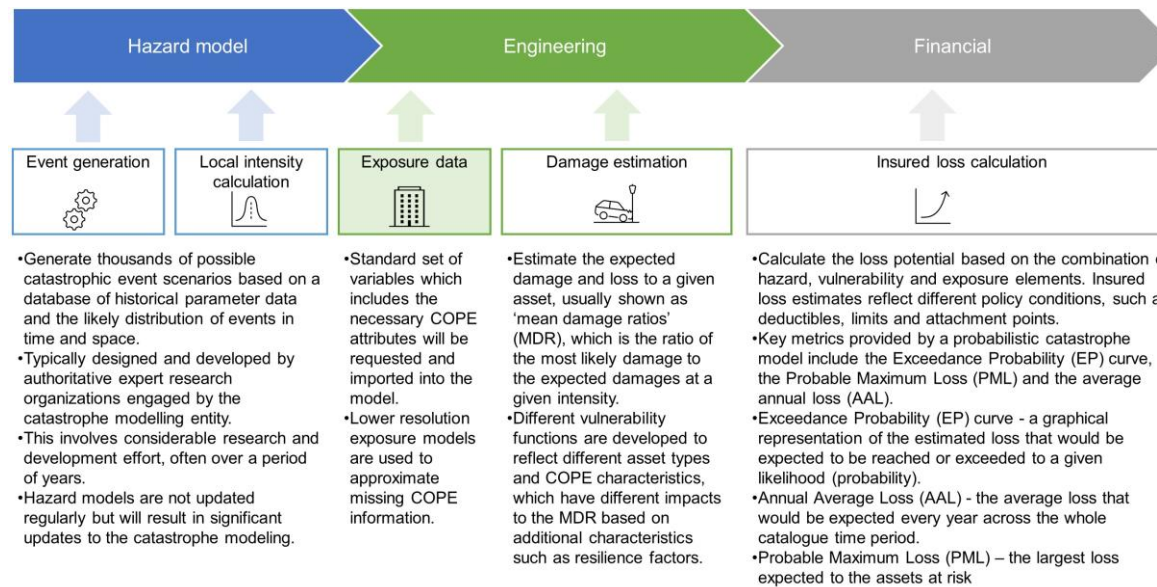


## Box 2. Catastrophe Risk Modeling

Despite the rare occurrence of devastating and extreme disasters, there is limited historical data available to accurately estimate the severity and probability of future events. To compensate for this lack of actual data in considering risk-transfer options, risk modelers have developed computational modeling approaches (catastrophe models) to bridge the data gap when considering risk-transfer options for future events. Those approaches are useful for attempting to build a best-estimate view of the frequency and severity of potential events and quantifying their impact in terms of damage and loss. Catastrophe models incorporate the experience and research from disciplines including engineering, the natural and social sciences, statistics, and financial economics (for an overview, see Mitchell-Wallace et al. 2017).

Catastrophe models form a core risk-calculation component of both traditional reinsurance transactions, as well as parametric or catastrophe bond transactions (see figure 2). It is important, therefore, to regularly evaluate whether the model used (and its underlying assumptions) are appropriate, particularly in regards to the exposure data used to represent the assets at risk. For traditional insurance and reinsurance, brokers often provide catastrophe modeling services during the development, delivery, and renewal stages.

### Core Components of a Catastrophe Model



Source: Authors adapted from RMS 2008.

## Delivery Stage

Once the program planners have designed and agreed on a risk-transfer solution, the data and information provided should meet the ongoing needs of the private sector participants who have accepted those risks (for example, traditional reinsurers, parametric insurance organizations, and catastrophe bond investors).

The confidence those market participants place in the data and risk information supplied will significantly affect the availability and price of the financial protection offered. Although data collected for the development stage could be adequate to allow the transaction to proceed, parties to the transaction may require additional information to support it. Additional evidence about the resilience of key assets to the insured perils, for example, can help improve the assessment of the insured risks.

Ongoing data needs will also include data and information related to claims activity. For traditional insurance products such as indemnity insurance, this data collection will likely include damage reports and images, claims surveys, and loss adjuster reports; in many cases, it includes the final payment settlement to be recorded. This information will need to be linked to the original asset record in a central public asset database. Annex B provides detailed information on the types of public asset data required, as well as providing an overview of how to think about data accuracy, quality and precision, and how to manage data gaps over time. Annex C provides a detailed case study on New Zealand.

For parametric insurance products, the data required may be different to an indemnity insurance product. The data required to trigger the payout will need to be validated and agreed to, often by an independent third party before payment is made. Parametric solutions are chosen most often in instances when the insurance payout will be used primarily if not exclusively for the swift financing of emergency response efforts as opposed to repairing or replacing assets that have been damaged or destroyed. In the case of public assets, this could include installing urgently needed temporary infrastructure, for example, bridges or portable water treatment facilities. Therefore, in this context, the emphasis on asset level data is less strong and it is possible to approximate the values and distribution of assets to some extent; for example, by using the population density in a given district or country.

The increased complexity and rigor needed for these data, particularly as an input to analytical models and outputs, may require an outsourcing of the task to specialist advisers. If so, outsourcing should be included as part of the procurement and budgeting processes (as seen in Fact Sheet 2) when appointing third-party service providers.

### What data?

- A detailed public asset register
- Catastrophe modeling analysis showing the physical and financial impacts on public assets under different disaster scenarios
- Engineering and resilience surveys for key and critical assets
- A summary of asset risk-management practices
- A summary of planned infrastructure and asset upgrades
- A record of past natural disaster claims and losses (if available)



<b>For what purpose?</b>	<p>Delivery involves securing a tailored, cost-effective risk-financing program.</p> <ul style="list-style-type: none"> <li>• Establish a detailed basis for transferring the risk profile into the private markets.</li> <li>• Support decisions regarding the scale of funding required to meet solution costs such as retained losses, risk-transfer premiums, and administrative expenses.</li> <li>• Drive decisions regarding contributions by participating agencies.</li> <li>• Support decisions around the type and scale of services required, which in turn will support decisions regarding the in-housing versus outsourcing of different services.</li> <li>• Assist in setting specifications for any required procurement.</li> </ul>
<b>How is it used?</b>	<ul style="list-style-type: none"> <li>• The collated data requirements will form a detailed submission to risk-transfer markets (see box 3).</li> <li>• The collated data will support content for a presentation to risk-transfer markets designed to differentiate the insured as a risk-mature customer.</li> <li>• The data will support procurement processes including (re)insurance, intermediary, and outsourced services requirements.</li> <li>• The data may also assist with the coverage design and customization of (re)insurance policy terms and conditions.</li> <li>• The data will drive actuarial calculations for cost allocation.</li> </ul>
<b>What is the benefit?</b>	<ul style="list-style-type: none"> <li>• Risk-transfer market certainty will likely improve coverage and cost outcomes.</li> <li>• Service delivery will be tailored and prepared to hit the ground running.</li> <li>• Cost allocation will be equitable, transparent, and defensible.</li> </ul>

### **Box 3. What Underwriters Expect**

Because underwriters receive thousands of insurance submissions every year, they often manage submissions through a preselection process involving three distinct categories: (a) best practice, (b) minimum requirement, and (c) more information required or decline.

The more appropriate that the data are to the risks identified, the greater the confidence an underwriter will place in its submission. A low-quality submission can lead to increased uncertainty, which usually results in either a refusal of coverage or a significant premium loading (in other words, more expensive coverage).

The material that follows outlines the information that underwriters expect to receive in a submission:

#### **Submission Pack**

Preferably, submissions will include a supporting overview document of the program, which sets out the following:

- Overview and description of company or institution

- Insurance program overview and goals
- Key contacts
- Snapshot of the program that includes summaries of total values
- Maps of asset locations to show risk spread
- Desired specifications and coverages required
- Desired deductibles for each peril
- Renewal timeline showing important milestone dates

### **Schedule of Values**

This is a client's inventory identifying each asset to be insured under the program and detailing critical characteristics of each location.

### **Loss Experience**

This is a five-year minimum history of the nature and extent of any losses suffered in relation to the proposed schedule of assets. It shows the underwriter the likely profitability of an insurance proposal over time.

### **Valuation Methodology**

Underwriters are usually concerned about the accuracy of property valuations, particularly as it relates to the appropriate replacement cost value. Much scrutiny goes into the methodology of value calculations.

### **Proposed Policy Form**

Many clients appoint the services of a broker to determine the coverage that is required under the policy. Once this information is collated, a proposed policy form can be presented with the submission to the underwriters.

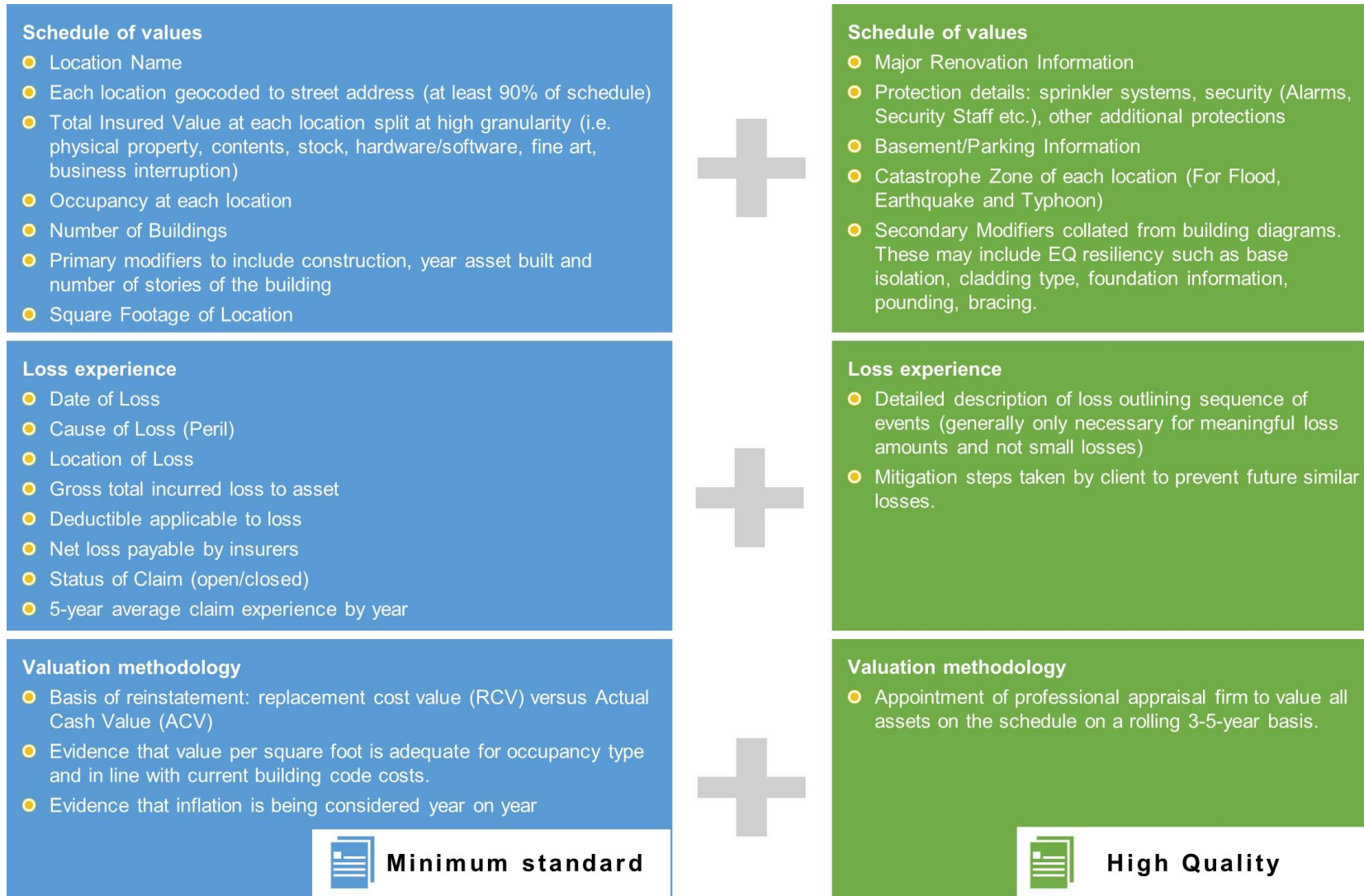
### **Additional Information**

Other useful information that can support the underwriting process includes the following:

- Engineering reports produced in detail by appointed risk engineers (often provided by insurance companies) to describe the practices and conditions of the larger locations of the schedule
- Maximum foreseeable loss and probable maximum loss reports to underwriters, which can have a favorable effect on rating (keeping in mind that larger locations may not suffer total losses if multiple buildings are on the premises)
- Catastrophe reports produced to outline the resiliency of assets to natural catastrophes

The quality of submission can vary significantly. Figure 3 provides an indication of best practices and minimum standards typically expected by underwriters.

Figure 2. High-Quality and Minimum Standard Submissions to Underwriters



## Renewal Stage

As a risk-transfer program matures and evolves over time, the data needs are not reduced. Ongoing development and quality management of data will be required to ensure that the data appropriately represent the risks being covered. Relevant considerations should include the following:

- Changes to assets caused by construction, renovation, and decommissioning
- Updated or improved scientific understanding of material hazards
- Updated or improved data collation and modeling technologies
- Claims experience over the previous period, which can influence the future price and terms of coverage and can be used to refine vulnerability data and to calibrate loss estimates
- Asset valuations found to have been significantly underestimated following a claim, subsequently indicating the potential need for a revaluation
- Changes to analytics-driven approaches that may affect the future risk profile (for instance, a catastrophe model version update)

The renewal process should be supported by a clear and reportable system of data quality management that enables continual assessment, reporting, and remediation of the data used. Preferably, this system would involve the following:

- Establish minimum data standards against which the data-contributing asset-owning agencies are benchmarked.
- Use relevant IT solutions to automate data collection as much as possible.
- Cross-use data to support multiple policy agendas.
- Adapt data needs for emerging risks.
- Have data- and information-reporting options that support governance and improved risk-management maturity.

Continued engagement with risk-transfer markets and intermediaries also enables an up-to-date awareness of changing data trends, which can lead to improved protection and pricing outcomes.

<b>What data?</b>	<ul style="list-style-type: none"> <li>• An updated, detailed public asset register</li> <li>• Catastrophe modeling analysis showing the physical and financial impacts on public assets under different disaster scenarios, which should be updated on a regular basis, especially if the nature of agency participation or covered assets has changed</li> <li>• Engineering and resilience surveys for critical assets</li> <li>• A summary of asset-risk management practices</li> <li>• A summary of improved resilience investments</li> <li>• A summary of planned infrastructure and asset upgrades</li> <li>• A record of past natural disaster claims or losses</li> </ul>
<b>For what purpose?</b>	Maintaining and evolving a tailored and cost-effective risk-financing program

	<ul style="list-style-type: none"> <li>• Update the detailed basis of the risk profile being sold into the risk-transfer markets.</li> <li>• Support decisions regarding scope change, such as adding new government agencies or public assets.</li> <li>• If needed, use to assess or validate service performance standards.</li> <li>• If needed, use to assess the effectiveness of resilience investments, such as those that exhibit reduced catastrophe modeling values and that result in fewer claims.</li> </ul>
<b>How is it used?</b>	<ul style="list-style-type: none"> <li>• Form the core of updated risk-transfer market submissions and presentations.</li> <li>• Position the solution for an annual anniversary review.</li> <li>• Make it possible for government officials to review the ongoing performance of the solution and to make relevant adjustments where necessary.</li> <li>• Assist government officials in reviewing their risk-retention appetite.</li> <li>• Position intermediaries to make best use of market pricing cycles and to introduce new markets.</li> </ul>
<b>What is the benefit?</b>	<ul style="list-style-type: none"> <li>• Effective governance and change management</li> <li>• Secure and controlled maturation and evolution of solutions</li> <li>• Unwavering market attraction and competitiveness</li> </ul>



## Annex A: Probabilistic Risk Assessment to support Fondo de Desastres Naturales (FONDEN) in Mexico

### Introduction

Disasters can impose a significant burden on the public budget; over the period 1999 to 2011, the costs of post-disaster reconstruction of public assets and low-income housing financed by the Mexican government averaged US\$1.46 billion per annum (in 2011 constant dollars), of which 77 percent were related to local (state and municipal) assets. The highest costs were incurred in 2010, when major floods generated rehabilitation needs exceeding US\$5 billion. Local assets, including low-income housing, accounted for two-thirds of this total.

Founded in 1996, the Fondo de Desastres Naturales (FONDEN) is a financial vehicle through which the Federal Government of Mexico allocates budget ex ante for post-disaster relief, rehabilitation, and reconstruction of public infrastructure such as roads, hospitals, and schools.

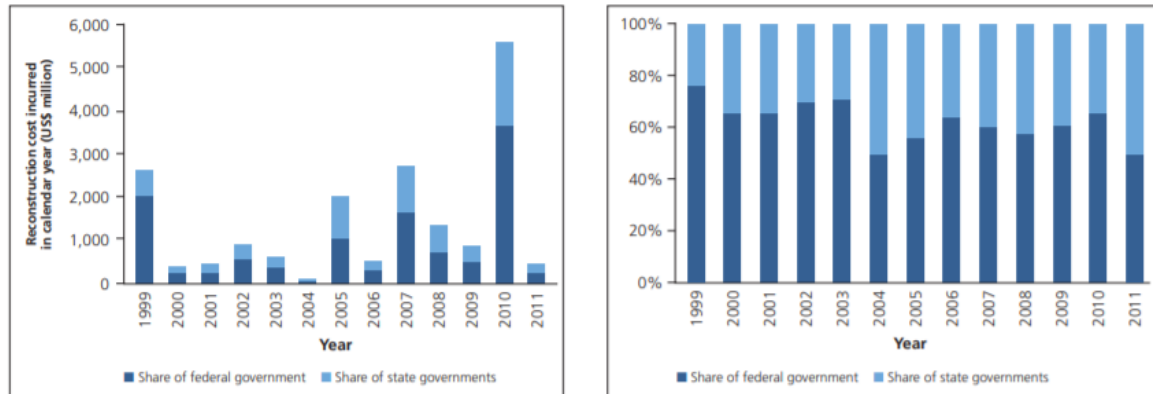
For the reconstruction of public assets, FONDEN operates on insurance principles: a transparent damage reporting system, clear rules for how funds are disbursed, a clear plan for how money is spent, and a credible monitoring system for expenditures. The fund pays for 100 percent of the post-disaster rehabilitation and reconstruction cost of federal public assets and 50 percent of the cost of local assets.

FONDEN has a layered financial risk management strategy. The bottom layer of risk amounts to up to US\$1 billion. This layer of risk is financed with FONDEN's annual budget appropriation and, if necessary, with an exceptional additional federal budget allocation of approximately US\$200 million. For higher risk layers, FONDEN has concluded a US\$400 million indemnity insurance contract on the whole FONDEN portfolio and placed its first catastrophe bond worth up to US\$360 million in August 2017.

### Design Phase: Understanding financing needs

The first step in the design of a financial protection initiative for public assets is usually to understand the historical financing needs. This gives a first sense of the amount and frequency of financing that would be required. Over the period 1999 to 2011, the federal and state governments respectively spent an average US\$939 million and US\$521 million (in 2011 constant dollars) each year on reconstruction (see Figure A1). As per FONDEN's operating guidelines, reconstruction costs are shared by the federal and state governments – the federal government finances all costs for federal assets and 50 percent for local assets, and states are responsible for the remaining 50 percent of costs for local assets. Accordingly, the federal government accounted for 64 percent of total public reconstruction expenditure.

**Figure A1: Post-disaster reconstruction costs paid by the federal government and state governments (in constant 2011 US dollars)**



Source: World Bank 2012

**Development Phase: using probabilistic risk assessment to support FONDEN’s risk financing strategy**

Moving into the development phase, more detailed data is required. At this stage, risk assessment typically moves from being based upon historical loss assessment to a probabilistic catastrophe risk assessment. Probabilistic catastrophe models are important to estimate the frequency of losses and the intensity of events that may not have been seen in historical losses. For example, FONDEN needed to be able to provide protection against a major earthquake like that in 1985 or 2017; this requires using earthquake science and detailed asset exposure and vulnerability data to estimate the potential losses of all probable events that could affect Mexico.

The FONDEN Technical Committee has conducted various studies to better assess natural disaster risks in Mexico since 2007. The initiative was designed specifically with the goal of informing protection of the assets of the FONDEN Trust against the risks of earthquake, flood, and tropical cyclone, aimed to identify the assets exposed to natural disasters: roads and bridges, hospitals, schools, hydraulic infrastructure, and low-income housing. The initiative relied on three components, conducted sequentially:

- 1) Data Gathering.** The required database was prepared, including hazard information, an asset inventory with the key variables (such as building characteristics) required for evaluating vulnerability and loss of infrastructure, and historical loss data to complement simulated data.
- 2) Catastrophe risk modeling.** The government, working with the Universidad Nacional Autónoma de México (UNAM), developed hazard models for earthquakes, tropical cyclones, and floods, and vulnerability functions for all types of infrastructure. In conjunction with the exposure database, this enabled the government of Mexico to carry out deterministic and probabilistic risk modeling used to inform financial analysis of probable disaster loss.
- 3) Financial Modeling.** Finally, the government carried out actuarial analysis of the simulated risk data and historical losses to develop and fine-tune the federal disaster risk

financing strategy for public infrastructure—including both risk retention and risk transfer. This step also included the development of a decision support tool to facilitate this process in the future (R-FONDEN).

**R-FONDEN** is a probabilistic catastrophe risk model that simulates disaster events and provides risk metrics such as annual average loss and loss exceedance probability curves. It analyzes four perils (earthquake, flood, tropical cyclone, and storm surge) for infrastructure in key sectors (roads and bridges, hospitals, schools, hydraulic infrastructure, and low-income housing) at national, state, and substate levels. R-FONDEN takes as input a detailed exposure database (including details of buildings, roads, and other public assets). The MOF uses the model together with actuarial analyses of historical loss data to monitor the disaster risk exposure of FONDEN’s portfolio and to design disaster risk transfer strategies. Figure A2 shows some modeling scenario outputs from R-FONDEN.

**Figure A2: R-FONDEN example outputs**



Source: World Bank 2012

### Delivery and Renewal Stages

A lesson from the evolution of FONDEN since its inception is that innovative use of technology can improve the quality and timeliness of information and information flows and can increase transparency and control of resources for both prevention and post-disaster reconstruction. In the case of Mexico’s FONDEN, the requirement for geo-referenced photographic images to be provided to the Damage Assessment Committee has helped FONDEN to efficiently record and manage its resources for the reconstruction of damaged infrastructure.

Additionally, the development of the probabilistic catastrophe risk model, R-FONDEN, has numerous applications to improve the effectiveness of Mexico’s DRM system, including informing decision making about the design of FONDEN’s risk financing and insurance strategy and risk mapping for visualization and increased ownership of disaster risk. Governments that invest in risk information and assessment systems will benefit from

reduced costs and increased effectiveness of their DRM system in the long run. Policy makers can also use these tools to improve communication to their constituents about the benefits of ex ante investment in risk reduction and the execution of funding for post-disaster reconstruction.

R-FONDEN has also been used to improve the individual insurance policies of the Federal agencies. For instance, it enabled the design of an insurance program for the Ministry of Transport (SCT) in charge of federal roads and bridges – a scheme that was difficult to insure due to insufficient asset information. It has also contributed to improve the design of the insurance program of the Ministry of Education (SEP).

## Annex B: The Types of Public Asset Data Required

### Concepts of Risk and Overview of Data Requirements

The concept of “utmost good faith” is one of the most fundamental doctrines in risk-transfer contracts between parties. The principle legally obliges all parties within the transaction to refrain from withholding information that could affect the representation of the scale or characteristics of the risks faced. Data disclosure underpins this concept of utmost good faith, because it is in the interests of each stakeholder to build an in-depth understanding of the risks being transferred.

The primary data requirements derive from the components that define risk, namely hazard, vulnerability, and exposure. Their definition and use are summarized in table B1.

**Table B1. Risk Components and Data Requirements**

$$Risk = Probability\ of\ Loss = Hazard \times Vulnerability \times Exposure$$

	Hazard	Vulnerability	Exposure
<b>Definition</b>	Data describing the types and intensities of the various perils that might negatively impact the assets	Data quantifying the expected level of damage and loss to the assets from the hazards	Data describing and quantifying the elements at risk, which will be public assets in the context of this fact sheet
<b>Use of data</b>	Definition of the characteristics of the peril, such as depth, velocity, and duration of a flood, as well as the spatial and temporal variations in the intensity of those features, which in many cases will determine the	Representation of the relationship between a measure of the hazard intensity and the expected level of damage or the likely range of damages, which for financial risk usually converts the damage function will	Description of the exposure data as COPE (construction, occupancy, protection and exposure), which reflects the key underwriting characteristics used to evaluate insurance risk (the exposure data will

	probability of the loss on the basis of the estimated probability of the occurrence of a hazard event, such as a 1:100-year return period	usually be converted to a suitable potential monetary loss value	represent where, what, and how much of those assets that will collectively characterize their value and expected resilience)
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In most cases, hazard and vulnerability data will be provided by specialized third parties such as academic research agencies, modeling companies, or engineering consultancies. The responsibility for the collection and quality of exposure data as a record of the insured assets usually rests with the insured. In the context of a government public assets approach, this endeavor will generally be a collective activity between asset-owning entities, as well as centralized surveying and administrative organizations that include public asset registries, which are further elaborated in the forthcoming Fact Sheet 4.

Other data sources can be used to support the risk-transfer negotiation and transaction process such as engineering or survey reports of key assets, infrastructure statistics, and data captured on claims and damage experience. All of those can be used to improve the representation of the key risk components and to support increased confidence in the quantification of risk.

### **Exposure Data Required from Asset Managers**

Although third parties will usually provide the hazard and vulnerability elements, responsibility for the capture and management of exposure data will most often rest with the asset-owning entity or an administrative agency that manages collection from the asset-owning agencies. In some cases, a centralized public asset registry holds all asset records and is the source of exposure data. Such records constitute a snapshot reflecting the extent and status of those assets at a given point in time. Fact Sheet 4 will discuss in more detail this information and the broader benefits of a public asset registry.

A typical insurance program transaction process will use an exposure snapshot created some months before the inception date so that by the end of a typical annual insurance or reinsurance contract, data will be more than 18 months old. In many countries, data could be even older, or incomplete. Nevertheless, the insurance program transaction process can form an important catalyst to improve data on public assets.

Exposure data can be used to characterize risks for assets as (a) stand-alone, individual buildings or structures; (b) one among an aggregate collection of other geographically distributed elements; and (c) time-variant, in other words, something that changes in character over its lifetime.

Key data elements (or attributes) will reflect the most important COPE information: where the assets are located, how close together they are, what their construction materials are, what the primary use is of the assets, what year they were constructed in, and what information



identifies key resilience features (roof bracing, window and door covers, flood defences and the like). The collection of COPE data is important, because catastrophe modeling programs use the collected data to generate an accurate snapshot of risk and to provide a basis for establishing insurance premiums. Without COPE data, underwriters may need to assume the worst, which could lead to higher insurance premiums.

Because insurance underwriters often use risk models, the structure of the exposure attributes will often get converted into model data format. Modeling companies often call such structures primary modifiers (see table B2 and the annex B(ii) for a more detailed explanation of each of the primary modifier attributes), and they include the COPE characteristics of the assets that influence the assumed vulnerability or resilience of an asset to the perils being covered. Primary modifiers, then, strongly influence estimated damage and loss expectations.

Table B2. Common Primary Modifier Attributes

Characteristic	Key use	Common approaches
<b>Location</b>	Hazard-exposure overlay, proximity, and spatial correlation	Latitude and longitude coordinates, address
<b>Construction</b>	Resilience, vulnerability assumptions	Applied Technology Council (ATC-13) <sup>a</sup> codes, GED4ALL
<b>Use or occupancy</b>	Resilience, vulnerability assumptions	Industrial, commercial, residential types of ATC, SIC, or NAICS codes <sup>b</sup>
<b>Age</b>	Building codes applied, resilience, vulnerability assumptions	Year built, retrofit date
<b>Floor area</b>	Resilience, vulnerability assumptions	Building footprint, survey floor area
<b>Height</b>	Vulnerability, structural response	Number of stories (building), height

Note:

- a) See Applied Technology Council, <https://www.atcouncil.org/about-atc>.
- b) ATC: Applied Technology Council, SIC: Standard Industrial Classification, NAICS: North American Industry Classification System

Other features called secondary modifiers may also be captured. A structure with additional risk-mitigation features such as extra roof bracings, for example, could reduce vulnerability. A list of commonly used primary and secondary modifiers can be found in the “World Bank Technical Contribution to the APEC Finance Ministers Process” (2017).

### Estimation of Total Insured Value

In public asset systems, there are ranges of potential valuation estimates that can be captured, depending on the final use of the data. Those ranges are often termed the bases of value. Estimates of market value (value that an asset will have for open sale at a given point in time), rental value (an asset’s leasing rate), fair value, book value, and acquisition value are all commonly captured for uses ranging from taxation to asset sales.

None of the estimate types, though, are suitable for insurance risk transfer, because the principle of insurance is to provide financial payments to support replacement of the asset function and the costs of rebuilding or restoring the asset, as well as to compensate for financial losses resulting from the termination or disruption to the asset function caused by damage.

Insurers often refer to the *total insured value* (TIV), which includes all monetary costs that the insurance policy covers in the event of damage or loss. TIV will often be reported using three or more categories, depending on whether the policy includes them in its coverage:

- *Buildings TIV* is the reinstatement or rebuilding costs for replacing the structure if it is totally destroyed.
- *Contents TIV* is the total value of all nonstructural assets contained within the structure.
- *Business interruption TIV* is the total insurable value related to loss of profit or other defined financial gains caused by the disruption from damage to the structure.

### Buildings and Contents

The specific form of insured value estimation will depend on the type of insurance coverage being sought.

In some cases, the coverage will supply the full rebuilding costs of the asset (called *full rebuilt cost*). If a school building was insured for rebuilding or replacement and if it required rebuilding, the costs associated with rebuilding (materials; labor; and fees and costs for land and debris clearance, legal fees, taxes) would be added to the TIV. The extra costs can be significant. Debris removal alone can add 15 percent or more to the overall cost of replacement.

Some assets are older and in poor condition because of wear and tear. In such cases or in instances where total replacement of the structure exactly as it was is not essential, the estimate takes depreciation into account, to what is called an actual cash value (ACV) estimate. Care should be taken when considering depreciation, because the value used for calculating depreciation may not reflect the actual costs for rebuilding or replacing the asset, especially if those assets are considered critical to providing service or are otherwise important. The actual costs of rebuilding or replacing might be higher if reconstruction required

the use of contemporary materials or adherence to higher building standards than those in force at the time of original construction.

Government asset owners need to consider the different valuation needs of historical buildings and other nationally important structures. Those structures may require special materials and reconstruction approaches that can be more expensive. Nonstructural assets such as works of art or commodities can also be difficult to value, particularly if their values and geographic concentrations vary over time. In such cases, specialist valuations can be conducted by insurance intermediaries.

### **Business Interruption**

If business interruption is covered, the business restoration period should also be included, especially if it lasts six months or more, because underwriters will proportionally reduce the TIV to account for the interruption.

It is important that care be taken when determining insurance value at risk. Incorrect estimations of full rebuild values, stock and content inventory values, and potential downstream liability costs such as those related to service interruption can significantly affect the overall level of exposure. In the event of a loss, those estimates may dictate the level of payment received from the insurer. Common errors are listed in box 4.

#### **Box 4. Common Errors in Valuation and Exposure Data**

- Undervaluation of assets leading to a coinsurance or average provision being applied in the event of loss
- Underestimation of full rebuilding costs that can occur when factors such as debris removal, mandated code improvements, or demand surge are not taken into account
- Lack of clarity about the currency used to declare the cost values or the making of declarations using multiple currencies
- A valuation of assets less often than the recommended three- to five-year minimum, failure to account for the annual inflation rate, leaving too much time between valuation and coverage, inflation of reconstruction costs, and (if ACV has been chosen) variation in depreciation over time
- Unclear or inconsistent data formats such as the use of abbreviations or inconsistent recording of address information

*Averaging* clauses are often included in property insurance policies to protect the insurer from significant underestimation of exposure compared to the likely claim size. For instance, if a property that is valued at US\$100 million for insurance purposes, but would cost US\$200 million to rebuild, suffers a total loss, the insurer is liable for paying only US\$100 million after averaging. In the event of a partial loss from a large fire or wind damage to part of the building (which would not require a 100 percent payout), the coverage would be based on the proportion of the underinsurance assumed. Thus, if a claim were received for US\$70 million

based on 50 percent underinsurance, the payout received would at most equal US\$35 million (50 percent of the claim).

Insurers will usually account for a degree of estimation error before applying averaging, normally on the order of 10 to 15 percent of the TIV.

## **Fitness for Purpose of Data for Public Assets Risk Transfer Data Quality and Data Adequacy**

The insurance and reinsurance industry often defines data quality in terms of the need for capital adequacy reporting and regulatory approvals. The European Union's Solvency II Directive, for instance, requires firms to assess and report the accuracy, completeness, and appropriateness of data used to estimate capital requirements and manage their operational risk. In the United States, the Sarbanes-Oxley Act (2002) adopts a similar approach.

The meaning of the term "quality" will differ, however, depending on several factors:

- **The importance of the decision to be made according to the information provided.** If the decision involves, for instance, insured value for a critical or high-valued asset, then the data quality requirements will probably be higher.
- **Application of standard practices.** Insurance industry expectations about data quality will differ across countries and asset classes, depending on the relative materiality of the risk to their business. A chemical storage facility, for example, may require higher data integrity than will an office building.
- **The regulatory demands placed on risk-transfer markets.** Again, the level of materiality will be a key driver of reporting requirements.

The required accuracy of risk-financing data depends on a combination of market expectation and pragmatism, which means that creating a single definition of data quality is difficult, because the definition will change according to the risk materiality and the importance of decisions made using it. Instead of "quality," a more suitable term to use when considering the appropriateness of data for risk assessment may be "adequacy."

As with many other activities, the adequacy of data for risk transfer will tend to follow the Pareto principle (the 80/20 rule), which places the highest priority on documenting characteristics that reflect the most material aspects of the risk faced. This approach implicitly recognizes that the creation of supposed perfect data is, in fact, both impossible and impractical.

If an insurance policy covers hundreds of thousands of individual assets, the insured values of those assets will likely vary, with some having high individual value and others having relatively low value. The priority for capturing detailed information often tends to focus on the most valuable assets and ensures that the majority of the "value at risk" is adequately represented in the risk assessment. Of course, there may be other reasons to consider some assets more important—an asset may be critical to providing a service—and this reason may

influence data capture priority. In general, however, data adequacy tends to be dictated by the level of confidence deemed necessary in the risk assessment.

### Data Accuracy and Data Precision

One common mistake made when considering the adequacy needs for risk data capture is when one confuses accuracy with precision. An asset registry database may hold records (including geographic coordinates) for all sites to a very high level of precision, even up to the nearest meter. However, the captured coordinate may not represent the actual location on the ground. It may instead represent another site location such as a town center several meters away from the actual asset. In this common situation, the precision of the data point would be high, but its accuracy would be low, resulting in “spurious precision” and misplaced confidence in the quality of the risk representation. Table B3 presents some examples of the accuracy levels considered for different types of data.

Table B3. Examples of Data Accuracy Requirements

Data Type	Accuracy Levels
<b>Hazard data such as in a flood event database</b>	<ul style="list-style-type: none"> <li>• Calibration to historical events including out-of-bank flood extent positions</li> <li>• Elevation data accuracy (depth and flood extent positions)</li> <li>• Rainfall duration, intensity, and extents</li> </ul>
<b>Vulnerability data such as earthquake ground motion and loss function</b>	<ul style="list-style-type: none"> <li>• Calibration of damage-and-loss estimates to intensity</li> <li>• Calibration to local asset characteristics</li> </ul>
<b>Exposure data such as COPE data from an asset inventory</b>	<ul style="list-style-type: none"> <li>• Geographic location accuracy, such as the percentage of locations with coordinate positions falling within the structure footprint</li> <li>• Value at risk within certain percentages of actual reconstruction cost</li> <li>• Construction type that reflects actual structure</li> <li>• Age since year of construction</li> </ul>

### Managing Data Gaps over the Longer Term

Data management can be complex. The quality and consistency of data can improve over time, subject to improvements in processes from lessons learned, changes to the requirements of risk transfer markets or governance reporting needs, improved data collection technologies, and recognition of the value of new and different data sets.

Risk financing programs are subject to regular renewal and review cycles. These key review points should also encompass data management practices, with a focus on continual improvement. A government may establish a project within the program targeting specific and incremental data management improvements over multiple years. These increments should



be realistic, relevant and achievable so that practices mature over time. Depending on a government's starting point, these improvement objectives may include:

- developing a meta data standard for quality and consistency
- planning for a shift from manual collection to automated collection via a suitable software solution
- using data as a tool to better identify critical assets and vulnerabilities
- using data to link claims/losses to specific assets, thus supporting future resilience investment decisions

Data management planning should involve different stakeholder perspectives, including:

- Asset managers – what data capture is realistic and how can improved data capture support other asset management objectives
- Governance members – what data and reporting capabilities will better inform decisions regarding program performance and/or scope change
- Brokers – what data will better position them to effectively sell your risk profile into the risk transfer market at best coverage terms and price
- Loss modelers and actuaries – what data will provide greater certainty in modelling outputs and cost allocations
- (Re)insurers – what data is expected as a minimum standard and what additional data will add value to their considerations

Data and information are integral to a successful public asset risk financing program. Any journey towards an effective and efficient risk financing program must account for building data capture and analysis capability. The rewards for doing so are numerous, key among them being greater certainty that you are focusing on the right priorities and that you are making cost effective and defensible choices about what risk to retain and what to transfer.

Better data also will incentivize the creation of better early warning systems and the better risk management of public assets. This approach reinforces the importance of maintaining good records through a public asset registry system. Fact sheet number 4 will discuss how data and information can be captured and maintained within a broader asset- and risk-management context.

## Annex B(ii): Detailed Description of Primary Modifier Attributes

This annex provides a more detailed description of the following primary modifier attributes: (a) location, (b) construction, (c) age, (d) floor area, (e) height, (f) protection measures, and (g) exposures.

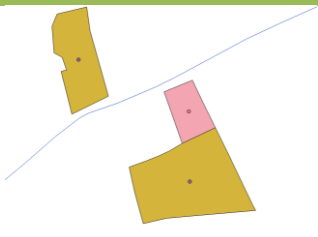

### Location

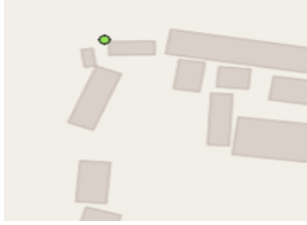

One of the most important features of exposure data is an accurate geographic position for each risk, which allows the identification of linkages to hazards and potential damage-causing events. Accurate geographic positioning also allows the assessment of whether assets are clustered or distributed.

For most insurance purposes, the best practice is to represent each insured asset element with a latitude and longitude coordinate describing a point on earth, which is usually based on a global referencing system such as that used by Google Earth (called WGS84). By providing a unique coordinate for each element, a geographical map of assets can be produced showing the position of each one relative to others.

Although the point is a reasonable estimate of location for most building assets and some infrastructures such as pylons, tanks, and other single stand-alone features, not all public assets and critical infrastructure can be easily represented by a single point, as table B4 demonstrates. Infrastructure such as roads and pipelines are linear; others such as sports facilities or compounds are geographically distributed across wider areas. Tall infrastructures such as large office blocks can be exposed to various, complex risks that are layered vertically. In such cases, asset managers should aim to capture the most appropriate geographic information available. In general, it is recommended that assets with the highest risk and largest insured values should be prioritized for more detailed geographic referencing.

Table B4. Different Types of Assets and Use of Location References

Asset type	Reference	Graphical example	Advantages and disadvantages
<b>Stand-alone building, structure, or parcel</b>	<ul style="list-style-type: none"> <li>• Single point coordinate falling within the property area</li> <li>• Decimal degree or degree-minutes-seconds</li> </ul>		<ul style="list-style-type: none"> <li>• Shows relative positions of structures</li> <li>• Needs low data storage</li> <li>• Poorly represents larger buildings and areas</li> </ul>
<b>Linear assets (roads, rail, power transmission lines, pipelines)</b>	<ul style="list-style-type: none"> <li>• Linear segments with start and end coordinates (nodes)</li> <li>• Geographic Information System</li> </ul>		<ul style="list-style-type: none"> <li>• Higher data storage</li> <li>• Lack of detailed road data available with coordinates</li> </ul>

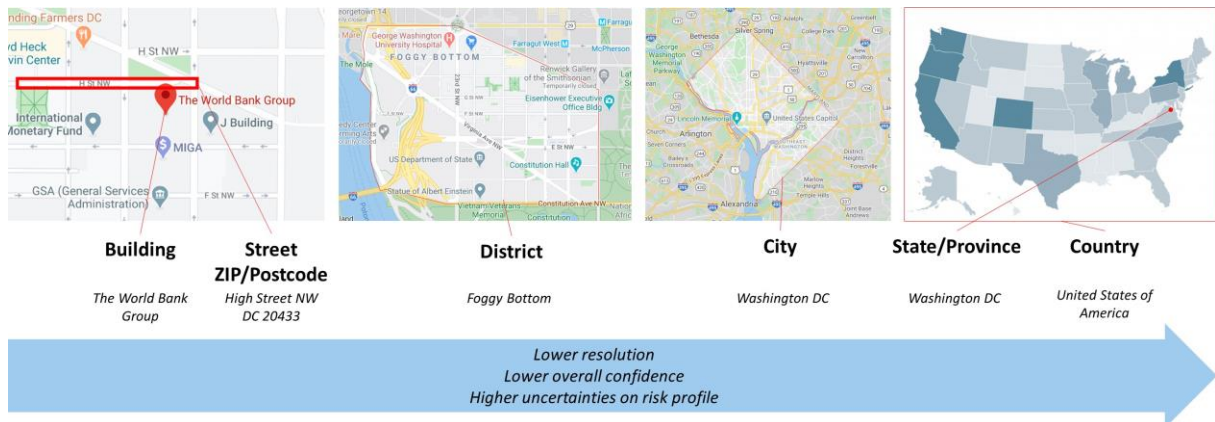
	representing linear assets in geographic line format		
<b>Campus risks (large schools, universities, government compounds)</b>	<ul style="list-style-type: none"> <li>Multiple structures within a single compound</li> </ul>		<ul style="list-style-type: none"> <li>Single coordinate that may not capture all locations, the varying asset types, or the area covered by the facility or compound</li> </ul>
<b>Complex risks (bridges, tunnels, and other complexes)</b>	<ul style="list-style-type: none"> <li>Either single point or multiple points to represent center and end points, depending on the size of asset</li> </ul>		<ul style="list-style-type: none"> <li>Points can be used for reference but may not capture full extent or complexity of the risk structure in all cases</li> </ul>

In many cases, a geographic coordinate may not be available. Address information can be used to find coordinates if the address is suitably complete, accurate, and unambiguous. Tools called geocoders provide automated methods to identify location coordinates for a given address. Insurers can often use address data to geocode risks, but doing so adds time to the process and tends to lower confidence in geographical referencing.

Care should be taken using address information to locate assets, because the format may be unsuitable if large numbers of abbreviations are used or if the addresses do not appear in a consistent format. Geocoding tends to be more suited to urban areas where detailed sources of address location data already exist. The quality of the underlying address-location matching data will be a key determinant of the level of quality likely to be achieved using address data geocoding.

Other lower levels of geographic resolution are often used for insurance purposes (figure B1 depicts them in descending order of geographic resolution). This approach produces aggregate data where data related to numbers of individual assets are grouped together. Lower-resolution aggregation tends to result in lower overall confidence in the quality of the risk data and may influence the price set for the risk, because the uncertainty of risk potential will be greater with lower-resolution geographical data. In addition to the areas shown in figure A1, *CRESTA (Catastrophe Risk Evaluation and Standardizing Target Accumulations)* zones, which are part of an international geographic zoning system that helps brokers and reinsurers manage natural hazard risk, can also be used.

**Figure B1. Other Geographic Resolutions to Represent Location Data**



For nonbuilding risks, insurer expectations of geographical data quality can often be lower (especially for lower-materiality regions). It is common for linear assets such as railway, road, and pipeline data to be displayed within the bounds of an aggregate geographical reference such as a postal code or administrative district. Although this proximity reduces overall confidence, insurers can and will compensate accordingly when assessing financial risk levels from such data.

## Construction Classification

A construction reference is important for risk assessment, because it determines the likely resilience of a structure to the hazard in question and can be used to drive the choice of vulnerability estimates used to assess damage potential to assets. An adobe or simple masonry structure will tend to be more vulnerable to earthquake tremors than will a reinforced concrete building with a load-bearing frame. Risk models will make assumptions to reflect construction codes when calculating damage-and-loss potential. Some construction references used in insurance are peril-specific. If the primary risk is from windstorms, then more focus will be on the roof materials and roof types when a construction code is selected.

Most construction codes are based on engineering approaches and often include generic descriptions to assist in making the appropriate choices for representing asset characteristics. Construction codes for building structures are often based on primary structural materials (wood, masonry, concrete, or steel).

For nonbuilding structures (bridges, tunnels, pipelines, roads, railways, towers, and pylons), separate construction codes are often provided. Codes often represent generic types of structural, risk, and resilience features such as construction material, span of bridge, height of pylon, and so on. Some construction codes are designed to reflect the susceptibility or resilience of a structure to fire rather than to natural perils. The fire codes of the Applied Technology Council and the Insurance Services Office are good examples.

In addition, discrete codes can be assigned to complex elements such as power generation, telecommunications, transport, sewage, and water structures. Those composite classifications are often included in the occupancy codes.

When asset managers provide construction information as part of their material disclosure, they need to select construction codes or text descriptions for assets—the selection which can be justified according to the asset’s known structural characteristics. The choice of codes can significantly alter the modeling of damage potential and loss estimates, so if in doubt, a lower-detail classification should be used to provide more confidence. If it is known that a property is built of masonry but there is no record of the specific type of reinforcement that may be included in its construction, the generic masonry code should be applied.

Asset-management teams will often have information that can be used to infer construction methods. It is possible to provide engineering and survey teams with a documentation of known design characteristics and with the appropriate insurance construction classes that can then be linked and captured directly in a centralized asset-management system.

Insurers can sometimes apply their own coding assumptions while using descriptions provided by insureds, particularly for complex asset and infrastructure risks. If a broker or intermediary has been retained to support disaster risk financing for insurance transactions, it is advisable to ask that intermediary to provide expert assistance in correctly coding assets.

### Occupancy Classification

The insurer will want to capture the occupancy of the assets being insured. This approach relates to the primary use of the asset and reflects a number of risk aspects such as the following:

- The likely risk-management regime applied by the asset owner or user
- The overall vulnerability of the asset and its contents to specific hazards
- An estimation of the business interruption or time element loss potential

In many commercial *catastrophe models*, if a construction code cannot be provided, an occupancy code that is based on the asset’s location will be used as a proxy to estimate the type of construction and vulnerability. The following are common generic classes for occupancy: (a) unknown, (b) residential, (c) commercial, (d) industrial, (e) government, (f) religious and nonprofit, (g) educational, (h) transportation, (i) utilities, and (j) flood control.

As noted earlier, some complex infrastructure classes may also be available.

Again, a hierarchical system will often be used to provide a more detailed description of various occupancy types.

### Age and Year-Built Classification

The age of an asset, particularly for a building, is a key attribute for insurance, because it can be used to infer two risk features: (a) the potential deterioration of the asset, especially if an asset is nearing the end of its expected lifetime, and (b) the building codes and other regulatory regimes under which the structure was designed and constructed.

Catastrophe models include year-built ranges that are usually based on the building code epochs that defined key resilience, construction, and other factors. In the Philippines, a year-



built range of 1972–91 is common in earthquake models, because this date range defines the period after the introduction of the National Building Code but before subsequent updates in the early 1990s.

If significant retrofitting or other resilience or maintenance improvements have been applied to assets (such as a new, more robust roofing system), the date can be included as a separate data field because it can be used to modify an underwriting view of the asset risk.

It is recommended that no age value be entered if it is not clear when an asset was built. If there is confidence that a structure was created within a given decade or building code period, then it possible to enter the mid-year date.

### Floor Area Values

The floor area is a proxy that can be used to infer (often with the number of stories) the rebuild construction values along with a construction estimation matrix. Floor area can also assist in risk assessment as an additional proxy for vulnerability.

### Height Values (number of stories)

The height of a structure, either as a linear measure for non-buildings or as a number of stories for buildings, will also exert a significant influence on the damage estimation, especially for losses through earthquakes. The height of a structure can determine the response to the ground motion affecting it and therefore its potential for damage or collapse.

As noted earlier, the number of a building's stories can serve as a useful contributor to construction cost estimates alongside floor area.

### Protection Measures

This category is important for risk managers from a safety standpoint and for underwriters concerned with reducing property damage. Various features that are usually considered while analyzing this category consist of the following:

- Sprinkler systems (type, condition, and coverage area)
- Fire extinguishers (number, class type, location in building, and inspection status)
- Fire doors and walls (noncombustible materials used in buildings or walls, HVAC ducts)
- Distance from fire departments (type of fire department, distance from structure)
- Security systems (type, monitoring system, installation, alarm sound)

In addition to the above-named features, any upgrades performed on the plumbing, roof, HVAC, and electrical systems within a building are also considered in the process of determining the risk profile of the building. Most important, the recording of such data is likely to reduce efforts spent by underwriters to collect facts and may influence the insurance premium as well.

### Exposure

The three categories discussed earlier usually focus on risks arising from within the building, whereas this category (exposure) deals with risks arising from external hazards. Various external hazards that are likely to be considered by underwriters include these:

- Damaging winds, waters, or floods
- Earthquakes and other seismic activity
- Wildfires

- Proximity to high-hazard operations such as nuclear power plants
- Human-made hazards such as war and terrorism

The data about risks caused by those hazards come from a separate database that records risk data for locations relative to various external hazards. Some agencies assign flood zones to various locations, areas, or provinces. Certain state or municipal departments assign building codes to structures. If one is to gauge the likelihood that a structure or asset may sustain damage from windstorms or seismic activity, various details must be considered. For windstorms, one must consider data about roof strapping and windows; for seismic activity, data about walls, overhang, and pounding.

## Annex C. Case Study in New Zealand Insurance Valuation

Commercial insurance customers (including government agencies) have learned important lessons about insurance valuations versus accounting (book value) valuations. Insurance brokers have contributed significantly to educating their customers about the importance of fit for purpose valuations in these ways:

- Valuations for insurance purposes focus on the costs to replace a building, while accounting valuations tend to include depreciation and do not typically reflect the cost of rebuilding a structure. The book value approach most often results in underinsurance and a loss of confidence by insurers.
- Valuations should be revisited or renewed on a regular basis. Typically, new valuations should be undertaken every three to five years and more often for organizations with a dynamic asset profile.

Insurance valuations in New Zealand include the components in table C1.

**Table C1. Components in New Zealand Insurance Valuations**

Component	Comment
Indemnity value	Represents the estimated current book value of the property, accounting for age, condition, and market forces
Indemnity inflationary allowance	A monetary allowance recognizing that inflation will increase a building's current book value over the course of a year simply because market forces are driving prices up (usually achieved by use of a simple consumer price index)
Replacement value	Represents the cost of replacing old with new, an estimate that does not account for betterment or exceptional inflation that may occur after a significant natural disaster and previously unforeseeable changes in building standards
Replacement inflationary allowance	An allowance (usually annual) relating to natural shifts in values due to inflation over a set period of time, similar to indemnity inflation
Demolition and removal of debris	An estimate of the cost to demolish a building and remove the debris, placing the land in a position to rebuild

Source: Author

By having valuations broken down this way, a customer can make coverage decisions tailored to the situation and strategies. If a customer foresees not rebuilding a particular building if it were destroyed, for instance, the customer may choose to insure for demolition and removal of debris only.

Replacement value estimates are designed to include the professional fees such as design and consenting costs, but those fees are typically not shown independently.

Generally, New Zealand commercial customers and government agencies take the traditional COPE (construction, occupancy, protection, and exposure) approach to asset exposure data collection.

A recent data collection exercise by the New Zealand government included the information in table C2.

**Table C2. Data Components in New Zealand Data Collection**

Data Type	Data Component	Comment
<b>General</b>	<ul style="list-style-type: none"> <li>• Agency name</li> <li>• Key contact(s)</li> <li>• Building name</li> <li>• Building location (physical address and latitude and longitude)</li> <li>• Valuation (see asset valuation section below)</li> </ul>	<p>If the location is a large complex with multiple buildings, each building is treated separately, so data are collected for each stand-alone structure on location. GIS mapping helps with a visual of the building, but if it is not available, a photo of the building is used.</p>
<b>Construction</b>	<ul style="list-style-type: none"> <li>• Age</li> <li>• Number of stories</li> <li>• Square meterage</li> <li>• Foundation type</li> <li>• Floor type</li> <li>• Wall type</li> <li>• Roof type</li> <li>• Percentage of new building standard</li> </ul>	<p>Many of the construction components have default settings (for example, wall construction includes settings for combustible or noncombustible).</p>
<b>Occupancy</b>	<ul style="list-style-type: none"> <li>• Type of occupancy (office, warehouse, manufacturing)</li> <li>• Percentage by occupancy type (if there are multiple occupancies)</li> <li>• Identification of any hazardous materials</li> </ul>	
<b>Protection</b>	<ul style="list-style-type: none"> <li>• Fire protection description</li> <li>• Seismic protection description</li> <li>• Physical access security</li> </ul>	<p>Ideally, commentary is made regarding general asset risk management. Proactive repair and maintenance are also sought at an organizational level.</p>
<b>Exposure</b>	<ul style="list-style-type: none"> <li>• Proximity to neighboring properties</li> <li>• Neighboring properties of note (such as oil depots)</li> <li>• Commentary on any natural exposures (such as next to a river)</li> </ul>	

The asset exposure data described earlier sets a base for loss modeling of different disaster scenarios. In the instance of the New Zealand All-of-Government approach, the services of the national geoscience agency, GNS Science, were used. In applying the modeling, GNS Science also added to the exposure database by overlaying other exposure factors, such as the following:

- Subsoil type (that is, the likely shaking intensity or liquefaction impact in modeled earthquake events)
- Vulnerabilities to failures in public utilities
- Potential negative impacts on accessibility
- Vulnerabilities to secondary risks such as fires that follow an earthquake

Those combined insights help customers to determine more precisely their business interruption exposures.

In addition to building exposure data, contents, plant, and equipment, data for each location are also collected.



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## Glossary of Selected Terms

<b>Actual cash value (ACV)</b>	The cost estimate for replacing an asset after taking account of depreciation
<b>Accuracy</b>	The degree to which the result of a measurement, calculation, or specification conforms to the correct value or a standard
<b>Adequacy</b>	Sufficiency for the purpose concerned
<b>Attribute</b>	An attribute is a specific data field in a database or schema that describes a particular characteristics of an asset, such as its primary use or occupancy (see <b>Modifier</b> )
<b>Averaging</b>	The process used by insurers to proportionally reduce claims payments in the event that the actual loss is significantly larger than the estimated insured value, which is usually included in the policy as an averaging clause
<b>Broker</b>	An arranger of insurance coverage with an insurer on behalf of a client
<b>Buildings TIV</b>	The reinstatement or rebuilding costs to replace the structure if it is totally destroyed
<b>Business interruption</b>	Insurance for the loss of financial or other monetary income (or loss of profits) usually related to the consequences of direct damage or disruption to affected property (indirect interruption coverage is called “contingent business interruption”)
<b>Business interruption TIV</b>	The total insurable value related to a loss of profit or other defined financial gain as a result of disruption from damage to the structure
<b>Business restoration period</b>	The actual loss of business income that the insured sustains during the necessary suspension of its operations in the period of restoration
<b>Catastrophe model</b>	A computational analytical approach that insurers use to quantify and manage the risk of large, potentially unsustainable losses from extreme events across their portfolio of insureds, which is usually licensed from specialist catastrophe modeling companies
<b>Construction class</b>	A key primary modifier attribute (often based on standard code systems) describing the structural characteristics of the asset such as its primary building materials, building method, and its link to specific vulnerability functions
<b>Contents TIV</b>	The total value of all nonstructural assets contained within the structure
<b>COPE</b>	Construction, occupancy, protection and exposure—an insurance underwriting term for the primary risk modifiers and values at risk

<b>Coverage</b>	An insurance and catastrophe modeling term to describe the various types of insurance being applied, which usually includes buildings, contents, and business interruption
<b>CRESTA</b>	Catastrophe Risk Evaluation and Standardizing Target Accumulations—an industry body that provides standardized geographic accumulation zones used for underwriting and risk aggregation assessments; also can describe the geographic zones used
<b>Exposure</b>	The collection of asset records, attributes, and values that describe the complete risk profile of assets to be insured, while exposure management is the process insurers use to evaluate, monitor, and manage their overall risk accumulations
<b>From ground up (FGU)</b>	The total amount of insured value covered and the risk of loss before ceding of risk to insurers, reinsurers, or retrocessionaires, considered the pure risk borne by the asset owner before insurance protection
<b>Full rebuild costs</b>	The costs associated with rebuilding, including materials, labor, and all other fees and costs such as land and debris clearance, legal and other professional fees, taxes, and so on
<b>Geocoding</b>	A method used to attach geographic, latitude and longitude coordinates to assets through inferential matching against specialist databases using address data provided in the exposure database
<b>Insured value</b>	The estimated monetary sum for which an asset is being insured, the “value at risk” used to determine total exposure and to calculate premium, while the total sum insured (TIV) is the aggregate insured value across all coverages
<b>Intermediary</b>	See <b>Broker</b>