Sharing Session

Catastrophe Risk Quantification: Economic Capital Based

Convesion A Asia Program

March 24th, 2026

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Catastrophe Modelling

Catastrophe Modelling

Catastrophe Exposure (Risk)

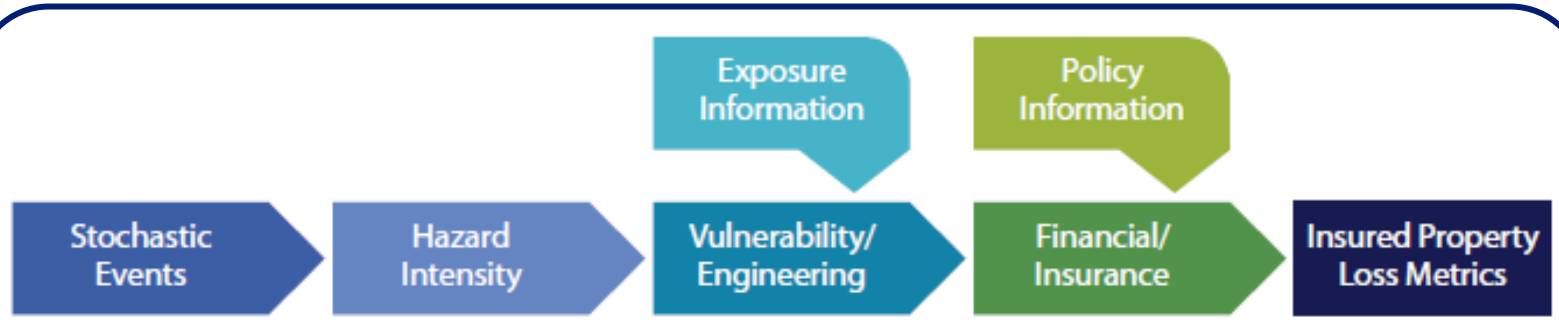
- A **catastrophic event** is an extreme, unexpected occurrence that causes widespread damage and usually happens suddenly, such that the impact of the loss may exceed the ability to cope with or absorb it.
- **Catastrophic events** rarely occur (low-frequency) but have catastrophic impacts (high severity).
- **Catastrophe exposure** is the total risk that an insurance or reinsurance company faces, which has the potential for loss due to catastrophic events.
- **Managing catastrophe risk** is the ongoing process of: (1) identifying the risk given the context of the organization or community, (2) quantifying the risk, (3) deciding what to do, given the level of risk and the risk appetite (i.e. how much risk an entity is willing to take) of the organization or community, and (4) monitoring the level of risk.

Source: US-Navy , Catastrophe Aceh, 2004

Source :AFP Photo/Mohd Rasfan, Catastrophe Palu, 2018

According United Kingdom Lloyd's Market Association (LMA, 2013)

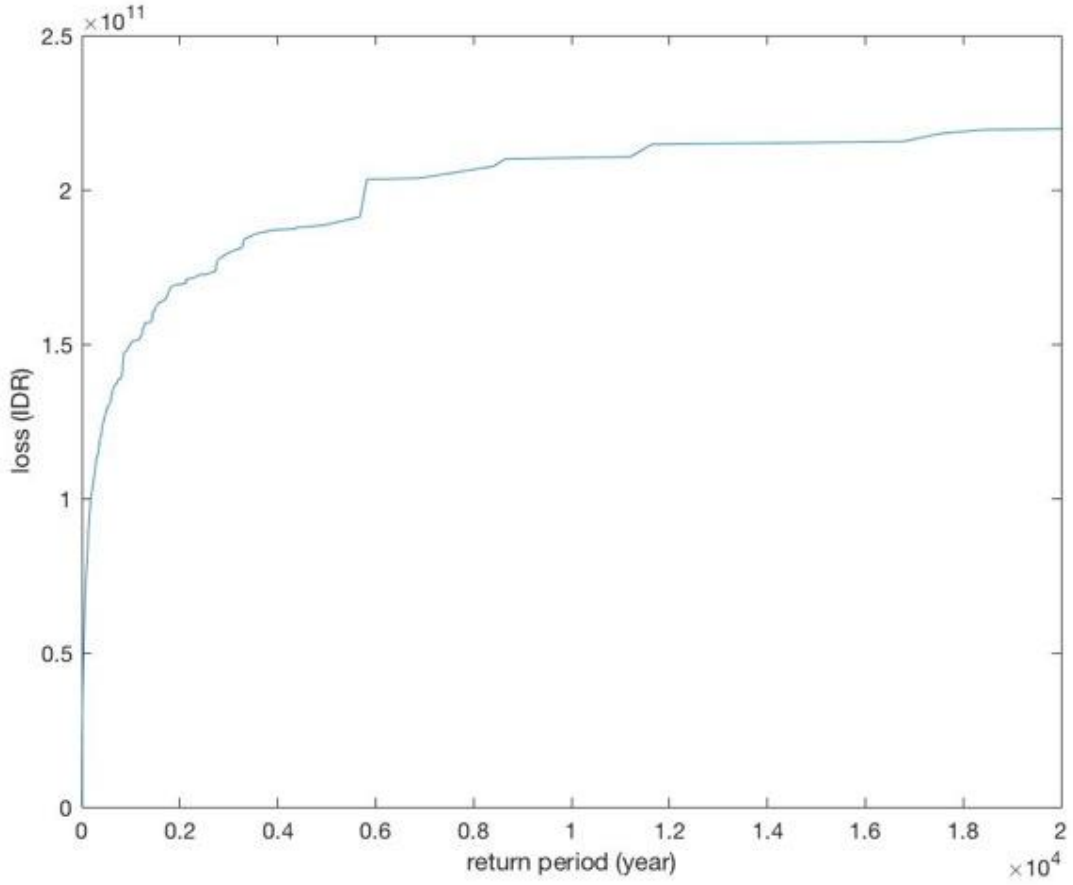
Catastrophe Model is a computerized system that generates a robust set of simulated events and estimates the magnitude, intensity, and location of the event to determine the amount of damage and calculate the insured loss as a result of a catastrophic event such as a hurricane or an earthquake.



Catastrophe Modelling

Catastrophe Risk Measure – Average Annual Loss

Average annual loss : The expected annual loss from all earthquake occurrences is denoted as the average annual loss (average annual loss). Average annual loss also referred to as the pure premium or burning cost



$$\mathrm{AAL} = \sum_i p_i L_i$$

$$\sigma = \sqrt{\sum_i (p_i L_i^2) - AAL^2}$$

Catastrophe Modelling

Catastrophe Risk Measure – Loss Exceedance Probability

An excess probability curve gives the probabilities of various loss levels over a specified time. It relates the level of loss exceedance to the probability of an event occurring over the observed period. Assuming a Poisson distribution, the probability of exceeding a loss within a certain timeframe.

- Occurrence Exceedance Probability (OEP) *is the annual probability that the losses for at least one occurrence will exceed at certain amount.*
- Aggregate Exceedance Probability (AEP) *is the probability that aggregate losses in a year.*

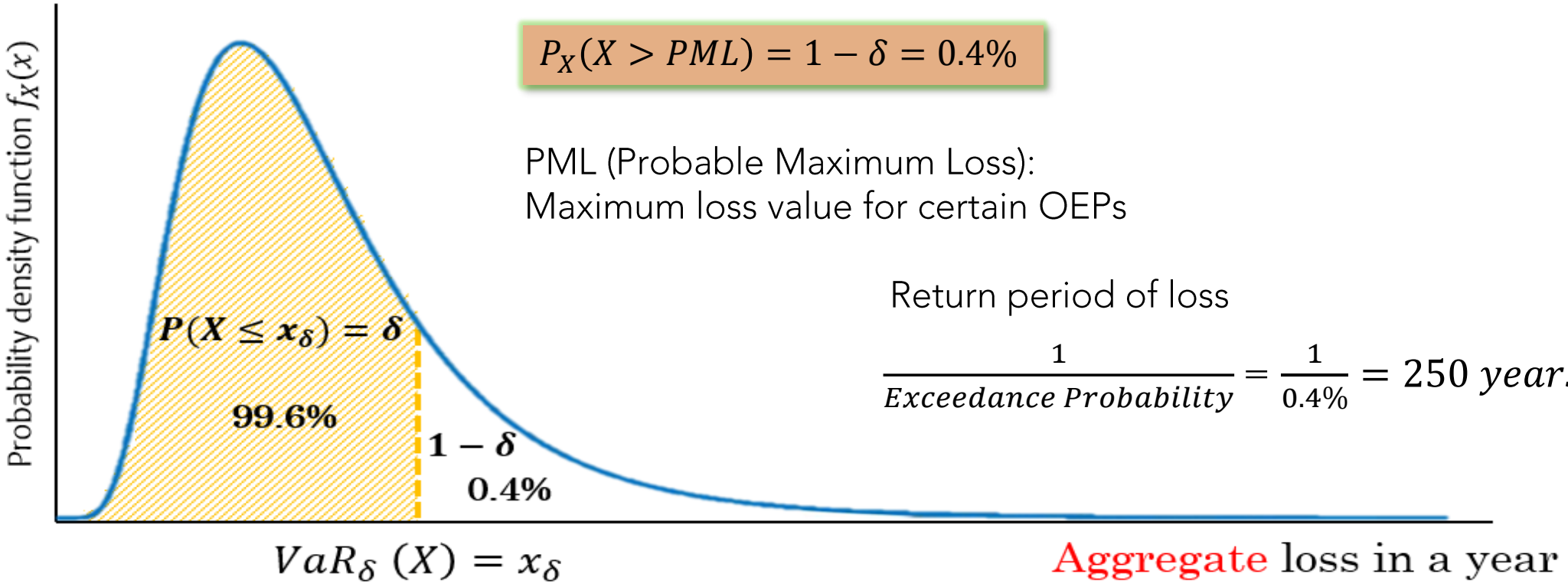
Occurrence Exceedence Probability (OEP) curve $F(x)$ describes the distribution of the largest event in a year, $F(x)$ is the probability that the largest event in a year exceeds x

$$P_X(X > PML) = 1 - \delta = 0.4\%$$

PML (Probable Maximum Loss):
Maximum loss value for certain OEPs

Return period of loss

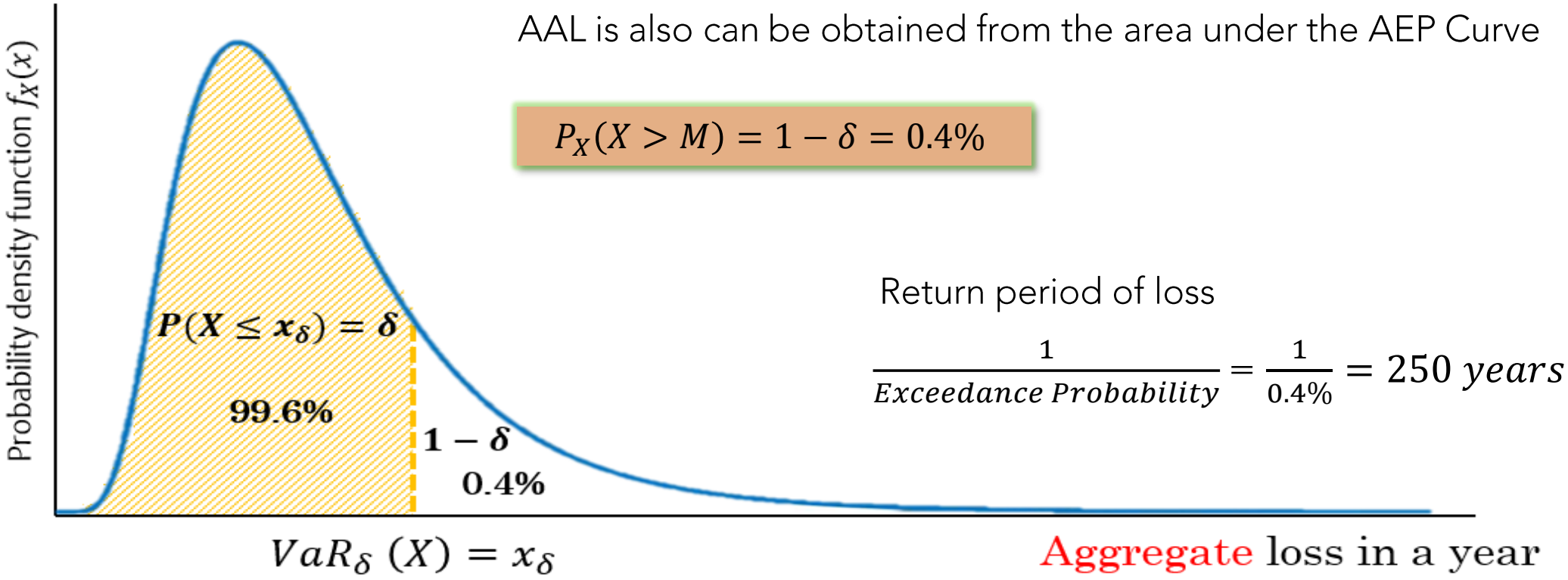
$$\frac{1}{Exceedance\ Probability} = \frac{1}{0.4\%} = 250\ years$$



Aggregate Exceedence Probability (AEP) curve $F(x)$ describes the sum of the events in a year. In particular, $F(x)$ is the probability that the sum of the events in a year exceeds x

AAL is also can be obtained from the area under the AEP Curve

$$P_X(X > M) = 1 - \delta = 0.4\%$$



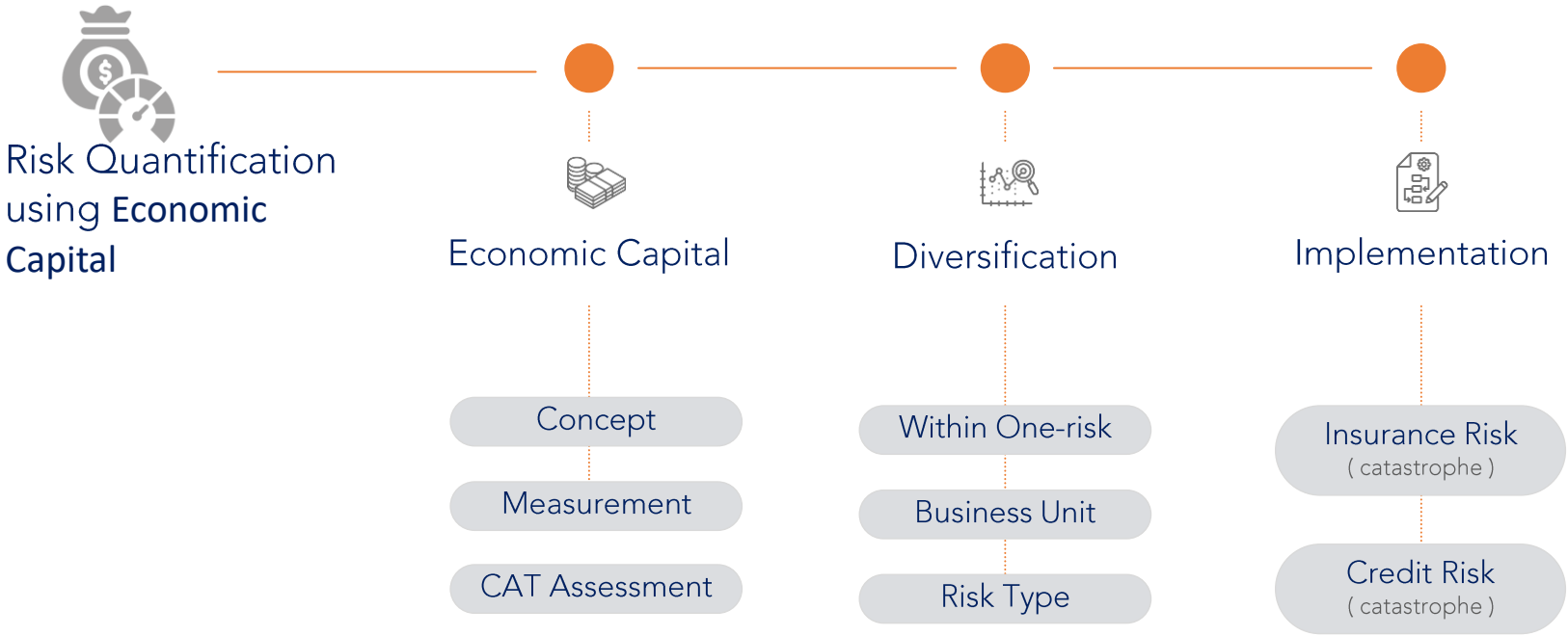
Return period of loss

$$\frac{1}{Exceedance\ Probability} = \frac{1}{0.4\%} = 250\ years$$

Economic Capital

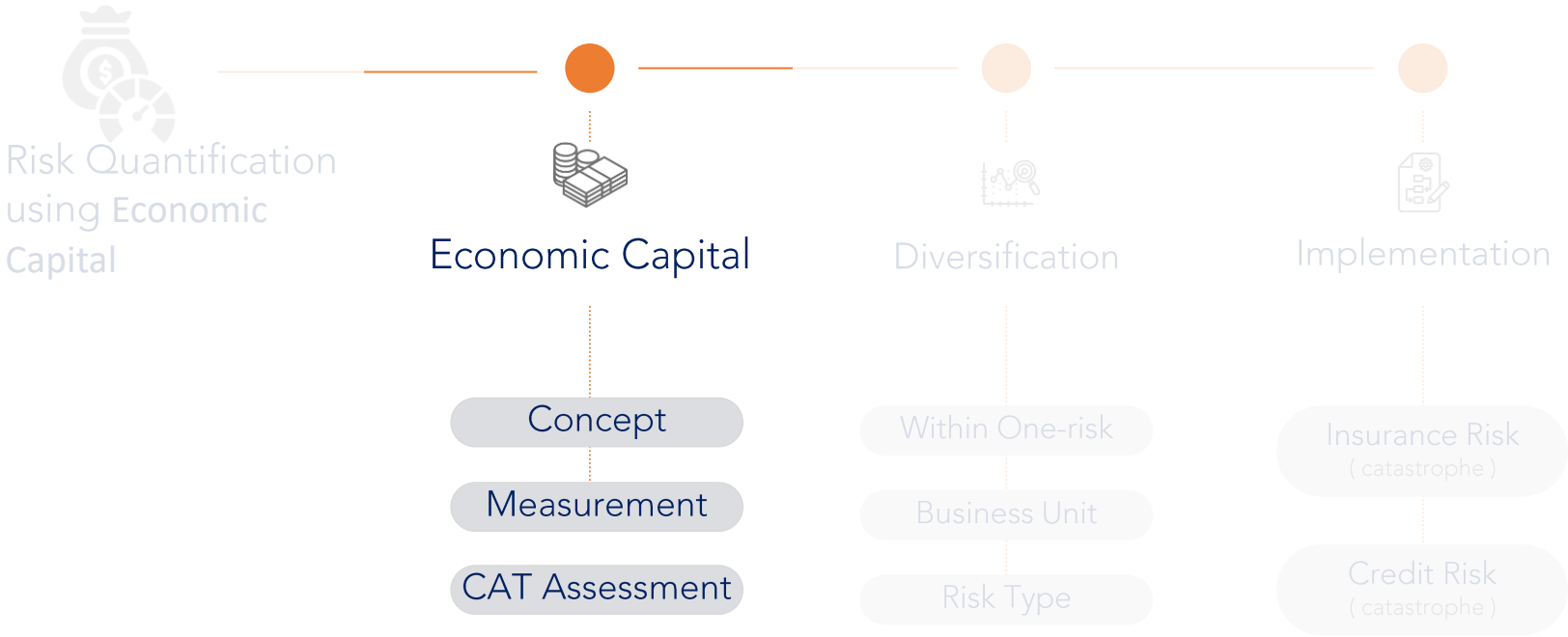
Economic Capital

Better understanding on risk assessment



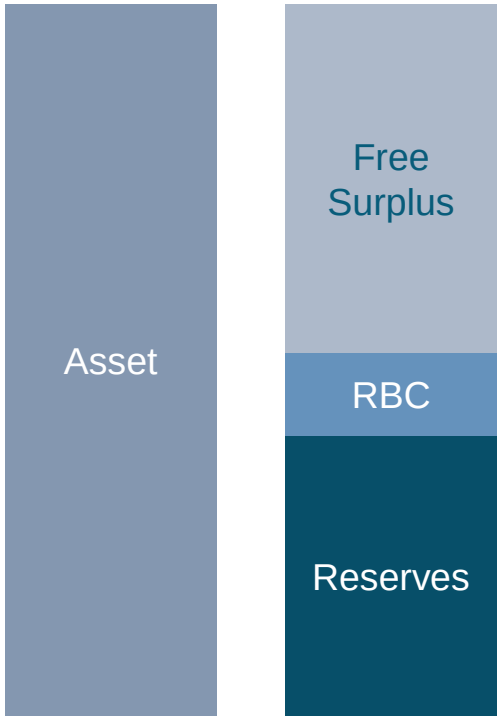
Economic Capital

Better understanding on risk assessment

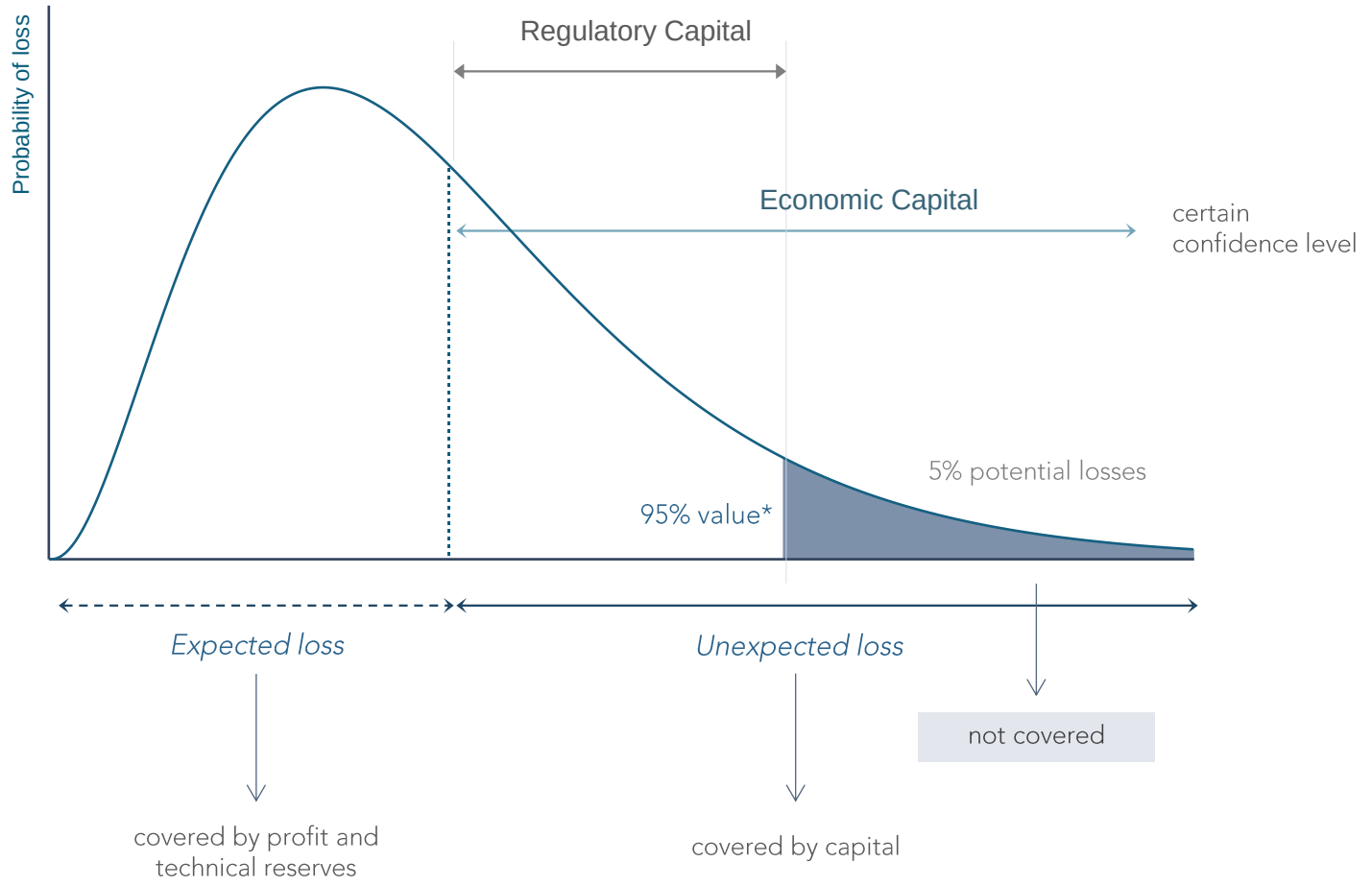


The Concept of Economic Capital

Not only a minimum capital adequacy, rather about strategic safeguards for business continuity



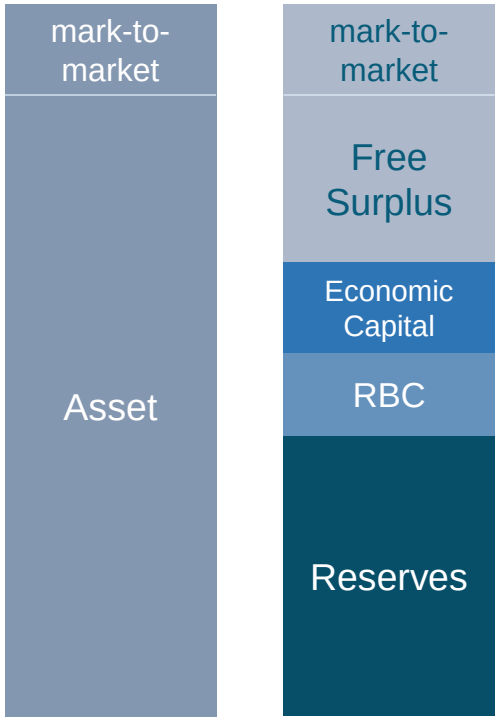
Regulatory risk-based capital (RBC) is based on prescribed formulaic approach and also using 'risk factor' as a constanta to determine the capital buffer for the risk.



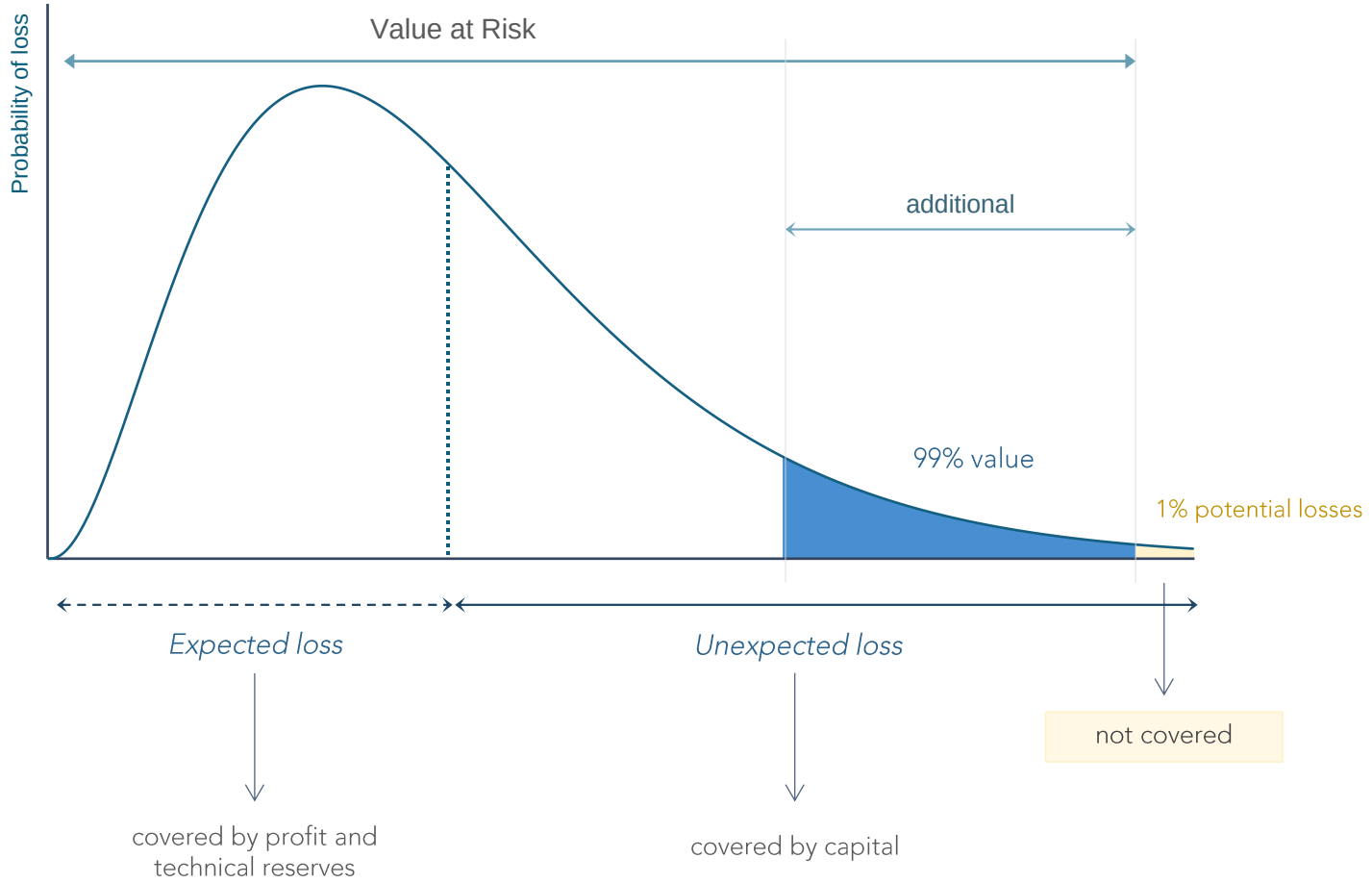
* Typical regulatory requirement

The Concept of Economic Capital

Not only a minimum capital adequacy, rather about strategic safeguards for business continuity

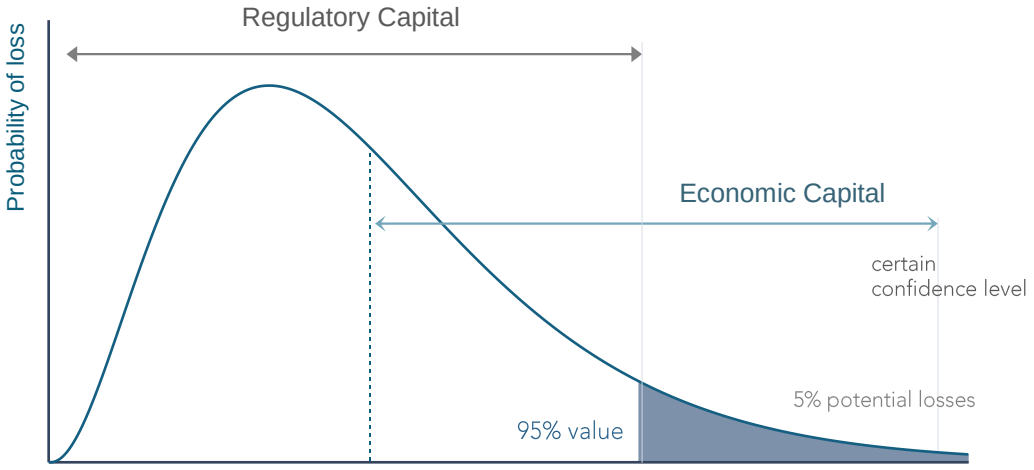


Economic capital is based on an insurer's individual risks. More actuarial work involved in the assessment and calculation



Economic Capital Measurement

Internal model used to improve risk-based capital allocation



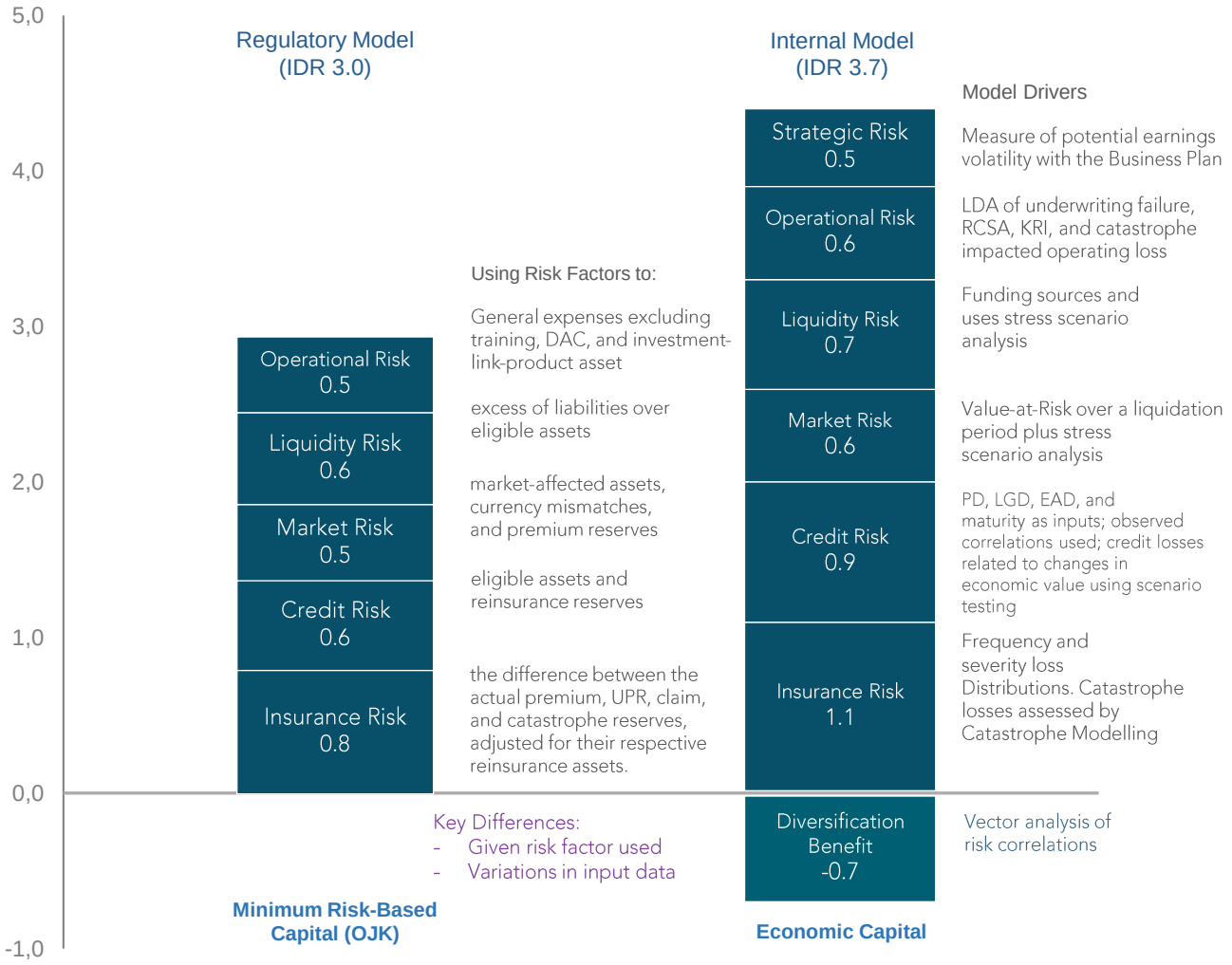
Strategic Risk | Operational Risk | Liquidity Risk

Market Risk | Credit Risk | Insurance Risk

Methodology
- ✓ More accurate and customized
- ✓ True risk exposure
- ✓ Advanced techniques

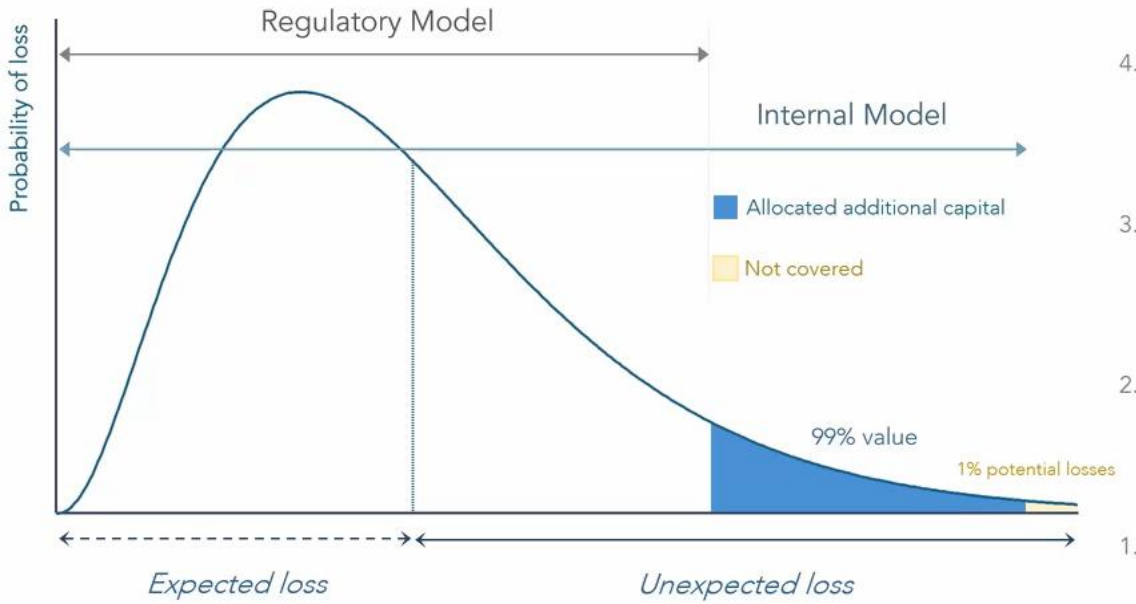
Values offered
- ☆ Aligning capital needs
- ☆ Strategic objectives
- ☆ Risk management objectives

*illustrative purposes only

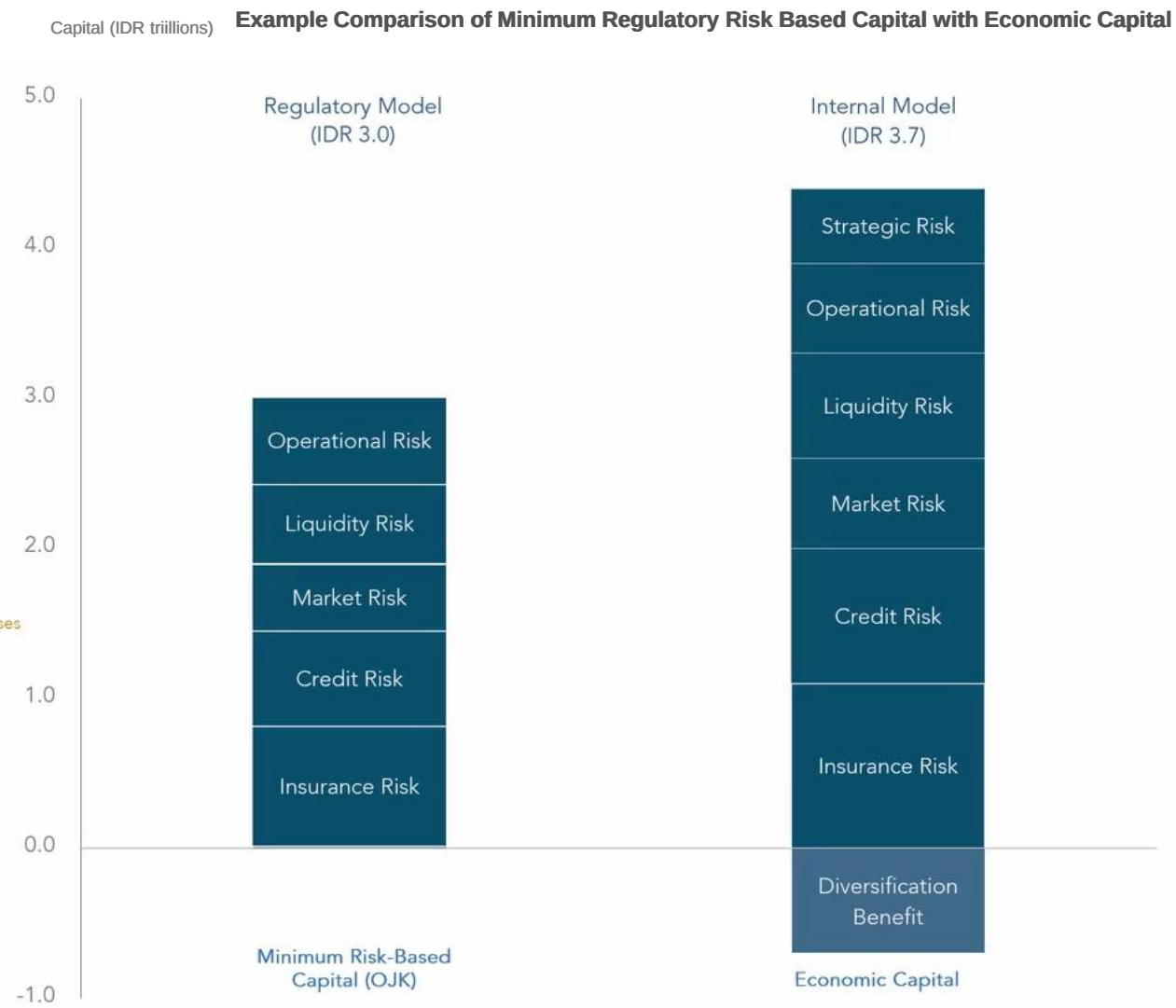


Economic Capital Measurement

Internal model used to improve risk-based capital allocation



- confidence level
- company's risk appetite.
- diversification benefit



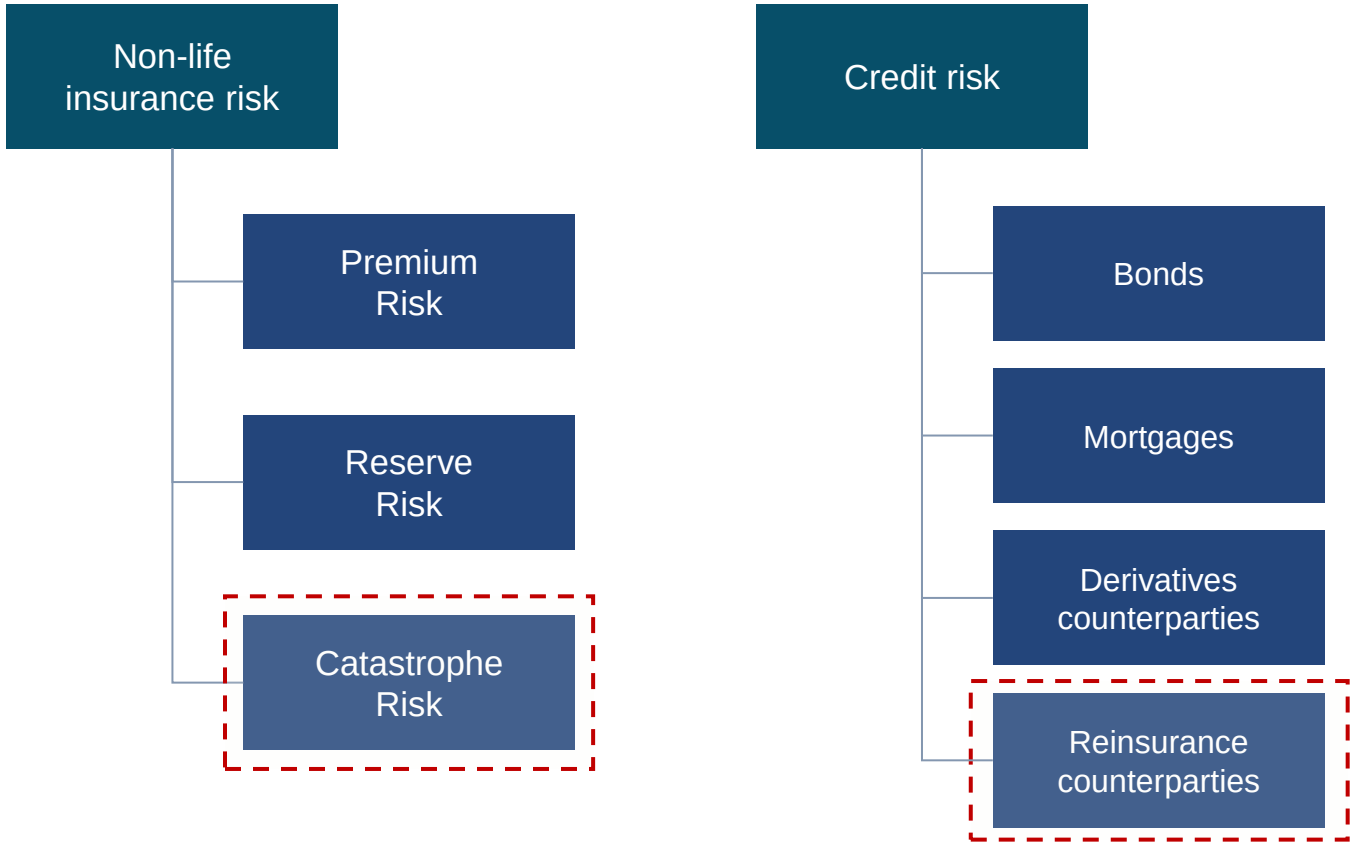
*Illustrative purposes only

Catastrophe Event – Economic Capital Assessment

Primary risk type affected by catastrophe event

Components of
non-life insurance risk

Components of
credit risk



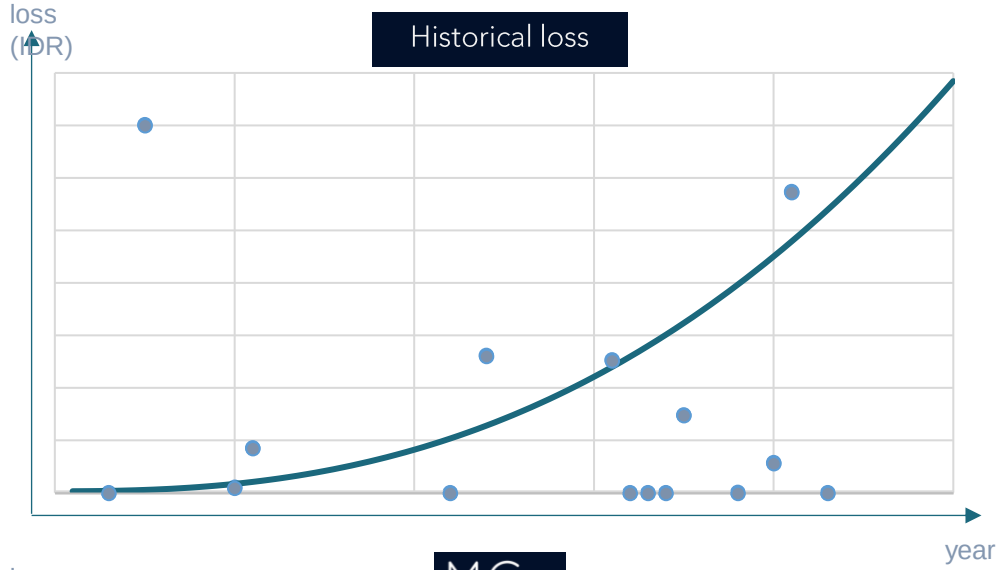
Risk types that would be heavily impacted by catastrophic event

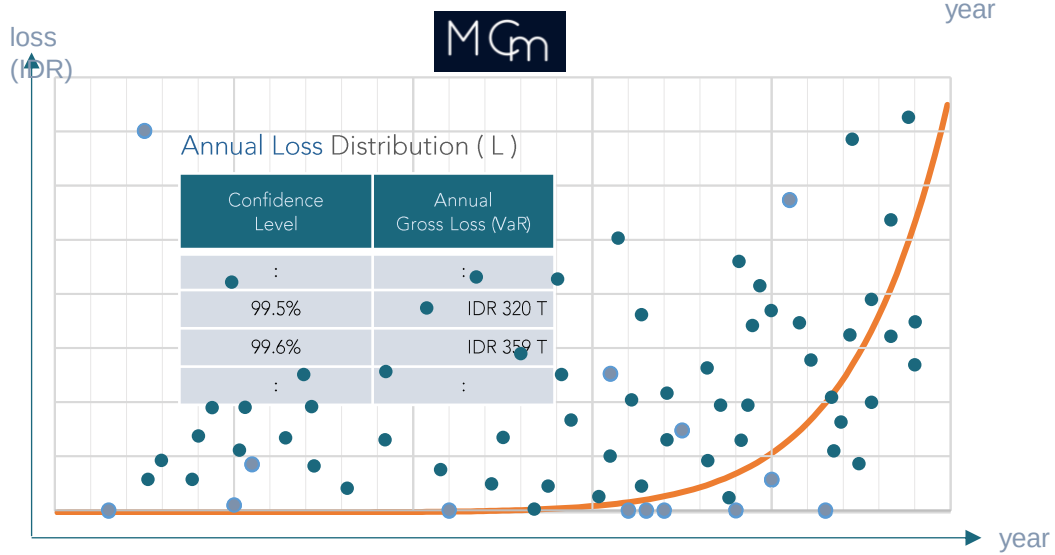
Specifically,

- ✓ Massive and simultaneous surge in claims within a short period
- ✓ Test the adequacy of booked technical reserves
- ✓ If the reinsurer fails to pay, the ceding company risks its free surplus (equity)

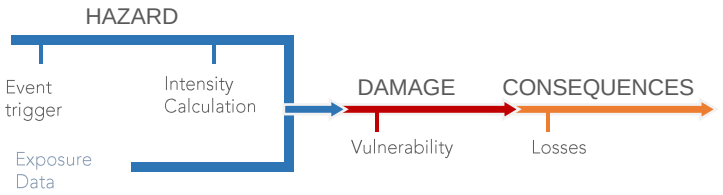
Catastrophe Event – Economic Capital Assessment

How we assess the impact of catastrophe





Insurance Risk



α VaR_α

$$VaR\alpha\ (L) - E\ [L]$$

Credit Risk

$$PD \times LGD \times EAD$$

Exposure at default (EAD) is calculated based on:

- each reinsurance panel
- loss distribution of the reinsured portion
- applicable reinsurance structure
- given confidence level
- company's risk appetite

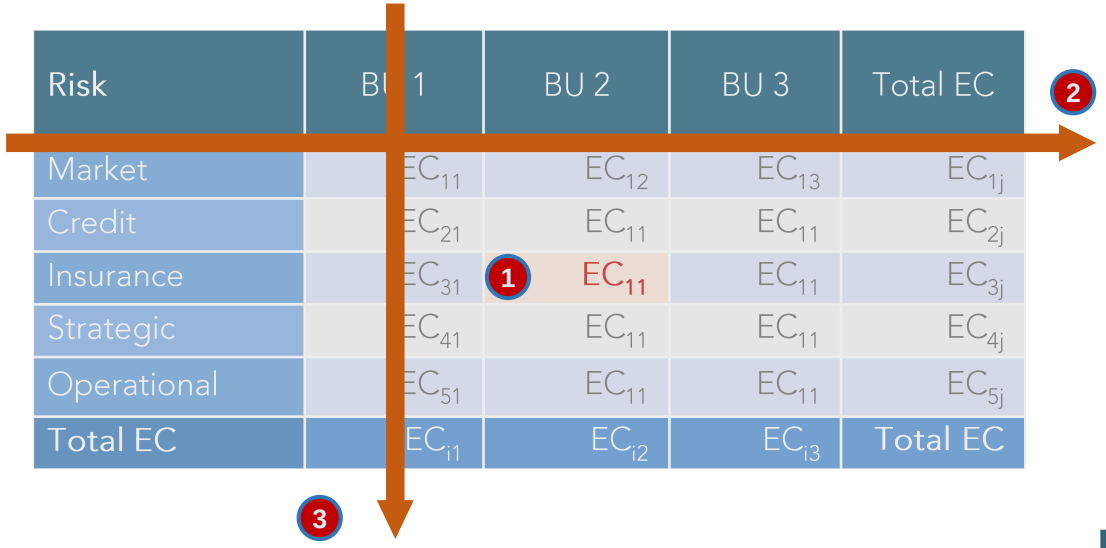
Economic Capital

Better understanding on risk assessment

Diversification Benefit Measurement

Assessed using correlation matrices for each type of diversification

Gross Economic Capital after Diversification Benefit



Correlation Matrix

RISK TYPE	Market Risk	Credit Risk	Insurance Risk	Strategic Risk	Operational Risk
Market Risk	1	0.29	0.75	0.19	0.01
Credit Risk	0.48	1	0.04	0.99	0.54
Insurance Risk	0.10	0.62	1	0.15	0.02
Strategic Risk	0.10	0.02	0.20	1	0.31
Operational Risk	0.93	0.00	0.83	0.82	1

Diversification Benefit Measurement

Three types of diversification benefit

Gross Economic Capital

in millions of IDR

Risk	BU 1	BU 2	BU 3	Total EC
Market	377,043	269,379	113,823	760,245
Credit	654,791	295,693	909,549	1,860,033
Insurance	712,278	1,135	197,926	911,339
Strategic	560,781	414,701	466,128	1,441,610
Operational	451,917	933,772	819,949	2,205,638
Total EC	2,756,810	1,914,680	2,507,375	7,178,865

Type I Diversification Benefit

in millions of IDR

Risk	BU 1	BU 2	BU 3	Total EC
Market	(42,515)	(53,460)	(19,637)	(115,729)
Credit	(107,060)	(48,013)	(189,737)	(331,385)
Insurance	(110,837)	(143)	(39,503)	(143,868)
Strategic	(87,895)	(68,272)	(84,097)	(232,455)
Operational	(59,621)	(190,579)	(121,119)	(440,213)
Total Div. Benefit	(407,928)	(360,467)	(454,094)	(1,263,649)

1

Gross Economic Capital[1]

in millions of IDR

Risk	BU 1	BU 2	BU 3	Total EC
Market	334,528	215,919	94,186	644,516
Credit	547,731	247,680	719,812	1,528,648
Insurance	601,441	992	158,423	767,471
Strategic	472,886	346,429	382,031	1,209,155
Operational	392,296	743,193	698,830	1,765,425
Total EC	2,348,882	1,554,213	2,053,281	5,915,216

Are assessed through three types:

1. Within-one risk
2. Between business unit
3. Between risk type

illustrative purposes only

Diversification Benefit Measurement

Three types of diversification benefit

Gross Economic Capital[1]

in millions of IDR

Risk	BU 1	BU 2	BU 3	Total EC
Market	334,528	215,919	94,186	644,516
Credit	547,731	247,680	719,812	1,528,648
Insurance	601,441	992	158,423	767,471
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Total EC	2,348,882	1,554,213	2,053,281	5,915,216

2 between BU

3 between Risks Type

Are assessed through three types:

1. Within-one risk
2. Between business unit
3. Between risk type

Type II and III Diversification Benefit

in millions of IDR

Risk	BU 1	BU 2	BU 3	Total EC	Type II DB
Market	334,528	215,919	94,186	644,516	(44,140)
Credit	547,731	247,680	719,812	1,528,648	(104,222)
Insurance	601,441	992	158,423	767,471	(52,330)
Strategic	472,886	346,429	382,031	1,209,155	(82,536)
Operational	392,296	743,193	698,830	1,765,425	(123,255)
Total EC	2,348,882	1,554,213	2,053,281	5,915,216	**(406,483)**
Type III DB	(176,527)	(116,805)	(154,312)	**(202,537)**	

*illustrative purposes only

Diversification Benefit Measurement

Three types of diversification benefit

Gross Economic Capital after Diversification Benefit[2]

in millions of IDR

Risk	BU 1	BU 2	BU 3	Total EC	Div. Benefit	EC - DB
Market	334,528	215,919	94,186	644,516	(44,140)	600,376
Credit	547,731	247,680	719,812	1,528,648	(104,222)	1,424,426
Insurance	601,441	992	158,423	767,471	(52,330)	715,141
Strategic	472,886	346,429	382,031	1,209,155	(82,536)	1,126,619
Operational	392,296	743,193	698,830	1,765,425	(123,255)	1,642,170
Total EC	2,348,882	1,554,213	2,053,281	5,915,216	**(406,483)**	5,508,732
Div. Benefit	(176,527)	(116,805)	(154,312)	**(202,537)**		
EC - DB	2,172,355	1,437,408	1,898,970	**5,508,732**		

Total Economic Capital

IDR 5.51 T

illustrative purposes only

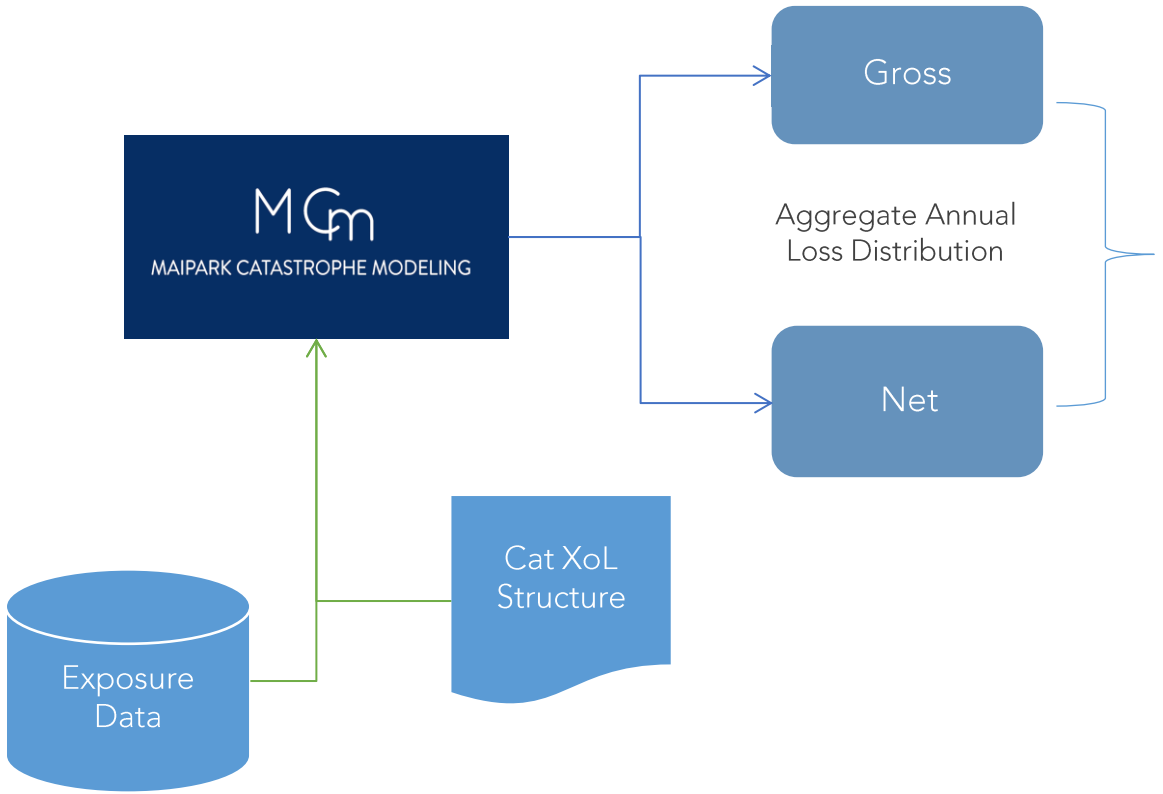
Economic Capital

Better understanding on risk assessment

Catastrophe Event – Economic Capital Assessment

MAIPARK implementation on Catastrophe Risk assessment

Insurance (CAT) Risk – Premium Risk



Conf. level	IDR Loss (VaR)
95%	$X_{95\%}$
99,6%	$X_{99.6\%}$
:	:
:	:

Variable	Before R/I (IDR)	After R/I (IDR)
Estimated Agg. Loss	A	B
Net Premium Reserve	a	b
Economic Capital	A - a	B – b

*) Practically some user refers to AEP as the Annual Aggregate Loss

Catastrophe Event – Economic Capital Assessment

MAIPARK implementation on Catastrophe Risk assessment

MAIPARK Reinsurance - Research

Insurance (CAT) Risk – Reserve Risk

Large and Catastrophic Loss

Conf. level	IDR Loss (VaR)
95%	$L_{95\%}$
99,6%	$L_{99.6\%}$
:	:
:	:

Variable	Before R/I (IDR)	After R/I (IDR)
Estimated Loss (VaR)	A	B
Net Claim Reserve	a	a
Economic Capital	A - a	B – a

Attritional Loss* triggered by CAT event

Conf. level	IDR Loss (VaR)
95%	$L_{95\%}$
99,6%	$L_{99.6\%}$
:	:
:	:

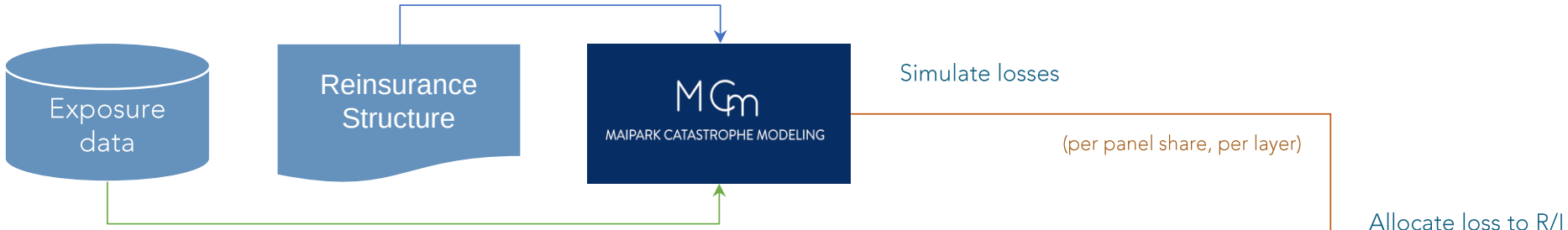
Variable	Before R/I (IDR)	After R/I (IDR)
Estimated Loss (VaR)	A	A
Net Claim Reserve	a	a
Economic Capital	A - a	A - a

*own retention

Catastrophe Event – Economic Capital Assessment

MAIPARK implementation on Catastrophe Risk assessment

Credit Risk – Reinsurance Counterparties



No.	Reasuradur	Rating	Rated by	PD (%)	LGD (%)	EAD	WCS	BEL	EC
1	Munchener Ruckversicherungs	AA/A+	AM Best	2.4	35	IDR	*x*	*a*	*x – a*
:	:	:	:	:	:	:	:	:	:

$$Economic\ Capital = LGD \times EAD \times \sqrt{PD \times (1 - PD)} - LGD \times EAD \times PD$$

$$= worst - case \text{ scenario} \qquad - best\ estimate\ loss$$

PD : Probability of default

LGD : Loss given default

EAD : Exposure at default

Economic Capital Output

Provides economic capital allocation per risk at a specified confidence level.

Risk-Based Economic Capital – VaR 99.6%

in millions of IDR

	MARKET RISK	CREDIT RISK	INSURANCE RISK	STRATEGIC RISK	OPERATIONAL RISK	DIVERSIFICATION RISK	TOTAL
As of 31 August	2025	2025	2025	2025	2025	2025	2025
Property Casualty	207,555	86,941	(12,892)	165,569	7,124	(186,241)	268,056
Life/Health	-	-	-	-	-	-	-
Corporate and Other	-	-	-	-	-	-	-
Total Group	207,555	86,941	(12,892)	165,569	7,124	(186,241)	268,056

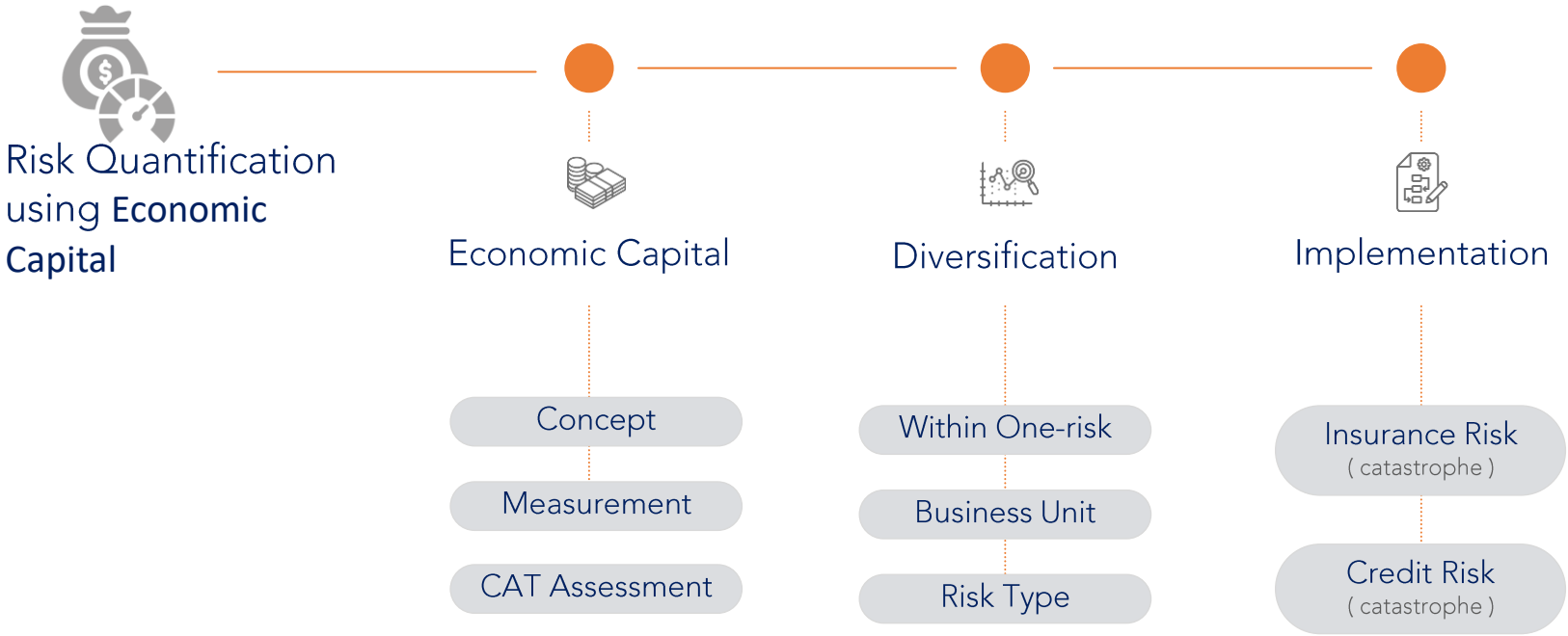
Taxes	N/A
Available Capital	854,291
Third country equivalent	N/A
Sectoral requirement	N/A
Surplus / (Deficit)	586,235

The table above presents the 2025 (as of August) economic capital calculation report using MAIPARK's internal modeling.

Additional capital to meet Economic Capital requirement

Economic Capital

Better understanding on risk assessment



Frequently Asked Questions

1. What is Challenges in Building an Economic Capital (EC) Model?
2. What is Differences Between EC and Indonesian Regulatory Risk-Based Capital (RBC)?
3. Does MAIPARK Have an Internal Catastrophe Model?
4. How to Construct a Correlation Matrix?
5. Based on Experience or References, What Level of Diversification Factor Is Typically Used?

Thank You