



P1.T1. Foundations of Risk

Chapter 1. The Building Blocks of
Risk Management





The building blocks of risk management

- Ten building blocks
- Tools used to measure and manage risk
- Relationship between risk and reward
- Key classes of risk
- How types of risk can arise
- Potential impact of each risk type on organizations



Ten Building Blocks

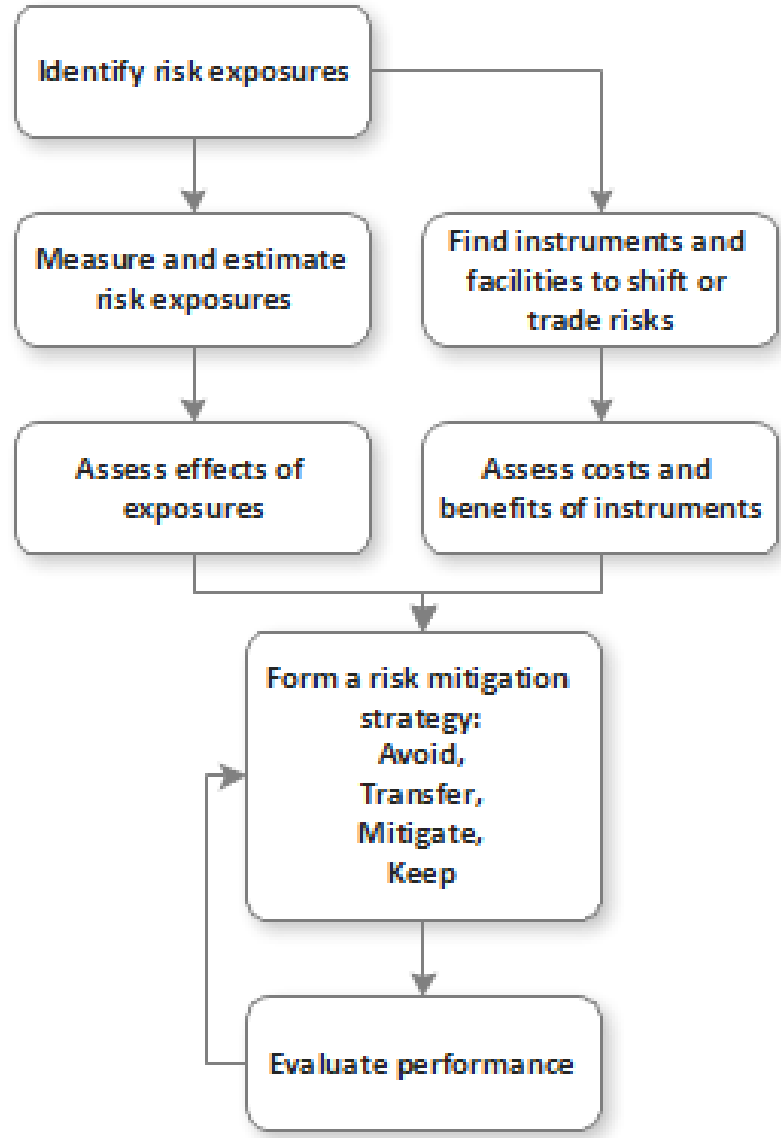


Ten building blocks¹

1. Risk management process
2. Identifying risk: knowns and unknowns
3. Expected loss, unexpected loss, and tail loss
4. Risk factor breakdown
5. Structural change: from tail risk to systematic crisis
6. Human agency and conflicts of interest
7. Typology of risks and risk interactions
8. Risk aggregation
9. Balancing risk and reward
10. Enterprise risk management (ERM)



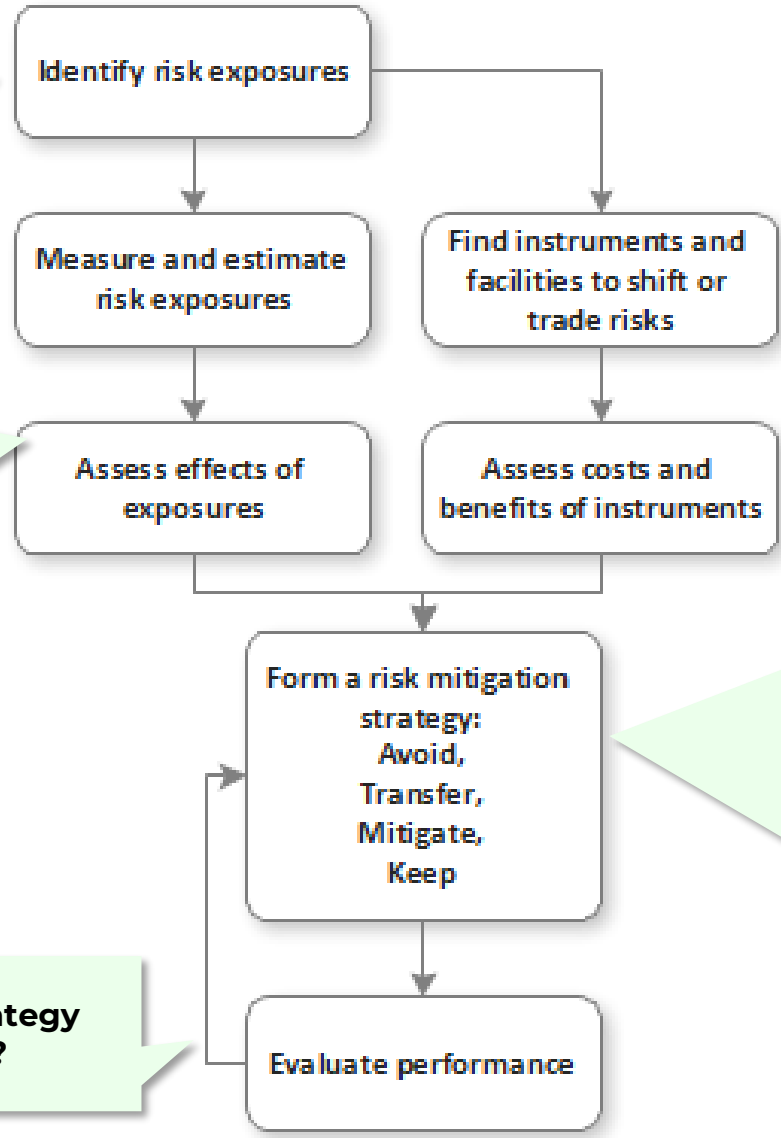
#1 (of 10): The Risk Management Process





#1 (of 10): The Risk Management Process

What risk is to an organization depends upon the selection of their type(s) and level(s) of risk.



Type of risk can be more important than magnitude of risk. This varies by industry (e.g., manufacturers might tolerate operational risk but not credit risk).

AVOID RISK: Easy to do (e.g., avoid risk by selling a business).

TRANSFER RISK: Derivatives are the most common method of transferring risk (e.g., buyer of a credit default swap (CDS) transfers credit risk to seller).

MITIGATE RISK: In hedging, the risk is retained but also reduced.

KEEP RISK: Not all risks are meant to be avoided or minimized. The firm's risk appetite implies that some risks should be retained.

In hindsight, was the risk strategy worth the actual reward?



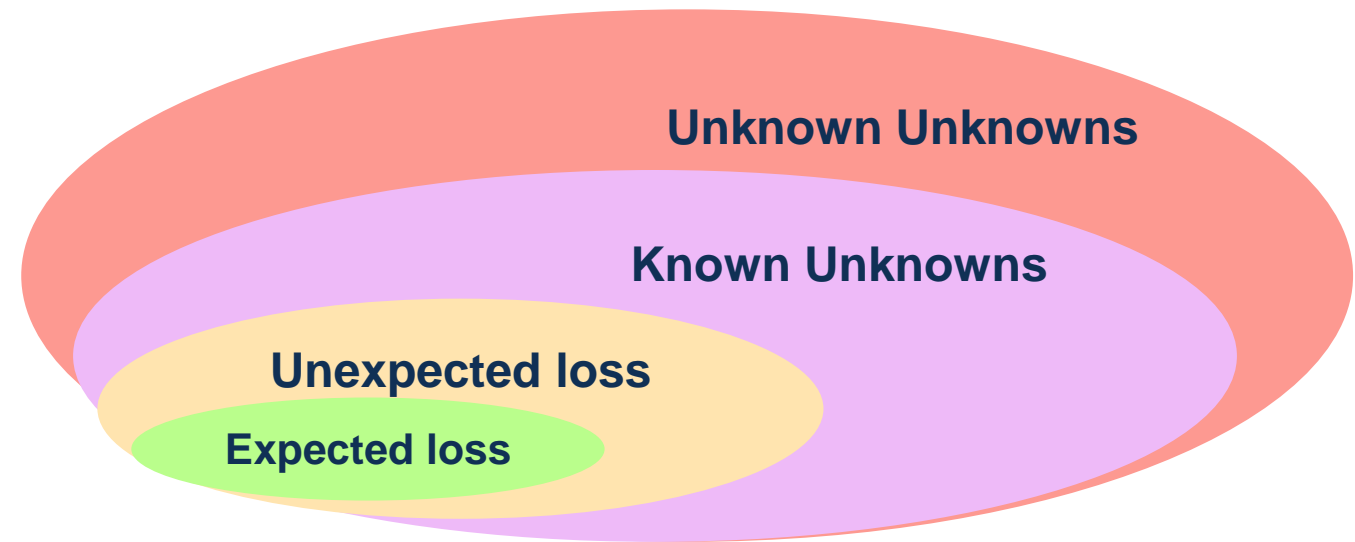
#2 (of 10): Identifying Risk: Knowns and Unknowns

KNOWN RISK

- Can be identified, analyzed & planned in advance.
- Examples: market shifts, geopolitical events, technology disruptors, acts of God, mergers

UNKNOWN RISK

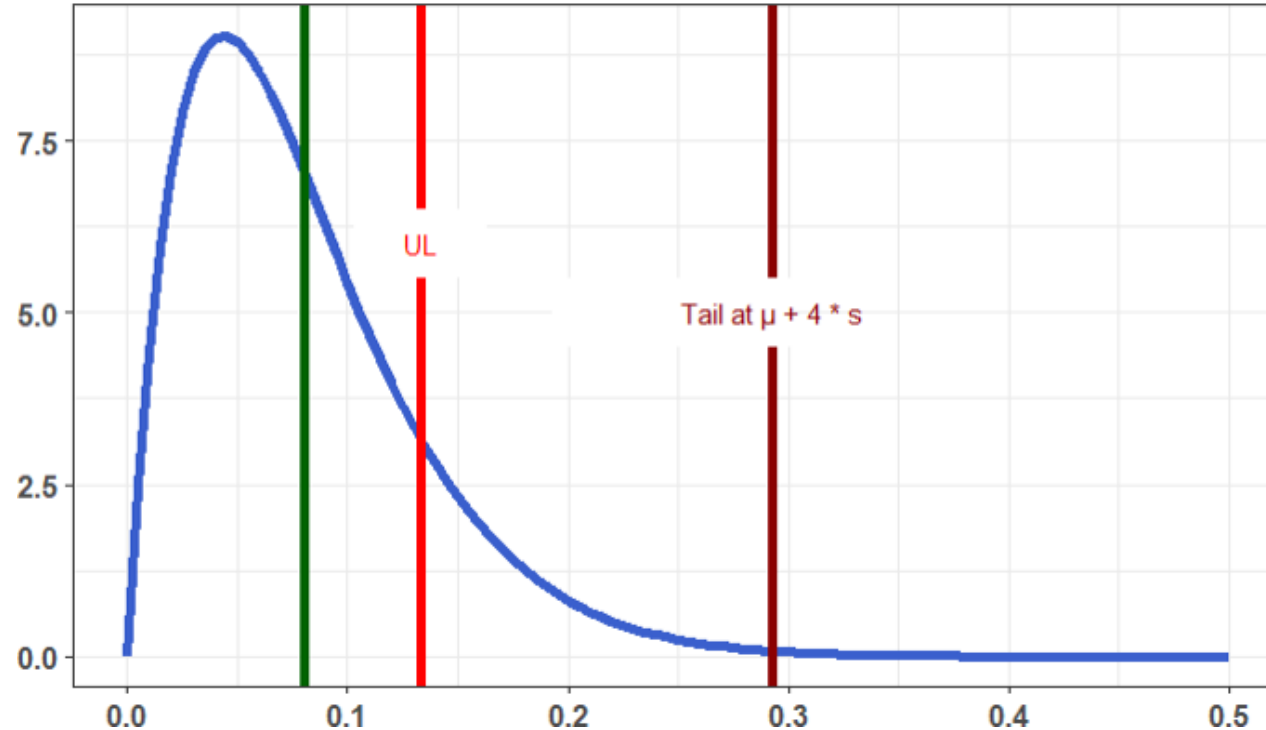
- Unable to anticipate and describe.
- Two types of unknown risk:
 - Known unknowns - risks that you know exist, but can't predict
 - Unknown unknowns - risks that you don't know exist





#3 (of 10): Expected Loss, Unexpected Loss & Tail Loss

beta pdf: $\mu = 0.08$, $sd = 0.053$, $conf1 = 85\%$, $conf2 = 100\%$



EXPECTED LOSS (EL)

EL is typically the weighted average (aka, mean) loss. EL is generally treated as a “cost of doing business”.

UNEXPECTED LOSS (UL)

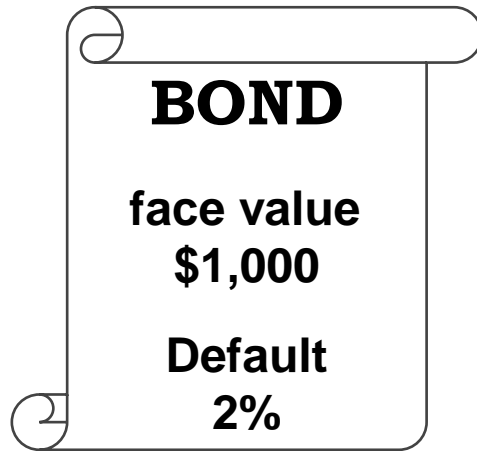
UL is the standard deviation about the expected loss.

TAIL LOSS

Very severe but rare events that can be measured by expected shortfall (ES), a statistical measure designed to quantify the mean risk in the tail of the distribution beyond the cut-off of the VaR measure.



For Example: Expected Loss



$$\begin{aligned} \text{expected loss} &= \\ \$1,000 \times 2.0\% &= \$20.00 \end{aligned}$$

Note: This is the **expected loss (EL)** although the **actual loss** is likely to be either zero or \$1,000; i.e., the expected loss is not necessarily itself an outcome.



For Example: Unexpected Loss

$$UL_P = \sqrt{\sum_{i=1}^n \sum_{j=1}^n w_i w_j \rho_{ij} UL_i UL_j}$$

$$UL_{P\$} = \sqrt{\sum_{i=1}^n \sum_{j=1}^n p_{ij} UL_i UL_j}$$

Where:

UL = unexpected loss

ρ = pair-wise correlation

w = weight (0 to 100%)

	Exposure #1	Exposure #2
Unexpected Loss, $UL(i)$	\$300,000	\$500,000
Default correlation, ρ	0.30	
Portfolio Unexpected Loss	\$655,744	



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$$UL_P^2 = 300 \cdot 300 \cdot 1.0 + 300 \cdot 500 \cdot 0.30 + 500 \cdot 300 \cdot 0.30 + 500 \cdot 500 \cdot 1.0$$

$$UL_P^2 = 300^2 + 500^2 + 2 \cdot 500 \cdot 300 \cdot 0.30 = 655.7^2$$



#4 (of 10): Risk Factor Breakdown

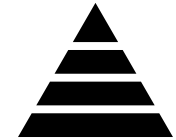
Break risk into factors

Risk should be broken down into significant discrete risk factors and understand how these factors might interact over time and under stress to generate losses.



Determine fundamental drivers behind each factor

Each primary risk factor is driven by a more fundamental set of risk factors (e.g., a firm's default may be driven by management quality, strength in industry, etc.).



Score risk factor

To score the risk factor, look at its sub-factors (e.g., management quality is driven by management's years of experience, previous experience, etc.).





#5 (of 10): Structural Change: From Tail Risk to Systemic Crisis

Look for structural change and model its future affects

It is difficult to find data on extremely rare events. However, tail risk events are rare but do exist.

If the structure underlying a system changes

- Risk tends to increase
- New types of risk can be introduced

Financial markets are subject to structural changes from levers such as social behavior, industry trends, regulatory reforms, and product innovations.

Can use **Extreme Value Theory (EVT)** to help make tails visible and to extract information.

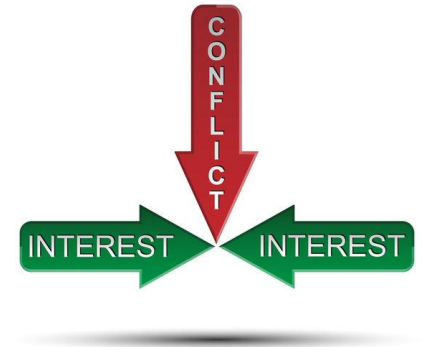




#6 (of 10): Human Agency and Conflicts of Interest

Risk management systems always have loopholes and become obsolete quickly in the face of industry innovations.

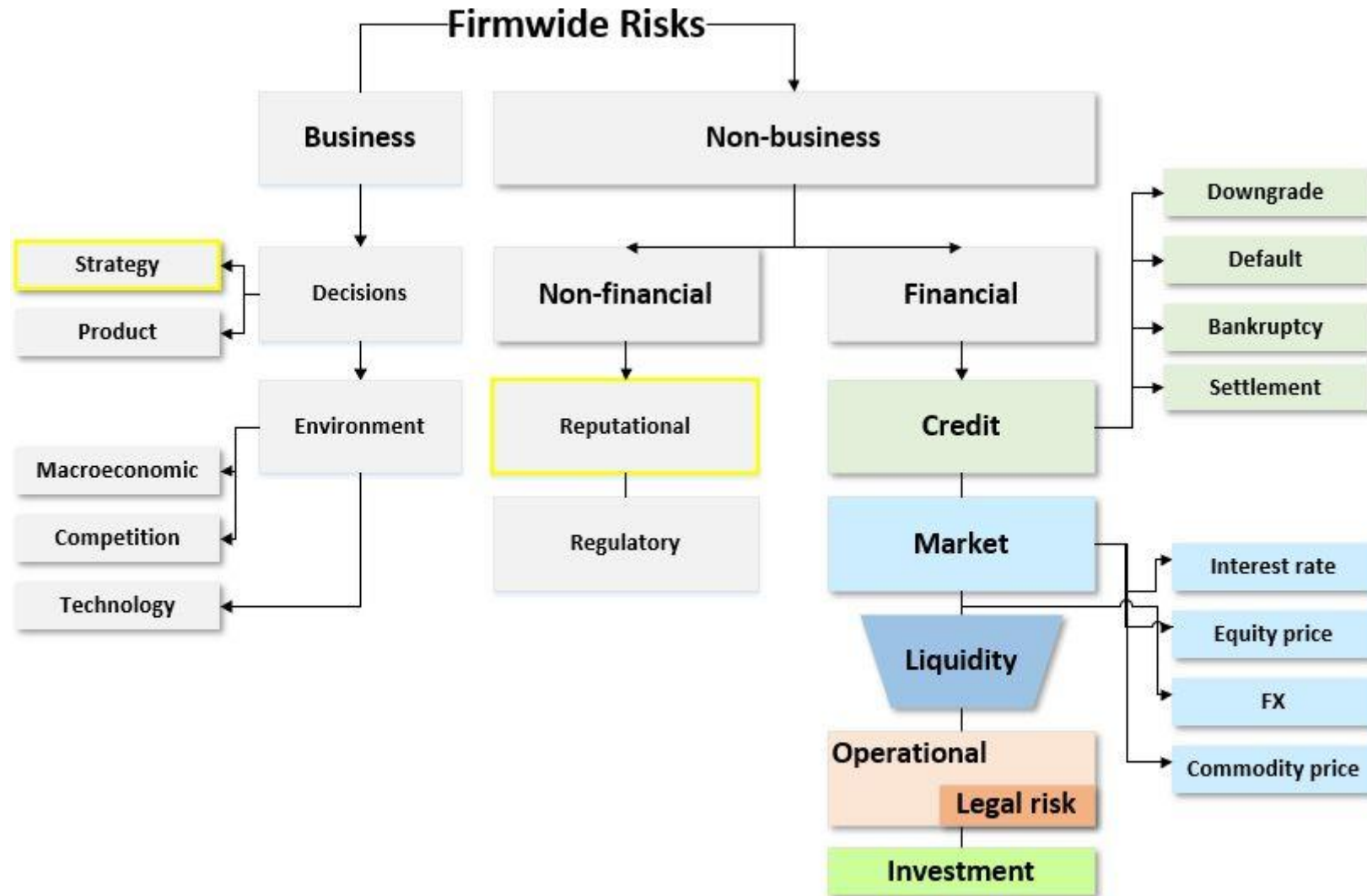
Those that understand how risk is generated and managed are in the best position to game it and keep it hidden.



Three lines of defense against this type of activity are:

- # 1 Business line that generates, owns, and manages risk.
- # 2 Risk managers that specialize in risk management and day-to-day oversight.
- # 3 Periodic independent oversight and assurance, such as an internal audit.

#7 (of 10): Typology of Risks and Risk Interactions





#8 (of 10): Risk Aggregation

A key problem in risk management is the challenge of seeing the bigger picture. Controlling market risk evolved throughout the years:

Notional amount held in each asset were compared (e.g., \$20 million of a blue-chip stock).

Problem: some stocks / sectors were more volatile than others so illogical to use notional amounts.



Derivatives were used with own measures of risk, including delta and theta.

Problem: The Greeks cannot be added together, nor do they imply the same level of risk across markets



Value at Risk (VaR) was calculated by simplifying assumptions

Problem: No set methodology. Also, at least 3 main methodologies (and many ways to implement them).



Improved calculation for VaR to be more consistent and reliable and strengthen the role of supplementary risk measures such as expected shortfall (ES) and worst-case scenario analysis.



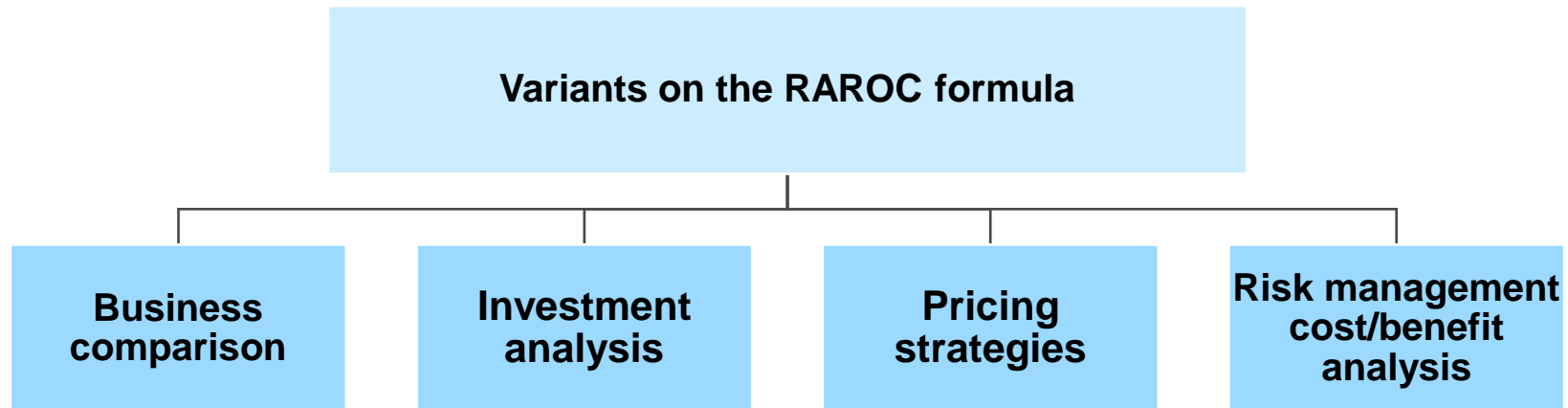
#9 (of 10): Balancing Risk and Reward

Risk capital (aka, capital) should be sufficient to absorption of unexpected risk.

$$\text{RAROC} = \frac{\text{Reward}}{\text{Risk}}$$

$$\text{RAROC} = \frac{\text{After – Tax Net Risk – Adjusted Expected Return}}{\text{Economic capital}}$$

For an activity/portfolio to add value to shareholders, RAROC > cost of equity capital.





#10 (of 10): Enterprise Risk Management (ERM)

ERM

- Incorporates risk into business decisions rather than isolating risk measures as separate add-ons.
- Incorporates a top-down perspective.
- Employs methods from other disciplines, experimental methods, and new technologies (e.g., cloud/ERP platforms).
- Blends with capital management tools because risk influences capital allocation decisions.
- Morphs traditional tools into new tools; e.g., scenario analysis



Remainder: Tools, Risk/Reward, Classes, Impact

End of Ten Building Blocks



Examine Tools Used to Measure & Manage Risk

QUANTITATIVE MEASURES

Assigns numbers to classified risks.



QUALITATIVE MEASURES

Assigns categorical rankings (aka, ordinal values).

Parse portfolio risk according to the type of risk.

- Market Risk – fluctuation of market prices and rates
- Credit Risk - default, credit deterioration, adverse migration, or rating deterioration
- Operational Risk - inadequate or failed processes, people and systems or from external events.



ENTERPRISE RISK MANAGEMENT

Builds a broad picture of risk across risk types and business lines.





Interpret the Relationship Between Risk and Reward

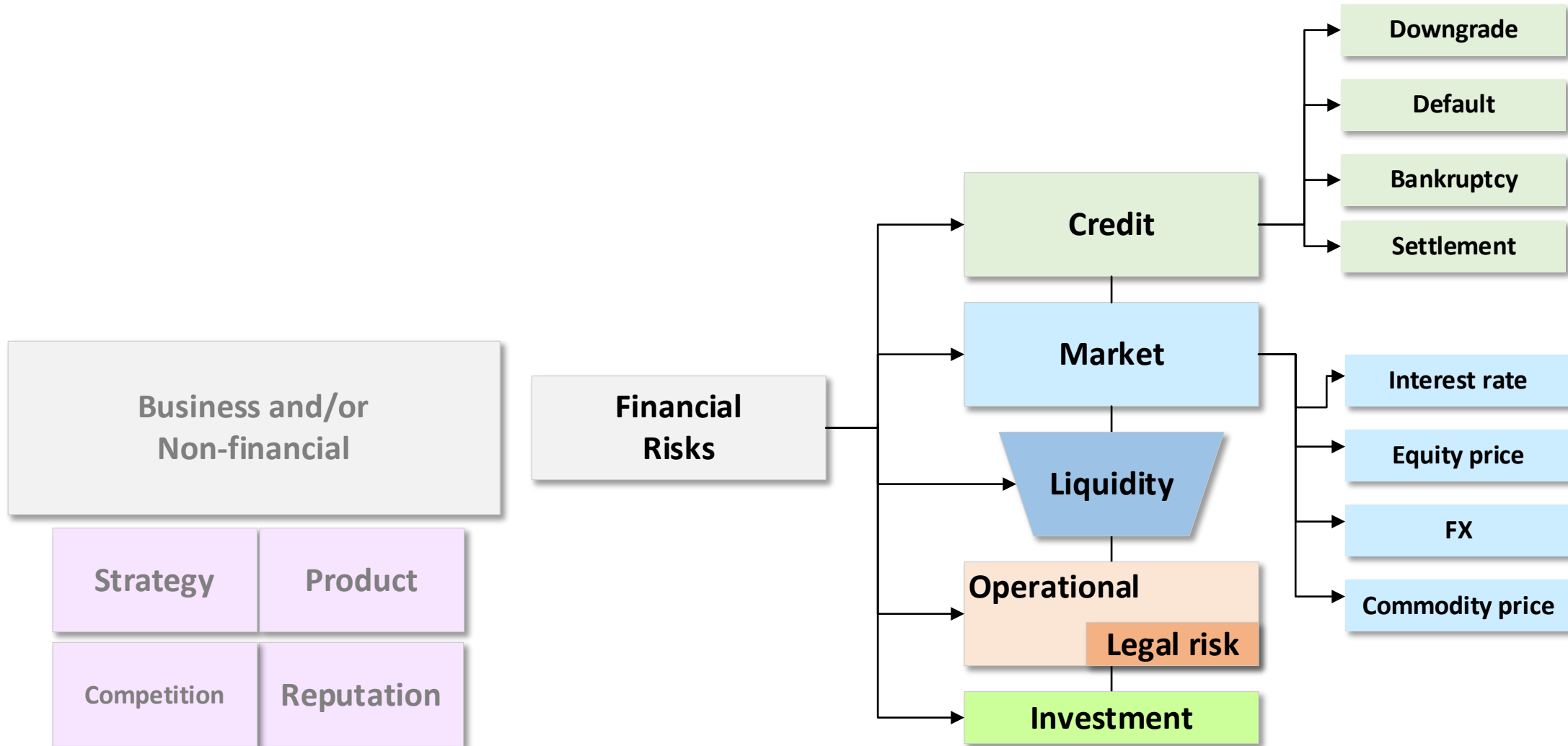
Remember, higher risk does NOT guarantee higher return!



Higher returns may be complicated by:

- **Sufficiently efficient markets** – Inefficient markets are illiquid and make it difficult to infer implied risk premiums.
- **Technical factors** - Bond prices often indicate relative risk, but technical factors (especially liquidity and tax effects) add confusing signals.
- **Traded market** - In the absence of traded instruments, the risk-reward relationship is distorted. Trading enables price discovery.
- **Compensation incentive programs** – For example, the firm may pay an annual bonus for recent performance. However, the risks incurred might have been delayed into future years.

Describe and Differentiate Between Key Classes of Risks



Explain How Each Type of Risk Can Arise



INTEREST RATE

When interest rates increase, bond price drops (e.g.)



FOREIGN EXCHANGE

Due to foreign currency denominated assets and liabilities.

TYPES OF RISK



CREDIT

Possibility of financial loss due to counterparty default or credit deterioration.



EQUITY PRICE

Can arise from stock price volatility and is made worse when there is a lack of diversification in the portfolio.



COMMODITY PRICE

Distinct because it is especially vulnerable to suppliers, as in supply and demand.



Assess Potential Impact of Each Risk Type on Organizations

MARKET RISK

Market risk takes many forms depending on the underlying asset.

- From a financial institution's perspective, the key forms are equity risk, interest rate risk, currency risk, and commodity price risk.



CREDIT RISK

Credit risk refers to default, credit deterioration, adverse migration, or rating deterioration.

OPERATIONAL RISK

Operational risk most often refers to Basel's definition: "the risk of loss resulting from inadequate or failed processes, people and systems or from external events."





Summary

- Ten building blocks (selected)
 - Process
 - Typology and Identification
 - EL vs. UL vs. Tail
 - Aggregation
- Enterprise risk management (ERM)
- RAROC → Economic capital
- Risk: types/classes, relationships and impacts