Applied Case Studies

Course: Enterprise Risk Management

1 Case Study 1: Market Risk, Value-at-Risk and Risk Appetite

1.1 Context

A mid-sized bank operates a trading desk managing a diversified market-risk portfolio with a total market value of **€100 million**. The bank has implemented an ERM framework centered on quantitative risk limits, with Value-at-Risk (VaR) as the primary risk metric.

The desk is considered compliant as long as its estimated VaR remains below the approved limit.

1.2 Portfolio Composition

The portfolio consists of the following exposures:

- Equity exposure: €60 million invested in a broad equity index.
- Interest rate exposure: €40 million in a 10-year government bond, managed through duration exposure.

1.3 Risk Parameters

The following risk parameters are provided:

- Daily equity volatility: 2%.
- Daily volatility of the 10-year yield: 5 basis points.
- Correlation between equity returns and yield changes: 0.
- Interest rate sensitivity: a **+1 bp** increase in yields results in a **€0.20 million loss**.

Assume normally distributed risk factors and a one-day holding period.

1.4 ERM Constraint

The bank has set the following limit:

- 1-day 99% Value-at-Risk limit: **€3.0 million**.

1.5 Questions

1. Compute the 1-day 99% Value-at-Risk of the portfolio using a variance–covariance approach.
2. Determine whether the trading desk complies with the VaR limit.
3. Consider the following stress scenario:
   - Equity index decline of 8%.
   - Increase of 30 basis points in the 10-year yield.

   Compute the portfolio loss under this scenario.
4. Explain why losses of this magnitude may occur despite compliance with the VaR limit.
5. Identify at least two weaknesses of relying exclusively on VaR from an ERM perspective.

2 Case Study 2: Expected Shortfall, Governance and Escalation

2.1 Context

Following internal reviews, the bank complements VaR with Expected Shortfall (ES) reporting to better capture tail risk. ES is monitored daily and compared against a predefined limit. Breaches are supposed to trigger immediate escalation to senior management.

2.2 Observed Portfolio Performance

The daily profit-and-loss (P&L) of the portfolio over the last 12 trading days (in millions of euros) is reported below:

Day	P&L (€m)
1	+0.6
2	-1.1
3	+0.4
4	-2.3
5	+0.9
6	-0.8
7	-3.5
8	+0.5
9	-1.7
10	-4.2
11	-0.6
12	-6.8

2.3 ERM Rules

The ERM framework specifies:

- 1-day 99% Expected Shortfall limit: **€4.0 million**.
- Mandatory escalation in case of a breach.

2.4 Questions

1. Sort the P&L distribution from worst to best.
2. Compute the empirical 1-day 99% Expected Shortfall.
3. Determine whether the ES limit is breached.
4. The large loss observed on Day 12 occurred without prior escalation. Identify possible failures related to:
    - Risk reporting,
    - Governance architecture,
    - Incentives or risk culture.
5. Explain why replacing VaR with Expected Shortfall does not, by itself, guarantee effective ERM.

3 Case study 3 : signals without escalation

3.1 Context

A mid-sized European bank operates across corporate lending, structured finance, and capital markets activities. The institution is considered well managed and has experienced several years of stable profitability and moderate growth.

The bank is subject to prudential supervision and regularly undergoes internal and external reviews of its risk management practices. No material weaknesses have been identified in recent assessments.

3.2 Risk governance practices

Risk management within the bank is organized around a centralized risk function that operates independently from business units. Risk policies define limits for key risk categories and specify reporting obligations at different levels of management.

Senior management receives periodic risk reports summarizing:

- utilization of risk limits,
- stress-test outcomes,
- qualitative risk assessments prepared by risk functions.

A committee involving senior executives meets regularly to review these reports and discuss emerging risks.

3.3 Strategic development

Over a two-year period, the bank expanded rapidly in structured finance and specialized lending activities. Individual transactions complied with existing risk limits and approval procedures.

However, several features characterized this expansion:

- repeated concentration in similar counterparties and sectors,
- increasing reliance on favorable macroeconomic assumptions,
- frequent use of exceptions and temporary adjustments to internal limits.

While no formal breaches were recorded, internal risk assessments increasingly highlighted rising portfolio sensitivity to adverse scenarios.

3.4 Risk signals

Risk analysts noted that portfolio-level exposures were approaching internally defined thresholds under adverse conditions. These observations were included in written risk reports and discussed during committee meetings.

The language used to describe these risks emphasized uncertainty rather than immediate concern. Follow-up actions were left to business judgment, and no explicit escalation was triggered.

3.5 The event

A sudden downturn affecting several correlated sectors led to a rapid deterioration in asset quality and valuation losses. The combined impact exceeded prior stress-test projections and resulted in a significant reduction in capital buffers.

Although regulatory minimums were not immediately breached, the bank faced heightened supervisory scrutiny, rating downgrades, and a loss of market confidence.

3.6 Questions

1. Based on the information provided, infer the **type of ERM framework** implemented by the bank. What elements support your inference?
2. Reconstruct the bank's **ERM architecture**. Who appears to:
    - take risk,
    - monitor and challenge risk,
    - decide on escalation?
3. Identify the **early warning signals** that preceded the event. Why did they fail to translate into corrective action?
4. Explain how incentives, governance dynamics, or risk culture may have weakened the effectiveness of the ERM system.
5. Propose two concrete changes that would strengthen the bank's ERM architecture and prevent similar failures.

4 Case study 4: hedging effectiveness under ERM (prospective vs retrospective)

4.1 Context

A global industrial firm consumes a key commodity input. To stabilize margins, the firm hedges its input cost exposure using standardized exchange-traded futures linked to a benchmark commodity index.

Let X denote the firm's unhedged monthly profit-and-loss (P&L) exposure (driven mainly by commodity price changes). Let H denote the monthly P&L of the hedging instrument (futures). The firm sets a hedge ratio h and defines the hedged P&L as:

$$Y = X - hH$$

The goal is to reduce risk (variance and tail losses) *without creating unacceptable liquidity stress from margin calls*.

4.2 Data provided

Risk management estimates hedging parameters using a 24-month historical window (*normal period*). A market disruption then occurs (*stress period*), during which correlations and liquidity conditions change.

All statistics below are monthly, expressed in **€ million**.

	Normal period (estimation)	Stress period (realized)
$\mathbb{E}[X]$	0.0	-2.0
$\mathbb{E}[H]$	0.0	0.0
Var(X)	100	225
Var(H)	64	144
Cov(X, H)	48	12

In the stress period, the firm also faces exchange margining:

- Initial margin posted at inception: 10€m (funded from cash).
- Average monthly *variation margin outflow* on the hedge: 18€m.

Assume the firm has a liquidity buffer of 25€m dedicated to hedging operations. If monthly margin outflows exceed this buffer, the firm must raise cash via asset sales or emergency credit.

4.3 Hedging rules used by the firm

- The hedge ratio is set using the minimum-variance benchmark:

  $$h^* = \frac{\text{Cov}(X, H)}{\text{Var}(H)}$$

  computed from the normal-period estimates.

- Hedging effectiveness is assessed via variance reduction:

$$\mathsf{HE} = 1 - \frac{\mathsf{Var}(Y)}{\mathsf{Var}(X)}$$

- Risk management reports prospective (ex ante) effectiveness using normal-period parameters, then evaluates retrospective (ex post) effectiveness using realized stress-period parameters *while keeping the same hedge ratio* h.

4.4 Tasks

1. **Hedge ratio.** Compute the minimum-variance hedge ratio h^* using the normal-period statistics.
2. **Prospective effectiveness (ex ante).** Using $h = h^*$ and the normal-period statistics, compute:

$$\mathsf{Var}(Y) = \mathsf{Var}(X) + h^2\mathsf{Var}(H) - 2h\,\mathsf{Cov}(X, H)$$

   and then compute $\mathsf{HE}_{\mathsf{pros}}$.
3. **Retrospective effectiveness (ex post).** Using the *same* hedge ratio $h = h^*$ but stress-period statistics, compute $\mathsf{Var}(Y)$ and $\mathsf{HE}_{\mathsf{retro}}$.
4. **Interpretation.** Explain why $\mathsf{HE}_{\mathsf{retro}}$ differs from $\mathsf{HE}_{\mathsf{pros}}$ in terms of correlation, basis risk, and regime change.
5. **Liquidity assessment.** Compare the average monthly variation margin outflow (18€m) to the hedging liquidity buffer (25€m). Is the buffer sufficient on average?
6. **ERM stress question.** Suppose variation margin outflows can spike to 40€m in bad months. Under ERM, list two governance or design changes that could reduce the probability of forced asset sales.
7. **ERM integration.** Identify at least three risk categories that interacted in this episode and explain how ERM should have governed the interactions (not the silos).

5 Case study 5: when hedging increased risk

5.1 Context

A large industrial firm operates globally and is highly exposed to commodity price fluctuations. Its core activity relies on a key input whose market price is volatile and subject to geopolitical and macroeconomic shocks.

To stabilize earnings and protect margins, management has historically relied on derivative contracts to hedge price risk. The firm is considered sophisticated and has a dedicated risk management function.

Over recent years, profitability has been stable and volatility of reported earnings has declined.

5.2 Risk governance and hedging strategy

The firm's risk management policy allows the use of derivative instruments to hedge commodity price exposure over a rolling horizon.

- Hedging is conducted primarily using futures and swap contracts linked to benchmark commodity prices.
- Hedge ratios are determined based on historical correlations between input costs and output prices.
- Hedging effectiveness is assessed ex ante using variance reduction metrics and reviewed periodically.

Risk reports show that the hedging program significantly reduces short-term price volatility under normal market conditions.

5.3 Quantitative information

Let X denote the unhedged price exposure of the firm and H the payoff of the hedging instrument.

The hedged position is defined as:

$$Y = X - hH$$

Based on historical data, the estimated minimum-variance hedge ratio is:

$$h^* = \frac{\mathsf{Cov}(X, H)}{\mathsf{Var}(H)} = 0.9$$

Prospective hedging effectiveness is estimated as:

$$\mathsf{HE}_{\mathsf{pros}} = 1 - \frac{\mathsf{Var}(Y)}{\mathsf{Var}(X)} = 75\%$$

As a result, management authorizes a large-scale hedging program aligned with this ratio.

5.4 The shock

Following a sudden market disruption:

- Correlations between the firm's input prices and benchmark contracts weaken significantly.
- Futures markets experience sharp volatility and liquidity deteriorates.
- Margin requirements on derivative positions increase rapidly.

Although the underlying commodity price moves in the expected direction, the firm faces substantial cash outflows due to margin calls.

5.5 Outcomes

Despite being economically hedged in the long term, the firm experiences:

- severe short-term liquidity stress,
- forced asset sales to meet margin calls,
- a deterioration of credit metrics and investor confidence.

Retrospective hedging effectiveness falls sharply:

$$\text{HE}_{\text{retro}} < 0$$

Senior management questions how a risk-reducing strategy could generate such outcomes.

5.6 Questions

1. Identify the main risks faced by the firm. Which risk categories interacted in this episode?
2. From an ERM perspective, explain why the hedging strategy appeared effective ex ante.
3. Interpret the hedge ratio h^*. What assumptions underlie its use?
4. Why did prospective hedging effectiveness fail to predict actual outcomes?
5. Using the ERM framework, identify which secondary risks were insufficiently considered.
6. How should ERM have governed the use of derivatives differently?
7. Propose two changes to the firm's ERM architecture or decision process that would have reduced the severity of the crisis.

6 Case study: enterprise risk management at Shell

Shell plc is a global energy company with operations covering upstream exploration and production, integrated gas, chemicals, trading, power generation, and retail activities. Its business model exposes it to a wide range of uncertainties, including commodity price volatility, geopolitical risk, operational and safety hazards, regulatory change, and long-term transition risks related to climate and energy policy. The scale of its operations, combined with capital intensity and global reach, makes risk management a central component of corporate governance.

Shell's current approach to enterprise risk management has been shaped by historical crises, including major operational incidents and periods of financial stress. These events revealed weaknesses in governance, escalation, and oversight, and led to a deliberate strengthening of group-level risk management. As a result, Shell has positioned ERM not as a purely technical or compliance-driven activity, but as an integral part of decision-making and strategic oversight.

At governance level, the Board of Directors retains ultimate responsibility for risk management and internal control. Specific oversight responsibilities are delegated to board committees. The Audit and Risk Committee reviews the effectiveness of Shell's risk management and internal control systems, while the Safety, Environment and Sustainability Committee focuses on risks related to safety performance, environmental impact, and the energy transition. This structure reflects an explicit recognition that non-financial risks can be as material as financial risks.

Within management, Shell operates a centralized enterprise risk management framework. Risk ownership is assigned to senior executives and business leaders, who remain accountable for the risks arising from their activities. The central risk function does not own risks; instead, it provides common methodologies, coordination across the group, and independent challenge. This separation between ownership and oversight is intended to ensure that risk remains embedded in line management rather than delegated to specialists.

Shell identifies a limited set of *principal risks* that are disclosed annually in its reporting. These principal risks represent those that could materially affect the company's strategy, performance, financial position, or reputation.

They include, among others, commodity price risk, geopolitical and regulatory risk, safety and operational incidents, climate transition risk, cyber risk, and liquidity and funding risk. The list is not static and evolves as the external environment and strategic priorities change.

Risk assessment combines quantitative analysis with qualitative judgment and scenario-based thinking. For market-related risks, particularly commodity price exposure, Shell relies on quantitative metrics, stress testing, and risk limits within its trading and treasury activities. For longer-term and structural uncertainties, such as the pace of the energy transition or major geopolitical shifts, Shell uses scenario analysis rather than point forecasts. These scenarios are designed to test strategic resilience rather than predict specific outcomes.

Risk responses are tailored to the nature of each principal risk. Operational risks are addressed through safety management systems, engineering standards, and process controls applied across the group. Financial risks, including commodity price, foreign exchange, and interest rate risks, are managed through a combination of natural hedging, portfolio diversification, and the use of derivative instruments. Derivatives are widely used in trading and treasury activities, but their use is governed by formal policies that define eligible instruments, limits, approval processes, and escalation thresholds. Hedging is intended to support the underlying business and protect cash flows rather than to eliminate all exposure.

Liquidity risk management is treated as a core enterprise risk. Shell maintains substantial liquidity buffers and diversified funding sources to ensure resilience under stress. The firm explicitly considers the interaction between derivative hedging and liquidity, including the potential for margin calls during periods of market volatility. This reflects an awareness that hedging strategies can create short-term funding stress even when they are economically sound over the long term.

Enterprise risk management is embedded in Shell's strategic planning and capital allocation processes. Major investment decisions are evaluated not only on expected returns but also on their robustness under adverse scenarios and consistency with risk appetite and balance-sheet capacity. Long-term risks, particularly those related to climate and energy transition, are treated as strategic uncertainties that cannot be hedged through financial instruments. Instead, they are managed through portfolio diversification, staged investment, and strategic flexibility.

Risk reporting is designed to support escalation and decision-making rather than passive monitoring. Reports to senior management and the board focus on key risk drivers, changes in the risk profile, and proximity to defined risk tolerances. When indicators deteriorate or approach limits, management is expected to respond by adjusting plans, revising exposures, or explicitly accepting the risk at the appropriate governance level.

Overall, Shell's enterprise risk management system reflects a principles-based and integrated approach. Risk management is embedded in governance, strategy, and capital allocation rather than operating as a separate technical layer. At the same time, the effectiveness of the system depends heavily on the quality of assumptions, the willingness of leaders to engage with challenge, and the organization's ability to adapt when familiar risk patterns break down. The case therefore illustrates both how ERM is implemented in practice by a large multinational firm and why even sophisticated ERM cannot eliminate the possibility of failure.

6.1 Discussion questions

Answer the following questions using evidence from the case above. Answers should focus on reasoning and diagnosis rather than description.

6.1.1 ERM framework and philosophy

1. How would you characterize Shell's ERM framework? Is it primarily rules-based or principles-based? Compliance-oriented or decision-oriented? Which elements of the case support your view?
2. Shell focuses on a limited number of *principal risks*. What does this reveal about its ERM philosophy, and what are the potential trade-offs of this approach?
3. Why does Shell rely heavily on scenario analysis rather than point forecasts for long-term risks? What does this imply about the limits of quantitative risk measurement?

6.1.2 ERM architecture and governance

4. Identify the key components of Shell's ERM architecture. How are risk ownership and risk oversight allocated across the organization?
5. Why is the separation between business risk ownership and the central ERM function emphasized? Under what circumstances could this separation weaken risk management?
6. How might the existence of multiple board-level committees complicate coordination and escalation of risks?

6.1.3 Risk integration and instruments

7. Identify several risk categories addressed in Shell's ERM system. How does the case suggest these risks are considered in an integrated way?
8. What role do derivative instruments play in Shell's risk management? Why are formal constraints on their use essential from an ERM perspective?
9. Why does Shell explicitly consider the liquidity implications of derivative hedging? What type of failure is this designed to prevent?

6.1.4 Strategy, limits, and failure modes

10. How is ERM embedded in Shell's strategic planning and capital allocation processes? Give concrete examples from the case.
11. Which aspects of Shell's ERM design appear most dependent on managerial judgment rather than formal rules? Why does this matter?
12. Describe a plausible scenario in which Shell's ERM system could fail despite being well designed. What would trigger such a failure, and which mechanisms would likely break down first?
13. Based on the case, explain why effective ERM reduces vulnerability but does not eliminate the possibility of failure.

7 Group exercise: designing ERM for a complex firm

This exercise asks you to design an enterprise risk management (ERM) system for a firm operating in a highly uncertain and capital-intensive environment. You are not asked to replicate an existing framework, but to propose a coherent ERM design that could realistically function within the organization described below.

7.1 Firm description

Consider a large multinational firm operating in a capital-intensive industry with global operations. The firm is exposed to volatile input prices, complex supply chains, geopolitical risk, regulatory uncertainty, and long-term structural change in its core markets. Its activities generate substantial cash flows in normal conditions, but downside risks can materialize rapidly and simultaneously across business lines.

The firm has grown through a combination of organic investment and acquisitions. As a result, its operations are diversified but organizational complexity is high. Decision-making authority is largely decentralized, with business units having significant autonomy over investments and commercial strategy. Central functions exist, but their influence varies across the organization.

The firm has experienced episodes of stress in the past, including periods of sharp earnings volatility and operational incidents. These events did not threaten its survival, but they revealed weaknesses in coordination, escalation, and anticipation of adverse scenarios. Senior management has therefore decided to strengthen enterprise-wide risk management.

7.2 Constraints and objectives

Senior management has defined the following high-level objectives for ERM:

The ERM system should support strategic decision-making rather than operate as a compliance or reporting exercise. It should improve the firm's ability to anticipate adverse outcomes, manage risk interactions, and preserve resilience under stress. At the same time, ERM should not paralyze decision-making or eliminate risk-taking, which remains essential to value creation.

You should assume that management is willing to support ERM in principle, but that incentives, power structures, and time constraints may limit how far formal processes can go. Your design should therefore be realistic and implementable.

7.3 Tasks

Your group is asked to propose an ERM design covering the following dimensions. You should justify each design choice by explicitly linking it to the firm's context and constraints.

1. ERM philosophy and scope Describe the overall philosophy of your ERM system. Will it be primarily principles-based or rules-based? Will it focus on a limited set of material risks or attempt comprehensive coverage? Explain how your chosen philosophy helps decision-makers under uncertainty.

2. ERM architecture and governance Propose an ERM architecture that specifies: who owns risks, who oversees risks, and how risk information flows to senior management and the board. Explain how your design balances

decentralization of decision-making with enterprise-wide coherence. Identify where challenge should occur and who has the authority to escalate concerns.

3. Risk identification and assessment Explain how material risks should be identified and assessed. How would you ensure that emerging risks and interactions between risks are captured, rather than only well-known or easily measurable risks? Discuss the role of quantitative metrics versus qualitative judgment and scenario analysis.

4. Risk response and use of instruments Describe how your ERM system would govern risk responses. Which types of risks should be mitigated, transferred, retained, or avoided? How should the use of financial instruments, such as derivatives or insurance, be constrained and monitored to avoid creating new enterprise-level risks?

5. Integration into strategy and capital allocation Explain how ERM should be embedded into strategic planning, budgeting, and capital allocation. How would your design ensure that risk considerations influence major investment decisions without becoming a purely formal requirement?

6. Reporting, dashboards, and escalation Propose principles for ERM reporting. What information should be escalated, to whom, and under what conditions? How would you design dashboards so that they support action rather than reassurance?

7. Failure modes Identify two plausible scenarios in which your ERM design could still fail. Explain which assumptions would break down and which parts of the system would be most vulnerable. What early warning signals would you expect to see before failure becomes unavoidable?

7.4 Expected output

Your group should produce a short written proposal (2–3 pages) summarizing your ERM design and the reasoning behind it. There is no single correct answer; the quality of your proposal will be assessed based on coherence, realism, and ability to anticipate trade-offs and failure modes.