# Lesson 4.4 Exercises: The New Risk Landscape

## Module 4: The Risk Problem

Prof. Dr. Joerg Osterrieder

Digital Finance — BSc Course

# Exercise 1: NIST Framework Mapping

**Scenario:** A mid-size European bank experiences the following cybersecurity events during a single quarter:

1. An employee clicks a phishing link, installing malware on their workstation
2. The bank's intrusion detection system flags unusual outbound traffic from the infected machine 4 hours later
3. The incident response team isolates the workstation and blocks the command-and-control IP address
4. A forensic investigation determines that no customer data was exfiltrated
5. IT restores the workstation from a clean backup and patches the vulnerability

**Tasks:**

a) Map each event (1–5) to the appropriate NIST CSF function (Identify, Protect, Detect, Respond, Recover). Justify each mapping in one sentence.

b) Which NIST function **failed** in this scenario? What specific control could have prevented the initial compromise?

c) The bank has no formal asset inventory. Explain how this gap in the Identify function could make events 2–5 *more difficult or less effective*.

*Difficulty: Introductory — tests understanding of the NIST CSF lifecycle.*

# Exercise 2: Order Book and Execution Cost

**Scenario:** The following synthetic order book is displayed for stock XYZ at 10:00 AM:

| Bids (Buy) | | Asks (Sell) | |
|---|---|---|---|
| **Price (€)** | **Qty (shares)** | **Price (€)** | **Qty (shares)** |
| 49.95 | 500 | 50.05 | 300 |
| 49.90 | 800 | 50.10 | 600 |
| 49.85 | 1,200 | 50.15 | 400 |
| 49.80 | 600 | 50.20 | 1,000 |

**Tasks:**

a. What is the current bid-ask spread (in € and in basis points relative to the midpoint)?

b. A trader submits a **market sell order** for 1,500 shares. Walk through the execution step by step: how many shares fill at each bid level? What is the volume-weighted average execution price (VWAP)?

c. Compare the VWAP to the midpoint price. Express the execution cost (slippage) in € per share and as a percentage.

d. If the trader instead used an **iceberg order** (hidden quantity) to sell 1,500 shares in batches of 200, what is the likely impact on execution quality?

*Difficulty: Intermediate — requires arithmetic and microstructure reasoning.*

# Exercise 3: Physical vs. Transition Risk Classification

**Scenario:** A bank's credit portfolio includes loans to the following borrowers. For each, determine whether the primary climate-related risk is **physical**, **transition**, or **both**.

| Borrower | Description |
|---|---|
| A | A coastal hotel chain in Southeast Asia |
| B | A German coal-fired power plant operator |
| C | An agricultural cooperative in sub-Saharan Africa |
| D | An electric vehicle manufacturer |
| E | A commercial real estate developer in a flood-prone European city |
| F | A diversified oil & gas major with a renewables division |

**Tasks:**

a. Classify each borrower (A–F) as primarily facing physical risk, transition risk, or both. Justify each in one sentence.

b. For borrower F, explain why a 1.5°C scenario might actually *benefit* part of the business while harming another part.

c. Which borrower faces the highest risk of holding **stranded assets**? Explain using the carbon budget concept.

*Difficulty: Introductory — tests classification of climate risk channels.*

# Exercise 4: DeFi Composability Cascade

**Scenario:** Consider the following DeFi stack:

1. **Base layer:** A lending protocol (Protocol A) accepts ETH as collateral and issues a synthetic stablecoin (sUSD)
2. **Layer 2:** A yield farming protocol (Protocol B) accepts sUSD and issues yield tokens (yBT)
3. **Layer 3:** A leveraged trading protocol (Protocol C) accepts yBT as collateral for leveraged positions

**Tasks:**

a) Draw a dependency diagram showing which protocol depends on which.

b) Suppose the ETH price drops 25% in 10 minutes. Trace the cascade: what happens at each layer? Be specific about liquidation triggers and collateral shortfalls.

c) Now suppose the oracle feeding ETH/USD prices to Protocol A goes offline for 5 minutes during the crash. How does this **worsen** the cascade?

d) Propose two design changes (one at the protocol level, one at the ecosystem level) that could reduce the severity of this cascade.

*Difficulty: Advanced — requires tracing multi-layer DeFi dependency chains.*

# Exercise 5: Flash Crash Mechanism

**Scenario:** At 14:32:00, a synthetic stock index is trading at 4,200 points. The following sequence of events occurs:

1. 14:32:05 — A large algorithmic sell order of 50,000 contracts is submitted
2. 14:32:06 — Market makers absorb the first 10,000 contracts; index drops to 4,180
3. 14:32:08 — Market makers pull remaining quotes (liquidity withdrawal)
4. 14:32:10 — Stop-loss orders at 4,175 are triggered, adding 30,000 sell contracts
5. 14:32:15 — Index reaches 4,050 (a 3.6% drop in 10 seconds)
6. 14:32:30 — The exchange activates a circuit breaker; trading pauses for 5 minutes
7. 14:37:30 — Trading resumes; index recovers to 4,185 within 3 minutes

**Tasks:**

a) Identify the three feedback loops that amplified the initial sell order into a flash crash.

b) Explain why the market makers withdrew quotes at step 3. Use the concept of adverse selection.

c) A trader had a stop-loss at 4,175. Their order executed at 4,080 (95 points of slippage). Explain why the execution price was so far from the trigger price.

d) Evaluate the circuit breaker: did it help or merely delay the problem? What are the trade-offs?

*Difficulty: Advanced — requires dynamic analysis of microstructure feedback loops.*

# Exercise 6: Supply-Chain Cyber Attack

**Scenario:** A major financial software vendor (used by 200 banks globally) is compromised. The attacker inserts a backdoor into a routine software update. Within 48 hours, 200 banks have installed the malicious update.

**Tasks:**

a) Classify this attack using the cyber attack taxonomy: what type of attack is this (phishing, ransomware, supply-chain, insider, DDoS)?

b) Explain why this attack type is **particularly dangerous** for the financial system (think: correlation, contagion, detection difficulty).

c) Map the ideal response to NIST CSF functions. For each of the five functions, describe one specific action the affected banks should take.

d) A risk model treats cyber events as independent across banks. Explain why this supply-chain attack violates the independence assumption and what this means for systemic risk estimation.

*Difficulty: Intermediate–Advanced — applies NIST CSF to a systemic cyber scenario.*

# Exercise 7: Evaluating a TCFD Disclosure

**Scenario:** A large European bank publishes the following TCFD-aligned climate risk disclosure excerpt:

> *"The Board reviews climate risks annually. Our strategy includes a commitment to net-zero financed emissions by 2050. We assess climate risk using qualitative expert judgment. Our Scope 1 and 2 emissions declined 15% last year. We do not currently measure Scope 3 financed emissions."*

**Tasks:**

a. Map each sentence of the disclosure to a TCFD pillar (Governance, Strategy, Risk Management, Metrics & Targets). Note any pillar that is missing or inadequately addressed.

b. The bank uses "qualitative expert judgment" for risk assessment. Critique this approach: what are its limitations compared to quantitative scenario analysis (e.g., NGFS scenarios)?

c. The bank omits Scope 3 (financed emissions). For a bank, which scope typically dominates total emissions? Why is this omission problematic?

d. Draft two specific recommendations for improving this disclosure, citing the TCFD guidance.

*Difficulty: Advanced — requires critical evaluation of a real-world-style disclosure.*

# Exercise 8: Compound Risk Scenario Design

**Scenario:** You are a risk manager at a bank with exposure to:

- A DeFi lending platform (through a subsidiary)
- A portfolio of fossil fuel corporate bonds
- Heavy reliance on a single cloud provider for core banking

**Tasks:**

a. Design a "compound stress scenario" that involves *all three* new risk types (cyber, DeFi, climate) materializing in a correlated sequence. Describe the triggering event, the transmission channels, and the expected portfolio impact.

b. For each leg of your scenario, identify which traditional risk category (market, credit, operational, liquidity) it maps to. Show that a single new risk event can trigger losses across multiple traditional categories.

c. Explain why a siloed risk management approach (separate cyber, climate, and DeFi risk teams) would **underestimate** the total loss in your compound scenario.

d. Propose three concrete actions the bank's risk committee should take to prepare for compound risk scenarios. For each, specify the responsible function (CRO, CISO, Board, etc.).

*Difficulty: Advanced–Integrative — synthesizes all lesson concepts into a scenario design.*