

Lab 3b Assignment: Advanced Cybersecurity Risk Quantification

Student Name: Oluwatimilehin
Oluwagbemi

Reg. No: 2025/GRC/10712

Date: 13th October, 2025

Executive Summary:

The quantification of the recent penetration test and vulnerability assessment of the new mobile banking platform revealed the top 3 risks, which are; Database Injection, Session Hijacking and API Authentication Bypass. The financial Impact of the risks and the recommended controls with expected risk reduction and ROI calculation is tabularized below:

Top Risks:

Vulnerability	Annualized Loss Expectancy (ALE)
Database Injection	\$31,250,000
Session Hijacking	\$3,000,000
API Authentication Bypass	\$750,000

Recommended Controls

Control	Cost	Risk Reduction	ROI
Web Application Firewall (WAF)	\$150,000	\$234,375,000	1562.3
Multi-Factor Authentication	\$200,000	\$2,700,000	13.35
API Security Gateway	\$350,000	\$675,000	1.785

Brief Explanation of the phases:

In phase 1, the risk exposure was calculated such as the SLE, ARO, ALE, and later visualized. The Database Injection has the highest risk exposure with \$31,250,000 Annualised Loss Expectancy.

In phase 2, cost-benefit analysis was carried out, the initial investment, effectiveness, risk reduction, ROI, Payback Period, and Annual Maintenance was derived for each control.

Phase 1: Risk Exposure Calculation

Task 1: Calculating SLE, ARO and ALE for all vulnerability:

Vulnerability 1: API Authentication Bypass:

- Single Loss Expectancy (SLE) = Maximum Single Incident Loss = \$5,000,000
- Annual Rate of Occurrence (ARO) = Exploit Probability = 15% = 0.15
- Annualized Loss Expectancy (ALE) = SLE x ARO = \$5,000,000 x 0.15 = \$750,000

Vulnerability 2: Database Injection

- Single Loss Expectancy (SLE) = Records at risk x Cost per record = 500,000 x 250 = \$125,000,000
- Annual Rate of Occurrence (ARO) = Exploit Probability = 25% = 0.25
- Annualized Loss Expectancy (ALE) = SLE x ARO = 125,000,000 x 0.25 = \$31,250,000

Vulnerability 3: Session Hijacking

- Single Loss Expectancy (SLE) = Accounts at risk x Average loss per account = 5,000 x 1,500 = \$7,500,000
- Annual Rate of Occurrence (ARO) = Exploit Probability = 40% = 0.4
- Annualized Loss Expectancy (ALE) = SLE x ARO = \$7,500,000 x 0.4 = \$3,000,000

Task 2: Risk Priority

Vulnerability	SLE	ARO	ALE	Risk Priority Level
API Authentication Bypass	\$5,000,000	0.15	\$750,000	Medium
Database Injection	\$125,000,000	0.25	\$31,250,000	Critical
Session Hijacking	\$7,500,000	0.4	\$3,000,000	High

Task 3: Risk Visualization

Fig. 1: Bar Chart comparing ALE for all Vulnerabilities

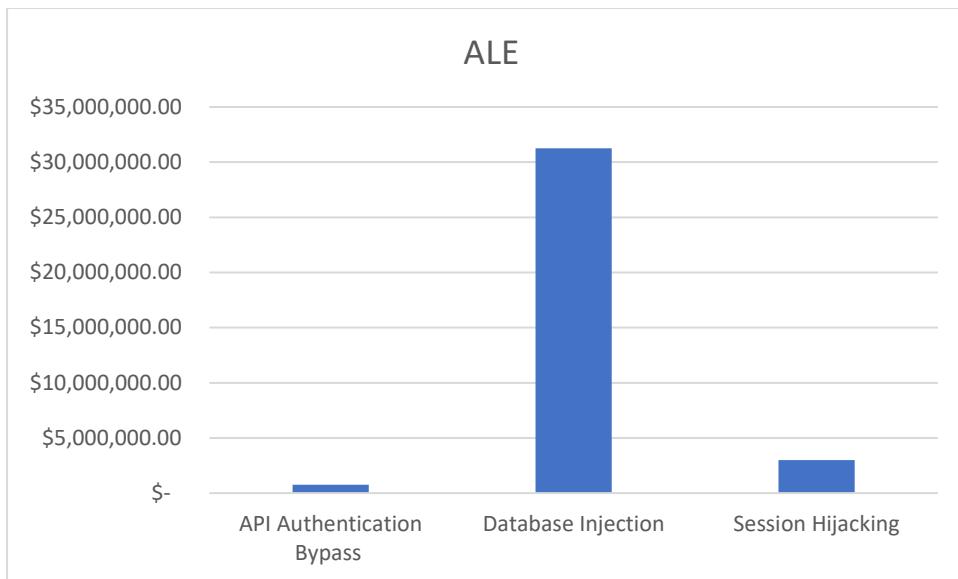
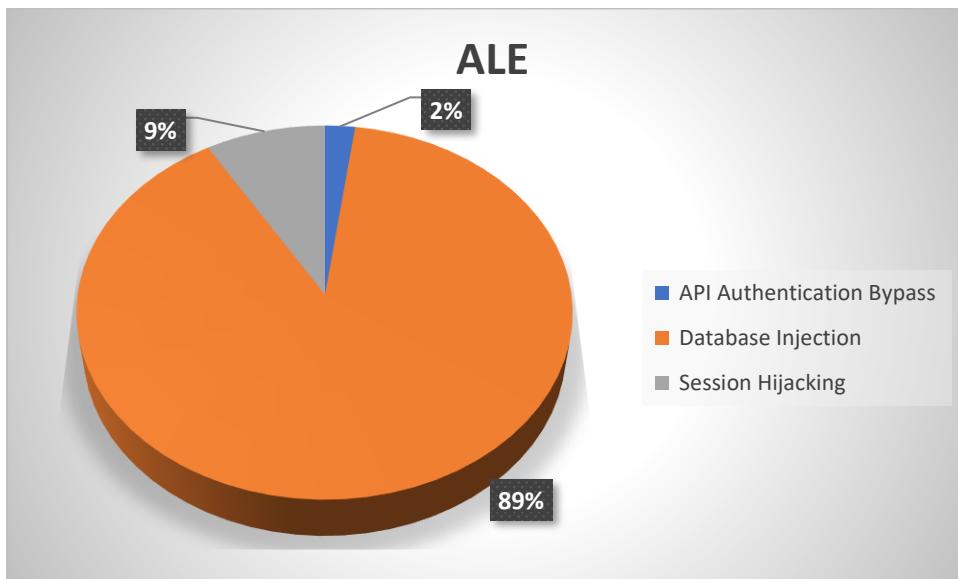


Fig. 2: Pie Chart Showing Risk Distribution



Phase 2: Control Evaluation

Task 4: Cost-Benefit Analysis

Advanced API Security Gateway

- Initial Investment = cost = \$350,000
- Annual Maintenance = Maintenance = \$50,000/year
- Risk Reduction (in \$) = Effectiveness x ALE = $0.9 \times 750,000 = \$675,000$
- Return on Investment (ROI) = risk reduction – annual maintenance / initial investment
 $= 675,000 - 50,000 / 350,000 = 625,000 / 350,000 = 1.785$
- Payback Period = initial investment / risk reduction = $350,000 / 675,000 = 0.5185$

Web Application Firewall (WAF)

- Initial Investment = cost = \$150,000
- Annual Maintenance = Maintenance = \$25,000/year
- Risk Reduction (in \$) = Effectiveness x ALE = $0.75 \times 31,250,000 = \$234,375,000$
- Return on Investment (ROI) = risk reduction – annual maintenance / initial investment
 $= 234,375,000 - 25,000 / 150,000 = 1562.3$
- Payback Period = initial investment / risk reduction = $150,000 / 234,375,000 = 0.00064$

Multi-Factor Authentication Enhancement

- Initial Investment = cost = \$200,000
- Annual Maintenance = Maintenance = \$30,000/year
- Risk Reduction (in\$) = Effectiveness x ALE = $0.9 \times 3,000,000 = \$2,700,000$
- Return on Investment (ROI) = risk reduction – annual maintenance / initial investment
 $= 2,700,000 - 30,000 / 200,000 = 2,670,000 / 200,000 = 13.35$
- Payback Period = initial investment / risk reduction = $200,000 / 2,700,000 = 0.0741$

Task 5: Control Selection Analysis

Fig. 3: Scatter Plot showing Cost vs. Effectiveness of Controls

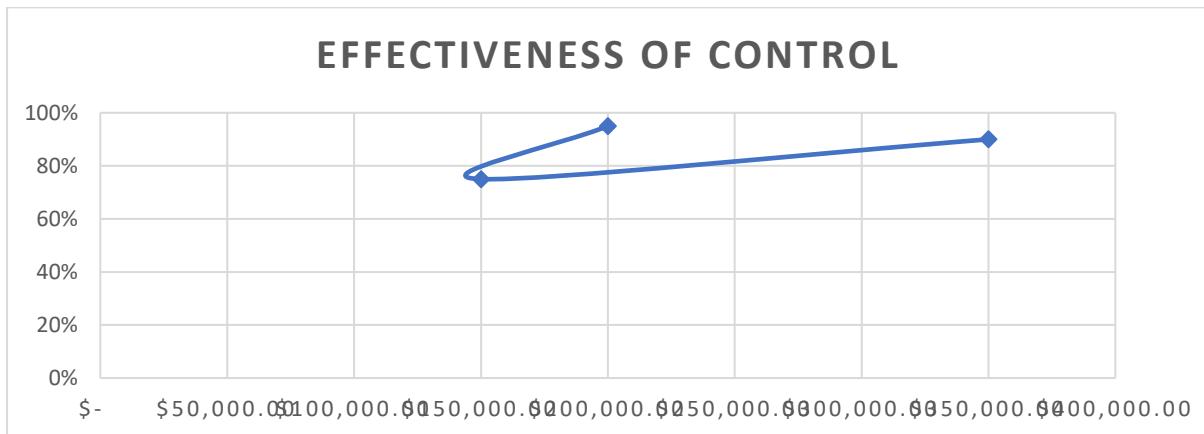


Fig. 4: Bar Chart comparing ROI for all controls

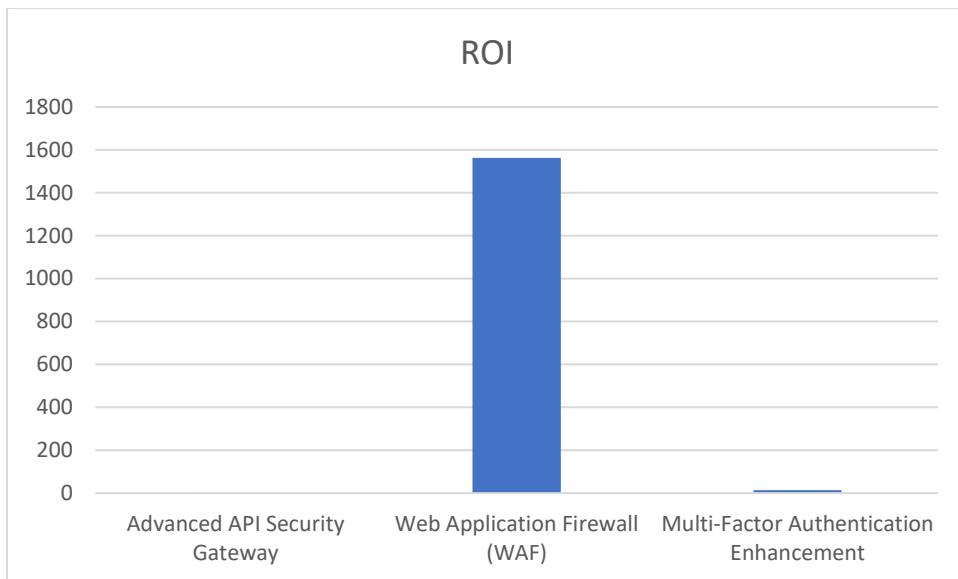


Fig. 5: Line Graph showing Risk Reduction over time

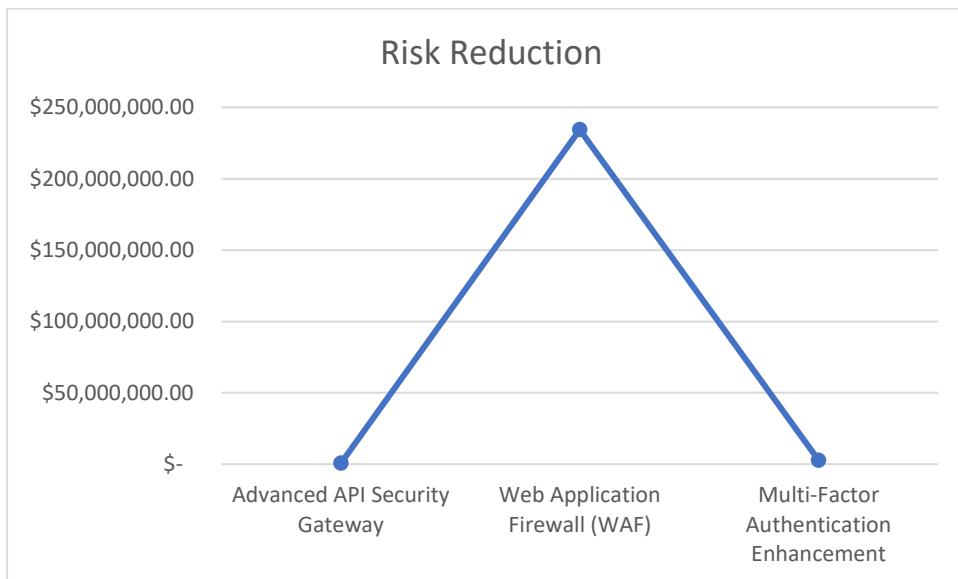


Fig. 6: Control Investment Breakdown

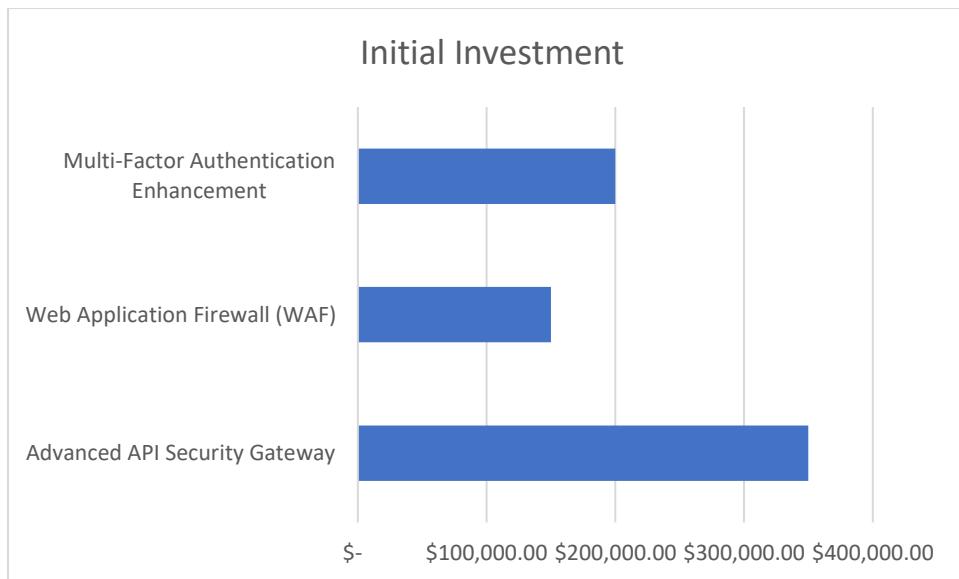


Fig. 7: Gantt chart showing Risk Treatment Timeline

