Risk Management and Threat Modeling

Cybersecurity

GRC Unit, Day 2

2.1: GRC - Risk Management and Threat Modeling

Class Preparation

1. Check into BCS
2. Update your git repository with `` `git pull` ``

Homework

- Unit 1 (*Security 101*): due Sunday October 4
- Unit 2 (GRC): due Sunday October 11

Upcoming Units

- Unit 3: *Terminal & Bash* (10/05 - 10/10)
  - Need VM configuration; will configure during Saturday's class
  - Special Mac note (updates required)
- Unit 4: *Linux Systems Administration* (10/12-10/17)
  - We will use the VM again

Schedule Notes

Thanksgiving Break - No Class

- Wed 11/25 & Sat 11/28
- Return on Monday 11/30

Winter Break - No Class

- Sat 12/19 - Sat 1/02
- Return on Monday 1/04

Class Objectives

By the end of today's class, you will be able to:

- Identify threat agents, possible attacks, and exploitable vulnerabilities relevant to a given asset.
- Prioritize risks based on likelihood and impact potential.
- Choose and justify controls for a given risk.

Risk Management and Threat Modeling

What’s the difference between a vulnerability, a threat, and a risk?

A **threat** is an actor that might exploit a vulnerability.

A **vulnerability** is an aspect of a business that can be exploited to compromise a system's CIA.

A **risk** is the possibility of losing something valuable.

Vulnerability, Threat, Risk

Another way of consider these...

Threat - *who* is doing the bad thing

Vulnerability - *how* they’re doing the bad thing

Risk - *what* can happen as a result

Risk Management And Threat Modeling

Risk Analysis	Understanding what risks face an organization, which are most severe, and which are most likely.
Risk Management	Using the results of risk analysis to create a plan for preventing likely risks.
Threat Modeling	Determining which attacks an organization is most likely to experience, who is most likely to launch them, and what actions can be done to prevent them.

Risk Management And Threat Modeling

What is a business's primary objective? **Profit!**

Risk analysis and management and **threat modeling** directly contribute to business profit.

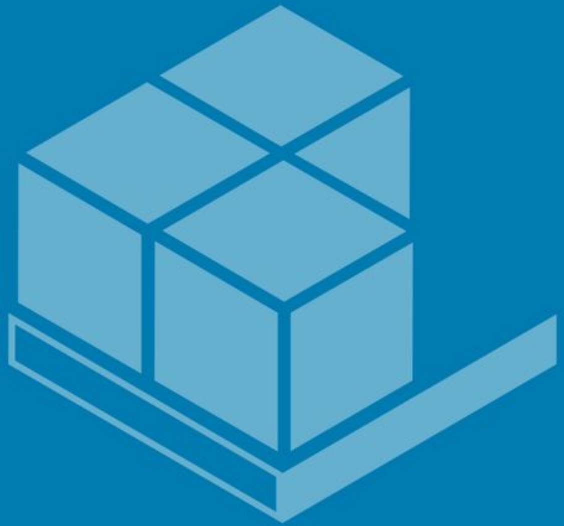
Risk analysis helps business understand how much they'll need to spend in the event of a given security break.

When possible, risks are measured quantitatively in financial figures, which businesses use to prioritize threats.

Threat modeling results are shared upwards to the executives who make the major business decisions.

Threat Modeling Methodology: PASTA

PASTA: **P**rocess for **A**ttack **S**imulation & **T**hreat **A**nalysis



PASTA focuses on aligning considerations of **business objectives** with **technical requirements**.

Threat Modeling Methodology: STRIDE

STRIDE: **S**poofing, **T**ampering, **R**epudiation, **I**nformation Disclosure, **D**oS (Denial of Service), **E**levation of Privilege

STRIDE focuses on identifying **what can fail** in the system being modeled.

Threat Modeling Methodology: OWASP

Today we'll focus on OWASP

OWASP: **O**pen **W**eb **A**pplication **S**ecurity **P**roject

OWASP focuses on **identifying possible threats**, **prioritizing risks**, and **planning mitigation strategies**. It is mainly used with web and desktop applications.

OWASP

The **OWASP Threat Modeling process** consists of six steps.

1. Determine assessment scope
2. Identify threat agents
3. Identify potential attacks
4. Identify exploitable vulnerabilities
5. Prioritize identified risks
6. Mitigate risks

Step 1
Determine Scope

List the assets under consideration, determine their value, and define objectives for your threat modeling assessment.

- Businesses can’t effectively evaluate everything at once, so they adjust their scope to focus on a specific category of risk.

  Example: Performing a risk analysis to assess the weakness of a network infrastructure. Within this scope, we are not concerned with application security.

- Scoping begins with **asset inventory**, the process of identifying and assigning asset value to all of an organization’s assets.

  Example: The asset value of a web application could be measured by the revenue or profit it generates.

Step 2
Identify Threat Agents

Determine which attackers would be interested in the relevant assets.

Threat agents include a person or group that can produce a threat, *whether or not* that person or group is malicious.

Threat agents include:

- APTs (Advanced Persistent Threats)
- Script kiddies
- Employees opening phishing emails
- Incompetent user breaking configurations on company computer

Today, we'll focus on *malicious* threat agents.

Previously in class, we addressed *unwitting* threat agents, like employees opening phishing emails.

Step 3
Identify Potential Attacks

Identify the attacks each agent is likely to perform.

- Different attackers use different modes of attacks. Different attacks mean different risks and different considerations.

  Example: Script kiddies will have different goals than a disgruntled employee.

- We can identify a potential attack by considering the threat agent's:
  - Motivation
  - Skill level
  - Amount of funding

  Example: If a client's web application is taken offline by a DoS attack, the severity of the risk depends on which threat agent is responsible.
  - Script kiddies might DoS a server simply to cause trouble.
  - An APT might DoS a server as a smoke screen to steal valuable data.

Step 4
Identify Exploitable Vulnerabilities

Identify the most vulnerable points in a system, how the agent will deliver the attack, and where an attack is most likely to occur.

- Once we determine who might attack and what methods they might use, we determine where exactly in the system they will likely direct their attacks, and what will be at risk if they do.

  Example: If a network has only one database that stores everything, the entire company will lose access to all data if it is compromised. An attacker seeking to DoS the company's network can exploit this database to achieve their goal.

Activity: Threat Modeling: Steps 1-4

In this activity, you'll learn more about GeldCorp's business operations and assets before applying steps 1-4 of the OWASP process.

Instructions shared on Slack.

Suggested Time:

30 Minutes

01_Threat_Modeling_Steps_1_4

Risk Analysis

Risk Analysis

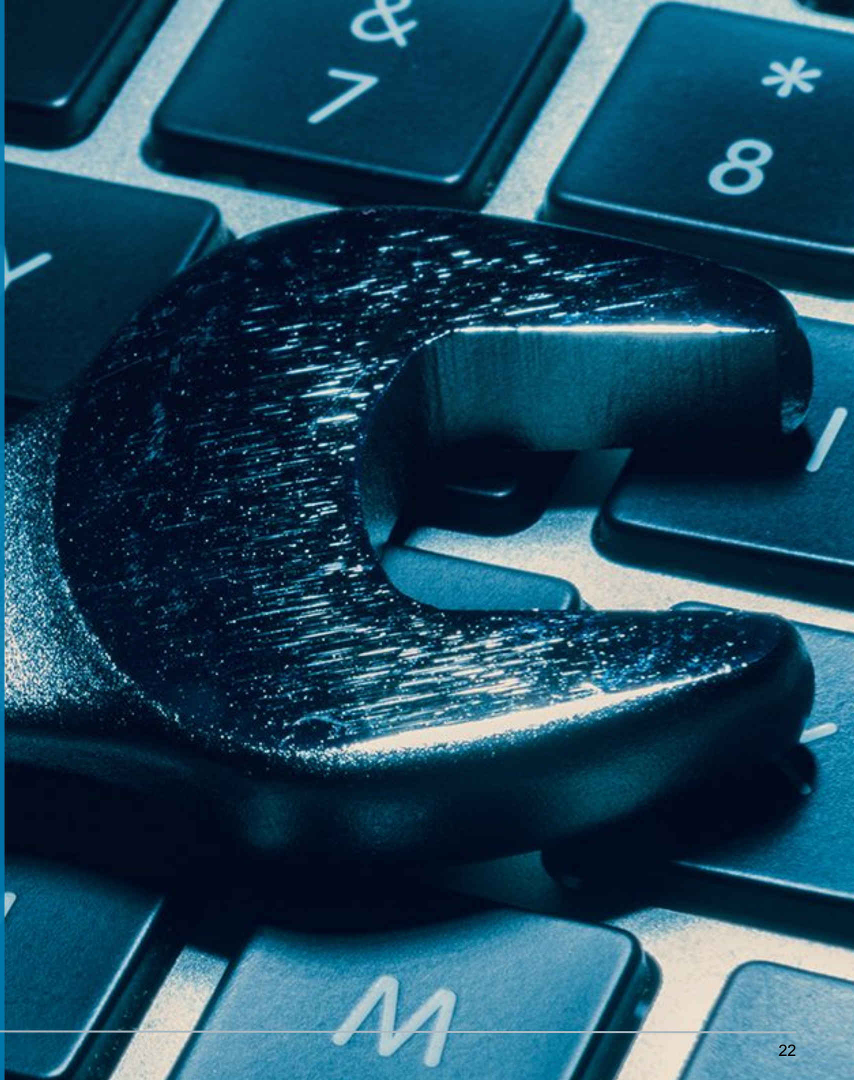
Risk analysis is the process of prioritizing threats identified in steps 1-4 based on their potential impact and likelihood.

Scenario

You've identified more than 10 potential attacks that GeldCorp should consider. All can be mitigated, but each fix costs around $2.5k. GeldCorp's Security Department only has $10k budgeted for the project. You must provide guidance on which four fixes should be prioritized.

Before completing this activity, we'll learn about:

- Qualitative vs. Quantitative Risk Analysis
- Likelihood, Impact, and Loss Expectancies
- Risk Factor and Heat Maps



Qualitative Analysis

VS

Quantitative Analysis

- Evaluating risk based on intangible, unmeasurable factors.
- Used when analysis leads to decisions without the need of cost-benefit analysis.

- Evaluating each risk based on its measured likelihood and impact.
  - **Likelihood**: The probability an event will take place.
  - **Impact**: The measure of damage done if a risk takes place.

Qualitative Risk Analysis

In some situations, likelihood and impact cannot be accurately measured.

- **Example 1:** It's impossible to calculate the precise probability that some lone attacker, somewhere in the world, will attack your servers within the next year.

- **Example 2:** It's impossible to determine the precise impact of a breach. The cost of an attack will depend on its length, which is impossible to determine ahead of time.

Qualitative Risk Analysis

- **Used when a complex evaluation of cost vs. benefit is unnecessary.**

  Example: When a company is deciding between an inexpensive VPN service that logs traffic on its servers for internal use, and a more expensive service that does not keep any logs.

A **bakery** can use qualitative analysis to decide on an inexpensive VPN, since it shouldn't matter much if they're logging non-confidential information.

A **government defense or financial organization** can use qualitative analysis to decide on a more expensive service, since it knows it needs to keep its data confidential.

Quantitative Risk Analysis: Example 1

However, there are circumstances where intuitive analysis is insufficient.

- **Example:** The Security Department wants to invest in protecting the organization's infrastructure.

  In order to secure the money from the Finance Department, they must justify their ask. They present a quantitative risk analysis to demonstrate that the cost of not investing is much greater than the budget they're requesting.

Quantitative Risk Analysis: Example 2

However, there are circumstances where intuitive analysis is insufficient.

- **Example:** The Executive Team must decide whether to migrate to a new cloud provider as part of negotiations with a potential partner.

  This transition has major financial implications. To make the decision, they need an accurate assessment of potential losses due to downtime, retraining, risk of data corruption during migration, and other issues.

Asset Value and Exposure Factor

To perform quantitative risk analysis, analysts start by calculating how much it will cost if an asset is breached.

- They first quantify **asset value** and **exposure factor**.
- As discussed earlier, **asset value** is how much money an asset is worth in currency.
- The **exposure factor** is how much of an asset will be affected in the event of a breach.
- In other words, will an attack result in **partial / temporary** or **complete / permanent** destruction of an asset.

Determining Exposure Factor

Exposure factor is always somewhat subjective. We apply a numerical value depending on the level of damage an exploited risk would produce.

1.0 — Attack would **completely eliminate** an asset.

.75 — Attack would **mostly eliminate** an asset.

0.5 — Attack would **half eliminate** an asset.

.25 — Attack would **partially eliminate** an asset.

Loss Expectancy

The measure of how much money an organization will lose in the event of a given breach.

Single Loss Expectancy (SLE)
Estimated cost of the risk occurring on a given asset.

SLE = AVE x EF

AV = Asset Value
EF = Exposure Factor

Annual Rate of Occurrence (ARO)
Estimated number of times the risk is likely to occur in a given year.

Annual Loss Expectancy (ALE)
Estimated cost of a risk occurring in a given year.

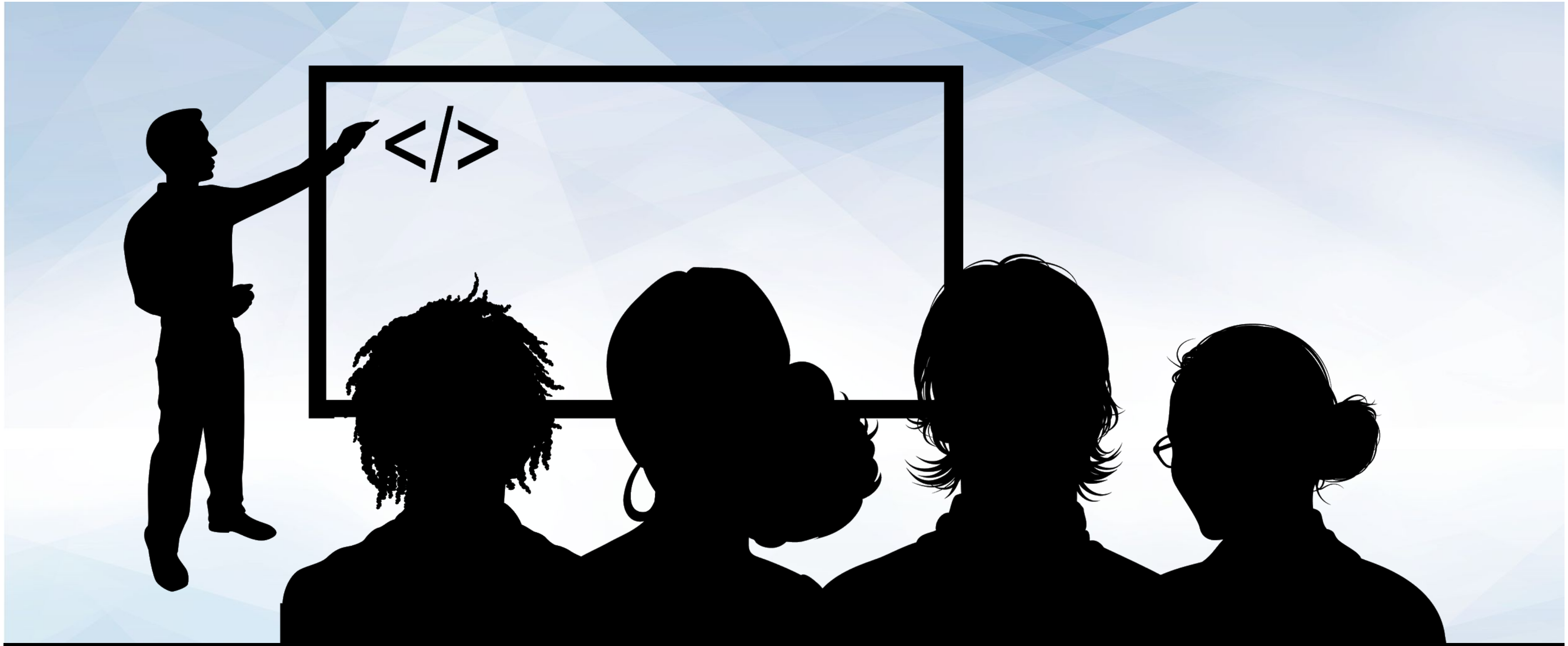
ALE = SLE x ARO

Loss Expectancy

Categories of loss expectancy refer to the degree of a breach's impact.

Marginal	Notable	Severe	Catastrophic
The organization has the resources to respond to the breach immediately, without affecting day-to-day operations or revenue.	The organization has the resources to respond to the breach, but may not be able to do so immediately. May experience interruptions to operations.	The organization experiences serious interruptions to operations, and doesn't have the monetary and/or personnel resources to respond to effectively. May have to defer revenue, delay project timelines, reassign employees, and/or hire consultants to address the issue.	The organization suffers severe, lasting damage to its reputation and/or infrastructure. The future of the business is threatened by reputational damage, bankruptcy, being found in contempt of federal regulations, or other issues.

In the next demonstration, we’ll see data presented in spreadsheet and visual formats through **risk matrices and heat maps.**



Instructor Demonstration

The Risk Spreadsheet


Countdown timer
15:00
(with alarm)
Break

Activity: Threat Modeling Step 5 - Risk Analysis

In this activity, you will complete a spreadsheet and generate a risk matrix and heat map for GeldCorp.

(Instructions sent via Slack.)

Suggested Time:
30 Minutes

Times Up! Let’s Review.

Threat Modeling: Step 5 - Risk Analysis

Mitigating Risks

Now that we're able to determine which threats are worth our attention and resources, we can craft controls for mitigating risks.

Deciding on Security Controls

Answer the following questions when determining an appropriate control.

Should the control be physical, administrative, or technical? **(Required Control Type)**

How strong does the control *really* need to be? **(Required Strength of Control)**

How much does the control cost compared to the benefit provided?
(Cost of Implementation)

How long will the control take to implement? **(Time of Implementation)**

Risk Mitigation: Example

LifeNotes is a new medical records company that makes it easy for doctors from different hospitals to share medical records.

When transferring a patient to another hospital or physician, they can use the application
to share the patient’s medical history, lab results, and medication schedules.

LifeNotes also ensures that doctors can only see records for their own patients.

However, a client recently reported that they were able to load records for patients they were not assigned to.

This violates regulatory standards protecting patient medical information, and must be resolved immediately.

Risk Mitigation: Example

What security controls should we suggest to LifeNotes?

- Required Control Type?
- Required Control Strength?
- Control Decisions?
- Cost of Implementation?
- Time of Implementation?

Activity: Threat Modeling Step 6 - Risk Mitigation

In this activity, you will conceptualize a risk mitigation plan.

Instructions shared on Slack.

Suggested Time:
15 Minutes

Times Up! Let’s Review.

Threat Modeling Step 6 - Risk Mitigation

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