

1ST EDITION

Aligning Security Operations with the MITRE ATT&CK Framework

Level up your security operations center for better security

REBECCA BLAIR



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Rebecca Blair



BIRMINGHAM—MUMBAI

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Contributors

About the author

Rebecca Blair has, for over a decade, focused on working in and building up **security operations center (SOC)** teams. She has had the unique experience of building multiple teams from scratch and scaling them for growth and 24/7 operations. She currently serves as the manager of the SOC, corporate security, and **network operations center (NOC)** at a Boston-based tech company, and as a cyber educational content creator for N2K Networks. She previously worked as the director of SOC operations at IronNet, a lead technical validator, a watch officer, and an SOC analyst for various government contractors. She has a bachelor of science degree in computer security and information assurance from Norwich University, a master of science degree in cybersecurity from the University of Maryland Global Campus, and a master of business degree in administration from Villanova University.

About the reviewer

Allen Ramsay has worked in the cyber trenches in 24/7 SOCs for most of his career. He has specialized in network defense and alert triage. He has previously contributed to multiple articles for SC magazine and has been a contributing author to *The Rook's Guide to C++*. He has a bachelor of science in computer security and information assurance from Norwich University and a master of science degree in cyber forensics and counterterrorism from the University of Maryland Global Campus.

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Strategies to Map to ATT&CK

In this chapter, we'll discuss how to analyze your environment, identify coverage gaps, and how to identify areas for improvement. Then, we'll cover how to map those gaps to the ATT&CK Framework to increase coverage and build out maturity in your security posture.

This chapter covers the following topics:

- Finding the gaps in your coverage
- Prioritization of efforts to increase efficiency
- Examples of mappings in real environments

Technical requirements

For this specific chapter, there is no specific technology or installations that are required.

Finding the gaps in your coverage

It's not logical to think that you can immediately review any/all controls from the MITRE ATT&CK Framework. Doing so will not only create a massive headache for yourself and your team but also could lead to adding unnecessary tools and leaving you trying to obtain the impossible. A perfect example is the **Actions on Objectives** control, which is complicated. The main principle is that there are various actions on an objective (actions taken against a target system such as a network or host) that can be carried out, such as stealing credentials, installing malware, and so on, but until an attack starts, you are unable to predict what is going to occur at some undetermined time in the future. In this case, you want to have a strong defense-in-depth approach by implementing standard security controls. Also, with regard to controls, it helps to understand that you will inevitably experience a compromise at some point in time if you haven't already. Technology is moving at a pace that is so fast and there are so many different factors that can impact your security that it is inevitable. What you can do is document your weaknesses and make a plan to mitigate as many as possible and hope that the controls that you have in place will protect you in the case of a catastrophic event.

The main approaches that my teams take to identify gaps are the use of purple team exercises, audits, and tabletop exercises, or the use of other commercial or open source tools. The first approach mentioned is **purple teams**, which as previously explained are collaborative efforts between a red team action (offense) and a blue team action (defense). They are needed when attacks are attempted to test response actions or security implementations and identify your weak spots. The weaknesses that are identified can be considered gaps, which you will add to your plan. The next approach is auditing. This can be aligned with any accreditation format that you have to follow, such as **Payment Card Industry Data Security Standard (PCI DSS)**, **Systems and Organizations Controls (SOC)**, the **Global Data Protection Regulation (GDPR)**, using the **Defense Information Systems Agency Security Technical Implementation Guide (DISA STIG)**, and so on. You can perform the audit internally or with a third party, which ensures you meet all controls to gain or maintain compliance. You can similarly do this with the MITRE ATT&CK Framework, but because the framework is not a compliance framework, it is more ambiguous. An example of the differences would be that DISA STIGs match specific systems, such as a STIG set for Windows Server 2019, and it tells you specifically where to go in the settings to ensure share drives cannot be enumerated. It looks like this:

Windows Server 2019 must not allow anonymous enumeration of shares.

Overview

| Finding ID | Version | Rule ID | IA Controls | Severity |
|------------|----------------|------------------|-------------|----------|
| V-93537 | WN19-SO-000230 | SV-103623r1_rule | | High |

Description

Allowing anonymous logon users (null session connections) to list all account names and enumerate all shared resources can provide a map of potential points to attack the system.

STIG

[Windows Server 2019 Security Technical Implementation Guide](#)

Date

2020-06-15

Details

Check Text (C-92853r1_chk)

If the following registry value does not exist or is not configured as specified, this is a finding:

Registry Hive: HKEY_LOCAL_MACHINE
Registry Path: \SYSTEM\CurrentControlSet\Control\Lsa\

Value Name: RestrictAnonymous

Value Type: REG_DWORD
Value: 0x00000001 (1)

Fix Text (F-99781r1_fix)

Configure the policy value for Computer Configuration >> Windows Settings >> Security Settings >> Local Policies >> Security Options >> "Network access: Do not allow anonymous enumeration of SAM accounts and shares" to "Enabled".

Figure 6.1 – STIG viewer details of Windows Server 2019's findings

For this specific control, as depicted in the preceding figure, you can see the description, details, fix, and so on. Meanwhile, a tactic in the ATT&CK framework for the enumeration of shares can be found at **Network Share Discovery**, which is Tactic T1135 and looks like this:

Network Share Discovery

Adversaries may look for folders and drives shared on remote systems as a means of identifying sources of information to gather as a precursor for Collection and to identify potential systems of interest for Lateral Movement. Networks often contain shared network drives and folders that enable users to access file directories on various systems across a network.

File sharing over a Windows network occurs over the SMB protocol. ^{[1] [2]} Net can be used to query a remote system for available shared drives using the `net view \\remotesystem` command. It can also be used to query shared drives on the local system using `net share`. For macOS, the `sharing -l` command lists all shared points used for smb services.

ID: T1135
 Sub-techniques: No sub-techniques
 ① Tactic: [Discovery](#)
 ① Platforms: Linux, Windows, macOS
 ① Permissions Required: User
 ① CAPEC ID: [CAPEC-643](#)
 Contributors: Praetorian
 Version: 3.1
 Created: 14 December 2017
 Last Modified: 13 October 2021

[Version Permalink](#)

Procedure Examples

| ID | Name | Description |
|-------|-------|---|
| G0006 | APT1 | APT1 listed connected network shares. ^[3] |
| G0050 | APT32 | APT32 used the <code>net view</code> command to show all shares available, including the administrative shares such as <code>C\$</code> and <code>ADMIN\$</code> . ^[4] |

Mitigations

| ID | Mitigation | Description |
|-------|--------------------------------|--|
| M1028 | Operating System Configuration | Enable Windows Group Policy "Do Not Allow Anonymous Enumeration of SAM Accounts and Shares" security setting to limit users who can enumerate network shares. ^[5] |

Detection

| ID | Data Source | Data Component | Detects |
|--------|-------------|-------------------|--|
| DS0017 | Command | Command Execution | Monitor executed commands and arguments that may look for folders and drives shared on remote systems as a means of identifying sources of information to gather as a precursor for Collection and to identify potential systems of interest for Lateral Movement. |
| DS0009 | Process | OS API Execution | Monitor for API calls that may look for folders and drives shared on remote systems as a means of identifying sources of information to gather as a precursor for Collection and to identify potential systems of interest for Lateral Movement. |
| | | Process Creation | Monitor for newly executed processes that may look for folders and drives shared on remote systems as a means of identifying sources of information to gather as a precursor for Collection and to identify potential systems of interest for Lateral Movement. |

References

1. Wikipedia. (2017, April 15). Shared resource. Retrieved June 30, 2017.
 2. Microsoft. (n.d.). Share a Folder or Drive. Retrieved June 30, 2017.

30. Hromcová, Z. (2018, June 07). InvisiMole: Surprisingly equipped spyware, undercover since 2013. Retrieved July 10, 2018.

Figure 6.2 – The Network Share Discovery tactic in the MITRE ATT&CK Framework

As you can see, there is a lot of data provided in the MITRE tactic details, but it doesn't go to the granular level that something such as a STIG does. That's why it's helpful to run audits based on the compliance standard that you are compliant with and then map the non-compliant findings to the MITRE tactics. In fact, it's pretty easy to find resources online that have done this mapping for you, which helps take some of that guesswork out. The third approach mentioned was the use of tabletop exercises, which we covered in previous chapters, but as a reminder, these are exercises where you bring a group of stakeholders into a room and talk through a hypothetical incident. The pro to this is that you can pick out major gaps; however, this shouldn't be your only approach to findings gaps

because it's easy to overlook technical controls or make assumptions about capabilities. If anything, it should be used for more assurance that your organization is doing the right thing. The last approach that was mentioned was to use tools that may either be commercial software offerings or open source tools. Tools such as SecurityScorecard, Splunk Security Essentials, Tripwire, and countless others map out your network through scanning, configurations, and so on and provide ratings for your security posture and let you know what areas need improvement. A pro of this approach is that it allows you to automate and check your security posture regularly, but a negative is that these tools usually take time to configure and don't account for compensating controls that might have been put in place. These tools can also display the findings in an easy-to-read and digestible format as follows:

Good afternoon, Rebecca!

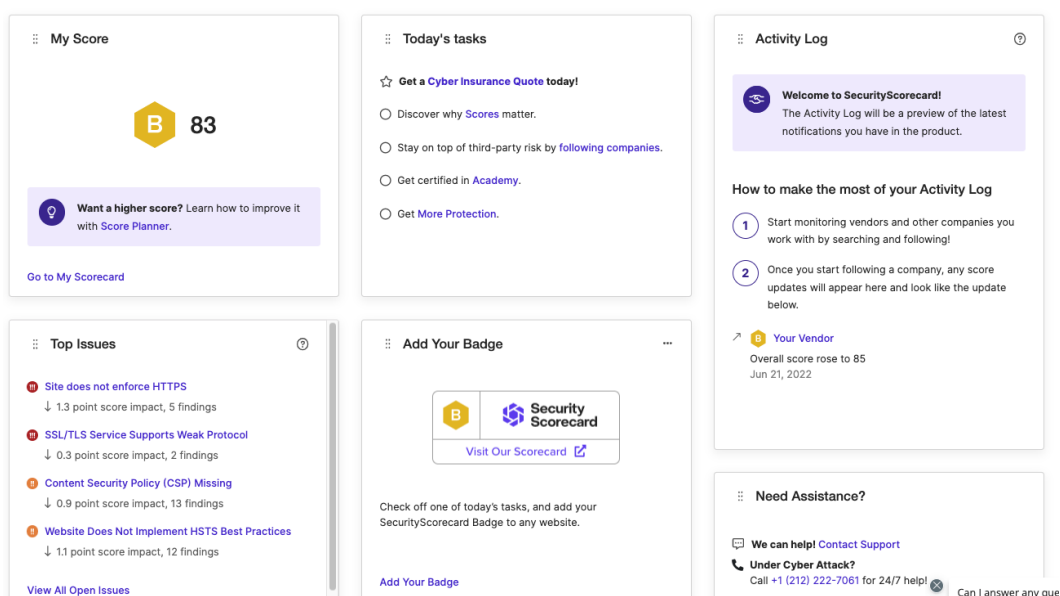


Figure 6.3 – SecurityScorecard dashboard

As you can see from the SecurityScorecard dashboard, just using the free version provides your security score and lists out the top issues that have been identified. This was set up within 5 minutes of registering for the free version and has provided findings. The gaps here appear to be around the website of the company that was registered, and the top issues found may be mapped to MITRE tactic T1600, **Weaken Encryption Technique**, due to HTTPS not being enforced.

The final approach that wasn't previously mentioned but is as important as purple team exercises, if not more, is to *trust your employees and coworkers*. Any SOC environment should strive to hire the best talent that they can, and many times, I've had employees approach me with gaps that they have identified through their experience or observations. You can then take a trust-but-verify approach of completing a proof of concept on the gap to ensure it is legitimate and then work together to map

the respective gaps and mitigate them when possible. That way, you are incorporating a purple team approach and making that employee feel valued.

Regardless of what approach you take, you should try to match all gaps to MITRE to understand the risks associated with each gap, which can help with prioritization efforts when deciding what to remediate. You should also ensure to use a committee setup so other stakeholders can review the gaps and add their input, either adding mitigating controls, adding gaps, or agreeing to the proposed changes. All gaps should be reviewed, and if any are not going to be remediated, they should be added to your organizational risk registry for future tracking.

In the next section, we'll look at some strategies for prioritizing the gaps that have been identified and the approaches that make the most sense to your organization.

Prioritization of efforts to increase efficiency

Prioritization can be made using a variety of approaches, and it sometimes can come down to a feeling. For the record, when possible, you should use a quantitative method for prioritization, primarily based on capabilities. To start with, you need to have your gaps identified. That can be done through a risk registry, a purple team exercise, an audit, and so on. From there, you need to take a look at your resources; this includes the current technical capabilities, the personnel and their skill sets, the budget constraints to upgrade or bring in new tools and services, and the work cycles you have available or can make available. After you take a look at your resources, you want to then begin assigning prioritization and scoping out levels of effort, potential fixes, and stakeholders. One helpful tool is to diagram and actually write down the risks. If we were to step through a process, we could start with the following gaps:

| Identified Gap | Tactics | Techniques | Risks | Likelihood | Impact | Stakeholders |
|--|-------------------|--|---|------------|---------------|--------------------|
| Multi-Factor Authentication is Not Enabled | Credential Access | Unsecured Credentials, Modify Authentication Process | Could make accounts more susceptible to takeover and allow unauthorized access. | High | High | IT Admins |
| Limited Phishing Prevention Training | Initial Access | Phishing | An end user could click on a phishing link, resulting in actions such as downloading a malicious file or credential misuse. | High | Moderate/High | Endusers/IT Admins |

Figure 6.4 – Identified gaps listed

From the example in the preceding figure, you can see that we have the gaps identified, what tactics and techniques they are related to, what some of the potential risks are, their likelihood and impact, and the stakeholders involved. This allows us to have a single point of reference for all gaps, as mentioned, like a **risk register**. The difference is that this will be used to add on columns and is for the prioritization of projects, whereas in my experience, risk registers are used for more long-term risk tracking and provide another way to prioritize gaps, depending on how you want to present the findings. If you're

struggling with a way to match them up, one way is as an exercise for the entire team. You would use a four-quadrant chart and place a dot or title wherever a gap falls. The chart would look like this:

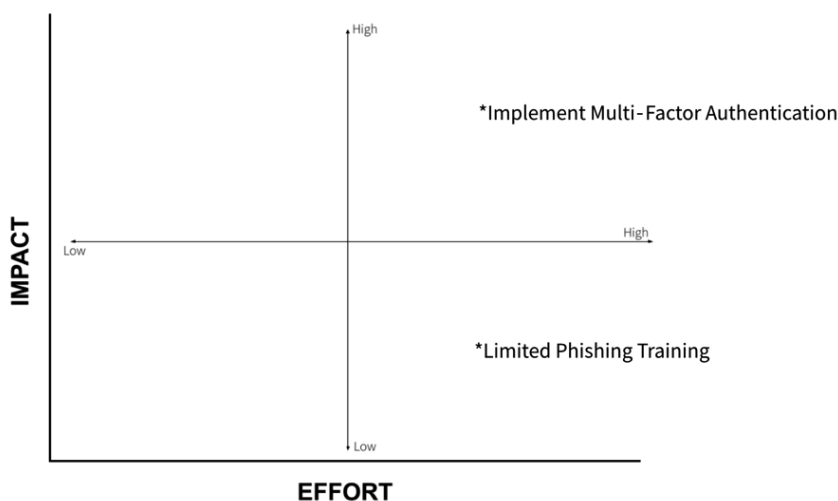


Figure 6.5 – Impact versus effort chart

As you can see from the preceding chart, you would mark where gap remediation would fall depending on the amount of impact it could have on the company if breached, and the amount of effort it would take to make the change. You could make this a collaborative effort by having all members of your team fill out their own chart and compare or create the single chart as a team. Regardless, there should be time built in to get feedback to ensure that all stakeholders agree on the general level of impact and effort needed to fill a gap.

A different way to prioritize might be based strictly on business needs. For example, if Company A is a provider of authentication services, and its gap is that it doesn't offer a centralized multi-factor authentication option, or that it doesn't enforce multi-factor authentication for privileged accounts, then that would be a higher priority than the phishing training. The reason is that if an authentication company has a compromise due to a lack of authentication protections, then it's a risk to the company, its customers' data, and its outward reputation, which enables it to continue to provide its services. While phishing training is important, other mitigating factors might be in place, so that gets pushed to the bottom of the priority list.

Similarly, if you feel your team needs some wins and you have enough business cycles, I would use a mixed approach. I would start with a lower-effort project, such as the phishing training, and work with a tool such as **KnowBe4** or create custom training to quickly push out phishing and cyber awareness training within the organization. I also recommend trying live tests through tools such as **gophish**, which you can use to send fake phishing emails to your workforce to test the click rate and assess the level of need for additional training, or even create smart groups so that when a user clicks on a fake phishing link, they are immediately enrolled into phishing training.

Regardless of the justification for prioritization, you'll want to gather contextual information that will be helpful. That's where including information such as the major milestones involved in the remediation and the stakeholders involved and tying this back to techniques and tactics can be extremely helpful. For example, by tying the gaps to tactics and techniques, you can use the resources provided by the MITRE ATT&CK Framework to help accurately assess the impact and likelihood of breaches. In the case of multi-factor authentication, you can see that it applies to the following techniques:

- **T1621:** Multi-Factor Authentication Request Generation
- **T1110:** Brute Force
- **T1111:** Multi-Factor Authentication Interception
- **T1098:** Account Manipulation
- **T1021:** Remote Services
- **T1199:** Trusted Relationship
- **T1136:** Create Account
- **T1530:** Data from Cloud Storage
- **T1213:** Data from information Repositories: Code Repositories
- **T1114:** Email Collection
- **T1133:** External Remote Services
- **T1556:** Modify Authentication Process
- **T1601:** Modify System Image
- **T1599:** Network Boundary Bridging
- **T1040:** Network Sniffing
- **T1072:** Software Deployment Tools
- **T1539:** Steal Web Session Cookie
- **T1078:** Valid Accounts (Domain and Cloud)

Primarily, multi-factor authentication ensures that only those authorized are able to authenticate and access specific resources, which is important, but it can also be helpful for mitigating credential stuffing and other brute-force attacks. As you can see, there are a large number of tactics that are related to multi-factor authentication, which is why it's important to completely map tactics to the gaps when possible. Effectively doing so will allow you to accurately assess the level of effort and impact that that gap involves and can allow you to properly prioritize your work.

Speaking with a colleague recently, they chose to prioritize operations that had synergy first. The reason is that you can potentially knock out multiple initiatives at once because some of them will require the same or similar steps to be taken. They found that by lining up gaps by synergy, they were able to optimize their team and make a greater short-term impact and then work on a plan to figure out the separate gaps and decide with their respective teams on what could and could not be remediated.

In the next section, I'll talk through a few different cases of a hypothetical scenario and how we would map it to the related tactics. After all of them are mapped, I'll walk through how I would prioritize the efforts.

Examples of mappings in real environments

Security vulnerabilities and coverage gaps are a fact of life for anyone who works in infosec. Here are a few different outlined security coverage issues that I've experienced and their applicable mapping and prioritization on a quad chart, as well as a discussion about what work streams I would implement. All of these issues are extremely common and hopefully can provide insight for you as you look at your environment.

The first issue that I've run into multiple times is a lack of logging, or a lack of logging the proper security logs. The reason that this is a problem is that logs are the first place a security responder will look when investigating an alert and attempting to find anything that is suspicious or malicious. If logging is not up to par, there are likely compromised activities occurring that you are not aware of because logs are also typically used to set up detection and alerts. To identify whether this is an issue, you need to determine what logs you need to capture based on the infrastructure and work structure of your organization. You also want to project out the size of the logs that you want to ingest into your log correlation tool. That way, you can assign priority to the missing logs. I assign my logs priority based on the number of potential detection rules and the level of effort needed to ingest them. For example, a list of missing logs might look like this:

| Data Source | Vendor | Product | Priority | Relative Size | 2023 GB | Notes |
|---------------------|--------------|------------|----------|---------------|---------|-------|
| Zero-Trust VPN | OpenVPN | OpenVPN | Critical | Extra Large | 500 | |
| Authentication | One Identity | OneLogin | Critical | Large | 115 | |
| Cloud Security | AWS | Guard Duty | Moderate | Medium | 50 | |
| Vulnerability Scans | Tenable | Nessus | Low | Small | 10 | |

Figure 6.6 – Log source organization

As you can see, I've created a table that has the list of data sources that I want added to ingest, the vendor the sources come from (this matters when you have to determine potential integrations), the specific product the logs are coming from, the priority, the size based off of an internal scale, the size in the form of project GB for the next year, and a section for any additional notes. I would then be able to take this list and work with the respective teams to either implement integration or forwarders

for ingesting logs. Even then, it's not quite that simple because you have to take into consideration costs and technical constraints. The number one reason I have experienced limited logging is due to cost, as some SIEM tools can be cost-prohibitive as you ingest more data, which isn't reasonable for a smaller organization to pay for. If that's the case, and you have the bandwidth for management, you should look into using an open source solution, such as standing up an **Elastic, Logstash, and Kibana (ELK)** stack.

Now, how does limited logging map to MITRE? In quite a few areas. Depending on the data, in this case, we'll use some of the examples from the chart of missing zero-trust VPN logs, authentication logs, guard duty logs, and vulnerability scans; they could be mapped to the following tactics:

- **T1133:** External Remote Services
- **T1021:** Remote Services
- **T1570:** Lateral Tool Transfer
- **T1078:** Valid Accounts
- **T1098:** Account Manipulation
- **T1046:** Network Service Discovery

These are just a few that could potentially be mapped to the missing logs. It of course would depend on the level of configuration that you have for the various tools as to other ones that could be mapped. In general, I find it easier to identify all of the tactics that could apply, and that determines which ones have coverage for mitigation and other implementations. That way, I don't accidentally leave one out of the potential list.

Another common security flaw that I have found at smaller companies was a lack of security training or immature security training. In general, I recommend yearly training, on top of exercises such as phishing exercises to test the employee group, so that everyone can become cyber-smart. Some controls that could relate to the lack of training could be as follows:

- **T1566:** Phishing Spearphishing Link
- **T1598:** Phishing for Information
- **T1550:** Use Alternate Authentication Material
- **T1098:** Account Manipulation

In this case, phishing tactics are obvious to map to security awareness training. However, other tactics were mentioned, which shows that training has a far reach. For example, if there are no procedures and no training on security, then what is keeping an administrator from granting overly permissive permissions or adding different methods of authentication because they might not understand the consequences? This shows that when mapping, you need to keep an open mind and try to understand the blast radius of an attack.

The third security flaw that I have seen is that **Access Control Lists (ACLs)** might be open to the internet or at least less restrictive than they should be. This is a common area, especially in development teams, where instances are stood up and down. It's easier to leave the instance open to the internet than taking the time to restrict it due to the thought that it'll get torn down quickly, or is just an oversight. I have worked on multiple incidents in my career, even early on, caused by shadow instances that had overly permissive ACLs, and given the move of practically everything to the cloud, this will only continue to occur. Some tactics that could be mapped to this finding are as follows:

- **T1069:** Permission Groups Discovery
- **T1046:** Network Service Discovery
- **T1557:** Adversary in the Middle
- **T1563:** Remote Service Session Hijacking

Again, these are just a few of the tactics that could apply, and if you have an overly permissive ACL and weak authentication, then you are at a higher risk for an overall compromise, which would be detrimental to your organization.

Taking these three security areas into account and thinking about work streams, I would categorize them on a quad chart as follows:

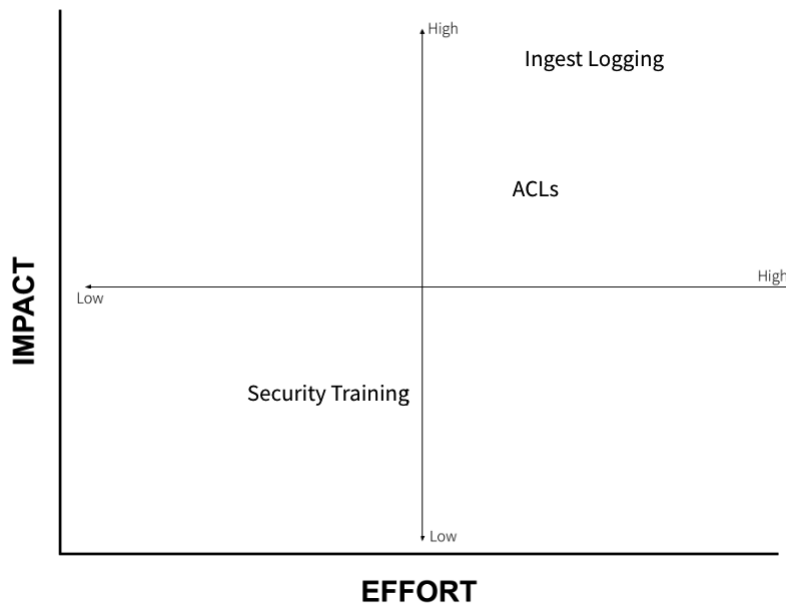


Figure 6.7 – Prioritization quad chart

As you can see on this chart, I placed logging at high-effort/high-impact, placed ACLS as mostly high-effort and mostly high-impact, and placed security training as low- to mid-effort with a moderate impact. I chose these designations because implementing logging will take significant effort via creating integration or setting up forwarders, and that's if you even have the bandwidth on your tool to ingest the additional logs. The logs do provide a significant amount of impact because of the visibility they provide and the detections that can be created based on the logs. The ACLs involve moderate to high effort because they will need monitoring solutions, the likes of **Guard Duty**, **Twistlock**, or other tools. Policy creation will be needed to determine the proper ways to stand up instances and training. It is also ranked as having a moderate to high impact because of my experience with how common a security flaw this is, and having worked on multiple incidents in the past that were a result of this. Security training is placed as low to moderate in terms of both effort and impact. For effort, it's because there are a large number of solutions that can be implemented to easily assign and manage security training, and while there is a large amount of effort to set it up, you can coast to an extent (depending on your organization). In terms of impact, I am a big believer in training. However, it alone is not enough, and more needs to be done to protect your workforce. You may agree or disagree with the placements, but any placement is dependent on your organizational priorities.

For work streams, I would start implementing strong ACLs because I believe that will have the greatest impact-to-effort ratio. I think there is also synergy between implementing the ACLs and training, as in, training end users to set up proper ACLs. This shows that even though the logging project has a higher impact, it isn't the first one worked on in the work streams because of the amount of effort it involves, and the amount of discovery that would need to occur. If anything, it would make sense to start with implementing smaller, more accessible sources while scoping out larger sources.

Summary

As you can see, some of the concepts we've learned previously, such as purple team exercises and threat modeling, can all play a role when it comes to prioritization and mapping tactics to gaps. As you'll continue to see, security, in general, is interconnected, which means that when processes and teams work in synergy, then you are more likely able to implement a defense-in-depth approach to make your organization more secure. In the next chapter, we'll continue to talk through implementation and examine some of the mistakes that get made when implementing securing infrastructure and processes. I'll also walk through some of my previously failed security projects to go through what the lessons learned from those experiences were and what I would do differently if I were to complete those projects again.