



# Advanced Security (Information Security Management)

## Session 2: Information Security Frameworks and IS Organizations

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## Goals of the Lecture

- Setting the Scene: IS in the context of companies
- Clarify some basic vocabulary
- Getting first insights to IS compliance frameworks



# Introduction

Organizations of all types and sizes:

- collect, process, store, and transmit **information**
- recognise that **information**, and related processes, systems, networks and people are important **assets** for achieving organization objectives
- Face a range of **risks** that can affect the functioning of **assets**
- Address their perceived risk exposure by **information security controls**



# What is a Risk?

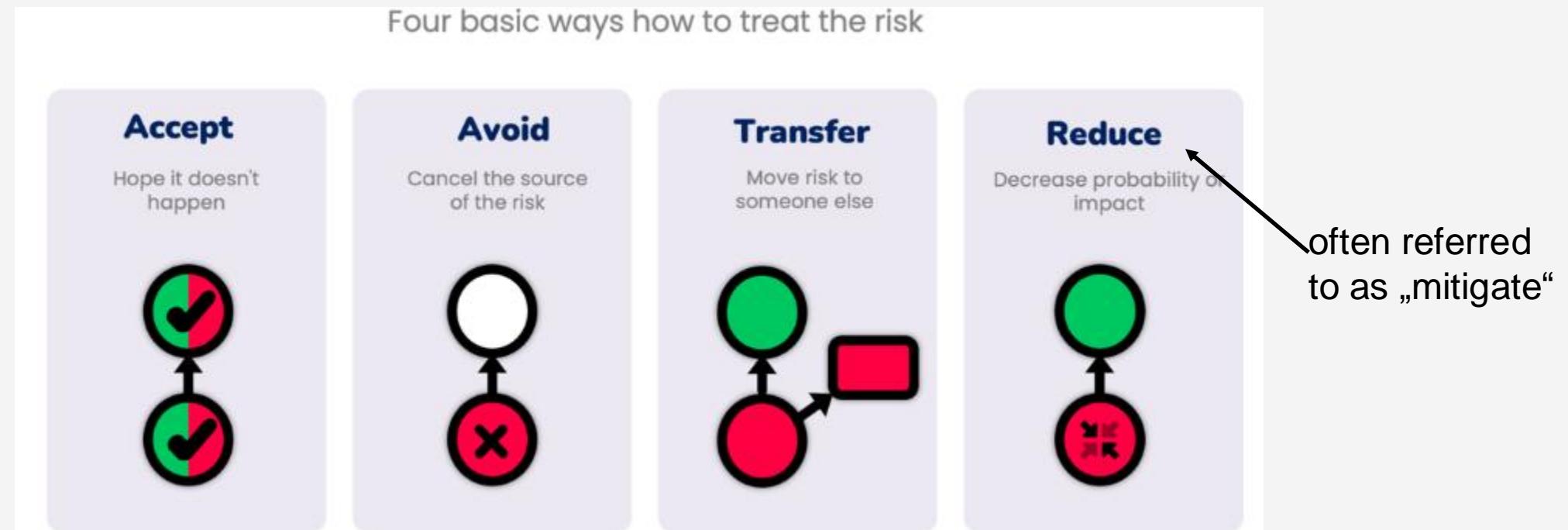
The level of impact on organizational operations (including mission, functions, image, or reputation), organizational assets, or individuals resulting from the operation of an information system given the potential impact of a threat and the likelihood of that threat occurring.

		Consequence				
		Negligible 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Likelihood	5 Almost certain	Moderate 5	High 10	Extreme 15	Extreme 20	Extreme 25
	4 Likely	Moderate 4	High 8	High 12	Extreme 16	Extreme 20
	3 Possible	Low 3	Moderate 6	High 9	High 12	Extreme 15
	2 Unlikely	Low 2	Moderate 4	Moderate 6	High 8	High 10
	1 Rare	Low 1	Low 2	Low 3	Moderate 4	Moderate 5

Source: NIST glossary



# Risk Treatment Strategies





# Risk Management Cycle





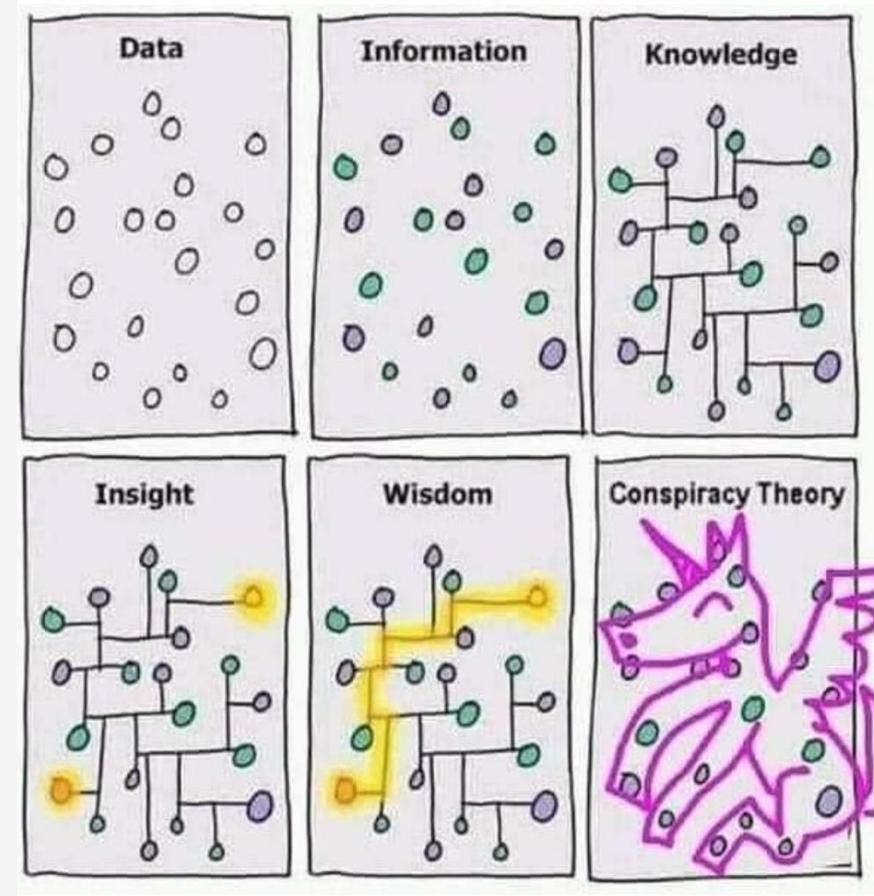
# Risk Types





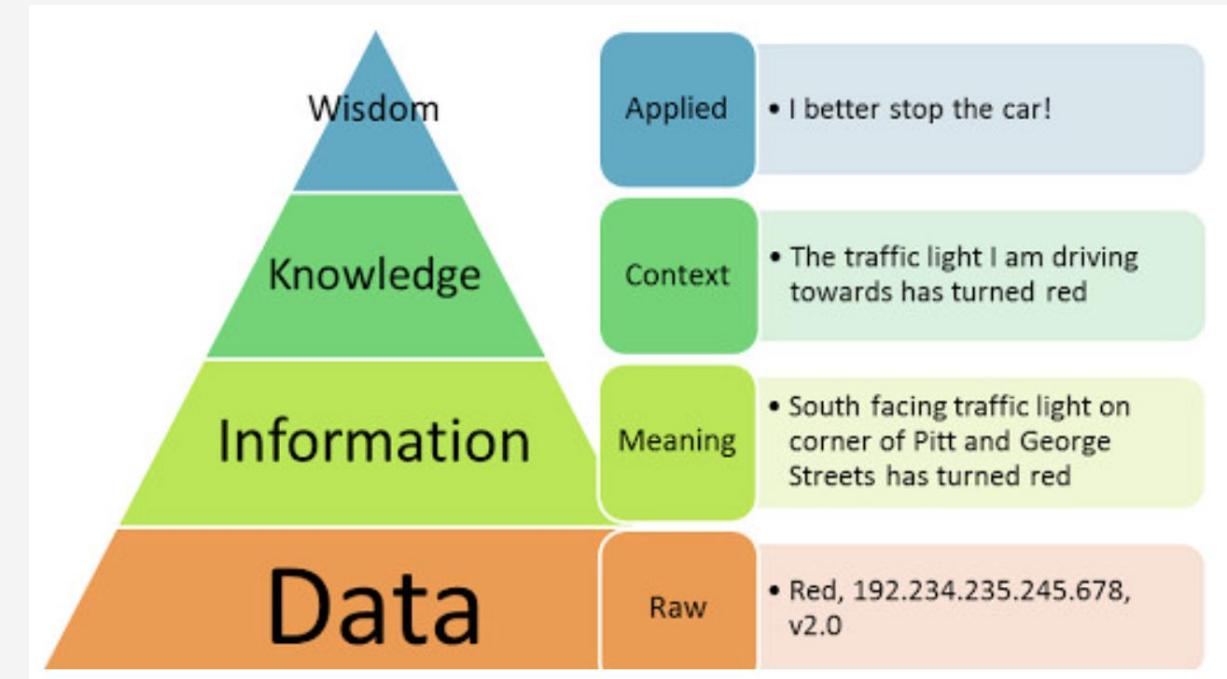
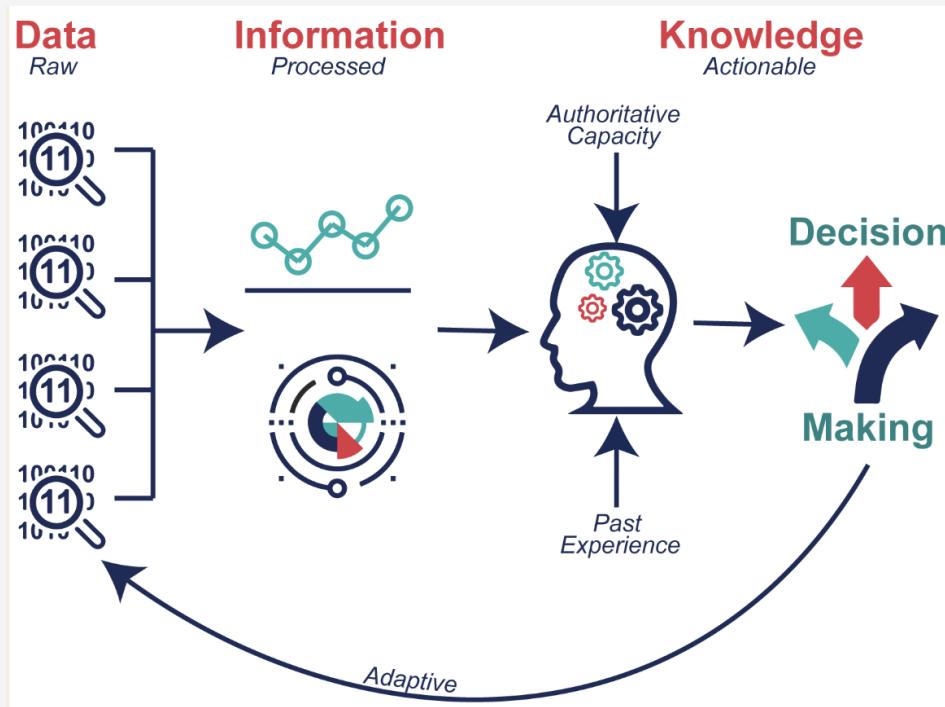
# What is information?

- Information is processed data that holds meaning and value
- It is essential for decision-making, communication, and operations
- Example: Personal data, financial records, intellectual property.





# Other Perspectives on Information



# Another Perspective on Information: Information Theory

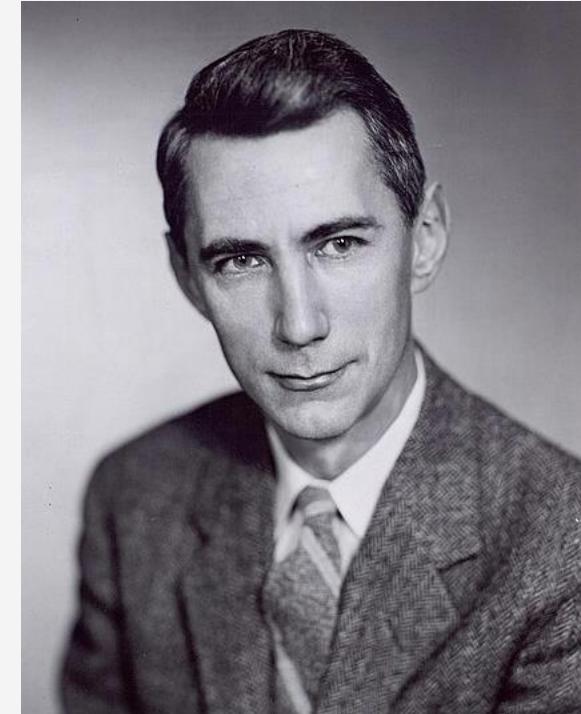


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**Entropy:** In information theory, the amount of uncertainty or unpredictability in a message is measured by a concept called **entropy**.

$$H(X) = - \sum_{i=1}^n p(X = x_i) \log_2 p(X = x_i))$$

The information content or **self-information** of a specific event or symbol is defined as the negative logarithm of its probability. Rare events have higher information content because they reduce more uncertainty when they occur.



$$I(x_i) = - \log_2 p(x_i)$$



## Question

What kind of information would you consider protect-worthy in a company context?



# Why Information needs Protection?

Can you imagine main reasons for the need to protect information?



## Threats to IS (extract)

- **Cyber Attacks:** Hacking, malware, phishing
- **Insider Threats:** Employees or insiders misusing access
- **Physical Theft:** Stealing hardware or devices containing sensitive information
- **Human Error:** Accidental data breaches or improper handling of information.

# Protection Goals for Cybersecurity



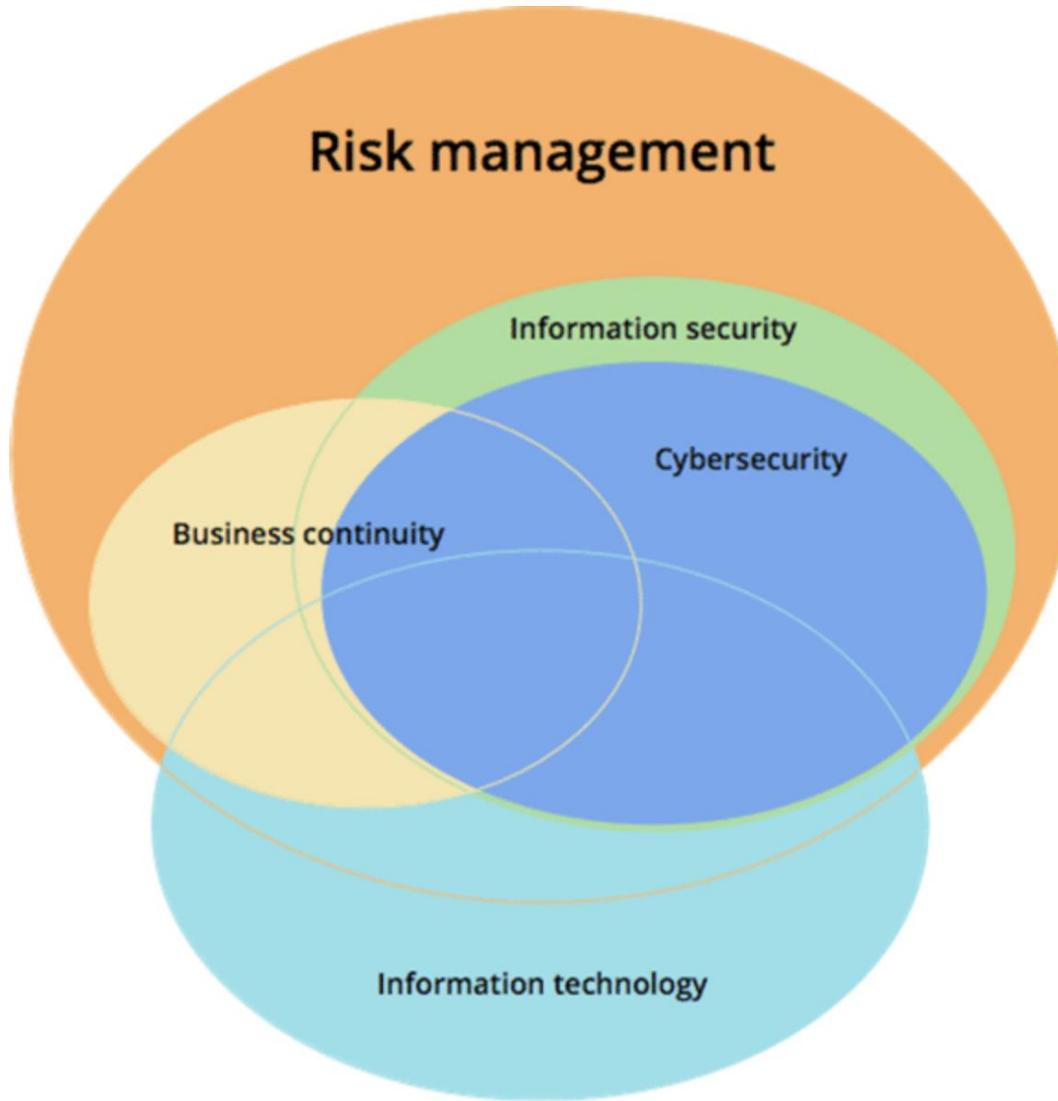
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# Role of Information Security in a Wider Context



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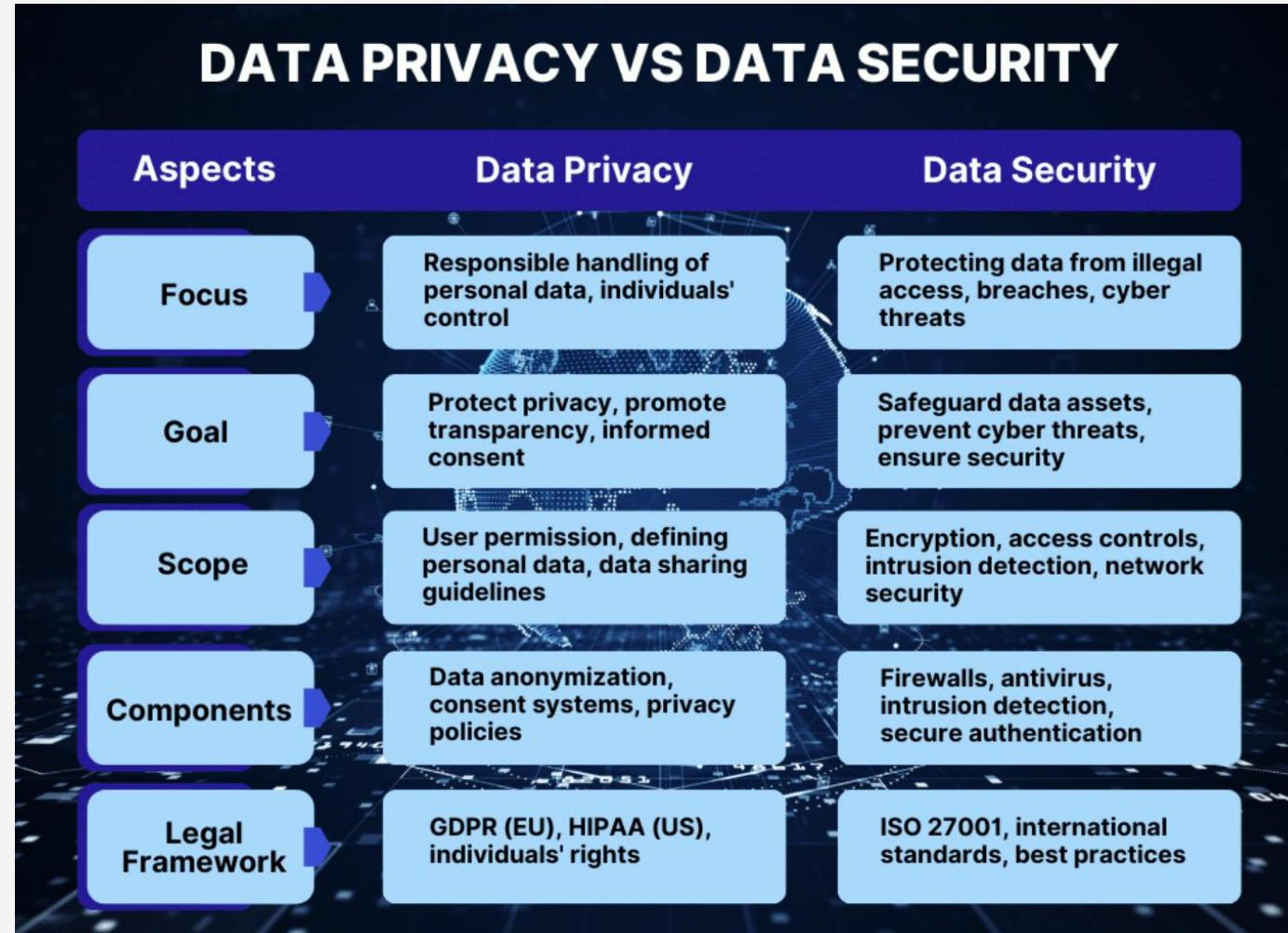


Try to define the terms and distinguish between them!

Also, what is the difference between privacy and security? (Next slide)



# Information Security vs. Privacy





## Question

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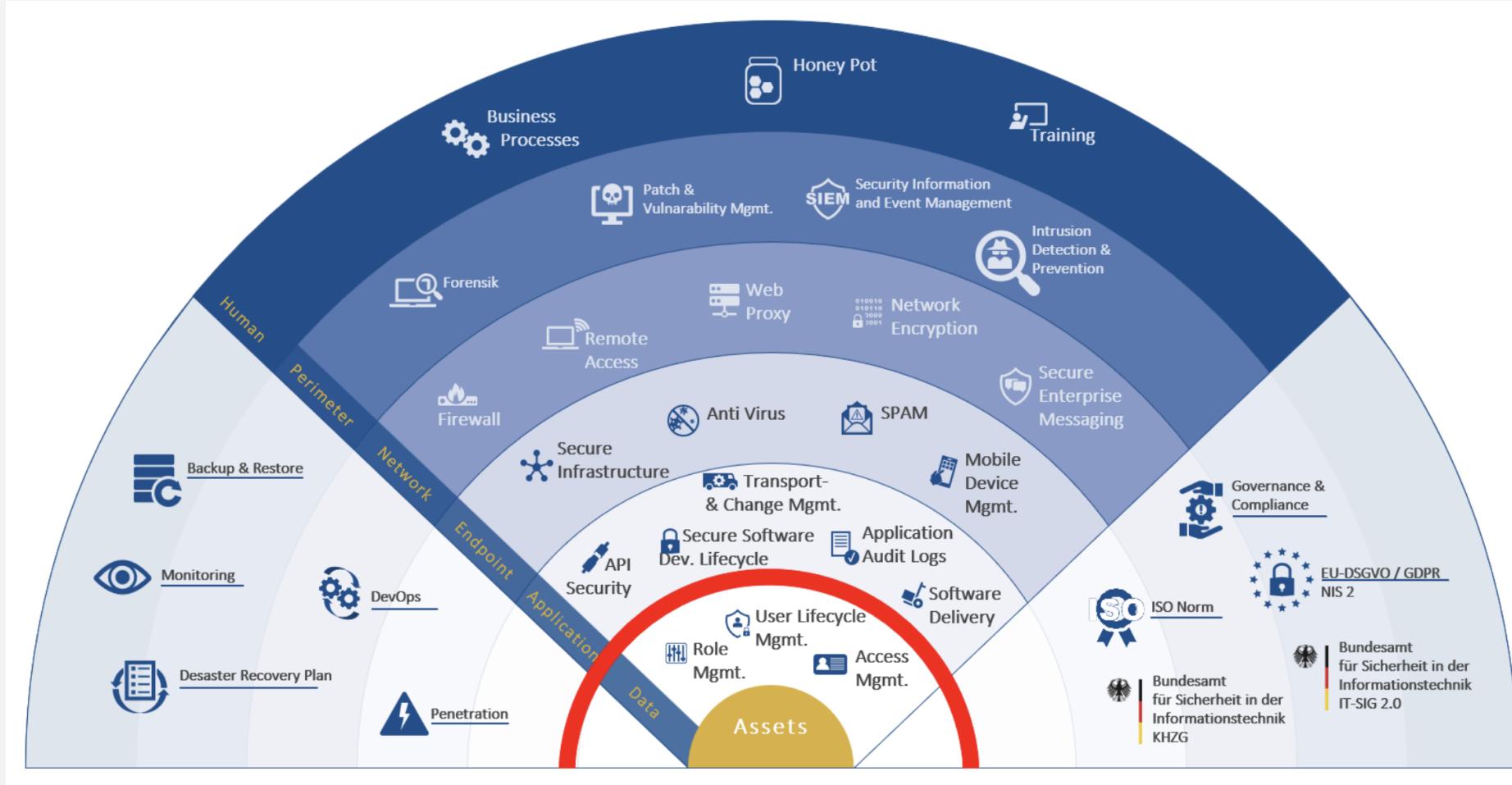
Can you imagine some challenges to ensure information security in a company context?

What kind of tasks would you consider to be relevant for the cybersecurity domain in a company?

# Some Tasks Relevant for Cybersecurity Department

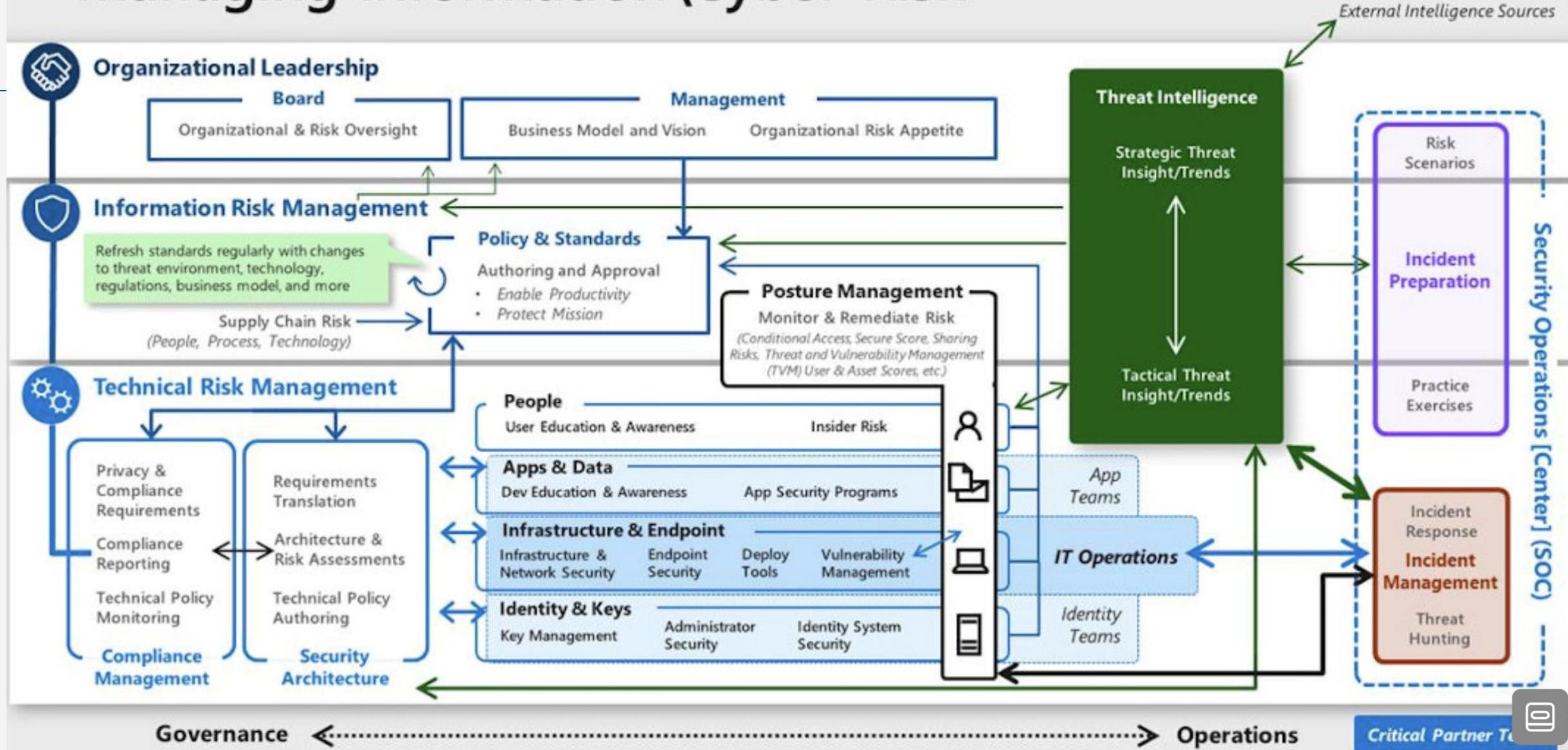


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Source: [https://www.ibsolution.com/academy/blog\\_en/cyber-security/nis-2-what-companies-must-do-for-their-cyber-security](https://www.ibsolution.com/academy/blog_en/cyber-security/nis-2-what-companies-must-do-for-their-cyber-security)

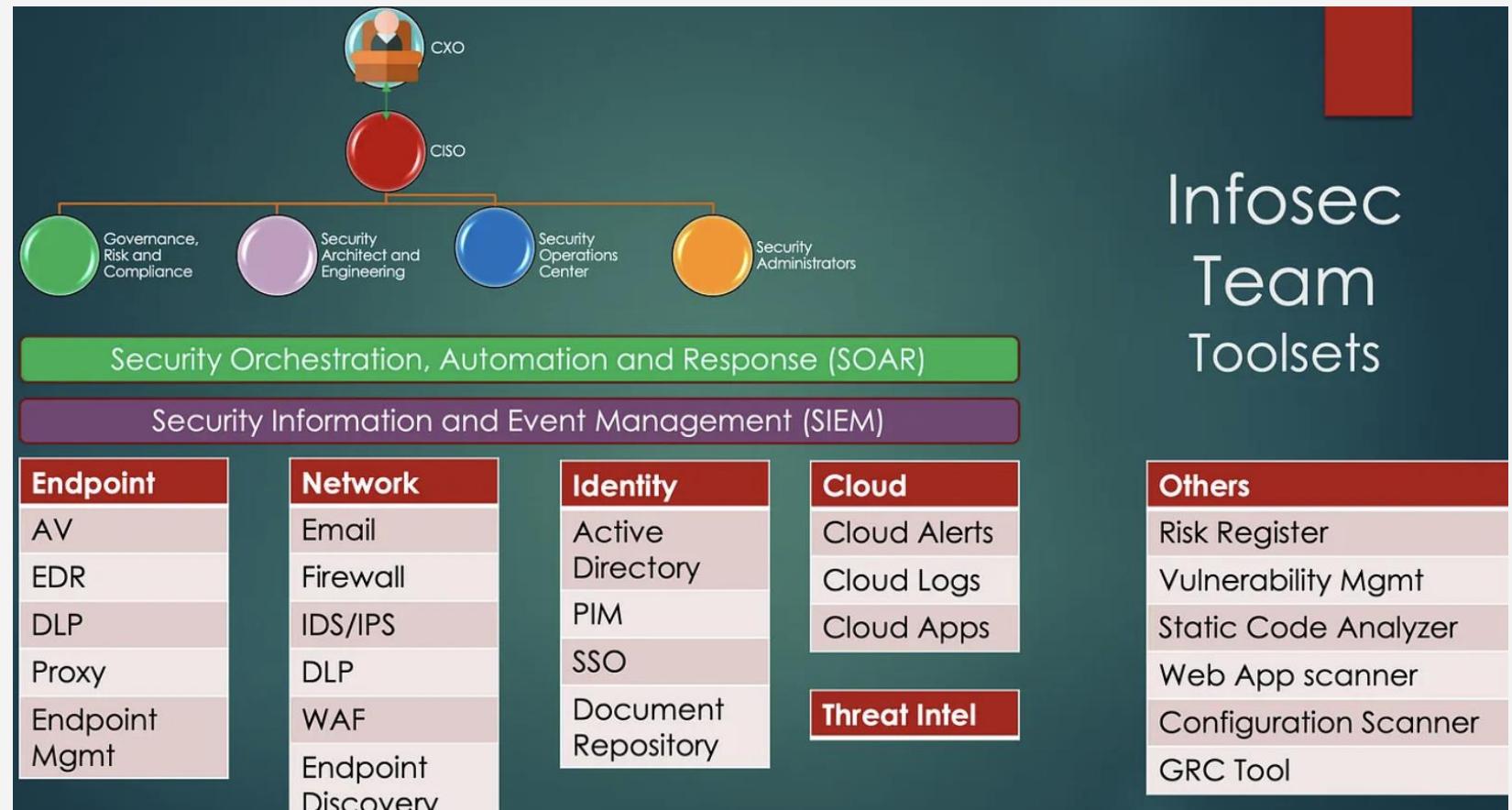
# Managing Information\Cyber Risk





# Cybersecurity Organizations

- Chief Information Security Officer (CISO)
- Security Operations Center (SOC)
- Identity and Access Management (IAM)
- Compliance / Trust & Assurance
- Product / Application Security
- ...



# Some Roles in Cybersecurity Organizations

- Chief Information Security Officer (CISO)
- Software Engineer
- Security Engineer
- Product / Application Security Experts
- Rapid Responder
- Security Architect
- Security Analyst
- Forensic Specialists
- Auditors
- Compliance Managers
- ...

Try to guess what the responsibilities of those roles are and where they are



# Operational Security in Company Context

Do you know some tools to support cybersec?

# Some Key Tools for Cybersecurity



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- Security Information and Event Management (SIEM)
- Endpoint Detection and Response (EDR)
- Intrusion Detection Systems (IDS) / Intrusion Prevention Systems (IPS)
- Security Orchestration, Automation, and Response (SOAR)
- DDoS Prevention
- Firewalls
- Vulnerability Management Tools
- Threat Intelligence Platforms (TIPs)
- Network Traffic Analysis Tools (NTA)
- Data Loss Prevention (DLP)
- IAM Tools
- Penetration Testing Tools
- Web Application Firewalls (WAF)
- Encryption Tools
- Backup and Recovery Tools

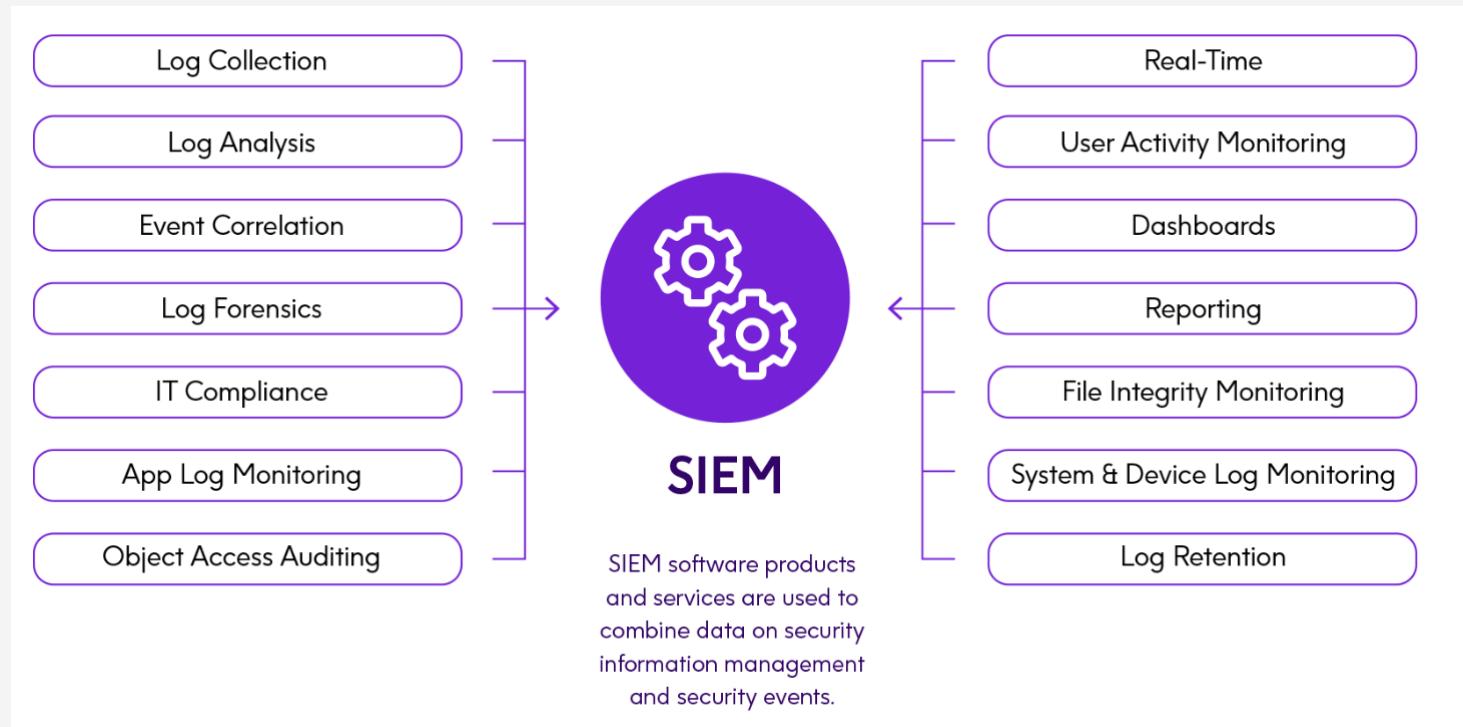


# SIEM Systems

## Key Features

- Real-time monitoring
- Event correlation
- Log management
- Incident detection and response

**Examples:** Splunk, IBM QRadar, ArcSight, LogRhythm.



# Endpoint Detection and Response (EDR) Systems



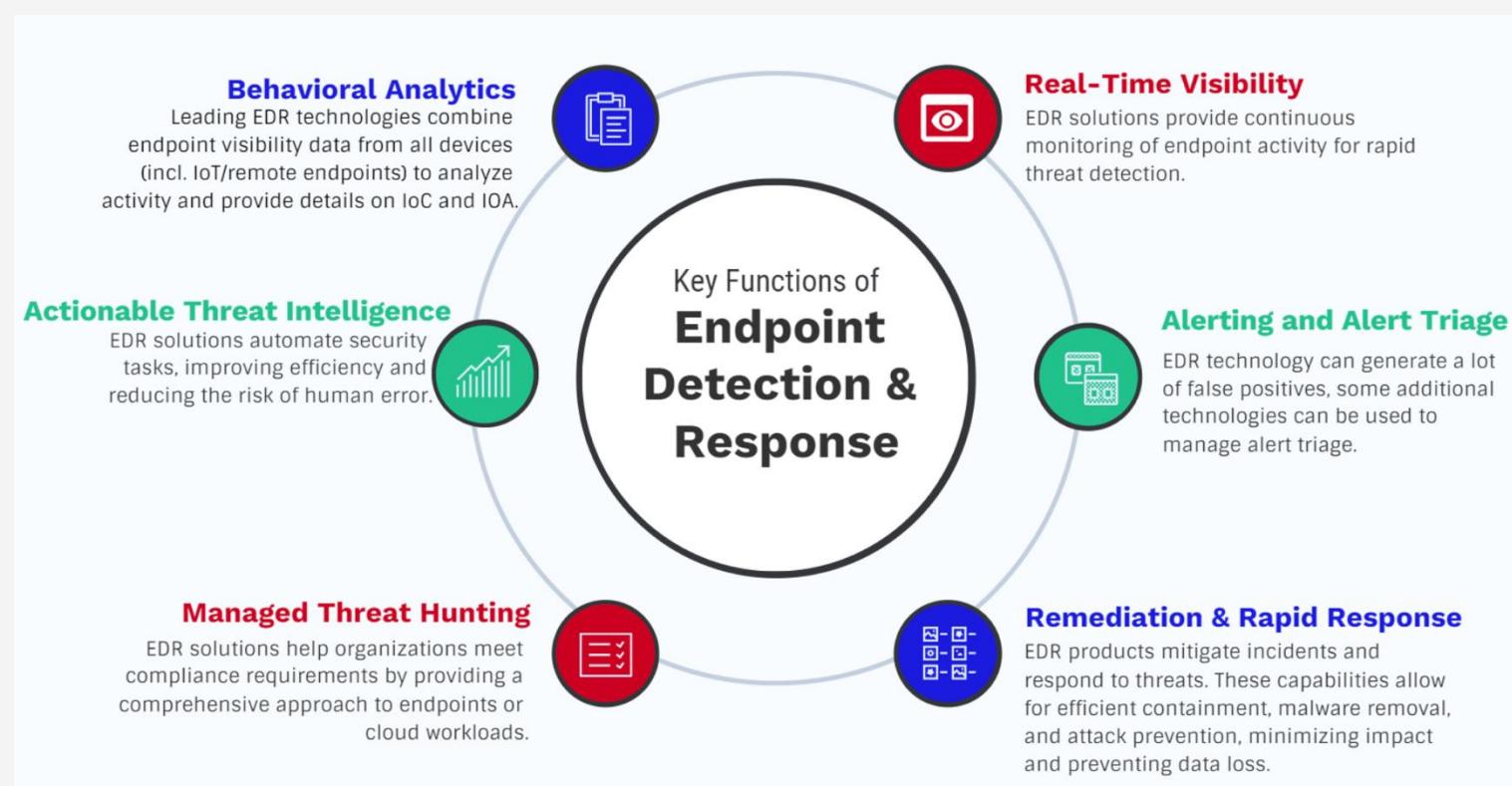
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- To protect endpoints (APIs)

## Key features

- Real-Time Continuous Monitoring
- Endpoint Data Collection
- Automated response (rule-based / AI-based)

**Examples:** VMWare Carbon Black, CrowdStrike Falcon, Akamai API Security



Source: <https://www.openedr.com/blog/what-is-edr/>



# IDS / IPS Systems

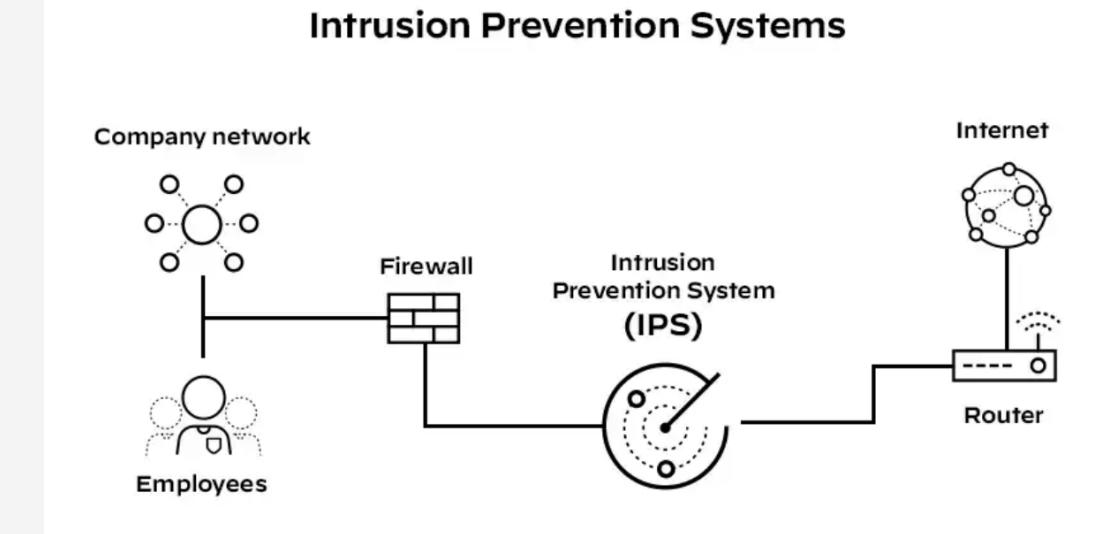
## IDS Features

- **Log Analysis:** Scrutinizing system logs to identify patterns indicative of potential security breaches.
- **Real-Time Monitoring:** Continuous monitoring of network traffic for immediate threat detection.
- **Alerts and Notifications:** Promptly notifying administrators of suspicious activities for swift response.

## IPS Features

- **Firewall Integration:** Seamlessly integrating with firewalls to enhance preemptive security measures.
- **Policy-Based Blocking:** Applying predefined policies to automatically block malicious activities.
- **Anomaly Detection:** Identifying deviations from normal network behavior and taking preventive actions.

**Examples:** Palo Alto Networks, Check Point Quantum IPS, Zscalar Cloud IPS, Kismet, Cisco NGIPS



Source: <https://www.paloaltonetworks.com/cyberpedia/what-is-an-intrusion-prevention-system-ips>



## Task

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Can you imagine some patterns that may be recognised by an IDS that indicate spurious behavior?

Try to differentiate SIEM, EDR, IDS/IPS systems from each other.

# Differentiation of the systems we encountered so far



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## IDS vs IPS vs SIEM



### IDS

An IDS by itself doesn't fix problems. It detects and reports them. System administrators have to read the report, decide whether it indicates a real problem, and lay out a course of action.



### IPS

An IPS takes automated actions in response to a detected threat. It can close off an IP address, limit access, or block an account.



### SIEM

SIEM is not a replacement for IDS and IPS. SIEM uses the information from IDS, IPS, logs, and firewalls to construct a full picture of network security and take measures beyond the screening of hostile traffic.

# Security Orchestration Automation and Response (SOAR)

- Closely related with SIEM
- In a view SIEM on a larger scale
- Focus on top attack vectors and orchestration around that
- Higher-order inference on lower-level observations
- Tools and culture / approach

Examples: IBM QRadar, ServiceNow, Splunk, Fortinet

Exercise: Splunk →

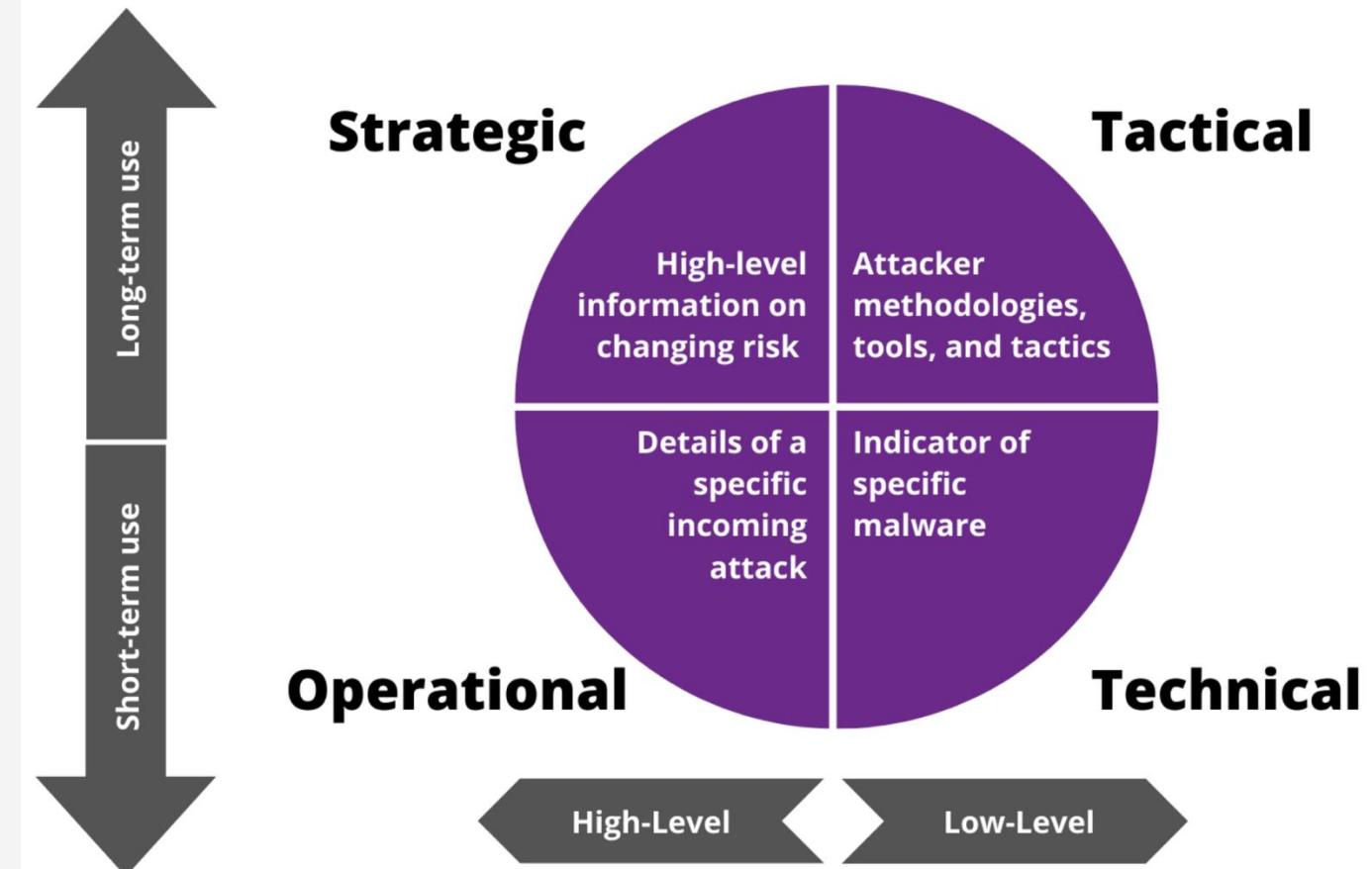
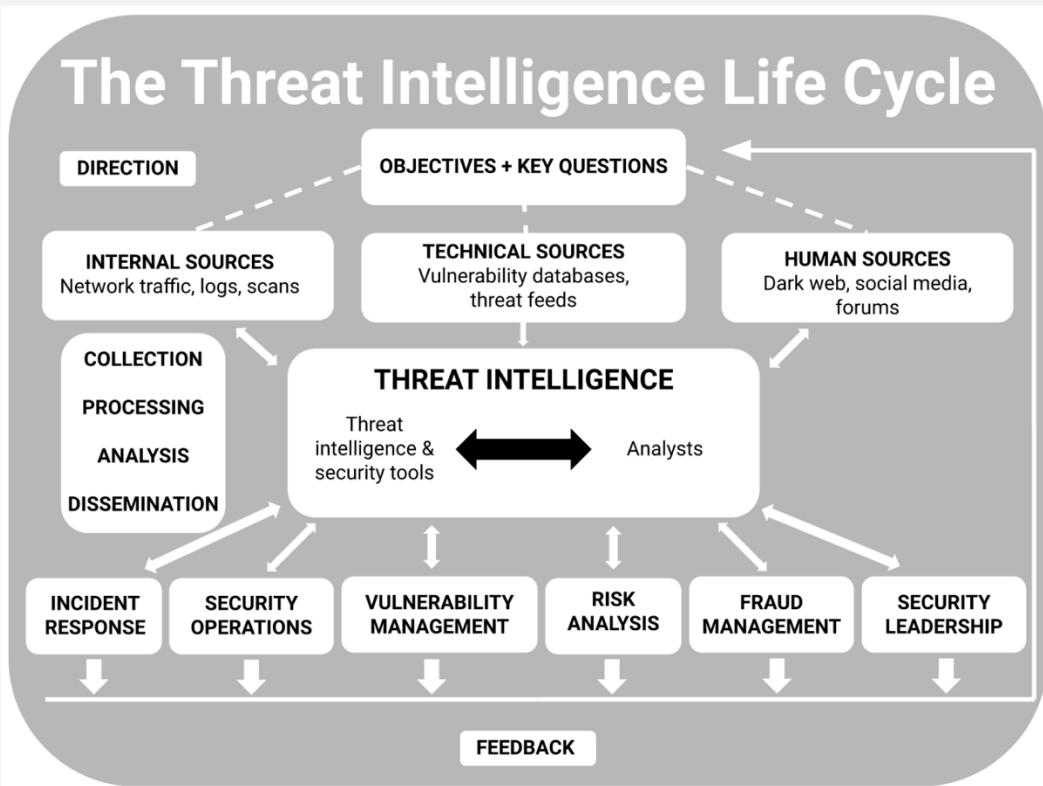
<https://docs.splunk.com/Documentation/SOAR>

Register for test account, generate sample log data via ChatGPT, ingest it and analyse it





# Threat Intelligence



**Examples:** ThreatConnect, Rapid7 Threat Command, Palo Alto Networks Cortex XSOAR



# Forensics

The Scalyr interface shows a search for "dataset = "accesslog" & serverHost = \* & status >= 500 & stat = 1". The results are filtered by "backend3". The timeline shows events from 1:22 PM to 1:28 PM. The log entries are as follows:

```
13:25[182.000 backend3] /var/log/apache2/access.log 33.291.177.40 - [12/Jan/2017:12:17:51 +0000] "GET /dashboard HTTP/1.1" 500 16295 "-" "Mozilla/5.0 (Macintosh; Intel Mac OS X 10_10_1) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/60.0.3112.117 Safari/537.36"
```

Below the log search is a diagram showing the intersection of Metrics, Logging, and Tracing.

The diagram consists of three overlapping circles. The top circle is labeled "Metrics", the left circle is labeled "Logging", and the bottom circle is labeled "Tracing". The intersection of all three circles contains a small icon of colored dots.

The OpenTrace logo features a large blue circular graphic with radiating lines, followed by the text "OPEN TRACE" in a bold, blue, sans-serif font.

The screenshot shows a transaction sample from November 1st, 2018, at 11:34:28.798. The timeline spans 12 ms. The request was a GET to http://172.18.0.8:3000/api/types. The response was an HTTP 2xx result. The user ID was N/A. The transaction involved several services: opbeans-ruby, opbeans-python, opbeans-java, and opbeans-go. The timeline highlights various stages of the request, including the initial connection, processing by different services, and the final response. A legend indicates the color coding for different service types.

The dashboard displays security indicators across five categories: ACCESS NOTABLES (72), NETWORK NOTABLES (202), IDENTITY NOTABLES (0), AUDIT NOTABLES (0), and THREAT NOTABLES (83). It includes charts for notable events by urgency and over time, as well as lists of top notable events and sources.

What to consider when enabling forensics?

splunk>

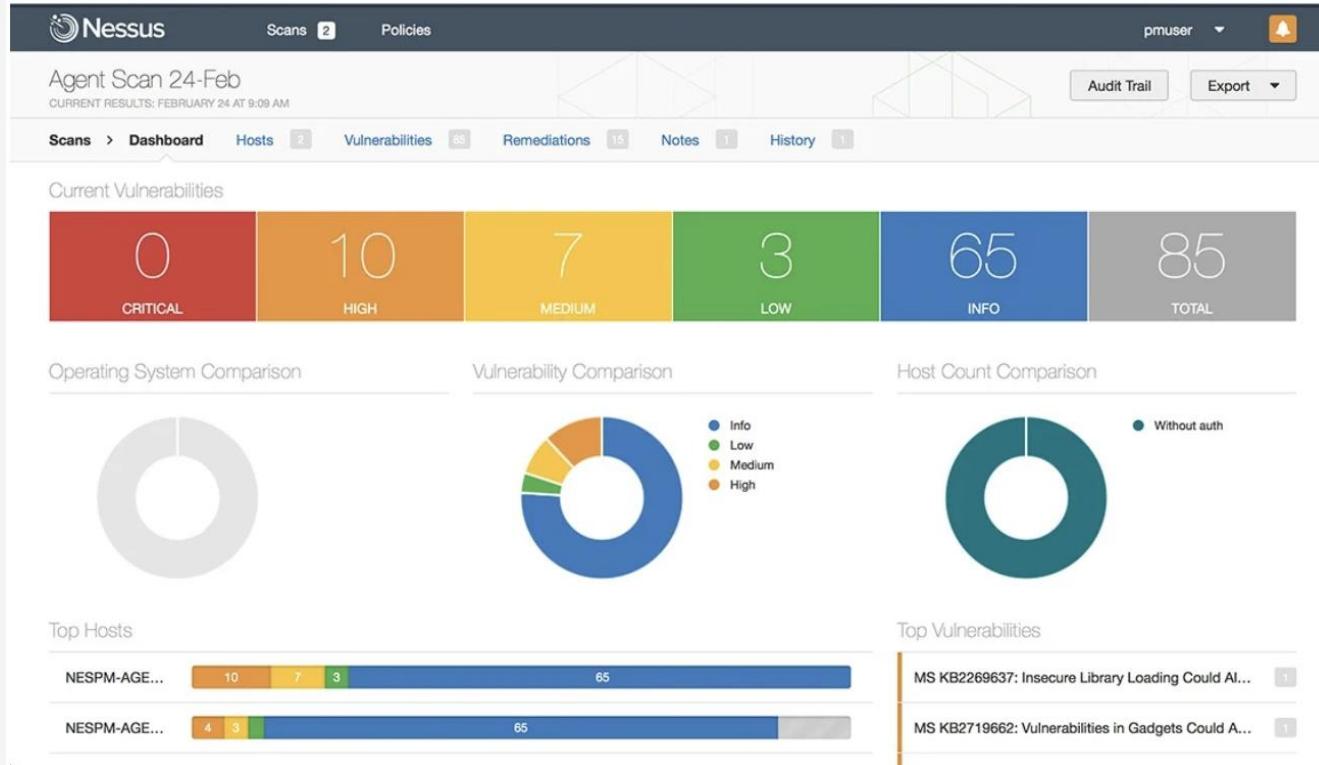


## Question

- Where do you see the challenges in implementing such a system (comprising EDR, IPS, SIEM, SOAR, Threat Intelligence)?
- How could steps be to implement such systems? How would you tackle the problem?
- What to consider?



# Asset Management and Scanning

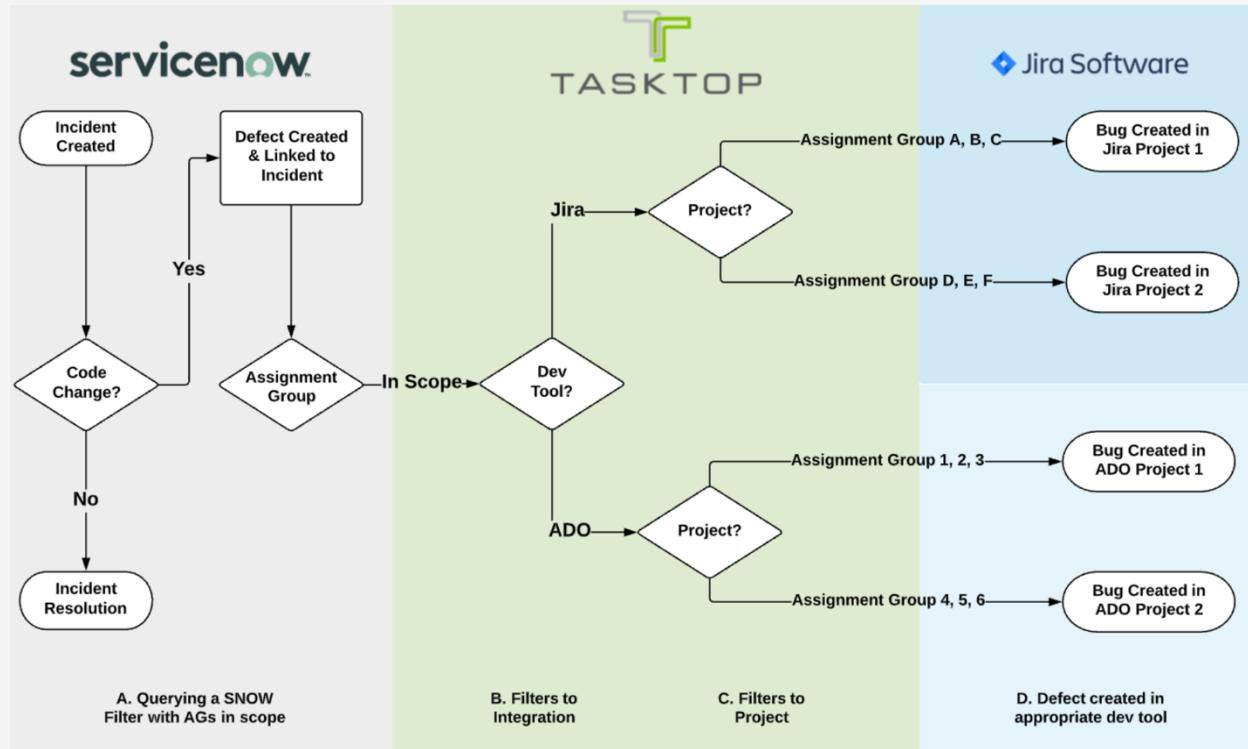


- Regular Scanning for changes in the infrastructure
- Internal and external posture
- Asset Management: Inventory of assets together with meta info and classifications

## Questions

- Why is asset management and scanning important?
- What are challenges around that?

# Incident Management



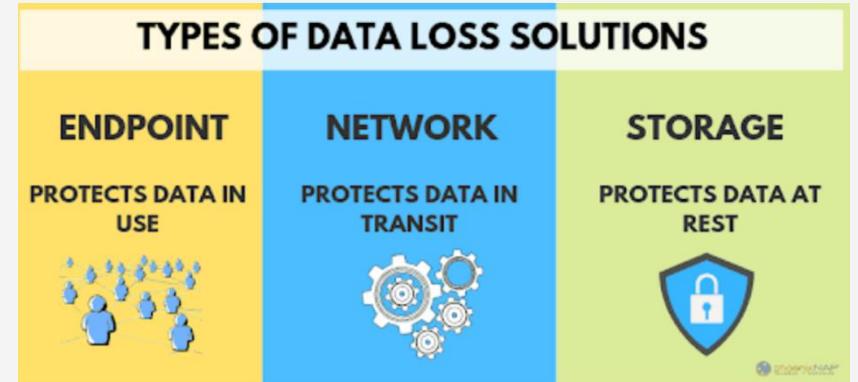
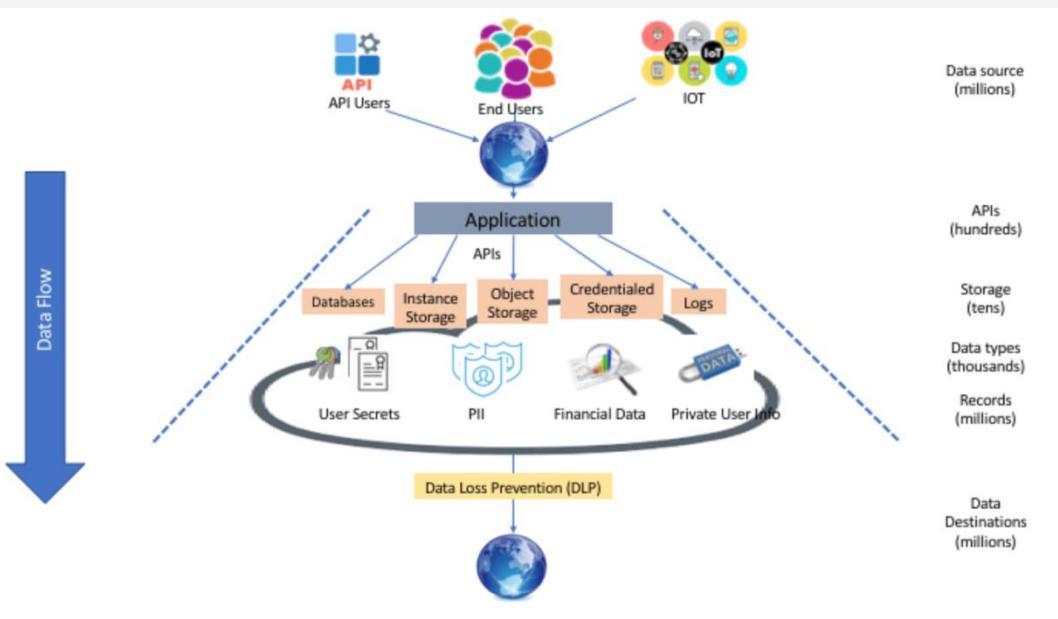
- Operational Excellence
  - Focus at Web: MTTR prio (vs. MTBF focus)
  - Entails rapid response, forensics
  - Operational Excellence Meetings

# Question

- What challenges do you expect?



# Data Loss Prevention



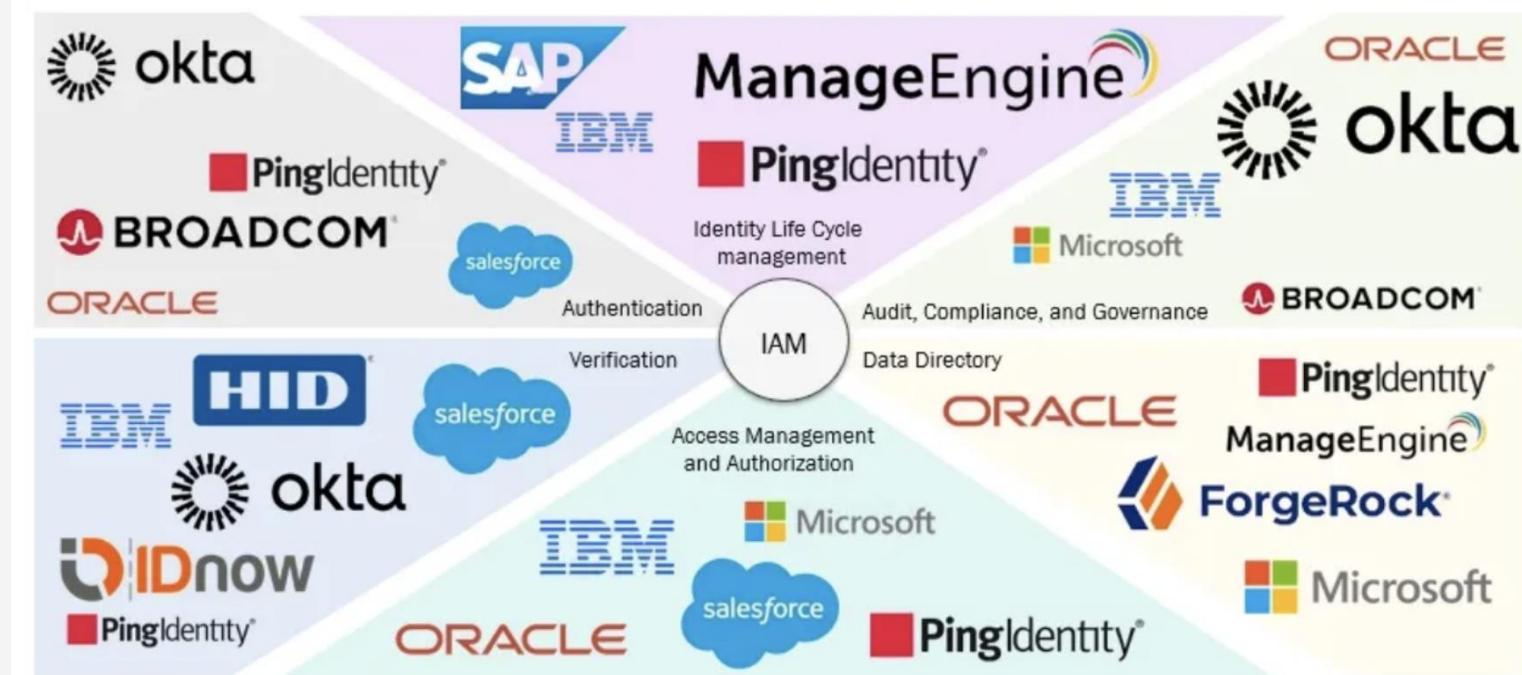
Examples: Digital Guardian, BetterCloud, Endpoint Protector, Broadcom Symantec DLP, Check Point



# IAM Tools

Some tasks around IAM

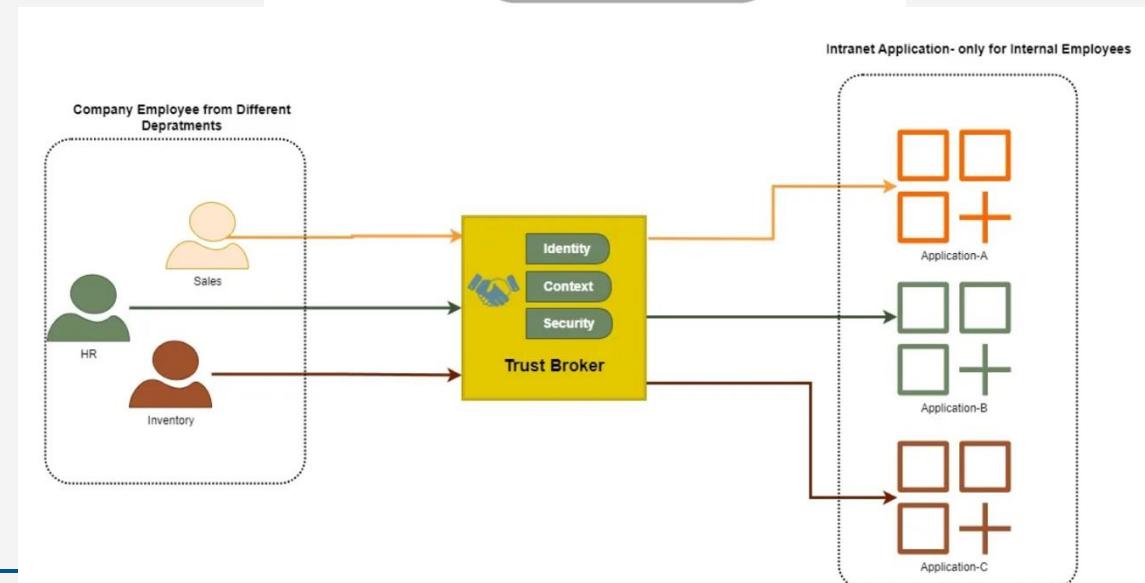
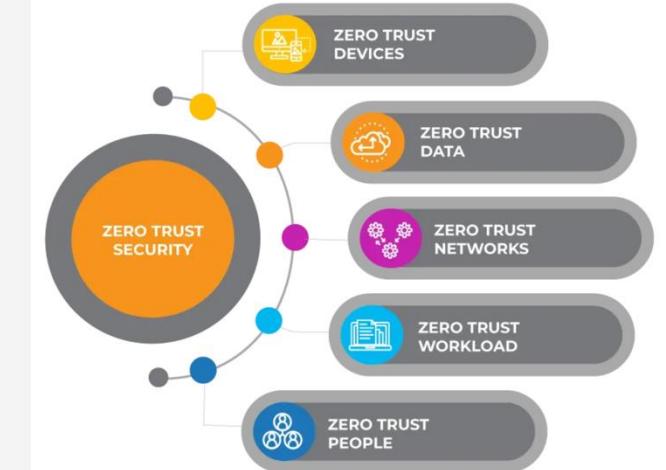
- User provisioning, life cycle management
- Authentication, SSO
- Authorization, access control
- MFA
- Privileged Access Management
- Auditing & Compliance





# Zero Trust Approach

- No user or device can be trusted by default (no one outside or inside the network unless authenticated)
- Need to know principle, least privilege principle
- Verification via **identity**, **context**, **security posture** of connecting device (compliance)



Source: <https://medium.com/google-cloud/zero-trust-security-model-a-new-approach-to-network-security-9dee89564b3e>



## Question

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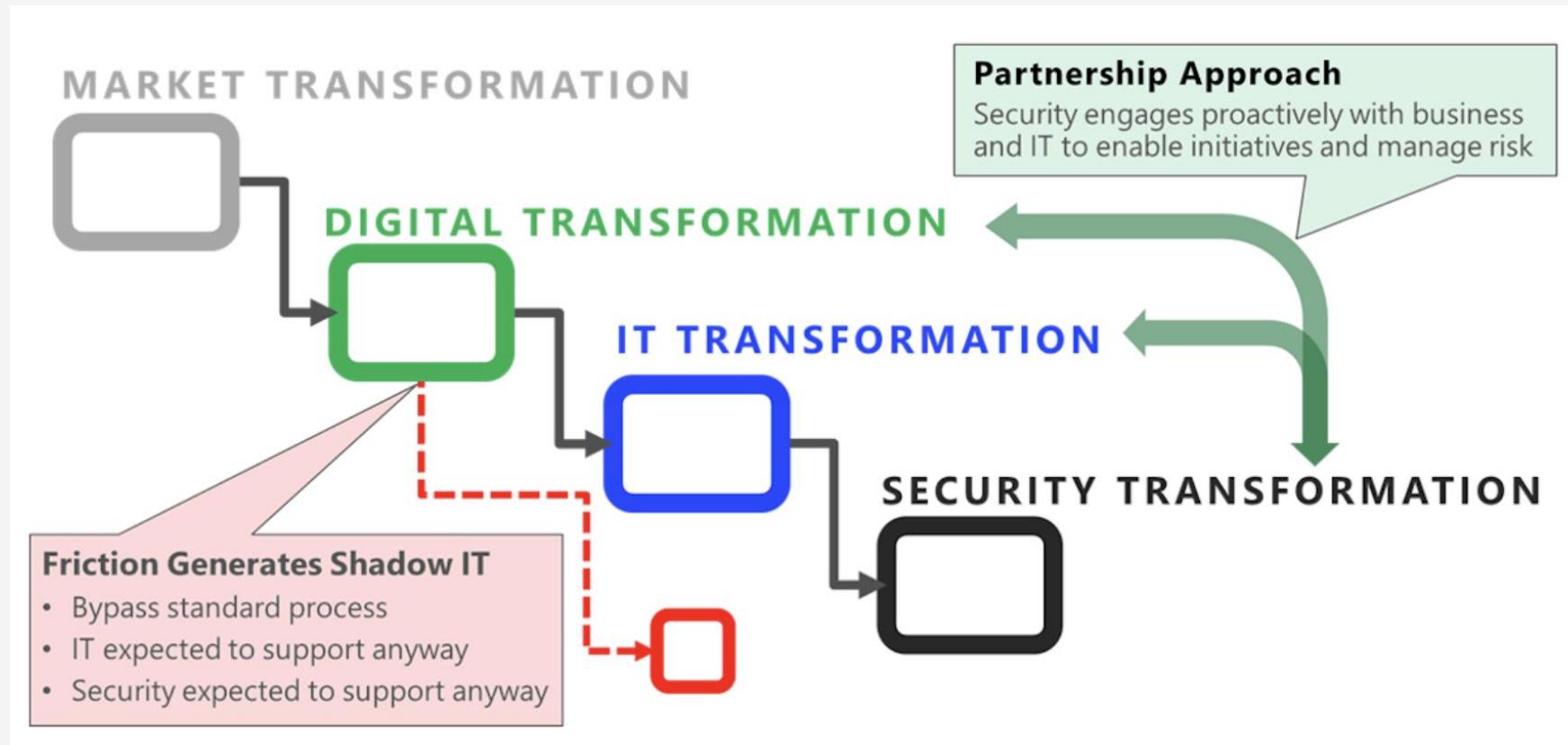
We took a look at a standard IS organization. However, key is the entanglement with business.

Why?

How can that be achieved?



# Challenges for Security in Organizations



# Derive a Security Strategy from the Business Strategy



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## ENTERPRISE SECURITY STRATEGY



### ASSESS

To protect you must first identify the 'what', the associated risks and requirements.



### PROTECT

To maintain confidentiality, integrity and availability you must enforce policy and continuously adapt security controls.



### DETECT & RESPOND

Real-time detection of security incidents and automated response to contain are crucial to preserving a secure state.



Security  
Identity & access mgt, encryption, workload protection and analytics



Data protection  
Active snapshots, backup, archiving and Disaster Recovery



Compliance  
GDPR, industry regulations, standards and certifications

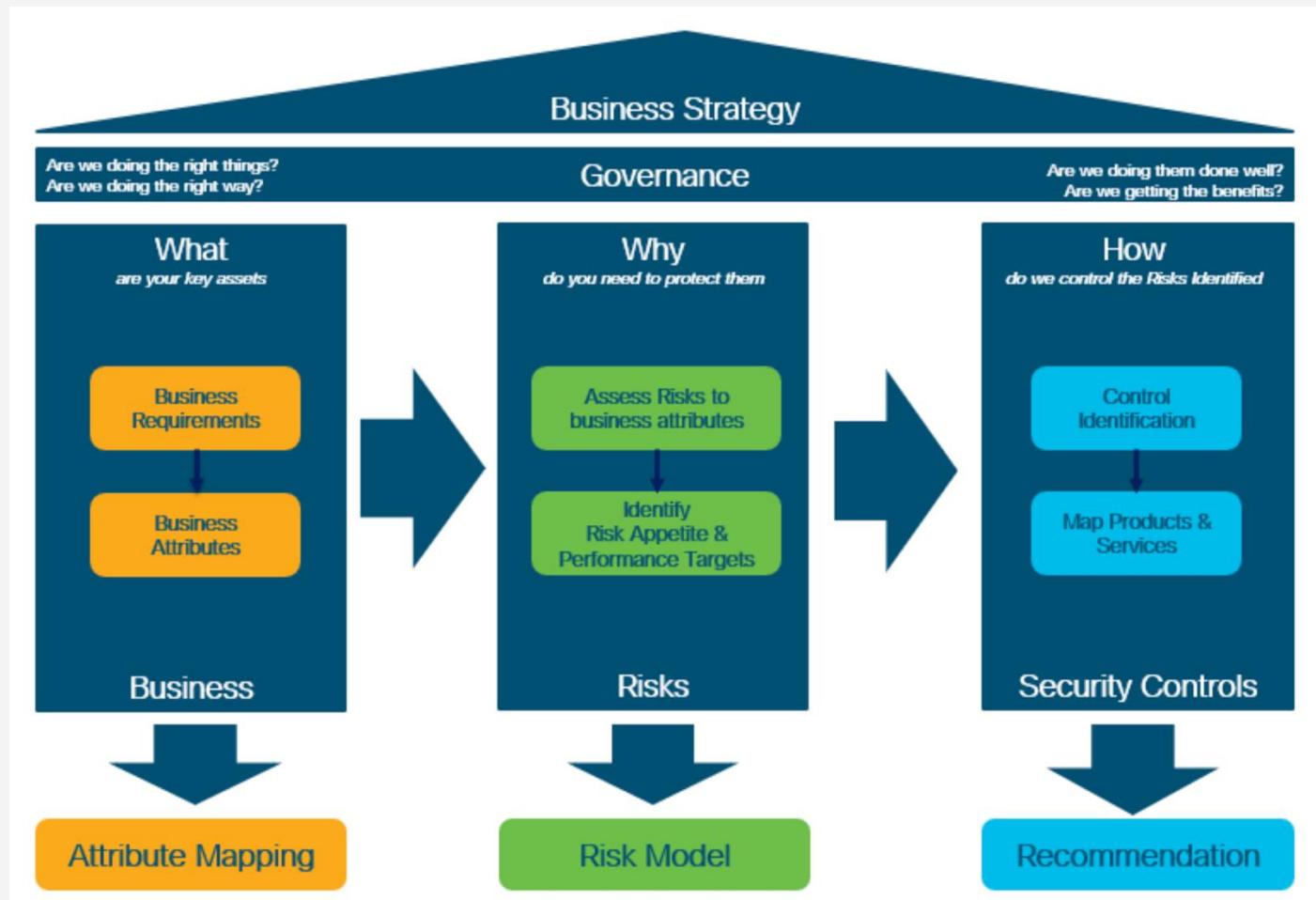


Contractual  
Risk reduction & business SLA's under local law

# Derive a Security Strategy from the Business Strategy



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# Why is it important to balance business strategy and security strategy?



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Source: <https://citysecuritymagazine.com/risk-management/opinion-corporate-security-strategy-3/>



# Some related strategic terms

## Risk Management



Risk management plan chart illustration



Source: <https://www.invensislearning.com/blog/risk-management-process-steps/>,  
<https://iso-docs.com/blogs/iso-22301-standard/iso-22301-clause-1-scope> , <https://www.wallstreetmojo.com/business-continuity-planning/>

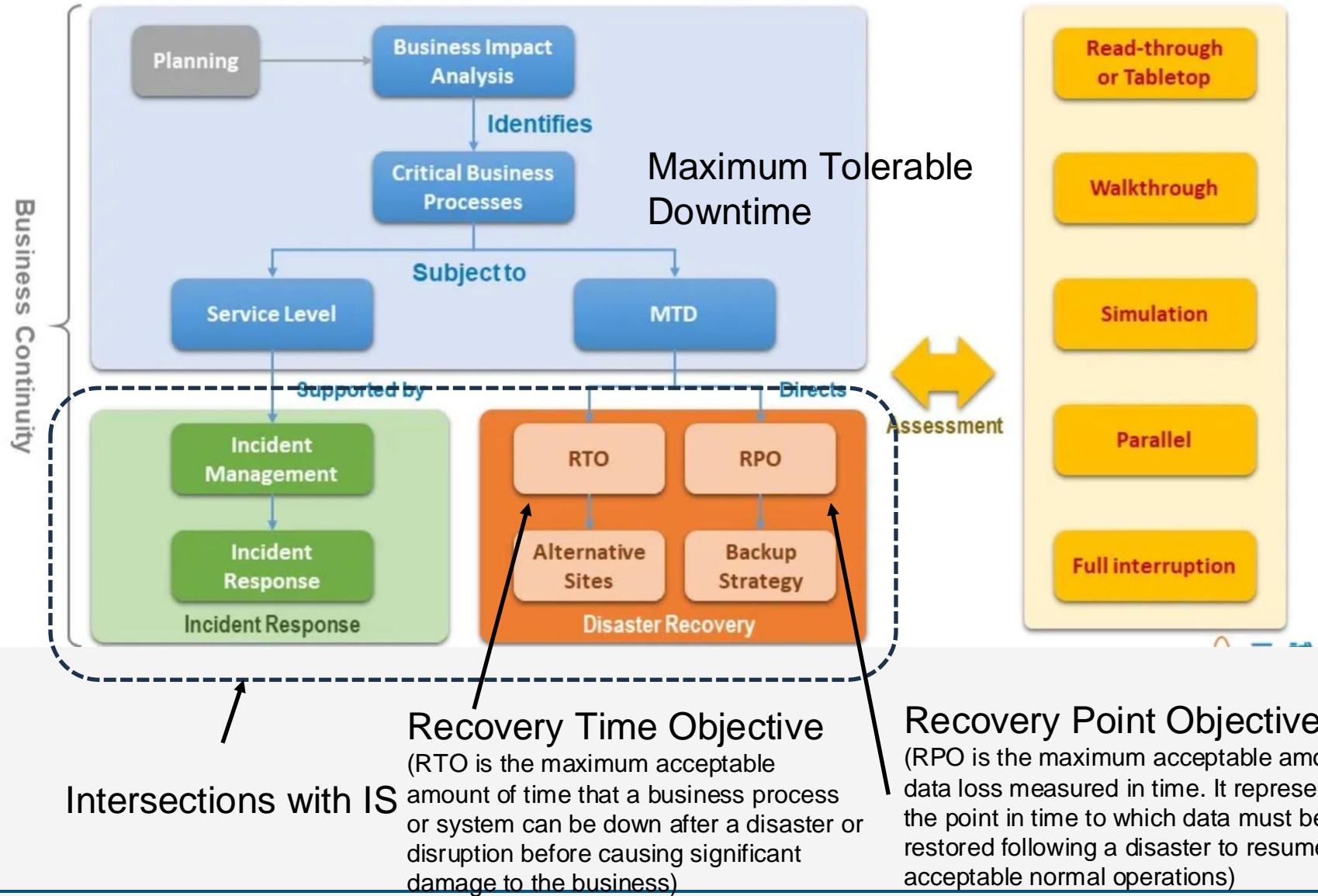
## Business Continuity Management



Which interfaces to IS do you see?



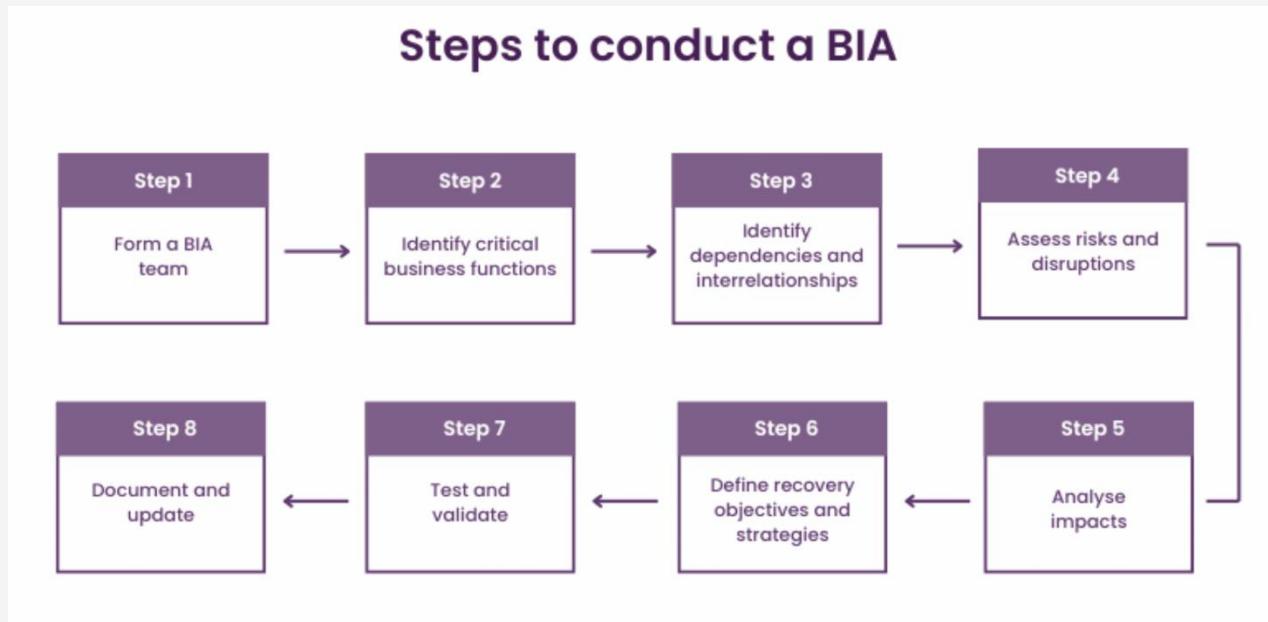
# Business Continuity Management



# In these contexts, Business Impact Analyses are being used



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	IMPACTS			
	Compliance & Regulatory	Reputation	Financial	Mission
Human Resources	Low	High	Low	High
Information Technology	Low	High	High	High
Product Development	Low	High	High	High
Information Security	High	High	Low	Low
Finance	High	High	Low	High

# Case Study

You can also use your  
own company as case  
study



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TechWave Solutions is a mid-sized IT services and consulting company based in London, specializing in [cloud computing](#), [cybersecurity](#), and [software development](#). With a workforce of 500 employees, TechWave serves clients across various sectors, including finance, healthcare, and retail. The company's reputation is built on delivering high-quality, secure, and reliable IT solutions.

**Scenario:** TechWave Solutions is preparing for an upcoming merger with a larger multinational IT corporation. As part of the due diligence process, the company needs to exercise and strengthen its risk management, business continuity management (BCM), business impact analysis (BIA), and information security management practices.

## Key Business Elements:

**1. Primary Services:** Cloud computing, cybersecurity, software development.

**2. Key Resources:** IT infrastructure, proprietary software, client data, skilled workforce.

**3. Critical Departments:** IT, Cybersecurity, Software Development, HR, Finance, and Client Support.

**Task:** Gather together in groups, and, from this high level description, try to

- Risk Management Plan: Establish some key risks: simulate a small risk identification: Identify risks, assess risks, risk treatment strategies; deliverables: Risk Matrix, Risk Register
- BCM plan: identify critical business functions, assess the impact of their disruption, determine Recovery Time Objectives (RTOs) and Recovery Point Objectives (RPOs), develop continuity strategies (how to maintain operations during various disruption scenarios, including remote work capabilities and data recovery plans), incident response plan
- Try also to discuss the interplay between Risk Management, BCM, IS departments and processes



## Case Study - Examples for what to consider

- Cybersecurity Breaches
- IS breaches – externally and internally originated
- System Downtime
- Merger Challenges
- Pandemic / Natural Desaster
- Software Development risks
- There is no right or wrong
- Try to be creative



## Question

So far, we focussed mostly on detection and response (SOC topics) and Security Strategy.  
What other aspects may be of relevance?



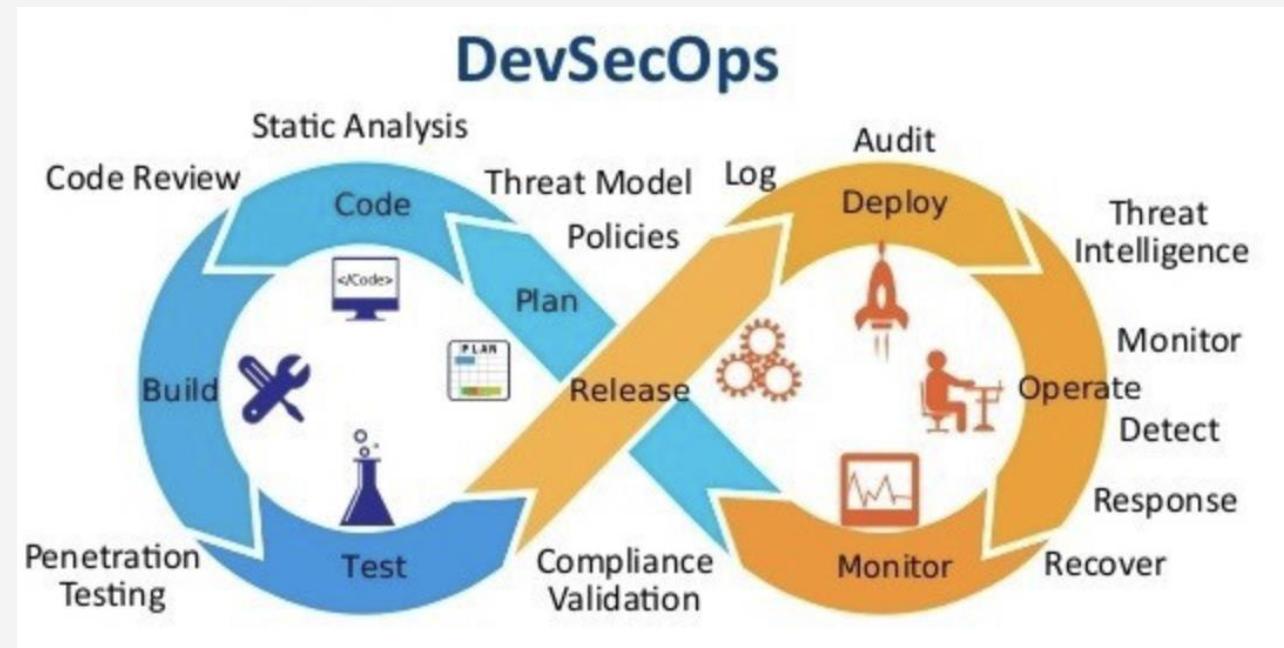
# Product / Application Security

- Idea: Add the security mindset in software development
- While SOC focusses on "stopping the bleeding" and enhancing the security posture of the company's assets in general, Product Security focusses on designing secure products
- Examples of activities:
  - Production Readiness Reviews
  - Architectural reviews
  - Developing secure solutions to mitigate risks
- → More on that when we get to Security Architectures



# DevSecOps

- Enrich DevOps by automated checks, processes, tech, e.g. automated static analyses built into the CI/CD pipeline
- shift left for security in the development lifecycle





# Offensive Security

## WHAT IS A PENETRATION TEST?

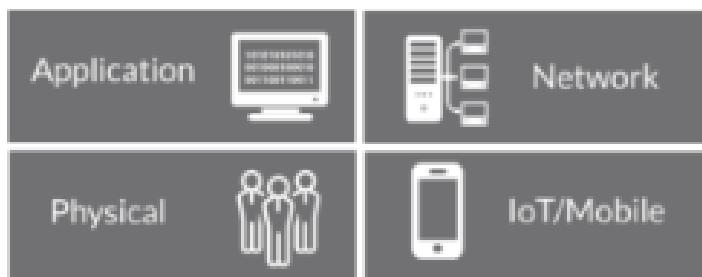


An authorized attack on a computer system, network, or application to identify security vulnerabilities bad actors might exploit.

### The Process



### Types of Penetration Tests



### Why Conduct a Penetration Test?



Identify  
security  
vulnerabilities



Validate  
compliance with  
policies



Evaluate  
effectiveness of  
defenses



## Question

What kind of skills do you consider relevant for the various security positions?

- SOC
- IAM
- Product / Application Security
- CISO
- Security Engineering
- Compliance / ISMS
- ...



# Question

What may be the purpose, the idea behind introducing an IS framework?

# Why use Security Frameworks?



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- Provide a **structured** approach to managing information security
- Help organizations **comply** with regulations and standards
- Facilitate **risk management** and incident response
- Enhance customer and **stakeholder** confidence



# Overview of ISO 27001

- International Standard for Information Security Management Systems (ISMS)
- Focuses on a risk management process to secure information assets

## Key Components

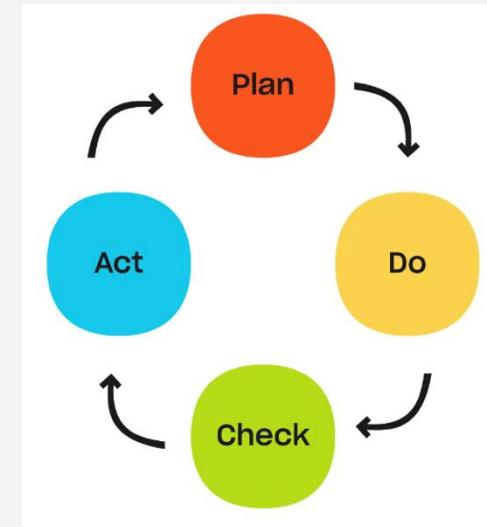
- **ISMS Scope:** Define the boundaries and context of the ISMS
- **Risk Assessment:** Identify and evaluate information security risks
- **Controls:** Implement controls to mitigate identified risks
- **Continuous Improvement:** Regularly review and update the ISMS



# What is an ISMS?

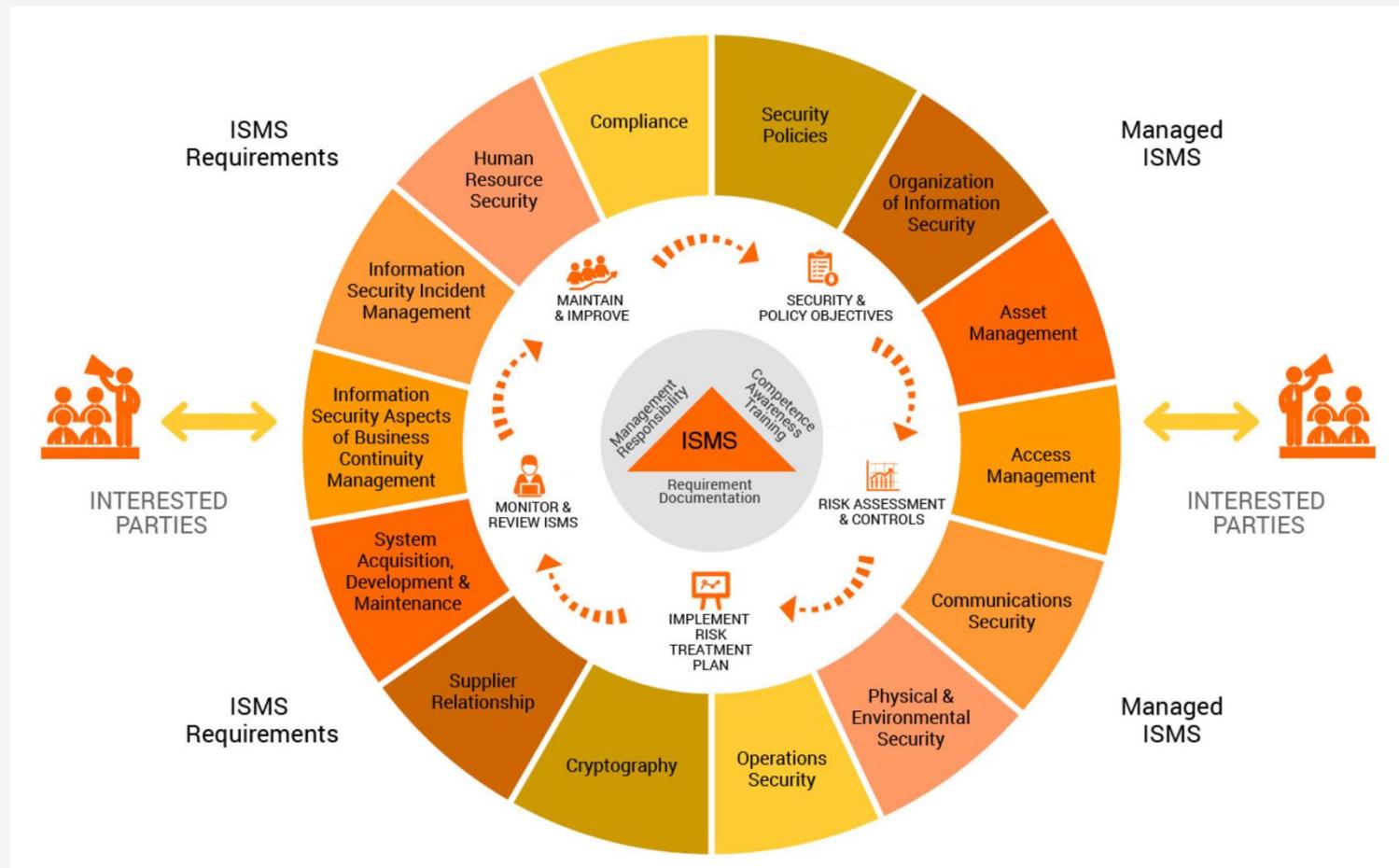
An **Information Security Management System (ISMS)** is a systematic approach for establishing, implementing, operating, monitoring, reviewing, maintaining, and improving an organization's **information security** to achieve business objectives.

It encompasses people, processes, and IT systems by applying a risk management process to daily data management workflows.





# ISMS Overview





# Key Domains in ISO 27001

## The 14 Domains of ISO 27001



Information Security Policies



Human Resource Security



Access Control



Physical and Environmental Security



Operations Security



Organization of Information Security



Asset Management



Cryptography



System Acquisition,  
Development, and Maintenance



Supplier Relationships



Communication Security



Business Continuity Management

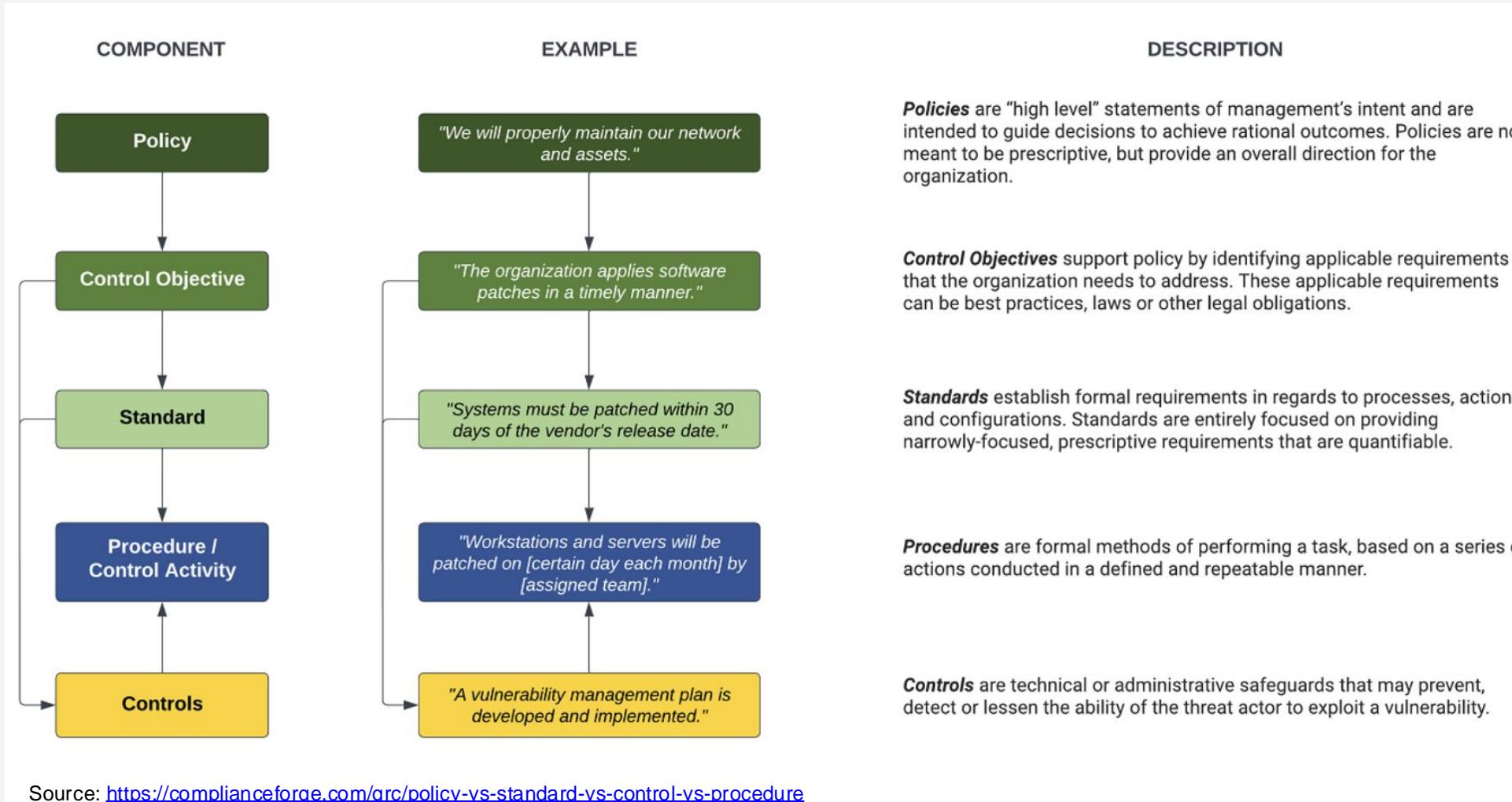


Compliance



Information Security Incident  
Management

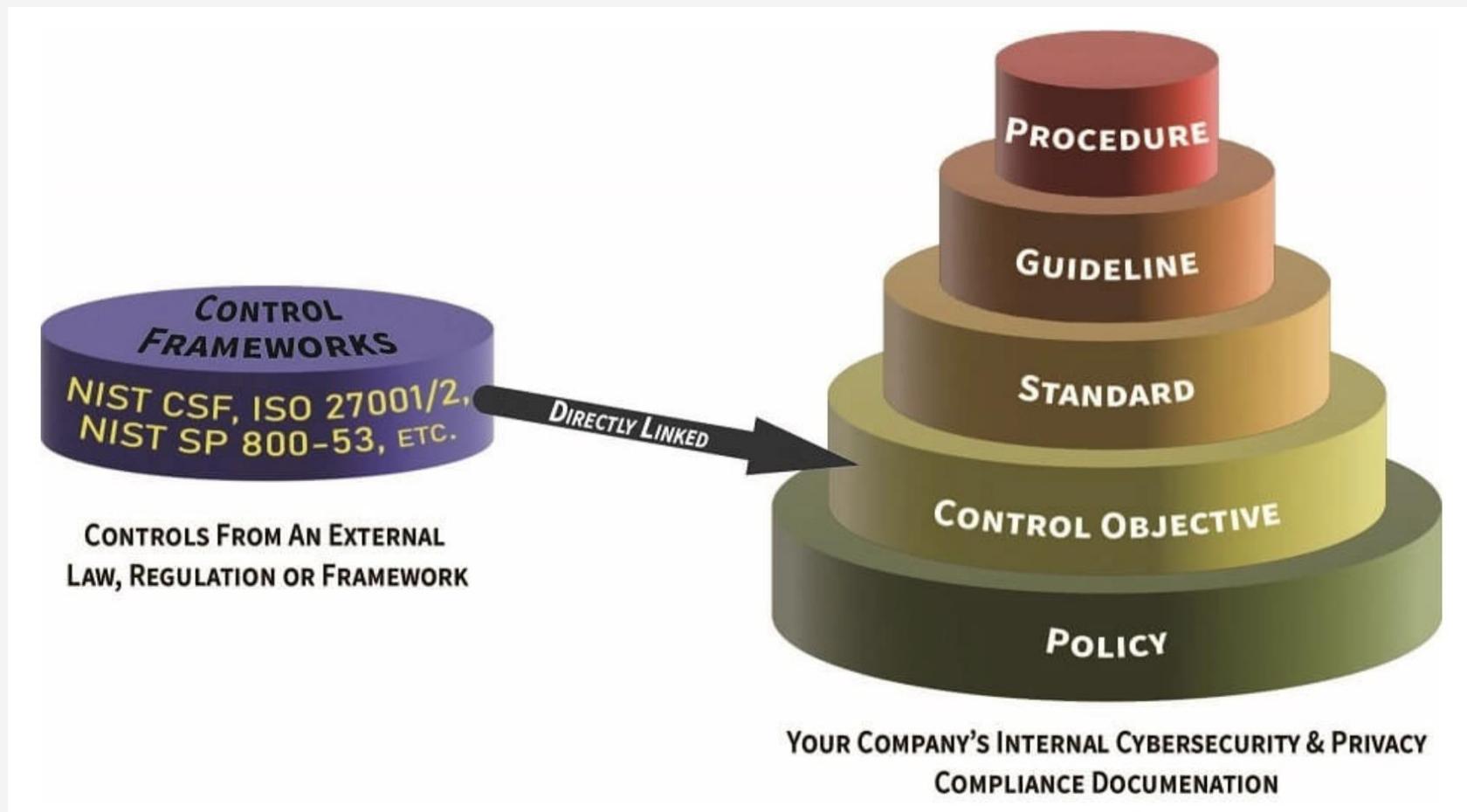
# Hierarchy of Documents in a Company's IS framework



# Hierarchy of Documents in a Company's IS framework



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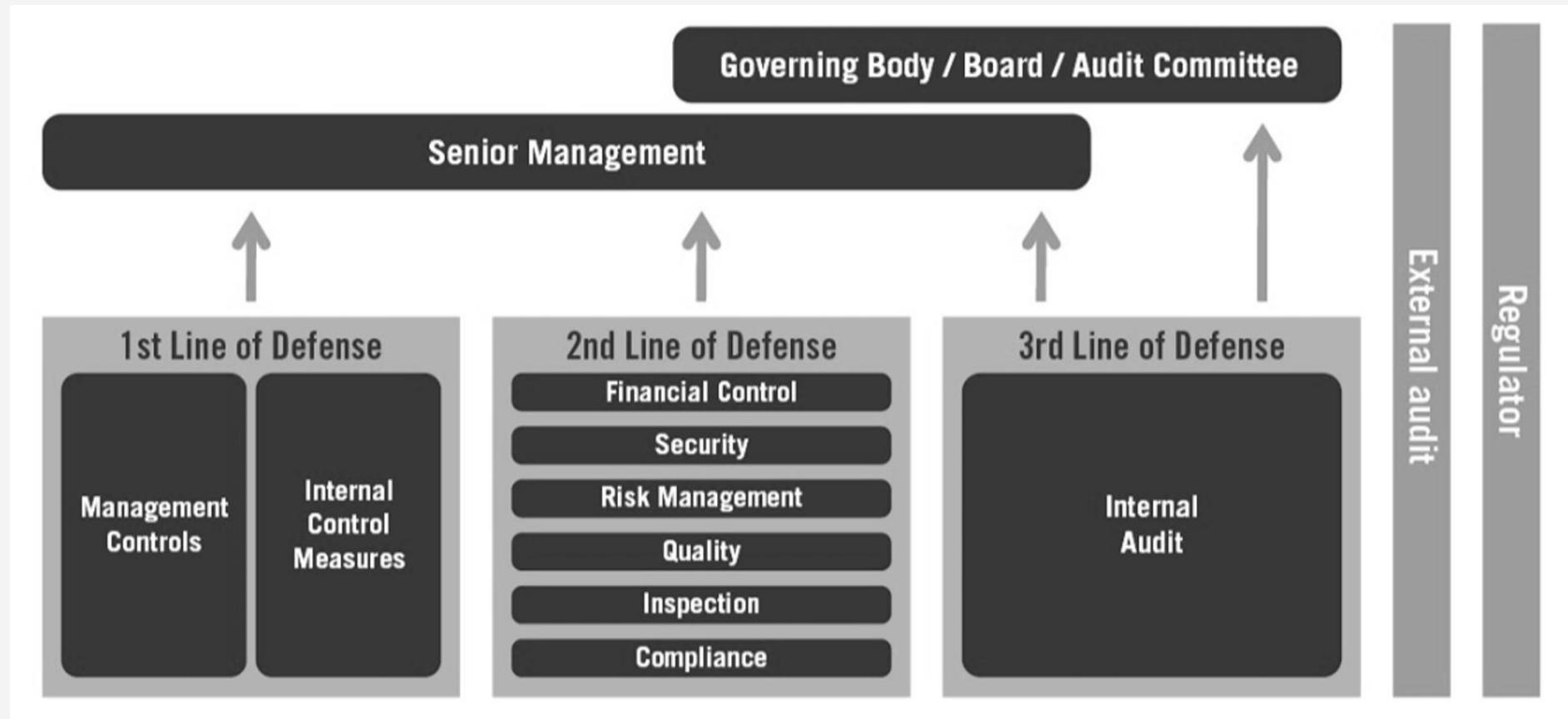


# Towards setting up ISO 27001

- InfoSec Policy (high level principles, responsibilities etc.)
- Control Objectives and Controls (Risk Assessment → select appropriate controls)
- Risk Management Policy (How risks are identified, assessed etc.)
- Access Control Policy
- Asset Management Policy
- Crypto Policy
- Physical and Environmental Security Policy
- Communications and Operations Management Policy
- Incident Management Policy
- Supplier Relationships Policy
- Business Continuity Policy
- Compliance Policy (regulatory requirements)
- HR Policy



# Three Lines of Defense Approach





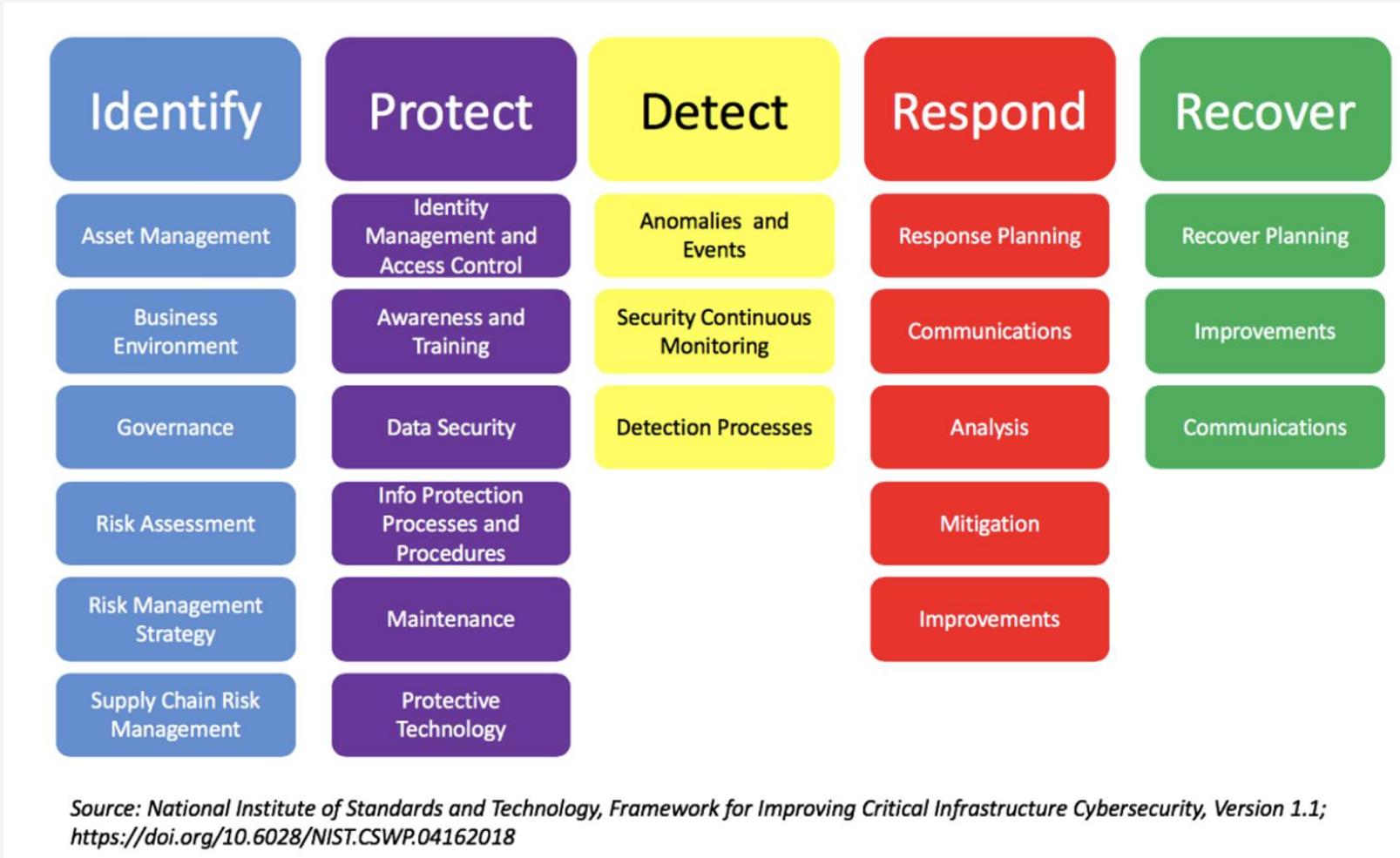
# NIST Cybersecurity Framework

- Framework that provides structure to manage cybersecurity risks
- Core consists of 5 concurrent and continuous functions: Identify, Protect, Detect, Respond, Recover
- Four Tiers for a maturity level: Partial, Risk Informed, Repeatable, Adaptive
- Tailoring: according to organization's business requirements, risk appetite, resources, environment etc.





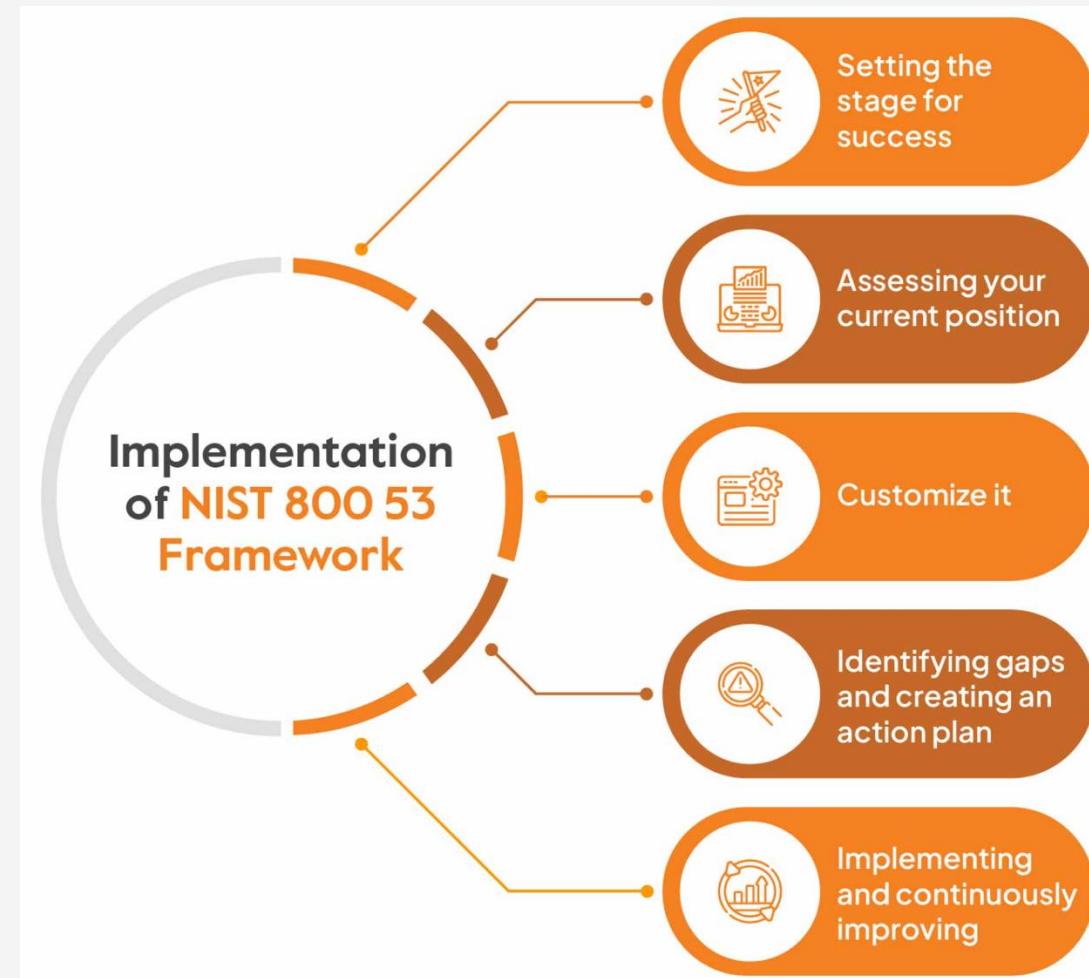
# NIST Cybersecurity Framework



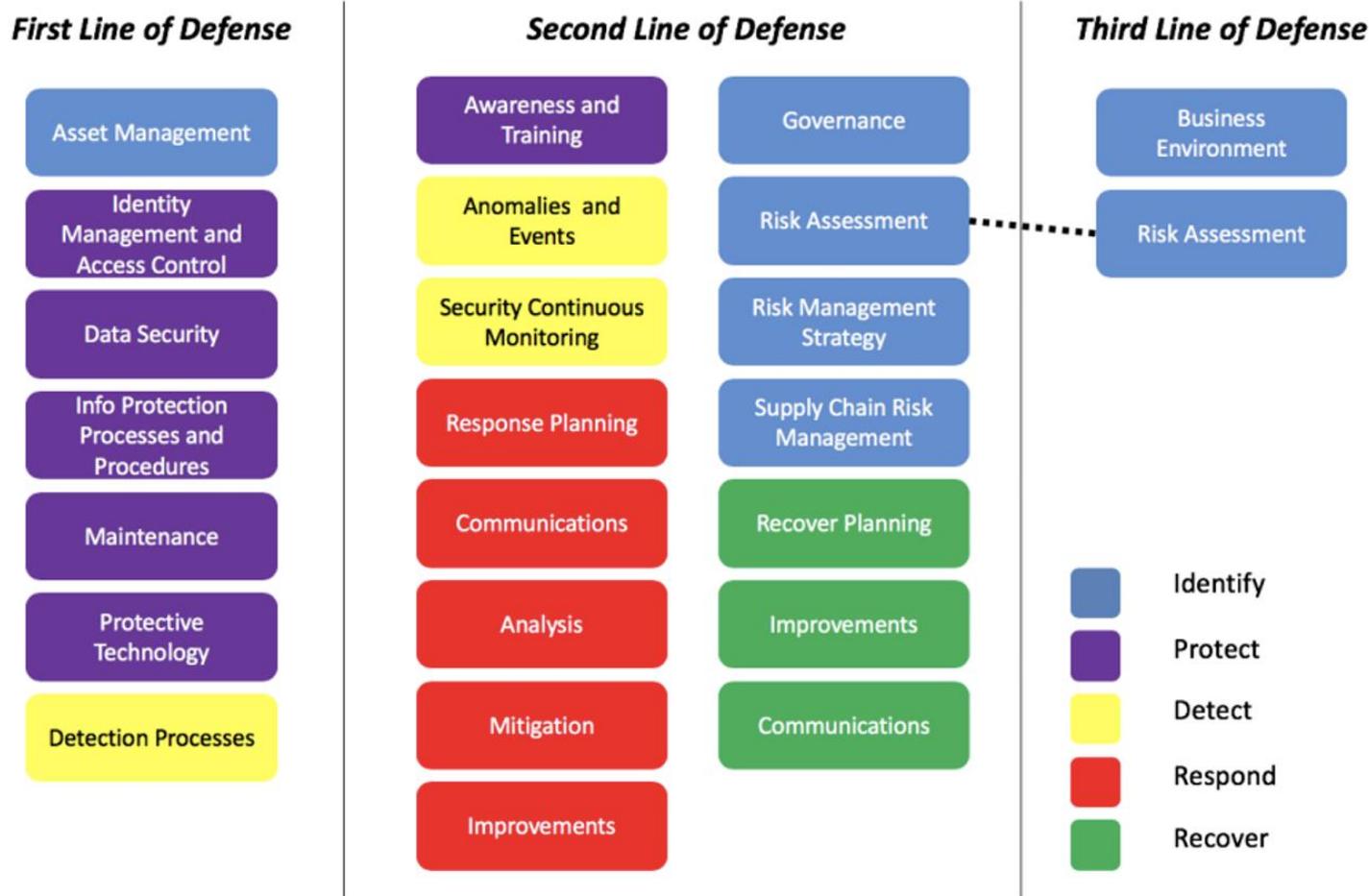


# Implementing NIST

- NIST also follows a PDCA cycle
- After typical assessment of the current situation and tailoring to the own organization, executing the plan, thereby reducing the gap between status quo and desired goal, a continuous improvement cycle begins



# Mapping Cybersecurity Framework to Three Lines of Defense

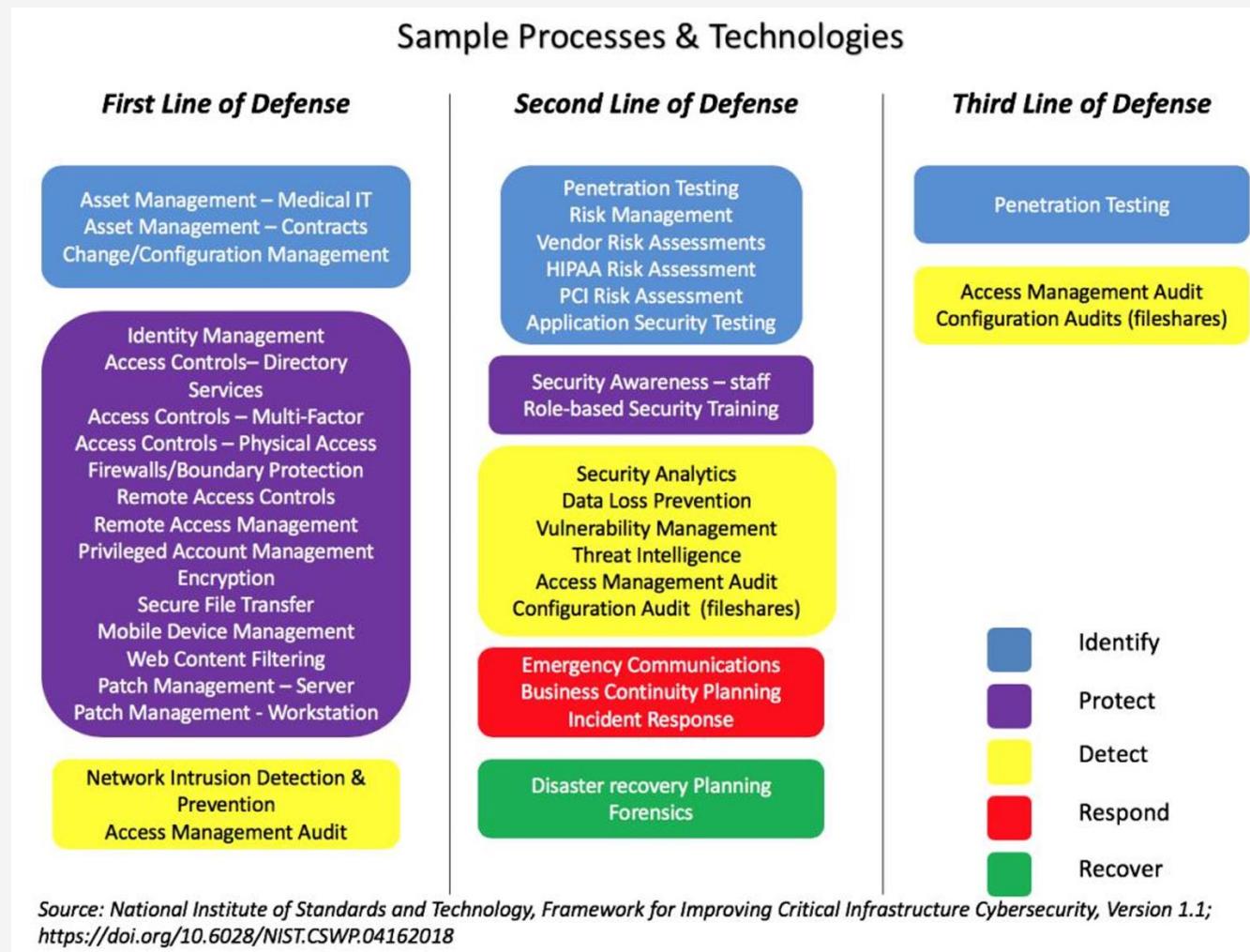


Source: National Institute of Standards and Technology, Framework for Improving Critical Infrastructure Cybersecurity, Version 1.1;  
<https://doi.org/10.6028/NIST.CSWP.04162018>

# Sample Processes and Technology Mapping



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# NIST SP 800-53

- “Security and Privacy Controls for Information Systems and Organizations”
- Catalog of controls (security and privacy)
- Split into 18 control families
- Controls split into three impact levels (low, moderate, high)
- Privacy controls as well

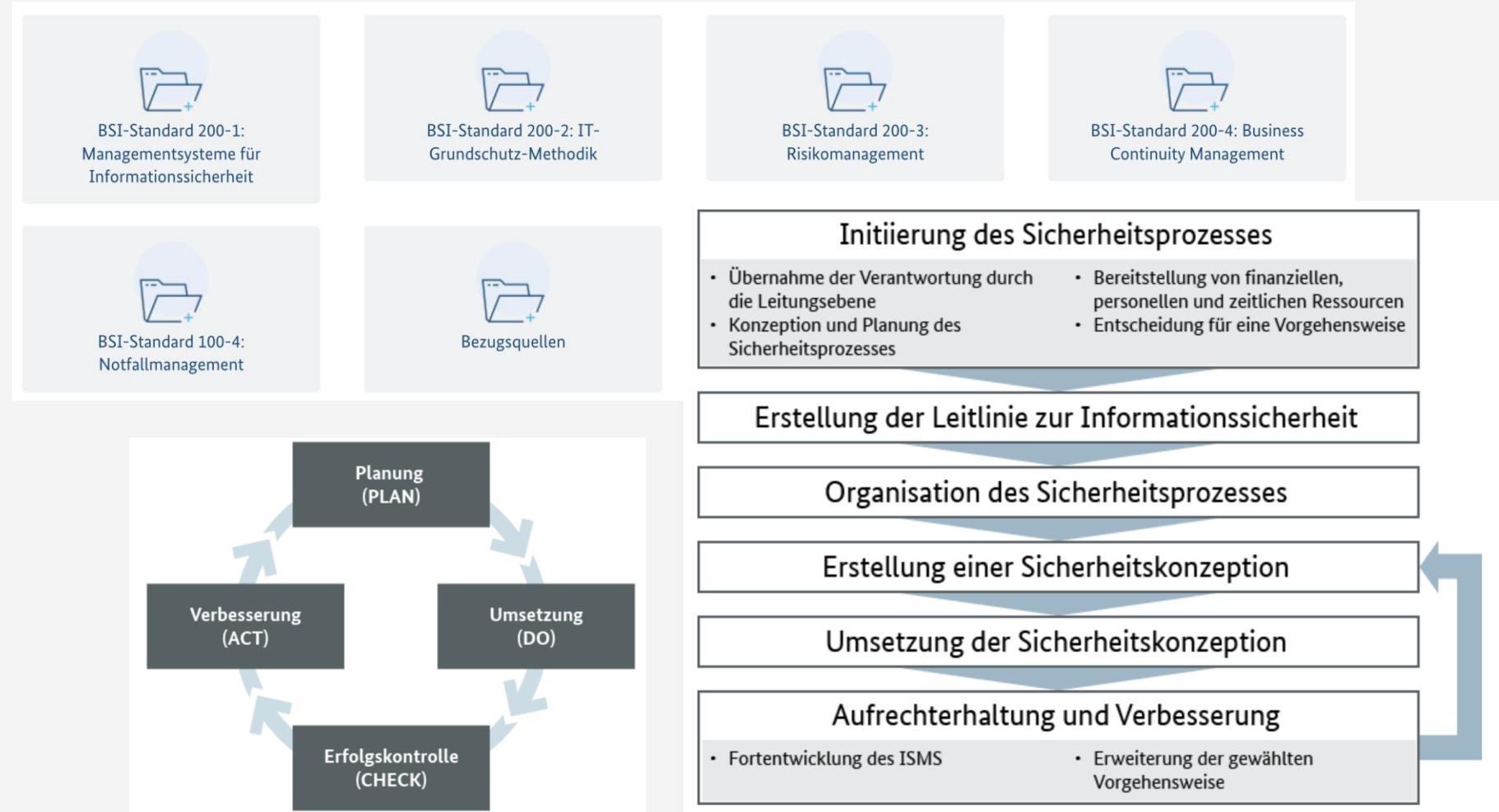
## Control Families

<u>AC</u>	ACCESS CONTROL
<u>AT</u>	AWARENESS AND TRAINING
<u>AU</u>	AUDIT AND ACCOUNTABILITY
<u>CA</u>	ASSESSMENT, AUTHORIZATION, AND MONITORING
<u>CM</u>	CONFIGURATION MANAGEMENT
<u>CP</u>	CONTINGENCY PLANNING
<u>IA</u>	IDENTIFICATION AND AUTHENTICATION
<u>IR</u>	INCIDENT RESPONSE
<u>MA</u>	MAINTENANCE
<u>MP</u>	MEDIA PROTECTION
<u>PE</u>	PHYSICAL AND ENVIRONMENTAL PROTECTION
<u>PL</u>	PLANNING
<u>PM</u>	PROGRAM MANAGEMENT
<u>PS</u>	PERSONNEL SECURITY
<u>PT</u>	PERSONALLY IDENTIFIABLE INFORMATION PROCESSING AND TRANSPARENCY
<u>RA</u>	RISK ASSESSMENT
<u>SA</u>	SYSTEM AND SERVICES ACQUISITION
<u>SC</u>	SYSTEM AND COMMUNICATIONS PROTECTION
<u>SI</u>	SYSTEM AND INFORMATION INTEGRITY
<u>SR</u>	SUPPLY CHAIN RISK MANAGEMENT



# BSI Grundsatz

- Framework from Bundesamt für Sicherheit in der Informationstechnik (BSI)
- IT-Grundschutz-Kompendium: central document with controls
- Sicherheitsprozess: continuous process to manage information security



# Task: Another approach - OWASP ASVS



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- Make yourself familiar with OWASP ASVS  
and present its main characteristics

A task for one group



# Task: Compare the approaches yourself



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Compare ISO 27001, NIST framework, NIST SP 800-53, BSI  
Grundschutz and draw your conclusions

A task for one group

# Task: Presentations about your Security Organization

- Gather in groups with relative homogeneity from a company affiliation perspective
- Each group: Prepare a brief presentation (15-20 minutes) that gives an overview on the IS organization in your company
- Aspects:
  - Organizational Setup
  - Selection of Processes & Tools
  - If you are part of InfoSec – where and how do you work there – if not, how do you interact with InfoSec
  - Selection of interesting aspects (e.g. example of an incident response, code review)
  - Also consider BCM, Risk Management etc.
- Presentations next week (one after another)

Task for multiple groups  
(multiple companies)