Protecting Information Assets
- Week 2 -

Understanding an Organization's Risk Environment

MIS5206 Week 2

- In the News
- Readings
- Week 1 Review
- Understanding an Organization’s Risk Environment
- Test Taking Tip
- Quiz

In the News

Anatomy of a Social Media Attack

“Social media threats are at an all-time high, ranging from account hijacking to impersonation attacks, scams, and new ways of distributing malware and executing phishing attacks…

Adversaries traditionally target a corporate network using two phases: reconnaissance and exploitation.

When attackers use social media, their strategy is similar, but the methods of attack are quite different. In social media, targeting an organization and corporate network involves footprinting, monitoring and profiling, impersonating or hijacking, and, finally, attacking….

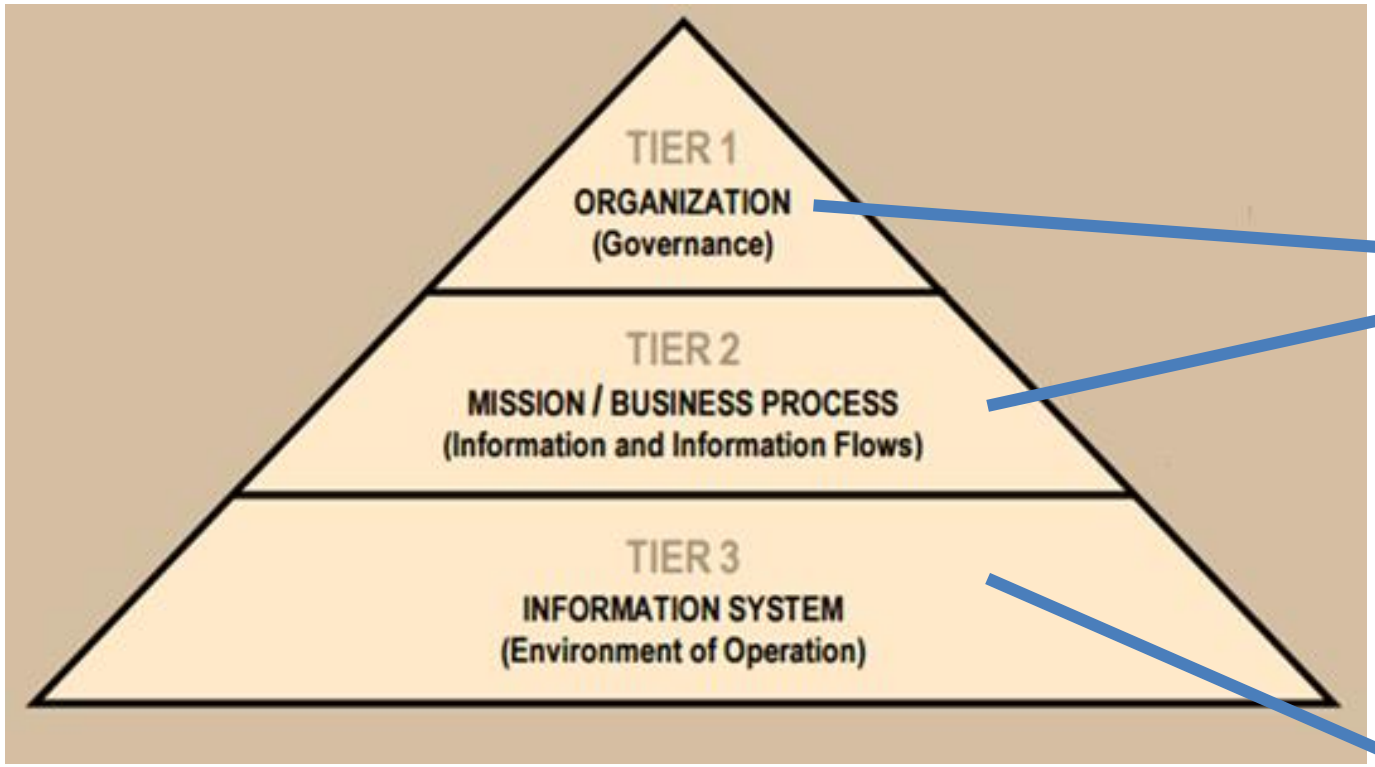
By impersonating a key executive, an attacker can quickly establish trust to befriend other employees.”

http://www.darkreading.com/analytics/anatomy-of-a-social-media-attack/a/d-id/1326680

Reading

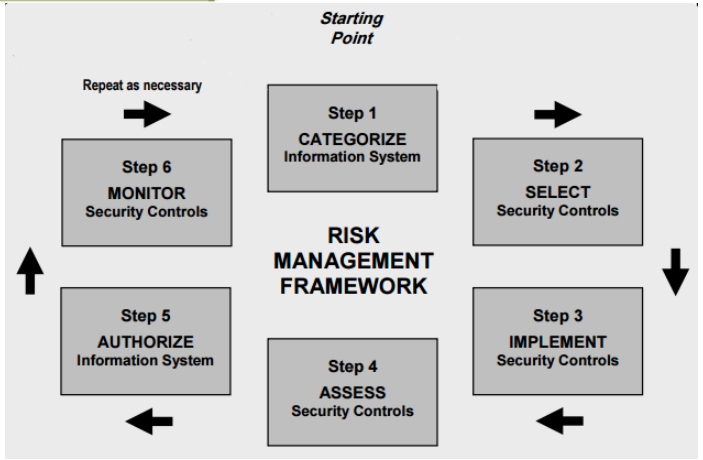
- Vacca Chapter 1
- ISACA RiskIT Framework pp. 1 - 42
- NIST Reading 1: “Framework for Improving Critical Infrastructure Cybersecurity”

Last time…



The RiskIT Framework

NIST
Risk Management
Framework



Understanding an Organization's Risk Environment

Information security means protecting information and information systems from:

- *Unauthorized access, use, disclosure* (***Confidentiality***)
- *Modification* (***Integrity***)
- *Disruption and destruction* (***Availability***)

Key concepts

Threat

Potential for the occurrence of a harmful event such as an attack

Vulnerability

Weakness that makes targets susceptible to an attack

Risk

Potential of loss from an attack

Risk Mitigation

Strategy for dealing with risk

What is a threat?

Any thing that has the potential to lead to:

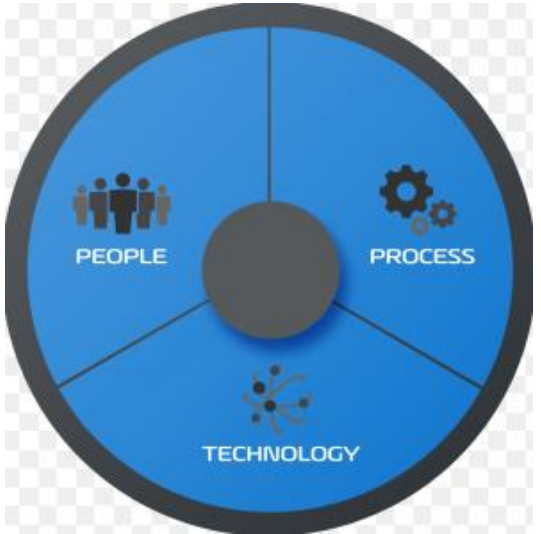
- ***Unauthorized access, use, disclosure***
- ***Modification***
- ***Disruption or Destruction***

of an enterprises' information

Physical

Technical

Administrative

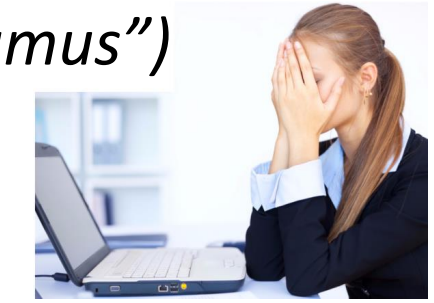


What is a threat…

Threats to information and information systems include:

- Purposeful attacks *(“Human malicious”)*

- Human errors *(“Human ignoramus”)*



- Structural Failures

- Environmental disruptions

Threats to information and information systems include:

Purposeful attacks

- Cyber attacks “are often aggressive, disciplined, well-organized, well-funded, and in a growing number of documented cases, very sophisticated
- Successful attacks on private and public sector information systems can result in serious or grave damage to organizations, and the national and economic security…” of the Nation
- “Given the significant and growing danger in these threats, it is imperative that leaders at all levels of an organization understand their responsibilities for achieving adequate information security and for managing information system-related security risks.”

Taxonomy of threat sources

NIST SP 800-30r1 “Guide for Conducting Risk Assessments”, page 66

Type of Threat Source	Description	Characteristics

ADVERSARIAL
- Individual
  - Outsider
  - Insider
  - Trusted Insider
  - Privileged Insider
- Group
  - Ad hoc
  - Established
- Organization
  - Competitor
  - Supplier
  - Partner
  - Customer
- Nation-State
	Individuals, groups, organizations, or states that seek to exploit the organization’s dependence on cyber resources (i.e., information in electronic form, information and communications technologies, and the communications and information-handling capabilities provided by those technologies).	Capability, Intent, Targeting

ACCIDENTAL - User - Privileged User/Administrator	Erroneous actions taken by individuals in the course of executing their everyday responsibilities.	Range of effects

STRUCTURAL
- Information Technology (IT) Equipment
  - Storage
  - Processing
  - Communications
  - Display
  - Sensor
  - Controller
- Environmental Controls
  - Temperature/Humidity Controls
  - Power Supply
- Software
  - Operating System
  - Networking
  - General-Purpose Application
  - Mission-Specific Application
	Failures of equipment, environmental controls, or software due to aging, resource depletion, or other circumstances which exceed expected operating parameters.	Range of effects

ENVIRONMENTAL
- Natural or man-made disaster
  - Fire
  - Flood/Tsunami
  - Windstorm/Tornado
  - Hurricane
  - Earthquake
  - Bombing
  - Overrun
- Unusual Natural Event (e.g., sunspots)
- Infrastructure Failure/Outage
  - Telecommunications
  - Electrical Power
	Natural disasters and failures of critical infrastructures on which the organization depends, but which are outside the control of the organization.
	Note: Natural and man-made disasters can also be characterized in terms of their severity and/or duration. However, because the threat source and the threat event are strongly identified, severity and duration can be included in the description of the threat event (e.g., Category 5 hurricane causes extensive damage to the facilities housing mission-critical systems, making those systems unavailable for three weeks).
		Range of effects

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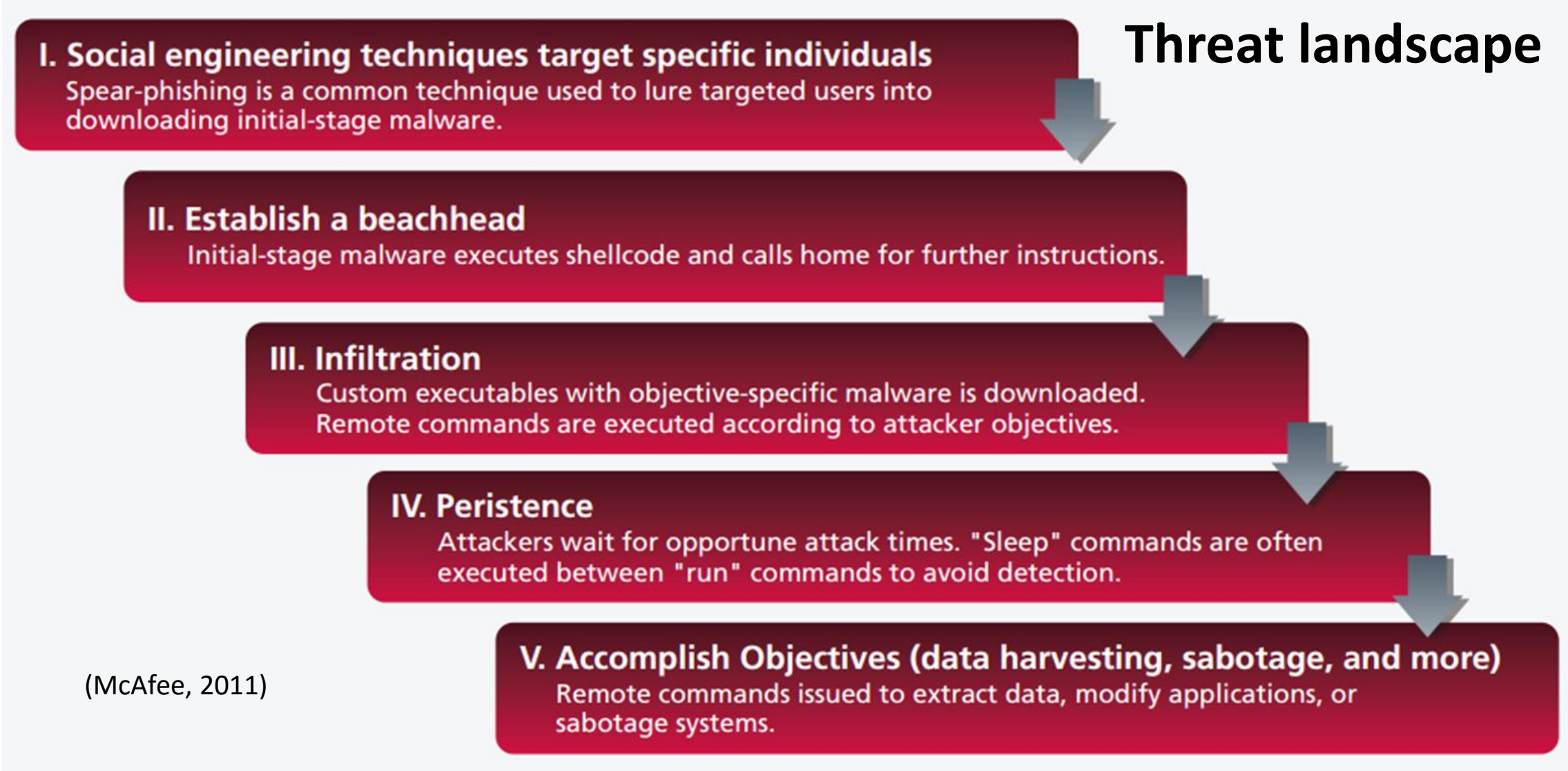
NIST SP 800-30r1 "Guide for Conducting Risk Assessments", page 66

Human malicious threat examples

- Accessing public material (80 percent unclassified and open to public)
- Black-hat hackers (lightweights to heavyweights)
- Bombing
- Career criminals
- Computer viruses (stealth, polymorphic, macro; over 6,500 different viruses identified)
- Corporate espionage (spies)
- Crackers/scriptkiddies (amateurs, novices; considerably less skilled than hackers)
- Cybercrime/fraud
- Data diddling
- Denial-of-service attacks
- Dumpster diving
- Employees, management (greed, vices, financial pressure, extravagant lifestyle, real or imagined grievances, workplace pressure/stress)
- High-energy radio frequency attacks (laser-like device aimed at buildings housing computers; high-frequency radio waves melt computer chips)
- Impersonation/spoofing (e-mail spoofs, anonymous eMailers, use of someone's login and password)
- Intelligence agencies
- Looping Internet Protocol ISP address (always-on Internet connections vulnerable)
- Password crackers (such as Cracker and LoPht Crack software)
- Physical attacks
- Remote access control software (examples include PCAnywhere, Timbuktu, NetBus, BackOrifice)
- Sabotage
- Social engineering (attacks against persons; using fake badges, blackmail, threat, harassment, bribery and impersonation)
- Surveillance (shoulder surfing, high-powered photography)
- Terrorists
- Trojan horses
- Unshredder software
- Van Eck receptors
- Vendors/suppliers/customers
- Vulnerability scanning software (such as Nessus, CyberCop software)
- War dialing
- Web crawlers

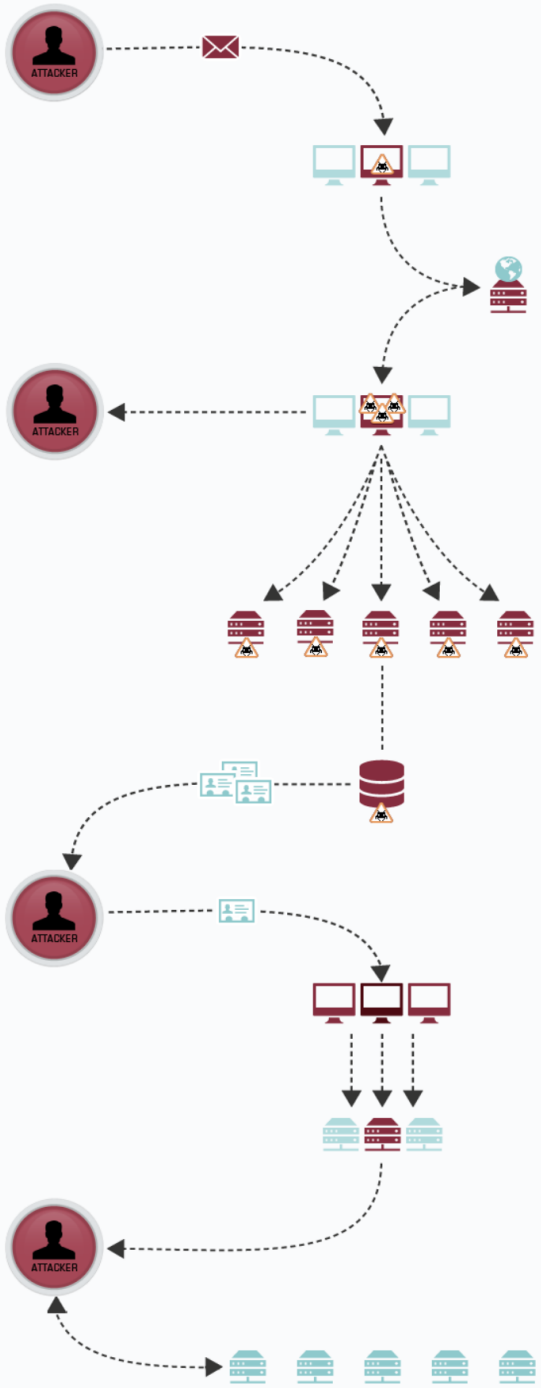
Anatomy of an Attack



(McAfee, 2011)

Anatomy of an Attack

(MANDIANT, 2015)



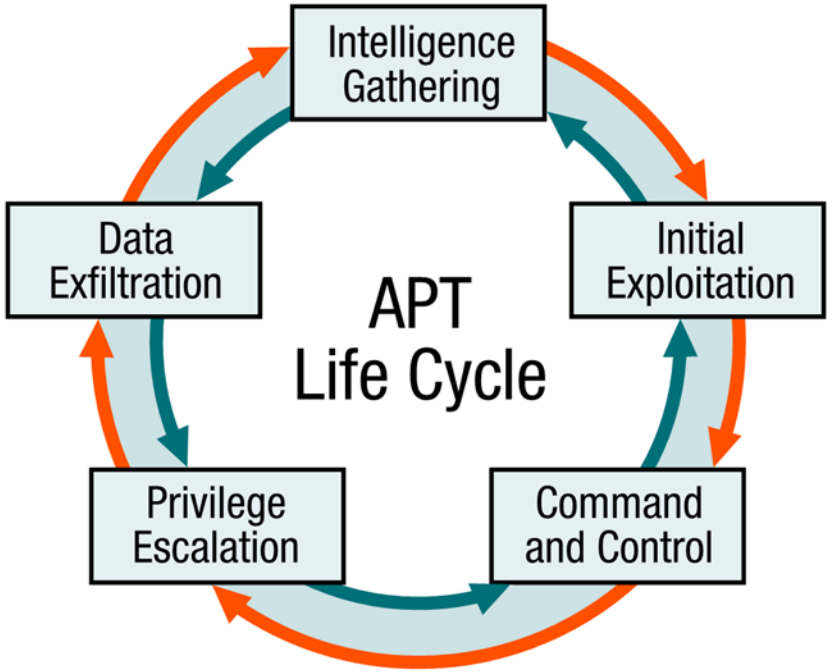
1. Attacker sends spear fishing e-mail
2. Victim opens attachment
   - Custom malware is installed
3. Custom malware communicates to control web site
   - Pulls down additional malware
4. Attacker establishes multiple backdoors
5. Attacker accesses system
   - Dumps account names and passwords from domain controller
6. Attacker cracks passwords
   - Has legitimate user accounts to continue attack undetected
7. Attacker reconnaissance
   - Identifies and gathers data
8. Data collected on staging server
9. Data exfiltrated
10. Attacker covers tracts
    - Deletes files
    - Can return any time

Assets

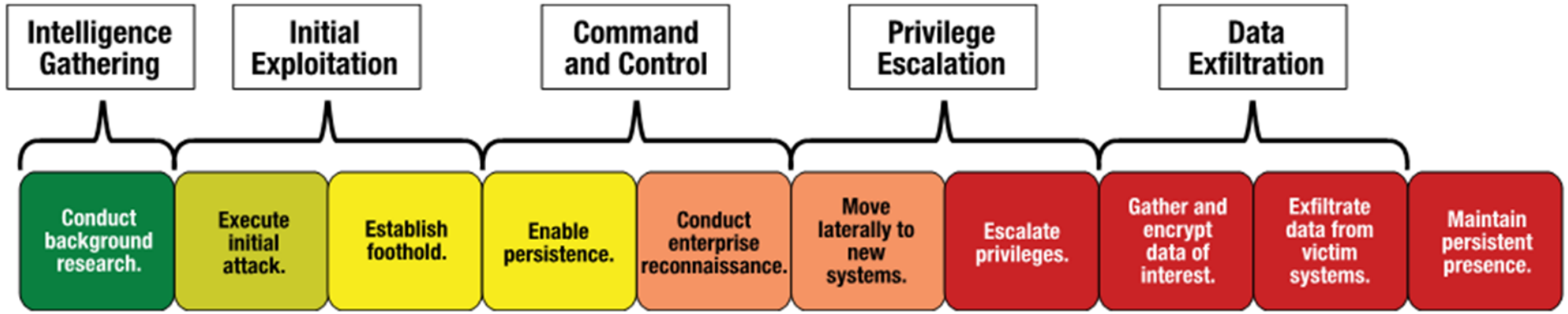
Threat landscape

Advanced threats usually maintain remote access to target environments for 6-18 months before being detected (i.e. they are persistent
(Holcomb & Stapf, 2014)

Threat landscape



Anatomy of Advanced Persistent Threats (APT) [19,20,21] to CII systems



Advanced threats usually maintain remote access to target environments for 6-18 months before being detected [22]

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NIST SP 800-30r1 “Guide for Conducting Risk Assessments”, page 66

Human non-malicious threat examples

- Computer operator errors
- Data entry (input) errors
- Inadequate access controls
- Inadequate training
- Inadequate human resource policies
- Inadequate program testing/controls incorporated into computer programs
- Inadequate risk analysis undertaken
- Inadequate supervision
- Lack of ethics
- Mislaid disk files
- Physical damage to disk
- Poor management philosophy/attitude
- Unlocked trash containers
- Update of wrong file
- Weak internal controls

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NIST SP 800-30r1 “Guide for Conducting Risk Assessments”, page 66

Structural Threat Examples

- Air conditioning failure
- Building collapse
- Destruction of data, disks, documents, reports
- Destruction of water mains, sewer lines
- Failure of hardware
- Failure of fire alarms, smoke detectors
- Failure of computer programs
- Freak accidents
- Gas line explosions
- Power outages (brownouts, blackouts, transients, spikes, sags and power surges)
- Product failure
- Software failure (operating system, database software)

Taxonomy of cybersecurity threat sources

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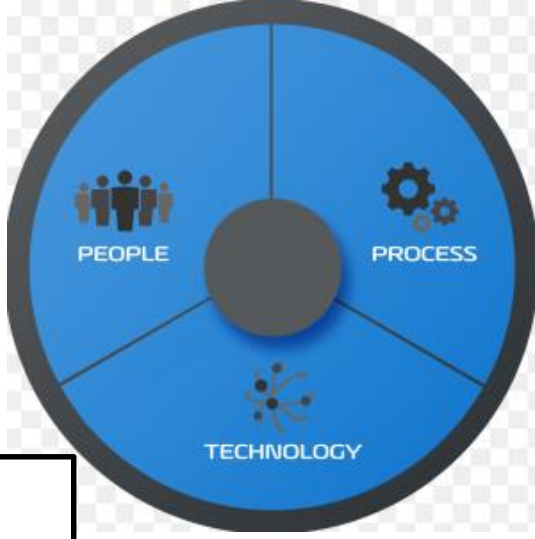
		Range of effects

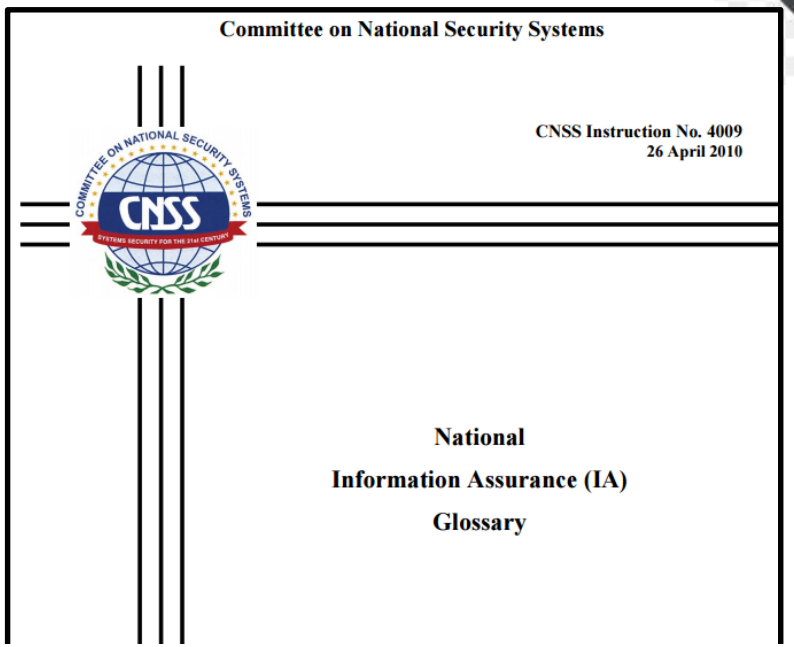
NIST SP 800-30r1 “Guide for Conducting Risk Assessments”, page 66

What is a Vulnerability?

- Physical
- Technical
- Administrative

Any unaddressed susceptibility to a Physical, Technical or Administrative information security threat




Committee on National Security Systems

CNSS Instruction No. 4009
26 April 2010

National
Information Assurance (IA)
Glossary

Weakness in an information system, system security procedures, internal controls, or implementation that could be exploited or triggered by a threat source.

This document prescribes minimum standards.
Your department or agency may require further implementation guidelines.

What is a Risk?

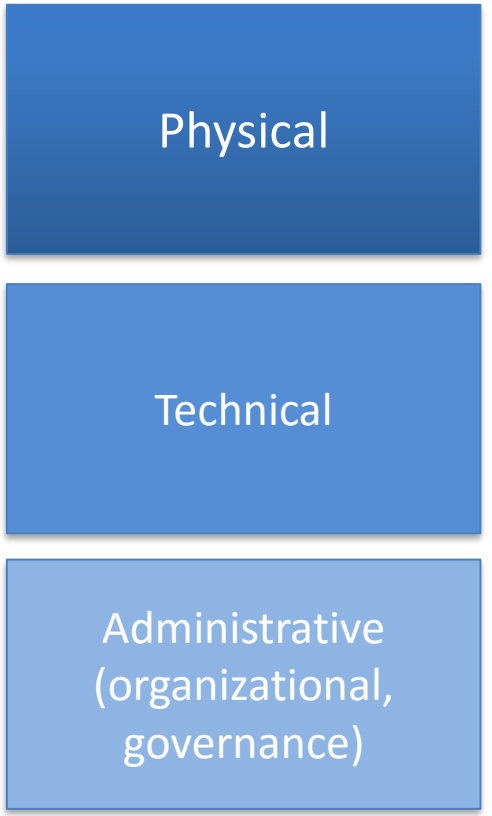
A measure of threat

Potential loss resulting from unauthorized:

- *Access, use, disclosure*
- *Modification*
- *Disruption or destruction*

…of an enterprises' information

Can be expresses in quantitative and qualitative terms



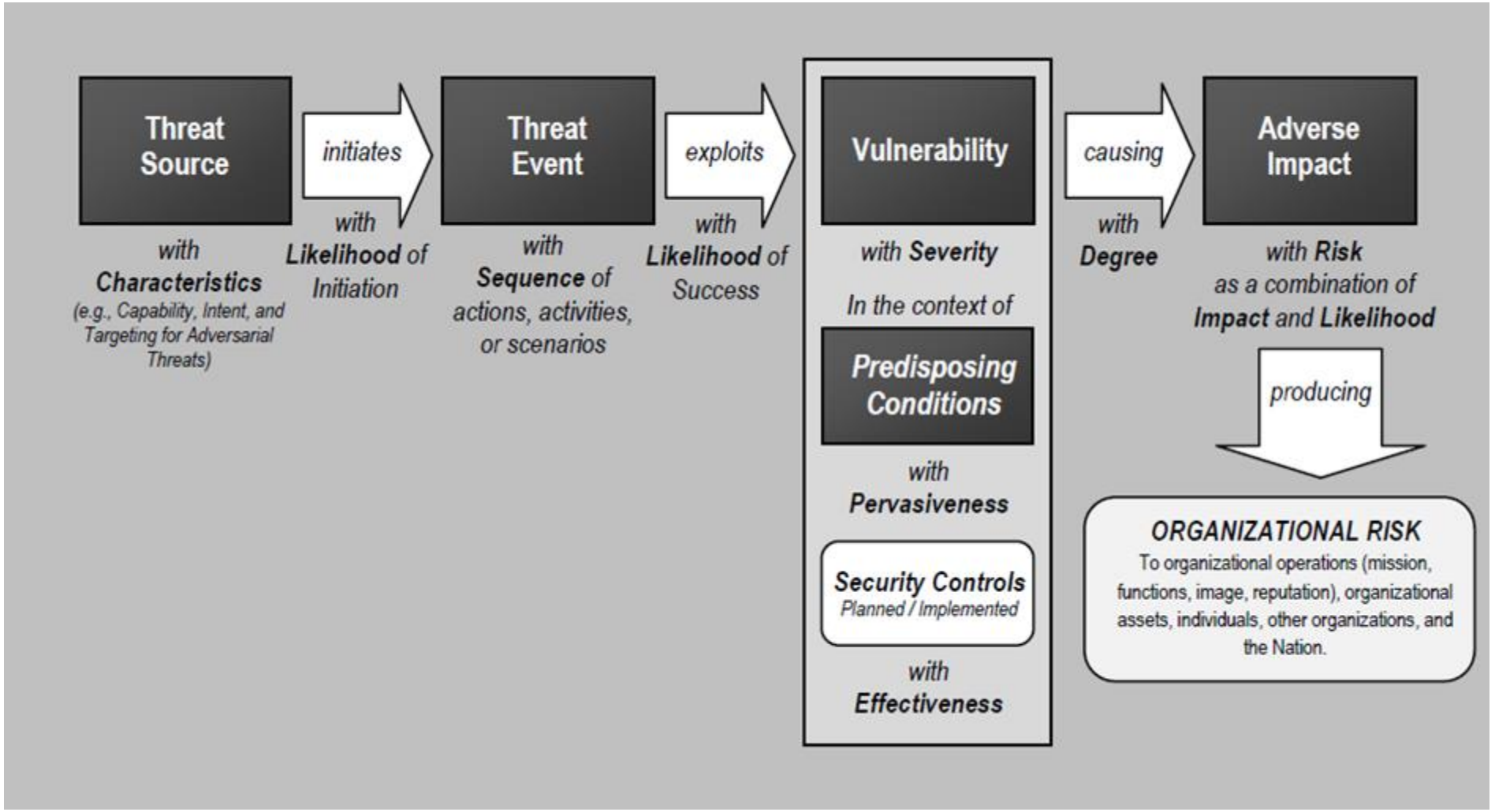
Information security risks

- Replacement costs (software, hardware, other)
- Backup restoration and recovery costs
- Reprocessing, reconstruction costs
- Crime (non-computer, computer)
- Loss of life
- Economic impact and financial loss
- Losses due to fraud, theft, larceny, bribery
- Impact of
  - lost competitive edge
  - lost data
  - lost time
  - lost productivity
  - lost business
- Bankruptcy
- Business interruption
- Frustration
- Ill will
- Injury
- Impacts of inaccurate data

Examples of types of information security risk

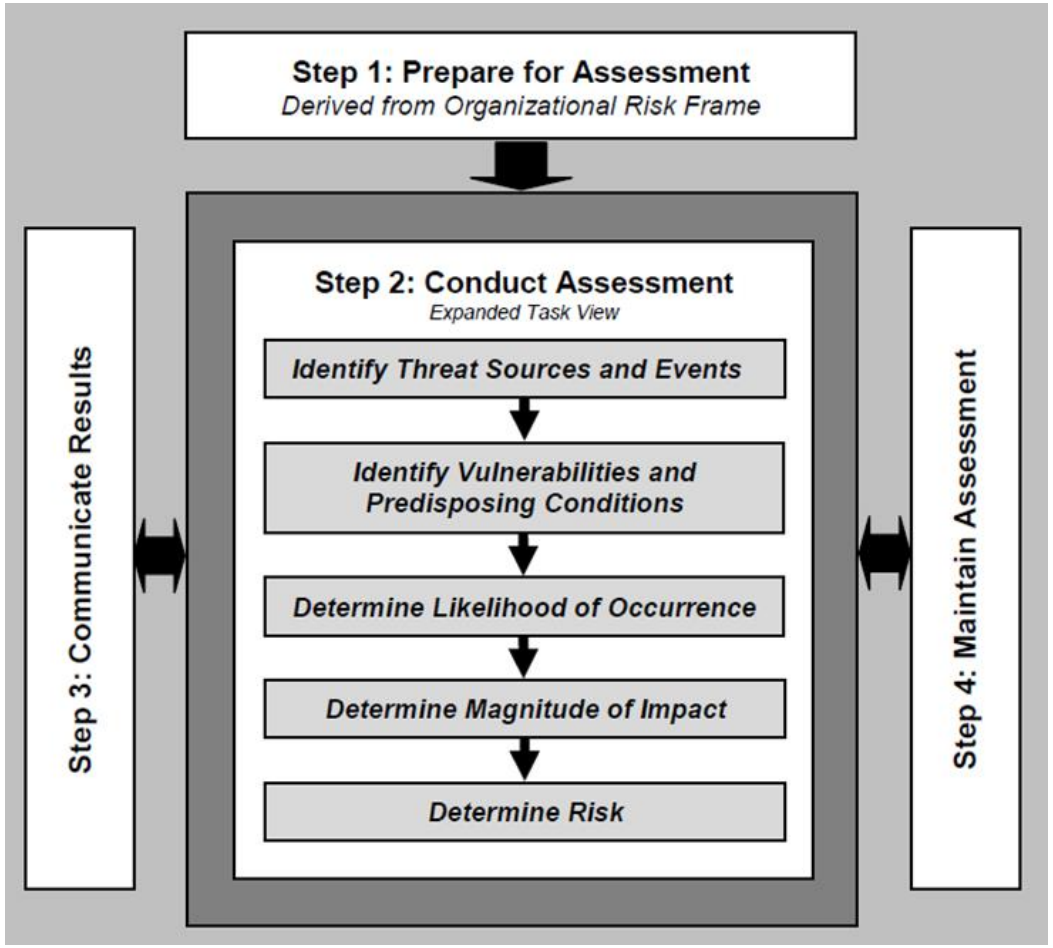
1. Safety
2. Compliance and regulatory
3. Financial
4. Legal
5. Reputational
6. Political
7. Strategic planning
8. Program/acquisition risk (cost, schedule, performance)
9. Project
10. Operational (mission/business)
11. Supply chain

Example of a risk model

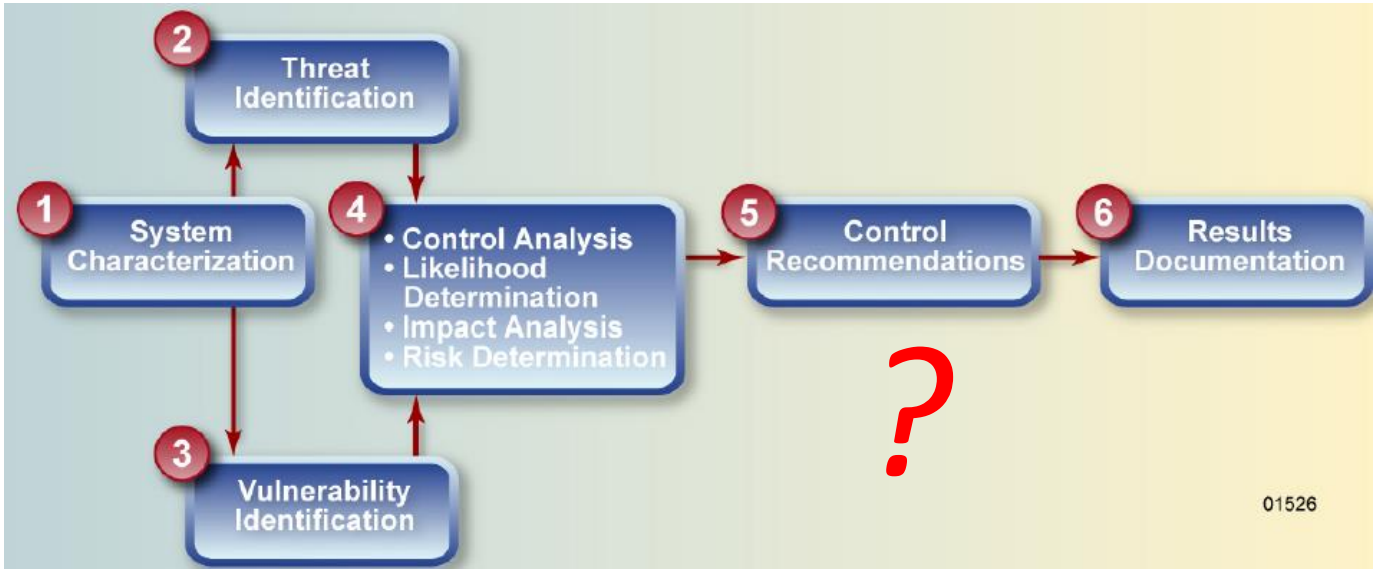


NIST SP 800-30r1 “Guide for Conducting Risk Assessments”, page 21 and page 32

Risk assessment process

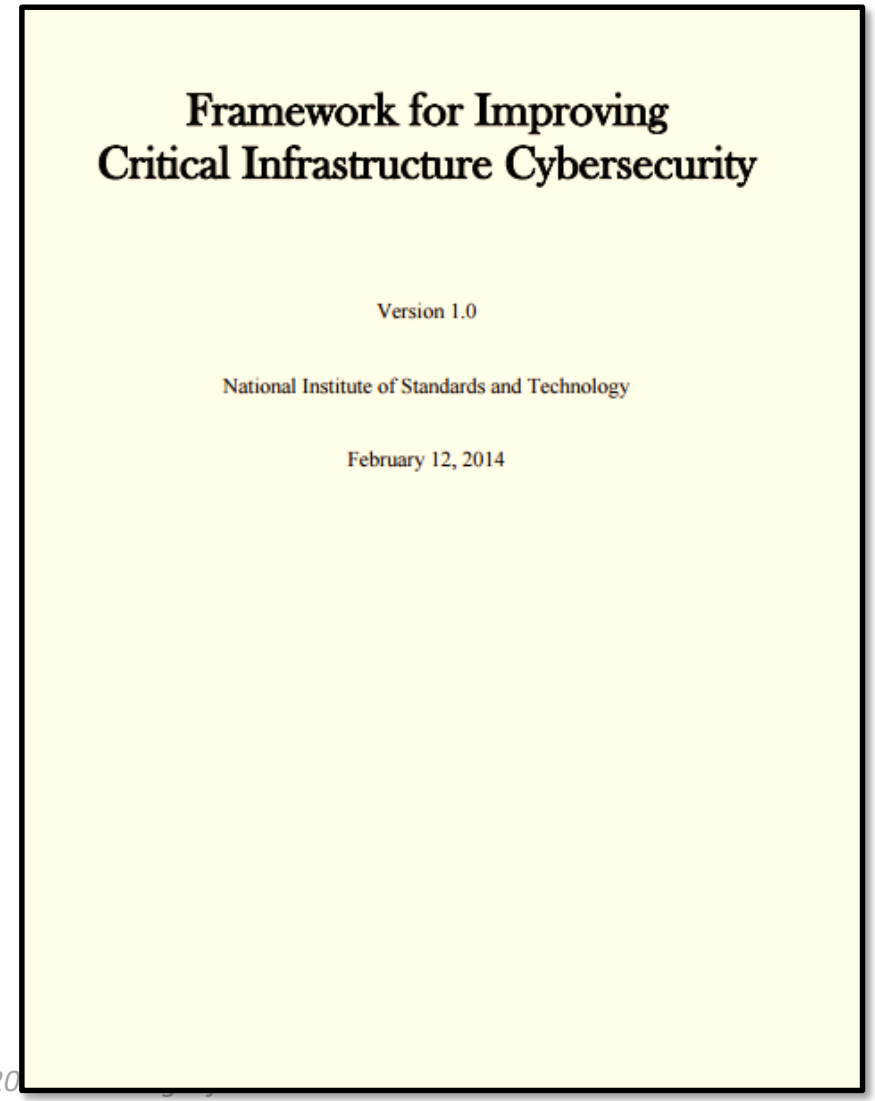


NIST SP 800-30r1 “Guide for Conducting Risk Assessments”, page 32



NIST SP 800-100 “Information Security Handbook: A Guide for Managers”, page 95

NIST Cybersecurity Framework



Framework for Improving
Critical Infrastructure Cybersecurity

Version 1.0

National Institute of Standards and Technology

February 12, 2014

Table of Contents

List of Figures

List of Tables

NIST Cybersecurity Framework

Core

Functions	Categories, Subcategories, Informative References
IDENTIFY	
PROTECT	
DETECT	
RESPOND	
RECOVER	

Tiers

Tier 1: Partial
Ad hoc risk management
Limited cybersecurity risk awareness
Low external participation

Tier 2: Risk Informed
Some risk management practices
Increased awareness, no program
Informal external participation

Tier 3: Repeatable
Formalized risk management
Organization-wide program
Receives external partner info

Tier 4: Adaptive
Adaptive risk management practices
Cultural, risk-informed program
Actively shares information

Profile

Current Profile

Current state of alignment between Core elements and organizational requirements, risk, tolerance, & resources.

Where am I today relative to the Framework?

ROADMAP

Target Profile

Desired state of alignment between Core elements and organizational requirements, risk, tolerance, & resources.

Where do I aspire to be relative to the Framework?

Can be done at the:

- Organizational level
- Program level
- Project level

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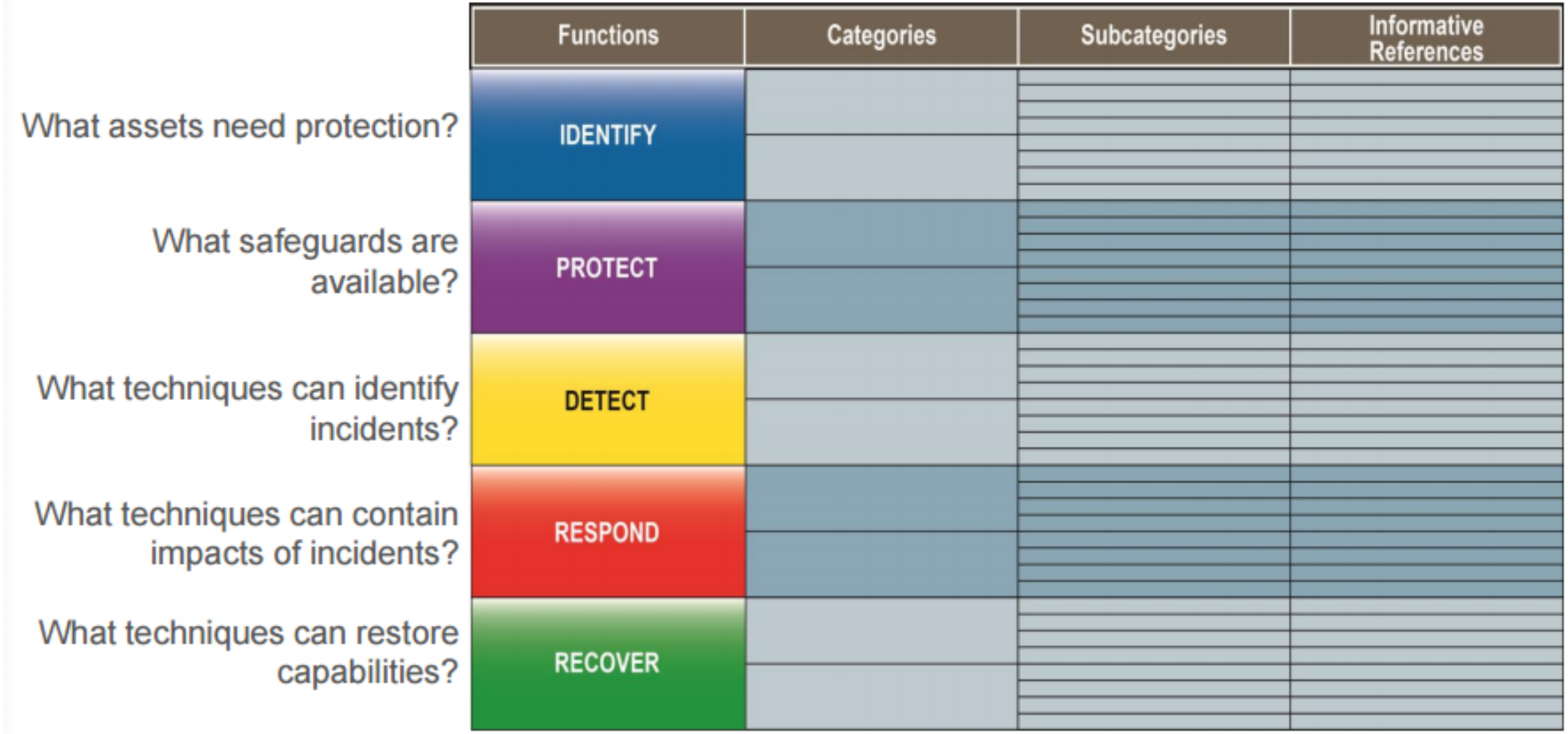
Version 7.0

NIST Cybersecurity Framework's Core Functions



NIST Cybersecurity Framework

functions and their categories

It is of paramount importance to first ***identify:*** what to protect, what to detect, what to respond to and recover from…

Function Unique Identifier	Function	Category Unique Identifier	Category
ID	Identify	ID.AM	Asset Management
		ID.BE	Business Environment
		ID.GV	Governance
		ID.RA	Risk Assessment
		ID.RM	Risk Management Strategy
PR	Protect	PR.AC	Access Control
		PR.AT	Awareness and Training
		PR.DS	Data Security
		PR.IP	Information Protection Processes and Procedures
		PR.MA	Maintenance
		PR.PT	Protective Technology
DE	Detect	DE.AE	Anomalies and Events
		DE.CM	Security Continuous Monitoring
		DE.DP	Detection Processes
RS	Respond	RS.RP	Response Planning
		RS.CO	Communications
		RS.AN	Analysis
		RS.MI	Mitigation
		RS.IM	Improvements
RC	Recover	RC.RP	Recovery Planning
		RC.IM	Improvements
		RC.CO	Communications

Functions and their categories…

Identify (function): Develop the institutional understanding of which organizational systems, assets, data, and capabilities need to be protected, determine priority in light of organizational mission, and establish processes to achieve risk management goals.

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ID	Identify	ID.AM	Asset Management
		ID.BE	Business Environment
		ID.GV	Governance
		ID.RA	Risk Assessment
		ID.RM	Risk Management Strategy

NIST Cybersecurity Framework - Evaluate and profile your organization's capabilities

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		ID.RM	Risk Management Strategy
PR	Protect	PR.AC	Access Control
		PR.AT	Awareness and Training
		PR.DS	Data Security
		PR.IP	Information Protection Processes and Procedures
		PR.MA	Maintenance
		PR.PT	Protective Technology
DE	Detect	DE.AE	Anomalies and Events
		DE.CM	Security Continuous Monitoring
		DE.DP	Detection Processes
RS	Respond	RS.RP	Response Planning
		RS.CO	Communications
		RS.AN	Analysis
		RS.MI	Mitigation
		RS.IM	Improvements
RC	Recover	RC.RP	Recovery Planning
		RC.IM	Improvements
		RC.CO	Communications

Each category is rated

Can be done at the:

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Evaluation of an organization's cybersecurity capabilities

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Where do I aspire to be relative to the Framework?

Assets

NIST Framework		maturity level				
		Immature	***Partial***	***Risk Informed***	***Repeatable***	***Adaptive***
dimensions	***Risk Management***	No processes	Ad hoc, not formalized	Management-approved processes	Organization-wide policy	Continuous improvements
	Risk Culture	No integration	Limited organizational awareness	Cybersecurity information shared informally	Consistent organization-wide methods in place	Cybersecurity risk management part of culture
	Risk Influence	No collaboration	Little collaboration	Informal external info sharing	Shared partner risk info fuels better responses	Proactively shares risk info with partners

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Assessing risk – financial method

1. **Estimate potential losses (SLE)**—This step involves determining the single loss expectancy (SLE). SLE is calculated as follows:

   – **Single loss expectancy (SLE) = Asset value X Exposure factor**

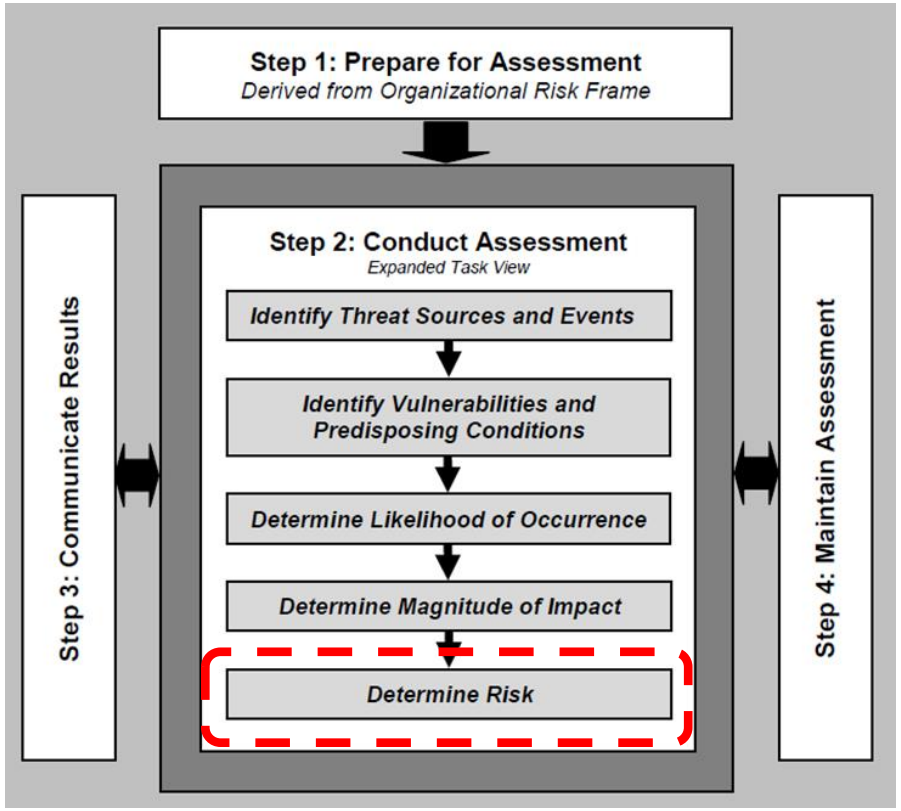
   Items to consider when calculating the SLE include the physical destruction or theft of assets, the loss of data, the theft of information, and threats that migh cause a delay in processing. The exposure factor is the measure or percent of damage that a realized threat would have on a specific asset.

2. **Conduct a threat analysis (ARO)**—The purpose of a threat analysis is to determine the likelihood of an unwanted event. The goal is t estimate the **annual rate of occurrence (ARO)**. Simply stated, **how many times is this expected to happen in one year?**

3. **Determine annual loss expectancy (ALE)**—This third and final step of the quantitative assessment seeks to combine the potential loss and rate per year to determine the magnitude of the risk. This is expressed as annual loss expectancy (ALE). ALE is calculated as follows:

   – **Annualized loss expectancy (ALE) = Single loss expectancy (SLE) X Annualized rate of occurrence (ARO)**

Assessing IT risk – financial method



Annualized loss expectancy (ALE) =

Single loss expectancy (SLE) X Annualized rate of occurrence (ARO)

NIST SP 800-30r1 “Guide for Conducting Risk Assessments”, page 32

Assessing IT risk – relative “scale” method

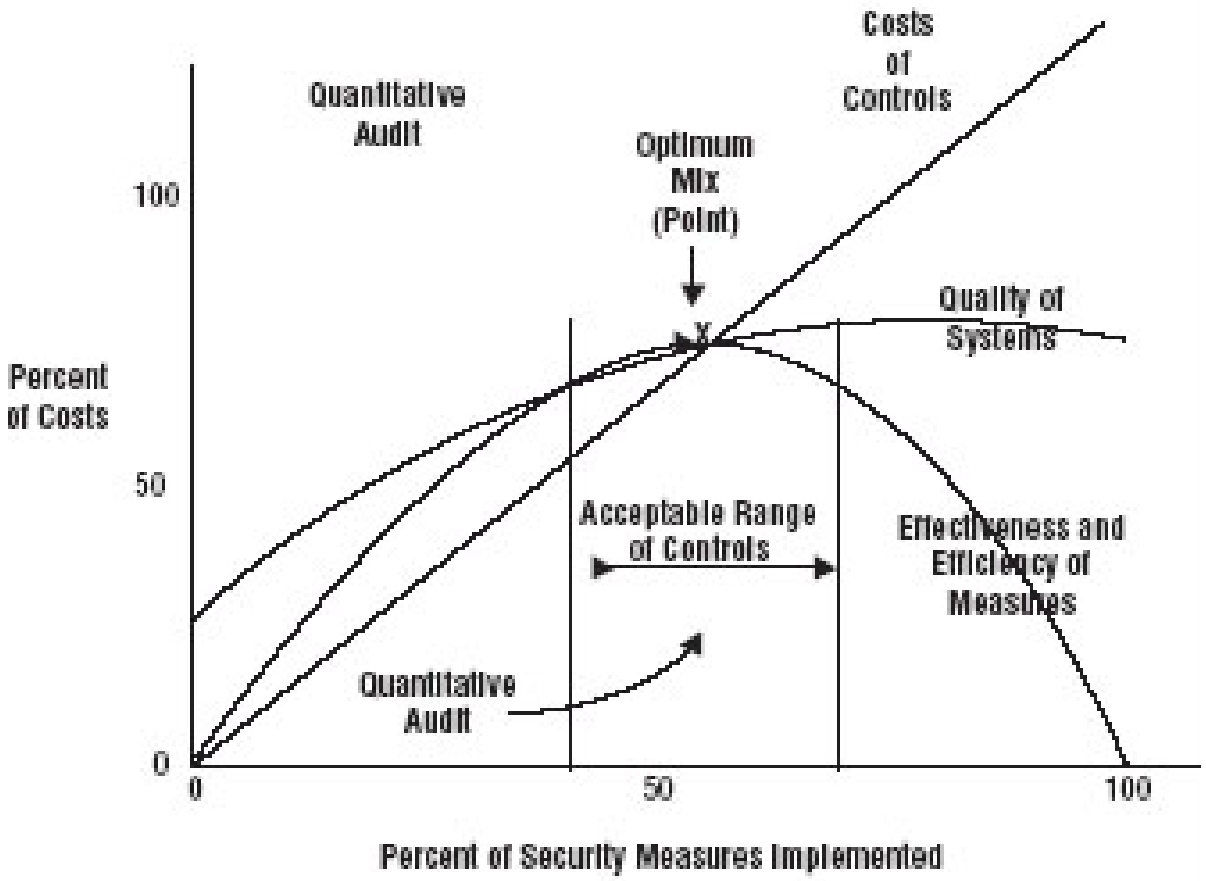
Threat Likelihood	Impact: Low (10)	Impact: Moderate (50)	Impact: High (100)
High (1.0)	10 x 1.0 = 10	50 x 1.0 = 50	100 x 1.0 = 100
Moderate (0.5)	10 x 0.5 = 5	50 x 0.5 = 25	100 x 0.5 = 50
Low (0.1)	10 x 0.1 = 1	50 x 0.1 = 5	100 x 0.1 = 10

01527a

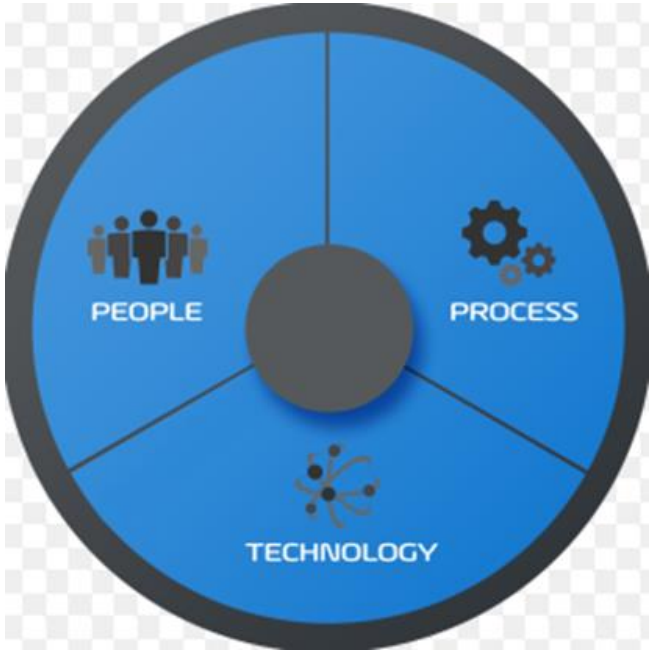
Risk Scale: High (>50 to 100) Moderate (>10 to 50) Low (1 to 10)

NIST SP 800-100 “Information Security Handbook: A Guide for Managers”, page 99

What is a Risk Mitigation?



An approach for lessening or avoiding the impact of a risk (i.e. potential impact) in an acceptable and cost-effective manner



Risk mitigation approaches

- Antivirus software
- Authentication/authorization servers
- Biometrics (thumbprints, retina scans, voice, face)
- Callback modems
- Canine patrols
- Card-activated locks
- Certificate authority
- Code of sanctions against vendors/suppliers/contractors
- Color-coded ID badges
- Content scanners
- Electronic scanning devices
- Encoded data (cryptography; public key infrastructure, private key infrastructure
- Fences
- Role-based access control
- Segregation of duties

- Redundant data center
- Corporate code of conduct
- Internal audit
- Grounds lighting
- Intrusion detection software
- Locked doors, terminals
- Motion-detection devices
- Firewalls
- Change management
- Penetration testing
- Placement of authentication / authorization / database / accounting servers in secure location
- Receptionists
- Residue controls - disintegrator / shredders
- Secure file wipes
- Secure passwords
- Single sign-on
- Environmental controls (air conditioners, humidifiers)

Risk mitigation approaches – Physical controls ?

- Antivirus software
- Authentication/authorization servers
- Biometrics (thumbprints, retina scans, voice, face)
- Callback modems
- Canine patrols
- Card-activated locks
- Certificate authority
- Code of sanctions against vendors/suppliers/contractors
- Color-coded ID badges
- Content scanners
- Electronic scanning devices
- Encoded data (cryptography; public key infrastructure, private key infrastructure
- Fences
- Role-based access control
- Segregation of duties

- Redundant data center
- Corporate code of conduct
- Internal audit
- Grounds lighting
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- **Redundant data center**
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- Internal audit
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- Intrusion detection software
- **Locked doors and terminals**
- **Motion-detection devices**
- Network firewalls
- Change management
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- **Placement of authentication / authorization / database / accounting servers in secure location**
- **Receptionists**
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Risk mitigation approaches – Technical controls ?

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- Secure passwords (may be organizational too)
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Risk mitigation approaches – Administrative controls?

- Antivirus software
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- Callback modems
- Canine patrols
- Card-activated locks
- Certificate authority
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- **Color-coded ID badges**
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- **Role-based access control**
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Next time: Information Security Classification…

Information Category	Description	Examples
Unclassified Public	Information is not confidential and can be made public without any implications for Company. Loss of availability due to system downtime is an acceptable risk. Integrity is important but not vital.	• Product brochures widely distributed • Information widely available in the public domain, including publicly available Company web site areas • Sample downloads of Company software that is for sale • Financial reports required by regulatory authorities • Newsletters for external transmission
Proprietary	Information is restricted to management-approved internal access and protected from external access. Unauthorized access could influence Company's operational effectiveness, cause an important financial loss, provide a significant gain to a competitor, or cause a major drop in customer confidence. Information integrity is vital.	• Passwords and information on corporate security procedures • Know-how used to process client information • Standard Operating Procedures used in all parts of Company's business • All Company-developed software code, whether used internally or sold to clients
Client Confidential Data	Information received from clients in any form for processing in production by Company. The original copy of such information must not be changed in any way without written permission from the client. The highest possible levels of integrity, confidentiality, and restricted availability are vital.	• Client media • Electronic transmissions from clients • Product information generated for the client by Company production activities as specified by the client
Company Confidential Data	Information collected and used by Company in the conduct of its business to employ people, to log and fulfill client orders, and to manage all aspects of corporate finance. Access to this information is very restricted within the company. The highest possible levels of integrity, confidentiality, and restricted availability are vital.	• Salaries and other personnel data • Accounting data and internal financial reports • Confidential customer business data and confidential contracts • Non disclosure agreements with clients\vendors • Company business plans

	POTENTIAL IMPACT		
Security Objective	**LOW**	**MODERATE**	**HIGH**
Confidentiality Preserving authorized restrictions on information access and disclosure, including means for protecting personal privacy and proprietary information. [44 U.S.C., SEC. 3542]	The unauthorized disclosure of information could be expected to have a **limited** adverse effect on organizational operations, organizational assets, or individuals.	The unauthorized disclosure of information could be expected to have a **serious** adverse effect on organizational operations, organizational assets, or individuals.	The unauthorized disclosure of information could be expected to have a **severe or catastrophic** adverse effect on organizational operations, organizational assets, or individuals.
Integrity Guarding against improper information modification or destruction, and includes ensuring information non-repudiation and authenticity. [44 U.S.C., SEC. 3542]	The unauthorized modification or destruction of information could be expected to have a **limited** adverse effect on organizational operations, organizational assets, or individuals.	The unauthorized modification or destruction of information could be expected to have a **serious** adverse effect on organizational operations, organizational assets, or individuals.	The unauthorized modification or destruction of information could be expected to have a **severe or catastrophic** adverse effect on organizational operations, organizational assets, or individuals.
Availability Ensuring timely and reliable access to and use of information. [44 U.S.C., SEC. 3542]	The disruption of access to or use of information or an information system could be expected to have a **limited** adverse effect on organizational operations, organizational assets, or individuals.	The disruption of access to or use of information or an information system could be expected to have a **serious** adverse effect on organizational operations, organizational assets, or individuals.	The disruption of access to or use of information or an information system could be expected to have a **severe or catastrophic** adverse effect on organizational operations, organizational assets, or individuals.

Test Taking Tip

- Read the answers first -

This contradicts many people's test taking recommendations…

…but, it works. Here's why:

- Quickly alerts you to the type of question to expect
- Focuses your attention in reading the question for meaningful information
- Gives you advanced warning that there may be more than one significant concepts (option to answer in the form "Both A & B")
- Gives you an opportunity to get a sense of the sort of answer the test maker is looking for
- There may be more than one valid answer, but the test maker may be looking for "best mitigation for the situation" or "least risk in the situation"

Test Taking Tip

Example:

A. Transaction authorization
B. Loss or duplication of EDI transmissions
C. Transmission delay
D. Deletion or manipulation of transactions prior to or after establishment of application controls

Test Taking Tip

Example:

Which of the following represents the GREATEST potential risk in an EDI environment?

A. Transaction authorization
B. Loss or duplication of EDI transmissions
C. Transmission delay
D. Deletion or manipulation of transactions prior to or after establishment of application controls

Test Taking Tip

Example:

Which of the following represents the GREATEST potential risk in an EDI environment?

A. Transaction authorization
B. Loss or duplication of EDI transmissions
C. Transmission delay
D. Deletion or manipulation of transactions prior to or after establishment of application controls

Answer: A

Moving forward…

When	Actor	Task	Type
Friday	Instructor (me)	Post reading questions (Friday am)	
Monday 11:59pm	Student	Post answers to reading questions	Assignment
Tuesday 9:00am	Student	Post case study analysis (when due)	Assignment
Wednesday 11:59am	Student	Post 4 comments to others' answers	Participation
Wednesday 11:59am	Student	Post "In The News" article	Participation
Thursday 5:30pm-8pm	Both of Us	Class meeting	Participation
Friday	Instructor	Post summary notes	

Reading questions for Week 3

1. What are the 3 types of risk mitigating controls? Which is the most important? Why is it the most important?
2. Which two security objectives are put at risk if the mitigations recommended by the FGDC guidelines are applied? Explain how they are put at risk?
3. Describe how you would apply the FIPS security categorizations to aid decisions between the risk mitigations described in the FGDC guidelines. Identify which FIPS security categorization would result in which FGDC guideline mitigation, and explain why?

Protecting Information Assets
- Week 2 -

Understanding an Organization's Risk Environment