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CISSP®

Certified Information Systems Security Professional

Official Study Guide

Eighth Edition

Mike Chapple, CISSP
James Michael Stewart, CISSP
Darril Gibson, CISSP

Covers all of the 2018 updated exam objectives, including Asset Security, Software Development Security, Security Operations, and much more...

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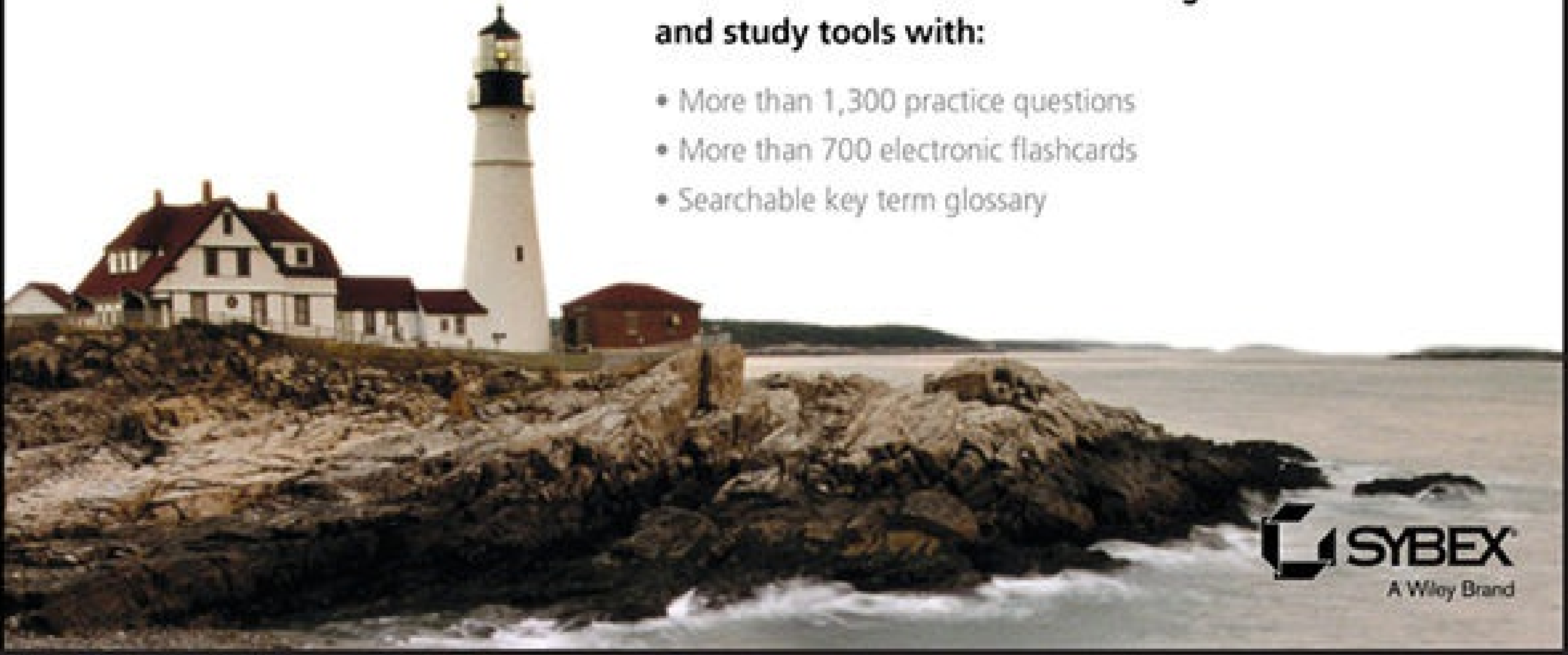

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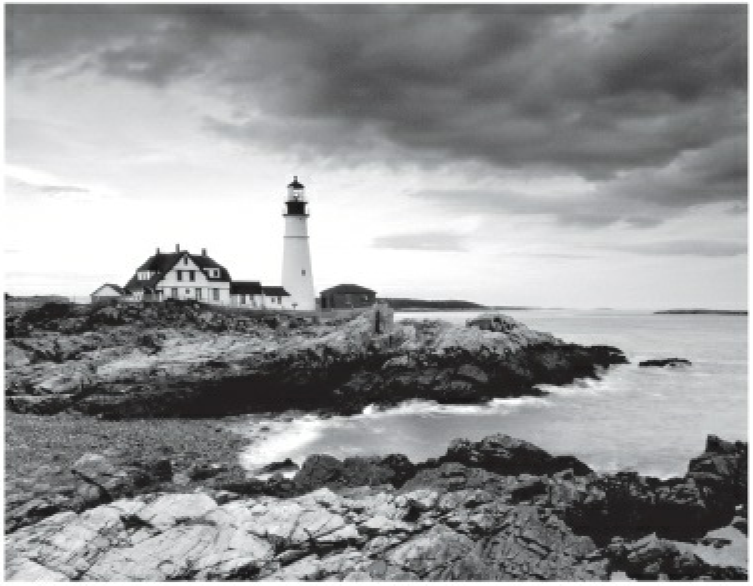

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To Dewitt Latimer, my mentor, friend, and colleague. I miss you dearly.
—Mike Chapple

To Cathy, your perspective on the world and life often surprises me, challenges me, and makes me love you even more.
—James Michael Stewart

To Nimfa, thanks for sharing your life with me for the past 26 years and letting me share mine with you.
—Darril Gibson

Dear Future (ISC)² Member,

Congratulations on starting your journey to CISSP® certification. Earning your CISSP is an exciting and rewarding milestone in your cybersecurity career. Not only does it demonstrate your ability to develop and manage nearly all aspects of an organization's cybersecurity operations, but you also signal to employers your commitment to life-long learning and taking an active role in fulfilling the (ISC)² vision of inspiring a safe and secure cyber world.

The material in this study guide is based upon the (ISC)² CISSP Common Body of Knowledge. It will help you prepare for the exam that will assess your competency in the following eight domains:

- Security and Risk Management
- Asset Security
- Security Architecture and Engineering
- Communication and Network Security
- Identity and Access Management (IAM)
- Security Assessment and Testing
- Security Operations
- Software Development Security

While this study guide will help you prepare, passing the CISSP exam depends on your mastery of the domains combined with your ability to apply those concepts using your real-world experience.

I wish you the best of luck as you continue on your path to become a CISSP and certified member of (ISC)^2.

Sincerely,

David P. Shearer

David Shearer, CISSP
CEO
(ISC)^2

Acknowledgments

We'd like to express our thanks to Sybex for continuing to support this project. Extra thanks to the eighth edition developmental editor, Kelly Talbot, and technical editors, Jeff Parker, Bob Sipes, and David Seidl, who performed amazing feats in guiding us to improve this book. Thanks as well to our agent, Carole Jelen, for continuing to assist in nailing down these projects.

—Mike, James, and Darril

Special thanks go to the information security team at the University of Notre Dame, who provided hours of interesting conversation and debate on security issues that inspired and informed much of the material in this book.

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I'd also like to thank the many people who participated in the production of this book but whom I never had the chance to meet: the graphics team, the production staff, and all of those involved in bringing this book to press.

—Mike Chapple

Thanks to Mike Chapple and Darril Gibson for continuing to contribute to this project. Thanks also to all my CISSP course students who have provided their insight and input to improve my training courseware and ultimately this tome. To my adoring wife, Cathy: Building a life and a family together has been more wonderful than I could have ever imagined. To Slayde and Remi: You are growing up so fast and learning at an outstanding pace, and you continue to delight and impress me daily. You are both growing into amazing individuals.

To my mom, Johnnie: It is wonderful to have you close by. To Mark: No matter how much time has passed or how little we see each other, I have been and always will be your friend. And finally, as always, to Elvis: You were way ahead of the current bacon obsession with your peanut butter/banana/bacon sandwich; I think that's proof you traveled through time!

—James Michael Stewart

Thanks to Jim Minatel and Carole Jelen for helping get this update in place before (ISC)^2 released the objectives. This helped us get a head start on this new edition, and we appreciate your efforts. It's been a pleasure working with talented people like James Michael Stewart and Mike Chapple. Thanks to both of you for all your work and collaborative efforts on this project. The technical editors, Jeff Parker, Bob Sipes, and David Seidl, provided us with some outstanding feedback, and this book is better because of their efforts. Thanks to the team at Sybex (including project managers, editors, and graphics artists) for all the work you did helping us get this book to print. Last, thanks to my wife, Nimfa, for putting up with my odd hours as I worked on this book.

—Darril Gibson

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James Michael Stewart, CISSP, CEH, ECSA, CHFI, Security+, Network+, has been writing and training for more than 20 years, with a current focus on security. He has been teaching CISSP training courses since 2002, not to mention other courses on Internet security and ethical hacking/penetration testing. He is the author of and contributor to more than 75 books and numerous courseware sets on security certification, Microsoft topics, and network administration, including the *Security+ (SY0-501) Review Guide*. More information about Michael can be found at his website at www.impactonline.com.

Darril Gibson, CISSP, Security+, CASP, is the CEO of YCDA (short for You Can Do Anything), and he has authored or coauthored more than 40 books. Darril regularly writes, consults, and teaches on a wide variety of technical and security topics and holds several certifications. He regularly posts blog articles at http://blogs.getcertifiedgetahead.com/ about certification topics and uses that site to help people stay abreast of changes in certification exams. He loves hearing from readers, especially when they pass an exam after using one of his books, and you can contact him through the blogging site.

About the Technical Editors

Jeff T. Parker, CISSP, is a technical editor and reviewer across many focuses of information security. Jeff regularly contributes to books, adding experience and practical know-how where needed. Jeff's experience comes from 10 years of consulting with Hewlett-Packard in Boston and from 4 years with Deutsche-Post in Prague, Czech Republic. Now residing in Canada, Jeff teaches his and other middle-school kids about building (and destroying) a home lab. He recently coauthored *Wireshark for Security Professionals* and is now authoring *CySA+ Practice Exams*. Keep learning!

Bob Sipes, CISSP, is an enterprise security architect and account security officer at DXC Technology providing tactical and strategic leadership for DXC clients. He holds several certifications, is actively involved in security organizations including ISSA and Infragard, and is an experienced public speaker on topics including cybersecurity, communications, and leadership. In his spare time, Bob is an avid antiquarian book collector with an extensive library of 19th and early 20th century boys' literature. You can follow Bob on Twitter at `@bobsipes`.

David Seidl, CISSP, is the senior director for Campus Technology Services at the University of Notre Dame, where he has also taught cybersecurity and networking in the Mendoza College of Business. David has written multiple books on cybersecurity certification and cyberwarfare, and he has served as the technical editor for the sixth, seventh, and eighth editions of *CISSP Study Guide*. David holds a master's degree in information security and a bachelor's degree in communication technology from Eastern Michigan University, as well as CISSP, GPEN, GCIH, and CySA+ certifications.

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Introduction

The *(ISC)2 CISSP: Certified Information Systems Security Professional Official Study Guide, Eighth Edition,* offers you a solid foundation for the Certified Information Systems Security Professional (CISSP) exam. By purchasing this book, you've shown a willingness to learn and a desire to develop the skills you need to achieve this certification. This introduction provides you with a basic overview of this book and the CISSP exam.

This book is designed for readers and students who want to study for the CISSP certification exam. If your goal is to become a certified security professional, then the CISSP certification and this study guide are for you. The purpose of this book is to adequately prepare you to take the CISSP exam.

Before you dive into this book, you need to have accomplished a few tasks on your own. You need to have a general understanding of IT and of security. You should have the necessary five years of full-time paid work experience (or four years if you have a college degree) in two or more of the eight domains covered by the CISSP exam. If you are qualified to take the CISSP exam according to (ISC)^2, then you are sufficiently prepared to use this book to study for it. For more information on (ISC)^2, see the next section.

(ISC)^2 also allows for a one-year reduction of the five-year experience requirement if you have earned one of the approved certifications from the (ISC)^2 prerequisite pathway. These include certifications such as CAP, CISM, CISA, CCNA Security, Security+, MCSA, MCSE, and many of the GIAC certifications. For a complete list of qualifying certifications, visit https://www.isc2.org/Certifications/CISSP/Prerequisite-Pathway. Note: You can use only one of the experience reduction measures, either a college degree or a certification, not both.

(ISC)^2

The CISSP exam is governed by the International Information Systems Security Certification Consortium (ISC)². (ISC)² is a global not-for-profit organization. It has four primary mission goals:

- Maintain the Common Body of Knowledge (CBK) for the field of information systems security.
- Provide certification for information systems security professionals and practitioners.
- Conduct certification training and administer the certification exams.
- Oversee the ongoing accreditation of qualified certification candidates through continued education.

The (ISC)² is operated by a board of directors elected from the ranks of its certified practitioners.

(ISC)² supports and provides a wide variety of certifications, including CISSP, SSCP, CAP, CSSLP, CCFP, HCISPP, and CCSP. These certifications are designed to verify the knowledge and skills of IT security professionals across all industries. You can obtain more information about (ISC)² and its other certifications from its website at www.isc2.org.

The Certified Information Systems Security Professional (CISSP) credential is for security professionals responsible for designing and maintaining security infrastructure within an organization.

Topical Domains

The CISSP certification covers material from the eight topical domains. These eight domains are as follows:

- Security and Risk Management
- Asset Security
- Security Architecture and Engineering
- Communication and Network Security
- Identity and Access Management (IAM)

- Security Assessment and Testing
- Security Operations
- Software Development Security

These eight domains provide a vendor-independent overview of a common security framework. This framework is the basis for a discussion on security practices that can be supported in all types of organizations worldwide.

The most recent revision of the topical domains will be reflected in exams starting April 15, 2018. For a complete view of the breadth of topics covered on the CISSP exam from the eight domain groupings, visit the (ISC)^2 website at www.isc2.org to request a copy of the Candidate Information Bulletin. This document includes a complete exam outline as well as other relevant facts about the certification.

Prequalifications

(ISC)^2 has defined the qualification requirements you must meet to become a CISSP. First, you must be a practicing security professional with at least five years' full-time paid work experience or with four years' experience and a recent IT or IS degree. Professional experience is defined as security work performed for salary or commission within two or more of the eight CBK domains.

Second, you must agree to adhere to a formal code of ethics. The CISSP Code of Ethics is a set of guidelines the (ISC)^2 wants all CISSP candidates to follow to maintain professionalism in the field of information systems security. You can find it in the Information section on the (ISC)^2 website at www.isc2.org.

(ISC)^2 also offers an entry program known as an Associate of (ISC)^2. This program allows someone without any or enough experience to qualify as a CISSP to take the CISSP exam anyway and then obtain experience afterward. Associates are granted six years to obtain five years' of security experience. Only after providing proof of such experience, usually by means of endorsement and a resume, can the individual be awarded CISSP certification.

Overview of the CISSP Exam

The CISSP exam focuses on security from a 30,000-foot view; it deals more with theory and concept than implementation and procedure. It is very broad but not very deep. To successfully complete this exam, you'll need to be familiar with every domain but not necessarily be a master of each domain.

As of December 18, 2017, the CISSP exam is in an adaptive format. (ISC)² calls the new version CISSP-CAT (Computerized Adaptive Testing). For complete details of this new version of exam presentation, please see https://www.isc2.org/certifications/CISSP/CISSP-CAT.

The CISSP-CAT exam will be a minimum of 100 questions and a maximum of 150. Not all items you are presented with count toward your score or passing status. These unscored items are called *pretest questions* by (ISC)², while the scored items are called *operational items*. The questions are not labeled on the exam as to whether they are scored or unscored. Test candidates will receive 25 unscored items on their exam, regardless of whether they achieve a passing rank at question 100 or see all of the 150 questions.

The CISSP-CAT grants a maximum of three hours to take the exam. If you run out of time before achieving a passing rank, you will automatically fail.

The CISSP-CAT does not allow you to return to a previous question to change your answer. Your answer selection is final once you leave a question.

The CISSP-CAT does not have a published or set score to achieve. Instead, you must demonstrate the ability to answer above the (ISC)² bar for passing, called the *passing standard* (which is not disclosed), within the last 75 operational items (i.e., questions).

If the computer determines that you have a less than 5 percent chance of achieving a passing standard and you have seen 75 operational items, your test will automatically end with a failure. You are not guaranteed to see any more questions than are necessary for the computer grading system to determine with 95 percent confidence your ability to achieve a passing standard or to fail to meet the passing standard.

If you do not pass the CISSP exam on your first attempt, you are allowed to retake the CISSP exam under the following conditions:

- You can take the CISSP exam a maximum of 3 times per 12-month period.
- You must wait 30 days after your first attempt before trying a second time.
- You must wait an additional 90 days after your second attempt before trying a third time.
- You must wait an additional 180 days after your third attempt before trying again or as long as needed to reach 12 months from the date of your first attempt.

You will need to pay full price for each additional exam attempt.

It is not possible to take the previous paper-based or CBT (computer based testing) flat 250 question version of the exam. CISSP is now available only in the CBT CISSP-CAT format.

The refreshed CISSP exam will be available in English, French, German, Brazilian Portuguese, Spanish, Japanese, Simplified Chinese and Korean.

Effective December 18, 2017, the Certified Information Systems Security Professional (CISSP) exam (English version only) will be available exclusively via CAT through (ISC)2-authorized Pearson VUE test centers in authorized markets. CISSP exams administered in languages other than English and all other (ISC)2 certification exams will continue to be available as fixed-form, linear examinations.

CISSP Exam Question Types

Most of the questions on the CISSP exam are four-option, multiple-choice questions with a single correct answer. Some are straightforward, such as asking you to select a definition. Some are a bit more involved, asking you to select the appropriate concept or best practice. And some questions present you with a scenario or situation and ask you to select the best response. Here’s an example:

1. What is the most important goal and top priority of a security solution?

   A. Preventing disclosure

   B. Maintaining integrity

   C. Maintaining human safety

   D. Sustaining availability

You must select the one correct or best answer and mark it. In some cases, the correct answer will be very obvious to you. In other cases, several answers may seem correct. In these instances, you must choose the best answer for the question asked. Watch for general, specific, universal, superset, and subset answer selections. In other cases, none of the answers will seem correct. In these instances, you’ll need to select the least incorrect answer.

> NOTE .By the way, the correct answer for this sample question is C. Maintaining human safety is always your first priority.

In addition to the standard multiple-choice question format, (ISC)^2 has added a few advanced question formats, which it calls *advanced innovative questions*. These include drag-and-drop questions and hotspot questions. These types of questions require you to place topics or concepts in order of operations, in priority preference, or in relation to proper positioning for the needed solution. Specifically, the drag-and-drop questions require the test taker to move labels or icons to mark items on an image. The hotspot questions require the test taker to pinpoint a location on an image with a cross-hair marker. These question concepts are easy to work with and understand, but be careful about your accuracy of dropping or marking.

Advice on Taking the Exam

The CISSP exam consists of two key elements. First, you need to know the material from the eight domains. Second, you must have good test-taking skills. You have a maximum of 3 hours to achieve a passing standard with the potential to see up to 150 questions. Thus, you will have on average just over a minute for each question. Thus, it is important to work quickly, without rushing but also without wasting time.

It is not clear from (ISC)²'s description of the CISSP-CAT format whether guessing is a good strategy in every case, but it does seem to be a better strategy than skipping questions. We recommend you attempt to eliminate as many answer selections as possible before making a guess, and consider skipping the question instead of randomly guessing only if you are unable to eliminate any answer options. Make educated guesses from a reduced set of options to increase your chance of getting a question correct.

Also note that (ISC)² does not disclose if there is partial credit given for multiple-part questions if you get only some of the elements correct. So, pay attention to questions with check boxes instead of radio buttons, and be sure to select as many items as necessary to properly address the question.

You will be provided a dry-erase board and a marker to jot down thoughts and make notes. But nothing written on that board will be used to alter your score. And that board must be returned to the test administrator prior to departing the test facility.

To maximize your test-taking activities, here are some general guidelines:

- Read each question, then read the answer options, and then reread the question.
- Eliminate wrong answers before selecting the correct one.
- Watch for double negatives.
- Be sure you understand what the question is asking.

Manage your time. You can take breaks during your test, but this might consume some of your test time. You might consider bringing a drink and snacks, but your food and drink will be stored for you away from the testing area, and that break time will count against your test time limit. Be sure to bring any medications or other essential items, but leave all things electronic at home or in your car. You should avoid wearing anything on your wrists, including watches, fitness trackers, and jewelry. You are not allowed to bring any form of noise-canceling headsets or ear buds, although you can use foam earplugs. We also recommend wearing comfortable clothes and taking a light jacket with you (some testing locations are a bit chilly).

If English is not your first language, you can register for one of several other language versions of the exam. Or, if you choose to use the English version of the exam, a translation dictionary is allowed. (Be sure to contact your test facility to organize and arrange this beforehand.) You must be able to prove that you need such a dictionary; this is usually accomplished with your birth certificate or your passport.

> NOTE .Occasionally, small changes are made to the exam or exam objectives. When that happens, Sybex will post updates to its website. Visit www.wiley.com/go/cissp8e before you sit for the exam to make sure you have the latest information.

Study and Exam Preparation Tips

We recommend planning for a month or so of nightly intensive study for the CISSP exam. Here are some suggestions to maximize your learning time; you can modify them as necessary based on your own learning habits:

- Take one or two evenings to read each chapter in this book and work through its review material.
- Answer all the review questions and take the practice exams provided in the book and in the test engine. Complete the written labs from each chapter, and use the review questions for each chapter to help guide you to topics for which more study or time

spent working through key concepts and strategies might be beneficial.

- Review the (ISC)^2's Exam Outline: www.isc2.org.
- Use the flashcards included with the study tools to reinforce your understanding of concepts.

> We recommend spending about half of your study time reading and reviewing concepts and the other half taking practice exams. Students have reported that the more time they spent taking practice exams, the better they retained test topics. In addition to the practice tests with this Study Guide, Sybex also publishes *(ISC)^2 CISSP Certified Information Systems Security Professional Official Practice Tests, 2nd Edition* (ISBN: 978-1-119-47592-7). It contains 100 or more practice questions for each domain and four additional complete practice exams. Like this Study Guide, it also comes with an online version of the questions.

Completing the Certification Process

Once you have been informed that you successfully passed the CISSP certification, there is one final step before you are actually awarded the CISSP certification. That final step is known as *endorsement*. Basically, this involves getting someone who is a CISSP, or other (ISC)^2 certification holder, in good standing and familiar with your work history to submit an endorsement form on your behalf. The endorsement form is accessible through the email notifying you of your achievement in passing the exam. The endorser must review your résumé, ensure that you have sufficient experience in the eight CISSP domains, and then submit the signed form to (ISC)^2 digitally or via fax or post mail. You must have submitted the endorsement files to (ISC)^2 within 90 days after receiving the confirmation-of-passing email. Once (ISC)^2 receives your endorsement form, the certification process will be completed and you will be sent a welcome packet via USPS.

Post-CISSP Concentrations

(ISC)² has three concentrations offered only to CISSP certificate holders. The (ISC)² has taken the concepts introduced on the CISSP exam and focused on specific areas, namely, architecture, management, and engineering. These three concentrations are as follows:

Information Systems Security Architecture Professional (ISSAP) Aimed at those who specialize in information security architecture. Key domains covered here include access control systems and methodology; cryptography; physical security integration; requirements analysis and security standards, guidelines, and criteria; technology-related aspects of business continuity planning and disaster recovery planning; and telecommunications and network security. This is a credential for those who design security systems or infrastructure or for those who audit and analyze such structures.

Information Systems Security Management Professional (ISSMP) Aimed at those who focus on management of information security policies, practices, principles, and procedures. Key domains covered here include enterprise security management practices; enterprise-wide system development security; law, investigations, forensics, and ethics; oversight for operations security compliance; and understanding business continuity planning, disaster recovery planning, and continuity of operations planning. This is a credential for professionals who are responsible for security infrastructures, particularly where mandated compliance comes into the picture.

Information Systems Security Engineering Professional (ISSEP) Aimed at those who focus on the design and engineering of secure hardware and software information systems, components, or applications. Key domains covered include certification and accreditation, systems security engineering, technical management, and U.S. government information assurance rules and regulations. Most ISSEPs work for the U.S. government or for a government contractor that manages government security clearances.

For more details about these concentration exams and certifications, please see the (ISC)^2 website at www.isc2.org.

Notes on This Book's Organization

This book is designed to cover each of the eight CISSP Common Body of Knowledge domains in sufficient depth to provide you with a clear understanding of the material. The main body of this book comprises 21 chapters. The domain/chapter breakdown is as follows:

Chapters 1, 2, 3, and 4: Security and Risk Management

Chapter 5: Asset Security

Chapters 6, 7, 8, 9, and 10: Security Architecture and Engineering

Chapters 11 and 12: Communication and Network Security

Chapters 13 and 14: Identity and Access Management (IAM)

Chapters 15: Security Assessment and Testing

Chapters 16, 17, 18, and 19: Security Operations

Chapters 20 and 21: Software Development Security

Each chapter includes elements to help you focus your studies and test your knowledge, detailed in the following sections. Note: please see the table of contents and chapter introductions for a detailed list of domain topics covered in each chapter.

The Elements of This Study Guide

You'll see many recurring elements as you read through this study guide. Here are descriptions of some of those elements:

Exam Essentials The Exam Essentials highlight topics that could appear on the exam in some form. While we obviously do not know exactly what will be included in a particular exam, this section reinforces significant concepts that are key to understanding the Common Body of Knowledge (CBK) area and the test specs for the CISSP exam.

Chapter Review Questions Each chapter includes practice questions that have been designed to measure your knowledge of key ideas that were discussed in the chapter. After you finish each chapter, answer the questions; if some of your answers are incorrect, it's an indication that you need to spend some more time studying the corresponding topics. The answers to the practice questions can be found at the end of each chapter.

Written Labs Each chapter includes written labs that synthesize various concepts and topics that appear in the chapter. These raise questions that are designed to help you put together various pieces you've encountered individually in the chapter and assemble them to propose or describe potential security strategies or solutions.

Real-World Scenarios As you work through each chapter, you'll find descriptions of typical and plausible workplace situations where an understanding of the security strategies and approaches relevant to the chapter content could play a role in fixing problems or in fending off potential difficulties. This gives readers a chance to see how specific security policies, guidelines, or practices should or may be applied to the workplace.

Summaries The summary is a brief review of the chapter to sum up what was covered.

What's Included with the Additional Study Tools

Readers of this book can get access to a number of additional study tools. We worked really hard to provide some essential tools to help you with your certification process. All of the following gear should be loaded on your workstation when studying for the test.

> NOTE .Readers can get access to the following tools by visiting
>
> www.wiley.com/go/cissptestprep.

The Sybex Test Preparation Software

The test preparation software, made by experts at Sybex, prepares you for the CISSP exam. In this test engine, you will find all the review and assessment questions from the book plus additional bonus practice exams that are included with the study tools. You can take the assessment test, test yourself by chapter, take the practice exams, or take a randomly generated exam comprising all the questions.

Electronic Flashcards

Sybex's electronic flashcards include hundreds of questions designed to challenge you further for the CISSP exam. Between the review questions, practice exams, and flashcards, you'll have more than enough practice for the exam!

Glossary of Terms in PDF

Sybex offers a robust glossary of terms in PDF format. This comprehensive glossary includes all of the key terms you should understand for the CISSP, in a searchable format.

Bonus Practice Exams

Sybex includes bonus practice exams, each comprising questions meant to survey your understanding of key elements in the CISSP CBK. This book has six bonus exams, each comprising 150 questions to match the longest possible length of the real exam. These exams are available digitally at http://www.wiley.com/go/sybextestprep.

How to Use This Book's Study Tools

This book has a number of features designed to guide your study efforts for the CISSP certification exam. It assists you by listing at the beginning of each chapter the CISSP Common Body of Knowledge domain topics covered in the chapter and by ensuring that each topic is fully discussed within the chapter. The review questions at the end of each chapter and the practice exams are designed to test your retention of the material you've read to make sure you are aware of areas in which you should spend additional study time. Here are some suggestions for using this book and study tools (found at www.wiley.com/go/cissptestprep):

- Take the assessment test before you start reading the material. This will give you an idea of the areas in which you need to spend additional study time as well as those areas in which you may just need a brief refresher.

- Answer the review questions after you've read each chapter; if you answer any incorrectly, go back to the chapter and review the topic, or utilize one of the additional resources if you need more information.
- Download the flashcards to your mobile device, and review them when you have a few minutes during the day.
- Take every opportunity to test yourself. In addition to the assessment test and review questions, there are bonus practice exams included with the additional study tools. Take these exams without referring to the chapters and see how well you've done—go back and review any topics you've missed until you fully understand and can apply the concepts.

Finally, find a study partner if possible. Studying for, and taking, the exam with someone else will make the process more enjoyable, and you'll have someone to help you understand topics that are difficult for you. You'll also be able to reinforce your own knowledge by helping your study partner in areas where they are weak.

Assessment Test

1. Which of the following types of access control seeks to discover evidence of unwanted, unauthorized, or illicit behavior or activity?

   A. Preventive

   B. Deterrent

   C. Detective

   D. Corrective

2. Define and detail the aspects of password selection that distinguish good password choices from ultimately poor password choices.

   A. Difficult to guess or unpredictable

   B. Meet minimum length requirements

   C. Meet specific complexity requirements

   D. All of the above

3. Which of the following is most likely to detect DoS attacks?

   A. Host-based IDS

   B. Network-based IDS

   C. Vulnerability scanner

   D. Penetration testing

4. Which of the following is considered a denial-of-service attack?

   A. Pretending to be a technical manager over the phone and asking a receptionist to change their password

   B. While surfing the Web, sending to a web server a malformed URL that causes the system to consume 100 percent of the CPU

   C. Intercepting network traffic by copying the packets as they pass through a specific subnet

   D. Sending message packets to a recipient who did not request them simply to be annoying

5. At which layer of the OSI model does a router operate?

   A. Network layer

   B. Layer 1

   C. Transport layer

   D. Layer 5

6. Which type of firewall automatically adjusts its filtering rules based on the content of the traffic of existing sessions?

   A. Static packet filtering

   B. Application-level gateway

   C. Circuit level gateway

   D. Dynamic packet filtering

7. A VPN can be established over which of the following?

   A. Wireless LAN connection

   B. Remote access dial-up connection

   C. WAN link

   D. All of the above

8. What type of malware uses social engineering to trick a victim into installing it?

   A. Viruses

   B. Worms

   C. Trojan horse

   D. Logic bomb

9. The CIA Triad comprises what elements?

   A. Contiguousness, interoperable, arranged

   B. Authentication, authorization, accountability

   C. Capable, available, integral

D. Availability, confidentiality, integrity

0. Which of the following is not a required component in the support of accountability?

A. Auditing

B. Privacy

C. Authentication

D. Authorization

11. Which of the following is not a defense against collusion?

A. Separation of duties

B. Restricted job responsibilities

C. Group user accounts

D. Job rotation

2. A data custodian is responsible for securing resources after ________________________ has assigned the resource a security label.

A. Senior management

B. The data owner

C. An auditor

D. Security staff

3. In what phase of the Capability Maturity Model for Software (SW-CMM) are quantitative measures utilized to gain a detailed understanding of the software development process?

A. Repeatable

B. Defined

C. Managed

D. Optimizing

4. Which one of the following is a layer of the ring protection scheme that is not normally implemented in practice?

A. Layer 0

B. Layer 1

C. Layer 3

D. Layer 4

15. What is the last phase of the TCP/IP three-way handshake sequence?

A. SYN packet

B. ACK packet

C. NAK packet

D. SYN/ACK packet

16. Which one of the following vulnerabilities would best be countered by adequate parameter checking?

A. Time of check to time of use

B. Buffer overflow

C. SYN flood

D. Distributed denial of service

17. What is the value of the logical operation shown here?

X: 0 1 1 0 1 0

Y: 0 0 1 1 0 1

———————————

X ∨ Y: ?

A. 0 1 1 1 1 1

B. 0 1 1 0 1 0

C. 0 0 1 0 0 0

D. 0 0 1 1 0 1

18. In what type of cipher are the letters of the plain-text message rearranged to form the cipher text?

A. Substitution cipher

B. Block cipher

C. Transposition cipher

D. Onetime pad

9. What is the length of a message digest produced by the MD5 algorithm?

A. 64 bits

B. 128 bits

C. 256 bits

D. 384 bits

0. If Renee receives a digitally signed message from Mike, what key does she use to verify that the message truly came from Mike?

A. Renee’s public key

B. Renee’s private key

C. Mike’s public key

D. Mike’s private key

21. Which of the following is not a composition theory related to security models?

A. Cascading

B. Feedback

C. Iterative

D. Hookup

2. The collection of components in the TCB that work together to implement reference monitor functions is called the ________________________ .

A. Security perimeter

B. Security kernel

C. Access matrix

D. Constrained interface

23. Which of the following statements is true?

A. The less complex a system, the more vulnerabilities it has.

B. The more complex a system, the less assurance it provides.

C. The less complex a system, the less trust it provides.

D. The more complex a system, the less attack surface it generates.

24. Ring 0, from the design architecture security mechanism known as protection rings, can also be referred to as all but which of the following?

A. Privileged mode

B. Supervisory mode

C. System mode

D. User mode

25. Audit trails, logs, CCTV, intrusion detection systems, antivirus software, penetration testing, password crackers, performance monitoring, and cyclic redundancy checks (CRCs) are examples of what?

A. Directive controls

B. Preventive controls

C. Detective controls

D. Corrective controls

26. System architecture, system integrity, covert channel analysis, trusted facility management, and trusted recovery are elements of what security criteria?

A. Quality assurance

B. Operational assurance

C. Lifecycle assurance

D. Quantity assurance

27. Which of the following is a procedure designed to test and perhaps bypass a system’s security controls?

    A. Logging usage data

    B. War dialing

    C. Penetration testing

    D. Deploying secured desktop workstations

28. Auditing is a required factor to sustain and enforce what?

    A. Accountability

    B. Confidentiality

    C. Accessibility

    D. Redundancy

29. What is the formula used to compute the ALE?

    A. ALE = AV * EF * ARO

    B. ALE = ARO * EF

    C. ALE = AV * ARO

    D. ALE = EF * ARO

30. What is the first step of the business impact assessment process?

    A. Identification of priorities

    B. Likelihood assessment

    C. Risk identification

    D. Resource prioritization

31. Which of the following represent natural events that can pose a threat or risk to an organization?

    A. Earthquake

    B. Flood

    C. Tornado

    D. All of the above

32. What kind of recovery facility enables an organization to resume operations as quickly as possible, if not immediately, upon failure of the primary facility?

    A. Hot site

    B. Warm site

    C. Cold site

    D. All of the above

33. What form of intellectual property is used to protect words, slogans, and logos?

    A. Patent

    B. Copyright

    C. Trademark

    D. Trade secret

34. What type of evidence refers to written documents that are brought into court to prove a fact?

    A. Best evidence

    B. Payroll evidence

    C. Documentary evidence

    D. Testimonial evidence

35. Why are military and intelligence attacks among the most serious computer crimes?

    A. The use of information obtained can have far-reaching detrimental strategic effects on national interests in an enemy's hands.

    B. Military information is stored on secure machines, so a successful attack can be embarrassing.

    C. The long-term political use of classified information can impact a country's leadership.

    D. The military and intelligence agencies have ensured that the laws protecting their information are the most severe.

36. What type of detected incident allows the most time for an investigation?

    A. Compromise

    B. Denial of service

    C. Malicious code

    D. Scanning

37. If you want to restrict access into or out of a facility, which would you choose?

    A. Gate

    B. Turnstile

    C. Fence

    D. Mantrap

38. What is the point of a secondary verification system?

    A. To verify the identity of a user

    B. To verify the activities of a user

    C. To verify the completeness of a system

    D. To verify the correctness of a system

39. Spamming attacks occur when numerous unsolicited messages are sent to a victim. Because enough data is sent to the victim to prevent legitimate activity, it is also known as what?

    A. Sniffing

    B. Denial of service

    C. Brute-force attack

    D. Buffer overflow attack

40. Which type of intrusion detection system (IDS) can be considered an expert system?

    A. Host-based

B. Network-based
C. Knowledge-based
D. Behavior-based

Answers to Assessment Test

1. C. Detective access controls are used to discover (and document) unwanted or unauthorized activity.
2. D. Strong password choices are difficult to guess, unpredictable, and of specified minimum lengths to ensure that password entries cannot be computationally determined. They may be randomly generated and utilize all the alphabetic, numeric, and punctuation characters; they should never be written down or shared; they should not be stored in publicly accessible or generally readable locations; and they shouldn't be transmitted in the clear.
3. B. Network-based IDSs are usually able to detect the initiation of an attack or the ongoing attempts to perpetrate an attack (including denial of service, or DoS). They are, however, unable to provide information about whether an attack was successful or which specific systems, user accounts, files, or applications were affected. Host-based IDSs have some difficulty with detecting and tracking down DoS attacks. Vulnerability scanners don't detect DoS attacks; they test for possible vulnerabilities. Penetration testing may cause a DoS or test for DoS vulnerabilities, but it is not a detection tool.
4. B. Not all instances of DoS are the result of a malicious attack. Errors in coding OSs, services, and applications have resulted in DoS conditions. Some examples of this include a process failing to release control of the CPU or a service consuming system resources out of proportion to the service requests it is handling. Social engineering and sniffing are typically not considered DoS attacks.
5. A. Network hardware devices, including routers, function at layer 3, the Network layer.
6. D. Dynamic packet-filtering firewalls enable the real-time modification of the filtering rules based on traffic content.
7. D. A VPN link can be established over any other network

communication connection. This could be a typical LAN cable connection, a wireless LAN connection, a remote access dial-up connection, a WAN link, or even an internet connection used by a client for access to the office LAN.

8. C. A Trojan horse is a form of malware that uses social engineering tactics to trick a victim into installing it—the trick is to make the victim believe that the only thing they have downloaded or obtained is the host file, when in fact it has a malicious hidden payload.
9. D. The components of the CIA Triad are confidentiality, availability, and integrity.
10. B. Privacy is not necessary to provide accountability.
11. C. Group user accounts allow for multiple people to log in under a single user account. This allows collusion because it prevents individual accountability.
12. B. The data owner must first assign a security label to a resource before the data custodian can secure the resource appropriately.
13. C. The Managed phase of the SW-CMM involves the use of quantitative development metrics. The Software Engineering Institute (SEI) defines the key process areas for this level as Quantitative Process Management and Software Quality Management.
14. B. Layers 1 and 2 contain device drivers but are not normally implemented in practice. Layer 0 always contains the security kernel. Layer 3 contains user applications. Layer 4 does not exist.
15. B. The SYN packet is first sent from the initiating host to the destination host. The destination host then responds with a SYN/ACK packet. The initiating host sends an ACK packet, and the connection is then established.
16. B. Parameter checking is used to prevent the possibility of buffer overflow attacks.
17. A. The ~ OR symbol represents the OR function, which is true when one or both of the input bits are true.

18. C. Transposition ciphers use an encryption algorithm to rearrange the letters of the plain-text message to form a cipher text message.

19. B. The MD5 algorithm produces a 128-bit message digest for any input.

20. C. Any recipient can use Mike's public key to verify the authenticity of the digital signature.

21. C. Iterative is not one of the composition theories related to security models. Cascading, feedback, and hookup are the three composition theories.

22. B. The collection of components in the TCB that work together to implement reference monitor functions is called the security kernel.

23. B. The more complex a system, the less assurance it provides. More complexity means more areas for vulnerabilities to exist and more areas that must be secured against threats. More vulnerabilities and more threats mean that the subsequent security provided by the system is less trustworthy.

24. D. Ring 0 has direct access to the most resources; thus user mode is not an appropriate label because user mode requires restrictions to limit access to resources.

25. C. Examples of detective controls are audit trails, logs, CCTV, intrusion detection systems, antivirus software, penetration testing, password crackers, performance monitoring, and CRCs.

26. B. Assurance is the degree of confidence you can place in the satisfaction of security needs of a computer, network, solution, and so on. Operational assurance focuses on the basic features and architecture of a system that lend themselves to supporting security.

27. C. Penetration testing is the attempt to bypass security controls to test overall system security.

28. A. Auditing is a required factor to sustain and enforce accountability.

29. A. The annualized loss expectancy (ALE) is computed as the product of the asset value (AV) times the exposure factor (EF) times the annualized rate of occurrence (ARO). This is the longer form of the formula ALE = SLE * ARO. The other formulas displayed here do not accurately reflect this calculation.

30. A. Identification of priorities is the first step of the business impact assessment process.

31. D. Natural events that can threaten organizations include earthquakes, floods, hurricanes, tornados, wildfires, and other acts of nature as well. Thus options A, B, and C are correct because they are natural and not man-made.

32. A. Hot sites provide backup facilities maintained in constant working order and fully capable of taking over business operations. Warm sites consist of preconfigured hardware and software to run the business, neither of which possesses the vital business information. Cold sites are simply facilities designed with power and environmental support systems but no configured hardware, software, or services. Disaster recovery services can facilitate and implement any of these sites on behalf of a company.

33. C. Trademarks are used to protect the words, slogans, and logos that represent a company and its products or services.

34. C. Written documents brought into court to prove the facts of a case are referred to as documentary evidence.

35. A. The purpose of a military and intelligence attack is to acquire classified information. The detrimental effect of using such information could be nearly unlimited in the hands of an enemy. Attacks of this type are launched by very sophisticated attackers. It is often very difficult to ascertain what documents were successfully obtained. So when a breach of this type occurs, you sometimes cannot know the full extent of the damage.

36. D. Scanning incidents are generally reconnaissance attacks. The real damage to a system comes in the subsequent attacks, so you may have some time to react if you detect the scanning attack early.

37. B. A turnstile is a form of gate that prevents more than one person

from gaining entry at a time and often restricts movement to one direction. It is used to gain entry but not exit, or vice versa.

8. D. Secondary verification mechanisms are set in place to establish a means of verifying the correctness of detection systems and sensors. This often means combining several types of sensors or systems (CCTV, heat and motion sensors, and so on) to provide a more complete picture of detected events.

9. B. A spamming attack (sending massive amounts of unsolicited email) can be used as a type of denial-of-service attack. It doesn’t use eavesdropping methods so it isn’t sniffing. Brute-force methods attempt to crack passwords. Buffer overflow attacks send strings of data to a system in an attempt to cause it to fail.

0. D. A behavior-based IDS can be labeled an expert system or a pseudo-artificial intelligence system because it can learn and make assumptions about events. In other words, the IDS can act like a human expert by evaluating current events against known events. A knowledge-based IDS uses a database of known attack methods to detect attacks. Both host-based and network-based systems can be either knowledge-based, behavior-based, or a combination of both.

Chapter 1
Security Governance Through Principles and Policies

THE CISSP EXAM TOPICS COVERED IN THIS CHAPTER INCLUDE:

- ✓ **Domain 1: Security and Risk Management**
  - 1.1 Understand and apply concepts of confidentiality, integrity and availability
  - 1.2 Evaluate and apply security governance principles
    - 1.2.1 Alignment of security function to business strategy, goals, mission, and objectives
    - 1.2.2 Organizational processes
    - 1.2.3 Organizational roles and responsibilities
    - 1.2.4 Security control frameworks
    - 1.2.5 Due care/due diligence
  - 1.6 Develop, document, and implement security policy, standards, procedures, and guidelines
  - 1.10 Understand and apply threat modeling concepts and methodologies
    - 1.10.1 Threat modeling methodologies
    - 1.10.2 Threat modeling concepts
  - 1.11 Apply risk-based management concepts to the supply chain
    - 1.11.1 Risks associated with hardware, software, and services
    - 1.11.2 Third-party assessment and monitoring
    - 1.11.3 Minimum security requirements
    - 1.11.4 Service-level requirements

.The Security and Risk Management domain of the Common Body of Knowledge (CBK) for the CISSP certification exam deals with many of the foundational elements of security solutions. These include elements essential to the design, implementation, and administration of security mechanisms. Additional elements of this domain are discussed in various chapters: Chapter 2, “Personal Security and Risk Management Concepts”; Chapter 3, “Business Continuity Planning”; Chapter 4, “Laws, Regulations, and Compliance”; and Chapter 19, “Investigations and Ethics.” Please be sure to review all of these chapters to have a complete perspective on the topics of this domain.

Understand and Apply Concepts of Confidentiality, Integrity, and Availability

Security management concepts and principles are inherent elements in a security policy and solution deployment. They define the basic parameters needed for a secure environment. They also define the goals and objectives that both policy designers and system implementers must achieve to create a secure solution. It is important for real-world security professionals, as well as CISSP exam students, to understand these items thoroughly. This chapter includes a range of topics related to the governance of security for global enterprises as well as smaller businesses.

Security must start somewhere. Often that somewhere is the list of most important security principles. In such a list, confidentiality, integrity, and availability (CIA) are usually present because these are typically viewed as the primary goals and objectives of a security infrastructure. They are so commonly seen as security essentials that they are referenced by the term *CIA Triad* (see Figure 1.1).

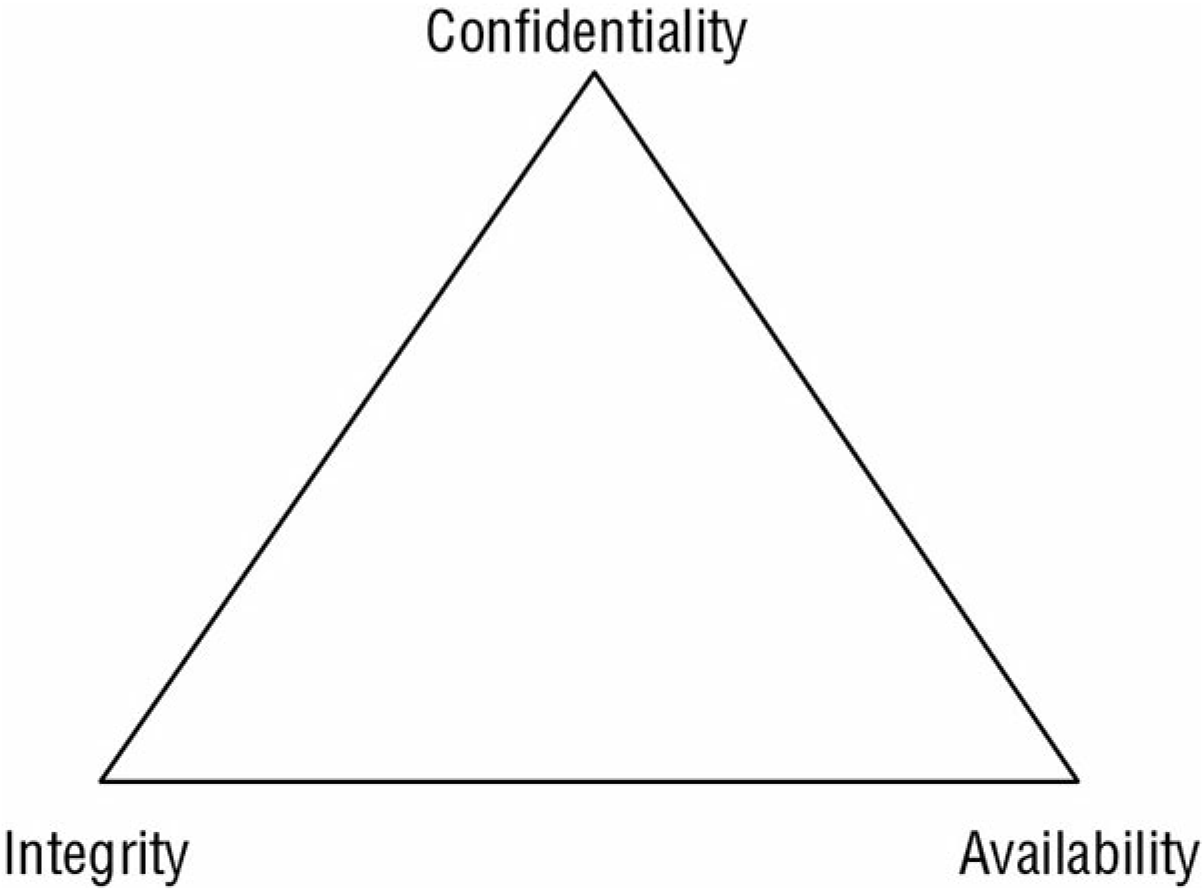


FIGURE 1.1 The CIA Triad

Security controls are typically evaluated on how well they address these three core information security tenets. Overall, a complete security solution should adequately address each of these tenets. Vulnerabilities and risks are also evaluated based on the threat they pose against one or more of the CIA Triad principles. Thus, it is a good idea to be familiar with these principles and use them as guidelines for judging all things related to security.

These three principles are considered the most important within the realm of security. However important each specific principle is to a specific organization depends on the organization's security goals and requirements and on the extent to which the organization's security might be threatened.

Confidentiality

The first principle of the CIA Triad is confidentiality. *Confidentiality* is the concept of the measures used to ensure the protection of the secrecy of data, objects, or resources. The goal of confidentiality protection is to prevent or minimize unauthorized access to data. Confidentiality focuses security measures on ensuring that no one other than the intended recipient of a message receives it or is able to read it. Confidentiality protection provides a means for authorized users to access and interact with resources, but it actively prevents unauthorized users from doing so. A wide range of security controls can provide protection for confidentiality, including, but not limited to, encryption, access controls, and steganography.

If a security mechanism offers confidentiality, it offers a high level of assurance that data, objects, or resources are restricted from unauthorized subjects. If a threat exists against confidentiality, unauthorized disclosure could take place. An object is the passive element in a security relationship, such as files, computers, network connections, and applications. A subject is the active element in a security relationship, such as users, programs, and computers. A subject acts upon or against an object. The management of the relationship between subjects and objects is known as access control.

In general, for confidentiality to be maintained on a network, data must be protected from unauthorized access, use, or disclosure while in storage, in process, and in transit. Unique and specific security controls are required for each of these states of data, resources, and objects to maintain confidentiality.

Numerous attacks focus on the violation of confidentiality. These include capturing network traffic and stealing password files as well as social engineering, port scanning, shoulder surfing, eavesdropping, sniffing, escalation of privileges, and so on.

Violations of confidentiality are not limited to directed intentional attacks. Many instances of unauthorized disclosure of sensitive or confidential information are the result of human error, oversight, or ineptitude. Events that lead to confidentiality breaches include failing to properly encrypt a transmission, failing to fully authenticate a remote system before transferring data, leaving open otherwise secured access points, accessing malicious code that opens a back door, misrouted faxes, documents left on printers, or even walking away from an access terminal while data is displayed on the monitor. Confidentiality violations can result from the actions of an end user or a system administrator. They can also occur because of an oversight in a security policy or a misconfigured security control.

Numerous countermeasures can help ensure confidentiality against possible threats. These include encryption, network traffic padding, strict access control, rigorous authentication procedures, data classification, and extensive personnel training.

Confidentiality and integrity depend on each other. Without object integrity (in other words, the inability of an object to be modified without permission), confidentiality cannot be maintained. Other concepts, conditions, and aspects of confidentiality include the following:

Sensitivity *Sensitivity* refers to the quality of information, which could cause harm or damage if disclosed. Maintaining confidentiality of sensitive information helps to prevent harm or damage.

Discretion *Discretion* is an act of decision where an operator can influence or control disclosure in order to minimize harm or damage.

Criticality The level to which information is mission critical is its measure of *criticality*. The higher the level of criticality, the more likely the need to maintain the confidentiality of the information. High levels of criticality are essential to the operation or function of an organization.

Concealment *Concealment* is the act of hiding or preventing disclosure. Often concealment is viewed as a means of cover, obfuscation, or distraction. A related concept to concealment is security through obscurity, which is the concept of attempting to gain protection through hiding, silence, or secrecy. While security through obscurity is typically not considered a valid security measure, it may still have value in some cases.

Secrecy *Secrecy* is the act of keeping something a secret or preventing the disclosure of information.

Privacy *Privacy* refers to keeping information confidential that is personally identifiable or that might cause harm, embarrassment, or disgrace to someone if revealed.

Seclusion *Seclusion* involves storing something in an out-of-the-way location. This location can also provide strict access controls. Seclusion can help enforcement of confidentiality protections.

Isolation *Isolation* is the act of keeping something separated from others. Isolation can be used to prevent commingling of information or disclosure of information.

Each organization needs to evaluate the nuances of confidentiality they wish to enforce. Tools and technology that implements one form of confidentiality might not support or allow other forms.

Integrity

The second principle of the CIA Triad is integrity. *Integrity* is the concept of protecting the reliability and correctness of data. Integrity protection prevents unauthorized alterations of data. It ensures that data remains correct, unaltered, and preserved. Properly implemented integrity protection provides a means for authorized changes while protecting against intended and malicious unauthorized activities (such as viruses and intrusions) as well as mistakes made by authorized users (such as mistakes or oversights).

For integrity to be maintained, objects must retain their veracity and be intentionally modified by only authorized subjects. If a security mechanism offers integrity, it offers a high level of assurance that the data, objects, and resources are unaltered from their original protected state. Alterations should not occur while the object is in storage, in transit, or in process. Thus, maintaining integrity means the object itself is not altered and the operating system and programming entities that manage and manipulate the object are not compromised.

Integrity can be examined from three perspectives:

- Preventing unauthorized subjects from making modifications
- Preventing authorized subjects from making unauthorized modifications, such as mistakes

- Maintaining the internal and external consistency of objects so that their data is a correct and true reflection of the real world and any relationship with any child, peer, or parent object is valid, consistent, and verifiable

For integrity to be maintained on a system, controls must be in place to restrict access to data, objects, and resources. Additionally, activity logging should be employed to ensure that only authorized users are able to access their respective resources. Maintaining and validating object integrity across storage, transport, and processing requires numerous variations of controls and oversight.

Numerous attacks focus on the violation of integrity. These include viruses, logic bombs, unauthorized access, errors in coding and applications, malicious modification, intentional replacement, and system back doors.

As with confidentiality, integrity violations are not limited to intentional attacks. Human error, oversight, or ineptitude accounts for many instances of unauthorized alteration of sensitive information. Events that lead to integrity breaches include modifying or deleting files; entering invalid data; altering configurations, including errors in commands, codes, and scripts; introducing a virus; and executing malicious code such as a Trojan horse. Integrity violations can occur because of the actions of any user, including administrators. They can also occur because of an oversight in a security policy or a misconfigured security control.

Numerous countermeasures can ensure integrity against possible threats. These include strict access control, rigorous authentication procedures, intrusion detection systems, object/data encryption, hash total verifications (see Chapter 6, “Cryptography and Symmetric Key Algorithms”), interface restrictions, input/function checks, and extensive personnel training.

Integrity is dependent on confidentiality. Other concepts, conditions, and aspects of integrity include the following:

- *Accuracy*: Being correct and precise
- *Truthfulness*: Being a true reflection of reality

- *Authenticity*: Being authentic or genuine
- *Validity*: Being factually or logically sound
- *Nonrepudiation*: Not being able to deny having performed an action or activity or being able to verify the origin of a communication or event
- *Accountability*: Being responsible or obligated for actions and results
- *Responsibility*: Being in charge or having control over something or someone
- *Completeness*: Having all needed and necessary components or parts
- *Comprehensiveness*: Being complete in scope; the full inclusion of all needed elements

Nonrepudiation

Nonrepudiation ensures that the subject of an activity or who caused an event cannot deny that the event occurred. Nonrepudiation prevents a subject from claiming not to have sent a message, not to have performed an action, or not to have been the cause of an event. It is made possible through identification, authentication, authorization, accountability, and auditing. Nonrepudiation can be established using digital certificates, session identifiers, transaction logs, and numerous other transactional and access control mechanisms. A system built without proper enforcement of nonrepudiation does not provide verification that a specific entity performed a certain action. Nonrepudiation is an essential part of accountability. A suspect cannot be held accountable if they can repudiate the claim against them.

Availability

The third principle of the CIA Triad is *availability*, which means authorized subjects are granted timely and uninterrupted access to objects. Often, availability protection controls support sufficient bandwidth and timeliness of processing as deemed necessary by the organization or situation. If a security mechanism offers availability, it offers a high level of assurance that the data, objects, and resources are accessible to authorized subjects. Availability includes efficient uninterrupted access to objects and prevention of denial-of-service (DoS) attacks. Availability also implies that the supporting infrastructure—including network services, communications, and access control mechanisms—is functional and allows authorized users to gain authorized access.

For availability to be maintained on a system, controls must be in place to ensure authorized access and an acceptable level of performance, to quickly handle interruptions, to provide for redundancy, to maintain reliable backups, and to prevent data loss or destruction.

There are numerous threats to availability. These include device failure, software errors, and environmental issues (heat, static, flooding, power loss, and so on). There are also some forms of attacks that focus on the violation of availability, including DoS attacks, object destruction, and communication interruptions.

As with confidentiality and integrity, violations of availability are not limited to intentional attacks. Many instances of unauthorized alteration of sensitive information are caused by human error, oversight, or ineptitude. Some events that lead to availability breaches include accidentally deleting files, overutilizing a hardware or software component, under-allocating resources, and mislabeling or incorrectly classifying objects. Availability violations can occur because of the actions of any user, including administrators. They can also occur because of an oversight in a security policy or a misconfigured security control.

Numerous countermeasures can ensure availability against possible threats. These include designing intermediary delivery systems properly, using access controls effectively, monitoring performance and network traffic, using firewalls and routers to prevent DoS attacks, implementing redundancy for critical systems, and maintaining and testing backup systems. Most security policies, as well as business continuity planning (BCP), focus on the use of fault tolerance features at the various levels of access/storage/security (that is, disk, server, or site) with the goal of eliminating single points of failure to maintain availability of critical systems.

Availability depends on both integrity and confidentiality. Without integrity and confidentiality, availability cannot be maintained. Other concepts, conditions, and aspects of availability include the following:

- *Usability*: The state of being easy to use or learn or being able to be understood and controlled by a subject
- *Accessibility*: The assurance that the widest range of subjects can interact with a resource regardless of their capabilities or limitations
- *Timeliness*: Being prompt, on time, within a reasonable time frame, or providing low-latency response

Real World Scenario

CIA Priority

Every organization has unique security requirements. On the CISSP exam, most security concepts are discussed in general terms, but in the real world, general concepts and best practices don’t get the job done. The management team and security team must work together to prioritize an organization’s security needs. This includes establishing a budget and spending plan, allocating expertise and hours, and focusing the information technology (IT) and security staff efforts. One key aspect of this effort is to prioritize the security requirements of the organization. Knowing which tenet or asset is more important than another guides the creation of a security stance and ultimately the deployment of a security solution. Often, getting started in establishing priorities is a challenge. A possible solution to this challenge is to start with prioritizing the three primary security tenets of confidentiality, integrity, and availability. Defining which of these elements is most important to the organization is essential in crafting a sufficient security solution. This establishes a pattern that can be replicated from concept through design, architecture, deployment, and finally, maintenance.

Do you know the priority your organization places on each of the components of the CIA Triad? If not, find out.

An interesting generalization of this concept of CIA prioritization is that in many cases military and government organizations tend to prioritize confidentiality above integrity and availability, whereas private companies tend to prioritize availability above confidentiality and integrity. Although such prioritization focuses efforts on one aspect of security over another, it does not imply that the second or third prioritized items are ignored or improperly addressed. Another perspective on this is discovered when comparing standard IT systems with Operational Technology (OT) systems such as programmable logic controllers (PLCs), supervisory control and data acquisition (SCADA), and MES (Manufacturing Execution Systems) devices and systems used on manufacturing plant floors. IT systems, even in private companies, tend to follow the CIA Triad; however, OT systems tend to follow the AIC Triad, where availability is prioritized overall and integrity is valued over confidentiality. Again, this is just a generalization but one that may serve you well in deciphering questions on the CISSP exam. Each individual organization decides its own security priorities.

Other Security Concepts

In addition to the CIA Triad, you need to consider a plethora of other security-related concepts and principles when designing a security policy and deploying a security solution.

You may have heard of the concept of *AAA services*. The three A’s in this abbreviation refer to authentication, authorization, and accounting (or sometimes auditing). However, what is not as clear is that although there are three letters in the acronym, it actually refers to five elements: identification, authentication, authorization, auditing, and accounting. These five elements represent the following processes of security:

- *Identification*: Claiming to be an identity when attempting to access a secured area or system
- *Authentication*: Proving that you are that identity
- *Authorization*: Defining the permissions (i.e., allow/grant and/or deny) of a resource and object access for a specific identity
- *Auditing*: Recording a log of the events and activities related to the system and subjects
- *Accounting* (aka *accountability*): Reviewing log files to check for compliance and violations in order to hold subjects accountable for their actions

Although AAA is typically referenced in relation to authentication systems, it is actually a foundational concept for security. Missing any of these five elements can result in an incomplete security mechanism. The following sections discuss identification, authentication, authorization, auditing, and accountability (see Figure 1.2).

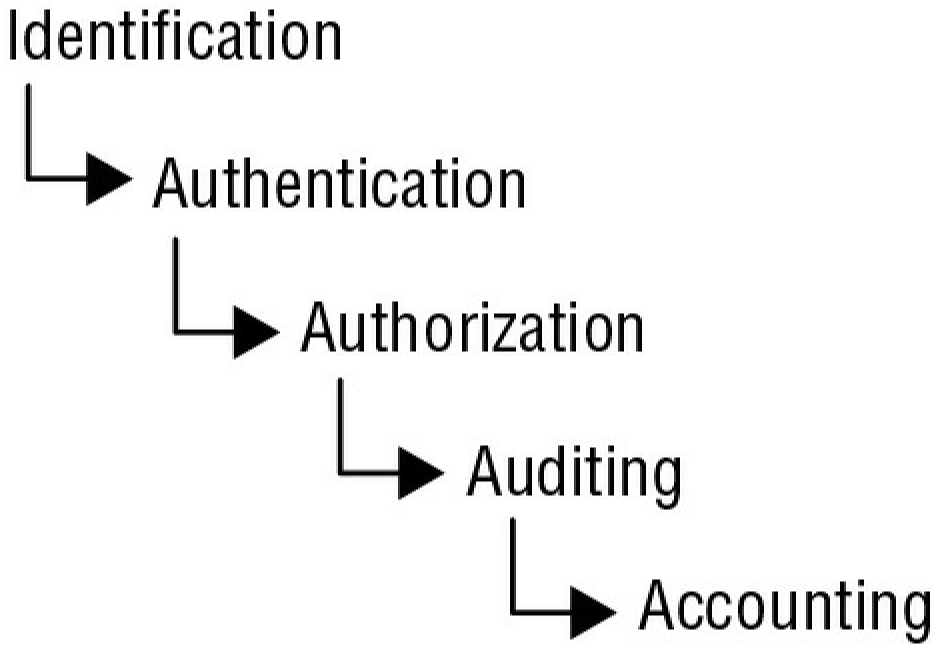


FIGURE 1.2 The five elements of AAA services

Identification

Identification is the process by which a subject professes an identity and accountability is initiated. A *subject* must provide an identity to a system to start the process of authentication, authorization, and accountability (AAA). Providing an identity can involve typing in a username; swiping a smart card; waving a proximity device; speaking a phrase; or positioning your face, hand, or finger for a camera or scanning device. Providing a process ID number also represents the identification process. Without an identity, a system has no way to correlate an authentication factor with the subject.

Once a subject has been identified (that is, once the subject's identity has been recognized and verified), the identity is accountable for any further actions by that subject. IT systems track activity by identities, not by the subjects themselves. A computer doesn't know one human from another, but it does know that your user account is different from all other user accounts. A subject's identity is typically labeled as, or considered to be, public information. However, simply claiming an identity does not imply access or authority. The identity must be proven (authentication) or verified (ensuring nonrepudiation) before access to controlled resources is allowed (verifying authorization).

That process is authentication.

Authentication

The process of verifying or testing that the claimed identity is valid is authentication. Authentication requires the subject to provide additional information that corresponds to the identity they are claiming. The most common form of authentication is using a password (this includes the password variations of personal identification numbers (PINs) and passphrases). Authentication verifies the identity of the subject by comparing one or more factors against the database of valid identities (that is, user accounts). The *authentication factor* used to verify identity is typically labeled as, or considered to be, private information. The capability of the subject and system to maintain the secrecy of the authentication factors for identities directly reflects the level of security of that system. If the process of illegitimately obtaining and using the authentication factor of a target user is relatively easy, then the authentication system is insecure. If that process is relatively difficult, then the authentication system is reasonably secure.

Identification and authentication are often used together as a single two-step process. Providing an identity is the first step, and providing the authentication factors is the second step. Without both, a subject cannot gain access to a system—neither element alone is useful in terms of security. In some systems, it may seem as if you are providing only one element but gaining access, such as when keying in an ID code or a PIN. However, in these cases either the identification is handled by another means, such as physical location, or authentication is assumed by your ability to access the system physically. Both identification and authentication take place, but you might not be as aware of them as when you manually type in both a name and a password.

A subject can provide several types of authentication—for example, something you know (e.g., passwords, PINs), something you have (e.g., keys, tokens, smart cards), something you are (e.g., biometrics, such as fingerprints, iris, or voice recognition), and so on. Each authentication technique or factor has its unique benefits and drawbacks. Thus, it is important to evaluate each mechanism in light of the environment in which it will be deployed to determine viability. (We discuss authentication at length in Chapter 13, “Managing Identity and Authentication.”)

Authorization

Once a subject is authenticated, access must be authorized. The process of authorization ensures that the requested activity or access to an object is possible given the rights and *privileges* assigned to the authenticated identity. In most cases, the system evaluates an *access control matrix* that compares the subject, the object, and the intended activity. If the specific action is allowed, the subject is authorized. If the specific action is not allowed, the subject is not authorized.

Keep in mind that just because a subject has been identified and authenticated does not mean they have been authorized to perform any function or access all resources within the controlled environment. It is possible for a subject to be logged onto a network (that is, identified and authenticated) but to be blocked from accessing a file or printing to a printer (that is, by not being authorized to perform that activity). Most network users are authorized to perform only a limited number of activities on a specific collection of resources. Identification and authentication are all-or-nothing aspects of access control. Authorization has a wide range of variations between all or nothing for each object within the environment. A user may be able to read a file but not delete it, print a document but not alter the print queue, or log on to a system but not access any resources. Authorization is usually defined using one of the models of access control, such as *Discretionary Access Control (DAC)*, *Mandatory Access Control (MAC)*, or *Role Based Access Control (RBAC or role-BAC)*; see Chapter 14, “Controlling and Monitoring Access.”

Auditing

Auditing, or *monitoring*, is the programmatic means by which a subject’s actions are tracked and recorded for the purpose of holding the subject accountable for their actions while authenticated on a system. It is also the process by which unauthorized or abnormal activities are detected on a system. Auditing is recording activities of a subject and its objects as well as recording the activities of core system functions that maintain the operating environment and the security mechanisms. The audit trails created by recording system events to logs can be used to evaluate the health and performance of a system. System crashes may indicate faulty programs, corrupt drivers, or intrusion attempts. The event logs leading up to a crash can often be used to discover the reason a system failed. Log files provide an audit trail for re-creating the history of an event, intrusion, or system failure. Auditing is needed to detect malicious actions by subjects, attempted intrusions, and system failures and to reconstruct events, provide evidence for prosecution, and produce problem reports and analysis. Auditing is usually a native feature of operating systems and most applications and services. Thus, configuring the system to record information about specific types of events is fairly straightforward.

> NOTE Monitoring is part of what is needed for audits, and audit logs are part of a monitoring system, but the two terms have different meanings. Monitoring is a type of watching or oversight, while auditing is a recording of the information into a record or file. It is possible to monitor without auditing, but you can't audit without some form of monitoring. But even so, these terms are often used interchangeably in casual discussions of these topics.

Accountability

An organization's security policy can be properly enforced only if accountability is maintained. In other words, you can maintain security only if subjects are held accountable for their actions. Effective accountability relies on the capability to prove a subject's identity and track their activities. Accountability is established by linking a human to the activities of an online identity through the security services and mechanisms of auditing, authorization, authentication, and identification. Thus, human accountability is ultimately dependent on the strength of the authentication process. Without a strong authentication process, there is doubt that the human associated with a specific user account was the actual entity controlling that user account when the undesired action took place.

To have viable accountability, you may need to be able to support your security decisions and their implementation in a court of law. If you are unable to legally support your security efforts, then you will be unlikely to be able to hold a human accountable for actions linked to a user account. With only a password as authentication, there is significant room for doubt. Passwords are the least secure form of authentication, with dozens of different methods available to compromise them. However, with the use of multifactor authentication, such as a password, smartcard, and fingerprint scan in combination, there is very little possibility that any other human could have compromised the authentication process in order to impersonate the human responsible for the user account.

Legally Defensible Security

The point of security is to keep bad things from happening while supporting the occurrence of good things. When bad things do happen, organizations often desire assistance from law enforcement and the legal system for compensation. To obtain legal restitution, you must demonstrate that a crime was committed, that the suspect committed that crime, and that you took reasonable efforts to prevent the crime. This means your organization’s security needs to be legally defensible. If you are unable to convince a court that your log files are accurate and that no other person other than the subject could have committed the crime, you will not obtain restitution. Ultimately, this requires a complete security solution that has strong multifactor authentication techniques, solid authorization mechanisms, and impeccable auditing systems. Additionally, you must show that the organization complied with all applicable laws and regulations, that proper warnings and notifications were posted, that both logical and physical security were not otherwise compromised, and that there are no other possible reasonable interpretations of the electronic evidence. This is a fairly challenging standard to meet.

Thus, an organization should evaluate its security infrastructure and redouble its effort to design and implement legally defensible security.

Protection Mechanisms

Another aspect of understanding and applying concepts of confidentiality, integrity, and availability is the concept of protection mechanisms or protection controls. Protection mechanisms are common characteristics of security controls. Not all *security controls* must have them, but many controls offer their protection for confidentiality, integrity, and availability through the use of these mechanisms. Some common examples of these mechanisms include using multiple layers or levels of access, employing abstraction, hiding data, and using encryption.

Layering

Layering, also known as *defense in depth*, is simply the use of multiple controls in a series. No one control can protect against all possible threats. Using a multilayered solution allows for numerous, different controls to guard against whatever threats come to pass. When security solutions are designed in layers, a failed control should not result in exposure of systems or data.

Using layers in a series rather than in parallel is important. Performing security restrictions in a series means to perform one after the other in a linear fashion. Only through a series configuration will each attack be scanned, evaluated, or mitigated by every security control. In a series configuration, failure of a single security control does not render the entire solution ineffective. If security controls were implemented in parallel, a threat could pass through a single checkpoint that did not address its particular malicious activity.

Serial configurations are very narrow but very deep, whereas parallel configurations are very wide but very shallow. Parallel systems are useful in distributed computing applications, but parallelism is not often a useful concept in the realm of security.

Think of physical entrances to buildings. A parallel configuration is used for shopping malls. There are many doors in many locations around the entire perimeter of the mall. A series configuration would most likely be used in a bank or an airport. A single entrance is provided, and that entrance is actually several gateways or checkpoints that must be passed in sequential order to gain entry into active areas of the building.

Layering also includes the concept that networks comprise numerous separate entities, each with its own unique security controls and vulnerabilities. In an effective security solution, there is a synergy between all networked systems that creates a single security front. Using separate security systems creates a layered security solution.

Abstraction

Abstraction is used for efficiency. Similar elements are put into groups, classes, or roles that are assigned security controls, restrictions, or permissions as a collective. Thus, the concept of abstraction is used when classifying objects or assigning roles to subjects. The concept of abstraction also includes the definition of object and subject types or of objects themselves (that is, a data structure used to define a template for a class of entities). Abstraction is used to define what types of data an object can contain, what types of functions can be performed on or by that object, and what capabilities that object has. Abstraction simplifies security by enabling you to assign security controls to a group of objects collected by type or function.

Data Hiding

Data hiding is exactly what it sounds like: preventing data from being discovered or accessed by a subject by positioning the data in a logical storage compartment that is not accessible or seen by the subject. Forms of data hiding include keeping a database from being accessed by unauthorized visitors and restricting a subject at a lower classification level from accessing data at a higher classification level. Preventing an application from accessing hardware directly is also a form of data hiding. Data hiding is often a key element in security controls as well as in programming.

The term *security through obscurity* may seem relevant here. However, that concept is different. Data hiding is the act of intentionally positioning data so that it is not viewable or accessible to an unauthorized subject, while security through obscurity is the idea of not informing a subject about an object being present and thus hoping that the subject will not discover the object. Security through obscurity does not actually implement any form of protection. It is instead an attempt to hope something important is not discovered by keeping knowledge of it a secret. An example of security though obscurity is when a programmer is aware of a flaw in their software code, but they release the product anyway hoping that no one discovers the issue and exploits it.

Encryption

Encryption is the art and science of hiding the meaning or intent of a communication from unintended recipients. Encryption can take many forms and be applied to every type of electronic communication, including text, audio, and video files as well as applications themselves. Encryption is an important element in security controls, especially in regard to the transmission of data between systems. There are various strengths of encryption, each of which is designed and/or appropriate for a specific use or purpose. Weak or poor encryption can be considered as nothing more than obfuscation or potentially even security through obscurity. Encryption is discussed at length in Chapter 6, “Cryptography and Symmetric Key Algorithms,” and Chapter 7, “PKI and Cryptographic Applications.”

Evaluate and Apply Security Governance Principles

Security governance is the collection of practices related to supporting, defining, and directing the security efforts of an organization. Security governance principles are often closely related to and often intertwined with corporate and IT governance. The goals of these three governance agendas are often the same or interrelated. For example, a common goal of organizational governance is to ensure that the organization will continue to exist and will grow or expand over time. Thus, the common goal of governance is to maintain business processes while striving toward growth and resiliency.

Some aspects of governance are imposed on organizations due to legislative and regulatory compliance needs, whereas others are imposed by industry guidelines or license requirements. All forms of governance, including security governance, must be assessed and verified from time to time. Various requirements for auditing and validation may be present due to government regulations or industry best practices. Governance compliance issues often vary from industry to industry and from country to country. As many organizations expand and adapt to deal with a global market, governance issues become more complex. This is especially problematic when laws in different countries differ or in fact conflict. The organization as a whole should be given the direction, guidance, and tools to provide sufficient oversight and management to address threats and risks with a focus on eliminating downtime and keeping potential loss or damage to a minimum.

As you can tell, the definitions of security governance are often rather stilted and high level. Ultimately, security governance is the implementation of a security solution and a management method that are tightly interconnected. Security governance directly oversees and gets involved in all levels of security. Security is not and should not be treated as an IT issue only. Instead, security affects every aspect of an organization. It is no longer just something the IT staff can handle on their own. Security is a business operations issue. Security is an organizational process, not just something the IT geeks do behind the scenes. Using the term “security governance” is an attempt to emphasize this point by indicating that security needs to be managed and governed throughout the organization, not just in the IT department.

Security governance is commonly managed by a governance committee or at least a board of directors. This is the group of influential knowledge experts whose primary task is to oversee and guide the actions of security and operations for an organization. Security is a complex task. Organizations are often large and difficult to understand from a single viewpoint. Having a group of experts work together toward the goal of reliable security governance is a solid strategy.

There are numerous security frameworks and governance guidelines, including NIST 800-53 or 800-100. While the NIST guidance is focused on government and military use, it can be adopted and adapted by other types of organization as well. Many organizations adopt security frameworks in an effort to standardize and organize what can become a complex and bewilderingly messy activity, namely, attempting to implement reasonable security governance.

Alignment of Security Function to Business Strategy, Goals, Mission, and Objectives

Security management planning ensures proper creation, implementation, and enforcement of a *security policy*. Security management planning aligns the security functions to the strategy, goals, mission, and objectives of the organization. This includes designing and implementing security based on business cases, budget restrictions, or scarcity of resources. A *business case* is usually a documented argument or stated position in order to define a need to make a decision or take some form of action. To make a business case is to demonstrate a business-specific need to alter an existing process or choose an approach to a business task. A business case is often made to justify the start of a new project, especially a project related to security. It is also important to consider the budget that can be allocated to a business need–based security project. Security can be expensive but is most often less costly than the absence of that security. Thus, security becomes an essential element of reliable and long-term business operation. In most organizations, money and resources, such as people, technology, and space, are limited. Due to resource limitations like these, the maximum benefit needs to be obtained from any endeavor.

One of the most effective ways to tackle security management planning is to use a *top-down approach*. Upper, or senior, management is responsible for initiating and defining policies for the organization. Security policies provide direction for all levels of the organization's hierarchy. It is the responsibility of middle management to flesh out the security policy into standards, baselines, guidelines, and procedures. The operational managers or security professionals must then implement the configurations prescribed in the security management documentation. Finally, the end users must comply with all the security policies of the organization.

NOTE The opposite of the top-down approach is the bottom-up approach. In a *bottom-up approach* environment, the IT staff makes security decisions directly without input from senior management. The bottom-up approach is rarely used in organizations and is considered problematic in the IT industry.

Security management is a responsibility of upper management, not of the IT staff, and is considered an issue of business operations rather than IT administration. The team or department responsible for security within an organization should be autonomous. The *information security (InfoSec) team* should be led by a designated chief information security officer (CISO) who must report directly to senior management. Placing the autonomy of the CISO and the CISO's team outside the typical hierarchical structure in an organization can improve security management across the entire organization. It also helps to avoid cross-department and internal political issues. The term *chief security officer (CSO)* is sometimes used as an alternative to *CISO*, but in many organizations the CSO position is a subposition under the CISO that focuses on physical security. Another potential term for the CISO is *information security officer (ISO)*, but this also can be used as a subposition under the CISO.

Elements of security management planning include defining security roles; prescribing how security will be managed, who will be responsible for security, and how security will be tested for effectiveness; developing security policies; performing risk analysis; and requiring security education for employees. These efforts are guided through the development of management plans.

The best security plan is useless without one key factor: approval by *senior management*. Without senior management's approval of and commitment to the security policy, the policy will not succeed. It is the responsibility of the policy development team to educate senior management sufficiently so it understands the risks, liabilities, and exposures that remain even after security measures prescribed in the policy are deployed. Developing and implementing a security policy is evidence of due care and due diligence on the part of senior management. If a company does not practice due care and due diligence, managers can be held liable for negligence and held accountable for both asset and financial losses.

A security management planning team should develop three types of plans, as shown in Figure 1.3.

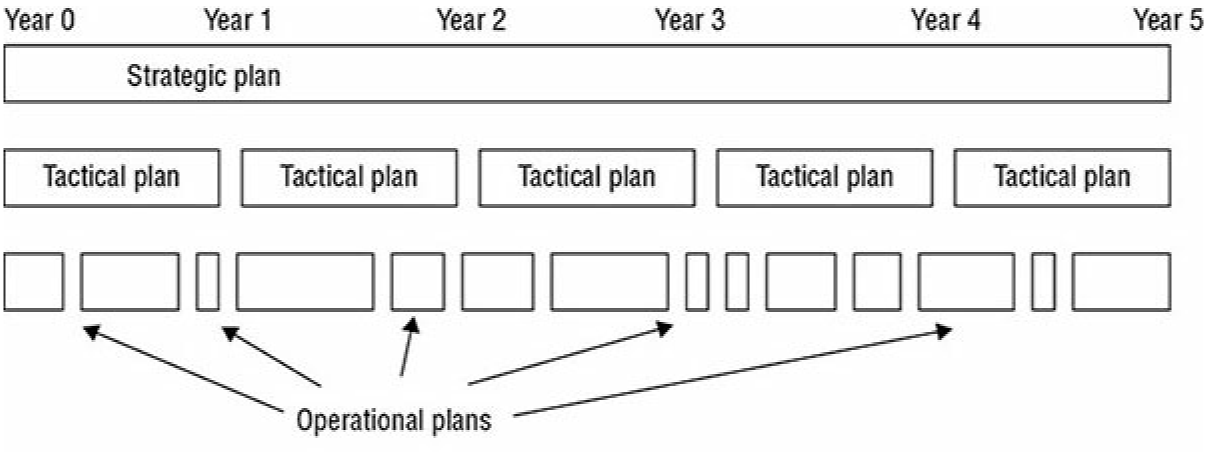


FIGURE 1.3 Strategic, tactical, and operational plan timeline comparison

Strategic Plan A *strategic plan* is a long-term plan that is fairly stable. It defines the organization's security purpose. It also helps to understand security function and align it to the goals, mission, and objectives of the organization. It's useful for about five years if it is maintained and updated annually. The strategic plan also serves as the planning horizon. Long-term goals and visions for the future are discussed in a strategic plan. A strategic plan should include a risk assessment.

Tactical Plan The *tactical plan* is a midterm plan developed to provide more details on accomplishing the goals set forth in the strategic plan or can be crafted ad hoc based upon unpredicted events. A tactical plan is typically useful for about a year and often prescribes and schedules the tasks necessary to accomplish organizational goals. Some examples of tactical plans are project plans, acquisition plans, hiring plans, budget plans, maintenance plans, support plans, and system development plans.

Operational Plan An *operational plan* is a short-term, highly detailed plan based on the strategic and tactical plans. It is valid or useful only for a short time. Operational plans must be updated often (such as monthly or quarterly) to retain compliance with tactical plans. Operational plans spell out how to accomplish the various goals of the organization. They include resource allotments, budgetary requirements, staffing assignments, scheduling, and step-by-step or implementation procedures. Operational plans include details on how the implementation processes are in compliance with the organization's security policy. Examples of operational plans are training plans, system deployment plans, and product design plans.

Security is a continuous process. Thus, the activity of security management planning may have a definitive initiation point, but its tasks and work are never fully accomplished or complete. Effective security plans focus attention on specific and achievable objectives, anticipate change and potential problems, and serve as a basis for decision making for the entire organization. Security documentation should be concrete, well defined, and clearly stated. For a security plan to be effective, it must be developed, maintained, and actually used.

Organizational Processes

Security governance needs to address every aspect of an organization. This includes the organizational processes of acquisitions, divestitures, and governance committees. Acquisitions and mergers place an organization at an increased level of risk. Such risks include inappropriate information disclosure, data loss, downtime, or failure to achieve sufficient return on investment (ROI). In addition to all the typical business and financial aspects of mergers and acquisitions, a healthy dose of security oversight and increased scrutiny is often essential to reduce the likelihood of losses during such a period of transformation.

Similarly, a divestiture or any form of asset or employee reduction is another time period of increased risk and thus increased need for focused security governance. Assets need to be sanitized to prevent data leakage. Storage media should be removed and destroyed, because media sanitization techniques do not guarantee against data remnant recovery. Employees released from duty need to be debriefed. This process is often called an exit interview. This process usually involves reviewing any nondisclosure agreements as well as any other binding contracts or agreements that will continue after employment has ceased.

Two additional examples of organizational processes that are essential to strong security governance are change control/change management and data classification.

Change Control/Management

Another important aspect of security management is the control or management of change. Change in a secure environment can introduce loopholes, overlaps, missing objects, and oversights that can lead to new vulnerabilities. The only way to maintain security in the face of change is to systematically manage change. This usually involves extensive planning, testing, logging, auditing, and monitoring of activities related to security controls and mechanisms. The records of changes to an environment are then used to identify agents of change, whether those agents are objects, subjects, programs, communication pathways, or even the network itself.

The goal of *change management* is to ensure that any change does not lead to reduced or compromised security. Change management is also responsible for making it possible to roll back any change to a previous secured state. Change management can be implemented on any system despite the level of security. Ultimately, change management improves the security of an environment by protecting implemented security from unintentional, tangential, or affected reductions in security. Although an important goal of change management is to prevent unwanted reductions in security, its primary purpose is to make all changes subject to detailed documentation and auditing and thus able to be reviewed and scrutinized by management.

Change management should be used to oversee alterations to every aspect of a system, including hardware configuration and operating system (OS) and application software. Change management should be included in design, development, testing, evaluation, implementation, distribution, evolution, growth, ongoing operation, and modification. It requires a detailed inventory of every component and configuration. It also requires the collection and maintenance of complete documentation for every system component, from hardware to software and from configuration settings to security features.

The change control process of configuration or change management has several goals or requirements:

- Implement changes in a monitored and orderly manner. Changes are always controlled.
- A formalized testing process is included to verify that a change produces expected results.
- All changes can be reversed (also known as backout or rollback plans/procedures).
- Users are informed of changes before they occur to prevent loss of productivity.
- The effects of changes are systematically analyzed to determine whether security or business processes are negatively affected.

- The negative impact of changes on capabilities, functionality, and performance is minimized.
- Changes are reviewed and approved by a *Change Advisory Board (CAB)*.

One example of a change management process is a parallel run, which is a type of new system deployment testing where the new system and the old system are run in parallel. Each major or significant user process is performed on each system simultaneously to ensure that the new system supports all required business functionality that the old system supported or provided.

Data Classification

Data classification, or categorization, is the primary means by which data is protected based on its need for secrecy, sensitivity, or confidentiality. It is inefficient to treat all data the same way when designing and implementing a security system because some data items need more security than others. Securing everything at a low security level means sensitive data is easily accessible. Securing everything at a high security level is too expensive and restricts access to unclassified, noncritical data. Data classification is used to determine how much effort, money, and resources are allocated to protect the data and control access to it. Data classification, or categorization, is the process of organizing items, objects, subjects, and so on into groups, categories, or collections with similarities. These similarities could include value, cost, sensitivity, risk, vulnerability, power, privilege, possible levels of loss or damage, or need to know.

The primary objective of data classification schemes is to formalize and stratify the process of securing data based on assigned labels of importance and sensitivity. Data classification is used to provide security mechanisms for storing, processing, and transferring data. It also addresses how data is removed from a system and destroyed.

The following are benefits of using a data classification scheme:

- It demonstrates an organization's commitment to protecting valuable resources and assets.

- It assists in identifying those assets that are most critical or valuable to the organization.
- It lends credence to the selection of protection mechanisms.
- It is often required for regulatory compliance or legal restrictions.
- It helps to define access levels, types of authorized uses, and parameters for declassification and/or destruction of resources that are no longer valuable.
- It helps with data lifecycle management which in part is the storage length (retention), usage, and destruction of the data.

The criteria by which data is classified vary based on the organization performing the classification. However, you can glean numerous generalities from common or standardized classification systems:

- Usefulness of the data
- Timeliness of the data
- Value or cost of the data
- Maturity or age of the data
- Lifetime of the data (or when it expires)
- Association with personnel
- Data disclosure damage assessment (that is, how the disclosure of the data would affect the organization)
- Data modification damage assessment (that is, how the modification of the data would affect the organization)
- National security implications of the data
- Authorized access to the data (that is, who has access to the data)
- Restriction from the data (that is, who is restricted from the data)
- Maintenance and monitoring of the data (that is, who should maintain and monitor the data)
- Storage of the data

Using whatever criteria is appropriate for the organization, data is evaluated, and an appropriate data classification label is assigned to it. In some cases, the label is added to the data object. In other cases, labeling occurs automatically when the data is placed into a storage mechanism or behind a security protection mechanism.

To implement a classification scheme, you must perform seven major steps, or phases:

1. Identify the custodian, and define their responsibilities.
2. Specify the evaluation criteria of how the information will be classified and labeled.
3. Classify and label each resource. (The owner conducts this step, but a supervisor should review it.)
4. Document any exceptions to the classification policy that are discovered, and integrate them into the evaluation criteria.
5. Select the security controls that will be applied to each classification level to provide the necessary level of protection.
6. Specify the procedures for declassifying resources and the procedures for transferring custody of a resource to an external entity.
7. Create an enterprise-wide awareness program to instruct all personnel about the classification system.

Declassification is often overlooked when designing a classification system and documenting the usage procedures. Declassification is required once an asset no longer warrants or needs the protection of its currently assigned classification or sensitivity level. In other words, if the asset were new, it would be assigned a lower sensitivity label than it currently is assigned. When assets fail to be declassified as needed, security resources are wasted, and the value and protection of the higher sensitivity levels is degraded.

The two common classification schemes are government/military classification (Figure 1.4) and commercial business/private sector classification. There are five levels of government/military classification (listed here from highest to lowest):

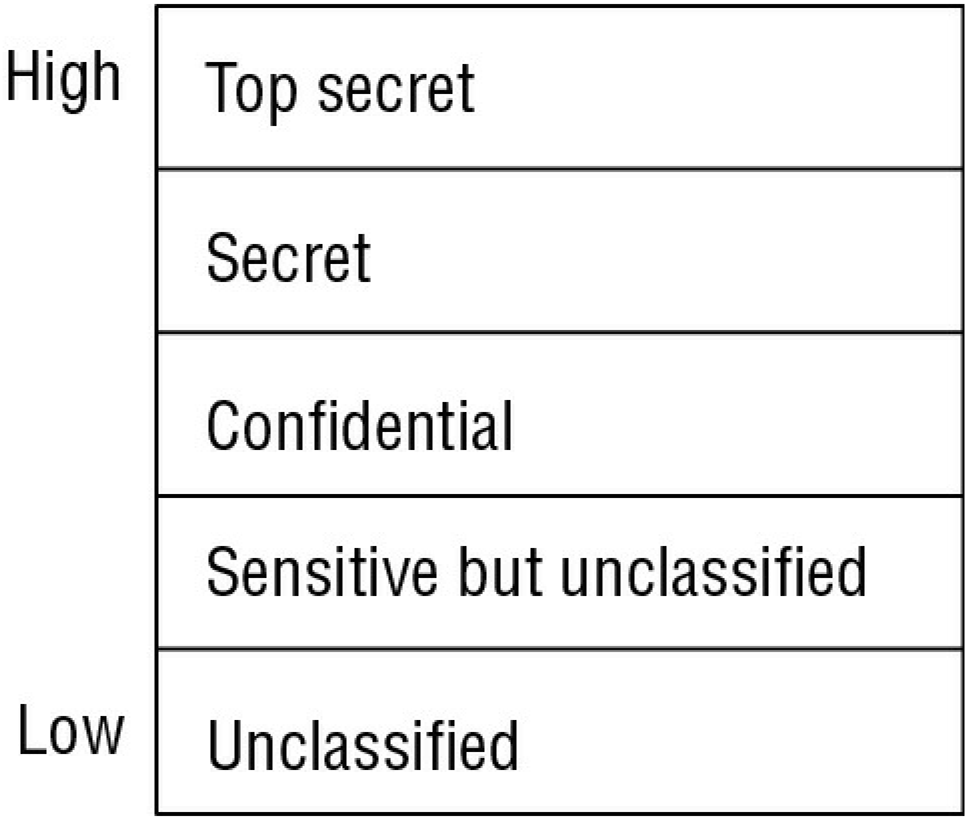


FIGURE 1.4 Levels of government/military classification

Top Secret *Top secret* is the highest level of classification. The unauthorized disclosure of top-secret data will have drastic effects and cause grave damage to national security. Top-secret data is compartmentalized on a need-to-know basis such that a user could have top-secret clearance and have access to no data until the user has a need to know.

Secret *Secret* is used for data of a restricted nature. The unauthorized disclosure of data classified as secret will have significant effects and cause critical damage to national security.

Confidential *Confidential* is used for data of a sensitive, proprietary, or highly valuable nature. The unauthorized disclosure of data classified as confidential will have noticeable effects and cause serious damage to national security. This classification is used for all data between secret and sensitive but unclassified classifications.

Sensitive But Unclassified *Sensitive but unclassified (SBU)* is used for data that is for internal use or for office use only (FOUO). Often

SBU is used to protect information that could violate the privacy rights of individuals. This is not technically a classification label; instead, it is a marking or label used to indicate use or management.

Unclassified *Unclassified* is used for data that is neither sensitive nor classified. The disclosure of unclassified data does not compromise confidentiality or cause any noticeable damage. This is not technically a classification label; instead, it is a marking or label used to indicate use or management.

> NOTE An easy way to remember the names of the five levels of the government or military classification scheme in least secure to most secure order is with a memorization acronym: U.S. Can Stop Terrorism. Notice that the five uppercase letters represent the five named classification levels, from least secure on the left to most secure on the right (or from bottom to top in the preceding list of items).

Items labeled as confidential, secret, and top secret are collectively known as classified. Often, revealing the actual classification of data to unauthorized individuals is a violation of that data. Thus, the term *classified* is generally used to refer to any data that is ranked above the unclassified level. All classified data is exempt from the Freedom of Information Act as well as many other laws and regulations. The United States (U.S.) military classification scheme is most concerned with the sensitivity of data and focuses on the protection of confidentiality (that is, the prevention of disclosure). You can roughly define each level or label of classification by the level of damage that would be caused in the event of a confidentiality violation. Data from the top-secret level would cause grave damage to national security, whereas data from the unclassified level would not cause any serious damage to national or localized security.

Commercial business/private sector classification systems can vary widely because they typically do not have to adhere to a standard or regulation. The CISSP exam focuses on four common or possible business classification levels (listed highest to lowest and shown in

Figure 1.5):

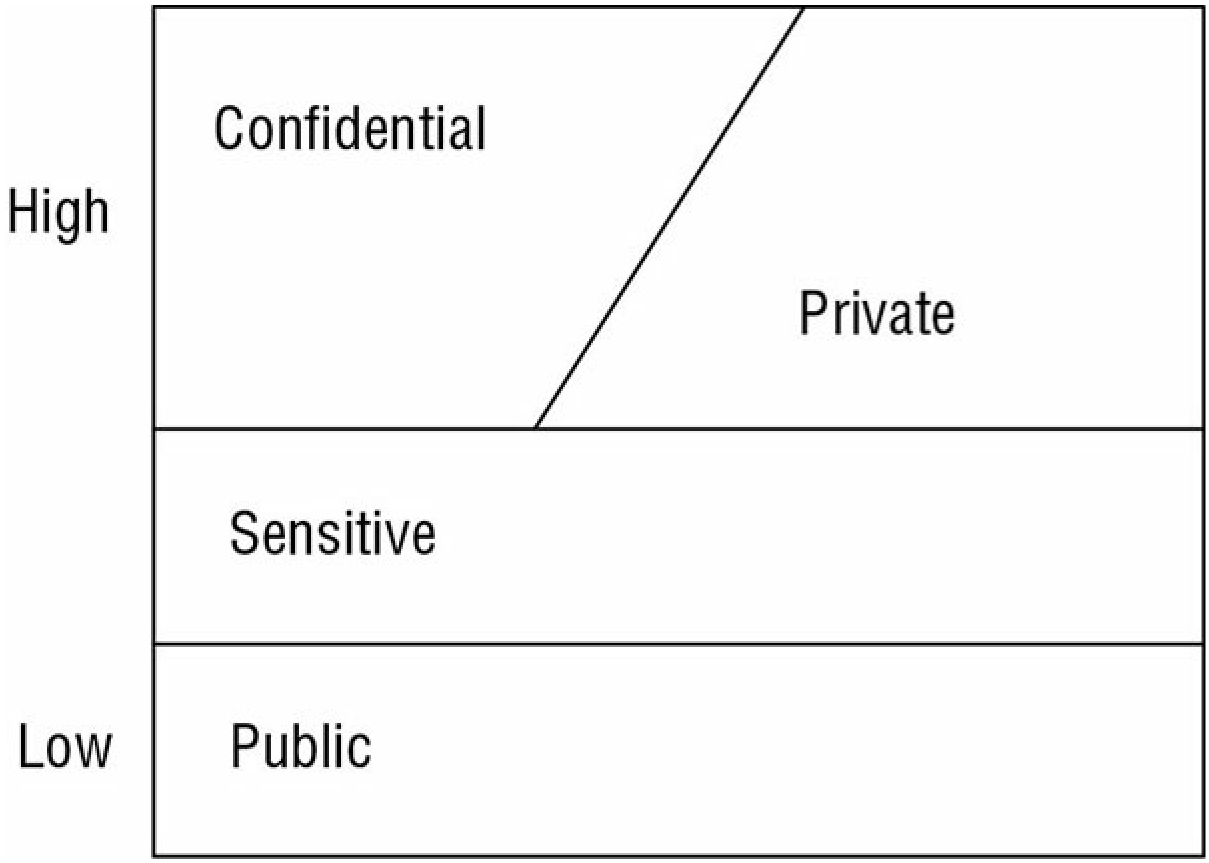


FIGURE 1.5 Commercial business/private sector classification levels

Confidential *Confidential* is the highest level of classification. This is used for data that is extremely sensitive and for internal use only. A significant negative impact could occur for a company if confidential data is disclosed. Sometimes the label *proprietary* is substituted for *confidential*. Sometimes proprietary data is considered a specific form of confidential information. If proprietary data is disclosed, it can have drastic effects on the competitive edge of an organization.

Private *Private* is used for data that is of a private or personal nature and intended for internal use only. A significant negative impact could occur for the company or individuals if private data is disclosed.

Confidential and private data in a commercial business/private sector classification scheme both require roughly the same level of security protection. The real difference between the two labels is that confidential data is company data whereas private data is data related to individuals, such as medical data.

Sensitive *Sensitive* is used for data that is more classified than public data. A negative impact could occur for the company if sensitive data is disclosed.

Public *Public* is the lowest level of classification. This is used for all data that does not fit in one of the higher classifications. Its disclosure does not have a serious negative impact on the organization.

Another consideration related to data classification or categorization is ownership. *Ownership* is the formal assignment of responsibility to an individual or group. Ownership can be made clear and distinct within an operating system where files or other types of objects can be assigned an owner. Often, an owner has full capabilities and privileges over the object they own. The ability to take ownership is often granted to the most powerful accounts in an operating system, such as the administrator in Windows or root in Unix or Linux. In most cases, the subject that creates a new object is by default the owner of that object. In some environments, the security policy mandates that when new objects are created, a formal change of ownership from end users to an administrator or management user is necessary. In this situation, the admin account can simply take ownership of the new objects.

Ownership of objects outside formal IT structures is often not as obvious. A company document can define owners for the facility, business tasks, processes, assets, and so on. However, such documentation does not always “enforce” this ownership in the real world. The ownership of a file object is enforced by the operating system and file system, whereas ownership of a physical object, intangible asset, or organizational concept (such as the research department or a development project) is defined only on paper and can be more easily undermined. Additional security governance must be implemented to provide enforcement of ownership in the physical world.

Organizational Roles and Responsibilities

A *security role* is the part an individual plays in the overall scheme of security implementation and administration within an organization. Security roles are not necessarily prescribed in job descriptions because they are not always distinct or static. Familiarity with security roles will help in establishing a communications and support structure within an organization. This structure will enable the deployment and enforcement of the security policy. The following six roles are presented in the logical order in which they appear in a secured environment:

Senior Manager The organizational owner (*senior manager*) role is assigned to the person who is ultimately responsible for the security maintained by an organization and who should be most concerned about the protection of its assets. The senior manager must sign off on all policy issues. In fact, all activities must be approved by and signed off on by the senior manager before they can be carried out. There is no effective security policy if the senior manager does not authorize and support it. The senior manager's endorsement of the security policy indicates the accepted ownership of the implemented security within the organization. The senior manager is the person who will be held liable for the overall success or failure of a security solution and is responsible for exercising due care and due diligence in establishing security for an organization.

Even though senior managers are ultimately responsible for security, they rarely implement security solutions. In most cases, that responsibility is delegated to security professionals within the organization.

Security Professional The *security professional*, *information security (InfoSec) officer*, or *computer incident response team (CIRT)* role is assigned to a trained and experienced network, systems, and security engineer who is responsible for following the directives mandated by senior management. The security professional has the functional responsibility for security, including writing the security policy and implementing it. The role of security professional can be labeled as an IS/IT function role. The security professional role is often filled by a team that is responsible for designing and implementing security solutions based on the approved security policy. Security professionals are not decision makers; they are implementers. All decisions must be left to the senior manager.

Data Owner The *data owner* role is assigned to the person who is responsible for classifying information for placement and protection within the security solution. The data owner is typically a high-level manager who is ultimately responsible for data protection. However, the data owner usually delegates the responsibility of the actual data management tasks to a data custodian.

Data Custodian The *data custodian* role is assigned to the user who is responsible for the tasks of implementing the prescribed protection defined by the security policy and senior management. The data custodian performs all activities necessary to provide adequate protection for the CIA Triad (confidentiality, integrity, and availability) of data and to fulfill the requirements and responsibilities delegated from upper management. These activities can include performing and testing backups, validating data integrity, deploying security solutions, and managing data storage based on classification.

User The *user* (*end user* or *operator*) role is assigned to any person who has access to the secured system. A user's access is tied to their work tasks and is limited so they have only enough access to perform the tasks necessary for their job position (the principle of least privilege). Users are responsible for understanding and upholding the security policy of an organization by following prescribed operational procedures and operating within defined security parameters.

Auditor An *auditor* is responsible for reviewing and verifying that the security policy is properly implemented and the derived security solutions are adequate. The auditor role may be assigned to a security professional or a trained user. The auditor produces compliance and effectiveness reports that are reviewed by the senior manager. Issues discovered through these reports are transformed into new directives assigned by the senior manager to security professionals or data custodians. However, the auditor is listed as the final role because the auditor needs a source of activity (that is, users or operators working in an environment) to audit or monitor.

All of these roles serve an important function within a secured environment. They are useful for identifying liability and responsibility as well as for identifying the hierarchical management and delegation scheme.

Security Control Frameworks

Crafting a security stance for an organization often involves a lot more than just writing down a few lofty ideals. In most cases, a significant amount of planning goes into developing a solid security policy. Many Dilbert fans may recognize the seemingly absurd concept of holding a meeting to plan a meeting for a future meeting. But it turns out that planning for security must start with planning to plan, then move into planning for standards and compliance, and finally move into the actual plan development and design. Skipping any of these "planning to plan" steps can derail an organization's security solution before it even gets started.

One of the first and most important security planning steps is to consider the overall *security control framework* or structure of the security solution desired by the organization. You can choose from several options in regard to security concept infrastructure; however, one of the more widely used security control frameworks is Control Objectives for Information and Related Technology (COBIT). COBIT is a documented set of best IT security practices crafted by the Information Systems Audit and Control Association (ISACA). It prescribes goals and requirements for security controls and encourages the mapping of IT security ideals to business objectives. COBIT 5 is based on five key principles for governance and management of enterprise IT:

- *Principle 1*: Meeting Stakeholder Needs
- *Principle 2*: Covering the Enterprise End-to-End
- *Principle 3*: Applying a Single, Integrated Framework
- *Principle 4*: Enabling a Holistic Approach
- *Principle 5*: Separating Governance From Management

COBIT is used not only to plan the IT security of an organization but also as a guideline for auditors. COBIT is a widely recognized and respected security control framework.

Fortunately, COBIT is only modestly referenced on the exam, so further details are not necessary. However, if you have interest in this concept, please visit the ISACA website (www.isaca.org), or if you want a general overview, read the COBIT entry on Wikipedia.

There are many other standards and guidelines for IT security. A few of these are:

- Open Source Security Testing Methodology Manual (OSSTMM) (www.isecom.org/ research/): A peer-reviewed guide for the testing and analysis of a security infrastructure
- ISO/IEC 27002 (which replaced ISO 17799) (https://www.iso.org/standard/ 54533.html): An international standard that can be the basis of implementing organizational security and related management practices
- Information Technology Infrastructure Library (ITIL) (www.itlibrary.org): Initially crafted by the British government, ITIL is a set of recommended best practices for core IT security and operational processes and is often used as a starting point for the crafting of a customized IT security solution

Due Care and Due Diligence

Why is planning to plan security so important? One reason is the requirement for *due care* and *due diligence*. Due care is using reasonable care to protect the interests of an organization. Due diligence is practicing the activities that maintain the due care effort. For example, due care is developing a formalized security structure containing a security policy, standards, baselines, guidelines, and procedures. Due diligence is the continued application of this security structure onto the IT infrastructure of an organization. Operational security is the ongoing maintenance of continued due care and due diligence by all responsible parties within an organization.

In today's business environment, prudence is mandatory. Showing due care and due diligence is the only way to disprove negligence in an occurrence of loss. Senior management must show due care and due diligence to reduce their culpability and liability when a loss occurs.

Develop, Document, and Implement Security Policy, Standards, Procedures, and Guidelines

For most organizations, maintaining security is an essential part of ongoing business. If their security were seriously compromised, many organizations would fail. To reduce the likelihood of a security failure, the process of implementing security has been somewhat formalized with a hierarchical organization of documentation. Each level focuses on a specific type or category of information and issues. Developing and implementing documented security policy, standards, procedures, and guidelines produces a solid and reliable security infrastructure. This formalization has greatly reduced the chaos and complexity of designing and implementing security solutions for IT infrastructures.

Security Policies

The top tier of the formalization is known as a security policy. A *security policy* is a document that defines the scope of security needed by the organization and discusses the assets that require protection and the extent to which security solutions should go to provide the necessary protection. The security policy is an overview or generalization of an organization’s security needs. It defines the main security objectives and outlines the security framework of an organization. It also identifies the major functional areas of data processing and clarifies and defines all relevant terminology. It should clearly define why security is important and what assets are valuable. It is a strategic plan for implementing security. It should broadly outline the security goals and practices that should be employed to protect the organization’s vital interests. The document discusses the importance of security to every aspect of daily business operation and the importance of the support of the senior staff for the implementation of security. The security policy is used to assign responsibilities, define roles, specify audit requirements, outline enforcement processes, indicate compliance requirements, and define acceptable risk levels. This document is often used as the proof that senior management has exercised due care in protecting itself against intrusion, attack, and disaster. Security policies are compulsory.

Many organizations employ several types of security policies to define or outline their overall security strategy. An *organizational security policy* focuses on issues relevant to every aspect of an organization. An *issue-specific security policy* focuses on a specific network service, department, function, or other aspect that is distinct from the organization as a whole. A *system-specific security policy* focuses on individual systems or types of systems and prescribes approved hardware and software, outlines methods for locking down a system, and even mandates firewall or other specific security controls.

In addition to these focused types of security policies, there are three overall categories of security policies: regulatory, advisory, and informative. A *regulatory policy* is required whenever industry or legal standards are applicable to your organization. This policy discusses the regulations that must be followed and outlines the procedures that should be used to elicit compliance. An *advisory policy* discusses behaviors and activities that are acceptable and defines consequences of violations. It explains senior management's desires for security and compliance within an organization. Most policies are advisory. An *informative policy* is designed to provide information or knowledge about a specific subject, such as company goals, mission statements, or how the organization interacts with partners and customers. An informative policy provides support, research, or background information relevant to the specific elements of the overall policy.

From the security policies flow many other documents or sub-elements necessary for a complete security solution. Policies are broad overviews, whereas standards, baselines, guidelines, and procedures include more specific, detailed information on the actual security solution. Standards are the next level below security policies.

Security Policies and Individuals

As a rule of thumb, security policies (as well as standards, guidelines, and procedures) should not address specific individuals. Instead of assigning tasks and responsibilities to a person, the policy should define tasks and responsibilities to fit a role. That role is a function of administrative control or personnel management. Thus, a security policy does not define who is to do what but rather defines what must be done by the various roles within the security infrastructure. Then these defined security roles are assigned to individuals as a job description or an assigned work task.

Acceptable Use Policy

An *acceptable use policy* is a commonly produced document that exists as part of the overall security documentation infrastructure. The acceptable use policy is specifically designed to assign security roles within the organization as well as ensure the responsibilities tied to those roles. This policy defines a level of acceptable performance and expectation of behavior and activity. Failure to comply with the policy may result in job action warnings, penalties, or termination.

Security Standards, Baselines, and Guidelines

Once the main security policies are set, then the remaining security documentation can be crafted under the guidance of those policies. *Standards* define compulsory requirements for the homogenous use of hardware, software, technology, and security controls. They provide a course of action by which technology and procedures are uniformly implemented throughout an organization. Standards are tactical documents that define steps or methods to accomplish the goals and overall direction defined by security policies.

At the next level are baselines. A *baseline* defines a minimum level of security that every system throughout the organization must meet. All systems not complying with the baseline should be taken out of production until they can be brought up to the baseline. The baseline establishes a common foundational secure state on which all additional and more stringent security measures can be built. Baselines are usually system specific and often refer to an industry or government standard, like the Trusted Computer System Evaluation Criteria (TCSEC) or Information Technology Security Evaluation and Criteria (ITSEC) or NIST (National Institute of Standards and Technology) standards.

Guidelines are the next element of the formalized security policy structure. A *guideline* offers recommendations on how standards and baselines are implemented and serves as an operational guide for both security professionals and users. Guidelines are flexible so they can be customized for each unique system or condition and can be used in the creation of new procedures. They state which security mechanisms should be deployed instead of prescribing a specific product or control and detailing configuration settings. They outline methodologies, include suggested actions, and are not compulsory.

Security Procedures

Procedures are the final element of the formalized security policy structure. A *procedure* or *standard operating procedure (SOP)* is a detailed, step-by-step how-to document that describes the exact actions necessary to implement a specific security mechanism, control, or solution. A procedure could discuss the entire system deployment operation or focus on a single product or aspect, such as deploying a firewall or updating virus definitions. In most cases, procedures are system and software specific. They must be updated as the hardware and software of a system evolve. The purpose of a procedure is to ensure the integrity of business processes. If everything is accomplished by following a detailed procedure, then all activities should be in compliance with policies, standards, and guidelines. Procedures help ensure standardization of security across all systems.

All too often, policies, standards, baselines, guidelines, and procedures are developed only as an afterthought at the urging of a consultant or auditor. If these documents are not used and updated, the administration of a secured environment will be unable to use them as guides. And without the planning, design, structure, and oversight provided by these documents, no environment will remain secure or represent proper diligent due care.

It is also common practice to develop a single document containing aspects of all these elements. This should be avoided. Each of these structures must exist as a separate entity because each performs a different specialized function. At the top of the formalization security policy documentation structure there are fewer documents because they contain general broad discussions of overview and goals. There are more documents further down the formalization structure (in other words, guidelines and procedures) because they contain details specific to a limited number of systems, networks, divisions, and areas.

Keeping these documents as separate entities provides several benefits:

- Not all users need to know the security standards, baselines, guidelines, and procedures for all security classification levels.
- When changes occur, it is easier to update and redistribute only the affected material rather than updating a monolithic policy and redistributing it throughout the organization.

Crafting the totality of security policy and all supporting documentation can be a daunting task. Many organizations struggle just to define the foundational parameters of their security, much less detail every single aspect of their day-to-day activities. However, in theory, a detailed and complete security policy supports real-world security in a directed, efficient, and specific manner. Once the security policy documentation is reasonably complete, it can be used to guide decisions, train new users, respond to problems, and predict trends for future expansion. A security policy should not be an afterthought but a key part of establishing an organization.

There are a few additional perspectives to understand about the documentation that comprises a complete security policy. Figure 1.6 shows the dependencies of these components: policies, standards, guidelines, and procedures. The security policies define the overall structure of organized security documentation. Then, standards are based on those policies as well as mandated by regulations and contracts. From these the guidelines are derived. Finally, procedures are based on the three other components. The inverted pyramid is used to convey the volume or size of each of these documents. There are typically significantly more procedures than any other element in a complete security policy. Comparatively, there are fewer guidelines than procedures, fewer still standards, and usually even fewer still of overarching or organization-wide security policies.

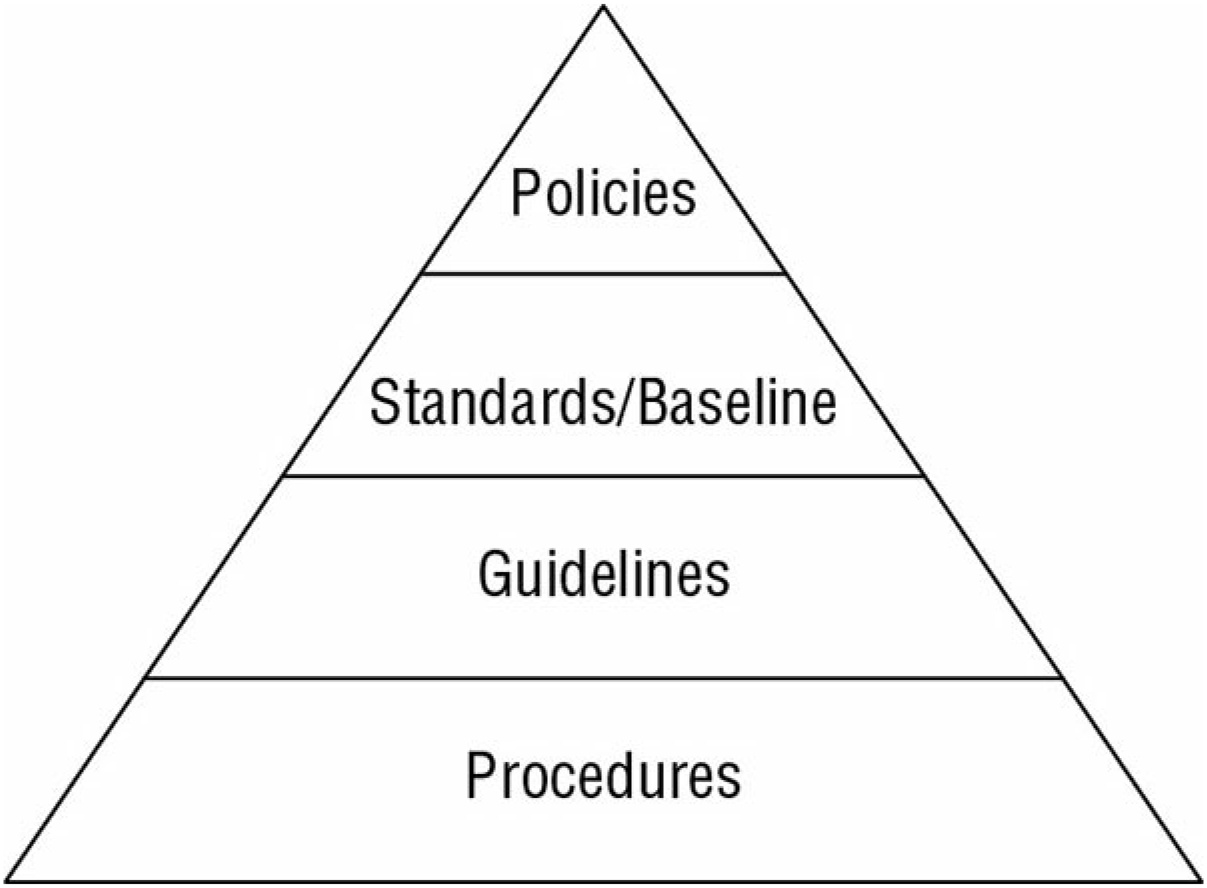


FIGURE 1.6 The comparative relationships of security policy components

Understand and Apply Threat Modeling Concepts and Methodologies

Threat modeling is the security process where potential threats are identified, categorized, and analyzed. *Threat modeling* can be performed as a proactive measure during design and development or as a reactive measure once a product has been deployed. In either case, the process identifies the potential harm, the probability of occurrence, the priority of concern, and the means to eradicate or reduce the threat. In this section we present various examples of threat modeling concepts as well as several threat modeling methodologies.

Threat modeling isn't meant to be a single event. Instead it's common for an organization to begin threat modeling early in the design process of a system and continue throughout its lifecycle. For example, Microsoft uses a *Security Development Lifecycle (SDL)* process to consider and implement security at each stage of a product's development. This supports the motto of "Secure by Design, Secure by Default, Secure in Deployment and Communication" (also known as *SD3+C*). It has two goals in mind with this process:

- To reduce the number of security-related design and coding defects
- To reduce the severity of any remaining defects

In other words, it attempts to reduce vulnerabilities and reduce the impact of any vulnerabilities that remain. The overall result is reduced risk.

A *proactive approach* to threat modeling takes place during the early stages of systems development, specifically during initial design and specifications establishment. This type of threat modeling is also known as a defensive approach. This method is based on predicting threats and designing in specific defenses during the coding and crafting process, rather than relying on post-deployment updates and patches. In most cases, integrated security solutions are more cost effective and more successful than those shoehorned in later. Unfortunately, not all threats can be predicted during the design phase, so reactive approach threat modeling is still needed to address unforeseen issues.

A *reactive approach* to threat modeling takes place after a product has been created and deployed. This deployment could be in a test or laboratory environment or to the general marketplace. This type of threat modeling is also known as the adversarial approach. This technique of threat modeling is the core concept behind ethical hacking, penetration testing, source code review, and fuzz testing. Although these processes are often useful in finding flaws and threats that need to be addressed, they unfortunately result in additional effort in coding to add in new countermeasures. Returning back to the design phase might produce better products in the long run, but starting over from scratch is massively expensive and causes significant time delays to product release. Thus, the shortcut is to craft updates or patches to be added to the product after deployment. This results in less effective security improvements (over-proactive threat modeling) at the cost of potentially reducing functionality and user-friendliness.

Fuzz testing is a specialized dynamic testing technique that provides many different types of input to software to stress its limits and find previously undetected flaws. Fuzz testing software supplies invalid input to the software, either randomly generated or specially crafted to trigger known software vulnerabilities. The fuzz tester then monitors the performance of the application, watching for software crashes, buffer overflows, or other undesirable and/or unpredictable outcomes. See Chapter 15, “Security Assessment and Testing,” for more on fuzz testing.

Identifying Threats

There’s an almost infinite possibility of threats, so it’s important to use a structured approach to accurately identify relevant threats. For example, some organizations use one or more of the following three approaches:

Focused on Assets This method uses asset valuation results and attempts to identify threats to the valuable assets. For example, a specific asset can be evaluated to determine if it is susceptible to an attack. If the asset hosts data, access controls can be evaluated to identify threats that can bypass authentication or authorization mechanisms.

Focused on Attackers Some organizations are able to identify potential attackers and can identify the threats they represent based on the attacker's goals. For example, a government is often able to identify potential attackers and recognize what the attackers want to achieve. They can then use this knowledge to identify and protect their relevant assets. A challenge with this approach is that new attackers can appear that weren't previously considered a threat.

Focused on Software If an organization develops software, it can consider potential threats against the software. Although organizations didn't commonly develop their own software years ago, it's common to do so today. Specifically, most organizations have a web presence, and many create their own web pages. Fancy web pages drive more traffic, but they also require more sophisticated programming and present additional threats.

If the threat is identified as an attacker (as opposed to a natural threat), threat modeling attempts to identify what the attacker may be trying to accomplish. Some attackers may want to disable a system, whereas other attackers may want to steal data. Once such threats are identified, they are categorized based on their goals or motivations. Additionally, it's common to pair threats with vulnerabilities to identify threats that can exploit vulnerabilities and represent significant risks to the organization. An ultimate goal of threat modeling is to prioritize the potential threats against an organization's valuable assets.

When attempting to inventory and categorize threats, it is often helpful to use a guide or reference. Microsoft developed a threat categorization scheme known as the STRIDE threat model. STRIDE is often used in relation to assessing threats against applications or operating systems. However, it can also be used in other contexts as well. *STRIDE* is an acronym standing for the following:

- *Spoofing*: An attack with the goal of gaining access to a target system through the use of a falsified identity. Spoofing can be used against Internet Protocol (IP) addresses, MAC addresses, usernames, system names, wireless network service set identifiers (SSIDs), email addresses, and many other types of logical identification. When an attacker spoofs their identity as a valid or authorized entity, they are often able to bypass filters and blockades against unauthorized access. Once a spoofing attack has successfully granted an attacker access to a target system, subsequent attacks of abuse, data theft, or privilege escalation can be initiated.

- *Tampering*: Any action resulting in unauthorized changes or manipulation of data, whether in transit or in storage. Tampering is used to falsify communications or alter static information. Such attacks are a violation of integrity as well as availability.

- *Repudiation*: The ability of a user or attacker to deny having performed an action or activity. Often attackers engage in repudiation attacks in order to maintain plausible deniability so as not to be held accountable for their actions. Repudiation attacks can also result in innocent third parties being blamed for security violations.

- *Information disclosure*: The revelation or distribution of private, confidential, or controlled information to external or unauthorized entities. This could include customer identity information, financial information, or proprietary business operation details. Information disclosure can take advantage of system design and implementation mistakes, such as failing to remove debugging code, leaving sample applications and accounts, not sanitizing programming notes from client-visible content (such as comments in Hypertext Markup Language (HTML) documents), using hidden form fields, or allowing overly detailed error messages to be shown to users.

- *Denial of service (DoS)*: An attack that attempts to prevent authorized use of a resource. This can be done through flaw exploitation, connection overloading, or traffic flooding. A DoS attack does not necessarily result in full interruption to a resource; it could instead reduce throughput or introduce latency in order to hamper productive use of a resource. Although most DoS attacks are temporary and last only as long as the attacker maintains the onslaught, there are some permanent DoS attacks. A permanent DoS attack might involve the destruction of a dataset, the replacement of software with malicious alternatives, or forcing a firmware flash operation that could be interrupted or that installs faulty firmware. Any of these DoS attacks would render a permanently damaged system that is not able to be restored to normal operation with a simple reboot or by waiting out the attackers. A full system repair and backup restoration would be required to recover from a permanent DoS attack.

- *Elevation of privilege*: An attack where a limited user account is transformed into an account with greater privileges, powers, and access. This might be accomplished through theft or exploitation of the credentials of a higher-level account, such as that of an administrator or root. It also might be accomplished through a system or application exploit that temporarily or permanently grants additional powers to an otherwise limited account.

Although STRIDE is typically used to focus on application threats, it is applicable to other situations, such as network threats and host threats. Other attacks may be more specific to network and host concerns, such as sniffing and hijacking for networks and malware and arbitrary code execution for hosts, but the six threat concepts of STRIDE are fairly broadly applicable.

Process for Attack Simulation and Threat Analysis (PASTA) is a seven-stage (Figure 1.7) threat modeling methodology. PASTA is a risk-centric approach that aims at selecting or developing countermeasures in relation to the value of the assets to be protected. The following are the seven steps of PASTA:

- *Stage I*: Definition of the Objectives (DO) for the Analysis of Risks
- *Stage II*: Definition of the Technical Scope (DTS)

- *Stage III*: Application Decomposition and Analysis (ADA)
- *Stage IV*: Threat Analysis (TA)
- *Stage V*: Weakness and Vulnerability Analysis (WVA)
- *Stage VI*: Attack Modeling & Simulation (AMS)
- *Stage VII*: Risk Analysis & Management (RAM)

Each stage of PASTA has a specific list of objectives to achieve and deliverables to produce in order to complete the stage. For more information on PASTA, please see the book *Risk Centric Threat Modeling: Process for Attack Simulation and Threat Analysis*, first edition, by Tony UcedaVelez and Marco M. Morana. (You can view the appendix of this book online where PASTA is explored at http://www.isaca.org/chapters5/Ireland/Documents/2013%20Present
%20November%202013.pdf.)

Trike is another threat modeling methodology that focuses on a risk-based approach instead of depending upon the aggregated threat model used in STRIDE and Disaster, Reproducibility, Exploitability, Affected Users, and Discoverability (DREAD) (see the “Prioritization and Response” section later in this chapter). Trike provides a method of performing a security audit in a reliable and repeatable procedure. It also provides a consistent framework for communication and collaboration among security workers. Trike is used to craft an assessment of an acceptable level of risk for each class of asset that is then used to determine appropriate risk response actions.

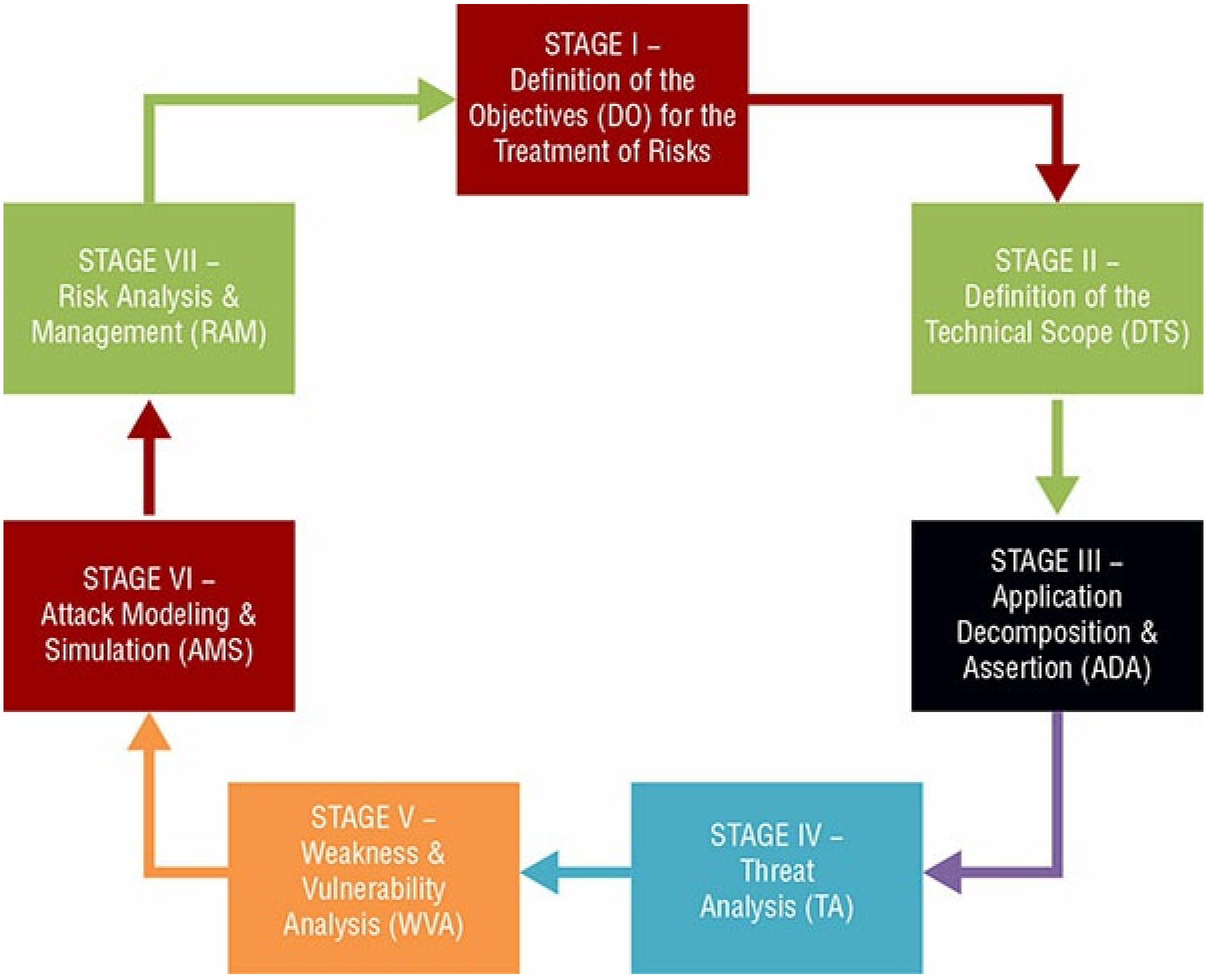

STAGE I –
Definition of the Objectives (DO) for the Treatment of Risks
STAGE II –
Definition of the Technical Scope (DTS)
STAGE III –
Application Decomposition & Assertion (ADA)
STAGE IV –
Threat Analysis (TA)
STAGE V –
Weakness & Vulnerability Analysis (WVA)
STAGE VI –
Attack Modeling & Simulation (AMS)
STAGE VII –
Risk Analysis & Management (RAM)

FIGURE 1.7 An example of diagramming to reveal threat concerns

Visual, Agile, and Simple Threat (VAST) is a threat modeling concept based on Agile project management and programming principles. The goal of VAST is to integrate threat and risk management into an Agile programming environment on a scalable basis.

These are just a few of the vast array of threat modeling concepts and methodologies available from community groups, commercial entities, government agencies, and international associations.

Generally, the purpose of STRIDE and other threat modeling methodologies is to consider the range of compromise concerns and to focus on the goal or end results of an attack. Attempting to identify each and every specific attack method and technique is an impossible task—new attacks are being developed constantly. Although the goals or purposes of attacks can be loosely categorized and grouped, they remain relatively constant over time.

Be Alert for Individual Threats

Competition is often a key part of business growth, but overly adversarial competition can increase the threat level from individuals. In addition to criminal hackers and disgruntled employees, adversaries, contractors, employees, and even trusted partners can be a threat to an organization if relationships go sour.

- Never assume that a consultant or contractor has the same loyalty to your organization as a long-term employee. Contractors and consultants are effectively mercenaries who will work for the highest bidder. Don’t take employee loyalty for granted either. Employees who are frustrated with their working environment or feel they’ve been treated unfairly may attempt to retaliate. An employee experiencing financial hardship may consider unethical and illegal activities that pose a threat to your business for their own gain.
- A trusted partner is only a trusted partner as long as it is in your mutual self-interest to be friendly and cooperative toward each other. Eventually a partnership might sour or become adversarial; then, your former partner might take actions that pose a threat to your business.

Potential threats to your business are broad and varied. A company faces threats from nature, technology, and people. Most businesses focus on natural disasters and IT attacks in preparing for threats, but it’s also important to consider threat potential from individuals. Always consider the best and worst possible outcomes of your organization’s activities, decisions, and interactions. Identifying threats is the first step toward designing defenses to help reduce or eliminate downtime, compromise, and loss.

Determining and Diagramming Potential Attacks

Once an understanding has been gained in regard to the threats facing your development project or deployed infrastructure, the next step in threat modeling is to determine the potential attack concepts that could be realized. This is often accomplished through the creation of a diagram of the elements involved in a transaction along with indications of data flow and privilege boundaries (Figure 1.8). This image is an example of a data flow diagram that shows each major component of a system, the boundaries between security zones, and the potential flow or movement of information and data. By crafting such a diagram for each environment or system, it is possible to more closely examine each point where a compromise could occur.

Such data flow diagrams are useful in gaining a better understanding of the relationships of resources and movement of data through a visual representation. This process of diagramming is also known as crafting an architecture diagram. The creation of the diagram helps to detail the functions and purpose of each element of a business task, development process, or work activity. It is important to include users, processors, applications, data-stores, and all other essential elements needed to perform the specific task or operation. This is a high-level overview and not a detailed evaluation of the coding logic. However, for more complex systems, multiple diagrams may need to be created at various focus points and at varying levels of detail magnification.

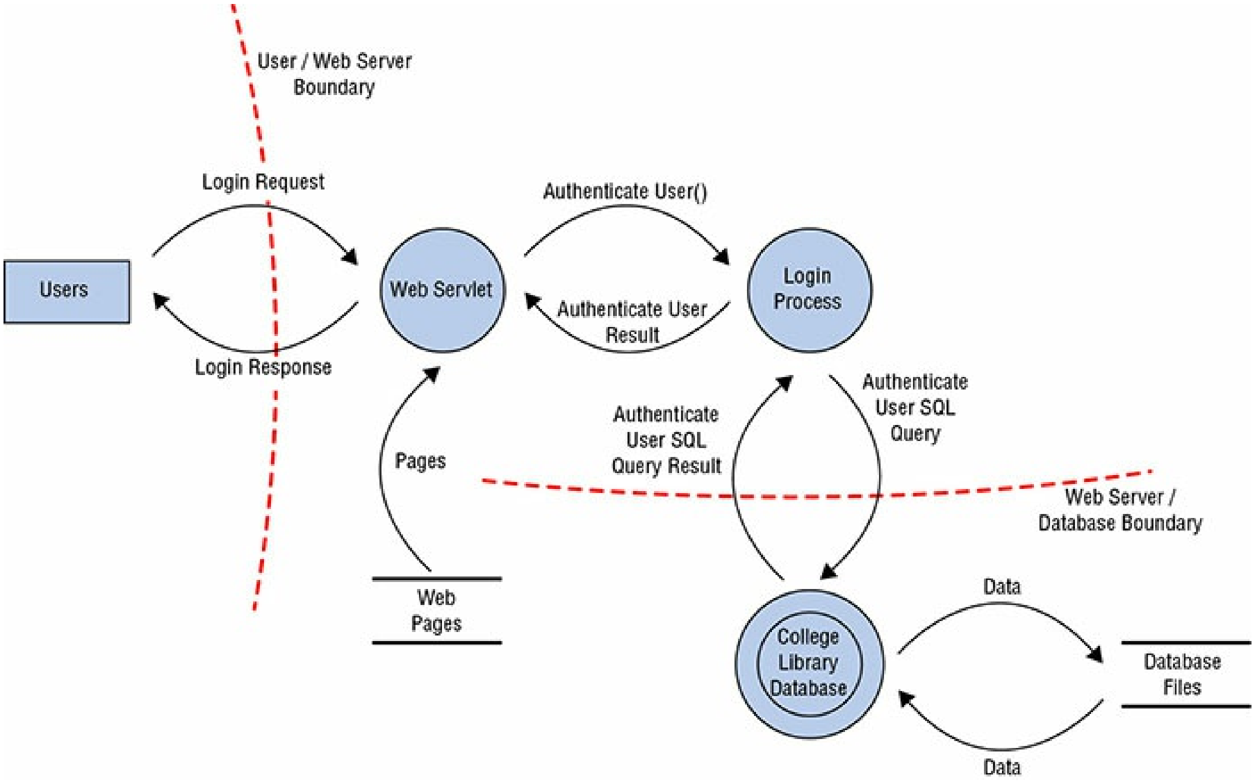


FIGURE 1.8 An example of diagramming to reveal threat concerns

Once a diagram has been crafted, identify all of the technologies involved. This would include operating systems, applications (network service and client based), and protocols. Be specific as to the version numbers and update/patch level in use.

Next, identify attacks that could be targeted at each element of the diagram. Keep in mind that all forms of attacks should be considered, including logical/technical, physical, and social. For example, be sure to include spoofing, tampering, and social engineering. This process will quickly lead you into the next phase of threat modeling: reduction analysis.

Performing Reduction Analysis

The next step in threat modeling is to perform reduction analysis. *Reduction analysis* is also known as *decomposing* the application, system, or environment. The purpose of this task is to gain a greater understanding of the logic of the product as well as its interactions with external elements. Whether an application, a system, or an entire environment, it needs to be divided into smaller containers or compartments. Those might be subroutines, modules, or objects if you're focusing on software, computers, or operating systems; they might be protocols if you're focusing on systems or networks; or they might be departments, tasks, and networks if you're focusing on an entire business infrastructure. Each identified sub-element should be evaluated in order to understand inputs, processing, security, data management, storage, and outputs.

In the decomposition process, you must identify five key concepts:

Trust Boundaries Any location where the level of trust or security changes

Data Flow Paths The movement of data between locations

Input Points Locations where external input is received

Privileged Operations Any activity that requires greater privileges than of a standard user account or process, typically required to make system changes or alter security

Details about Security Stance and Approach The declaration of the security policy, security foundations, and security assumptions

Breaking down a system into its constituent parts makes it much easier to identity the essential components of each element as well as take notice of vulnerabilities and points of attack. The more you understand exactly how a program, system, or environment operates, the easier it is to identity threats to it.

Prioritization and Response

As threats are identified through the threat modeling procedure, additional activities are prescribed to round out the process. Next is to fully document the threats. In this documentation, you should define the means, target, and consequences of a threat. Consider including the techniques required to implement an exploitation as well as list potential countermeasures and safeguards.

After documentation, rank or rate the threats. This can be accomplished using a wide range of techniques, such as Probability ×

Damage Potential ranking, high/medium/low rating, or the DREAD system.

The ranking technique of Probability × Damage Potential produces a risk severity number on a scale of 1 to 100, with 100 the most severe risk possible. Each of the two initial values can be assigned numbers between 1 and 10, with 1 being lowest and 10 being highest. These rankings can be somewhat arbitrary and subjective, but since the same person or team will be assigning the numbers for their own organization, it should still result in assessment values that are accurate on a relative basis.

The high/medium/low rating process is even simpler. Each threat is assigned one of these three priority labels. Those given the high-priority label need to be addressed immediately. Those given the medium-priority label should be addressed eventually, but they don't require immediate action. Those given the low-priority level might be addressed, but they could be deemed optional if they require too much effort or expense in comparison to the project as a whole.

The *DREAD* rating system is designed to provide a flexible rating solution that is based on the answers to five main questions about each threat:

- *Damage potential*: How severe is the damage likely to be if the threat is realized?
- *Reproducibility*: How complicated is it for attackers to reproduce the exploit?
- *Exploitability*: How hard is it to perform the attack?
- *Affected users*: How many users are likely to be affected by the attack (as a percentage)?
- *Discoverability*: How hard is it for an attacker to discover the weakness?

By asking these and potentially additional customized questions, along with assigning H/M/L or 3/2/1 values to the answers, you can establish a detailed threat prioritization.

Once threat priorities are set, responses to those threats need to be determined. Technologies and processes to remediate threats should be considered and weighted according to their cost and effectiveness. Response options should include making adjustments to software architecture, altering operations and processes, and implementing defensive and detective components.

Apply Risk-Based Management Concepts to the Supply Chain

Applying risk-based management concepts to the supply chain is a means to ensure a more robust and successful security strategy in organizations of all sizes. A *supply chain* is the concept that most computers, devices, networks, and systems are not built by a single entity. In fact, most of the companies we know of as computer and equipment manufacturers, such as Dell, Cisco, Extreme Networks, Juniper, Asus, Acer, and Apple, generally perform the final assembly rather than manufacture all of the individual components. Often the CPU, memory, drive controllers, hard drives, SSDs, and video cards are created by other third-party vendors. Even these commodity vendors are unlikely to have mined their own metals or processed the oil for plastics or etched the silicon of their chips. Thus, any finished system has a long and complex history, known as its *supply chain*, that enabled it to come into existence.

A secure supply chain is one in which all of the vendors or links in the chain are reliable, trustworthy, reputable organizations that disclose their practices and security requirements to their business partners (although not necessarily to the public). Each link in the chain is responsible and accountable to the next link in the chain. Each hand-off from raw materials to refined products to electronics parts to computer components to the finished product is properly organized, documented, managed, and audited. The goal of a secure supply chain is to ensure that the finished product is of sufficient quality, meets performance and operational goals, and provides stated security mechanisms, and that at no point in the process was any element counterfeited or subjected to unauthorized or malicious manipulation or sabotage. For an additional perspective on supply chain risk, view a NIST case study located at https://www.nist.gov/sites/default/files/documents/itl/csd/NIST_USBoeing-Exostar-Case-Study.pdf.

When acquisitions and mergers are made without security considerations, the risks inherent in those products remain throughout their deployment life span. Minimizing inherent threats in acquired elements will reduce security management costs and likely reduce security violations.

It is important to evaluate the risks associated with hardware, software, and services. Products and solutions that have resilient integrated security are often more expensive than those that fail to have a security foundation. However, this additional initial expense is often a much more cost-effective expenditure than addressing security needs over the life of a poorly designed product. Thus, when considering the cost of a merger/acquisition, it is important to consider the total cost of ownership over the life of the product's deployment rather than just initial purchase and implementation.

Acquisition does not relate exclusively to hardware and software. Outsourcing, contracting with suppliers, and engaging consultants are also elements of acquisition. Integrating security assessments when working with external entities is just as important as ensuring a product was designed with security in mind.

In many cases, ongoing security monitoring, management, and assessment may be required. This could be an industry best practice or a regulation. Such assessment and monitoring might be performed by the organization internally or may require the use of external auditors. When engaging third-party assessment and monitoring services, keep in mind that the external entity needs to show security-mindedness in their business operations. If an external organization is unable to manage their own internal operations on a secure basis, how can they provide reliable security management functions for yours?

When evaluating a third party for your security integration, consider the following processes:

On-Site Assessment Visit the site of the organization to interview personnel and observe their operating habits.

Document Exchange and Review Investigate the means by which datasets and documentation are exchanged as well as the formal processes by which they perform assessments and reviews.

Process/Policy Review Request copies of their security policies, processes/procedures, and documentation of incidents and responses for review.

Third-Party Audit Having an independent third-party auditor, as defined by the American Institute of Certified Public Accountants (AICPA), can provide an unbiased review of an entity's security infrastructure, based on Service Organization Control (SOC) (SOC) reports. Statement on Standards for Attestation Engagements (SSAE) is a regulation that defines how service organizations report on their compliance using the various SOC reports. The SSAE 16 version of the regulation, effective June 15, 2011, was replaced by SSAE 18 as of May 1, 2017. The SOC1 and SOC2 auditing frameworks are worth considering for the purpose of a security assessment. The SOC1 audit focuses on a description of security mechanisms to assess their suitability. The SOC2 audit focuses on implemented security controls in relation to availability, security, integrity, privacy, and confidentiality. For more on SOC audits, see https://www.aicpa.org/interestareas/frc/assuranceadvisoryservices/socguidesandpublications.html.

For all acquisitions, establish minimum security requirements. These should be modeled from your existing security policy. The security requirements for new hardware, software, or services should always meet or exceed the security of your existing infrastructure. When working with an external service, be sure to review any *service-level agreement (SLA)* to ensure that security is a prescribed component of the contracted services. This could include customization of service-level requirements for your specific needs.

Here are some excellent resources related to security integrated with acquisition:

- Improving Cybersecurity and Resilience through Acquisition. Final Report of the Department of Defense and General Services Administration, published November 2013 (www.gsa.gov/portal/getMediaData?mediaId=185371)
- NIST Special Publication 800-64 Revision 2: Security Considerations in the System Development Life Cycle (http://csrc.nist.gov/publications/nistpubs/800-64-Rev2/SP800-

64-Revision2.pdf)

Summary

Security governance, management concepts, and principles are inherent elements in a security policy and in solution deployment. They define the basic parameters needed for a secure environment. They also define the goals and objectives that both policy designers and system implementers must achieve in order to create a secure solution.

The primary goals and objectives of security are contained within the CIA Triad: confidentiality, integrity, and availability. These three principles are considered the most important within the realm of security. Their importance to an organization depends on the organization's security goals and requirements and on how much of a threat to security exists in its environment.

The first principle from the CIA Triad is confidentiality, the principle that objects are not disclosed to unauthorized subjects. Security mechanisms that offer confidentiality offer a high level of assurance that data, objects, or resources are not exposed to unauthorized subjects. If a threat exists against confidentiality, there is the possibility that unauthorized disclosure could take place.

The second principle from the CIA Triad is integrity, the principle that objects retain their veracity and are intentionally modified by only authorized subjects. Security mechanisms that offer integrity offer a high level of assurance that the data, objects, and resources are unaltered from their original protected state. This includes alterations occurring while the object is in storage, in transit, or in process. Maintaining integrity means the object itself is not altered and the operating system and programming entities that manage and manipulate the object are not compromised.

The third principle from the CIA Triad is availability, the principle that authorized subjects are granted timely and uninterrupted access to objects. Security mechanisms that offer availability offer a high level of assurance that the data, objects, and resources are accessible to authorized subjects. Availability includes efficient uninterrupted access to objects and prevention of denial-of-service attacks. It also implies that the supporting infrastructure is functional and allows authorized users to gain authorized access.

Other security-related concepts and principles that should be considered and addressed when designing a security policy and deploying a security solution are privacy, identification, authentication, authorization, accountability, nonrepudiation, and auditing.

Other aspects of security solution concepts and principles are the elements of protection mechanisms: layering, abstraction, data hiding, and encryption. These are common characteristics of security controls, and although not all security controls must have them, many controls use these mechanisms to protect confidentiality, integrity, and availability.

Security roles determine who is responsible for the security of an organization's assets. Those assigned the senior management role are ultimately responsible and liable for any asset loss, and they are the ones who define security policy. Security professionals are responsible for implementing security policy, and users are responsible for complying with the security policy. The person assigned the data owner role is responsible for classifying information, and a data custodian is responsible for maintaining the secure environment and backing up data. An auditor is responsible for making sure a secure environment is properly protecting assets.

A formalized security policy structure consists of policies, standards, baselines, guidelines, and procedures. These individual documents are essential elements to the design and implementation of security in any environment.

The control or management of change is an important aspect of security management practices. When a secure environment is changed, loopholes, overlaps, missing objects, and oversights can lead to new vulnerabilities. You can, however, maintain security by systematically managing change. This typically involves extensive logging, auditing, and monitoring of activities related to security controls and security mechanisms. The resulting data is then used to identify agents of change, whether objects, subjects, programs, communication pathways, or even the network itself.

Data classification is the primary means by which data is protected based on its secrecy, sensitivity, or confidentiality. Because some data items need more security than others, it is inefficient to treat all data the same when designing and implementing a security system. If everything is secured at a low security level, sensitive data is easily accessible, but securing everything at a high security level is too expensive and restricts access to unclassified, noncritical data. Data classification is used to determine how much effort, money, and resources are allocated to protect the data and control access to it.

An important aspect of security management planning is the proper implementation of a security policy. To be effective, the approach to security management must be a top-down approach. The responsibility of initiating and defining a security policy lies with upper or senior management. Security policies provide direction for the lower levels of the organization’s hierarchy. Middle management is responsible for fleshing out the security policy into standards, baselines, guidelines, and procedures. It is the responsibility of the operational managers or security professionals to implement the configurations prescribed in the security management documentation. Finally, the end users’ responsibility is to comply with all security policies of the organization.

Security management planning includes defining security roles, developing security policies, performing risk analysis, and requiring security education for employees. These responsibilities are guided by the developments of management plans. The security management team should develop strategic, tactical, and operational plans.

Threat modeling is the security process where potential threats are identified, categorized, and analyzed. Threat modeling can be performed as a proactive measure during design and development or as a reactive measure once a product has been deployed. In either case, the process identifies the potential harm, the probability of occurrence, the priority of concern, and the means to eradicate or reduce the threat.

Integrating cyber security risk management with supply chain, acquisition strategies, and business practices is a means to ensure a more robust and successful security strategy in organizations of all sizes. When purchases are made without security considerations, the risks inherent in those products remain throughout their deployment life span.

Exam Essentials

Understand the CIA Triad elements of confidentiality, integrity, and availability. Confidentiality is the principle that objects are not disclosed to unauthorized subjects. Integrity is the principle that objects retain their veracity and are intentionally modified by only authorized subjects. Availability is the principle that authorized subjects are granted timely and uninterrupted access to objects. Know why these are important, the mechanisms that support them, the attacks that focus on each, and the effective countermeasures.

Be able to explain how identification works. Identification is the process by which a subject professes an identity and accountability is initiated. A subject must provide an identity to a system to start the process of authentication, authorization, and accountability.

Understand the process of authentication. Authentication is the process of verifying or testing that a claimed identity is valid. Authentication requires information from the subject that must exactly correspond to the identity indicated.

Know how authorization fits into a security plan. Once a subject is authenticated, its access must be authorized. The process of authorization ensures that the requested activity or object access is possible given the rights and privileges assigned to the authenticated identity.

Understand security governance. Security governance is the collection of practices related to supporting, defining, and directing the security efforts of an organization.

Be able to explain the auditing process. Auditing, or monitoring, is the programmatic means by which subjects are held accountable for their actions while authenticated on a system. Auditing is also the process by which unauthorized or abnormal activities are detected on a system. Auditing is needed to detect malicious actions by subjects, attempted intrusions, and system failures and to reconstruct events, provide evidence for prosecution, and produce problem reports and analysis.

Understand the importance of accountability. An organization's security policy can be properly enforced only if accountability is maintained. In other words, security can be maintained only if subjects are held accountable for their actions. Effective accountability relies on the capability to prove a subject's identity and track their activities.

Be able to explain nonrepudiation. Nonrepudiation ensures that the subject of an activity or event cannot deny that the event occurred. It prevents a subject from claiming not to have sent a message, not to have performed an action, or not to have been the cause of an event.

Understand security management planning. Security management is based on three types of plans: strategic, tactical, and operational. A strategic plan is a long-term plan that is fairly stable. It defines the organization's goals, mission, and objectives. The tactical plan is a midterm plan developed to provide more details on accomplishing the goals set forth in the strategic plan. Operational plans are short-term and highly detailed plans based on the strategic and tactical plans.

Know the elements of a formalized security policy structure. To create a comprehensive security plan, you need the following items in place: security policy, standards, baselines, guidelines, and procedures. Such documentation clearly states security requirements and creates due diligence on the part of the responsible parties.

Understand key security roles. The primary security roles are senior manager, organizational owner, upper management, security professional, user, data owner, data custodian, and auditor. By creating a security role hierarchy, you limit risk overall.

Know how to implement security awareness training. Before actual training can take place, awareness of security as a recognized entity must be created for users. Once this is accomplished, training, or teaching employees to perform their work tasks and to comply with the security policy, can begin. All new employees require some level of training so they will be able to comply with all standards, guidelines, and procedures mandated by the security policy. Education is a more detailed endeavor in which students/users learn much more than they actually need to know to perform their work tasks. Education is most often associated with users pursuing certification or seeking job promotion.

Know how layering simplifies security. Layering is the use of multiple controls in series. Using a multilayered solution allows for numerous controls to guard against threats.

Be able to explain the concept of abstraction. Abstraction is used to collect similar elements into groups, classes, or roles that are assigned security controls, restrictions, or permissions as a collective. It adds efficiency to carrying out a security plan.

Understand data hiding. Data hiding is exactly what it sounds like: preventing data from being discovered or accessed by a subject. It is often a key element in security controls as well as in programming.

Understand the need for encryption. Encryption is the art and science of hiding the meaning or intent of a communication from unintended recipients. It can take many forms and be applied to every type of electronic communication, including text, audio, and video files, as well as programs themselves. Encryption is an important element in security controls, especially in regard to the transmission of data between systems.

Be able to explain the concepts of change control and change management. Change in a secure environment can introduce loopholes, overlaps, missing objects, and oversights that can lead to new vulnerabilities. The only way to maintain security in the face of change is to systematically manage change.

Know why and how data is classified. Data is classified to simplify the process of assigning security controls to groups of objects rather than to individual objects. The two common classification schemes are government/military and commercial business/private sector. Know the five levels of government/military classification and the four levels of commercial business/private sector classification.

Understand the importance of declassification.

Declassification is required once an asset no longer warrants the protection of its currently assigned classification or sensitivity level.

Know the basics of COBIT. Control Objectives for Information and Related Technologies (COBIT) is a security concept infrastructure used to organize the complex security solutions of companies.

Know the basics of threat modeling. Threat modeling is the security process where potential threats are identified, categorized, and analyzed. Threat modeling can be performed as a proactive measure during design and development or as a reactive measure once a product has been deployed. Key concepts include assets/attackers/software, STRIDE, PASTA, Trike, VAST, diagramming, reduction/decomposing, and DREAD.

Understand the need to apply risk-based management concepts to the supply chain. Applying risk-based management concepts to the supply chain is a means to ensure a more robust and successful security strategy in organizations of all sizes. When purchases and acquisitions are made without security considerations, the risks inherent in those products remain throughout their deployment life span.

Written Lab

1. Discuss and describe the CIA Triad.
2. What are the requirements to hold a person accountable for the actions of their user account?
3. Describe the benefits of change control management.
4. What are the seven major steps or phases in the implementation of a classification scheme?
5. Name the six primary security roles as defined by (ISC)^2 for CISSP.
6. What are the four components of a complete organizational security policy and their basic purpose?

Review Questions

1. Which of the following contains the primary goals and objectives of security?

   A. A network's border perimeter

   B. The CIA Triad

   C. A stand-alone system

   D. The internet

2. Vulnerabilities and risks are evaluated based on their threats against which of the following?

   A. One or more of the CIA Triad principles

   B. Data usefulness

   C. Due care

   D. Extent of liability

3. Which of the following is a principle of the CIA Triad that means authorized subjects are granted timely and uninterrupted access to objects?

   A. Identification

   B. Availability

   C. Encryption

   D. Layering

4. Which of the following is *not* considered a violation of confidentiality?

   A. Stealing passwords

   B. Eavesdropping

   C. Hardware destruction

   D. Social engineering

5. Which of the following is not true?

   A. Violations of confidentiality include human error.

   B. Violations of confidentiality include management oversight.

   C. Violations of confidentiality are limited to direct intentional attacks.

   D. Violations of confidentiality can occur when a transmission is not properly encrypted.

6. STRIDE is often used in relation to assessing threats against applications or operating systems. Which of the following is not an element of STRIDE?

   A. Spoofing

   B. Elevation of privilege

   C. Repudiation

   D. Disclosure

7. If a security mechanism offers availability, then it offers a high level of assurance that authorized subjects can ______________________ the data, objects, and resources.

   A. Control

   B. Audit

   C. Access

   D. Repudiate

8. ________________ refers to keeping information confidential that is personally identifiable or that might cause harm, embarrassment, or disgrace to someone if revealed.

   A. Seclusion

   B. Concealment

   C. Privacy

   D. Criticality

9. All but which of the following items requires awareness for all individuals affected?

   A. Restricting personal email

   B. Recording phone conversations

   C. Gathering information about surfing habits

   D. The backup mechanism used to retain email messages

10. What element of data categorization management can override all other forms of access control?

   A. Classification

   B. Physical access

   C. Custodian responsibilities

   D. Taking ownership

11. What ensures that the subject of an activity or event cannot deny that the event occurred?

   A. CIA Triad

   B. Abstraction

   C. Nonrepudiation

   D. Hash totals

12. Which of the following is the most important and distinctive concept in relation to layered security?

   A. Multiple

   B. Series

   C. Parallel

   D. Filter

13. Which of the following is *not* considered an example of data hiding?

   A. Preventing an authorized reader of an object from deleting that object

B. Keeping a database from being accessed by unauthorized visitors

C. Restricting a subject at a lower classification level from accessing data at a higher classification level

D. Preventing an application from accessing hardware directly

14. What is the primary goal of change management?

A. Maintaining documentation

B. Keeping users informed of changes

C. Allowing rollback of failed changes

D. Preventing security compromises

15. What is the primary objective of data classification schemes?

A. To control access to objects for authorized subjects

B. To formalize and stratify the process of securing data based on assigned labels of importance and sensitivity

C. To establish a transaction trail for auditing accountability

D. To manipulate access controls to provide for the most efficient means to grant or restrict functionality

16. Which of the following is typically *not* a characteristic considered when classifying data?

A. Value

B. Size of object

C. Useful lifetime

D. National security implications

17. What are the two common data classification schemes?

A. Military and private sector

B. Personal and government

C. Private sector and unrestricted sector

D. Classified and unclassified

8. Which of the following is the lowest military data classification for classified data?

   A. Sensitive

   B. Secret

   C. Proprietary

   D. Private

9. Which commercial business/private sector data classification is used to control information about individuals within an organization?

   A. Confidential

   B. Private

   C. Sensitive

   D. Proprietary

0. Data classifications are used to focus security controls over all but which of the following?

   A. Storage

   B. Processing

   C. Layering

   D. Transfer

Chapter 2
Personnel Security and Risk Management Concepts

THE CISSP EXAM TOPICS COVERED IN THIS CHAPTER INCLUDE:

- ✓ **Domain 1: Security and Risk Management**
    - 1.8 Contribute to and enforce personnel security policies and procedures
        - 1.8.1 Candidate screening and hiring
        - 1.8.2 Employment agreements and policies
        - 1.8.3 Onboarding and termination processes
        - 1.8.4 Vendor, consultant, and contractor agreements and controls
        - 1.8.5 Compliance policy requirements
        - 1.8.6 Privacy policy requirements
    - 1.9 Understand and apply risk management concepts
        - 1.9.1 Identify threats and vulnerabilities
        - 1.9.2 Risk assessment/analysis
        - 1.9.3 Risk response
        - 1.9.4 Countermeasure selection and implementation
        - 1.9.5 Applicable types of controls (e.g., preventive, detective, corrective)
        - 1.9.6 Security Control Assessment (SCA)
        - 1.9.7 Monitoring and measurement
        - 1.9.8 Asset valuation
        - 1.9.9 Reporting

- 1.9.10 Continuous improvement
- 1.9.11 Risk frameworks

- 1.12 Establish and maintain a security awareness, education, and training program
  - 1.12.1 Methods and techniques to present awareness and training
  - 1.12.2 Periodic content reviews
  - 1.12.3 Program effectiveness evaluation

✓ **Domain 6: Security Assessment and Testing**

- 6.3.5 Training and awareness

The Security and Risk Management domain of the Common Body of Knowledge (CBK) for the CISSP certification exam deals with many of the foundational elements of security solutions. These include elements essential to the design, implementation, and administration of security mechanisms.

Additional elements of this domain are discussed in various chapters: Chapter 1, “Security Governance Through Principles and Policies”; Chapter 3, “Business Continuity Planning”; and Chapter 4, “Laws, Regulations, and Compliance.” Please be sure to review all of these chapters to have a complete perspective on the topics of this domain.

Because of the complexity and importance of hardware and software controls, security management for employees is often overlooked in overall security planning. This chapter explores the human side of security, from establishing secure hiring practices and job descriptions to developing an employee infrastructure. Additionally, we look at how employee training, management, and termination practices are considered an integral part of creating a secure environment. Finally, we examine how to assess and manage security risks.

Personnel Security Policies and Procedures

Humans are the weakest element in any security solution. No matter what physical or logical controls are deployed, humans can discover ways to avoid them, circumvent or subvert them, or disable them. Thus, it is important to take into account the humanity of your users when designing and deploying security solutions for your environment. To understand and apply security governance, you must address the weakest link in your security chain—namely, people.

Issues, problems, and compromises related to humans occur at all stages of a security solution development. This is because humans are involved throughout the development, deployment, and ongoing administration of any solution. Therefore, you must evaluate the effect users, designers, programmers, developers, managers, and implementers have on the process.

Hiring new staff typically involves several distinct steps: creating a *job description or position description*, setting a classification for the job, screening employment candidates, and hiring and training the one best suited for the job. Without a job description, there is no consensus on what type of individual should be hired. Thus, crafting job descriptions is the first step in defining security needs related to personnel and being able to seek out new hires. Some organizations recognize a difference between a role description and a job description. Roles typically align to a rank or level of privilege, while job descriptions map to specifically assigned responsibilities and tasks.

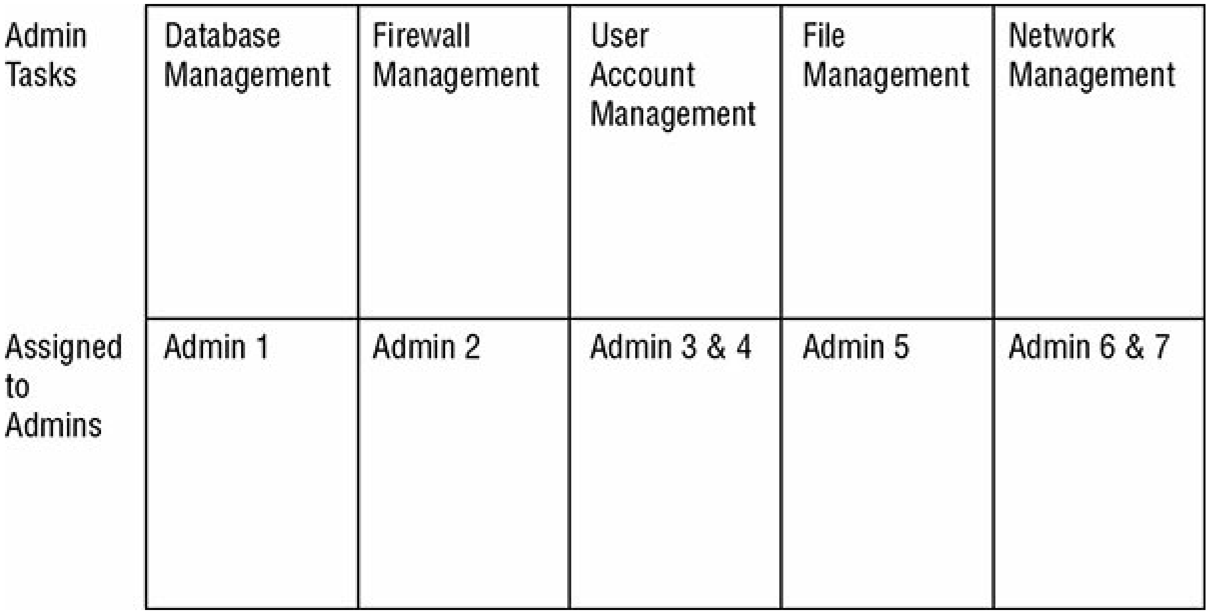
Personnel should be added to an organization because there is a need for their specific skills and experience. Any job description for any position within an organization should address relevant security issues. You must consider items such as whether the position requires the handling of sensitive material or access to classified information. In effect, the job description defines the roles to which an employee needs to be assigned to perform their work tasks. The job description should define the type and extent of access the position requires on the secured network. Once these issues have been resolved, assigning a security classification to the job description is fairly standard.

The Importance of Job Descriptions

Job descriptions are important to the design and support of a security solution. However, many organizations either have overlooked this or have allowed job descriptions to become stale and out-of-sync with reality. Try to track down your job description. Do you even have one? If so, when was it last updated? Does it accurately reflect your job? Does it describe the type of security access you need to perform the prescribed job responsibilities? Some organizations must craft job descriptions to be in compliance with Service Organization Control (SOC) 2, while others following ISO 27001 require annual reviews of job descriptions.

Important elements in constructing job descriptions that are in line with organizational processes include separation of duties, job responsibilities, and job rotation.

Separation of Duties *Separation of duties* is the security concept in which critical, significant, and sensitive work tasks are divided among several individual administrators or high-level operators (Figure 2.1). This prevents any one person from having the ability to undermine or subvert vital security mechanisms. Think of separation of duties as the application of the principle of least privilege to administrators. Separation of duties is also a protection against collusion. *Collusion* is the occurrence of negative activity undertaken by two or more people, often for the purposes of fraud, theft, or espionage. By limiting the powers of individuals, separation of duties requires employees to work with others to commit larger violations. The act of finding others to assist in a violation and then the actions to perform that violation are more likely to leave behind evidence and be detectible, which directly reduces the occurrence of collusion (via deterrence, the chance that they might get caught). Thus, collusion is difficult and increases risk to the initiator prior to the commission of the act.



Admin Tasks	Database Management	Firewall Management	User Account Management	File Management	Network Management
Assigned to Admins	Admin 1	Admin 2	Admin 3 & 4	Admin 5	Admin 6 & 7

FIGURE 2.1 An example of separation of duties related to five admin tasks and seven administrators

Job Responsibilities *Job responsibilities* are the specific work tasks an employee is required to perform on a regular basis. Depending on their responsibilities, employees require access to various objects, resources, and services. On a secured network, users must be granted access privileges for those elements related to their work tasks. To maintain the greatest security, access should be assigned according to the principle of least privilege. The *principle of least privilege* states that in a secured environment, users should be granted the minimum amount of access necessary for them to complete their required work tasks or job responsibilities. True application of this principle requires low-level granular control over all resources and functions.

Job Rotation *Job rotation*, or rotating employees among multiple job positions, is simply a means by which an organization improves its overall security (Figure 2.2). Job rotation serves two functions. First, it provides a type of knowledge redundancy. When multiple employees are all capable of performing the work tasks required by several job positions, the organization is less likely to experience serious downtime or loss in productivity if an illness or other incident keeps one or more employees out of work for an extended period of time.

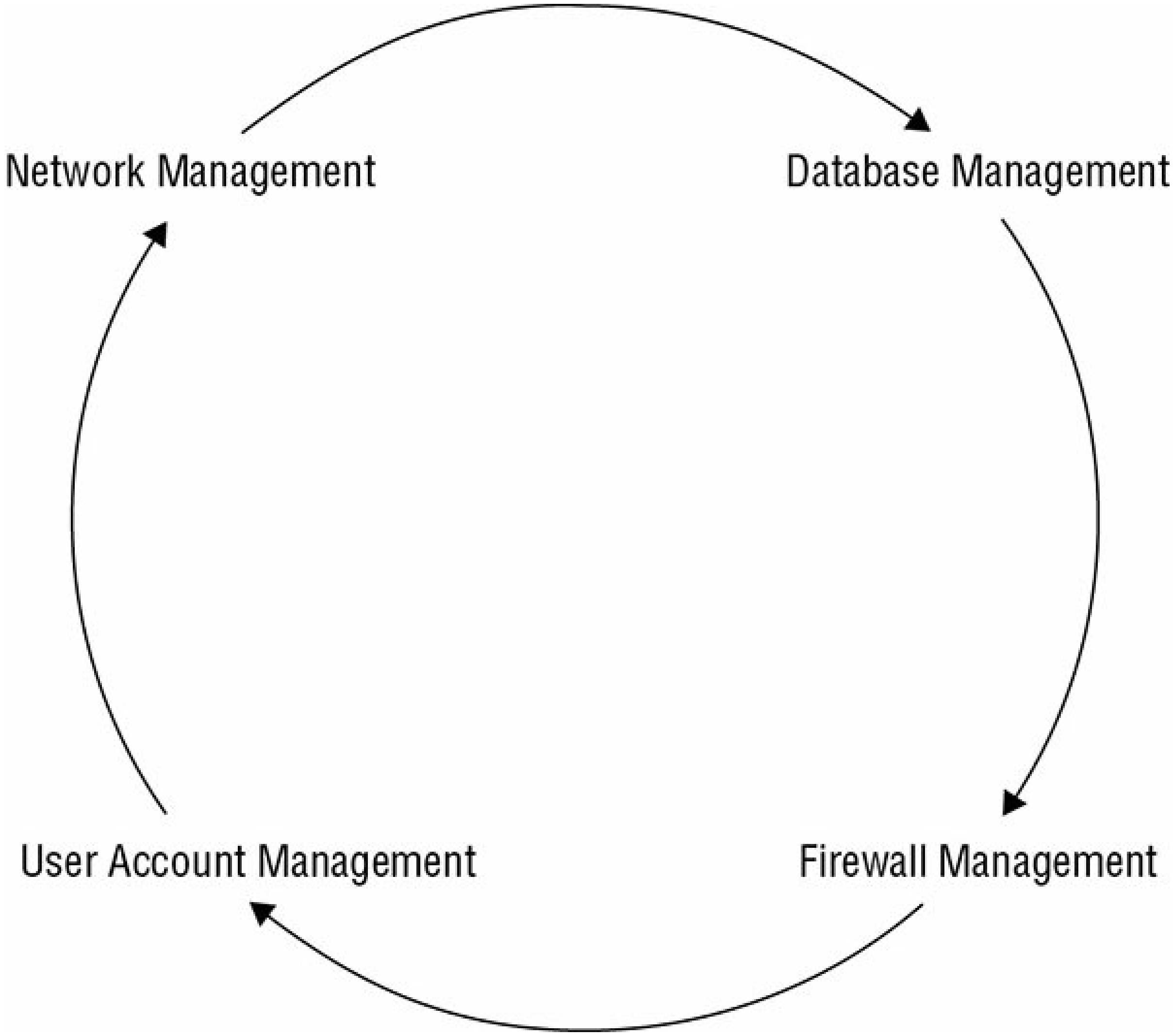


FIGURE 2.2 An example of job rotation among management positions

Second, moving personnel around reduces the risk of fraud, data modification, theft, sabotage, and misuse of information. The longer a person works in a specific position, the more likely they are to be assigned additional work tasks and thus expand their privileges and access. As a person becomes increasingly familiar with their work tasks, they may abuse their privileges for personal gain or malice. If misuse or abuse is committed by one employee, it will be easier to detect by another employee who knows the job position and work responsibilities. Therefore, job rotation also provides a form of peer auditing and protects against collusion.

Job rotation requires that security privileges and accesses be reviewed to maintain the principle of least privilege. One concern with job rotation, cross-training, and long-tenure employees is their continued collection of privileges and accesses, many of which they no longer need. The assignment of privileges, permissions, rights, access, and so on, should be periodically reviewed to check for privilege creep or misalignment with job responsibilities. Privilege creep occurs when workers accumulate privileges over time as their job responsibilities change. The end result is that a worker has more privileges than the principle of least privilege would dictate based on that individual's current job responsibilities.

Cross-training

Cross-training is often discussed as an alternative to job rotation. In both cases, workers learn the responsibilities and tasks of multiple job positions. However, in cross-training the workers are just prepared to perform the other job positions; they are not rotated through them on a regular basis. Cross-training enables existing personnel to fill the work gap when the proper employee is unavailable as a type of emergency response procedure.

When several people work together to perpetrate a crime, it's called collusion. Employing the principles of separation of duties, restricted job responsibilities, and job rotation reduces the likelihood that a co-worker will be willing to collaborate on an illegal or abusive scheme because of the higher risk of detection. Collusion and other privilege abuses can be reduced through strict monitoring of special privileges, such as those of an administrator, backup operator, user manager, and others.

Job descriptions are not used exclusively for the hiring process; they should be maintained throughout the life of the organization. Only through detailed job descriptions can a comparison be made between what a person should be responsible for and what they actually are responsible for. It is a managerial task to ensure that job descriptions overlap as little as possible and that one worker's responsibilities do not drift or encroach on those of another. Likewise, managers should audit privilege assignments to ensure that workers do not obtain access that is not strictly required for them to accomplish their work tasks.

Candidate Screening and Hiring

Employment candidate screening for a specific position is based on the sensitivity and classification defined by the job description. The sensitivity and classification of a specific position is dependent on the level of harm that could be caused by accidental or intentional violations of security by a person in the position. Thus, the thoroughness of the screening process should reflect the security of the position to be filled.

Employment candidate screening, background checks, reference checks, education verification, and security clearance validation are essential elements in proving that a candidate is adequate, qualified, and trustworthy for a secured position. *Background checks* include obtaining a candidate’s work and educational history; checking references; verifying education; interviewing colleagues, neighbors, and friends; checking police and government records for arrests or illegal activities; verifying identity through fingerprints, driver’s license, and birth certificate; and holding a personal interview. This process could also include a polygraph test, drug testing, and personality testing/evaluation.

Performing online background checks and reviewing the social networking accounts of applicants has become standard practice for many organizations. If a potential employee has posted inappropriate materials to their photo sharing site, social networking biographies, or public instant messaging services, then they are not as attractive a candidate as those who did not. Our actions in the public eye become permanent when they are recorded in text, photo, or video and then posted online. A general picture of a person’s attitude, intelligence, loyalty, common sense, diligence, honesty, respect, consistency, and adherence to social norms and/or corporate culture can be gleaned quickly by viewing a person’s online identity.

Employment Agreements and Policies

When a new employee is hired, they should sign an employment agreement. Such a document outlines the rules and restrictions of the organization, the security policy, the acceptable use and activities policies, details of the job description, violations and consequences, and the length of time the position is to be filled by the employee. These items might be separate documents. In such a case, the employment agreement is used to verify that the employment candidate has read and understood the associated documentation for their prospective job position.

In addition to employment agreements, there may be other security-related documentation that must be addressed. One common document is a *nondisclosure agreement (NDA)*. An NDA is used to protect the confidential information within an organization from being disclosed by a former employee. When a person signs an NDA, they agree not to disclose any information that is defined as confidential to anyone outside the organization. Violations of an NDA are often met with strict penalties.

Real World Scenario

NCA: The NDA's Evil Sibling

The NDA has a common companion contract known as the *noncompete agreement (NCA)*. The noncompete agreement attempts to prevent an employee with special knowledge of secrets from one organization from working in a competing organization in order to prevent that second organization from benefiting from the worker's special knowledge of secrets. NCAs are also used to prevent workers from jumping from one company to another competing company just because of salary increases or other incentives. Often NCAs have a time limit, such as six months, one year, or even three years. The goal is to allow the original company to maintain its competitive edge by keeping its human resources working for its benefit rather than against it.

Many companies require new hires to sign NCAs. However, fully enforcing an NCA in court is often a difficult battle. The court recognizes the need for a worker to be able to work using the skills and knowledge they have in order to provide for themselves and their families. If the NCA would prevent a person from earning a reasonable income, the courts often invalidate the NCA or prevent its consequences from being realized.

Even if an NCA is not always enforceable in court, however, that does not mean it doesn't have benefits to the original company, such as the following:

- The threat of a lawsuit because of NCA violations is often sufficient incentive to prevent a worker from violating the terms of secrecy when they seek employment with a new company.
- If a worker does violate the terms of the NCA, then even without specifically defined consequences being levied by court restrictions, the time and effort, not to mention the cost, of battling the issue in court is a deterrent.

Did you sign an NCA when you were hired? If so, do you know the terms and the potential consequences if you break that NCA?

Throughout the employment lifetime of personnel, managers should regularly audit the job descriptions, work tasks, privileges, and responsibilities for every staff member. It is common for work tasks and privileges to drift over time. This can cause some tasks to be overlooked and others to be performed multiple times. Drifting or privilege creep can also result in security violations. Regularly reviewing the boundaries of each job description in relation to what is actually occurring aids in keeping security violations to a minimum.

A key part of this review process is enforcing mandatory vacations. In many secured environments, mandatory vacations of one to two weeks are used to audit and verify the work tasks and privileges of employees. The vacation removes the employee from the work environment and places a different worker in their position, which makes it easier to detect abuse, fraud, or negligence on the part of the original employee.

Onboarding and Termination Processes

Onboarding is the process of adding new employees to the identity and access management (IAM) system of an organization. The onboarding process is also used when an employee's role or position changes or when that person is awarded additional levels of privilege or access.

Offboarding is the reverse of this process. It is the removal of an employee's identity from the IAM system once that person has left the organization. This can include disabling and/or deleting the user account, revoking certificates, canceling access codes, and terminating other specifically granted privileges. This may also include informing security guards and other physical access management personnel to disallow entry into the building to the person in the future.

The procedures for onboarding and offboarding should be clearly documented in order to ensure consistency of application as well as compliance with regulations or contractual obligations.

Onboarding can also refer to organizational socialization. This is the process by which new employees are trained in order to be properly prepared for performing their job responsibilities. It can include training, job skill acquisition, and behavioral adaptation in an effort to integrate employees efficiently into existing organizational processes and procedures. Well-designed onboarding can result in higher levels of job satisfaction, higher levels of productivity, faster integration with existing workers, a rise in organizational loyalty, stress reduction, and a decreased occurrence of resignation. Another benefit of well-designed onboarding, in the context of separation of duties and job responsibilities, is that it applies the principle of least privilege as previously discussed.

When an employee must be terminated or offboarded, numerous issues must be addressed. A strong relationship between the security department and human resources (HR) is essential to maintain control and minimize risks during termination. An employee termination process or procedure policy is essential to maintaining a secure environment when a disgruntled employee must be removed from the organization. The reactions of terminated employees can range from calm, understanding acceptance to violent, destructive rage. A sensible procedure for handling terminations must be designed and implemented to reduce incidents.

The *termination* of an employee should be handled in a private and respectful manner. However, this does not mean that precautions should not be taken. Terminations should take place with at least one witness, preferably a higher-level manager and/or a security guard. Once the employee has been informed of their release, they should be escorted off the premises and not allowed to return to their work area without an escort for any reason. Before the employee is released, all organization-specific identification, access, or security badges as well as cards, keys, and access tokens should be collected (Figure 2.3). Generally, the best time to terminate an employee is at the end of their shift midweek. An early to midweek termination provides the ex-employee with time to file for unemployment and/or start looking for new employment before the weekend. Also, end-of-shift terminations allow the worker to leave with other employees in a more natural departure, thus reducing stress.

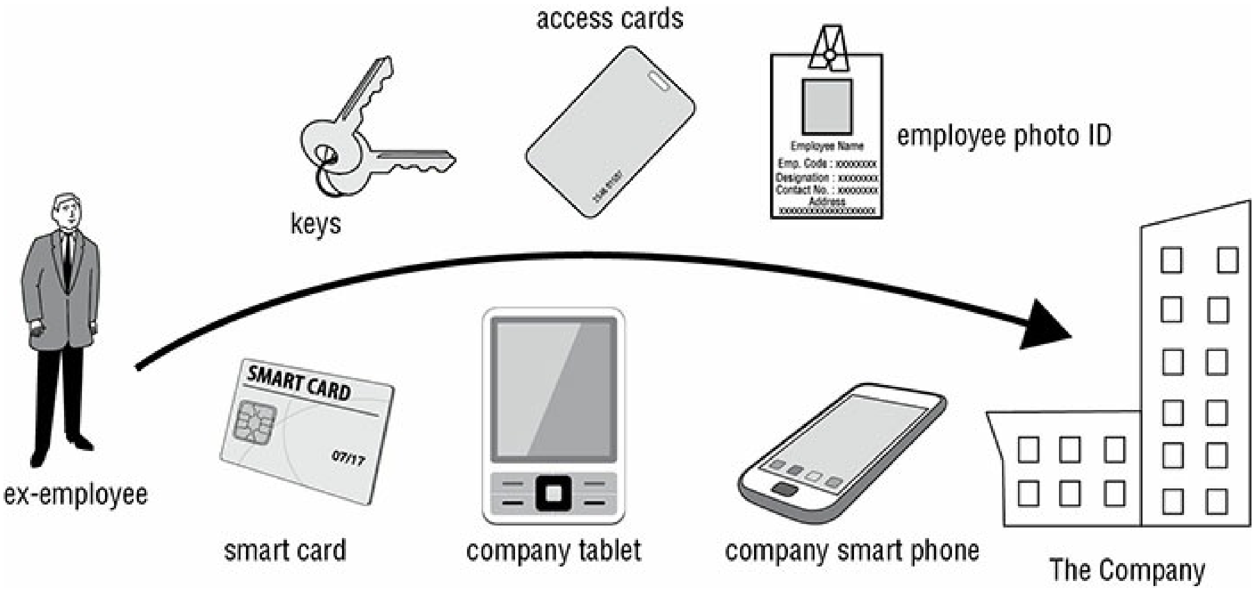


FIGURE 2.3 Ex-employees must return all company property

When possible, an *exit interview* should be performed. However, this typically depends on the mental state of the employee upon release and numerous other factors. If an exit interview is unfeasible immediately upon termination, it should be conducted as soon as possible. The primary purpose of the exit interview is to review the liabilities and restrictions placed on the former employee based on the employment agreement, nondisclosure agreement, and any other security-related documentation.

The following list includes some other issues that should be handled as soon as possible:

- Make sure the employee returns any organizational equipment or supplies from their vehicle or home.
- Remove or disable the employee's network user account.
- Notify human resources to issue a final paycheck, pay any unused vacation time, and terminate benefit coverage.
- Arrange for a member of the security department to accompany the released employee while they gather their personal belongings from the work area.
- Inform all security personnel and anyone else who watches or monitors any entrance point to ensure that the ex-employee does not attempt to reenter the building without an escort.

In most cases, you should disable or remove an employee's system access at the same time as or just before they are notified of being terminated. This is especially true if that employee is capable of accessing confidential data or has the expertise or access to alter or damage data or services. Failing to restrict released employees' activities can leave your organization open to a wide range of vulnerabilities, including theft and destruction of both physical property and logical data.

Real World Scenario

Firing: Not Just a Pink Slip Anymore

Firing an employee has become a complex process. Gone are the days of firing merely by placing a pink slip in an employee's mail slot. In most IT-centric organizations, termination can create a situation in which the employee could cause harm, putting the organization at risk. That's why you need a well-designed exit interview process.

However, just having the process isn't enough. It has to be followed correctly every time. Unfortunately, this doesn't always happen. You might have heard of some fiasco caused by a botched termination procedure. Common examples include performing any of the following before the employee is officially informed of their termination (thus giving the employee prior warning of their termination):

- The information technology (IT) department requesting the return of a notebook computer
- Disabling a network account
- Blocking a person's personal identification number (PIN) or smartcard for building entrance
- Revoking a parking pass
- Distributing a company reorganization chart
- Positioning a new employee in the cubicle
- Allowing layoff information to be leaked to the media

It should go without saying that in order for the exit interview and safe termination processes to function properly, they must be implemented in the correct order and at the correct time (that is, at the start of the exit interview), as in the following example:

- Inform the person that they are relieved of their job.
- Request the return of all access badges, keys, and company equipment.
- Disable the person's electronic access to all aspects of the organization.
- Remind the person about the NDA obligations.
- Escort the person off the premises.

Vendor, Consultant, and Contractor Agreements and Controls

Vendor, consultant, and contractor controls are used to define the levels of performance, expectation, compensation, and consequences for entities, persons, or organizations that are external to the primary organization. Often these controls are defined in a document or policy known as a *service-level agreement (SLA)*.

Using SLAs is an increasingly popular way to ensure that organizations providing services to internal and/or external customers maintain an appropriate level of service agreed on by both the service provider and the vendor. It’s a wise move to put SLAs in place for any data circuits, applications, information processing systems, databases, or other critical components that are vital to your organization’s continued viability. SLAs are important when using any type of third-party service provider, which would include cloud services. The following issues are commonly addressed in SLAs:

- System uptime (as a percentage of overall operating time)
- Maximum consecutive downtime (in seconds/minutes/and so on)
- Peak load
- Average load
- Responsibility for diagnostics
- Failover time (if redundancy is in place)

SLAs also commonly include financial and other contractual remedies that kick in if the agreement is not maintained. For example, if a critical circuit is down for more than 15 minutes, the service provider might agree to waive all charges on that circuit for one week.

SLAs and vendor, consultant, and contractor controls are an important part of risk reduction and risk avoidance. By clearly defining the expectations and penalties for external parties, everyone involved knows what is expected of them and what the consequences are in the event of a failure to meet those expectations. Although it may be very cost effective to use outside providers for a variety of business functions or services, it does increase potential risk by expanding the potential attack surface and range of vulnerabilities. SLAs should include a focus on protecting and improving security in addition to ensuring quality and timely services at a reasonable price. Some SLAs are set and cannot be adjusted, while with others you may have significant influence over their content. You should ensure that an SLA supports the tenets of your security policy and infrastructure rather than being in conflict with it, which could introduce weak points, vulnerabilities, or exceptions.

Compliance Policy Requirements

Compliance is the act of conforming to or adhering to rules, policies, regulations, standards, or requirements. Compliance is an important concern to *security governance*. On a personnel level, compliance is related to whether individual employees follow company policy and perform their job tasks in accordance to defined procedures. Many organizations rely on employee compliance in order to maintain high levels of quality, consistency, efficiency, and cost savings. If employees do not maintain compliance, it could cost the organization in terms of profit, market share, recognition, and reputation. Employees need to be trained in regard to what they need to do (i.e., stay in line with company standards as defined in the security policy and remain in compliance with any contractual obligations such as Payment Card Industry Data Security Standard (PCI DSS) to maintain the ability to perform credit card processing); only then can they be held accountable for violations or lacking compliance.

Privacy Policy Requirements

Privacy can be a difficult concept to define. The term is used frequently in numerous contexts without much quantification or qualification. Here are some partial definitions of privacy:

- Active prevention of unauthorized access to information that is personally identifiable (that is, data points that can be linked directly to a person or organization)
- Freedom from unauthorized access to information deemed

personal or confidential

- Freedom from being observed, monitored, or examined without consent or knowledge

> NOTE A concept that comes up frequently in discussions of privacy is personally identifiable information (PII). PII is any data item that can be easily and/or obviously traced back to the person of origin or concern. A phone number, email address, mailing address, social security number, and name are all PII. A MAC address, Internet Protocol (IP) address, OS type, favorite vacation spot, name of high school mascot, and so forth are not typically considered to be PII. However, that is not a universally true statement. In Germany and other member countries of the European Union (EU), IP addresses and MAC addresses are considered PII in some situations (see https://www.whitecase.com/publications/alert/court-confirms-ip-addresses-are-personal-data-some-cases).

When addressing privacy in the realm of IT, there is usually a balancing act between individual rights and the rights or activities of an organization. Some claim that individuals have the right to control whether information can be collected about them and what can be done with it. Others claim that any activity performed in public view—such as most activities performed over the LC internet or activities performed on company equipment—can be monitored without knowledge of or permission from the individuals being watched and that the information gathered from such monitoring can be used for whatever purposes an organization deems appropriate or desirable.

Protecting individuals from unwanted observation, direct marketing, and disclosure of private, personal, or confidential details is usually considered a worthy effort. However, some organizations profess that demographic studies, information gleaning, and focused marketing improve business models, reduce advertising waste, and save money for all parties.

There are many legislative and regulatory compliance issues in regard to privacy. Many US regulations—such as the Health Insurance Portability and Accountability Act (HIPAA), the Sarbanes-Oxley Act of 2002 (SOX), the Family Educational Rights and Privacy Act (FERPA), and the Gramm-Leach-Bliley Act—as well as the EU's Directive 95/46/EC (aka the Data Protection Directive), the General Data Protection Regulation (GDPR) (Regulation (EU) 2016/679), and the contractual requirement Payment Card Industry Data Security Standard (PCI DSS)—include privacy requirements. It is important to understand all government regulations that your organization is required to adhere to and ensure compliance, especially in the areas of privacy protection.

Whatever your personal or organizational stance is on the issue of online privacy, it must be addressed in an organizational security policy. Privacy is an issue not just for external visitors to your online offerings but also for your customers, employees, suppliers, and contractors. If you gather any type of information about any person or company, you must address privacy.

In most cases, especially when privacy is being violated or restricted, the individuals and companies must be informed; otherwise, you may face legal ramifications. Privacy issues must also be addressed when allowing or restricting personal use of email, retaining email, recording phone conversations, gathering information about surfing or spending habits, and so on.

Security Governance

Security governance is the collection of practices related to supporting, defining, and directing the security efforts of an organization. Security governance is closely related to and often intertwined with corporate and IT governance. The goals of these three governance agendas often interrelate or are the same. For example, a common goal of organizational governance is to ensure that the organization will continue to exist and will grow or expand over time. Thus, the goal of all three forms of governance is to maintain business processes while striving toward growth and resiliency.

Third-party governance is the system of oversight that may be mandated by law, regulation, industry standards, contractual obligation, or licensing requirements. The actual method of governance may vary, but it generally involves an outside investigator or auditor. These auditors might be designated by a governing body or might be consultants hired by the target organization.

Another aspect of third-party governance is the application of security oversight on third parties that your organization relies on. Many organizations choose to outsource various aspects of their business operations. Outsourced operations can include security guards, maintenance, technical support, and accounting services. These parties need to stay in compliance with the primary organization's security stance. Otherwise, they present additional risks and vulnerabilities to the primary organization.

Third-party governance focuses on verifying compliance with stated security objectives, requirements, regulations, and contractual obligations. On-site assessments can provide firsthand exposure to the security mechanisms employed at a location. Those performing on-site assessment or audits need to follow auditing protocols (such as Control Objectives for Information and Related Technology [COBIT]) and have a specific checklist of requirements to investigate.

In the auditing and assessment process, both the target and the governing body should participate in full and open document exchange and review. An organization needs to know the full details of all requirements it must comply with. The organization should submit security policy and self-assessment reports back to the governing body. This open document exchange ensures that all parties involved are in agreement about all the issues of concern. It reduces the chances of unknown requirements or unrealistic expectations. Document exchange does not end with the transmission of paperwork or electronic files. Instead, it leads into the process of documentation review.

Documentation review is the process of reading the exchanged materials and verifying them against standards and expectations. The documentation review is typically performed before any on-site inspection takes place. If the exchanged documentation is sufficient and meets expectations (or at least requirements), then an on-site review will be able to focus on compliance with the stated documentation. However, if the documentation is incomplete, inaccurate, or otherwise insufficient, the on-site review is postponed until the documentation can be updated and corrected. This step is important because if the documentation is not in compliance, chances are the location will not be in compliance either.

In many situations, especially related to government or military agencies or contractors, failing to provide sufficient documentation to meet requirements of third-party governance can result in a loss of or a voiding of *authorization to operate (ATO)*. Complete and sufficient documentation can often maintain existing ATO or provide a temporary ATO (TATO). However, once an ATO is lost or revoked, a complete documentation review and on-site review showing full compliance is usually necessary to reestablish the ATO.

A portion of the documentation review is the logical and practical investigation of the business processes and organizational policies. This review ensures that the stated and implemented business tasks, systems, and methodologies are practical, efficient, and cost effective and most of all (at least in relation to security governance) that they support the goal of security through the reduction of vulnerabilities and the avoidance, reduction, or mitigation of risk. Risk management, risk assessment, and addressing risk are all methods and techniques involved in performing process/policy review.

Understand and Apply Risk Management Concepts

Security is aimed at preventing loss or disclosure of data while sustaining authorized access. The possibility that something could happen to damage, destroy, or disclose data or other resources is known as risk. Understanding risk management concepts is not only important for the CISSP exam, it's also essential to the establishment of a sufficient security stance, proper security governance, and legal proof of due care and due diligence.

Managing risk is therefore an element of sustaining a secure environment. *Risk management* is a detailed process of identifying factors that could damage or disclose data, evaluating those factors in light of data value and countermeasure cost, and implementing cost-effective solutions for mitigating or reducing risk. The overall process of risk management is used to develop and implement information security strategies. The goal of these strategies is to reduce risk and to support the mission of the organization.

The primary goal of risk management is to reduce risk to an acceptable level. What that level actually is depends on the organization, the value of its assets, the size of its budget, and many other factors. One organization might consider something to be an acceptable risk, while another organization might consider the very same thing to be an unreasonably high level of risk. It is impossible to design and deploy a totally risk-free environment; however, significant risk reduction is possible, often with little effort.

Risks to an IT infrastructure are not all computer based. In fact, many risks come from noncomputer sources. It is important to consider all possible risks when performing risk evaluation for an organization. Failing to properly evaluate and respond to all forms of risk will leave a company vulnerable. Keep in mind that IT security, commonly referred to as logical or technical security, can provide protection only against logical or technical attacks. To protect IT against physical attacks, physical protections must be erected.

The process by which the goals of risk management are achieved is known as *risk analysis*. It includes examining an environment for risks, evaluating each threat event as to its likelihood of occurring and the cost of the damage it would cause if it did occur, assessing the cost of various countermeasures for each risk, and creating a cost/benefit report for safeguards to present to upper management. In addition to these risk-focused activities, risk management requires evaluation, assessment, and the assignment of value for all assets within the organization. Without proper asset valuations, it is not possible to prioritize and compare risks with possible losses.

Risk Terminology

Risk management employs a vast terminology that must be clearly understood, especially for the CISSP exam. This section defines and discusses all the important risk-related terminology:

Asset An *asset* is anything within an environment that should be protected. It is anything used in a business process or task. It can be a computer file, a network service, a system resource, a process, a program, a product, an IT infrastructure, a database, a hardware device, furniture, product recipes/formulas, intellectual property, personnel, software, facilities, and so on. If an organization places any value on an item under its control and deems that item important enough to protect, it is labeled an asset for the purposes of risk management and analysis. The loss or disclosure of an asset could result in an overall security compromise, loss of productivity, reduction in profits, additional expenditures, discontinuation of the organization, and numerous intangible consequences.

Asset Valuation *Asset valuation* is a dollar value assigned to an asset based on actual cost and nonmonetary expenses. These can include costs to develop, maintain, administer, advertise, support, repair, and replace an asset; they can also include more elusive values, such as public confidence, industry support, productivity enhancement, knowledge equity, and ownership benefits. Asset valuation is discussed in detail later in this chapter.

Threats Any potential occurrence that may cause an undesirable or unwanted outcome for an organization or for a specific asset is a *threat*. Threats are any action or inaction that could cause damage, destruction, alteration, loss, or disclosure of assets or that could block access to or prevent maintenance of assets. Threats can be large or small and result in large or small consequences. They can be intentional or accidental. They can originate from people, organizations, hardware, networks, structures, or nature. Threat agents intentionally exploit vulnerabilities. Threat agents are usually people, but they could also be programs, hardware, or systems. Threat events are accidental and intentional exploitations of vulnerabilities. They can also be natural or man-made. Threat events include fire, earthquake, flood, system failure, human error (due to a lack of training or ignorance), and power outage.

Vulnerability The weakness in an asset or the absence or the weakness of a safeguard or countermeasure is a *vulnerability*.

In other words, a vulnerability is a flaw, loophole, oversight, error, limitation, frailty, or susceptibility in the IT infrastructure or any other aspect of an organization. If a vulnerability is exploited, loss or damage to assets can occur.

Exposure *Exposure* is being susceptible to asset loss because of a threat; there is the possibility that a vulnerability can or will be exploited by a threat agent or event. Exposure doesn't mean that a realized threat (an event that results in loss) is actually occurring (the exposure to a realized threat is called experienced exposure). It just means that if there is a vulnerability and a threat that can exploit it, there is the possibility that a threat event, or potential exposure, can occur. Another way of thinking about exposure is to answer the question "What is the worst that could happen?" You are not stating that harm has occurred or that it will actually occur, only that there is the potential for harm and how extensive or serious that harm might be. The quantitative risk analysis value of exposure factor (EF) is derived from this concept.

Risk *Risk* is the possibility or likelihood that a threat will exploit a vulnerability to cause harm to an asset. It is an assessment of probability, possibility, or chance. The more likely it is that a threat event will occur, the greater the risk. Every instance of exposure is a risk. When written as a formula, risk can be defined as follows:

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risk = threat * vulnerability
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Thus, reducing either the threat agent or the vulnerability directly results in a reduction in risk.

When a risk is realized, a *threat agent*, a *threat actor*, or a *threat event* has taken advantage of a vulnerability and caused harm to or disclosure of one or more assets. The whole purpose of security is to prevent risks from becoming realized by removing vulnerabilities and blocking threat agents and threat events from jeopardizing assets. As a risk management tool, security is the implementation of safeguards.

Safeguards A *safeguard*, *security control*, or *countermeasure* is anything that removes or reduces a vulnerability or protects against one or more specific threats. A safeguard can be installing a software patch, making a configuration change, hiring security guards, altering the infrastructure, modifying processes, improving the security policy, training personnel more effectively, electrifying a perimeter fence, installing lights, and so on. It is any action or product that reduces risk through the elimination or lessening of a threat or a vulnerability anywhere within an organization. Safeguards are the only means by which risk is mitigated or removed. It is important to remember that a safeguard, security control, or countermeasure need not involve the purchase of a new product; reconfiguring existing elements and even removing elements from the infrastructure are also valid safeguards.

Attack An *attack* is the exploitation of a vulnerability by a threat agent. In other words, an attack is any intentional attempt to exploit a vulnerability of an organization’s security infrastructure to cause damage, loss, or disclosure of assets. An attack can also be viewed as any violation or failure to adhere to an organization’s security policy.

Breach A *breach* is the occurrence of a security mechanism being bypassed or thwarted by a threat agent. When a breach is combined with an attack, a penetration, or intrusion, can result. A penetration is the condition in which a threat agent has gained access to an organization's infrastructure through the circumvention of security controls and is able to directly imperil assets.

The elements asset, threat, vulnerability, exposure, risk, and safeguard are related, as shown in Figure 2.4. Threats exploit vulnerabilities, which results in exposure. Exposure is risk, and risk is mitigated by safeguards. Safeguards protect assets that are endangered by threats.

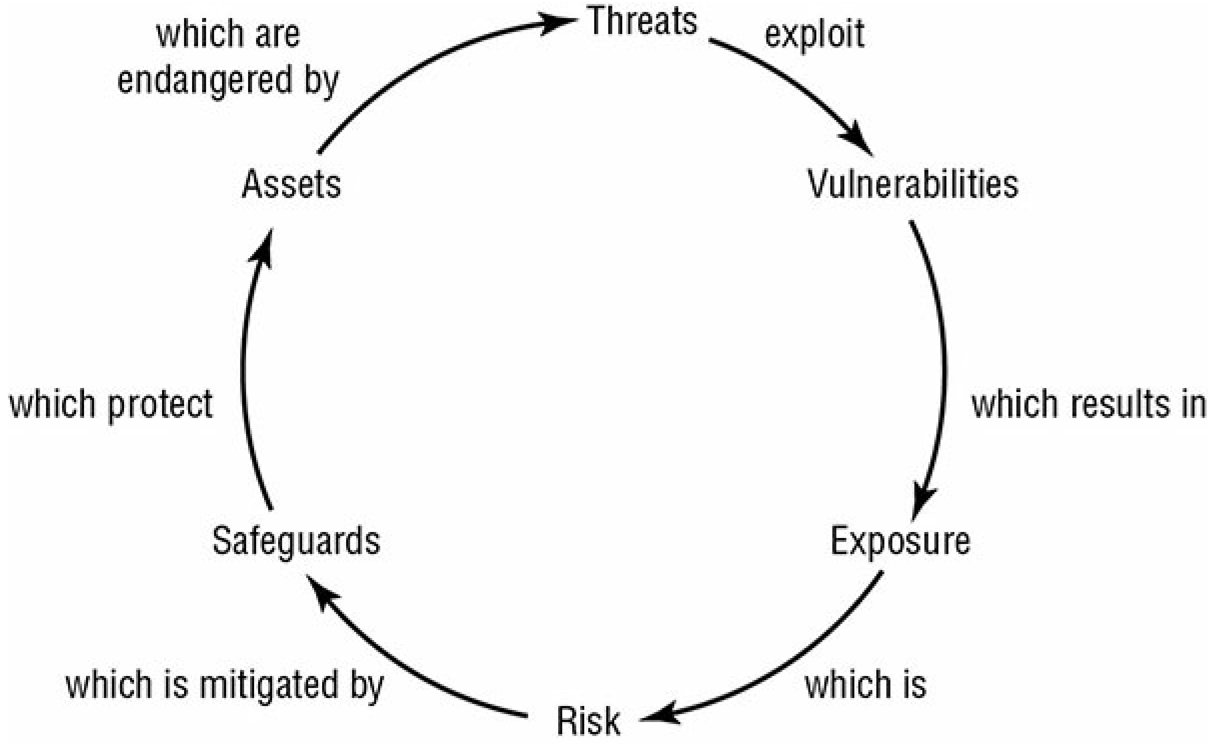


FIGURE 2.4 The elements of risk

Identify Threats and Vulnerabilities

An essential part of risk management is identifying and examining threats. This involves creating an exhaustive list of all possible threats for the organization's identified assets. The list should include threat agents as well as threat events. It is important to keep in mind that threats can come from anywhere. Threats to IT are not limited to IT sources. When compiling a list of threats, be sure to consider the following:

- Viruses
- Cascade errors (a series of escalating errors) and dependency faults

(caused by relying on events or items that don’t exist)

- Criminal activities by authorized users (espionage, IP theft, embezzlement, etc.)
- Movement (vibrations, jarring, etc.)
- Intentional attacks
- Reorganization
- Authorized user illness or epidemics
- Malicious hackers
- Disgruntled employees
- User errors
- Natural disasters (earthquakes, floods, fire, volcanoes, hurricanes, tornadoes, tsunamis, and so on)
- Physical damage (crushing, projectiles, cable severing, and so on)
- Misuse of data, resources, or services
- Changes or compromises to data classification or security policies
- Government, political, or military intrusions or restrictions
- Processing errors, buffer overflows
- Personnel privilege abuse
- Temperature extremes
- Energy anomalies (static, EM pulses, radio frequencies [RFs], power loss, power surges, and so on)
- Loss of data
- Information warfare
- Bankruptcy or alteration/interruption of business activity
- Coding/programming errors
- Intruders (physical and logical)
- Environmental factors (presence of gases, liquids, organisms, and

so on)

- Equipment failure
- Physical theft
- Social engineering

In most cases, a team rather than a single individual should perform risk assessment and analysis. Also, the team members should be from various departments within the organization. It is not usually a requirement that all team members be security professionals or even network/system administrators. The diversity of the team based on the demographics of the organization will help to exhaustively identify and address all possible threats and risks.

The Consultant Cavalry

Risk assessment is a highly involved, detailed, complex, and lengthy process. Often risk analysis cannot be properly handled by existing employees because of the size, scope, or liability of the risk; thus, many organizations bring in risk management consultants to perform this work. This provides a high level of expertise, does not bog down employees, and can be a more reliable measurement of real-world risk. But even risk management consultants do not perform risk assessment and analysis on paper only; they typically employ complex and expensive risk assessment software. This software streamlines the overall task, provides more reliable results, and produces standardized reports that are acceptable to insurance companies, boards of directors, and so on.

Risk Assessment/Analysis

Risk management/analysis is primarily an exercise for upper management. It is their responsibility to initiate and support risk analysis and assessment by defining the scope and purpose of the endeavor. The actual processes of performing risk analysis are often delegated to security professionals or an evaluation team. However, all risk assessments, results, decisions, and outcomes must be understood and approved by upper management as an element in providing prudent due care.

All IT systems have risk. There is no way to eliminate 100 percent of all risks. Instead, upper management must decide which risks are acceptable and which are not. Determining which risks are acceptable requires detailed and complex asset and risk assessments.

Once you develop a list of threats, you must individually evaluate each threat and its related risk. There are two risk assessment methodologies: quantitative and qualitative. *Quantitative risk analysis* assigns real dollar figures to the loss of an asset. *Qualitative risk analysis* assigns subjective and intangible values to the loss of an asset. Both methods are necessary for a complete risk analysis. Most environments employ a hybrid of both risk assessment methodologies in order to gain a balanced view of their security concerns.

Quantitative Risk Analysis

The quantitative method results in concrete probability percentages. That means the end result is a report that has dollar figures for levels of risk, potential loss, cost of countermeasures, and value of safeguards. This report is usually fairly easy to understand, especially for anyone with knowledge of spreadsheets and budget reports. Think of quantitative analysis as the act of assigning a quantity to risk—in other words, placing a dollar figure on each asset and threat. However, a purely quantitative analysis is not sufficient; not all elements and aspects of the analysis can be quantified because some are qualitative, subjective, or intangible.

The process of quantitative risk analysis starts with asset valuation and threat identification. Next, you estimate the potential and frequency of each risk. This information is then used to calculate various cost functions that are used to evaluate safeguards.

The six major steps or phases in quantitative risk analysis are as follows (Figure 2.5):

1. Inventory assets, and assign a value (asset value, or AV). (Asset value is detailed further in a later section of this chapter named

"Asset Valuation.")

2. Research each asset, and produce a list of all possible threats of each individual asset. For each listed threat, calculate the exposure factor (EF) and single loss expectancy (SLE).
3. Perform a threat analysis to calculate the likelihood of each threat being realized within a single year—that is, the annualized rate of occurrence (ARO).
4. Derive the overall loss potential per threat by calculating the annualized loss expectancy (ALE).
5. Research countermeasures for each threat, and then calculate the changes to ARO and ALE based on an applied countermeasure.
6. Perform a cost/benefit analysis of each countermeasure for each threat for each asset. Select the most appropriate response to each threat.

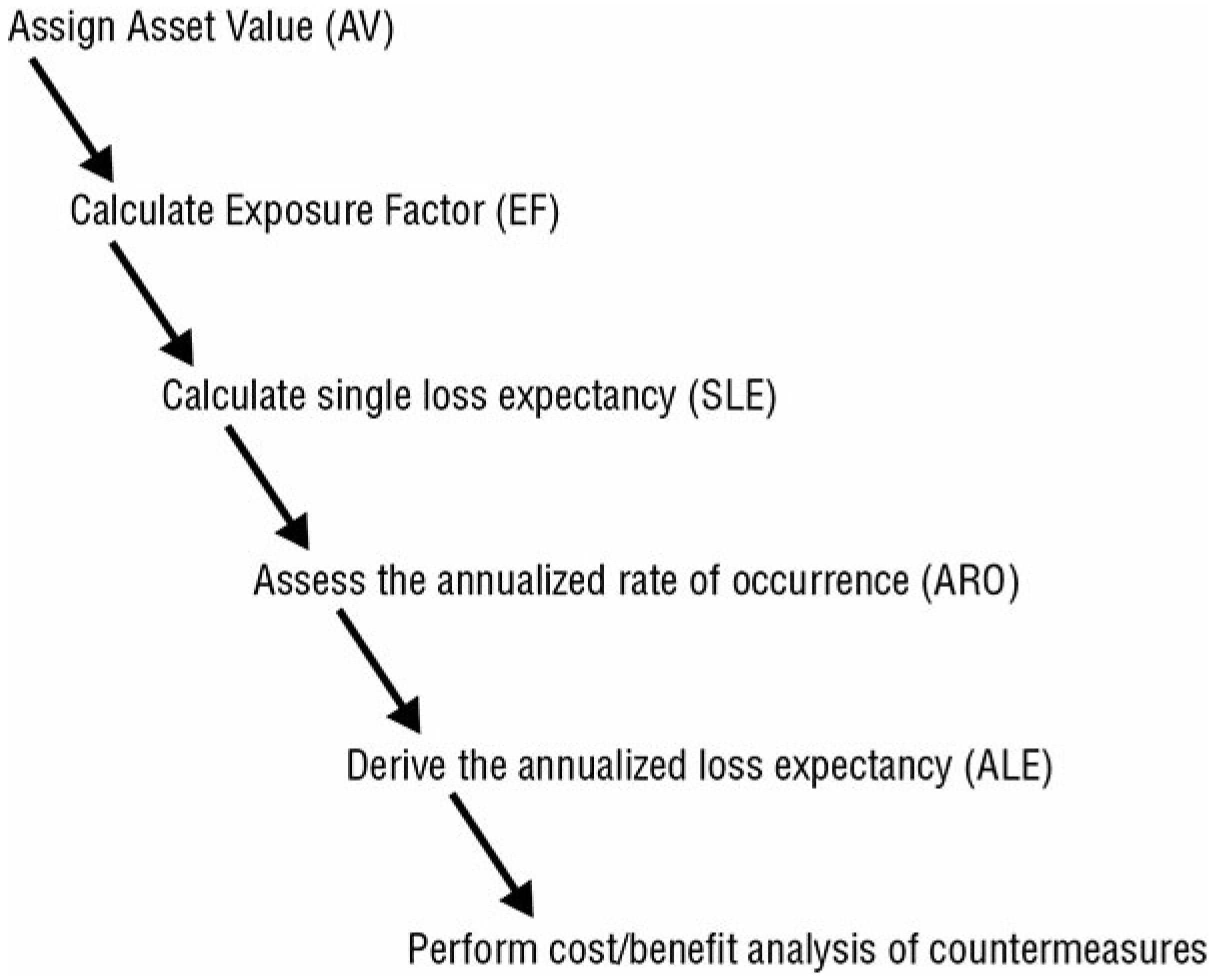

Assign Asset Value (AV)
Calculate Exposure Factor (EF)
Calculate single loss expectancy (SLE)
Assess the annualized rate of occurrence (ARO)
Derive the annualized loss expectancy (ALE)
Perform cost/benefit analysis of countermeasures

FIGURE 2.5 The six major elements of quantitative risk analysis

The cost functions associated with quantitative risk analysis include the exposure factor, single loss expectancy, annualized rate of occurrence, and annualized loss expectancy:

Exposure Factor The *exposure factor (EF)* represents the percentage of loss that an organization would experience if a specific asset were violated by a realized risk. The EF can also be called the loss potential. In most cases, a realized risk does not result in the total loss of an asset. The EF simply indicates the expected overall asset value loss because of a single realized risk. The EF is usually small for assets that are easily replaceable, such as hardware. It can be very large for assets that are irreplaceable or proprietary, such as product designs or a database of customers. The EF is expressed as a percentage.

Single Loss Expectancy The EF is needed to calculate the SLE. The *single loss expectancy (SLE)* is the cost associated with a single realized risk against a specific asset. It indicates the exact amount of loss an organization would experience if an asset were harmed by a specific threat occurring.

The SLE is calculated using the following formula:

> SLE = asset value (AV) * exposure factor (EF)
>
> or more simply:
>
> SLE = AV * EF

The SLE is expressed in a dollar value. For example, if an asset is valued at $200,000 and it has an EF of 45 percent for a specific threat, then the SLE of the threat for that asset is $90,000.

Annualized Rate of Occurrence The *annualized rate of occurrence (ARO)* is the expected frequency with which a specific threat or risk will occur (that is, become realized) within a single year. The ARO can range from a value of 0.0 (zero), indicating that the threat or risk will never be realized, to a very large number, indicating that the threat or risk occurs often. Calculating the ARO can be complicated. It can be derived from historical records, statistical analysis, or guesswork. ARO calculation is also known as probability determination. The ARO for some threats or risks is calculated by multiplying the likelihood of a single occurrence by the number of users who could initiate the threat. For example, the ARO of an earthquake in Tulsa may be .00001, whereas the ARO of an earthquake in San Francisco may be .03 (for a 6.7+ magnitude), or you can compare the ARO of an earthquake in Tulsa of .00001 to the ARO of an email virus in an office in Tulsa of 10,000,000.

Annualized Loss Expectancy The *annualized loss expectancy (ALE)* is the possible yearly cost of all instances of a specific realized threat against a specific asset.

The ALE is calculated using the following formula:

> ALE = single loss expectancy (SLE) * annualized rate of occurrence (ARO)

Or more simply:

ALE = SLE * ARO

For example, if the SLE of an asset is $90,000 and the ARO for a specific threat (such as total power loss) is .5, then the ALE is $45,000. On the other hand, if the ARO for a specific threat (such as compromised user account) is 15, then the ALE would be $1,350,000.

The task of calculating EF, SLE, ARO, and ALE for every asset and every threat/risk is a daunting one. Fortunately, quantitative risk assessment software tools can simplify and automate much of this process. These tools produce an asset inventory with valuations and then, using predefined AROs along with some customizing options (that is, industry, geography, IT components, and so on), produce risk analysis reports. The following calculations are often involved:

Calculating Annualized Loss Expectancy with a Safeguard In addition to determining the annual cost of the safeguard, you must calculate the ALE for the asset if the safeguard is implemented. This requires a new EF and ARO specific to the safeguard. In most cases, the EF to an asset remains the same even with an applied safeguard. (Recall that the EF is the amount of loss incurred if the risk becomes realized.) In other words, if the safeguard fails, how much damage does the asset receive? Think about it this way: If you have on body armor but the body armor fails to prevent a bullet from piercing your heart, you are still experiencing the same damage that would have occurred without the body armor. Thus, if the safeguard fails, the loss on the asset is usually the same as when there is no safeguard. However, some safeguards *do* reduce the resultant damage even when they fail to fully stop an attack. For example, though a fire might still occur and the facility may be damaged by the fire and the water from the sprinklers, the total damage is likely to be less than having the entire building burn down.

Even if the EF remains the same, a safeguard changes the ARO. In fact, the whole point of a safeguard is to reduce the ARO. In other words, a safeguard should reduce the number of times an attack is successful in causing damage to an asset. The best of all possible safeguards would reduce the ARO to zero. Although there are some perfect safeguards, most are not. Thus, many safeguards have an applied ARO that is smaller (you hope much smaller) than the non-safeguarded ARO, but it is not often zero. With the new ARO (and possible new EF), a new ALE with the application of a safeguard is computed.

With the pre-safeguard ALE and the post-safeguard ALE calculated, there is yet one more value needed to perform a cost/benefit analysis. This additional value is the annual cost of the safeguard.

Calculating Safeguard Costs For each specific risk, you must evaluate one or more safeguards, or countermeasures, on a cost/benefit basis. To perform this evaluation, you must first compile a list of safeguards for each threat. Then you assign each safeguard a deployment value. In fact, you must measure the deployment value or the cost of the safeguard against the value of the protected asset. The value of the protected asset therefore determines the maximum expenditures for protection mechanisms. Security should be cost effective, and thus it is not prudent to spend more (in terms of cash or resources) protecting an asset than its value to the organization. If the cost of the countermeasure is greater than the value of the asset (that is, the cost of the risk), then you should accept the risk.

Numerous factors are involved in calculating the value of a countermeasure:

- Cost of purchase, development, and licensing
- Cost of implementation and customization
- Cost of annual operation, maintenance, administration, and so on
- Cost of annual repairs and upgrades
- Productivity improvement or loss
- Changes to environment
- Cost of testing and evaluation

Once you know the potential cost of a safeguard, it is then possible to evaluate the benefit of that safeguard if applied to an infrastructure. As mentioned earlier, the annual costs of safeguards should not exceed the expected annual cost of asset loss.

Calculating Safeguard Cost/Benefit One of the final computations in this process is the *cost/benefit calculation* or *cost/benefit analysis* to determine whether a safeguard actually improves security without costing too much. To make the determination of whether the safeguard is financially equitable, use the following formula:

> ALE before safeguard – ALE after implementing the safeguard – annual cost of safeguard (ACS) = value of the safeguard to the company

If the result is negative, the safeguard is not a financially responsible choice. If the result is positive, then that value is the annual savings your organization may reap by deploying the safeguard because the rate of occurrence is not a guarantee of occurrence.

The annual savings or loss from a safeguard should not be the only consideration when evaluating safeguards. You should also consider the issues of legal responsibility and prudent due care. In some cases, it makes more sense to lose money in the deployment of a safeguard than to risk legal liability in the event of an asset disclosure or loss.

In review, to perform the cost/benefit analysis of a safeguard, you must calculate the following three elements:

- The pre-countermeasure ALE for an asset-and-threat pairing
- The post-countermeasure ALE for an asset-and-threat pairing
- The ACS (annual cost of the safeguard)

With those elements, you can finally obtain a value for the cost/benefit formula for this specific safeguard against a specific risk against a specific asset:

> (pre-countermeasure ALE – post-countermeasure ALE) – ACS

Or, even more simply:

> (ALE1 – ALE2) – ACS

The countermeasure with the greatest resulting value from this cost/benefit formula makes the most economic sense to deploy against the specific asset-and-threat pairing.

Table 2.1 illustrates the various formulas associated with quantitative risk analysis.

TABLE 2.1 Quantitative risk analysis formulas

Concept	**Formula**
Exposure factor (EF)	%
Single loss expectancy (SLE)	SLE = AV * EF
Annualized rate of occurrence (ARO)	# / year
Annualized loss expectancy (ALE)	ALE = SLE * ARO or ALE = AV * EF * ARO
Annual cost of the safeguard (ACS)	$ / year
Value or benefit of a safeguard	(ALE1 – ALE2) – ACS

Yikes, So Much Math!

Yes, quantitative risk analysis involves a lot of math. Math questions on the exam are likely to involve basic multiplication. Most likely, you will be asked definition, application, and concept synthesis questions on the CISSP exam. This means you need to know the definition of the equations/formulas and values, what they mean, why they are important, and how they are used to benefit an organization. The concepts you must know are AV, EF, SLE, ARO, ALE, and the cost/benefit formula.

It is important to realize that with all the calculations used in the quantitative risk assessment process, the end values are used for prioritization and selection. The values themselves do not truly reflect real-world loss or costs due to security breaches. This should be obvious because of the level of guesswork, statistical analysis, and probability predictions required in the process.

Once you have calculated a cost/benefit for each safeguard for each risk that affects each asset, you must then sort these values. In most cases, the cost/benefit with the highest value is the best safeguard to implement for that specific risk against a specific asset. But as with all things in the real world, this is only one part of the decision-making process. Although very important and often the primary guiding factor, it is not the sole element of data. Other items include actual cost, security budget, compatibility with existing systems, skill/knowledge base of IT staff, and availability of product as well as political issues, partnerships, market trends, fads, marketing, contracts, and favoritism. As part of senior management or even the IT staff, it is your responsibility to either obtain or use all available data and information to make the best security decision for your organization.

Most organizations have a limited and all-too-finite budget to work with. Thus, obtaining the best security for the cost is an essential part of security management. To effectively manage the security function, you must assess the budget, the benefit and performance metrics, and the necessary resources of each security control. Only after a thorough evaluation can you determine which controls are essential and beneficial not only to security, but also to your bottom line.

Qualitative Risk Analysis

Qualitative risk analysis is more scenario based than it is calculator based. Rather than assigning exact dollar figures to possible losses, you rank threats on a scale to evaluate their risks, costs, and effects. Since a purely quantitative risk assessment is not possible, balancing the results of a quantitative analysis is essential. The method of combining quantitative and qualitative analysis into a final assessment of organizational risk is known as hybrid assessment or hybrid analysis. The process of performing qualitative risk analysis involves judgment, intuition, and experience. You can use many techniques to perform qualitative risk analysis:

- Brainstorming
- Delphi technique
- Storyboarding
- Focus groups

- Surveys
- Questionnaires
- Checklists
- One-on-one meetings
- Interviews

Determining which mechanism to employ is based on the culture of the organization and the types of risks and assets involved. It is common for several methods to be employed simultaneously and their results compared and contrasted in the final risk analysis report to upper management.

Scenarios

The basic process for all these mechanisms involves the creation of scenarios. A *scenario* is a written description of a single major threat. The description focuses on how a threat would be instigated and what effects its occurrence could have on the organization, the IT infrastructure, and specific assets. Generally, the scenarios are limited to one page of text to keep them manageable. For each scenario, one or more safeguards are described that would completely or partially protect against the major threat discussed in the scenario. The analysis participants then assign to the scenario a threat level, a loss potential, and the advantages of each safeguard. These assignments can be grossly simple—such as High, Medium, and Low or a basic number scale of 1 to 10—or they can be detailed essay responses. The responses from all participants are then compiled into a single report that is presented to upper management. For examples of reference ratings and levels, please see Table 3-6 and Table 3-7 in National Institute of Technology (NIST) Special Publication (SP) 800-30:

http://csrc.nist.gov/publications/nistpubs/800-30/sp800-30.pdf

The usefulness and validity of a qualitative risk analysis improves as the number and diversity of the participants in the evaluation increases. Whenever possible, include one or more people from each level of the organizational hierarchy, from upper management to end user. It is also important to include a cross section from each major department, division, office, or branch.

Delphi Technique

The Delphi technique is probably the only mechanism on the previous list that is not immediately recognizable and understood. The *Delphi technique* is simply an anonymous feedback-and-response process used to enable a group to reach an anonymous consensus. Its primary purpose is to elicit honest and uninfluenced responses from all participants. The participants are usually gathered into a single meeting room. To each request for feedback, each participant writes down their response on paper anonymously. The results are compiled and presented to the group for evaluation. The process is repeated until a consensus is reached.

Both the quantitative and qualitative risk analysis mechanisms offer useful results. However, each technique involves a unique method of evaluating the same set of assets and risks. Prudent due care requires that both methods be employed. Table 2.2 describes the benefits and disadvantages of these two systems.

TABLE 2.2 Comparison of quantitative and qualitative risk analysis

Characteristic	**Qualitative**	**Quantitative**
Employs complex functions	No	Yes
Uses cost/benefit analysis	No	Yes
Results in specific values	No	Yes
Requires guesswork	Yes	No
Supports automation	No	Yes
Involves a high volume of information	No	Yes
Is objective	No	Yes
Uses opinions	Yes	No
Requires significant time and effort	No	Yes
Offers useful and meaningful results	Yes	Yes

Risk Responses

The results of risk analysis are many:

- Complete and detailed valuation of all assets
- An exhaustive list of all threats and risks, rate of occurrence, and extent of loss if realized
- A list of threat-specific safeguards and countermeasures that identifies their effectiveness and ALE
- A cost/benefit analysis of each safeguard

This information is essential for management to make educated, intelligent decisions about safeguard implementation and security policy alterations.

Once the risk analysis is complete, management must address each specific risk. There are several possible responses to risk:

- Reduce or mitigate
- Assign or transfer
- Accept
- Deter
- Avoid
- Reject or ignore

You need to know the following information about the possible risk responses:

Risk Mitigation *Reducing risk*, or *risk mitigation*, is the implementation of safeguards and countermeasures to eliminate vulnerabilities or block threats. Picking the most cost-effective or beneficial countermeasure is part of risk management, but it is not an element of risk assessment. In fact, countermeasure selection is a post-risk-assessment or post-risk-analysis activity. Another potential variation of risk mitigation is risk avoidance. The risk is avoided by eliminating the risk cause. A simple example is removing the File Transfer Protocol (FTP) protocol from a server to avoid FTP attacks, and a larger example is to move to an inland location to avoid the risks from hurricanes.

Risk Assignment *Assigning risk* or *transferring risk* is the placement of the cost of loss a risk represents onto another entity or organization. Purchasing insurance and outsourcing are common forms of assigning or transferring risk.

Risk Acceptance Accepting risk, risk tolerance, or acceptance of risk is the result after a cost/benefit analysis shows countermeasure costs would outweigh the possible cost of loss due to a risk. It also means that management has agreed to accept the consequences and the loss if the risk is realized. In most cases, accepting risk requires a clearly written statement that indicates why a safeguard was not implemented, who is responsible for the decision, and who will be responsible for the loss if the risk is realized, usually in the form of a sign-off letter. An organization's decision to accept risk is based on its risk tolerance. This is also known as risk tolerance or risk appetite which is the ability of an organization to absorb the losses associated with realized risks.

Risk Deterrence *Risk deterrence* is the process of implementing deterrents to would-be violators of security and policy. Some examples include implementation of auditing, security cameras, security guards, instructional signage, warning banners, motion detectors, strong authentication, and making it known that the organization is willing to cooperate with authorities and prosecute those who participate in cybercrime.

Risk Avoidance *Risk avoidance* is the process of selecting alternate options or activities that have less associated risk than the default, common, expedient, or cheap option. For example, choosing to fly to a destination instead of driving to it is a form of risk avoidance. Another example is to locate a business in Arizona instead of Florida to avoid hurricanes.

Risk Rejection A final but unacceptable possible response to risk is to *reject risk* or *ignore risk*. Denying that a risk exists and hoping that it will never be realized are not valid or prudent due-care responses to risk.

Once countermeasures are implemented, the risk that remains is known as residual risk. *Residual risk* comprises threats to specific assets against which upper management chooses not to implement a safeguard. In other words, residual risk is the risk that management has chosen to accept rather than mitigate. In most cases, the presence of residual risk indicates that the cost/benefit analysis showed that the available safeguards were not cost-effective deterrents.

Total risk is the amount of risk an organization would face if no safeguards were implemented. A formula for total risk is as follows:

threats * vulnerabilities * asset value = total risk

(Note that the * here does not imply multiplication, but a combination function; this is not a true mathematical formula.) The difference between total risk and residual risk is known as the controls gap. The controls gap is the amount of risk that is reduced by implementing safeguards. A formula for residual risk is as follows:

total risk – controls gap = residual risk

As with risk management in general, handling risk is not a onetime process. Instead, security must be continually maintained and reaffirmed. In fact, repeating the risk assessment and analysis process is a mechanism to assess the completeness and effectiveness of the security program over time. Additionally, it helps locate deficiencies and areas where change has occurred. Because security changes over time, reassessing on a periodic basis is essential to maintaining reasonable security.

Countermeasure Selection and Implementation

Selecting a countermeasure or control (short for *security control*) within the realm of risk management relies heavily on the cost/benefit analysis results. However, you should consider several other factors when assessing the value or pertinence of a security control:

- The cost of the countermeasure should be less than the value of the asset.
- The cost of the countermeasure should be less than the benefit of the countermeasure.

- The result of the applied countermeasure should make the cost of an attack greater for the perpetrator than the derived benefit from an attack.
- The countermeasure should provide a solution to a real and identified problem. (Don’t install countermeasures just because they are available, are advertised, or sound cool.)
- The benefit of the countermeasure should not be dependent on its secrecy. This means that “security through obscurity” is not a viable countermeasure and that any viable countermeasure can withstand public disclosure and scrutiny.
- The benefit of the countermeasure should be testable and verifiable.
- The countermeasure should provide consistent and uniform protection across all users, systems, protocols, and so on.
- The countermeasure should have few or no dependencies to reduce cascade failures.
- The countermeasure should require minimal human intervention after initial deployment and configuration.
- The countermeasure should be tamperproof.
- The countermeasure should have overrides accessible to privileged operators only.
- The countermeasure should provide fail-safe and/or fail-secure options.

Keep in mind that security should be designed to support and enable business tasks and functions. Thus, countermeasures and safeguards need to be evaluated in the context of a business task.

Security controls, countermeasures, and safeguards can be implemented administratively, logically/technically, or physically. These three categories of security mechanisms should be implemented in a defense-in-depth manner in order to provide maximum benefit (Figure 2.6).

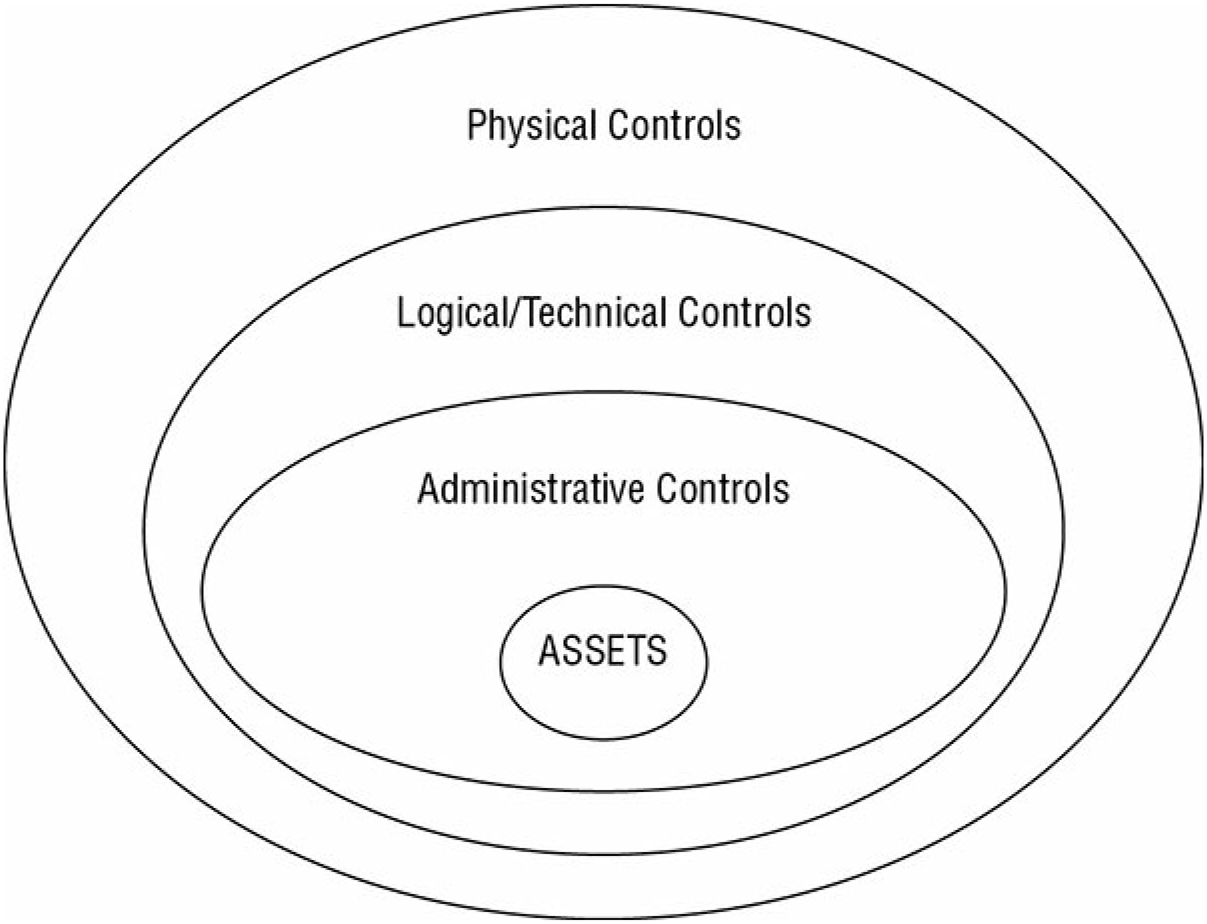


FIGURE 2.6 The categories of security controls in a defense-in-depth implementation

Technical

Technical or logical controls involve the hardware or software mechanisms used to manage access and to provide protection for resources and systems. As the name implies, it uses technology. Examples of logical or technical controls include authentication methods (such as usernames, passwords, smartcards, and biometrics), encryption, constrained interfaces, access control lists, protocols, firewalls, routers, intrusion detection systems (IDSs), and clipping levels.

Administrative

Administrative controls are the policies and procedures defined by an organization's security policy and other regulations or requirements.

They are sometimes referred to as management controls. These controls focus on personnel and business practices. Examples of administrative controls include policies, procedures, hiring practices, background checks, data classifications and labeling, security awareness and training efforts, vacation history, reports and reviews, work supervision, personnel controls, and testing.

Physical

Physical controls are items you can physically touch. They include physical mechanisms deployed to prevent, monitor, or detect direct contact with systems or areas within a facility. Examples of physical controls include guards, fences, motion detectors, locked doors, sealed windows, lights, cable protection, laptop locks, badges, swipe cards, guard dogs, video cameras, mantraps, and alarms.

Applicable Types of Controls

The term *security control* refers to a broad range of controls that perform such tasks as ensuring that only authorized users can log on and preventing unauthorized users from gaining access to resources. *Controls* mitigate a wide variety of information security risks.

Whenever possible, you want to prevent any type of security problem or incident. Of course, this isn't always possible, and unwanted events occur. When they do, you want to detect the events as soon as possible. And once you detect an event, you want to correct it.

As you read the control descriptions, notice that some are listed as examples of more than one access-control type. For example, a fence (or perimeter-defining device) placed around a building can be a preventive control (physically barring someone from gaining access to a building compound) and/or a deterrent control (discouraging someone from trying to gain access).

Deterrent

A *deterrent control* is deployed to discourage violation of security policies. Deterrent and preventive controls are similar, but deterrent controls often depend on individuals deciding not to take an unwanted action. In contrast, a preventive control actually blocks the action. Some examples include policies, security-awareness training, locks, fences, security badges, guards, mantraps, and security cameras.

Preventive

A *preventive control* is deployed to thwart or stop unwanted or unauthorized activity from occurring. Examples of preventive controls include fences, locks, biometrics, mantraps, lighting, alarm systems, separation of duties, job rotation, data classification, penetration testing, access-control methods, encryption, auditing, presence of security cameras or closed-circuit television (CCTV), smartcards, callback procedures, security policies, security-awareness training, antivirus software, firewalls, and intrusion prevention systems (IPSs).

Detective

A *detective control* is deployed to discover or detect unwanted or unauthorized activity. Detective controls operate after the fact and can discover the activity only after it has occurred. Examples of detective controls include security guards, motion detectors, recording and reviewing of events captured by security cameras or CCTV, job rotation, mandatory vacations, audit trails, honeypots or honeynets, intrusion detection systems (IDSs), violation reports, supervision and reviews of users, and incident investigations.

Compensating

A *compensation control* is deployed to provide various options to other existing controls to aid in enforcement and support of security policies. They can be any controls used in addition to, or in place of, another control. For example, an organizational policy may dictate that all PII must be encrypted. A review discovers that a preventive control is encrypting all PII data in databases, but PII transferred over the network is sent in cleartext. A compensation control can be added to protect the data in transit.

Corrective

A *corrective control* modifies the environment to return systems to normal after an unwanted or unauthorized activity has occurred. It attempts to correct any problems that occurred as a result of a security incident. Corrective controls can be simple, such as terminating malicious activity or rebooting a system. They also include antivirus solutions that can remove or quarantine a virus, backup and restore plans to ensure that lost data can be restored, and active IDs that can modify the environment to stop an attack in progress. The control is deployed to repair or restore resources, functions, and capabilities after a violation of security policies.

Recovery

Recovery controls are an extension of corrective controls but have more advanced or complex abilities. Examples of recovery controls include backups and restores, fault-tolerant drive systems, system imaging, server clustering, antivirus software, and database or virtual machine shadowing. In relation to business continuity and disaster recovery, recovery controls can include hot sites, warm sites, cold sites, alternate processing facilities, service bureaus, reciprocal agreements, cloud providers, rolling mobile operating centers, and multisite solutions.

Directive

A *directive control* is deployed to direct, confine, or control the actions of subjects to force or encourage compliance with security policies. Examples of directive controls include security policy requirements or criteria, posted notifications, escape route exit signs, monitoring, supervision, and procedures.

Security Control Assessment

A *security control assessment (SCA)* is the formal evaluation of a security infrastructure's individual mechanisms against a baseline or reliability expectation. The SCA can be performed in addition to or independently of a full security evaluation, such as a penetration test or vulnerability assessment.

The goals of an SCA are to ensure the effectiveness of the security mechanisms, evaluate the quality and thoroughness of the risk management processes of the organization, and produce a report of the relative strengths and weaknesses of the deployed security infrastructure.

Generally, an SCA is a process implemented by federal agencies based on the NIST Special Publication 800-53A titled “Guide for Assessing the Security Controls in Federal Information Systems” (https://csrc.nist.gov/publications/detail/sp/800-53a/rev-4/final). However, while defined as a government process, the concept of evaluating the reliability and effectiveness of security controls should be adopted by every organization that is committed to sustaining a successful security endeavor.

Monitoring and Measurement

Security controls should provide benefits that can be monitored and measured. If a security control’s benefits cannot be quantified, evaluated, or compared, then it does not actually provide any security. A security control may provide native or internal monitoring, or external monitoring might be required. You should take this into consideration when making initial countermeasure selections.

Measuring the effectiveness of a countermeasure is not always an absolute value. Many countermeasures offer degrees of improvement rather than specific hard numbers as to the number of breaches prevented or attack attempts thwarted. Often to obtain countermeasure success or failure measurements, monitoring and recording of events both prior to and after safeguard installation is necessary. Benefits can only be accurately measured if the starting point (that is, the normal point or initial risk level) is known. Part of the cost/benefit equation takes countermeasure monitoring and measurement into account. Just because a security control provides some level of increased security does not necessarily mean that the benefit gained is cost effective. A significant improvement in security should be identified to clearly justify the expense of new countermeasure deployment.

Asset Valuation and Reporting

An important step in risk analysis is to appraise the value of an organization’s assets. If an asset has no value, then there is no need to provide protection for it. A primary goal of risk analysis is to ensure that only cost-effective safeguards are deployed. It makes no sense to spend $100,000 protecting an asset that is worth only $1,000. The value of an asset directly affects and guides the level of safeguards and security deployed to protect it. As a rule, the annual costs of safeguards should not exceed the expected annual cost of asset loss.

When the cost of an asset is evaluated, there are many aspects to consider. The goal of asset valuation is to assign to an asset a specific dollar value that encompasses tangible costs as well as intangible ones. Determining an exact value is often difficult if not impossible, but nevertheless, a specific value must be established. (Note that the discussion of qualitative versus quantitative risk analysis in the next section may clarify this issue.) Improperly assigning value to assets can result in failing to properly protect an asset or implementing financially infeasible safeguards. The following list includes some of the tangible and intangible issues that contribute to the valuation of assets:

- Purchase cost
- Development cost
- Administrative or management cost
- Maintenance or upkeep cost
- Cost in acquiring asset
- Cost to protect or sustain asset
- Value to owners and users
- Value to competitors
- Intellectual property or equity value
- Market valuation (sustainable price)
- Replacement cost
- Productivity enhancement or degradation

- Operational costs of asset presence and loss
- Liability of asset loss
- Usefulness

Assigning or determining the value of assets to an organization can fulfill numerous requirements. It serves as the foundation for performing a cost/benefit analysis of asset protection through safeguard deployment. It serves as a means for selecting or evaluating safeguards and countermeasures. It provides values for insurance purposes and establishes an overall net worth or net value for the organization. It helps senior management understand exactly what is at risk within the organization. Understanding the value of assets also helps to prevent negligence of due care and encourages compliance with legal requirements, industry regulations, and internal security policies.

Risk reporting is a key task to perform at the conclusion of a risk analysis. Risk reporting involves the production of a risk report and a presentation of that report to the interested/relevant parties. For many organizations, risk reporting is an internal concern only, whereas other organizations may have regulations that mandate third-party or public reporting of their risk findings.

A risk report should be accurate, timely, comprehensive of the entire organization, clear and precise to support decision making, and updated on a regular basis.

Continuous Improvement

Risk analysis is performed to provide upper management with the details necessary to decide which risks should be mitigated, which should be transferred, which should be deterred, which should be avoided, and which should be accepted. The result is a cost/ benefit comparison between the expected cost of asset loss and the cost of deploying safeguards against threats and vulnerabilities. Risk analysis identifies risks, quantifies the impact of threats, and aids in budgeting for security. It helps integrate the needs and objectives of the security policy with the organization’s business goals and intentions. The risk analysis/risk assessment is a "point in time" metric. Threats and vulnerabilities constantly change, and the risk assessment needs to be redone periodically in order to support continuous improvement.

Security is always changing. Thus any implemented security solution requires updates and changes over time. If a continuous improvement path is not provided by a selected countermeasure, then it should be replaced with one that offers scalable improvements to security.

Risk Frameworks

A *risk framework* is a guideline or recipe for how risk is to be assessed, resolved, and monitored. The primary example of a risk framework referenced by the CISSP exam is that defined by NIST in Special Publication 800-37 (http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-37r1.pdf). We encourage you to review this publication in its entirety, but here are a few excerpts of relevance to CISSP:

> This publication provides guidelines for applying the *Risk Management Framework (RMF)* to federal information systems. The six-step RMF includes security categorization, security control selection, security control implementation, security control assessment, information system authorization, and security control monitoring. The RMF promotes the concept of near real-time risk management and ongoing information system authorization through the implementation of robust continuous monitoring processes, provides senior leaders the necessary information to make cost-effective, risk-based decisions with regard to the organizational information systems supporting their core missions and business functions, and integrates information security into the enterprise architecture and systems development lifecycle (SDLC). Applying the RMF within enterprises links risk management processes at the information system level to risk management processes at the organization level through a risk executive (function) and establishes lines of responsibility and accountability for security controls deployed within organizational information systems and inherited by those systems (i.e., common controls). The RMF has the following characteristics:

- Promotes the concept of near real-time risk management and ongoing information system authorization through the implementation of robust continuous monitoring processes;
- Encourages the use of automation to provide senior leaders the necessary information to make cost-effective, risk-based decisions with regard to the organizational information systems supporting their core missions and business functions;
- Integrates information security into the enterprise architecture and SDLC;
- Provides emphasis on the selection, implementation, assessment, and monitoring of security controls, and the authorization of information systems;
- Links risk management processes at the information system level to risk management processes at the organization level through a risk executive (function); and
- Establishes responsibility and accountability for security controls deployed within organizational information systems and inherited by those systems (i.e., common controls)

The RMF steps include [(see Figure 2.7)]:

- **Categorize** the information system and the information processed, stored, and transmitted by that system based on an impact analysis.
- **Select** an initial set of baseline security controls for the information system based on the security categorization; tailoring and supplementing the security control baseline as needed based on an organizational assessment of risk and local conditions.
- **Implement** the security controls and describe how the controls are employed within the information system and its environment of operation.
- **Assess** the security controls using appropriate assessment procedures to determine the extent to which the controls are implemented correctly, operating as intended, and producing

the desired outcome with respect to meeting the security requirements for the system.

- **Authorize** information system operation based on a determination of the risk to organizational operations and assets, individuals, other organizations, and the Nation resulting from the operation of the information system and the decision that this risk is acceptable.
- **Monitor** the security controls in the information system on an ongoing basis including assessing control effectiveness, documenting changes to the system or its environment of operation, conducting security impact analyses of the associated changes, and reporting the security state of the system to designated organizational officials."

[From NIST SP 800-37]

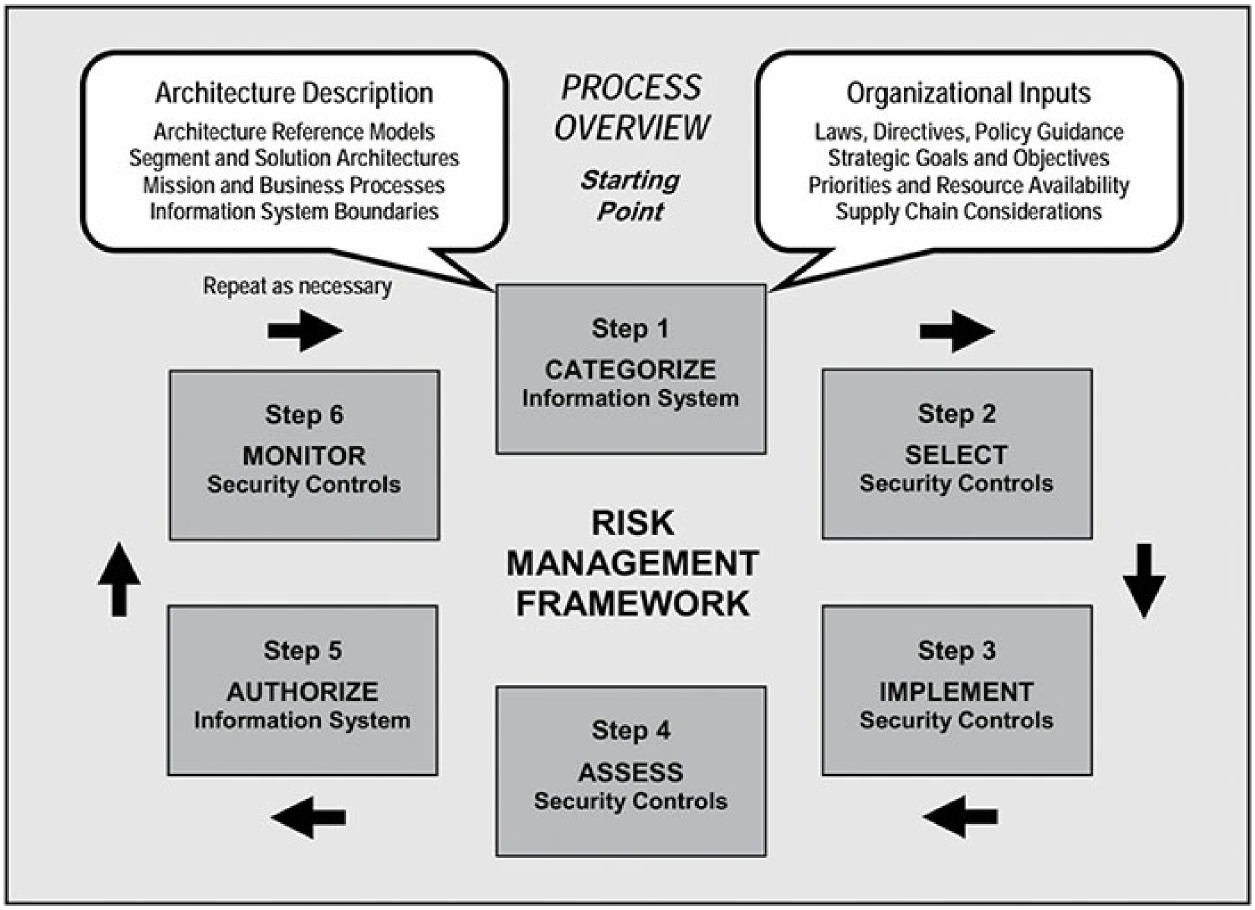

Architecture Description
Architecture Reference Models
Segment and Solution Architectures
Mission and Business Processes
Information System Boundaries
PROCESS OVERVIEW
Starting Point
Organizational Inputs
Laws, Directives, Policy Guidance
Strategic Goals and Objectives
Priorities and Resource Availability
Supply Chain Considerations
Repeat as necessary
Step 1 CATEGORIZE Information System
Step 2 SELECT Security Controls
Step 3 IMPLEMENT Security Controls
Step 4 ASSESS Security Controls
Step 5 AUTHORIZE Information System
Step 6 MONITOR Security Controls
RISK MANAGEMENT FRAMEWORK

FIGURE 2.7 The six steps of the risk management framework

There is significantly more detail about RMF in the NIST publication; please review that document for a complete perspective on risk frameworks.

The NIST RMF is the primary focus of the CISSP exam, but you might want to review other risk management frameworks for use in the real world. Please consider operationally critical threat, asset, and vulnerability evaluation (OCTAVE), Factor Analysis of Information Risk (FAIR), and Threat Agent Risk Assessment (TARA). For further research, you'll find a useful article here: www.csoonline.com/article/2125140/metrics-budgets/it-risk-assessment-frameworks–real-world-experience.html. Understanding that there are a number of well-recognized frameworks and that selecting one that fits your organization's requirements and style is important.

Establish and Maintain a Security Awareness, Education, and Training Program

The successful implementation of a security solution requires changes in user behavior. These changes primarily consist of alterations in normal work activities to comply with the standards, guidelines, and procedures mandated by the security policy. *Behavior modification* involves some level of learning on the part of the user. To develop and manage security education, training, and awareness, all relevant items of knowledge transference must be clearly identified and programs of presentation, exposure, synergy, and implementation crafted.

A prerequisite to security training is *awareness*. The goal of creating awareness is to bring security to the forefront and make it a recognized entity for users. Awareness establishes a common baseline or foundation of security understanding across the entire organization and focuses on key or basic topics and issues related to security that all employees must understand and comprehend. Awareness is not exclusively created through a classroom type of exercise but also through the work environment. Many tools can be used to create awareness, such as posters, notices, newsletter articles, screen savers, T-shirts, rally speeches by managers, announcements, presentations, mouse pads, office supplies, and memos as well as the traditional instructor-led training courses.

Awareness establishes a minimum standard common denominator or foundation of security understanding. All personnel should be fully aware of their security responsibilities and liabilities. They should be trained to know what to do and what not to do.

The issues that users need to be aware of include avoiding waste, fraud, and unauthorized activities. All members of an organization, from senior management to temporary interns, need the same level of awareness. The awareness program in an organization should be tied in with its security policy, incident-handling plan, business continuity, and disaster recovery procedures. For an awareness-building program to be effective, it must be fresh, creative, and updated often. The awareness program should also be tied to an understanding of how the corporate culture will affect and impact security for individuals as well as the organization as a whole. If employees do not see enforcement of security policies and standards, especially at the awareness level, then they may not feel obligated to abide by them.

Training is teaching employees to perform their work tasks and to comply with the security policy. Training is typically hosted by an organization and is targeted to groups of employees with similar job functions. All new employees require some level of training so they will be able to comply with all standards, guidelines, and procedures mandated by the security policy. New users need to know how to use the IT infrastructure, where data is stored, and how and why resources are classified. Many organizations choose to train new employees before they are granted access to the network, whereas others will grant new users limited access until their training in their specific job position is complete. Training is an ongoing activity that must be sustained throughout the lifetime of the organization for every employee. It is considered an administrative security control.

Methods and techniques to present awareness and training should be revised and improved over time to maximize benefits. This will require that training metrics be collected and evaluated. This may include post-learning testing as well as monitoring for job consistency improvements and reductions in downtime, security incidents, or mistakes. This can be seen as a program effectiveness evaluation.

Awareness and training are often provided in-house. That means these teaching tools are created and deployed by and within the organization itself. However, the next level of knowledge distribution is usually obtained from an external third-party source.

Education is a more detailed endeavor in which students/users learn much more than they actually need to know to perform their work tasks. Education is most often associated with users pursuing certification or seeking job promotion. It is typically a requirement for personnel seeking security professional positions. A security professional requires extensive knowledge of security and the local environment for the entire organization and not just their specific work tasks.

An assessment of the appropriate levels of awareness, training, and education required within the organization should be revised on a regular basis using periodic content reviews. Training efforts need to be updated and tuned as the organization evolves over time. Additionally, new bold and subtle means of awareness should be implemented as well to keep the content fresh and relevant. Without periodic reviews for content relevancy, materials will become stale and workers will likely resort to making up their own guidelines and procedures. It is the responsibility of the security governance team to establish security rules as well as provide training and education to further the implementation of those rules.

Manage the Security Function

To manage the security function, an organization must implement proper and sufficient security governance. The act of performing a risk assessment to drive the security policy is the clearest and most direct example of management of the security function.

Security must be cost effective. Organizations do not have infinite budgets and thus must allocate their funds appropriately. Additionally, an organizational budget includes a percentage of monies dedicated to security just as most other business tasks and processes require capital, not to mention payments to employees, insurance, retirement, and so on. Security should be sufficient to withstand typical or standard threats to the organization but not when such security is more expensive than the assets being protected. As discussed in “Understand and Apply Risk Management Concepts” earlier in this chapter, a countermeasure that is more costly than the value of the asset itself is not usually an effective solution.

Security must be measurable. Measurable security means that the various aspects of the security mechanisms function, provide a clear benefit, and have one or more metrics that can be recorded and analyzed. Similar to performance metrics, security metrics are measurements of performance, function, operation, action, and so on as related to the operation of a security feature. When a countermeasure or safeguard is implemented, security metrics should show a reduction in unwanted occurrences or an increase in the detection of attempts. Otherwise, the security mechanism is not providing the expected benefit. The act of measuring and evaluating security metrics is the practice of assessing the completeness and effectiveness of the security program. This should also include measuring it against common security guidelines and tracking the success of its controls. Tracking and assessing security metrics are part of effective security governance. However, it is worth noting that choosing incorrect security metrics can cause significant problems, such as choosing to monitor or measure something the security staff has little control over or that is based on external drivers.

Resources will be consumed both by the security mechanisms themselves and by the security governance processes. Obviously, security mechanisms should consume as few resources as possible and impact the productivity or throughput of a system at as low a level as feasible. However, every hardware and software countermeasure as well as every policy and procedure users must follow will consume resources. Being aware of and evaluating resource consumption before and after countermeasure selection, deployment, and tuning is an important part of security governance and managing the security function.

Managing the security function includes the development and implementation of information security strategies. Most of the content of the CISSP exam, and hence this book, addresses the various aspects of development and implementation of information security strategies.

Summary

When planning a security solution, it's important to consider the fact that humans are often the weakest element in organizational security. Regardless of the physical or logical controls deployed, humans can discover ways to avoid them, circumvent or subvert them, or disable them. Thus, it is important to take users into account when designing and deploying security solutions for your environment. The aspects of secure hiring practices, roles, policies, standards, guidelines, procedures, risk management, awareness training, and management planning all contribute to protecting assets. The use of these security structures provides some protection from the threat humans present against your security solutions.

Secure hiring practices require detailed job descriptions. Job descriptions are used as a guide for selecting candidates and properly evaluating them for a position. Maintaining security through job descriptions includes the use of separation of duties, job responsibilities, and job rotation.

A termination policy is needed to protect an organization and its existing employees. The termination procedure should include witnesses, return of company property, disabling network access, an exit interview, and an escort from the property.

Third-party governance is a system of oversight that is sometimes mandated by law, regulation, industry standards, or licensing requirements. The method of governance can vary, but it generally involves an outside investigator or auditor. Auditors might be designated by a governing body, or they might be consultants hired by the target organization.

The process of identifying, evaluating, and preventing or reducing risks is known as risk management. The primary goal of risk management is to reduce risk to an acceptable level. Determining this level depends on the organization, the value of its assets, and the size of its budget. Although it is impossible to design and deploy a completely risk-free environment, it is possible to significantly reduce risk with little effort. Risk analysis is the process by which risk management is achieved and includes analyzing an environment for risks, evaluating each risk as to its likelihood of occurring and the cost of the resulting damage, assessing the cost of various countermeasures for each risk, and creating a cost/benefit report for safeguards to present to upper management.

For a security solution to be successfully implemented, user behavior must change. Such changes primarily consist of alterations in normal work activities to comply with the standards, guidelines, and procedures mandated by the security policy. Behavior modification involves some level of learning on the part of the user. There are three commonly recognized learning levels: awareness, training, and education.

Exam Essentials

Understand the security implications of hiring new employees. To properly plan for security, you must have standards in place for job descriptions, job classification, work tasks, job responsibilities, preventing collusion, candidate screening, background checks, security clearances, employment agreements, and nondisclosure agreements. By deploying such mechanisms, you ensure that new hires are aware of the required security standards, thus protecting your organization's assets.

Be able to explain separation of duties. Separation of duties is the security concept of dividing critical, significant, sensitive work tasks among several individuals. By separating duties in this manner, you ensure that no one person can compromise system security.

Understand the principle of least privilege. The principle of least privilege states that in a secured environment, users should be granted the minimum amount of access necessary for them to complete their required work tasks or job responsibilities. By limiting user access only to those items that they need to complete their work tasks, you limit the vulnerability of sensitive information.

Know why job rotation and mandatory vacations are necessary. Job rotation serves two functions. It provides a type of knowledge redundancy, and moving personnel around reduces the risk of fraud, data modification, theft, sabotage, and misuse of information. Mandatory vacations of one to two weeks are used to audit and verify the work tasks and privileges of employees. This often results in easy detection of abuse, fraud, or negligence.

Understand vendor, consultant, and contractor controls. Vendor, consultant, and contractor controls are used to define the levels of performance, expectation, compensation, and consequences for entities, persons, or organizations that are external to the primary organization. Often these controls are defined in a document or policy known as a service-level agreement (SLA).

Be able to explain proper termination policies. A termination policy defines the procedure for terminating employees. It should include items such as always having a witness, disabling the employee's network access, and performing an exit interview. A termination policy should also include escorting the terminated employee off the premises and requiring the return of security tokens and badges and company property.

Know how privacy fits into the realm of IT security. Know the multiple meanings/definitions of privacy, why it is important to protect, and the issues surrounding it, especially in a work environment.

Be able to discuss third-party governance of security. Third-party governance is the system of oversight that may be mandated by law, regulation, industry standards, or licensing requirements.

Be able to define overall risk management. The process of identifying factors that could damage or disclose data, evaluating those factors in light of data value and countermeasure cost, and implementing cost-effective solutions for mitigating or reducing risk is known as risk management. By performing risk management, you lay the foundation for reducing risk overall.

Understand risk analysis and the key elements involved. Risk analysis is the process by which upper management is provided with details to make decisions about which risks are to be mitigated, which should be transferred, and which should be accepted. To fully evaluate risks and subsequently take the proper precautions, you must analyze the following: assets, asset valuation, threats, vulnerability, exposure, risk, realized risk, safeguards, countermeasures, attacks, and breaches.

Know how to evaluate threats. Threats can originate from numerous sources, including IT, humans, and nature. Threat assessment should be performed as a team effort to provide the widest range of perspectives. By fully evaluating risks from all angles, you reduce your system's vulnerability.

Understand quantitative risk analysis. Quantitative risk analysis focuses on hard values and percentages. A complete quantitative analysis is not possible because of intangible aspects of risk. The process involves asset valuation and threat identification and then determining a threat's potential frequency and the resulting damage; the result is a cost/benefit analysis of safeguards.

Be able to explain the concept of an exposure factor (EF). An exposure factor is an element of quantitative risk analysis that represents the percentage of loss that an organization would experience if a specific asset were violated by a realized risk. By calculating exposure factors, you are able to implement a sound risk management policy.

Know what single loss expectancy (SLE) is and how to calculate it. SLE is an element of quantitative risk analysis that represents the cost associated with a single realized risk against a specific asset. The formula is SLE = asset value (AV) * exposure factor (EF).

Understand annualized rate of occurrence (ARO). ARO is an element of quantitative risk analysis that represents the expected frequency with which a specific threat or risk will occur (in other words, become realized) within a single year. Understanding AROs further enables you to calculate the risk and take proper precautions.

Know what annualized loss expectancy (ALE) is and how to calculate it. ALE is an element of quantitative risk analysis that represents the possible yearly cost of all instances of a specific realized threat against a specific asset. The formula is ALE = single loss expectancy (SLE) * annualized rate of occurrence (ARO).

Know the formula for safeguard evaluation. In addition to determining the annual cost of a safeguard, you must calculate the ALE for the asset if the safeguard is implemented. Use the formula: ALE before safeguard – ALE after implementing the safeguard – annual cost of safeguard = value of the safeguard to the company, or (ALE1 – ALE2) – ACS.

Understand qualitative risk analysis. Qualitative risk analysis is based more on scenarios than calculations. Exact dollar figures are not assigned to possible losses; instead, threats are ranked on a scale to evaluate their risks, costs, and effects. Such an analysis assists those responsible in creating proper risk management policies.

Understand the Delphi technique. The Delphi technique is simply an anonymous feedback-and-response process used to arrive at a consensus. Such a consensus gives the responsible parties the opportunity to properly evaluate risks and implement solutions.

Know the options for handling risk. Reducing risk, or risk mitigation, is the implementation of safeguards and countermeasures. Assigning risk or transferring a risk places the cost of loss a risk represents onto another entity or organization. Purchasing insurance is one form of assigning or transferring risk. Accepting risk means the management has evaluated the cost/benefit analysis of possible safeguards and has determined that the cost of the countermeasure greatly outweighs the possible cost of loss due to a risk. It also means that management has agreed to accept the consequences and the loss if the risk is realized.

Be able to explain total risk, residual risk, and controls gap. Total risk is the amount of risk an organization would face if no safeguards were implemented. To calculate total risk, use this formula: threats * vulnerabilities * asset value = total risk. Residual risk is the risk that management has chosen to accept rather than mitigate. The difference between total risk and residual risk is the controls gap, which is the amount of risk that is reduced by implementing safeguards. To calculate residual risk, use the following formula: total risk – controls gap = residual risk.

Understand control types. The term *control* refers to a broad range of controls that perform such tasks as ensuring that only authorized users can log on and preventing unauthorized users from gaining access to resources. Control types include preventive, detective, corrective, deterrent, recovery, directive, and compensation. Controls can also be categorized by how they are implemented: administrative, logical, or physical.

Know how to implement security awareness training and education. Before actual training can take place, awareness of security as a recognized entity must be created for users. Once this is accomplished, training, or teaching employees to perform their work tasks and to comply with the security policy, can begin. All new employees require some level of training so they will be able to comply with all standards, guidelines, and procedures mandated by the security policy. Education is a more detailed endeavor in which students/users learn much more than they actually need to know to perform their work tasks. Education is most often associated with users pursuing certification or seeking job promotion.

Understand how to manage the security function. To manage the security function, an organization must implement proper and sufficient security governance. The act of performing a risk assessment to drive the security policy is the clearest and most direct example of management of the security function. This also relates to budget, metrics, resources, information security strategies, and assessing the completeness and effectiveness of the security program.

Know the six steps of the risk management framework. The six steps of the risk management framework are: Categorize, Select, Implement, Assess, Authorize, and Monitor.

Written Lab

1. Name six different administrative controls used to secure personnel.
2. What are the basic formulas used in quantitative risk assessment?
3. Describe the process or technique used to reach an anonymous consensus during a qualitative risk assessment.
4. Discuss the need to perform a balanced risk assessment. What are the techniques that can be used and why is this necessary?

Review Questions

1. Which of the following is the weakest element in any security solution?

   A. Software products

   B. Internet connections

   C. Security policies

   D. Humans

2. When seeking to hire new employees, what is the first step?

   A. Create a job description.

   B. Set position classification.

   C. Screen candidates.

   D. Request résumés.

3. Which of the following is a primary purpose of an exit interview?

   A. To return the exiting employee’s personal belongings

   B. To review the nondisclosure agreement

   C. To evaluate the exiting employee’s performance

   D. To cancel the exiting employee’s network access accounts

4. When an employee is to be terminated, which of the following should be done?

   A. Inform the employee a few hours before they are officially terminated.

   B. Disable the employee’s network access just as they are informed of the termination.

   C. Send out a broadcast email informing everyone that a specific employee is to be terminated.

   D. Wait until you and the employee are the only people remaining in the building before announcing the termination.

5. If an organization contracts with outside entities to provide key business functions or services, such as account or technical support, what is the process called that is used to ensure that these entities support sufficient security?

   A. Asset identification

   B. Third-party governance

   C. Exit interview

   D. Qualitative analysis

6. A portion of the ___________________ is the logical and practical investigation of business processes and organizational policies. This process/policy review ensures that the stated and implemented business tasks, systems, and methodologies are practical, efficient, and cost-effective, but most of all (at least in relation to security governance) that they support security through the reduction of vulnerabilities and the avoidance, reduction, or mitigation of risk.

   A. Hybrid assessment

   B. Risk aversion process

   C. Countermeasure selection

   D. Documentation review

7. Which of the following statements is *not* true?

   A. IT security can provide protection only against logical or technical attacks.

   B. The process by which the goals of risk management are achieved is known as risk analysis.

   C. Risks to an IT infrastructure are all computer based.

   D. An asset is anything used in a business process or task.

8. Which of the following is *not* an element of the risk analysis process?

A. Analyzing an environment for risks

B. Creating a cost/benefit report for safeguards to present to upper management

C. Selecting appropriate safeguards and implementing them

D. Evaluating each threat event as to its likelihood of occurring and cost of the resulting damage

9. Which of the following would generally *not* be considered an asset in a risk analysis?

A. A development process

B. An IT infrastructure

C. A proprietary system resource

D. Users' personal files

10. Which of the following represents accidental or intentional exploitations of vulnerabilities?

A. Threat events

B. Risks

C. Threat agents

D. Breaches

11. When a safeguard or a countermeasure is not present or is not sufficient, what remains?

A. Vulnerability

B. Exposure

C. Risk

D. Penetration

12. Which of the following is *not* a valid definition for risk?

A. An assessment of probability, possibility, or chance

B. Anything that removes a vulnerability or protects against one or more specific threats

C. Risk = threat * vulnerability

D. Every instance of exposure

13. When evaluating safeguards, what is the rule that should be followed in most cases?

A. The expected annual cost of asset loss should not exceed the annual costs of safeguards.

B. The annual costs of safeguards should equal the value of the asset.

C. The annual costs of safeguards should not exceed the expected annual cost of asset loss.

D. The annual costs of safeguards should not exceed 10 percent of the security budget.

14. How is single loss expectancy (SLE) calculated?

A. Threat + vulnerability

B. Asset value ($) * exposure factor

C. Annualized rate of occurrence * vulnerability

D. Annualized rate of occurrence * asset value * exposure factor

15. How is the value of a safeguard to a company calculated?

A. ALE before safeguard – ALE after implementing the safeguard – annual cost of safeguard

B. ALE before safeguard * ARO of safeguard

C. ALE after implementing safeguard + annual cost of safeguard – controls gap

D. Total risk – controls gap

16. What security control is directly focused on preventing collusion?

A. Principle of least privilege

B. Job descriptions

C. Separation of duties

D. Qualitative risk analysis

17. What process or event is typically hosted by an organization and is targeted to groups of employees with similar job functions?

A. Education

B. Awareness

C. Training

D. Termination

8. Which of the following is *not* specifically or directly related to managing the security function of an organization?

A. Worker job satisfaction

B. Metrics

C. Information security strategies

D. Budget

9. While performing a risk analysis, you identify a threat of fire and a vulnerability because there are no fire extinguishers. Based on this information, which of the following is a possible risk?

A. Virus infection

B. Damage to equipment

C. System malfunction

D. Unauthorized access to confidential information

0. You’ve performed a basic quantitative risk analysis on a specific threat/vulnerability/risk relation. You select a possible countermeasure. When performing the calculations again, which of the following factors will change?

A. Exposure factor

B. Single loss expectancy (SLE)

C. Asset value

D. Annualized rate of occurrence

Chapter 3
Business Continuity Planning

THE CISSP EXAM TOPICS COVERED IN THIS CHAPTER INCLUDE:

- ✓ **Domain 1: Security and Risk Management**
  - 1.7 Identify, analyze, and prioritize Business Continuity (BC) requirements
    - 1.7.1 Develop and document scope and plan
    - 1.7.2 Business Impact Analysis (BIA)
- ✓ **Domain 7: Security Operations**
  - 7.14 Participate in Business Continuity (BC) planning and exercises

Despite our best wishes, disasters of one form or another eventually strike every organization. Whether it's a natural disaster such as a hurricane or earthquake or a man-made calamity such as a building fire or burst water pipes, every organization will encounter events that threaten their operations or even their very existence.

Resilient organizations have plans and procedures in place to help mitigate the effects a disaster has on their continuing operations and to speed the return to normal operations. Recognizing the importance of planning for business continuity (BC) and disaster recovery (DR), the International Information Systems Security Certification Consortium (ISC)^2 included these two processes in the Common Body of Knowledge (CBK) for the CISSP program. Knowledge of these fundamental topics will help you prepare for the exam and help you prepare your organization for the unexpected.

In this chapter, we’ll explore the concepts behind business continuity planning (BCP). Chapter 18, “Disaster Recovery Planning,” will continue the discussion and delve into the specifics of the technical controls that organizations can put in place to restore operations as quickly as possible after a disaster strikes.

Planning for Business Continuity

Business continuity planning (BCP) involves assessing the risks to organizational processes and creating policies, plans, and procedures to minimize the impact those risks might have on the organization if they were to occur. BCP is used to maintain the continuous operation of a business in the event of an emergency situation. The goal of BCP planners is to implement a combination of policies, procedures, and processes such that a potentially disruptive event has as little impact on the business as possible.

BCP focuses on maintaining business operations with reduced or restricted infrastructure capabilities or resources. As long as the continuity of the organization's ability to perform its mission-critical work tasks is maintained, BCP can be used to manage and restore the environment.

Business Continuity Planning vs. Disaster Recovery Planning

CISSP candidates often become confused about the difference between business continuity planning (BCP) and disaster recovery planning (DRP). They might try to sequence them in a particular order or draw firm lines between the two activities. The reality of the situation is that these lines are blurry in real life and don't lend themselves to neat and clean categorization.

The distinction between the two is one of perspective. Both activities are designed to help prepare an organization for a disaster. They intend to keep operations running continuously, when possible, and recover operations as quickly as possible if they are disrupted. The perspective difference is that business continuity activities are typically strategically focused at a high level and center themselves on business processes and operations. Disaster recovery plans tend to be more tactical in nature and describe technical activities such as recovery sites, backups, and fault tolerance.

In any event, don’t get hung up on the difference between the two. We’ve yet to see an exam question force anyone to draw a solid line between the two activities. It’s much more important that you understand the processes and technologies involved in these two related disciplines.

You’ll learn more about disaster recovery planning in Chapter 18.

The overall goal of BCP is to provide a quick, calm, and efficient response in the event of an emergency and to enhance a company’s ability to recover from a disruptive event promptly. The BCP process has four main steps.

- Project scope and planning
- Business impact assessment
- Continuity planning
- Approval and implementation

The next four sections of this chapter cover each of these phases in detail. The last portion of this chapter will introduce some of the critical elements you should consider when compiling documentation of your organization’s business continuity plan.

.The top priority of BCP and DRP is always *people*. The primary concern is to get people out of harm’s way; then you can address IT recovery and restoration issues.

Project Scope and Planning

As with any formalized business process, the development of a strong business continuity plan requires the use of a proven methodology. This requires the following:

- Structured analysis of the business's organization from a crisis planning point of view
- The creation of a BCP team with the approval of senior management
- An assessment of the resources available to participate in business continuity activities
- An analysis of the legal and regulatory landscape that governs an organization's response to a catastrophic event

The exact process you use will depend on the size and nature of your organization and its business. There isn't a "one-size-fits-all" guide to business continuity project planning. You should consult with project planning professionals within your organization and determine the approach that will work best within your organizational culture.

Business Organization Analysis

One of the first responsibilities of the individuals responsible for business continuity planning is to perform an analysis of the business organization to identify all departments and individuals who have a stake in the BCP process. Here are some areas to consider:

- Operational departments that are responsible for the core services the business provides to its clients
- Critical support services, such as the information technology (IT) department, facilities and maintenance personnel, and other groups responsible for the upkeep of systems that support the operational departments
- Corporate security teams responsible for physical security, as they are many times the first responders to an incident and are also

responsible for the physical safeguarding of the primary facility and alternate processing facility

- Senior executives and other key individuals essential for the ongoing viability of the organization

This identification process is critical for two reasons. First, it provides the groundwork necessary to help identify potential members of the BCP team (see the next section). Second, it provides the foundation for the remainder of the BCP process.

Normally, the business organization analysis is performed by the individuals spearheading the BCP effort. This is acceptable, given that they normally use the output of the analysis to assist with the selection of the remaining BCP team members. However, a thorough review of this analysis should be one of the first tasks assigned to the full BCP team when it is convened. This step is critical because the individuals performing the original analysis may have overlooked critical business functions known to BCP team members that represent other parts of the organization. If the team were to continue without revising the organizational analysis, the entire BCP process might be negatively affected, resulting in the development of a plan that does not fully address the emergency-response needs of the organization as a whole.

> TIP .When developing a business continuity plan, be sure to account for both your headquarters location and any branch offices. The plan should account for a disaster that occurs at any location where your organization conducts its business.

BCP Team Selection

In many organizations, the IT and/or security departments are given sole responsibility for BCP, and no arrangements are made for input from other operational and support departments. In fact, those departments may not even know of the plan’s existence until disaster strikes or is imminent. This is a critical flaw! The isolated development of a business continuity plan can spell disaster in two ways. First, the plan itself may not take into account knowledge possessed only by the individuals responsible for the day-to-day operation of the business. Second, it keeps operational elements "in the dark" about plan specifics until implementation becomes necessary. This reduces the possibility that operational elements will agree with the provisions of the plan and work effectively to implement it. It also denies organizations the benefits achieved by a structured training and testing program for the plan.

To prevent these situations from adversely impacting the BCP process, the individuals responsible for the effort should take special care when selecting the BCP team. The team should include, at a minimum, the following individuals:

- Representatives from each of the organization's departments responsible for the core services performed by the business
- Business unit team members from the functional areas identified by the organizational analysis
- IT subject-matter experts with technical expertise in areas covered by the BCP
- Cybersecurity team members with knowledge of the BCP process
- Physical security and facility management teams responsible for the physical plant
- Attorneys familiar with corporate legal, regulatory, and contractual responsibilities
- Human resources team members who can address staffing issues and the impact on individual employees
- Public relations team members who need to conduct similar planning for how they will communicate with stakeholders and the public in the event of a disruption
- Senior management representatives with the ability to set vision, define priorities, and allocate resources

Tips for Selecting an Effective BCP Team

Select your team carefully! You need to strike a balance between representing different points of view and creating a team with explosive personality differences. Your goal should be to create a group that is as diverse as possible and still operates in harmony.

Take some time to think about the BCP team membership and who would be appropriate for your organization’s technical, financial, and political environment. Who would you include?

Each one of the individuals mentioned in the preceding list brings a unique perspective to the BCP process and will have individual biases. For example, the representatives from each of the operational departments will often consider their department the most critical to the organization’s continued viability. Although these biases may at first seem divisive, the leader of the BCP effort should embrace them and harness them in a productive manner. If used effectively, the biases will help achieve a healthy balance in the final plan as each representative advocates the needs of their department. On the other hand, if proper leadership isn’t provided, these biases may devolve into destructive turf battles that derail the BCP effort and harm the organization as a whole.

Senior Management and BCP

The role of senior management in the BCP process varies widely from organization to organization and depends on the internal culture of the business, interest in the plan from above, and the legal and regulatory environment in which the business operates. Important roles played by senior management usually include setting priorities, providing staff and financial resources, and arbitrating disputes about the criticality (i.e., relative importance) of services.

One of the authors recently completed a BCP consulting engagement with a large nonprofit institution. At the beginning of the engagement, he had a chance to sit down with one of the organization’s senior executives to discuss his goals and objectives for their work together. During that meeting, the senior executive asked him, “Is there anything you need from me to complete this engagement?”

The senior executive must have expected a perfunctory response because his eyes widened when the response began with, “Well, as a matter of fact….” He then learned that his active participation in the process was critical to its success.

When you work on a business continuity plan, you, as the BCP team leader, must seek and obtain as active a role as possible from a senior executive. This conveys the importance of the BCP process to the entire organization and fosters the active participation of individuals who might otherwise write BCP off as a waste of time better spent on operational activities. Furthermore, laws and regulations might require the active participation of those senior leaders in the planning process. If you work for a publicly traded company, you may want to remind executives that the officers and directors of the firm might be found personally liable if a disaster cripples the business and they are found not to have exercised due diligence in their contingency planning.

You may also have to convince management that BCP and DRP spending should not be viewed as a discretionary expense. Management’s fiduciary responsibilities to the organization’s shareholders require them to at least ensure that adequate BCP measures are in place.

In the case of this BCP engagement, the executive acknowledged the importance of his support and agreed to participate. He sent an email to all employees introducing the effort and stating that it had his full backing. He also attended several of the high-level planning sessions and mentioned the effort in an organization-wide “town hall” meeting.

Resource Requirements

After the team validates the business organization analysis, it should turn to an assessment of the resources required by the BCP effort. This involves the resources required by three distinct BCP phases.

- The BCP team will require some resources to perform the four elements of the BCP process (project scope and planning, business impact assessment, continuity planning, and approval and implementation). It’s more than likely that the major resource consumed by this BCP phase will be effort expended by members of the BCP team and the support staff they call on to assist in the development of the plan.
- The testing, training, and maintenance phases of BCP will require some hardware and software commitments, but once again, the major commitment in this phase will be effort on the part of the employees involved in those activities.
- When a disaster strikes and the BCP team deems it necessary to conduct a full-scale implementation of the business continuity plan, this implementation will require significant resources. This includes a large amount of effort (BCP will likely become the focus of a large part, if not all, of the organization) and the utilization of hard resources. For this reason, it’s important that the team uses its BCP implementation powers judiciously yet decisively.

An effective business continuity plan requires the expenditure of a large amount of resources, ranging all the way from the purchase and deployment of redundant computing facilities to the pencils and paper used by team members scratching out the first drafts of the plan. However, as you saw earlier, personnel are one of the most significant resources consumed by the BCP process. Many security professionals overlook the importance of accounting for labor, but you can rest assured that senior management will not. Business leaders are keenly aware of the effect that time-consuming side activities have on the operational productivity of their organizations and the real cost of personnel in terms of salary, benefits, and lost opportunities. These concerns become especially paramount when you are requesting the time of senior executives.

You should expect that leaders responsible for resource utilization management will put your BCP proposal under a microscope, and you should be prepared to defend the necessity of your plan with coherent, logical arguments that address the business case for BCP.

Real World Scenario

Explaining the Benefits of BCP

At a recent conference, one of the authors discussed business continuity planning with the chief information security officer (CISO) of a health system from a medium-sized United States (U.S.) city. The CISO's attitude was shocking. His organization had not conducted a formal BCP process, and he was confident that a "seat-of-the-pants" approach would work fine in the unlikely event of a disaster.

This "seat-of-the-pants" attitude is one of the most common arguments against committing resources to BCP. In many organizations, the attitude that the business has always survived and the key leaders will figure something out in the event of a disaster pervades corporate thinking. If you encounter this objection, you might want to point out to management the costs that will be incurred by the business (both direct costs and the indirect cost of lost opportunities) for each day that the business is down. Then ask them to consider how long a "seat-of-the-pants" recovery might take when compared to an orderly, planned continuity of operations.

Legal and Regulatory Requirements

Many industries may find themselves bound by federal, state, and local laws or regulations that require them to implement various degrees of BCP. We've already discussed one example in this chapter—the officers and directors of publicly traded firms have a fiduciary responsibility to exercise due diligence in the execution of their business continuity duties. In other circumstances, the requirements (and consequences of failure) might be even more severe. Emergency services, such as police, fire, and emergency medical operations, have a responsibility to the community to continue operations in the event of a disaster. Indeed, their services become even more critical in an emergency when public safety is threatened. Failure on their part to implement a solid BCP could result in the loss of life and/or property and the decreased confidence of the population in their government.

In many countries, financial institutions, such as banks, brokerages, and the firms that process their data, are subject to strict government and international banking and securities regulations. These regulations are necessarily strict because they are intended to ensure the continued operation of the institution as a crucial part of the economy. When pharmaceutical manufacturers must produce products in less-than-optimal circumstances following a disaster, they are required to certify the purity of their products to government regulators. There are countless other examples of industries that are required to continue operating in the event of an emergency by various laws and regulations.

Even if you're not bound by any of these considerations, you might have contractual obligations to your clients that require you to implement sound BCP practices. If your contracts include commitments to customers expressed as *service-level agreements* (SLAs), you might find yourself in breach of those contracts if a disaster interrupts your ability to service your clients. Many clients may feel sorry for you and want to continue using your products/services, but their own business requirements might force them to sever the relationship and find new suppliers.

On the flip side of the coin, developing a strong, documented business continuity plan can help your organization win new clients and additional business from existing clients. If you can show your customers the sound procedures you have in place to continue serving them in the event of a disaster, they'll place greater confidence in your firm and might be more likely to choose you as their preferred vendor. That's not a bad position to be in!

All of these concerns point to one conclusion—it's essential to include your organization's legal counsel in the BCP process. They are intimately familiar with the legal, regulatory, and contractual obligations that apply to your organization and can help your team implement a plan that meets those requirements while ensuring the continued viability of the organization to the benefit of all—employees, shareholders, suppliers, and customers alike.

> **WARNING** Laws regarding computing systems, business practices, and disaster management change frequently and vary from jurisdiction to jurisdiction. Be sure to keep your attorneys involved throughout the lifetime of your BCP, including the testing and maintenance phases. If you restrict their involvement to a pre-implementation review of the plan, you may not become aware of the impact that changing laws and regulations have on your corporate responsibilities.

Business Impact Assessment

Once your BCP team completes the four stages of preparing to create a business continuity plan, it's time to dive into the heart of the work—the *business impact assessment* (BIA). The BIA identifies the resources that are critical to an organization's ongoing viability and the threats posed to those resources. It also assesses the likelihood that each threat will actually occur and the impact those occurrences will have on the business. The results of the BIA provide you with quantitative measures that can help you prioritize the commitment of business continuity resources to the various local, regional, and global risk exposures facing your organization.

It's important to realize that there are two different types of analyses that business planners use when facing a decision.

Quantitative decision-making Quantitative decision-making involves the use of numbers and formulas to reach a decision. This type of data often expresses options in terms of the dollar value to the business.

Qualitative decision-making Qualitative decision-making takes non-numerical factors, such as reputation, investor/customer confidence, workforce stability, and other concerns, into account. This type of data often results in categories of prioritization (such as high, medium, and low).

> NOTE .Quantitative analysis and qualitative analysis both play an important role in the BCP process. However, most people tend to favor one type of analysis over the other. When selecting the individual members of the BCP team, try to achieve a balance between people who prefer each strategy. This will result in the development of a well-rounded BCP and benefit the organization in the long run.

The BIA process described in this chapter approaches the problem from both quantitative and qualitative points of view. However, it’s tempting for a BCP team to “go with the numbers” and perform a quantitative assessment while neglecting the somewhat more difficult qualitative assessment. It’s important that the BCP team performs a qualitative analysis of the factors affecting your BCP process. For example, if your business is highly dependent on a few important clients, your management team is probably willing to suffer significant short-term financial loss to retain those clients in the long term. The BCP team must sit down and discuss (preferably with the involvement of senior management) qualitative concerns to develop a comprehensive approach that satisfies all stakeholders.

Identify Priorities

The first BIA task facing the BCP team is identifying business priorities. Depending on your line of business, there will be certain activities that are most essential to your day-to-day operations when disaster strikes. The priority identification task, or criticality prioritization, involves creating a comprehensive list of business processes and ranking them in order of importance. Although this task may seem somewhat daunting, it’s not as hard as it seems.

A great way to divide the workload of this process among the team members is to assign each participant responsibility for drawing up a prioritized list that covers the business functions for which their department is responsible. When the entire BCP team convenes, team members can use those prioritized lists to create a master prioritized list for the entire organization. One caution with this approach—if your team is not truly representative of the organization, you may miss critical priorities. Be sure to gather input from all parts of the organization, even if some areas are not included on the team.

This process helps identify business priorities from a qualitative point of view. Recall that we’re describing an attempt to simultaneously develop both qualitative and quantitative BIAs. To begin the quantitative assessment, the BCP team should sit down and draw up a list of organization assets and then assign an *asset value* (AV) in monetary terms to each asset. These numbers will be used in the remaining BIA steps to develop a financially based BIA.

The second quantitative measure that the team must develop is the *maximum tolerable downtime* (MTD), sometimes also known as *maximum tolerable outage* (MTO). The MTD is the maximum length of time a business function can be inoperable without causing irreparable harm to the business. The MTD provides valuable information when you're performing both BCP and DRP planning.

This leads to another metric, the *recovery time objective* (RTO), for each business function. This is the amount of time in which you think you can feasibly recover the function in the event of a disruption. Once you have defined your recovery objectives, you can design and plan the procedures necessary to accomplish the recovery tasks.

The goal of the BCP process is to ensure that your RTOs are less than your MTDs, resulting in a situation in which a function should never be unavailable beyond the maximum tolerable downtime.

Risk Identification

The next phase of the BIA is the identification of risks posed to your organization. Some elements of this organization-specific list may come to mind immediately. The identification of other, more obscure risks might take a little creativity on the part of the BCP team.

Risks come in two forms: natural risks and man-made risks. The following list includes some events that pose natural threats:

- Violent storms/hurricanes/tornadoes/blizzards
- Lightning strikes
- Earthquakes
- Mudslides/avalanches
- Volcanic eruptions

Man-made threats include the following events:

- Terrorist acts/wars/civil unrest
- Theft/vandalism

- Fires/explosions
- Prolonged power outages
- Building collapses
- Transportation failures
- Internet disruptions
- Service provider outages

Remember, these are by no means all-inclusive lists. They merely identify some common risks that many organizations face. You may want to use them as a starting point, but a full listing of risks facing your organization will require input from all members of the BCP team.

The risk identification portion of the process is purely qualitative in nature. At this point in the process, the BCP team should not be concerned about the likelihood that each type of risk will actually materialize or the amount of damage such an occurrence would inflict upon the continued operation of the business. The results of this analysis will drive both the qualitative and quantitative portions of the remaining BIA tasks.

Business Impact Assessment and the Cloud

As you conduct your business impact assessment, don't forget to take any cloud vendors on which your organization relies into account. Depending on the nature of the cloud service, the vendor's own business continuity arrangements may have a critical impact on your organization's business operations as well.

Consider, for example, a firm that outsourced email and calendaring to a third-party Software as a service (SaaS) provider. Does the contract with that provider include details about the provider's SLA and commitments for restoring operations in the event of a disaster?

Also remember that a contract is not normally sufficient due diligence when choosing a cloud provider. You should also verify that they have the controls in place to deliver on their contractual commitments. Although it may not be possible for you to physically visit the vendor's facilities to verify their control implementation, you can always do the next best thing—send someone else!

Now, before you go off identifying an emissary and booking flights, realize that many of your vendor's customers are probably asking the same question. For this reason, the vendor may have already hired an independent auditing firm to conduct an assessment of their controls. They can make the results of this assessment available to you in the form of a Service Organization Control (SOC) report.

Keep in mind that there are three different versions of the SOC report. The simplest of these, an SOC-1 report, covers only internal controls over financial reporting. If you want to verify the security, privacy, and availability controls, you'll want to review either an SOC-2 or SOC-3 report. The American Institute of Certified Public Accountants (AICPA) sets and maintains the standards surrounding these reports to maintain consistency between auditors from different accounting firms.

For more information on this topic, see the AICPA's document comparing the SOC report types at https://www.aicpa.org/interestareas/frc/assuranceadvisoryservices/soc-1-3.pdf.

Likelihood Assessment

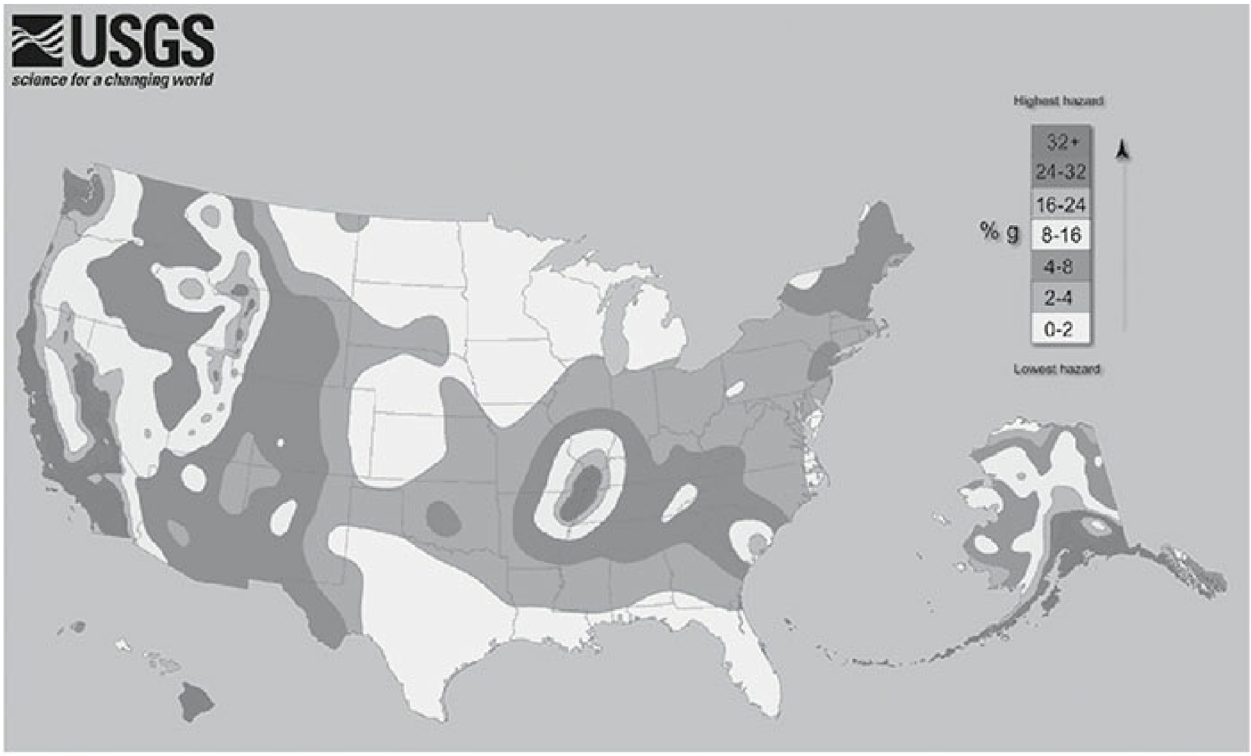
The preceding step consisted of the BCP team's drawing up a comprehensive list of the events that can be a threat to an organization. You probably recognized that some events are much more likely to happen than others. For example, an earthquake is a much more likley risk than a tropical storm for a business located in Southern California. A business based in Florida might have the exact opposite likelihood that each risk would occur.

To account for these differences, the next phase of the business impact assessment identifies the likelihood that each risk will occur. To keep calculations consistent, this assessment is usually expressed in terms of an *annualized rate of occurrence* (ARO) that reflects the number of times a business expects to experience a given disaster each year.

The BCP team should sit down and determine an ARO for each risk identified in the previous section. These numbers should be based on corporate history, professional experience of team members, and advice from experts, such as meteorologists, seismologists, fire prevention professionals, and other consultants, as needed.

> TIP In addition to the government resources identified in this chapter, insurance companies develop large repositories of risk information as part of their actuarial processes. You may be able to obtain this information from them to assist in your BCP efforts. After all, you have a mutual interest in preventing damage to your business!

In many cases, you may be able to find likelihood assessments for some risks prepared by experts at no cost to you. For example, the U.S. Geological Survey (USGS) developed the earthquake hazard map shown in Figure 3.1. This map illustrates the ARO for earthquakes in various regions of the United States. Similarly, the Federal Emergency Management Agency (FEMA) coordinates the development of detailed flood maps of local communities throughout the United States. These resources are available online and offer a wealth of information to organizations performing a business impact assessment.



(Source: U.S. Geological Survey)

FIGURE 3.1 Earthquake hazard map of the United States

Impact Assessment

As you may have surmised based on its name, the impact assessment is one of the most critical portions of the business impact assessment. In this phase, you analyze the data gathered during risk identification and likelihood assessment and attempt to determine what impact each one of the identified risks would have on the business if it were to occur.

From a quantitative point of view, we will cover three specific metrics: the exposure factor, the single loss expectancy, and the annualized loss expectancy. Each one of these values is computed for each specific risk/asset combination evaluated during the previous phases.

The *exposure factor* (EF) is the amount of damage that the risk poses to the asset, expressed as a percentage of the asset's value. For example, if the BCP team consults with fire experts and determines that a building fire would cause 70 percent of the building to be destroyed, the exposure factor of the building to fire is 70 percent.

The *single loss expectancy* (SLE) is the monetary loss that is expected each time the risk materializes. You can compute the SLE using the following formula:

$$SLE = AV \times EF$$

Continuing with the preceding example, if the building is worth $500,000, the single loss expectancy would be 70 percent of $500,000, or $350,000. You can interpret this figure to mean that a single fire in the building would be expected to cause $350,000 worth of damage.

The *annualized loss expectancy* (ALE) is the monetary loss that the business expects to occur as a result of the risk harming the asset over the course of a year. You already have all the data necessary to perform this calculation. The SLE is the amount of damage you expect each time a disaster strikes, and the ARO (from the likelihood analysis) is the number of times you expect a disaster to occur each year. You compute the ALE by simply multiplying those two numbers:

$$ALE = SLE \times ARO$$

Returning once again to our building example, if fire experts predict that a fire will occur in the building once every 30 years, the ARO is ~1/30, or 0.03. The ALE is then 3 percent of the $350,000 SLE, or $10,500. You can interpret this figure to mean that the business should expect to lose $10,500 each year due to a fire in the building.

Obviously, a fire will not occur each year—this figure represents the average cost over the 30 years between fires. It’s not especially useful for budgeting considerations but proves invaluable when attempting to prioritize the assignment of BCP resources to a given risk. These concepts were also covered in Chapter 2, “Personnel Security and Risk Management Concepts.”

TIP .Be certain you’re familiar with the quantitative formulas contained in this chapter and the concepts of asset value, exposure factor, annualized rate of occurrence, single loss expectancy, and annualized loss expectancy. Know the formulas and be able to work through a scenario.

From a qualitative point of view, you must consider the nonmonetary impact that interruptions might have on your business. For example, you might want to consider the following:

- Loss of goodwill among your client base
- Loss of employees to other jobs after prolonged downtime
- Social/ethical responsibilities to the community
- Negative publicity

It’s difficult to put dollar values on items like these in order to include them in the quantitative portion of the impact assessment, but they are equally important. After all, if you decimate your client base, you won’t have a business to return to when you’re ready to resume operations!

Resource Prioritization

The final step of the BIA is to prioritize the allocation of business continuity resources to the various risks that you identified and assessed in the preceding tasks of the BIA.

From a quantitative point of view, this process is relatively straightforward. You simply create a list of all the risks you analyzed during the BIA process and sort them in descending order according to the ALE computed during the impact assessment phase. This provides you with a prioritized list of the risks that you should address. Select as many items as you’re willing and able to address simultaneously from the top of the list and work your way down. Eventually, you’ll reach a point at which you’ve exhausted either the list of risks (unlikely!) or all your available resources (much more likely!).

Recall from the previous section that we also stressed the importance of addressing qualitatively important concerns. In previous sections about the BIA, we treated quantitative and qualitative analysis as mainly separate functions with some overlap in the analysis. Now it’s time to merge the two prioritized lists, which is more of an art than a science. You must sit down with the BCP team and representatives from the senior management team and combine the two lists into a single prioritized list.

Qualitative concerns may justify elevating or lowering the priority of risks that already exist on the ALE-sorted quantitative list. For example, if you run a fire suppression company, your number-one priority might be the prevention of a fire in your principal place of business despite the fact that an earthquake might cause more physical damage. The potential loss of reputation within the business community resulting from the destruction of a fire suppression company by fire might be too difficult to overcome and result in the eventual collapse of the business, justifying the increased priority.

Continuity Planning

The first two phases of the BCP process (project scope and planning and the business impact assessment) focus on determining how the BCP process will work and prioritizing the business assets that must be protected against interruption. The next phase of BCP development, continuity planning, focuses on developing and implementing a continuity strategy to minimize the impact realized risks might have on protected assets.

In this section, you'll learn about the subtasks involved in continuity planning.

- Strategy development
- Provisions and processes
- Plan approval
- Plan implementation
- Training and education

Strategy Development

The strategy development phase bridges the gap between the business impact assessment and the continuity planning phases of BCP development. The BCP team must now take the prioritized list of concerns raised by the quantitative and qualitative resource prioritization exercises and determine which risks will be addressed by the business continuity plan. Fully addressing all the contingencies would require the implementation of provisions and processes that maintain a zero-downtime posture in the face of every possible risk. For obvious reasons, implementing a policy this comprehensive is simply impossible.

The BCP team should look back to the MTD estimates created during the early stages of the BIA and determine which risks are deemed acceptable and which must be mitigated by BCP continuity provisions. Some of these decisions are obvious—the risk of a blizzard striking an operations facility in Egypt is negligible and would be deemed an acceptable risk. The risk of a monsoon in New Delhi is serious enough that it must be mitigated by BCP provisions.

Once the BCP team determines which risks require mitigation and the level of resources that will be committed to each mitigation task, they are ready to move on to the provisions and processes phase of continuity planning.

Provisions and Processes

The provisions and processes phase of continuity planning is the meat of the entire business continuity plan. In this task, the BCP team designs the specific procedures and mechanisms that will mitigate the risks deemed unacceptable during the strategy development stage. Three categories of assets must be protected through BCP provisions and processes: people, buildings/facilities, and infrastructure. In the next three sections, we'll explore some of the techniques you can use to safeguard these categories.

People

First, you must ensure that the people within your organization are safe before, during, and after an emergency. Once you've achieved that goal, you must make provisions to allow your employees to conduct both their BCP and operational tasks in as normal a manner as possible given the circumstances.

> WARNING Don't lose sight of the fact that people are your most valuable asset. The safety of people must always come before the organization's business goals. Make sure that your business continuity plan makes adequate provisions for the security of your employees, customers, suppliers, and any other individuals who may be affected!

People should be provided with all the resources they need to complete their assigned tasks. At the same time, if circumstances dictate that people be present in the workplace for extended periods of time, arrangements must be made for shelter and food. Any continuity plan that requires these provisions should include detailed instructions for the BCP team in the event of a disaster. The organization should maintain stockpiles of provisions sufficient to feed the operational and support teams for an extended period of time in an accessible location. Plans should specify the periodic rotation of those stockpiles to prevent spoilage.

Buildings and Facilities

Many businesses require specialized facilities in order to carry out their critical operations. These might include standard office facilities, manufacturing plants, operations centers, warehouses, distribution/logistics centers, and repair/maintenance depots, among others. When you perform your BIA, you will identify those facilities that play a critical role in your organization's continued viability. Your continuity plan should address two areas for each critical facility.

Hardening Provisions Your BCP should outline mechanisms and procedures that can be put in place to protect your existing facilities against the risks defined in the strategy development phase. This might include steps as simple as patching a leaky roof or as complex as installing reinforced hurricane shutters and fireproof walls.

Alternate Sites In the event that it's not feasible to harden a facility against a risk, your BCP should identify alternate sites where business activities can resume immediately (or at least in a period of time that's shorter than the maximum tolerable downtime for all affected critical business functions). Chapter 18 describes a few of the facility types that might be useful in this stage.

Infrastructure

Every business depends on some sort of infrastructure for its critical processes. For many businesses, a critical part of this infrastructure is an IT backbone of communications and computer systems that process orders, manage the supply chain, handle customer interaction, and perform other business functions. This backbone consists of a number of servers, workstations, and critical communications links between sites. The BCP must address how these systems will be protected against risks identified during the strategy development phase. As with buildings and facilities, there are two main methods of providing this protection.

Physically Hardening Systems You can protect systems against the risks by introducing protective measures such as computer-safe fire suppression systems and uninterruptible power supplies.

Alternative Systems You can also protect business functions by introducing redundancy (either redundant components or completely redundant systems/communications links that rely on different facilities).

These same principles apply to whatever infrastructure components serve your critical business processes—transportation systems, electrical power grids, banking and financial systems, water supplies, and so on.

Plan Approval and Implementation

Once the BCP team completes the design phase of the BCP document, it's time to gain top-level management endorsement of the plan. If you were fortunate enough to have senior management involvement throughout the development phases of the plan, this should be a relatively straightforward process. On the other hand, if this is your first time approaching management with the BCP document, you should be prepared to provide a lengthy explanation of the plan's purpose and specific provisions.

> .Senior management approval and buy-in is essential to the success of the overall BCP effort.

Plan Approval

If possible, you should attempt to have the plan endorsed by the top executive in your business—the chief executive officer, chairperson, president, or similar business leader. This move demonstrates the importance of the plan to the entire organization and showcases the business leader's commitment to business continuity. The signature of such an individual on the plan also gives it much greater weight and credibility in the eyes of other senior managers, who might otherwise brush it off as a necessary but trivial IT initiative.

Plan Implementation

Once you've received approval from senior management, it's time to dive in and start implementing your plan. The BCP team should get together and develop an implementation schedule that utilizes the resources dedicated to the program to achieve the stated process and provision goals in as prompt a manner as possible given the scope of the modifications and the organizational climate.

After all the resources are fully deployed, the BCP team should supervise the conduct of an appropriate BCP maintenance program to ensure that the plan remains responsive to evolving business needs.

Training and Education

Training and education are essential elements of the BCP implementation. All personnel who will be involved in the plan (either directly or indirectly) should receive some sort of training on the overall plan and their individual responsibilities.

Everyone in the organization should receive at least a plan overview briefing to provide them with the confidence that business leaders have considered the possible risks posed to continued operation of the business and have put a plan in place to mitigate the impact on the organization should business be disrupted.

People with direct BCP responsibilities should be trained and evaluated on their specific BCP tasks to ensure that they are able to complete them efficiently when disaster strikes. Furthermore, at least one backup person should be trained for every BCP task to ensure redundancy in the event personnel are injured or cannot reach the workplace during an emergency.

BCP Documentation

Documentation is a critical step in the business continuity planning process. Committing your BCP methodology to paper provides several important benefits.

- It ensures that BCP personnel have a written continuity document to reference in the event of an emergency, even if senior BCP team members are not present to guide the effort.
- It provides a historical record of the BCP process that will be useful to future personnel seeking to both understand the reasoning behind various procedures and implement necessary changes in the plan.
- It forces the team members to commit their thoughts to paper—a process that often facilitates the identification of flaws in the plan. Having the plan on paper also allows draft documents to be

distributed to individuals not on the BCP team for a “sanity check.”

In the following sections, we’ll explore some of the important components of the written business continuity plan.

Continuity Planning Goals

First, the plan should describe the goals of continuity planning as set forth by the BCP team and senior management. These goals should be decided on at or before the first BCP team meeting and will most likely remain unchanged throughout the life of the BCP.

The most common goal of the BCP is quite simple: to ensure the continuous operation of the business in the face of an emergency situation. Other goals may also be inserted in this section of the document to meet organizational needs. For example, you might have goals that your customer call center experience no more than 15 consecutive minutes of downtime or that your backup servers be able to handle 75 percent of your processing load within 1 hour of activation.

Statement of Importance

The statement of importance reflects the criticality of the BCP to the organization’s continued viability. This document commonly takes the form of a letter to the organization’s employees stating the reason that the organization devoted significant resources to the BCP development process and requesting the cooperation of all personnel in the BCP implementation phase.

Here’s where the importance of senior executive buy-in comes into play. If you can put out this letter under the signature of the chief executive officer (CEO) or an officer at a similar level, the plan will carry tremendous weight as you attempt to implement changes throughout the organization. If you have the signature of a lower-level manager, you may encounter resistance as you attempt to work with portions of the organization outside of that individual’s direct control.

Statement of Priorities

The statement of priorities flows directly from the identify priorities phase of the business impact assessment. It simply involves listing the functions considered critical to continued business operations in a prioritized order. When listing these priorities, you should also include a statement that they were developed as part of the BCP process and reflect the importance of the functions to continued business operations in the event of an emergency and nothing more. Otherwise, the list of priorities could be used for unintended purposes and result in a political turf battle between competing organizations to the detriment of the business continuity plan.

Statement of Organizational Responsibility

The statement of organizational responsibility also comes from a senior-level executive and can be incorporated into the same letter as the statement of importance. It basically echoes the sentiment that "business continuity is everyone's responsibility!" The statement of organizational responsibility restates the organization's commitment to business continuity planning and informs employees, vendors, and affiliates that they are individually expected to do everything they can to assist with the BCP process.

Statement of Urgency and Timing

The statement of urgency and timing expresses the criticality of implementing the BCP and outlines the implementation timetable decided on by the BCP team and agreed to by upper management. The wording of this statement will depend on the actual urgency assigned to the BCP process by the organization's leadership. If the statement itself is included in the same letter as the statement of priorities and statement of organizational responsibility, the timetable should be included as a separate document. Otherwise, the timetable and this statement can be put into the same document.

Risk Assessment

The risk assessment portion of the BCP documentation essentially recaps the decision-making process undertaken during the business impact assessment. It should include a discussion of all the risks considered during the BIA as well as the quantitative and qualitative analyses performed to assess these risks. For the quantitative analysis, the actual AV, EF, ARO, SLE, and ALE figures should be included. For the qualitative analysis, the thought process behind the risk analysis should be provided to the reader. It’s important to note that the risk assessment must be updated on a regular basis because it reflects a point-in-time assessment.

Risk Acceptance/Mitigation

The risk acceptance/mitigation section of the BCP documentation contains the outcome of the strategy development portion of the BCP process. It should cover each risk identified in the risk analysis portion of the document and outline one of two thought processes.

- For risks that were deemed acceptable, it should outline the reasons the risk was considered acceptable as well as potential future events that might warrant reconsideration of this determination.
- For risks that were deemed unacceptable, it should outline the risk management provisions and processes put into place to reduce the risk to the organization’s continued viability.

> WARNING It’s far too easy to look at a difficult risk mitigation challenge and say “we accept this risk” before moving on to easier things. Business continuity planners should resist these statements and ask business leaders to formally document their risk acceptance decisions. If auditors later scrutinize your business continuity plan, they will most certainly look for formal artifacts of any risk acceptance decisions made in the BCP process.

Vital Records Program

The BCP documentation should also outline a vital records program for the organization. This document states where critical business records will be stored and the procedures for making and storing backup copies of those records.

One of the biggest challenges in implementing a vital records program is often identifying the vital records in the first place! As many organizations transitioned from paper-based to digital workflows, they often lost the rigor that existed around creating and maintaining formal file structures. Vital records may now be distributed among a wide variety of IT systems and cloud services. Some may be stored on central servers accessible to groups, whereas others may be located in digital repositories assigned to an individual employee.

If that messy state of affairs sounds like your current reality, you may want to begin your vital records program by identifying the records that are truly critical to your business. Sit down with functional leaders and ask, “If we needed to rebuild the organization today in a completely new location without access to any of our computers or files, what records would you need?” Asking the question in this way forces the team to visualize the actual process of re-creating operations and, as they walk through the steps in their minds, will produce an inventory of the organization’s vital records. This inventory may evolve over time as people remember other important information sources, so you should consider using multiple conversations to finalize it.

Once you’ve identified the records that your organization considers vital, the next task is a formidable one: find them! You should be able to identify the storage locations for each record identified in your vital records inventory. Once you’ve completed this task, you can then use this vital records inventory to inform the rest of your business continuity planning efforts.

Emergency-Response Guidelines

The emergency-response guidelines outline the organizational and individual responsibilities for immediate response to an emergency situation. This document provides the first employees to detect an emergency with the steps they should take to activate provisions of the BCP that do not automatically activate. These guidelines should include the following:

- Immediate response procedures (security and safety procedures, fire suppression procedures, notification of appropriate emergency-response agencies, etc.)
- A list of the individuals who should be notified of the incident (executives, BCP team members, etc.)
- Secondary response procedures that first responders should take while waiting for the BCP team to assemble

Your guidelines should be easily accessible to everyone in the organization who may be among the first responders to a crisis incident. Any time a disruption strikes, time is of the essence. Slowdowns in activating your business continuity procedures may result in undesirable downtime for your business operations.

Maintenance

The BCP documentation and the plan itself must be living documents. Every organization encounters nearly constant change, and this dynamic nature ensures that the business's continuity requirements will also evolve. The BCP team should not be disbanded after the plan is developed but should still meet periodically to discuss the plan and review the results of plan tests to ensure that it continues to meet organizational needs.

Obviously, minor changes to the plan do not require conducting the full BCP development process from scratch; they can simply be made at an informal meeting of the BCP team by unanimous consent. However, keep in mind that drastic changes in an organization's mission or resources may require going back to the BCP drawing board and beginning again.

Any time you make a change to the BCP, you must practice good version control. All older versions of the BCP should be physically destroyed and replaced by the most current version so that no confusion exists as to the correct implementation of the BCP.

It is also a good practice to include BCP components in job descriptions to ensure that the BCP remains fresh and is performed correctly. Including BCP responsibilities in an employee's job description also makes them fair game for the performance review process.

Testing and Exercises

The BCP documentation should also outline a formalized exercise program to ensure that the plan remains current and that all personnel are adequately trained to perform their duties in the event of a disaster. The testing process is quite similar to that used for the disaster recovery plan, so we'll reserve the discussion of the specific test types for Chapter 18.

Summary

Every organization dependent on technological resources for its survival should have a comprehensive business continuity plan in place to ensure the sustained viability of the organization when unforeseen emergencies take place. There are a number of important concepts that underlie solid business continuity planning practices, including project scope and planning, business impact assessment, continuity planning, and approval and implementation.

Every organization must have plans and procedures in place to help mitigate the effects a disaster has on continuing operations and to speed the return to normal operations. To determine the risks that your business faces and that require mitigation, you must work with a cross-functional team to conduct a business impact assessment from both quantitative and qualitative points of view. You must take the appropriate steps in developing a continuity strategy for your organization and know what to do to weather future disasters.

Finally, you must create the documentation required to ensure that your plan is effectively communicated to present and future BCP team participants. Such documentation should include continuity planning guidelines. The business continuity plan must also contain statements of importance, priorities, organizational responsibility, and urgency and timing. In addition, the documentation should include plans for risk assessment, acceptance, and mitigation; a vital records program; emergency-response guidelines; and plans for maintenance and testing.

Chapter 18 will take this planning to the next step—developing and implementing a disaster recovery plan that includes the technical controls required to keep your business running in the face of a disaster.

Exam Essentials

Understand the four steps of the business continuity planning process. Business continuity planning involves four distinct phases: project scope and planning, business impact assessment, continuity planning, and approval and implementation. Each task contributes to the overall goal of ensuring that business operations continue uninterrupted in the face of an emergency situation.

Describe how to perform the business organization analysis. In the business organization analysis, the individuals responsible for leading the BCP process determine which departments and individuals have a stake in the business continuity plan. This analysis is used as the foundation for BCP team selection and, after validation by the BCP team, is used to guide the next stages of BCP development.

List the necessary members of the business continuity planning team. The BCP team should contain, at a minimum, representatives from each of the operational and support departments; technical experts from the IT department; physical and IT security personnel with BCP skills; legal representatives familiar with corporate legal, regulatory, and contractual responsibilities; and representatives from senior management. Additional team members depend on the structure and nature of the organization.

Know the legal and regulatory requirements that face business continuity planners. Business leaders must exercise due diligence to ensure that shareholders' interests are protected in the event disaster strikes. Some industries are also subject to federal, state, and local regulations that mandate specific BCP procedures. Many businesses also have contractual obligations to their clients that must be met before and after a disaster.

Explain the steps of the business impact assessment process. The five steps of the business impact assessment process are identification of priorities, risk identification, likelihood assessment, impact assessment, and resource prioritization.

Describe the process used to develop a continuity strategy. During the strategy development phase, the BCP team determines which risks will be mitigated. In the provisions and processes phase, mechanisms and procedures that will mitigate the risks are designed. The plan must then be approved by senior management and implemented. Personnel must also receive training on their roles in the BCP process.

Explain the importance of fully documenting an organization's business continuity plan. Committing the plan to writing provides the organization with a written record of the procedures to follow when disaster strikes. It prevents the "it's in my head" syndrome and ensures the orderly progress of events in an emergency.

Written Lab

1. Why is it important to include legal representatives on your business continuity planning team?
2. What is wrong with the “seat-of-the-pants” approach to business continuity planning?
3. What is the difference between quantitative and qualitative risk assessment?
4. What critical components should be included in your business continuity training plan?
5. What are the four main steps of the business continuity planning process?

Review Questions

1. What is the first step that individuals responsible for the development of a business continuity plan should perform?

   A. BCP team selection

   B. Business organization analysis

   C. Resource requirements analysis

   D. Legal and regulatory assessment

2. Once the BCP team is selected, what should be the first item placed on the team's agenda?

   A. Business impact assessment

   B. Business organization analysis

   C. Resource requirements analysis

   D. Legal and regulatory assessment

3. What is the term used to describe the responsibility of a firm's officers and directors to ensure that adequate measures are in place to minimize the effect of a disaster on the organization's continued viability?

   A. Corporate responsibility

   B. Disaster requirement

   C. Due diligence

   D. Going concern responsibility

4. What will be the major resource consumed by the BCP process during the BCP phase?

   A. Hardware

   B. Software

   C. Processing time

D. Personnel

5. What unit of measurement should be used to assign quantitative values to assets in the priority identification phase of the business impact assessment?

   A. Monetary

   B. Utility

   C. Importance

   D. Time

6. Which one of the following BIA terms identifies the amount of money a business expects to lose to a given risk each year?

   A. ARO

   B. SLE

   C. ALE

   D. EF

7. What BIA metric can be used to express the longest time a business function can be unavailable without causing irreparable harm to the organization?

   A. SLE

   B. EF

   C. MTD

   D. ARO

8. You are concerned about the risk that an avalanche poses to your $3 million shipping facility. Based on expert opinion, you determine that there is a 5 percent chance that an avalanche will occur each year. Experts advise you that an avalanche would completely destroy your building and require you to rebuild on the same land. Ninety percent of the $3 million value of the facility is attributed to the building, and 10 percent is attributed to the land itself. What is the single loss expectancy of your shipping facility to avalanches?

A. $3,000,000

B. $2,700,000

C. $270,000

D. $135,000

9. Referring to the scenario in question 8, what is the annualized loss expectancy?

A. $3,000,000

B. $2,700,000

C. $270,000

D. $135,000

10. You are concerned about the risk that a hurricane poses to your corporate headquarters in South Florida. The building itself is valued at $15 million. After consulting with the National Weather Service, you determine that there is a 10 percent likelihood that a hurricane will strike over the course of a year. You hired a team of architects and engineers who determined that the average hurricane would destroy approximately 50 percent of the building. What is the annualized loss expectancy (ALE)?

A. $750,000

B. $1.5 million

C. $7.5 million

D. $15 million

11. Which task of BCP bridges the gap between the business impact assessment and the continuity planning phases?

A. Resource prioritization

B. Likelihood assessment

C. Strategy development

D. Provisions and processes

12. Which resource should you protect first when designing continuity

plan provisions and processes?

A. Physical plant

B. Infrastructure

C. Financial resources

D. People

13. Which one of the following concerns is not suitable for quantitative measurement during the business impact assessment?

A. Loss of a plant

B. Damage to a vehicle

C. Negative publicity

D. Power outage

14. Lighter Than Air Industries expects that it would lose $10 million if a tornado struck its aircraft operations facility. It expects that a tornado might strike the facility once every 100 years. What is the single loss expectancy for this scenario?

A. 0.01

B. $10,000,000

C. $100,000

D. 0.10

15. Referring to the scenario in question 14, what is the annualized loss expectancy?

A. 0.01

B. $10,000,000

C. $100,000

D. 0.10

16. In which business continuity planning task would you actually design procedures and mechanisms to mitigate risks deemed unacceptable by the BCP team?

A. Strategy development

B. Business impact assessment

C. Provisions and processes

D. Resource prioritization

17. What type of mitigation provision is utilized when redundant communications links are installed?

A. Hardening systems

B. Defining systems

C. Reducing systems

D. Alternative systems

18. What type of plan addresses the technical controls associated with alternate processing facilities, backups, and fault tolerance?

A. Business continuity plan

B. Business impact assessment

C. Disaster recovery plan

D. Vulnerability assessment

19. What is the formula used to compute the single loss expectancy for a risk scenario?

A. SLE = AV × EF

B. SLE = RO × EF

C. SLE = AV × ARO

D. SLE = EF × ARO

20. Of the individuals listed, who would provide the best endorsement for a business continuity plan's statement of importance?

A. Vice president of business operations

B. Chief information officer

C. Chief executive officer

D. Business continuity manager

Chapter 4
Laws, Regulations, and Compliance

THE CISSP EXAM TOPICS COVERED IN THIS CHAPTER INCLUDE:

- ✓ **Domain 1: Security and Risk Management**
  - 1.3 Determine compliance requirements
    - 1.3.1 Contractual, legal, industry standards, and regulatory requirements
    - 1.3.2 Privacy requirements
  - 1.4 Understand legal and regulatory issues that pertain to information security in a global context
    - 1.4.1 Cyber crimes and data breaches
    - 1.4.2 Licensing and intellectual property requirements
    - 1.4.3 Import/export controls
    - 1.4.4 Trans-border data flow
    - 1.4.5 Privacy

The world of compliance is a legal and regulatory jungle for information technology (IT) and cybersecurity professionals. National, state, and local governments have all passed overlapping laws regulating different components of cybersecurity in a patchwork manner. This leads to an incredibly confusing landscape for security professionals who must reconcile the laws of multiple jurisdictions. Things become even more complicated for multinational