MANGALAYATAN UNIVERSITY
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BACHELOR OF COMPUTER APPLICATION (BCA)

CSB-1111 (Management Information System)

Block 2: System Analysis and Design

Unit 7: Information Systems Security and Risk Management

Structure

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7.0 Introduction

In an era where digital transformation drives nearly every facet of business and daily life, the importance of Information System Security cannot be overstated. As organizations increasingly rely on interconnected systems and data-driven decision-making, they become more vulnerable to a variety of cyber threats. Information System Security encompasses the policies, procedures, and technologies implemented to protect information systems from unauthorized access, disruption, modification, or destruction. This discipline is essential for maintaining the confidentiality, integrity, and availability of information, which are the foundational principles of security.

The introduction of sophisticated cyber threats and the growing complexity of IT environments necessitate a comprehensive approach to security. Traditional threats like malware and phishing have evolved, and new risks, including those associated with the Internet of Things (IoT) and cloud computing, continue to emerge. Addressing these challenges requires robust risk assessment and mitigation strategies, well-defined security policies, and the implementation of effective security controls. By understanding and

proactively managing these risks, organizations can safeguard their critical assets, ensure business continuity, and build resilience against the ever-changing cyber threat landscape. This section delves into the critical components of Information System Security, including threat identification, risk management, policy development, and the implementation of a comprehensive security program.

7.1 Objectives

After learning this unit, you will be able to understand,

- **Understanding Threat Landscape**: Provide insight into the diverse range of threats that pose risks to information security, including both external and internal threats.
- **Identifying Emerging Threats**: Explore emerging trends and new challenges in the cybersecurity landscape, such as zero-day exploits, IoT vulnerabilities, and cloud security risks.
- **Risk Assessment and Mitigation**: Discuss methodologies for assessing and prioritizing risks, as well as strategies for mitigating these risks effectively.
- **Security Policies and Controls**: Examine the importance of establishing robust security policies, procedures, and controls to enforce security measures and mitigate potential vulnerabilities.
- **Implementing Security Programs**: Explore the process of implementing an information security program, including key components, best practices, and emerging trends in security management.

7.2 Information System Security

In today's digital age, an information system (IS) is the foundation of any organization's data and activities. In essence, it is an organized group of parts that collaborate to manage data. The information system (IS) consists of hardware (computers, servers), software (applications, databases), data (electronic information), people (users, IT experts), and processes (defined procedures). Picture this as a well-oiled machine with many moving components. Together, these parts enable the gathering, storing, processing, analyzing, and sharing of information.

This data can include anything from product designs and marketing materials to financial records and consumer information. An IS gives users the ability to cooperate successfully, expedite processes, and make well-informed decisions. It is also essential for communication since it makes it possible for data to move both inside and outside of the company. To put it succinctly, the foundation of information management is a well-designed IS that keeps businesses connected, informed, and productive.

Information systems security and risk management are fundamental practices for protecting your organization's data and IT infrastructure from ever-evolving threats. This section dives deeper into each subtopic with examples and visuals to enhance understanding.

Information Systems Security refers to the practices and methodologies designed to protect digital data and information systems from unauthorized access, cyber threats, and data breaches. It's crucial in safeguarding sensitive information, ensuring business continuity, and maintaining trust with customers and stakeholders. Effective security measures prevent financial losses, protect intellectual property, and comply with legal requirements.

Historical Context

With the introduction of computer systems in the middle of the 20th century, information security started to develop. Security was first primarily concerned with physical defenses and entry restrictions. With the development of technology, especially the internet, the emphasis moved to protecting against increasingly

complex cyberthreats. The creation of security standards, the advancement of encryption methods, and the increasing significance of cybersecurity in national defense plans are notable turning points.

7.2.1 Threats to Information Security

Imagine your information system as a fortress. Here's a breakdown of some common invaders you need to be aware of:

7.2.1.1 External Threats

These originate from outside your network and can be malicious or unintentional.

- **Malware (Malicious Software):** Malicious software like viruses, worms, Trojans, and ransomware are designed to damage or exploit computer systems. Viruses attach to files, worms self-replicate, Trojans disguise as legitimate software, and ransomware encrypts data for ransom. These threats can lead to data loss, financial damage, and operational disruption.

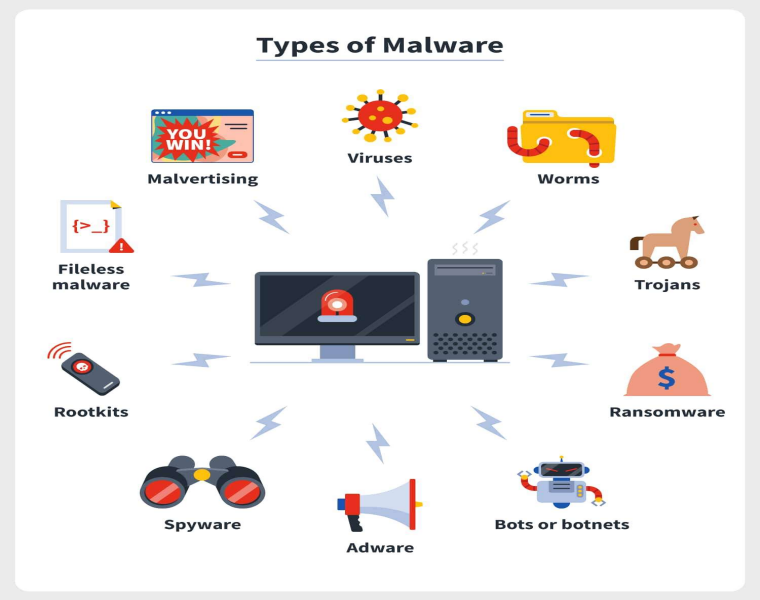

Image Source: Norton

- **Phishing Attacks:** Deceptive emails or messages designed to trick users into revealing sensitive information like passwords or clicking on malicious links.

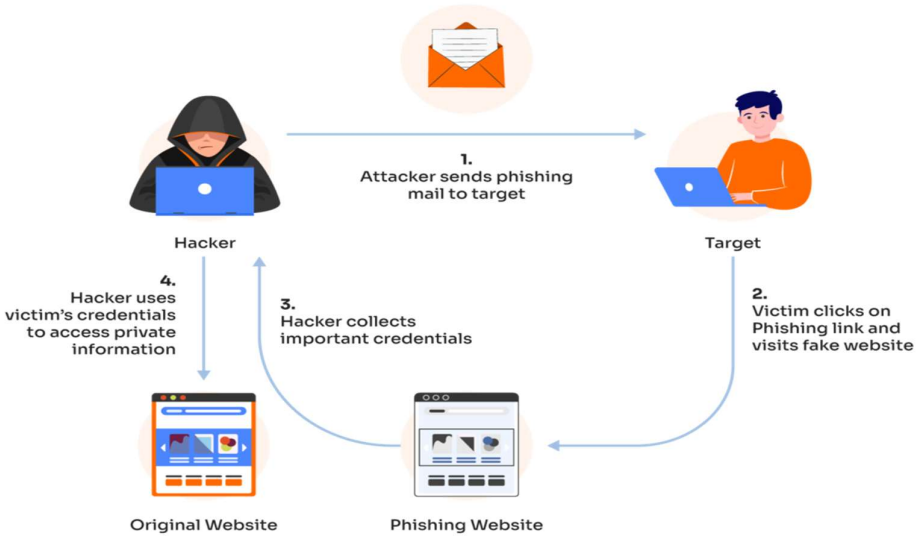

Image Source: Valimail

- **Unauthorized Access:** Gaining access to a system or data without permission, often through hacking attempts or exploiting system vulnerabilities.

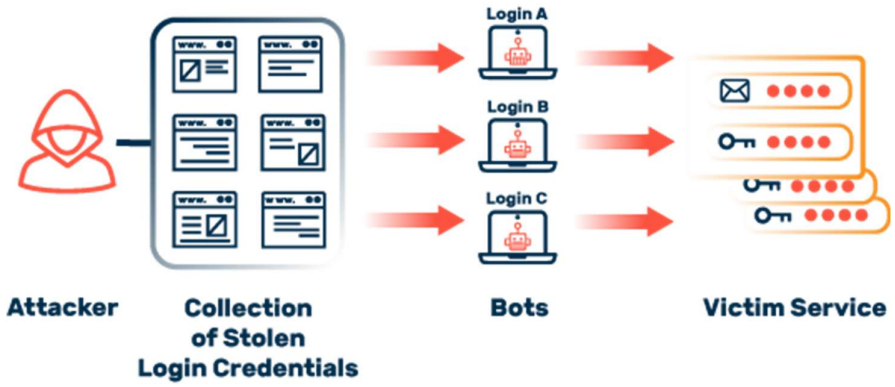

Image Source: Myra Security

- **Data Breaches:** The unauthorized access or disclosure of sensitive data, often due to security weaknesses or human error.

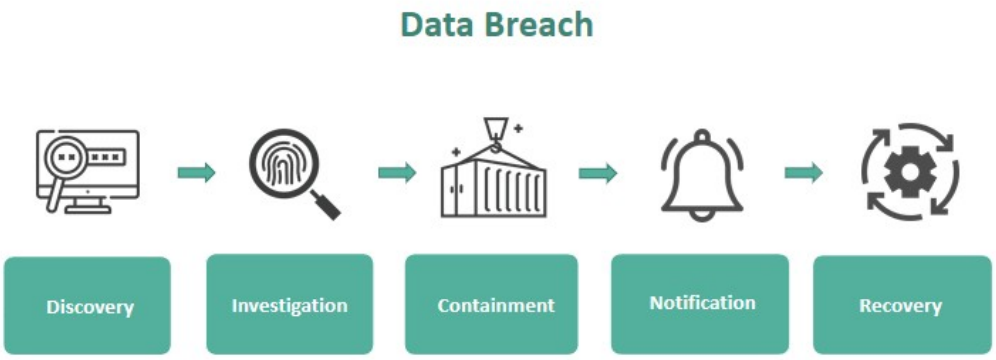

Image Source: Wall Street Mojo

7.2.1.2 Internal Threats

These threats originate from within your organization and can be accidental or deliberate.

- **Insider Threats:** These originate from within the organization and can be malicious or accidental. Malicious insiders intentionally misuse their access to steal or damage information, while negligent insiders inadvertently compromise security through carelessness or lack of awareness. Both can lead to significant data breaches and financial losses. Employees, contractors, or anyone with authorized access who misuse their privileges or intentionally steal or damage data.

Image Source: Stealthlabs

- **Social Engineering:** Manipulative tactics used to trick users into revealing sensitive information or taking actions that compromise security. This can involve impersonation, emotional appeals, or creating a sense of urgency.

Image Source: Arctic Wolf

- **Denial-of-Service (DoS) and Distributed Denial-of-Service (DDoS) Attacks:** DoS attacks flood a system with excessive requests, overwhelming its capacity and causing service disruptions. DDoS attacks are more potent, involving multiple compromised systems to amplify the attack. These attacks can cripple online services, causing downtime and financial loss.

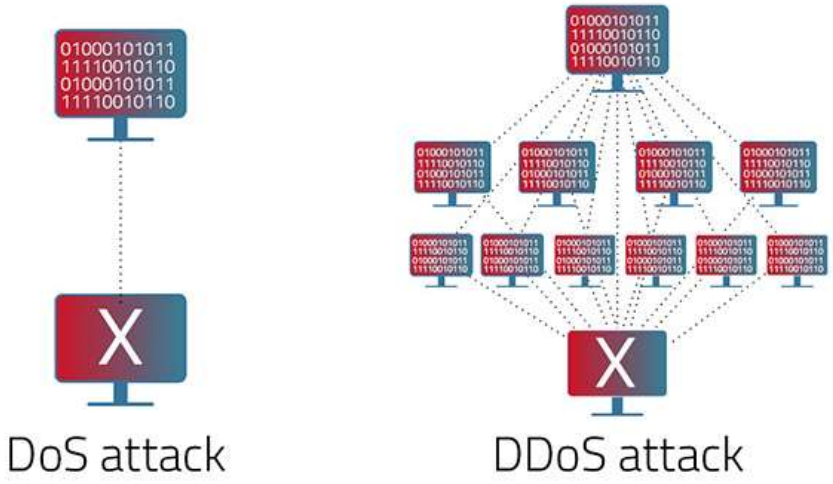

Image Source: Radware

- **Man-in-the-Middle Attacks:** This involves intercepting and potentially altering communications between two parties without their knowledge. Attackers can eavesdrop on sensitive information or inject malicious data. Techniques include session hijacking, where attackers take over an active session, and SSL stripping, which downgrades secure connections.

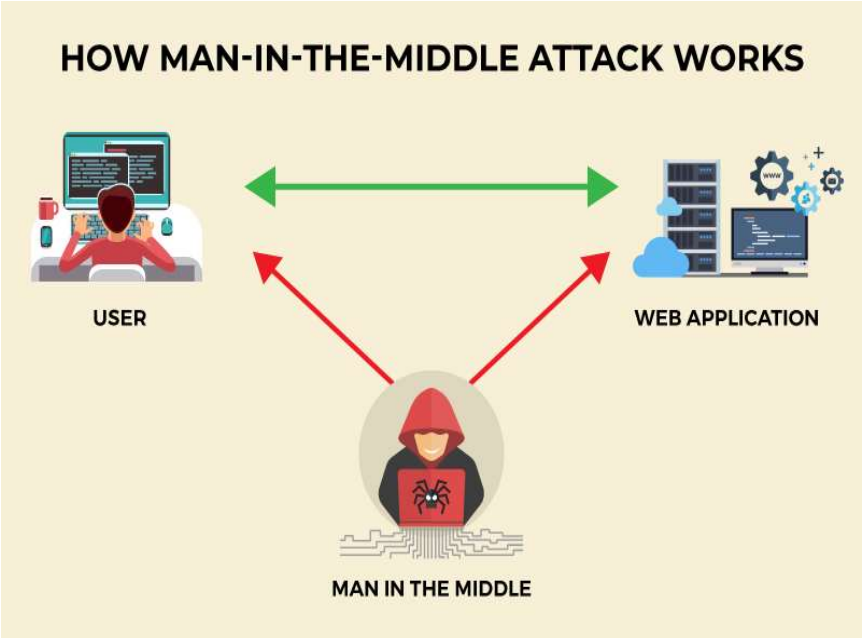

Image Source: Threatcop

- **Advanced Persistent Threats (APTs):** APTs are prolonged and targeted cyberattacks where intruders aim to steal data or monitor activities over an extended period. They often involve sophisticated techniques, including social engineering, custom malware, and exploiting zero-day vulnerabilities, posing severe risks to high-value targets like government agencies and large corporations.

7.2.2 Emerging Threats

- **Zero-Day Exploits:** These are attacks that take use of undiscovered flaws in hardware or software before a fix is released by the developer. Because zero-day exploits can evade current security safeguards and cause major damage or unauthorized access before being discovered, they are extremely dangerous.
- **IoT Vulnerabilities:** As Internet of Things (IoT) devices proliferate, new security risks arise. Due to their lax security measures, many IoT devices are open to intrusions. Default passwords, insufficient encryption, and out-of-date firmware are examples of common vulnerabilities that can be used to obtain unauthorized access or interfere with operations.
- **Cloud Security Threats:** Although cloud computing provides scalability and flexibility, there are security concerns associated with it, including the possibility of data breaches, account takeovers, and unsecure APIs. These risks are made worse by improperly configured cloud settings as well as a lack of visibility and control over data kept on the cloud.
- **Mobile Security Threats**: Malware, unprotected Wi-Fi networks, and the possibility of physical theft are some of the particular security issues that mobile devices must deal with. The widespread usage of mobile apps, which have the capacity to access and transmit sensitive data without the necessary security measures, also raises security issues.

7.3 Risk Assessment and Mitigation Strategies

Information security faces a wide range of threats including malware, phishing, insider threats, denial-of-service (DoS) attacks, and advanced persistent threats (APTs). Emerging threats such as zero-day exploits, vulnerabilities in Internet of Things (IoT) devices, cloud security risks, and mobile security challenges further complicate the landscape. Effective risk assessment and mitigation strategies are critical in managing these threats. This involves identifying and prioritizing risks, implementing security controls, and developing comprehensive policies and procedures. Key mitigation strategies include risk avoidance, reduction, transfer, and acceptance, supported by tools like vulnerability scanning, penetration testing, and Security Information and Event Management (SIEM) systems. Furthermore, the implementation of administrative, technical, and physical controls, along with the establishment of a well-defined security framework, ensures a proactive and resilient approach to safeguarding information assets.

Risk Assessment is like identifying potential weaknesses in your fortress's defences. Here's the process:

- **Identifying Assets and Resources:** This step involves cataloging all information assets, including hardware, software, data, and personnel. Understanding the value and importance of each asset helps prioritize protection efforts and allocate resources effectively to safeguard critical components.
- **Identifying Threats and Vulnerabilities:** Organizations must identify potential threats and weaknesses that could be exploited. This involves threat modeling, which anticipates possible attack scenarios, and vulnerability assessments that scan for weaknesses in systems, applications, and networks.
- **Assessing the Impact and Likelihood of Threats:** Risk assessment evaluates the potential impact and probability of identified threats. Qualitative analysis uses expert judgment to rank risks, while quantitative analysis assigns numerical values to risks based on statistical data, helping prioritize mitigation efforts.
- **Risk Evaluation and Prioritization:** After identifying and assessing risks, they are evaluated based on their potential impact and likelihood. This process helps prioritize risks, focusing on those

with the highest potential damage and the greatest chance of occurrence, guiding the allocation of security resources.

Risk Mitigation Strategy involves strengthening your defenses against these prioritized risks. Here are some common strategies:

- **Implementing Security Controls:** Organizations deploy various controls to mitigate risks, including administrative controls (policies and training), technical controls (firewalls, encryption), and physical controls (security guards, locks). These measures work together to protect information assets and reduce vulnerabilities.
- **Risk Avoidance:** Risk avoidance involves eliminating activities or processes that pose unacceptable risks. For example, an organization might choose not to store sensitive data online or discontinue using vulnerable software, thereby eliminating the associated risks.
- **Risk Reduction:** This strategy aims to reduce the severity or likelihood of risks through mitigation measures. Examples include updating software to patch vulnerabilities, enhancing network security protocols, or implementing multi-factor authentication to protect against unauthorized access.
- **Risk Transfer (Insurance):** Risk transfer involves shifting the risk to another entity, such as an insurance company. Cyber insurance policies can cover financial losses from data breaches, cyberattacks, and other security incidents, providing a safety net for organizations.
- **Risk Acceptance:** In some cases, organizations may accept certain risks if the cost of mitigation exceeds the potential impact. This decision requires a thorough understanding of the risk and a conscious choice to tolerate it, often with contingency plans in place.

Tools and Techniques for Risk Assessment

- **Qualitative and Quantitative Risk Analysis:** Qualitative analysis relies on expert judgment and scenarios to evaluate risks, while quantitative analysis uses mathematical models and statistical data. Both methods help assess risks' potential impact and likelihood, guiding decision-making and prioritization.
- **Vulnerability Scanning and Penetration Testing:** Vulnerability scanning identifies security weaknesses in systems, networks, and applications. Penetration testing simulates real-world attacks to test the effectiveness of security measures, uncover vulnerabilities, and provide actionable insights for improvement.
- **Security Information and Event Management (SIEM) Systems:** SIEM systems aggregate and analyze security data from various sources, providing real-time monitoring, detection, and response to security incidents. They enhance visibility, streamline incident management, and help organizations comply with regulatory requirements.

7.4 Security Policies, Procedures, and Controls

Security Policies are the written rules outlining information security best practices within your organization. They set expectations for user behavior and system usage. Here are some examples:

- **Purpose and Importance**: The goal and significance of security policies are to create the foundation for safeguarding the information assets of an organization. They provide guidance to staff members in upholding security standards and guaranteeing that security procedures are applied consistently by outlining expectations, roles, and responsibilities.

- **Types of Security Policies**: Security policy types include organizational policies, which offer general security guidelines, system-specific policies, which deal with specific systems or applications, and issue-specific policies, which guarantee thorough coverage by focusing on particular security concerns like acceptable use or data classification.
- **Developing and Implementing Security Policies**: Creating and Putting into Practice Security Policies: Effective security policy creation entails determining the most important security requirements, talking to relevant parties, and putting together precise, legally binding rules. In order to assure compliance and handle changing threats, implementation calls for communication, training, and frequent reviews.
- **Policy Compliance and Enforcement**: Employee training, evaluations, and frequent audits are used to keep an eye on compliance. Clear processes for handling non-compliance—such as disciplinary measures or extra training—are necessary for enforcing policies and guaranteeing adherence to security requirements.

Security Procedures translate these policies into actionable steps. They outline specific actions for users and IT staff to follow in various situations. Examples include:

Security Standard Operating Procedures (SOPs): SOPs guarantee consistency and dependability by offering comprehensive, step-by-step guidance for common security tasks. Examples of protocols that support the upkeep of security standards are those for data backup, system updates, and incident reporting.

Incident Response Procedures: The actions to be taken in the event of a security issue, such as identification, containment, eradication, recovery, and lessons learned, are outlined in incident response procedures. Efficient handling of incidents reduces harm, guarantees speedy recuperation, and enhances readiness for subsequent events.

Business Continuity and Disaster Recovery Procedures: Plans for business continuity make sure that essential operations carry on in the event of a disruption, whereas disaster recovery concentrates on recovering IT systems following an event. In order to reduce downtime and preserve service availability, both are essential.

Access Control Procedures: These procedures outline the methods for managing user authentication, authorization, and auditing as well as access to information and resources. Strict access control implementation aids in preventing unwanted access and safeguarding private information.

Security Controls The fundamental instruments and protocols that are employed in an organization's Information Systems Security (ISS) policy to protect data and information systems are known as security controls. They serve as several points of protection against several internal and external dangers. Below is a summary of the various types of security controls:

- **Administrative Controls**: These include policies, training programs, and security governance frameworks that guide how security is managed. Administrative controls focus on human factors, ensuring that personnel are aware of security practices and responsibilities.
- **Technical Controls**: Technical controls involve the use of technology to protect information systems. Examples include firewalls, intrusion detection/prevention systems, encryption, and identity and access management systems. These controls prevent, detect, and respond to security threats.
- **Physical Controls**: Physical controls protect the physical infrastructure of information systems. Examples include surveillance cameras, security guards, access control systems (e.g., key cards), and environmental controls (e.g., fire suppression systems) to safeguard against physical threats.

7.5 Implementing an Information Security Program

Protecting the vital information in your company is very important. A strong information security program (ISP) serves as a barrier against numerous dangers, safeguarding your systems and data. This is a road map that will help you implement a successful Internet service provider:

Components of an Information Security Program

- **Security Frameworks and Standards**: Frameworks like ISO/IEC 27001, NIST, and COBIT provide structured guidelines for implementing and managing information security. These frameworks help organizations establish effective security practices and ensure compliance with regulatory requirements.
- **Security Metrics and Reporting**: Security metrics track the effectiveness of security measures, providing insights into security performance. Reporting these metrics helps identify trends, measure progress, and communicate security status to stakeholders, supporting informed decision-making.
- **Continuous Monitoring and Improvement**: Continuous monitoring involves real-time surveillance of systems to detect and respond to security threats. Regular reviews and updates to security practices ensure that the organization adapts to evolving threats and maintains robust security.

7.5.1 Emerging Trends

- **Artificial Intelligence and Machine Learning**: AI and ML can enhance security by automating threat detection, analyzing large datasets for patterns, and predicting potential attacks. However, they also pose risks as attackers can use these technologies to develop sophisticated threats.
- **Blockchain and Distributed Ledger Technologies**: Blockchain offers security benefits like tamper-proof records and decentralized control. However, it also presents challenges, including the complexity of managing cryptographic keys and the potential for new attack vectors.
- **Quantum Computing**: Quantum computing promises significant advances in computing power but also poses risks to current encryption methods. Preparing for the impact of quantum computing on cryptography is crucial for maintaining future information security.

7.5.2 Evolving Threat Landscape

- **Cyber Warfare and State-Sponsored Attacks**: Nation-states increasingly engage in cyber warfare, targeting critical infrastructure and private enterprises for espionage or disruption. These attacks are sophisticated, well-funded, and pose significant challenges to national and organizational security.
- **Privacy and Data Protection Regulations (GDPR, CCPA)**: Regulations like the General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA) impose strict requirements on data protection and privacy. Compliance involves implementing robust security measures and ensuring transparency in data handling practices.

7.6 Summary

The section on Information System Security delves into the critical aspects of safeguarding digital assets in today's interconnected world. It begins by elucidating the multifaceted nature of threats posed to information security, ranging from external sources like malware and phishing to internal risks originating from employees or insiders. By comprehensively understanding the threat landscape, organizations can

better assess vulnerabilities and develop proactive strategies to mitigate potential risks. Furthermore, the section sheds light on emerging threats such as those associated with IoT devices and cloud computing, emphasizing the need for ongoing vigilance and adaptability in security measures.

Risk assessment and mitigation strategies emerge as pivotal elements in combating cyber threats effectively. Through meticulous evaluation and prioritization of risks, organizations can tailor mitigation strategies to address vulnerabilities and safeguard critical assets. This necessitates the establishment of robust security policies, procedures, and controls to enforce compliance and resilience against evolving threats. By integrating risk management practices into their security framework, organizations can enhance their preparedness and responsiveness to security incidents, mitigating the impact of potential breaches.

Implementing an information security program requires a proactive and multifaceted approach, encompassing the adoption of security frameworks, best practices, and emerging trends in security management. By staying abreast of evolving threats and leveraging technological advancements, organizations can strengthen their security posture and foster a culture of cybersecurity awareness. Ultimately, the section underscores the imperative for organizations to prioritize information security as a fundamental component of their operations, ensuring the integrity, confidentiality, and availability of their digital assets in an increasingly interconnected world.

7.7 Questions & Answers

1. **What are some examples of external threats to information security?**

   Answer: External threats to information security encompass a wide range of risks, including malware infections, phishing attacks, denial-of-service (DoS) attacks, and unauthorized access attempts. These threats are often perpetrated by individuals or organizations outside of the targeted entity and aim to compromise the confidentiality, integrity, or availability of digital assets.

2. **How do organizations assess and prioritize risks in information security?**

   Answer*:* Organizations assess and prioritize risks through a systematic process that involves identifying potential threats, evaluating their likelihood and potential impact, and assigning risk levels based on predetermined criteria. Risk assessment methodologies may vary but commonly involve qualitative or quantitative analysis to determine the most significant risks requiring mitigation efforts.

3. **What role do security policies and controls play in information security management?**

   Answer: Security policies and controls provide the framework for enforcing security measures and ensuring compliance with regulatory requirements. Policies define expectations, roles, and responsibilities related to information security, while controls encompass technical, administrative, and physical measures implemented to mitigate risks and protect digital assets.

4. **How can organizations stay informed about emerging threats in information security?**

   Answer: Organizations can stay informed about emerging threats through various channels, including cybersecurity news sources, industry reports, threat intelligence feeds, and participation in security forums and communities. Additionally, collaboration with cybersecurity professionals, information sharing initiatives, and engagement with government agencies and cybersecurity organizations can provide valuable insights into evolving threat landscapes.

5. **What are some key components of an effective information security program?**

   Answer: Key components of an effective information security program include the development of security frameworks and policies, implementation of security controls and procedures, ongoing

risk assessment and mitigation efforts, security awareness training for employees, incident response planning and testing, and regular evaluation and improvement of security measures based on emerging threats and industry best practices.

7.8 References

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