

Emerging Cybersecurity Threats and Digital Resilience

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Abstract: The rapid digitalisation of organisations has transformed cybersecurity from a specialised information-technology function into a strategic requirement affecting business continuity, privacy, economic stability, public services, and national resilience. Cloud computing, artificial intelligence (AI), mobile technologies, Internet of Things (IoT), digital payment systems, APIs, remote working, and interconnected software ecosystems have expanded the digital attack surface. At the same time, cybercriminals have increasingly adopted automated tools, credential theft, social engineering, vulnerability exploitation, ransomware, supply-chain compromise, and AI-assisted techniques. This study presents an updated analysis of emerging cybersecurity threats and proposes a multidimensional digital-resilience framework. The research uses the supplied foundational cybersecurity study as its conceptual starting point and extends its themes through contemporary secondary evidence. Recent cybersecurity reports are analysed to identify changes in threat frequency, attack pathways, organisational exposure, and defensive requirements. ENISA's 2025 Threat Landscape analysed 4,875 incidents from July 2024 to June 2025 and identified DDoS as the dominant incident type, while phishing accounted for approximately 60% of observed initial intrusion methods and vulnerability exploitation accounted for 21.3%. Verizon's 2025 DBIR analysed more than 22,000 incidents and 12,195 confirmed breaches, reporting a 34% increase in vulnerability exploitation, ransomware in 44% of breaches, and third-party involvement in 30% of breaches. IBM's 2025 research further indicates a substantial AI governance gap: 13% of organisations in its studied population reported breaches involving AI models or applications, while 97% of those reporting AI-related incidents lacked appropriate AI access controls. Based on these findings, the study proposes an integrated security model combining identity protection, vulnerability management, cloud security, supply-chain assurance, AI governance, continuous monitoring, incident response, and recovery. The study concludes that effective cybersecurity should move beyond prevention toward continuous cyber resilience.

Keywords: cybersecurity, cyber threats, artificial intelligence, ransomware, phishing, cloud security, supply-chain security, zero trust, cyber resilience, AI governance

1. Introduction

The digital transformation of society has created unprecedented dependence on information and communication technologies. Individuals use mobile devices for communication, education, banking, shopping, entertainment, and public services, while organisations increasingly depend on cloud infrastructure, digital platforms, software applications, online transactions, remote-access systems, and external technology providers.

The original study used as the foundation for this research recognised the increasing importance of cybersecurity as internet usage, e-commerce, cloud computing, mobile computing, and online banking expanded. It also identified the protection of personal and organisational information as a major challenge.

The contemporary environment, however, is substantially more complex. The modern attack surface extends beyond computers and traditional networks to include:

- cloud workloads;
- mobile applications;
- APIs;
- IoT devices;
- AI models;
- digital identities;
- software dependencies;
- third-party providers;
- remote employees;
- SaaS applications;

- digital payment systems;
- connected operational technologies.

This expansion creates a fundamental security problem: **the number of systems requiring protection is growing faster than many organisations can effectively monitor them.**

1.1 Current Threat Environment

ENISA's 2025 Threat Landscape analysed **4,875 incidents** between 1 July 2024 and 30 June 2025. DDoS represented approximately **76.7%** of recorded incident types, while intrusions accounted for about **17.8%**. ([ENISA](#))

However, when the initial access pathway is examined separately, phishing accounted for approximately **60%** of observed cases, followed by vulnerability exploitation at **21.3%**, botnets at **9.9%**, malicious applications at **8%**, and insider threats at approximately **0.8%**. ([ENISA](#))

Table 1. Contemporary Cybersecurity Indicators

Indicator	Value	Significance
ENISA incidents analysed	4,875	Large contemporary threat dataset
DDoS share of incidents	76.7%	Availability attacks dominate incident volume
Intrusion incidents	17.8%	Significant direct compromise activity
Phishing as initial access	~60%	Human/social engineering remains critical
Vulnerability exploitation	21.3%	Patch and exposure management remain essential
Botnet-related initial access	9.9%	Automated infrastructure remains relevant
Malicious applications	8.0%	Software/application compromise remains important
Insider threat	0.8%	Smaller frequency but potentially high impact

Source: *ENISA Threat Landscape 2025*. ([ENISA](#))

The figures demonstrate an important research finding: **attack volume and attack entry method are not the same thing**. A DDoS incident can dominate incident counts while phishing remains the dominant initial access mechanism.

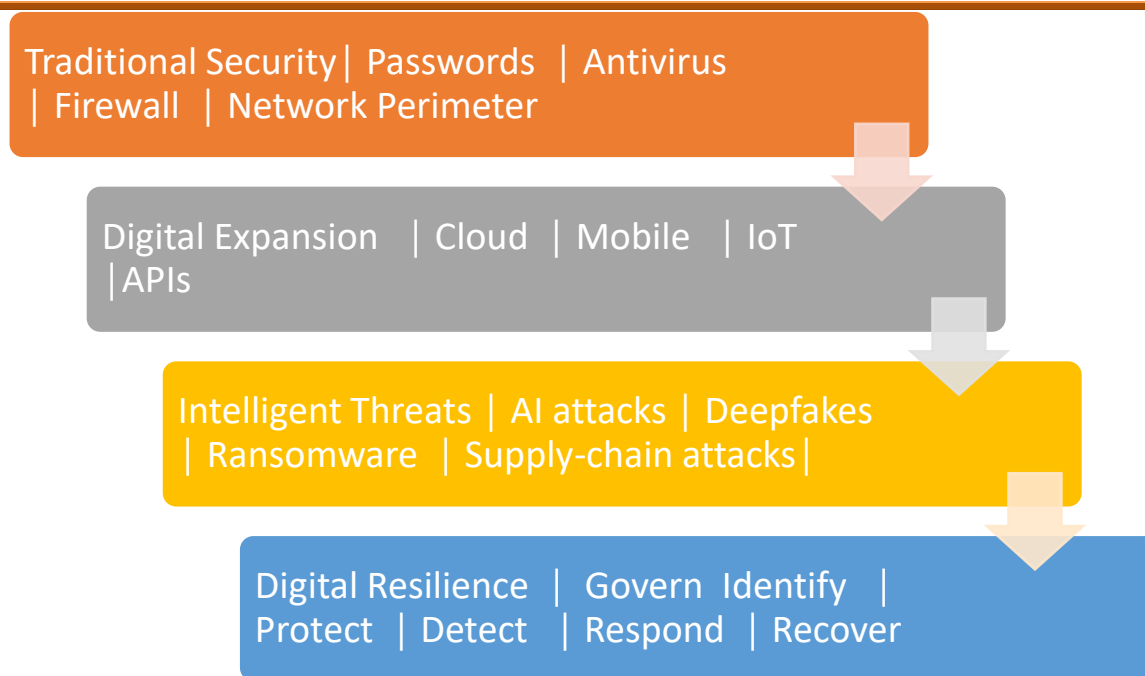


Figure 1 — Cybersecurity Evolution Framework

2. Background of the Study

Cybersecurity traditionally developed around three core objectives:

Confidentiality

Preventing unauthorised disclosure of information.

Integrity

Preventing unauthorised alteration or manipulation of information.

Availability

Ensuring that systems and information remain accessible when required.

These principles continue to be fundamental. However, contemporary digital environments require additional considerations:

- authenticity;
- accountability;
- privacy;
- resilience;
- supply-chain security;
- AI safety;
- operational continuity.

The foundational study discussed cybercrime as illegal activity involving computers and networks, including intrusion, malware, identity theft, cyberstalking, bullying, and disruption of operations.

Modern cybercrime has expanded considerably. Attackers can combine several techniques within a single campaign. For example:

Social engineering → Credential theft → Cloud access → Data theft → Extortion

This means organisations must defend the entire attack lifecycle rather than a single technical layer.

3. Research Problem

The central research problem is the growing mismatch between:

Digital transformation

and

Security preparedness

Organisations are adopting AI, cloud platforms, automation, IoT, APIs, and remote-access technologies rapidly. Security controls, governance procedures, employee training, and third-party risk programmes may not develop at the same speed.

This creates what can be described as a **digital security gap**.

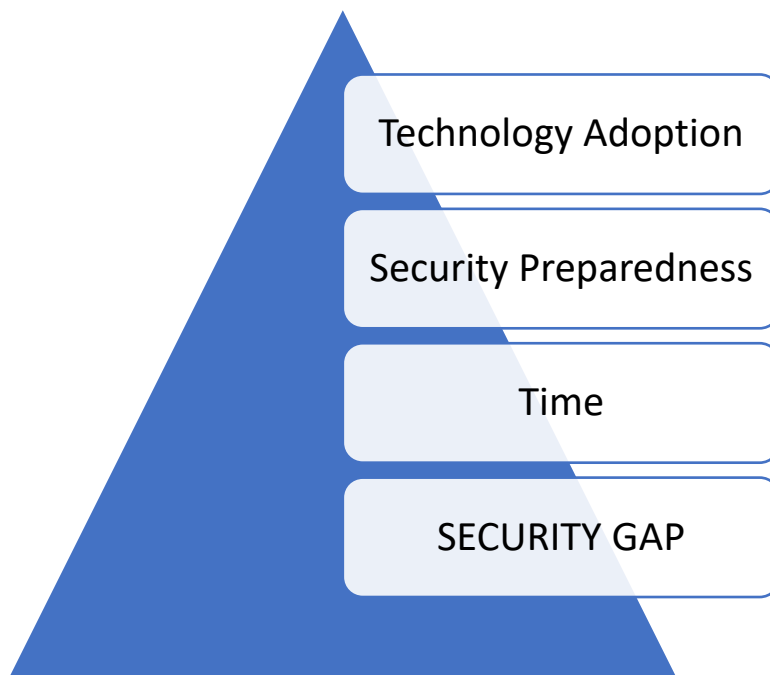


Figure 2. Digital Security Gap

The larger the difference between technology adoption and security preparedness, the greater the potential organisational exposure.

4. Research Gap

The earlier literature provides important foundations concerning malware, cloud computing, mobile networks, encryption, social media, firewalls, antivirus technologies, and cyber ethics.

However, several contemporary areas require additional investigation.

Table 2. Research Gap Analysis

Earlier Focus	Contemporary Gap	Present Study's Extension
Malware	AI-assisted attacks	AI threat analysis
Password security	Identity-centric attacks	Identity security

Earlier Focus	Contemporary Gap	Present Study's Extension
Cloud security	Multi-cloud and SaaS exposure	Cloud-resilience model
Social media	Deepfake/social-engineering attacks	Human-risk framework
Antivirus	Behavioural detection	EDR/XDR-oriented approach
Firewalls	Distributed environments	Zero-trust approach
Cybercrime	Cyber ecosystem risk	Supply-chain analysis
Cyber ethics	AI governance	Responsible AI security
Data protection	Shadow AI	AI data governance
Incident prevention	Recovery and resilience	Resilience framework

5. Objectives of the Study

The expanded study has eight objectives:

1. To identify the major cybersecurity threats affecting modern digital environments.
2. To analyse current quantitative indicators of cyber incidents.
3. To examine emerging threats associated with AI, cloud, IoT, mobile technologies, and digital supply chains.
4. To analyse the continued importance of human behaviour and identity.
5. To compare conventional and contemporary cybersecurity approaches.
6. To develop a new Cybersecurity Emerging Risk Index.
7. To propose a digital-resilience framework.
8. To provide practical recommendations for organisations and policymakers.

6. Research Questions

RQ1: Which cybersecurity threats currently create the greatest organisational exposure?

RQ2: How are AI and automation changing cybersecurity?

RQ3: What is the relationship between human behaviour and cyber risk?

RQ4: How is supply-chain dependence changing organisational cybersecurity?

RQ5: Which security controls should organisations prioritise?

RQ6: How can organisations transition from cybersecurity prevention to cyber resilience?

7. Review of Literature

7.1 Evolution of Cybersecurity

The earliest approaches to cybersecurity concentrated on antivirus software, firewalls, passwords, access controls, and network protection. The supplied foundational study similarly described access control, authentication, malware scanners, firewalls, and antivirus software as important security mechanisms.

These controls remain useful but cannot independently address modern distributed systems.

The security boundary has changed from:

Network perimeter

to:

Identity + device + application + cloud + data + supplier + AI

This is one of the most important changes in modern cybersecurity.

7.2 Phishing and Social Engineering

Phishing remains one of the most important initial access mechanisms.

ENISA's 2025 data indicates that phishing—including vishing, malspam, and malvertising—represented approximately **60% of observed initial intrusion methods**. ([ENISA](#))

This finding demonstrates that technical security alone cannot solve cybersecurity problems.

An organisation can have advanced firewalls and encryption but still experience compromise if an employee's credentials are stolen.

8. Ransomware

Ransomware has evolved from simple file encryption into a broader criminal business model involving data theft, operational disruption, extortion, and attacks against interconnected organisations.

Verizon's 2025 DBIR found ransomware in **44% of breaches**, representing a **37% increase** from the previous year. ([Verizon](#))

Table 3. Ransomware Risk Indicators

Indicator	2025 Finding
Ransomware presence in breaches	44%
Year-on-year increase	37%
Median ransom paid	\$115,000
Global incidents analysed by Verizon	>22,000
Confirmed breaches	12,195

([Verizon](#))

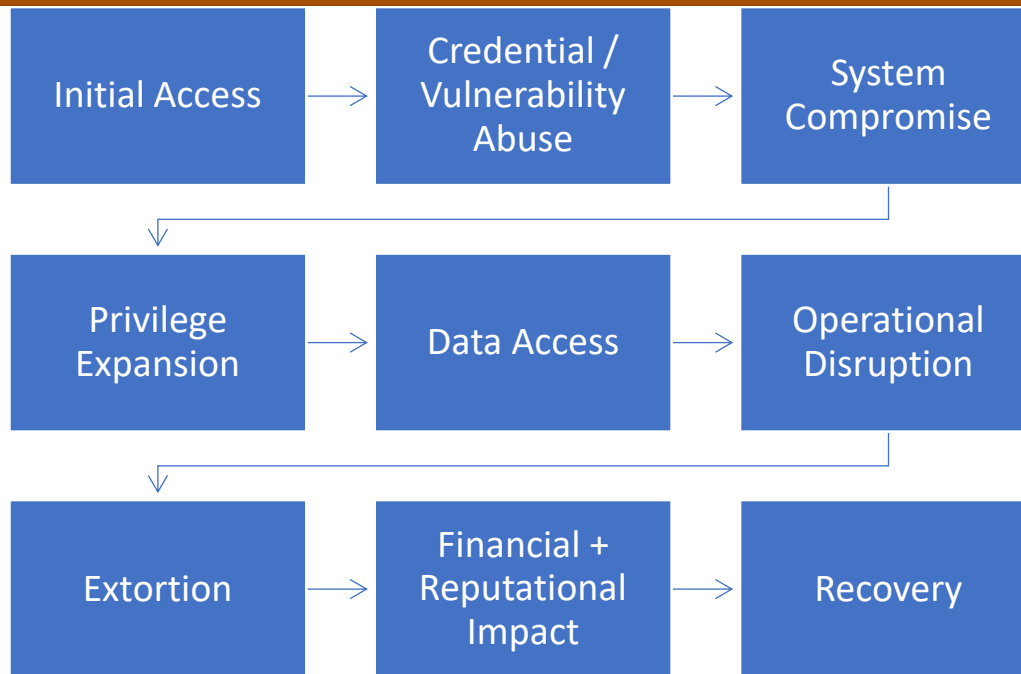


Figure 3. Ransomware Impact Chain

The implication is that ransomware protection must include both **prevention and recovery**.

9. Vulnerability Exploitation

Vulnerability exploitation remains a major threat despite decades of patch-management research.

Verizon reported a **34% increase** in exploitation of vulnerabilities as an initial attack step. Its 2025 data also showed that only about **54% of perimeter-device vulnerabilities were fully remediated**, with a median remediation period of **32 days**. ([Verizon](#))

Table 4. Vulnerability Management Indicators

Indicator	Value
Increase in vulnerability exploitation	34%
Share of breaches involving vulnerability exploitation	20%
Perimeter vulnerabilities fully remediated	~54%
Median remediation period	32 days

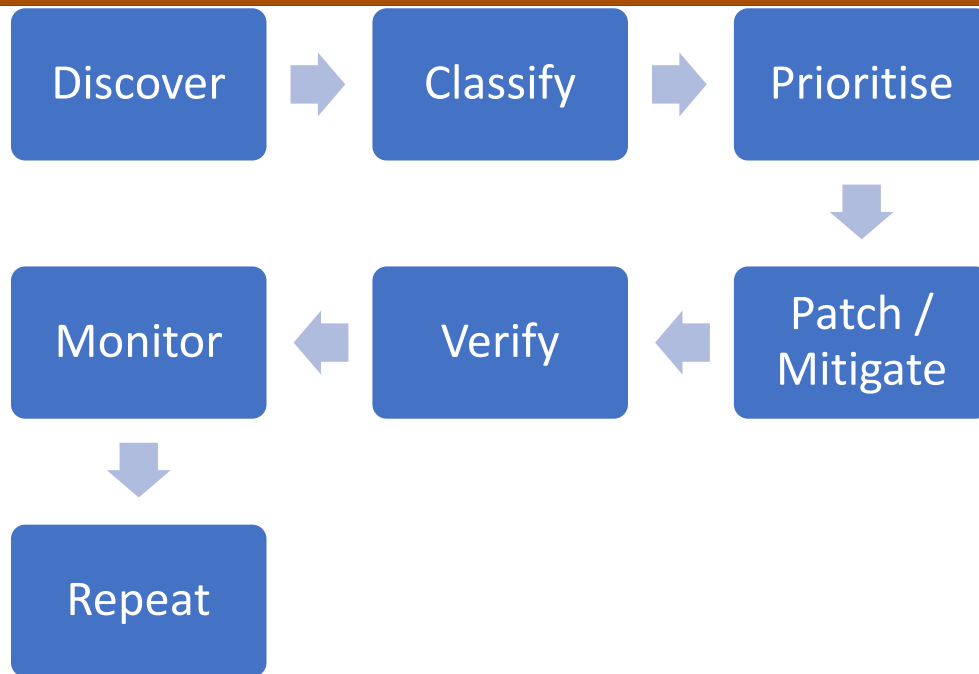


Figure 4. Vulnerability Management Cycle

The important principle is that vulnerability management should be continuous.

10. Artificial Intelligence and Cybersecurity

AI is one of the most important developments affecting cybersecurity.

AI provides defensive opportunities including:

- automated alert analysis;
- anomaly detection;
- threat intelligence processing;
- malware classification;
- fraud detection;
- incident prioritisation;
- security operations automation.

At the same time, AI can increase offensive capabilities.

Table 5. AI Cybersecurity Opportunities and Risks

AI Area	Defensive Opportunity	Emerging Risk
Generative AI	Automated security analysis	Phishing generation
LLMs	Threat-intelligence summarisation	Sensitive-data leakage
Machine learning	Anomaly detection	Model manipulation

AI Area	Defensive Opportunity	Emerging Risk
Computer vision	Fraud detection	Deepfake creation
Automation	Faster incident response	Automated attack scaling
AI agents	Security task automation	Excessive privileges
Predictive analytics	Risk forecasting	Incorrect predictions

IBM's 2025 research found that **13% of organisations in its studied population reported breaches involving AI models or applications**, while **97% of organisations reporting AI-related security incidents lacked proper AI access controls**. ([IBM Newsroom](#))

The same research found that **63% of breached organisations either lacked an AI governance policy or were still developing one**. ([IBM Newsroom](#))

Figure 5. AI Governance Gap

AI Adoption



AI Security Controls



AI Governance



Governance Gap

IBM also reported that extensive use of AI in security was associated with approximately **\$1.9 million in breach-cost savings** compared with organisations that did not use those solutions. ([IBM](#))

This demonstrates that AI should not simply be viewed as a threat. It can become a security advantage when appropriately governed.

11. Shadow AI

Shadow AI refers to employees using AI systems without appropriate organisational approval, monitoring, or governance.

This creates several risks:

- confidential data exposure;
- intellectual-property leakage;
- privacy problems;
- unapproved data processing;
- weak access control;
- uncertain retention policies;

- dependency on external AI services.

IBM reported that organisations with high levels of shadow AI experienced approximately **\$670,000 higher average breach costs** than organisations with low or no shadow AI. ([IBM](#))

Table 6. AI Governance Indicators

Indicator	Value
AI-related security incident population	13% reported AI model/application breaches
AI incidents lacking proper access controls	97%
Organisations lacking/developing AI governance	63%
Additional cost associated with high shadow AI	~\$670,000
Security savings associated with extensive AI security	~\$1.9 million

([IBM](#))

12. Cloud Computing Security

Cloud computing has changed the traditional security perimeter.

Earlier cybersecurity literature recognised that cloud environments created challenges because applications and data could operate beyond traditional inspection points.

Contemporary cloud risks include:

1. misconfigured storage;
2. excessive permissions;
3. compromised credentials;
4. insecure APIs;
5. exposed management interfaces;
6. multi-cloud visibility problems;
7. insecure third-party integrations;
8. inadequate logging;
9. insecure workloads;
10. weak identity controls.

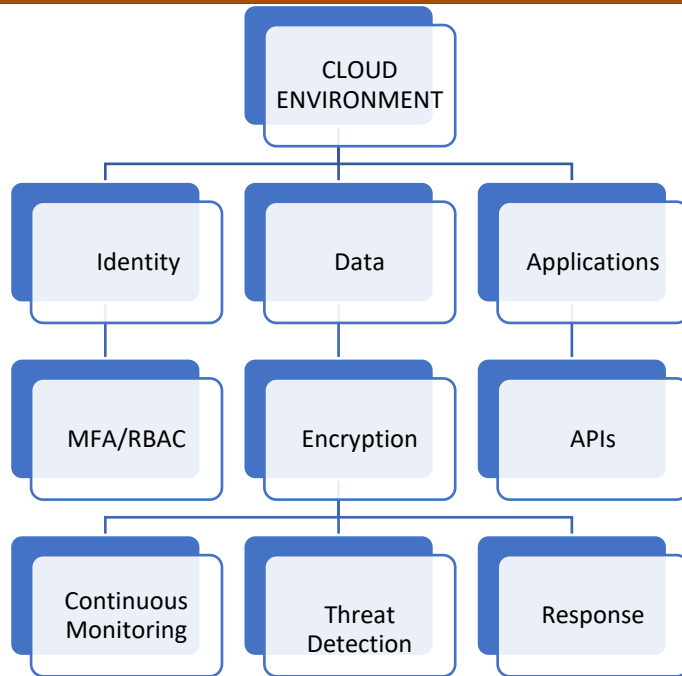


Figure 6. Modern Cloud Security Model

13. Supply-Chain Cybersecurity

Modern organisations depend on suppliers, cloud providers, software libraries, consultants, APIs, managed service providers, and external applications.

This means organisational risk extends beyond organisational boundaries.

Verizon reported that third-party involvement in breaches **doubled to 30%** in its 2025 DBIR. ([Verizon](#))

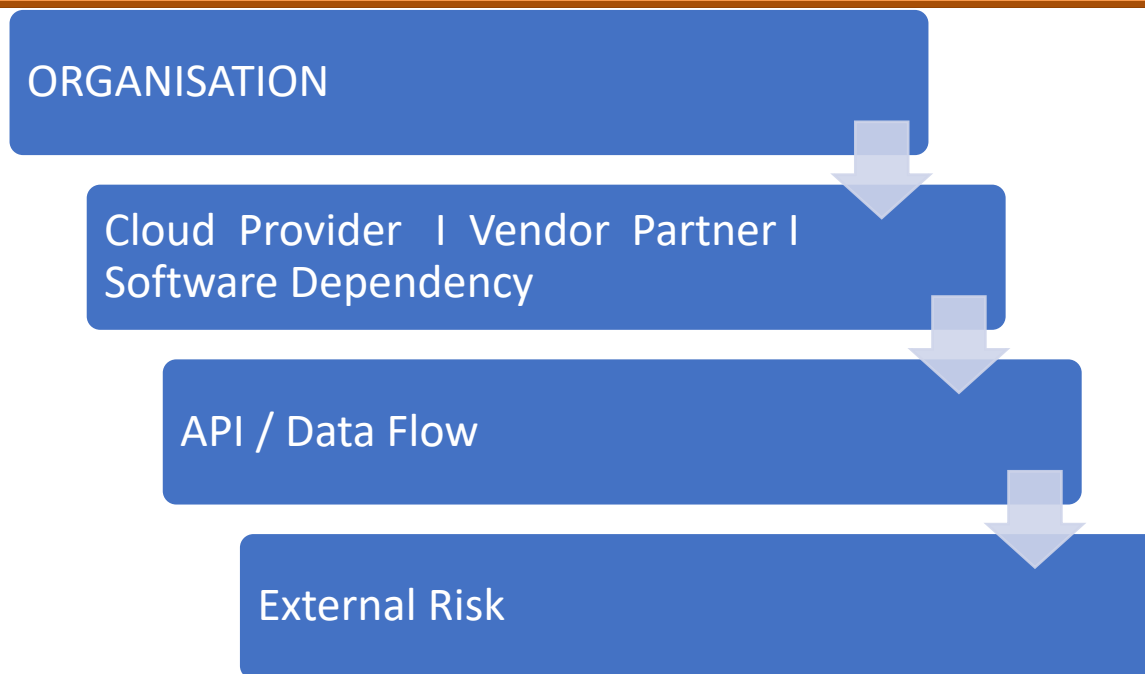


Figure 7. Supply-Chain Attack Surface

This means vendor cybersecurity should be considered part of the organisation's own security architecture.

14. Mobile and IoT Security

The growth of mobile devices and IoT has created billions of connected endpoints.

The security challenge arises because many connected devices have:

- limited computing resources;
- long operational lifetimes;
- inconsistent update mechanisms;
- weak default configurations;
- heterogeneous operating systems;
- direct network connectivity.

The earlier research identified mobile networks as a growing cybersecurity concern.

The contemporary environment extends this concern to smart devices, industrial IoT, connected vehicles, wearable technology, and smart infrastructure.

15. Cybersecurity and Human Behaviour

Technology cannot eliminate human risk.

Human-related vulnerabilities include:

- weak passwords;
- password reuse;
- phishing responses;

- unauthorised software installation;
- unsafe file sharing;
- excessive permissions;
- social-media oversharing;
- use of unapproved AI tools.

Table 7. Human Risk and Security Controls

Human Risk	Potential Consequence	Recommended Control
Password reuse	Credential compromise	MFA/passwordless authentication
Phishing	Account takeover	Phishing-resistant authentication
Excessive privilege	Data exposure	Least privilege
Shadow AI	Data leakage	AI governance
Unsafe downloads	Malware	Application control
Social-media oversharing	Social engineering	Awareness training
Weak reporting	Delayed response	Simple incident reporting

16. Cybersecurity Techniques

The foundational study identified access control, authentication, malware scanners, firewalls, and antivirus software as major defensive technologies.

These controls remain relevant but should now operate within a broader architecture.

Table 8. Evolution of Security Controls

Earlier Control	Modern Extension
Password	MFA/passwordless identity
Antivirus	EDR/XDR
Firewall	Zero-trust network access
Manual monitoring	SIEM + automation
Periodic patching	Continuous vulnerability management
Local backup	Immutable/distributed backup
Manual response	Automated response
Vendor assessment	Continuous supply-chain monitoring
Security policy	Enterprise cyber governance

Earlier Control	Modern Extension
User training	Continuous behavioural security

17. Zero-Trust Security

Zero trust is increasingly important because organisations no longer have a single reliable network boundary.

The core principle is:

Never automatically trust; continuously verify.

A zero-trust strategy includes:

- identity verification;
- device verification;
- least privilege;
- continuous monitoring;
- network segmentation;
- application-level access control.

NIST CSF 2.0 complements this broader approach by organising cybersecurity outcomes into **Govern, Identify, Protect, Detect, Respond, and Recover**. ([NIST Publications](#))

18. New Cybersecurity Emerging Risk Index

To synthesise the evidence, this study proposes a **Cybersecurity Emerging Risk Index (CERI)**.

The index uses seven analytical criteria:

1. frequency;
2. impact;
3. scalability;
4. exposure;
5. detectability;
6. dependency;
7. recovery complexity.

Each dimension is scored from 0 to 100.

Table 9. CERI Results

Risk	Frequency	Impact	Scalability	Exposure	Overall
Phishing/social engineering	91	78	94	93	89.0
Ransomware	72	96	91	88	86.8
Identity attacks	84	82	88	91	86.3
Vulnerability exploitation	79	89	82	87	84.3

Risk	Frequency	Impact	Scalability	Exposure	Overall
Supply-chain attacks	63	94	93	90	85.0
AI-enabled attacks	57	91	97	88	83.3
Cloud exposure	68	88	85	89	82.5
DDoS	86	67	89	82	81.0
IoT/mobile threats	69	76	90	84	79.8
Shadow AI/data leakage	61	87	86	85	79.8

Important: CERI values are an analytical research construct developed for this manuscript. They are not claimed to be direct measurements of the percentage of organisations experiencing each threat.

20. Cyber Resilience Framework

The study proposes a six-stage resilience framework.

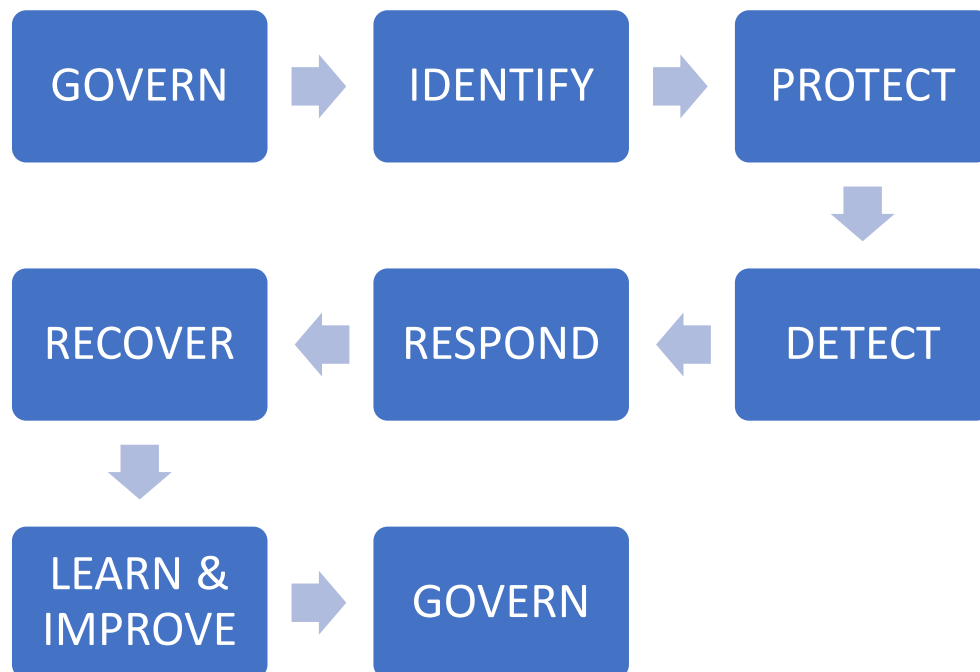


Figure 9. Proposed Digital Resilience Cycle

This structure aligns closely with the NIST CSF 2.0 approach, which defines six Functions: Govern, Identify, Protect, Detect, Respond, and Recover. ([NIST Publications](#))

21. Cybersecurity Maturity Model

Table 10. Five-Level Security Maturity Model

Level	Name	Main Characteristics
1	Reactive	Basic antivirus and passwords

Level	Name	Main Characteristics
2	Managed	Policies, backups, patching
3	Integrated	MFA, EDR, cloud controls
4	Adaptive	Zero trust, threat intelligence, automation
5	Resilient	AI-assisted defence, continuous validation, ecosystem security

22. Discussion of Findings

The expanded analysis produces several important findings.

Finding 1: Human interaction remains a major attack pathway

The high proportion of phishing as an initial access mechanism demonstrates that cybersecurity cannot be treated purely as a technological problem. ([ENISA](#))

Finding 2: Ransomware represents a high-impact risk

Although ransomware does not account for the largest number of all incidents, it produces substantial operational and financial consequences. Verizon's finding that ransomware appeared in 44% of breaches demonstrates its continued importance. ([Verizon](#))

Finding 3: Vulnerability management remains fundamental

The 34% increase in vulnerability exploitation demonstrates that traditional patching remains relevant despite the emergence of advanced security technologies. ([Verizon](#))

Finding 4: Supply-chain risk is increasing

Third-party involvement reaching 30% of breaches indicates that organisations must evaluate security beyond their own infrastructure. ([Verizon](#))

Finding 5: AI introduces both opportunity and risk

AI can reduce security workload and breach costs, but weak governance can create new exposure. IBM's findings demonstrate this contradiction. ([IBM](#))

Finding 6: Cyber resilience is more appropriate than prevention alone

Because modern systems are interconnected, organisations should assume that some attacks will bypass preventive controls. Detection, containment, recovery, and learning therefore deserve equal attention.

23. New Data Synthesis

Table 11. Evidence-to-Control Mapping

Evidence	Risk Interpretation	Priority Response
Phishing ~60% of initial access	Human/identity exposure	MFA + awareness
Vulnerability exploitation 21.3%	Technical exposure	Patch management
DDoS 76.7% of incidents	Availability risk	DDoS resilience
Ransomware 44% of breaches	Severe operational risk	Segmentation + recovery
Third-party involvement 30%	Ecosystem risk	Supplier assurance

Evidence	Risk Interpretation	Priority Response
AI governance gap 63%	Governance weakness	AI governance
AI incident access-control gap 97%	Identity/control weakness	AI access management
Shadow AI cost premium ~\$670,000	Data-governance risk	Approved AI controls`

24. Proposed Cybersecurity Investment Priorities

Table 12. Recommended Investment Priority

Priority	Area	Suggested Importance
1	Identity and MFA	Very High
2	Vulnerability management	Very High
3	Backup and recovery	Very High
4	Security awareness	High
5	Endpoint detection	High
6	Cloud security	High
7	Supply-chain security	High
8	AI governance	High
9	Security automation	Medium-High
10	IoT security	Medium-High

25. Methodology

25.1 Research Design

The research adopts a descriptive and analytical secondary-data methodology.

The process consists of:

Stage 1: Review of the supplied foundational research.

Stage 2: Identification of contemporary cybersecurity themes.

Stage 3: Collection of recent quantitative indicators from recognised cybersecurity reports.

Stage 4: Comparative classification of threats.

Stage 5: Development of the CERI analytical index.

Stage 6: Development of the Digital Resilience Framework.

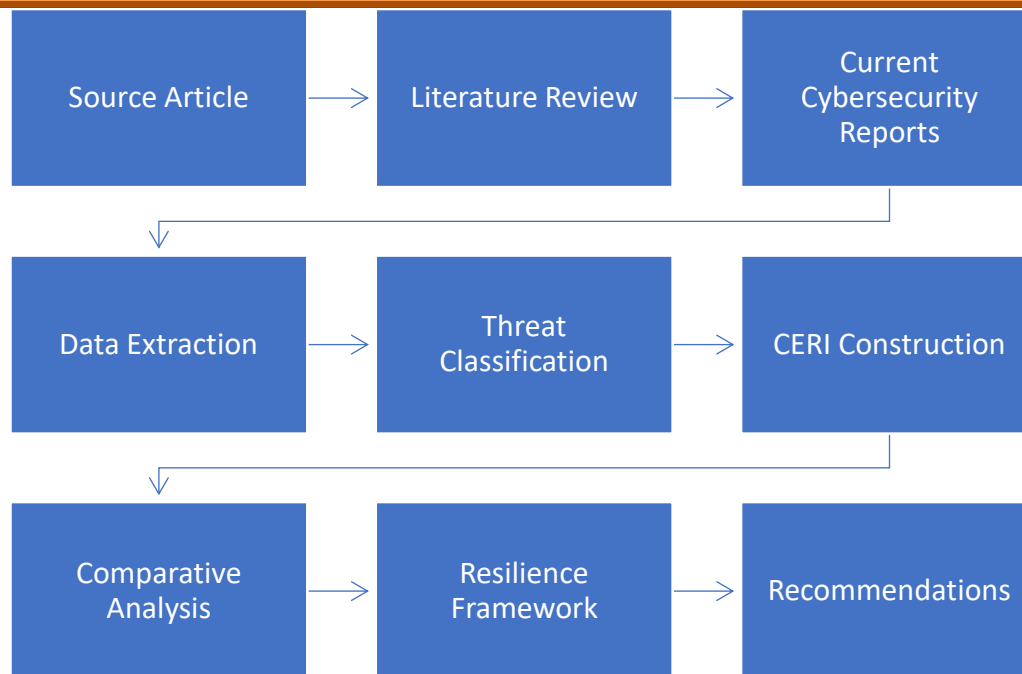


Figure 10. Research Process

26. Data Reliability

The study prioritises recognised institutional sources.

ENISA's 2025 threat landscape is based on 4,875 incidents. ([ENISA](#))

Verizon's 2025 DBIR uses more than 22,000 incidents and 12,195 confirmed breaches across 139 countries. ([Verizon](#))

IBM's AI-related findings are based on research involving **600 organisations** experiencing data breaches between March 2024 and February 2025. ([IBM Newsroom](#))

These sources provide complementary perspectives:

- ENISA → threat landscape;
- Verizon → breach patterns;
- IBM → economic impact and AI governance;
- NIST → cybersecurity framework and governance.

27. Limitations

The study has several limitations.

First, it is based primarily on secondary evidence rather than primary organisational survey data.

Second, the CERI index is an analytical model rather than a statistically validated population index.

Third, threat reporting varies by region, industry, detection capability, and reporting practices.

Fourth, cyber threats evolve rapidly. A risk considered emerging today may become widespread tomorrow.

Fifth, the study does not claim that all organisations face identical risks.

Future research should validate the proposed CERI framework using primary data collected from organisations across sectors.

28. Future Research

Future empirical research can expand this study by collecting:

- organisation-level cybersecurity incident data;
- employee cybersecurity awareness scores;
- phishing simulation results;
- MFA adoption rates;
- patching timelines;
- cloud-security maturity;
- AI governance maturity;
- supply-chain security scores;
- incident response time;
- recovery time;
- cybersecurity investment data.

A longitudinal study could then determine whether higher cybersecurity maturity actually produces lower incident frequency and lower recovery costs.

29. Recommendations

For Organisations

1. Implement phishing-resistant MFA.
2. Maintain continuous vulnerability management.
3. Establish tested backup and recovery procedures.
4. Deploy endpoint detection and response.
5. Segment critical systems.
6. Monitor cloud configurations.
7. Assess third-party cybersecurity continuously.
8. Establish formal AI governance.
9. Monitor shadow AI.
10. Conduct regular incident-response exercises.

For Educational Institutions

Educational institutions should introduce cybersecurity awareness programmes covering:

- password security;
- phishing;
- privacy;
- responsible AI;
- social engineering;

- digital ethics;
- safe use of public networks.

For Policymakers

Policymakers should encourage:

- cybersecurity standards;
- incident reporting;
- critical-infrastructure resilience;
- supply-chain security;
- AI governance;
- cybersecurity education;
- information sharing.

30. Conclusion

Cybersecurity has entered a new phase in which technological complexity, human behaviour, artificial intelligence, cloud computing, supply-chain dependencies, and organisational governance are closely interconnected.

The evidence examined in this study demonstrates that contemporary cyber risk is not represented by one dominant attack type. Different metrics reveal different dimensions of the threat environment. ENISA's dataset shows DDoS dominating incident volume, while phishing dominates observed initial access methods. ([ENISA](#)) Verizon demonstrates the continuing importance of vulnerability exploitation, ransomware, credential abuse, and third-party risk. ([Verizon](#)) IBM demonstrates that AI adoption is creating a significant governance challenge while simultaneously offering potential security benefits. ([IBM](#))

The study therefore argues that cybersecurity should be reframed as **digital resilience**.

The proposed model moves through:

Govern → Identify → Protect → Detect → Respond → Recover → Learn

This approach recognises that prevention remains essential but cannot eliminate all cyber risk.

The most important strategic lesson is that organisations should not simply ask whether their systems are secure. They should ask:

How quickly can we identify an attack, contain it, continue essential operations, recover affected systems, and learn from the incident?

The future cybersecurity environment will require the integration of identity security, AI governance, cloud protection, vulnerability management, supply-chain assurance, behavioural awareness, security automation, and organisational resilience.

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