The Top Nine factors for Effective Data Protection Controls

What, Why & How

Lessons from Payment Security Report

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June 11th, 2019

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Questions

What are Breached and non-Breached companies doing differently?

What can you learn from studying 12 years of data breach investigation data, and correlate that with 11 years of PCI Security compliance data?

How do you determine the effectiveness and sustainability of your control environment?

Differences…

What do breached organizations do differently from non-breached organizations:

1. **Prior to being breached**
2. **During a breach**
3. **After a breach**

Prior to being breached: differences in data handling and protection practices, policies, procedures

During a breach: differences in the initial reaction to the breach, the ability to respond to the breach the breach, ability to contain the breach.

After a breach: differences in breach recovery and data protection posture improvement

Why Do Organizations Get Breached And Data Compromised?

Security breaches and data compromises occur because one or more controls are:

a. missing (not implemented), or

b. not fully operational (partially implemented), or

c. operating as designed, but is knowingly or unknowingly ineffective, or

d. a control was operated in violation of its design specifications.

The real question is: Why did a/b/c/d occur?

WHAT you protect, WHERE and WHEN you protect it is important.
But understanding HOW you do it, is essential.

It's not a knowledge or technology problem.

It's a proficiency problem.

Operational Risk

Four broad operational risk categories:

1. **Actions of people:** Action, or lack of action, taken by people either deliberately or accidentally that impact security.
2. **Systems and technology failures:** Failure of hardware, software and information systems
3. **Failed internal processes:** Problems in internal business processes that impact the ability to implement, manage and sustain security
4. **External events:** Issues beyond the control of the company (disasters, legal issues and service provider dependencies)

Taxonomy of operational risk

1. Actions of people	2. Systems and technology failures	3. Failed internal processes	4. External events
1.1 Inadvertant 1.1.1 Mistakes 1.1.2 Errors 1.1.3 Omissions	**2.1 Hardware** 2.1.1 Capacity 2.1.2 Performance 2.1.3 Maintenance 2.1.4 Obsolescence	**3.1 Process design or execution** 3.1.1 Process flow 3.1.2 Process documentation 3.1.3 Roles and responsibilities 3.1.4 Notifications and alerts 3.1.5 Information flow 3.1.6 Escalation of issues 3.1.7 Service level agreements 3.1.8 Task hand-off	**4.1 Disasters** 4.1.1 Weather event 4.1.2 Fire 4.1.3 Flood 4.1.4 Earthquake 4.1.5 Unrest 4.1.6 Pandemic
1.2 Deliberate 1.2.1 Fraud 1.2.2 Sabotage 1.2.3 Theft 1.2.4 Vandalism	**2.2 Software** 2.2.1 Compatibility 2.2.2 Configuration management 2.2.3 Change control 2.2.4 Security settings 2.2.5 Coding practices 2.2.6 Testing	**3.2 Process controls** 3.2.1 Status monitoring 3.2.2 Metrics 3.2.3 Periodic review 3.2.4 Process ownership	**4.2 Legal issues** 4.2.1 Regular compliance 4.2.2 Legislation 4.2.3 Litigation
1.3 Inaction 1.3.1 Skills 1.3.2 Knowledge 1.3.3 Guidance 1.3.4 Availability	**2.3 Systems** 2.3.1 Design 2.3.2 Specifiions 2.3.3 Integration 2.3.4 Complexity	**3.3 Supporting processes** 3.3.1 Staffing 3.3.2 Funding 3.3.3 Training and development 3.3.4 Procurement	**4.3 Business issues** 4.3.1 Supplier failure 4.3.2 Market conditions 4.3.3 Economic conditions
			4.4 Service dependencies 4.4.1 Utilities 4.4.2 Emergency services 4.4.3 Fuel 4.4.4 Transportation

Figure 7. Taxonomy of operational risk, CMU/SEI, ibid. This publication incorporates portions of the Technical Report "A Taxonomy of Operational Cyber Security Risks Version 2" by James J. Cebula, Mary E. Popeck, and Lisa R. Young, (c) 2014 Mellon University, with special permission from its Software Engineering Institute.

The landscape today…

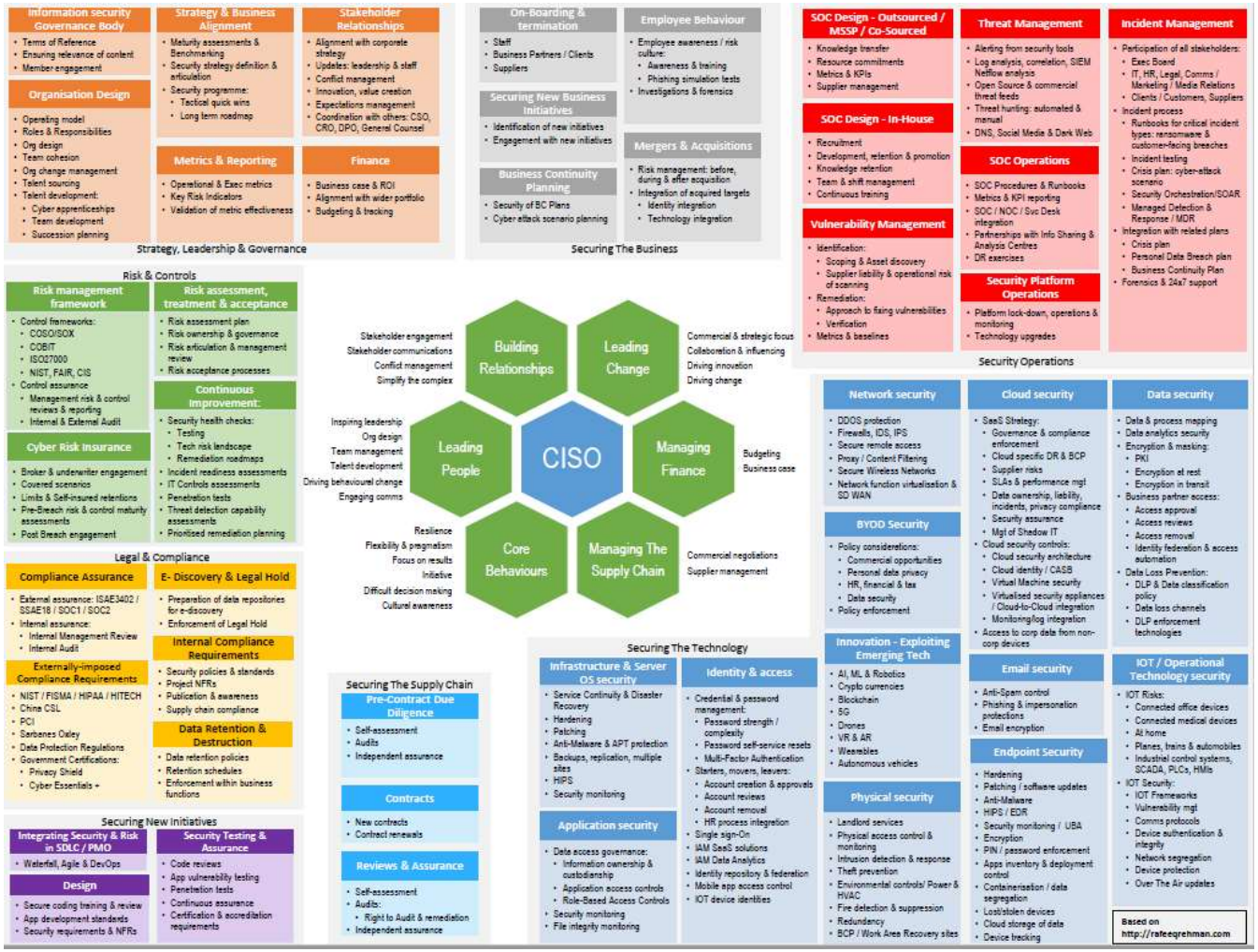
- The majority of breaches are committed by threat actors that exploit known vulnerabilities, using attacks that are not considered to be highly sophisticated.
- In the majority of data breach cases, the weaknesses that were exploited could have been prevented by applying fundamental principles of data protection. For example:
  - **Devaluing the data** – using encryption or tokenization for example.
  - **System hardening** – exploits could have been prevented applying available security patches for known vulnerabilities. Is it not true that in many data breach cases system patches were available for more than 12 months at the time of the breach?
  - **Strong authentication** – implementing strong multi-factor authentication to prevent access to data and egress of data.

Given the above, can it be claimed today that most data compromise occur as result of the organization's inability to address organizational complexity, or is it a consistent, widespread failure to attend to fundamental data protection principles, or both?

COMPLEXITY
Infographic:

The role of a CISO

Source: Louis Botha



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The Payment Security Report

Payment Security Report

A “go to” industry resource for the past nine years. The first and only industry research report of its kind to provide a global perspective on the state of payment security.

2010: Complexity and uncertainty
An exploration of the complexity of PCI security, the growing pains of the PCI compliance regulation, and the need to evolve toward a process-driven approach for compliance.

2011: Dealing with evolution
A review of the changing compliance requirements with insights into the importance of sound decision making, and how organizations can position themselves for success

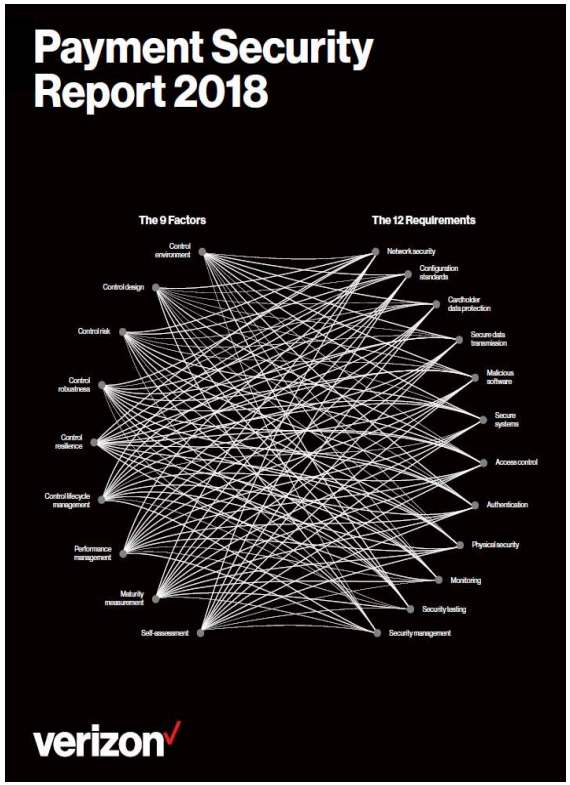
2014: Simplifying complexity
A review of the value of compliance and impact of PCI DSS standard changes, the need for sustainability, how to improve scope reduction and compliance program management.

2015: Achieving sustainability
A focus on improving the sustainability of compliance, a review of the state of scope reduction, payment security innovation and the need to avoid over-reliance on technology.

2016: Developing proficiency
The need to develop data protection proficiency, necessary skills and experience.

2017: Establishing internal control
The importance of establishing and maintaining an internal control environment and a holistic approach, including security control lifecycle management.

Verizon 2018 Payment Security Report



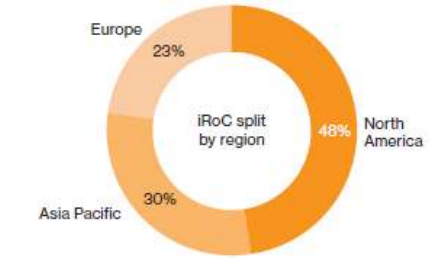


Figure 23. Distribution of iRoC data by region

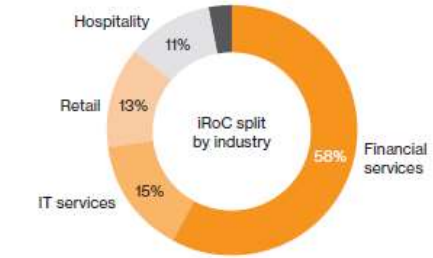


Figure 24. Distribution of iRoC data by industry

Data Protection Sustainability

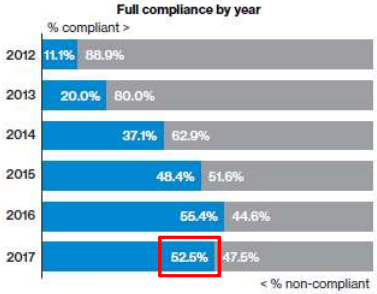


Figure 11. Full compliance at interim assessment by year

Some 52.5% of organizations achieved full compliance at interim PCI DSS validation in 2017. This is a 2.9 percentage point (pp) decrease from 2016 (55.4%). In the 2017 Payment Security Report (page 16), we noted the increases in full compliance have markedly slowed in the last few years and anticipated a possible decline in full compliance.

The Verizon PSR is the only industry report that tracks data protection sustainability using PCI Data Security as a barometer to measure data protection performance of organizations world wide.

Raising awareness about the importance of actively managing an organization's control environment effectives; nearly half (47.5%) of the organizations Verizon assessed during interim PCI DSS compliance validation did not maintain all DSS controls.

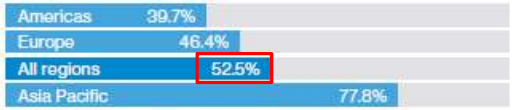


Figure 3. Organizations achieving 100% during interim validation

The majority of organizations across the payment security industry have room for improvement in designing and maintaining sustainable control environments. Trying to address the sustainability problem by attempting to improve it at an individual control level is unlikely to succeed. Control sustainability must start with improving the maturity of the control environment and follow with regular performance measurement.

Worldwide, the top performing industry remains IT services, where over three-quarters of organizations (77.8%) achieved full compliance. Retail (56.3%) and financial services (47.9%) were significantly ahead of hospitality organizations (38.5%) which demonstrated the lowest compliance sustainability.

Control environment management issues

52%

of organizations do NOT map security control dependencies

30%

of organizations use some form of documented control design profile for security controls.

70%

of organizations have no control-to-risk mapping documentation.

34%

of organizations do not use any metrics to measure and track the performance of their controls (apart from compliance validation reporting)

45%

of organizations rate the maturity of their security program as “Operational and Managed” Only 20% rate it as “Advanced”

18%

of organizations (less than a quarter) measure their PCI DSS controls more frequently than what the PCI DSS requires, across their entire environment.

Source: Verizon 2018 Payment Security Report Global PCI DSS Program Management Mini-Survey

Global Industry Problems

An inability to predict the outcomes of their data protection and compliance programs - due to lack of capability maturity in performance measurement and other competencies.

Sustainability Problem:

- Nearly half (47.5%) of the organizations Verizon assessed for interim PCI DSS compliance validation had not maintained all DSS controls.

Standards and Frameworks:

- About a quarter of organizations (22%) do not follow a unified compliance approach , and have no plans to do so in the future either.
- About two-thirds of organizations (66%) use more than one industry standard framework in addition to PCI DSS
- About half of organizations (48%) follow a unified compliance approach to meet requirements from multiple standards.
- About half of organizations (50%) have PCI DSS compliance programs that are not part of a larger GRC program.

Measurement and Reporting:

- In terms of compliance reporting, two fifths (40%) only measure their PCI compliance annually for compliance validation purposes. Less than a quarter (19%) measure and report their PCI DSS compliance monthly.

Source: Verizon 2018 Payment Security Report Global PCI DSS Program Management Mini-Survey

The shortcomings of PCI Data Security compliance

While PCI DSS guidance documents promote risk management and sustainability of controls, none of the versions of PCI DSS to date mandates measurement and reporting of:

- The condition and effectiveness of the control environment
- Individual security control effectiveness
  - Control systems and control dependencies
  - Control risk, control robustness and control resilience
  - Control design
- Control lifecycle management
- Compliance performance management
- Control maturity measurement

The Top 9 Factors

1. Control Environment
2. Control Design
3. Control Risk
4. Control Robustness
5. Control Resilience
6. Control Lifecycle Management
7. Performance Management
8. Maturity Measurement
9. Self-Assessment

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Research report

Top 9 factors of control effectiveness and sustainability

Today's increasingly complex ecosystems with evolving mobile technology, such as IT, IoT, FinTech, blockchain, and the cloud, make measuring the weakest points in compliance practices an additional priority.

About 70 years ago, Abraham Wald, a Hungarian mathematician and the founder of statistical sequential analysis, solved a serious military problem when he addressed the weakest points in World War II fighter aircraft defenses. A member of the Applied Mathematics Panel at Columbia University in Manhattan – a division of the National Defense Research Committee – he was assigned to analyze war-related statistical challenges. His most famous assignment occurred when the United States Air Force asked him to determine how much armor could be added to reinforce the sections of the fighter aircraft that incurred the heaviest damage from enemy fire. Reinforcing the entire plane's armor would add too much weight, compromising maneuverability.

Wald's analysis resulted in surprising conclusions. The military hadn't considered downed aircraft in their assessment. Their investigation only included planes that survived their missions and returned home safely, he pointed out. The sections of the planes with the greatest damage actually were the least vulnerable, his analysis concluded. Wald focused on areas of the planes with the least amount of damage and advised placing extra armor there – on the engines.

Full compliance may sometimes seem impractical or too high a bar to achieve. As the story of Abraham Wald shows, a top priority should be assessing and addressing the most vulnerable areas in a payment security system and reinforcing those concerns. Once the "engine" is better protected, the chances of a nosedive are significantly diminished.

Verizon's Top 9 factors of control effectiveness and sustainability are critical not only to vet out the weakest points in your security system but also to position you with the greatest confidence and maneuverability when facing evolving challenges. For additional insights into the statistical analysis performed by Abraham Wald and how it relates to your data security, see Appendix C.

The 9 factors of control effectiveness and sustainability

Figure 2. A relational model of the 9 factors. Factor 1 is the core from which the other factors emanate. After achieving the objectives of the first 8 factors, the final outcome is the ability to self-assess, the output of which can then be used to improve all the factors.

Valuable Security Books

1. CISO Guidance
2. Program Management
3. General Security Principles and Management
4. Risk Assessment & Management
5. Security Controls & Frameworks
6. Security Measurement & Metrics

Books: CISO Guidance

	YEAR	TITLE	AUTHOR	PUBLISHER	PAGES	ISBN
1	2003	The Information Systems Security Officer's Guide: Establishing and Managing an Information Protection Program	Gerald Kovacich	Butterworth-Heinemann	361	9780750676564
2	2005	The CISO Handbook: A Practical Guide to Securing Your Company 1st Edition	Michael Gentile	Auerbach	352	9780849319525
3	2005	Data Protection and Information Lifecycle Management	Tom Petrocelli	Prentice hall	288	9780131927575
4	2013	CISO and Now What?	Michael Oberlaender	Createspace	102	9781480237414
5	2013	Executive's Guide to COSO Internal Controls: Understanding and Implementing the New Framework	Robert Moeller	Wiley	304	9781118626412
6	2015	Enterprise Cybersecurity: How to Build a Successful Cyberdefense Program Against Advanced Threats	Scott Donaldson, Stanley Siegel, Chris Williams, Abdu Aslam	Apress	536	9781430260820
7	2016	CISO Desk Reference Guide: A Practical Guide for CISO's	Bill Bonney, Gary Hayslip, Matt Stamper	CISODRG	366	9780997744118

Books: Program Management

	YEAR	TITLE	AUTHOR	PUBLISHER	PAGES	ISBN
1	2008	Fundamentals of Effective Program Management: A Process Approach Based on the Global Standard	Paul Sanghera	J. Ross Publishing	344	9781932159691
2	2013	Implementing Program Management: Templates and Forms Aligned with the Standard for Program Management and Other Best Practices 3rd Edition	Ginger Levin, Allen R. Green	Auerbach	328	9781466597716
3	2014	The Handbook of Program Management: How to Facilitate Project Success with Optimal Program Management	James T Brown	McGraw-Hill Education	304	9780071837859
4	2017	The Standard for Program Management Fourth edition	Project Management Institute	Project Management Institute	176	9781628251968
5	2018	Program Management: A Practical Guide	Sorin Dumitrascu	Independent	621	9781976928581

Books: General Security Principles & Management

	YEAR	TITLE	AUTHOR	PUBLISHER	PAGES	ISBN
1	2003	Principles and Practice of Information Security	Linda Volonino & Stephen Robinson	Pearson	256	9780131840270
2	2004	A Practical Guide to Managing Information Security	Steve Purser	Artech House	259	9781580537025
3	2004	Executive Guide to Information Security: Threats, Challenges, and Solutions	Mark Egan, Tim Mather	Addison-Wesley	288	9780321304513
4	2009	Beautiful Security: Leading Security Experts Explain How They Think	Andy Oram, John Viega	O'Reilly Media	304	9780596527488
5	2016	Psychology of Information Security: Resolving Conflicts Between Security Compliance and Human Behaviour	Leron Zinatullin	IT Governance Ltd	128	9781849287890
6	2017	Principles of Information Security 6th Edition	Michael E. Whitman, Herbert J. Mattord	Cengage Learning	656	9781337102063
7	2018	Management of Information Security 6th Edition	Michael E. Whitman, Herbert J. Mattord	Course Technology	672	9781337405713

Books: Risk Assessment & Management

	YEAR	TITLE	AUTHOR	PUBLISHER	PAGES	ISBN
1	1999	Risk Management for Security Professionals	Carl A. Roper	Butterworth-Heinemann	304	9780750671132
2	2001	Information Security Risk Analysis	Thomas R. Peltier	Auerbach	281	9780849308802
3	2002	Managing Information Security Risks: The OCTAVE	Christopher Alberts & Audrey Dorofee	Addison-Wesley	512	9780321118868
4	2005	Security Risk Assessment Handbook: A Complete Guide for Performing Security Risk Assessments, The	Douglas Landoll	Auerbach	473	9780849329982
5	2006	A Practical Guide to Security Assessments	Sudhanshu Kairab	Auerbach	498	9780849317064
6	2009	The Failure of Risk Management: Why It's Broken and How to Fix It	Douglas W. Hubbard	Wiley	281	9780470387955
7	2011	Security Risk Management: Building an Information Security Risk Management Program from the Ground Up	Evan Wheeler	Syngress	340	9781597496155
8	2012	Information Security Risk Assessment Toolkit: Practical Assessments Through Data Collection and Data Analysis	Mark Talabis & Jason Martin	Syngress	258	9781597497350
9	2014	Measuring and Managing Information Risk: A Fair Approach	Jack Freund & Jack Jones	Butterworth-Heinemann	408	9780124202313
10	2016	IT Security Risk Control Management: An Audit Preparation Plan	Raymond Pompon	Apress	311	9781484221396

Books: Security Controls & Frameworks

	YEAR	TITLE	AUTHOR	PUBLISHER	PAGES	ISBN
1	2008	IT Compliance and Controls: Best Practices for Implementation	James J. DeLuccia	Wiley	274	9780470145012
2	2013	Executive's Guide to COSO Internal Controls: Understanding and Implementing the New Framework	Robert Moeller	Wiley	304	9781118626412
3	2015	Internal Control Audit and Compliance: Documentation and Testing Under the New COSO Framework	Lynford Graham	Wiley	416	9781118996218
4	2016	Security Controls Evaluation, Testing, and Assessment Handbook	Leighton Johnson	Syngress	678	9780128023242

Books: Security Measurement & Metrics

	YEAR	TITLE	AUTHOR	PUBLISHER	PAGES	ISBN
1	2005	The Chief Information Security Officer's Toolkit: Security Program Metrics	Fred Cohen	Fred Cohen & Associates	228	9781878109354
2	2007	Security Metrics: Replacing Fear, Uncertainty, and Doubt	Andrew Jaquith	Addison-Wesley	336	9780321349989
3	2007	How to Measure Anything: Finding the Value of "Intangibles" in Business	Douglas Hubbard	John Wiley	287	9780470110126
4	2007	Complete Guide to Security and Privacy Metrics - Measuring regulatory compliance, operational resilience, and ROI	Debra S. Herrmann	Auerbach	824	9780849354021
5	2009	Information Security Management Metrics: A Definitive Guide to Effective Security Monitoring and Measurement	W. Krag Brotby	CRC Press	223	9781420052855
6	2011	Security Metrics, a Beginner's Guide	Caroline Wong	McGraw-Hill	397	9780071744003
7	2013	Pragmatic Information Security Metrics	W. Krag Brotby & Gary Hinson	Auerbach	512	9781439881521
8	2014	Measures and Metrics in Corporate Security	George Campbell	Elsevier	145	9780128006887
9	2015	Measuring and Communicating Security's Value: A Compendium of Metrics for Enterprise Protection	George Campbell	Elsevier	226	9780128028414
10	2016	How to Measure Anything in Cybersecurity Risk	Douglas Hubbard, & Richard Seiersen	Wiley	304	9781119085294

Overview:

The Top Nine Factors of Data Protection Control Effectiveness and Sustainability

Terminology

Cybersecurity	• Protection of digital data and information systems against electronic attacks. The measures taken to protect information systems that store, process or transmit electronic data against the unauthorized access, use, disclosure or harm. Cybersecurity is limited to the protection of electronic/digital data and information only, and exclude protection of physical data.
Information Security	• The ongoing process of exercising due diligence to protect information, and information systems, from unauthorized access, use, disclosure, destruction, modification, disruption or distribution. It includes the design, implementation and evaluation of countermeasures that provide confidentiality, integrity, and availability to counter, prevent, detect, and document threats to digital and non-digital information assets.
Information Assurance	• The overarching approach for identifying, understanding, evaluating and managing risks through an organization's use of information and information systems. It is concerned with the lifecycle of information through the objectives of maintaining the following attributes: confidentiality, integrity, availability, non-repudiation, authentication, possession and utility. Information Assurance is the practice of assuring information and managing risks related to the use, processing, storage, and transmission of information or data and the systems and processes used for those purposes.
Privacy	• The ability of an individual or group to seclude themselves, or information about themselves, and thereby express themselves selectively. It is the requirement to maintain control over one's personal information to determine when, how, and to what extent information is communicated to others. Privacy concerns exist wherever uniquely identifiable data relating to a person are collected and stored, in digital form or otherwise, how data are collected, stored, and associated, and who is given access to information. Other issues include whether an individual has any ownership rights to data about them, and/or the right to view, verify, and challenge that information.

Terminology

Data Protection

- The act of protecting the possession, confidentiality and integrity and authorization of personal and corporate data where controls are implemented to ensure consent and choice, collection limitation, data minimization, use, retention, limitation of disclosure, accuracy and quality, openness, transparency and notice, individual participation and access, accountability, purpose legitimacy, and information security. Data protection focus on the protection of sensitive personal and corporate data that is collected, accessed, updated, stored and disposed of by people and information systems. It includes, inter alia, names, contact information such as physical addresses, phone numbers and email addresses, medical history, banking details, credit ratings, employment records, religious and political opinions.

- Therefore, data protection goes well beyond information security. It is a more comprehensive term which is inclusive of all data elements and selective security measures. It is usually covered by various data protection laws applicable to a specific region, such as the European Union's General Data Protection Regulation (GDPR). Data protection, although mostly focusing on personal data, can also be extended to include the protection of about sensitive corporate data which, when compromised, can harm a corporate entity.

Security Event

- Anything that happens that could potentially have information assurance implications.
  A security event can be any event such as access, use, disclosure, disruption, modification, or destruction of data, information or information systems and other actions that can impact information assurance with the potential to compromise the confidentiality, possession, control, integrity, authenticity, availability and utility of information systems or data.
  For example, a security event can be a system crash, packet floods, unauthorized use of system privileges, etc.

Terminology

Security Incident	• Any observable occurrence in a system or network that violates an organization's security or privacy policies, or compromises the integrity, confidentiality, availability, possession or utility of an information asset. For example, a suspected, attempted, or imminent threat of unauthorized access, use, disclosure, modification, or destruction of data or a system component.
Security Breach	• An act from outside an organization that bypasses or contravenes security policies, practices, or procedures. A similar internal act is called security violation. A security breach can be any confirmed security incident that involves access, use, disclosure, disruption, modification, or destruction of restricted information systems. A security breach differs from a data breach.
Data Breach	• When the security or privacy of data that should be protected is compromised due to the unauthorized acquisition, access, use, or disclosure, or the accidental or unlawful destruction, loss or alteration of protected data. It includes all security incidents where sensitive, protected or confidential data were confirmed to be copied, transmitted, viewed, stolen, used, or altered by a system or individual not unauthorized to do so. A data breach is an incident that results in the confirmed compromise—not just potential exposure—of data to an unauthorized party, as a result of accidental or unlawful breaches of security. It is a violation, transgression, infringement, a gap or breakthrough of restrictions and trust placed on the data and/or the information systems that store, process or transmits the data.
Data Compromise	• See Data Breach - The terms data compromise and data breach can be used interchangeably. Data compromise refers to the exposure of data to elements that violates the restriction placed on data to ensure the trust in its confidentiality, availability, integrity, use, possession, control, authenticity and utility.

Terminology

Sustainability

- A security control, and a control environment can be considered "sustainable" when an organization demonstrates the capacity, capability, competence and commitment needed to main the required level of configuration, functionality and performance of security controls to meet control design specifications and data protection objectives over extended periods of time.

  The level of sustainability can be measured by monitoring the amount of deviations from the established standard of control operation and performance, and tracking the amount of effort, resources (cost, people and time) required to maintain the required status (i.e. performance and effectiveness) of data protection operations.

- See *Control Robustness* and *Control Resilience.*

Technical sustainability:
the investment needed to maintain required configuration and functionality of system components**.**

Administrative sustainability:
the investment needed to communicated and maintain required documentation, and procedures.

Operations sustainability:
the investment needed to maintain required to monitor the operation and performance of a control, to ensure required level of effectiveness.

What prevents data compromises: sustainability (sustainable effectiveness)

The sustainability of a control environment can be measured by the level of robustness and resilience built into control systems and the control environment. Robustness and resilience of the control environment is achieved by maintaining the required capacity, capability, competence and commitment to effectively support the development of a mature data protection program.

QUOTE: 2018PSR - "Sustainable controls are extremely relevant to payment security. They can only be achieved in an environment that is measured and monitored for performance and that identifies weaknesses as they develop. To function well, payment systems need to be regularly maintained with reliable and measurable performance standards."

"Lack of sustainable control environments remains a top contributor and precursor to ineffective controls, which in turn become susceptible to data breaches."

Organizations achieve sustainability by design; i.e., by building sustainability into the functional, operational specifications of the compliance program and reinforcing it through frequent education, training and awareness campaigns."

The 9 Factors of Control Effectiveness and Sustainability

Control Environment
Control Design
Control Risk
Control Robustness
Control Resilience
Lifecycle Management
Performance Measurement
Maturity Measurement
Self-Assessment

The 9 Factors

Factor 1: Control Environment The sustainability and effectiveness of controls depend on a healthy control environment.

Factor 2: Control Design Proper control operation to meet security control objectives depends on sound Control Design.

Factor 3: Control Risk Without on-going maintenance (security testing, risk management, etc.), controls can degrade over time and eventually break down. Mitigation of control failures requires integrated management of Control Risk.

Factor 4: Control Robustness Controls operate in dynamic business and ever-changing threat environments. They must be robust to resist unwanted change to remain functional and perform to specifications (config standards, access control, system hardening, reviews etc.).

Factor 5: Control Resilience Security controls can potentially still fail, despite adding layers of control for increased robustness, therefore control resilience with proactive discovery and quick recovery from failure is essential for effectiveness and sustainability .

Factor 6: SCLM Security Control Lifecycle Management - to achieve all of the above, monitor and manage security controls throughout each stage from inception to retirement.

Factor 7: Performance Management Establishing performance standards (define, communicate, measure)

Factor 8: Maturity Measurement Prevent a stagnant control environment through continuous improvement

Factor 9: Self-Assessment Achieving all of the above requires in-house proficiency; capacity, capability, competency and commitment.

The Top Nine Factors: Control Effectiveness and Sustainability

1. Design and maintain a control environment
2. Design and integrate security controls
3. Measure the control risk of each control
   (inherent risk x residual risk x detection risk)
4. Enhance control robustness
5. Enhance control resilience
6. Maintain control lifecycle management
7. Performance Management
   - Integrated monitoring and reporting
8. Maturity Measurement
   - Continuous improvement
9. Control Evaluation Self-Assessment

F1: Control Environment

An effective control environment is:

"an environment in which **competent** people understand their **responsibilities**, the **limits** of their authority, and are **knowledgeable**, mindful and **committed** to doing what is right and doing it the right way.**"**

Source: Sanjay Anand "Sarbanes-Oxley Guide for Finance and Information Technology Professionals", page 49, chapter three "Control Environment", published by John Wiley & Sons.

F2: Control Design

Documented control profiles:

1. **Control Objective:** define objective of the control / control system
2. **Owner:** assigned ownership and responsibilities
3. **Function:** management, procedural, technical etc.
4. **Control type :** preventative, detective, corrective, directive
5. **Architecture:** system-specific, common, hybrid
6. **Control Risk:** control to risk matrix / mapping
7. **Control Testing:** test procedures and standards
8. **Implementation:** specifications, scope, dependencies
9. **Operation:** specifications, scope, processes, dependencies
10. **Maintenance:** specifications, scope, processes
11. **Performance Metrics:** KPI's and metrics to measure performance
12. **Governance:** related policies, standards and frameworks

- Control Environment
- Control Design
- Control Risk
- Control Robustness
- Control Resilience
- Lifecycle Management
- Performance Measurement
- Maturity Measurement
- Self-Assessment

The Control Landscape

Control Architecture Allocations:

- **System-Specific Controls**
  Controls that provide a security capability for a particular information system only

- **Common Controls**
  Controls that provide a security capability for multiple information systems

- **Hybrid controls**
  Controls that have both system-specific and common characteristics

Detecting Low Proficiency

Ask the right questions:

- Which controls are effective? (and not merely “in place”)
- Which controls fail? When and how?
- What is the impact when a control fails?
- How soon do you detect control failure?
- How quickly do you restore failed controls?
- Was the root cause of failure remedied?

Top performers proactively track the failure rate of their security controls.

Mediocre performers follow a “break / fix" model year-after-year.

Low performers wait for an assessor to point out the control failures.

Control Deficiencies

Deficiency in design exists when:

a. a control necessary to meet the control objective is missing, or

b. an existing control is not properly designed so that, even if the control operates as designed, the control objective would not be met.

Deficiency in operation exists when

a. a properly designed control does not operate as designed, or

b. when a person performing the control does not possess the necessary competence or authority to perform the control effectively.

Source: PCAOB Public Accounting Oversight Board Auditing Standard No. 5 available online at https://pcaobus.org/Standards/Auditing/Pages/Auditing_Standard_5_Appendix_A.aspx

F3: Control Risk

The likelihood and impact of control failure, due to absence or failure of control design or operation.

- Typically caused by controls losing effectiveness over time.
- Continuously measure and monitor:
  - *Inherent risk x Residual risk x Detection risk*

> *" Controls are effective only as long as they mitigate risk to an acceptable risk tolerance. They are often sustainable merely by luck—certainly not by design. "*
>
> ~ Verizon 2017 Payment Security Report

F4: Control Robustness

Robustness: "the ability of a system to resist change without adapting its initial stable configuration

The ability of a control, and/or the control environment, to absorb disturbance and still retain its basic structure and viability to meet control objectives, without the need for intervention.

Control Environment
Control Design
Control Risk
Control Robustness
Control Resilience
Lifecycle Management
Performance Measurement
Maturity Measurement
Self-Assessment

Capacity, Capability, Competence, Commitment

- **Capacity**
  Required number of resources; people, process and technology. You cannot measure, manage, and improve that which you do not have.

- **Capability**
  Ability to direct and apply resources to perform data protection tasks and the processes to support them.

- **Competence**
  Having the skills, knowledge and experience to establish and maintain an operational control environment. This requires a level of maturity in business process management to achieve quality (repeatability and consistency) in each step of the control lifecycle.

- **Commitment**
  Assurance that management and employees will consistently adhere to data protection and compliance programs.

Data protection with consistency:
doing the right things,
in the right manner and
at the right time.

Control Robustness and Resilience

Introduction of the "4 C's Model":

Control robustness relates to the ability of a control to remain effective in meeting its control objective , despite environmental disruption.

A robust control environment is more resistant to attacks and can operate effectively over extended periods of time.

Resilience, in its simplest form, is often defined as the ability to bounce back (or forward). Controls that are able to rapidly recover from disruptive events to resume operating effectively after being exposed to adverse events.

Capacity
An organization's "data protection capacity" can be described as the required amount of resources available to produce or deliver a determined amount of data protection objectives over an extended period. Data protection program performance depends heavily on the organization's ability to acquire and maintain the required number of resources; i.e., the people, processes, technology, time and attention needed to support the program. A threshold of resources is required for a successful program. You cannot measure, manage and improve what your teams cannot capture.

Capability
The ability of the organization to direct and apply resources to perform data protection tasks and the processes to support them. Individuals and teams must have the skills and capacity to perform the necessary actions. You need to determine whether the system components (people, processes, and technology) within your control environment have the awareness, knowledge and understanding to achieve the required standard of performance. Capability does not, however, mean there is an actual desire to apply those skills. They may just have the capability, but motivation and incentives are needed to make data protection and compliance a priority.

Competence
You need to have the knowledge, skills and experience to establish and maintain a sustainable operational control environment. It requires a level of maturity in business process management to achieve quality (repeatability and consistency) in each step of the control life cycle. Agility and flexibility also are needed to change and develop, in light of new situations, and to deal with constant changes in the threat and regulatory landscapes.

Commitment
Assurance that management and employees will consistently adhere to data protection and compliance programs is critical. It demands consistency of application and across-the-board discipline to adhere to standards and programs. In other words, consistency in doing the right things, in the right manner and at the right time.

F5: Control Resilience

Goals.

- **Anticipate:** Maintain a state of informed preparedness.
- **Withstand:** Continue essential functions despite attacks.
- **Recover:** Restore functions to fullest extent possible.
- **Evolve:** Change functions to minimize future adverse effects.

Source: MITRE, "Cyber Resiliency Basics" by Rosalie McQuaid, November 15, 2013
https://www.mitre.org/capabilities/cybersecurity/overview/cybersecurity-blog/cyber-resiliency-basics

Lines of Defense

For data protection to be effective, robust and resilient most organizations deploy four lines of defense:

1. **The individual** at the front line that operates a system or handles certain data
2. **The risk management or compliance team** responsible to guidance and enforce risk and compliance responsibilities
3. **Internal audit** to monitor adherence to policies and standards, and to cross check the performance of the risk and compliance teams
4. **External auditor and regulatory bodies** monitoring compliance to standards and agreements.

You need to manage maintain the “4C’s” (Capacity, Capability, Competence, Commitment) in each of the four lines of defense.

Security Control Lifecycle Management

Introduced in the 2016 & 2017 Payment Security Reports

Security control lifecycle management (SCLM) defines the control support requirements over the life of the control or control system—the journey from its conception and design to the retirement of a control. It's essential that organizations understand how each stage of the control lifecycle influences underlying support processes, operational efficiency and effectiveness of security controls.

The integration of SCLM into security compliance programs helps to prevent the continued degradation of the control environment and can enable and support early identification of control weaknesses.

Figure 9. The security control lifecycle

F7: Performance Measurement

1. Establish **performance standards** for each component of the control environment.

2. Maintain performance measurement program on:
   a. Control environment
   b. Control design, risk, robustness, resilience
   c. Control lifecycle management
   d. Defined metrics

3. Provide ongoing feedback, guidance on corrective actions.

Control Environment
Control Design
Control Risk
Control Robustness
Control Resilience
Lifecycle Management
Performance Measurement
Maturity Measurement
Self-Assessment

F8: Maturity Measurement

Security Control Performance & Maturity

1. **Measuring Control Design:**
   How well it should work in theory

2. **Measuring Control Implementation:**
   How well it actually performs in practice

3. **Measuring Control Monitoring:**
   How we know that it's still working

4. **Measuring Control Evaluation:**
   How frequently we evaluate effectiveness & efficiency

5. **Scoring Control Effectiveness** :
   DIME Model: "Design, Implementation, Monitoring, Evaluation"

Control Environment
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Maturity Measurement
Self-Assessment

Maturity Measurement

In the face of continuing high-profile data breaches, organizations are under pressure to demonstrate control effectiveness and higher degrees of data protection performance—underscoring the need for true data protection proficiency. Maturity models provide a roadmap toward higher proficiency.

Measuring the performance of a control environment and applying metrics for informed, data-driven decision making creates the foundation for structured growth of data protection and compliance capabilities.

Based on our field observations, less than a quarter of organizations apply security metrics, such as control coverage, control effectiveness and operational performance metrics.

Compliance program maturity

Based on the responses to our survey, only 40% of organizations use process maturity models to measure some aspects of their PCI Security compliance program as indication of how close developing processes are to being complete and capable of continual improvement.

One in five (20%) of respondents said they didn't know if they used capability and maturity models – indicating a need for training and awareness.

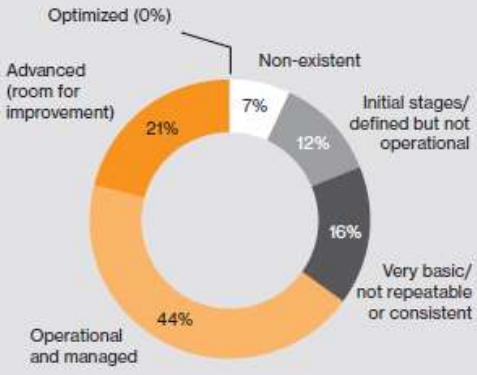
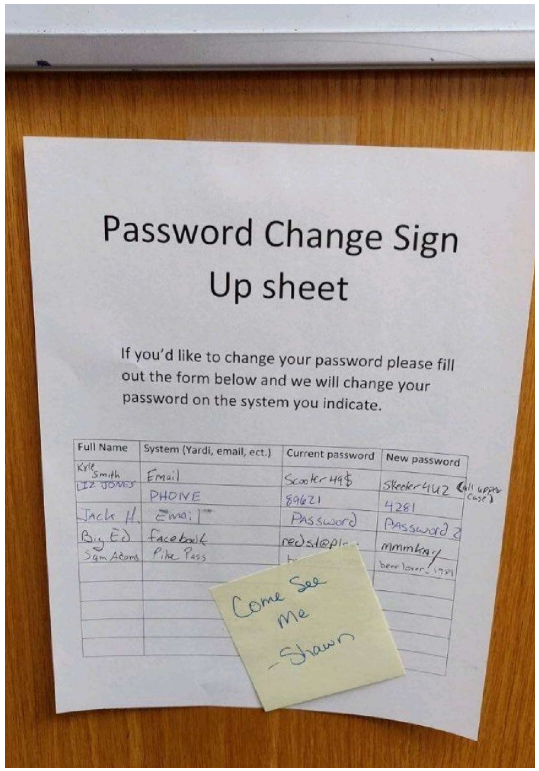


Figure 10. Use of process maturity models

Control Effectiveness: Observations and Analogies

Control Effectiveness: Observations and Analogies



QSA Horror Story

Terrifyingly short

Question: How long would you make your password if storing primary account numbers (PANs) in clear text?

During one assessment, a QSA found an admin account with access to 70 million PANs protected by the weakest password we've ever seen - **a single character**!

The operator's defense was that it was a "special character".

#lame_excuse

Control Effectiveness: Maturity

Control effectiveness	Guide
Fully effective	Nothing more to be done except review and monitor the existing controls.
Substantially effective	Most controls are designed correctly but more work to be done on design, validation.
Partially effective	Some controls are designed correctly and operate effectively, but many need work to ensure they address root causes and/or contributing factors.
Largely ineffective	Significant control gaps exist, or controls do not operate effectively at all.
None or totally ineffective	Management has no confidence that any degree of control is being achieved.

Control Effectiveness

Practical example of application:

- Measuring Control Effectiveness
- Measuring Control Maturity

Control effectiveness guide

Fully effective	Nothing more needs to be done except reviewing and monitoring the existing controls.
Substantially effective	Most controls are designed correctly, but more work needs to be done on design and control validation.
Partially effective	Some controls are designed correctly and operate effectively, but many need work to ensure they address root causes and/or contributing factors.
Largely ineffective	Significant control gaps exist, or controls do not operate effectively at all.
Totally ineffective	Management has no confidence that any degree of control is being achieved.

Figure 20. HB 158:2010, Delivering assurance based on ISO 31000:2009 Risk management – Principles and guidelines[24]

Example of how to measure control effectiveness

An example of applying the DIME model – "Design, Implementation, Monitoring, Evaluation" for scoring the effectiveness of security controls in four steps:

1. Measuring control design: How well it should work in theory
2. Measuring control implementation: How well it actually performs in practice
3. Measuring control monitoring: How we know that it's still working
4. Measuring control evaluation: How frequently we evaluate effectiveness and efficiency

NOTE: If either design or implementation is zero, then total score becomes zero.

Source: Dr John Mitchell, LHS Business Control[25]

Scoring:

1. Measuring control design
How well the control should work, in theory, if it's always applied in the way intended.

Very limited or badly designed, even where used correctly provides little/ no protection	Designed to reduce some areas of risk	Designed to reduce most aspects of risk	Designed to reduce risk aspect entirely
0	1	2	3

2. Measuring control implementation
The way the control performs in practice.

Control is not applied or applied incorrectly	Control is sometimes correctly applied	Control is generally operational but on occasions is not applied as intended	Control is always applied as intended
0	1	2	3

3. Measuring control monitoring
How we know that the control is continuing to operate.

Operation is not monitored at all	Operation is monitored on an ad-hoc basis	Operation is usually monitored but not always	Operation is always monitored
0	1	2	3

4. Measuring control evaluation
How frequently control effectiveness efficiency is evaluated.

Control is never evaluated	Control is evaluated very infrequently	Control is occasionally evaluated for effectiveness/ efficiency	Control is regularly evaluated for effectiveness/ efficiency
0	1	2	3

5. Scoring control effectiveness (no weighting)

Apply DIME.

Design	Implementation	Monitoring	Evaluation
2 (out of 3)	3 (out of 3)	3 (out of 3)	1 (out of 3)
Total = 8/12 = 75% total effectiveness			

Figure 21. The DIME model

Measuring Control Effectiveness

How To - Example:

5. Scoring Control Effectiveness (No Weighting)

Apply DIME:

Design = 2 (3)
Implementation = 3 (3)
Monitoring = 2 (3)
Evaluation = 1 (3)
TOTAL = 8 (12) = 0.75 (75% total effectiveness)

NOTE: If either Design, or Implementation is zero then total score becomes zero

- Control Environment
- Control Design
- Control Risk
- Control Robustness
- Control Resilience
- Lifecycle Management
- Performance Measurement
- Maturity Measurement
- Self-Assessment

Source: *John Mitchell - Measuring Control Effectiveness*
GRC 2.0 -Breaking Down The Silos, ISACA Ireland Conference –3rd October 2014
available at http://www.isaca.org/chapters5/Ireland/Documents/2014%20Presentations/easuring%20Control%20Effectiveness%20-%20John%20Mitchell.pdf

Self-Assessment

Self-assessment is an in-house organizational competency to establish, evaluate and record measurable outcomes for each of the 9 Factors that respectively also includes the assessment of self-assessment capability.

The "four Cs" as framework to develop a self-assessment program:

- evaluate the required number of resources (capacity),
- the ability to direct and apply resources (capability),
- the skills, knowledge and experience (competence),
- and the assurance from management to consistently adhere to compliance and data protection requirements (commitment).

The shortage of skilled professionals is not a new problem.

- In 2017, the US employed nearly 780,000 people in cybersecurity positions, with approximately 350,000 current cybersecurity openings and the same number of openings in Europe.
- Several years ago, estimates were that by 2014, the information security industry would experience a shortage of more than a million security professionals across the globe.
- In 2015, Symantec expected the demand for cybersecurity talent to rise to 6 million globally by 2019, with a projected shortfall of 1.5 million.
- A year later, a skills gap analysis from ISACA estimated a global shortage of 2 million cybersecurity professionals by 2019.
- It is now predicted that 3.5 million cybersecurity job openings will exist by 2021[22].

When struggling with empty positions or a lack of qualified individuals, businesses should find every opportunity to support their currently employed skilled professionals to maximize the value they can deliver. Organizations that rely on external parties to evaluate their internal control environments need to fully integrate learning opportunities to develop their own capabilities for evaluating control effectiveness, control risk, and measuring capability maturity to continue a path toward self-reliance.

F9: Control Self-Assessment

- Establish self-assessment program.
- Standardize assessment methods.
- Develop and maintain assessment procedures.
- Build internal assessment competency to measure, monitor and **proactively** manage factors.
- Self-assess your Capacity, Capability, Competence, and Commitment.

Control Environment
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Integrated Implementation Model

Measuring sustainability and effectiveness by evaluating your 4C's for each factor across every Line of Defense (SE = 4C x 9F x LoD)

Evaluate your 4C's across all 9 Factors for each **Line of Defense:**

1. Individual Accountability
2. Risk Management & Compliance Team
3. Internal Audit
4. External Audit, Regulators

FACTORS	Capacity	Capability	Competence	Commitment
1. Control Environment	✓	✓	✓	✓
2. Control Design	✓	✓	?	✓
3. Control Risk	✓	✓	✓	✓
4. Control Robustness	✓	?	✗	✓
5. Control Resilience	✓	?	✗	✓
6. Lifecycle Management	✗	✓	✓	?
7. Performance Management	✗	✗	✗	?
8. Maturity Measurement	✗	✗	✗	?
9. Self-Assessment	?	✓	?	?

Apply What You Have Learned Today

Lessons learned:

- ***Measure twice, cut once.***
  You seldom get a 2nd change
  at preventing data breaches.

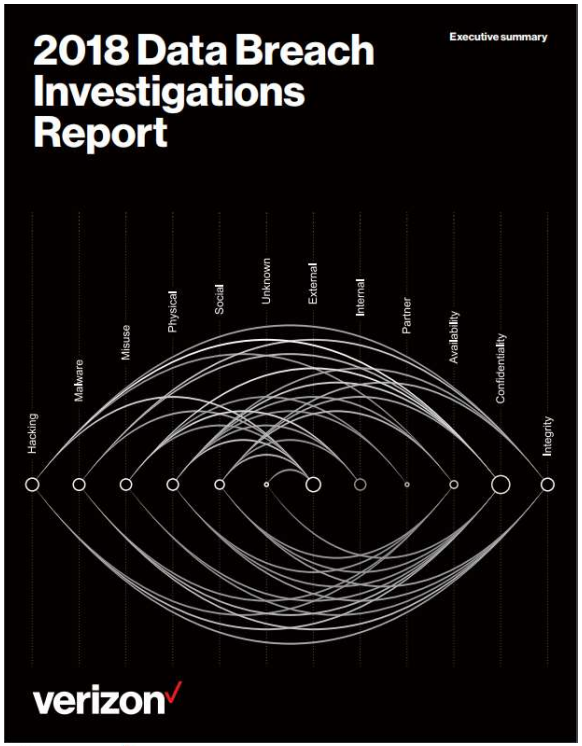
- **Develop your in-house proficiency.**
  Confidence and predictable outcomes
  are achieved through knowledge,
  skill, and experience.

- Do not place mission critical tasks in
  the hands of unqualified resources.

Q&A

√

Breach of PCI-DSS compliant company?



Data for the data breach correlation section is separate from our PCI DSS assessment dataset. It comes from **investigations** on organizations **following a breach of payment card data**.

These **investigations, 237 across 35 countries**, were carried out by our **PFI** group between 2010 and 2017. It is also part of the **Verizon Data Breach Investigations Report**.

In the last 12 years, not a single organization that we have assessed following a data breach was fully PCI DSS compliant at the time of the breach.

Overall, **breached organizations have significantly lower compliance** —there's a 42pp difference in total average PCI DSS
Compliance.

Value of PCI Security Compliance

The following is a list of five payment card data breach scenarios that can apply to organizations that are mandated to comply with the PCI Security regulation. Each scenario indicate the state of PCI Security compliance at the time of the data compromise. They are listed in order of data protection maturity.

1. The organization did not initiate a PCI Security compliance program. They have not yet introduced controls that are aligned to PCI Security requirements into their control environment, and have not attempted to validate their compliance. They are deemed non-compliant with PCI DSS at time of the compromise.

2. The organization initiated a PCI Security compliance program, but have not completed the implementation of the required security controls, and have not validated their compliance. They are deemed non-compliant with PCI DSS at time of the compromise.

3. The organization completed the implementation of their required PCI Security controls and validated their compliance, but subsequently did not maintain their security controls. They are deemed non-compliant with PCI DSS at time of the compromise.

4. The organization implemented all required PCI Security controls, validated their compliance, and maintained all their controls. They subsequently experienced a data compromise while in full compliance with the standard.
   They will be deemed to be compliant with PCI DSS at time of a compromise. This means that the attackers circumvented multiple layers of controls and that the standard is therefore demonstrably flawed as a baseline level of protection.

5. The organization is validated to be in full compliance with PCI Security requirements, and they maintain their compliance year round. In addition they also implement and maintain various other security frameworks and standards that go above and beyond PCI Security requirements. They will be deemed to be compliant with PCI DSS at time of a compromise.

There are no publicly known cases of scenarios 4 and 5 every occurring.

Sidenote: The PCI Security standards are not infallible and does not offer any guarantee of effectiveness to prevent data compromises. Various aspects of the PCI Data Security standard need to be improved. Yet, no disclosed case exist of any organization every experiencing a confirmed payment card data compromise while they were full compliance with any of the PCI Data Security standards, since the release of version 1.1. Such a case has to date not yet been made known.

What prevents data compromises

When people are asked what prevents sensitive data from being compromised by hackers, most people, including IT and Information Security professional will include various security technologies on top of their list of countermeasures – such as "firewalls", "anti-virus", and "password access control systems".
Some will include "system hardening, strong authentication, encryption, and tokenization" on their list of end point-based technology defenses.

However, few will include "integrated risk-based decision making", "security and risk-based processes", "change control", and "maintaining a sustainable control environment" – which are the more likely contributors of effective data protection.

<u>The top 3 key factors that prevent data compromises:</u>

1. **Integrated risk-based decision making, baked into the operational culture of the organization**
2. **The process and capability maturity to design and maintain the effectives of the control systems**
3. **The process and capability maturity to design and maintain the sustainability of the control environment**