OWASP
The Open Web Application Security Project

Cornucopia

Ecommerce Website Edition v1.05

OWASP Cornucopia is a mechanism to assist software development teams identify security requirements in Agile, conventional and formal development processes

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Reviewers

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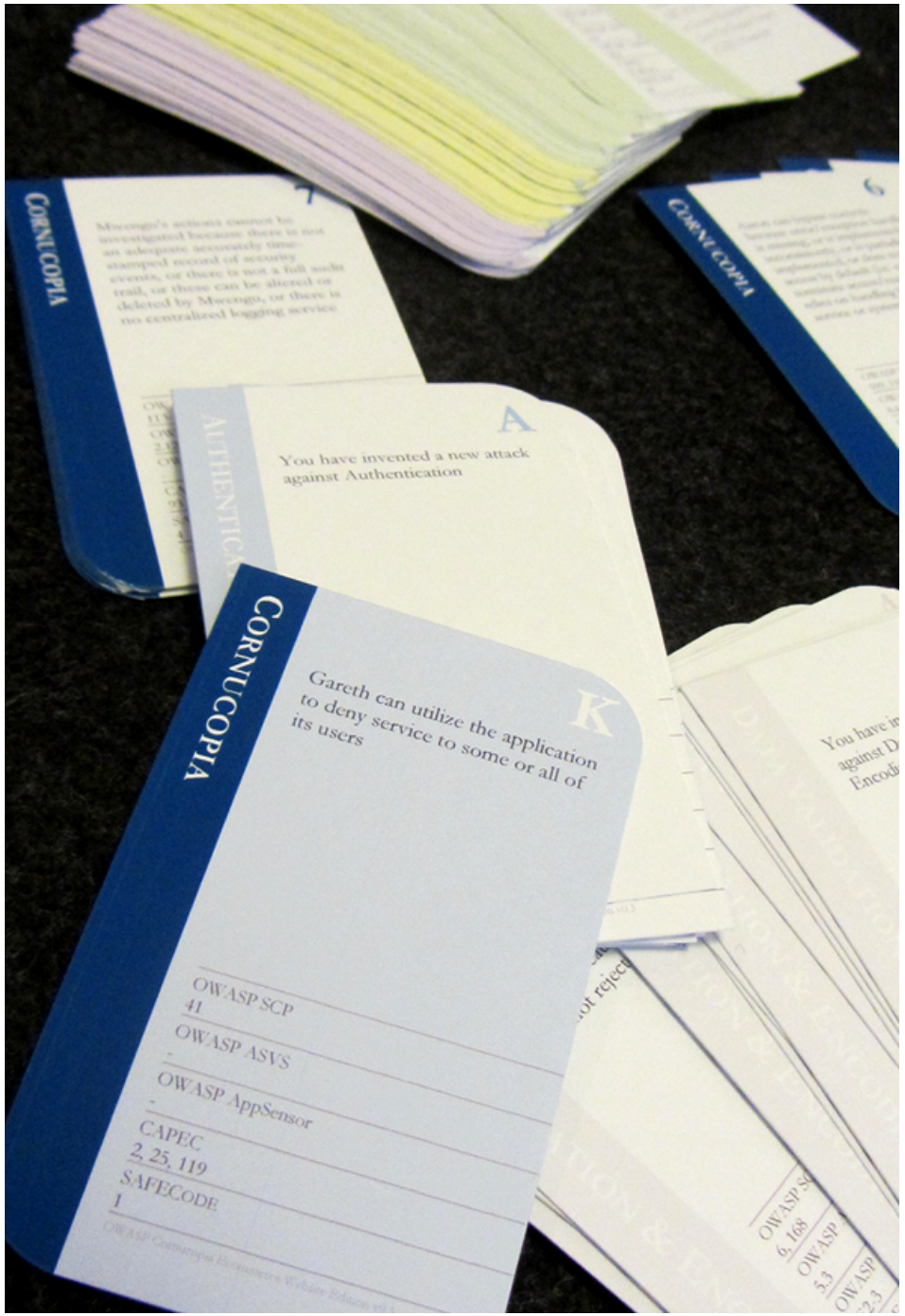
Acknowledgments

Microsoft SDL Team for the Elevation of Privilege Threat Modelling Game, published under a Creative Commons Attribution license, as the inspiration for Cornucopia and from which many ideas, especially the game theory, were copied.

Keith Turpin and contributors to the "OWASP Secure Coding Practices - Quick Reference Guide", originally donated to OWASP by Boeing, which is used as the primary source of security requirements information to formulate the content of the cards.

Contributors, supporters, sponsors and volunteers to the OWASP ASVS, AppSensor and Web Framework Security Matrix projects, Mitre's Common Attack Pattern Enumeration and Classification (CAPEC), and SAFECode's "Practical Security Stories and Security Tasks for Agile Development Environments" which are all used in the cross-references provided.

Playgen for providing an illuminating afternoon seminar on task gamification, and tartanmaker.com for the online tool to help create the card back pattern.



Introduction

The idea behind Cornucopia is to help development teams, especially those using Agile methodologies, to identify application security requirements and develop security-based user stories. Although the idea had been waiting for enough time to progress it, the final motivation came when SAFECode published its Practical Security Stories and Security Tasks for Agile Development Environments in July 2012.

The Microsoft SDL team had already published its super Elevation of Privilege: The Threat Modeling Game (EoP) but that did not seem to address the most appropriate kind of issues that web application development teams mostly have to address. EoP is a great concept and game strategy, and was published under a Creative Commons Attribution License.

Cornucopia Ecommerce Website Edition is based the concepts and game ideas in EoP, but those have been modified to be more relevant to the types of issues ecommerce website developers encounter. It attempts to introduce threat-modelling ideas into development teams that use Agile methodologies, or are more focused on web application weaknesses than other types of software vulnerabilities or are not familiar with STRIDE and DREAD.

Cornucopia Ecommerce Website Edition is referenced as an information resource in the PCI Security Standard Council's Information Supplement PCI DSS E-commerce Guidelines, v2, January 2013.

The card deck (pack)

Instead of EoP's STRIDE suits (sets of cards with matching designs), Cornucopia suits are based on the structure of the OWASP Secure Coding Practices - Quick Reference Guide (SCP), but with additional consideration of sections in the OWASP Application Security Verification Standard, the OWASP Testing Guide and David Rook's Principles of Secure Development. These provided five suits, and a sixth called "Cornucopia" was created for everything else:

- Data validation and encoding (VE)
- Authentication (AT)
- Session management (SM)
- Authorization (AZ)
- Cryptography (CR)
- Cornucopia (C)

Similar to poker-playing cards, each suit contains 13 cards (Ace, 2-10, Jack, Queen and King) but, unlike EoP, there are also two Joker cards. The content was mainly drawn from the SCP.

Mappings

The other driver for Cornucopia is to link the attacks with requirements and verification techniques. An initial aim had been to reference CWE weakness IDs, but these proved too numerous, and instead it was decided to map each card to CAPEC software attack pattern IDs which themselves are mapped to CWEs, so the desired result is achieved.

Each card is also mapped to the 36 primary security stories in the SAFECode document, as well as to the OWASP SCP v2, ASVS 2009 and AppSensor (application attack detection and response) to help teams create their own security-related stories for use in Agile processes.

Game strategy

Apart from the content differences, the game rules are virtually identical to those for EoP.

Printing the cards

The cards can be printed in black & white but are more effective in color. The cards in the later pages of this document have been laid out to fit on one type of pre-scored business A4 card sheets. This appeared to be the quickest way to initially provide to create playing cards quickly. Avery product codes C32015 and C32030 have been tested successfully, but any 10 up 85mm x 54 mm cards on A4 paper should work with a little adjustment. Other stationery suppliers like Ryman and Sigel produce similar sheets. These card sheets are not inexpensive, so care should be taken in deciding what to print and using what media and printer type.

The cards can of course just be printed on any size of paper or card and then cut-up manually, or a commercial printer would be able to print larger volumes and cut the cards to size. The cut lines are shown on the penultimate page of this document, but Avery also produce a landscape A4 template (A-0017-01_L.doc) that can be used as a guide.

Printing and cutting up can take an hour or so, and using a faster printer helps. Try to print add higher quality to increase legibility.

An optional card back design (in OWASP tartan) has been provided as the last page of this document. There is no special alignment needed. Dual-sided printing needs special care taken.

You could customize the card faces or the backs for your own organization's preferences.

Customization

After you have used Cornucopia a few times, you may feel that some cards are less relevant to your applications, or the threats are different for your organization. Edit this document yourself to make the cards more suitable for your teams, or create new decks completely.

Provide feedback

If you have ideas or feedback on the use of OWASP Cornucopia, please share them. Even better if you create alternative versions of the cards, or produce professional print-ready versions, please share that with the volunteers who created this edition and with the wider application development and application security community.

The best place to use to discuss or contribute is the mailing list for the OWASP project:

- Mailing list
  https://lists.owasp.org/mailman/listinfo/owasp_cornucopia
- Project home page
  https://www.owasp.org/index.php/OWASP_Cornucopia

Instructions

The text on each card describes an attack, but the attacker is given a name, which are unique across all the cards. The name can represent a computer system (e.g. the database, the file system, another application, a related service, a botnet), an individual person (e.g. a citizen, a customer, a client, an employee, a criminal, a spy), or even a group of people (e.g. a competitive organization, activists with a common cause). The attacker might be remote in some other device/location, or local/internal with access to the same device, host or network as the application is running on. The attacker is always named at the start of each description. An example is:

> *William has control over the generation of session identifiers*

This means the attacker (William) can create new session identifiers that the application accepts.

The attacks were primarily drawn from the security requirements listed in the SCP, v2 but then supplemented with verification objectives from the OWASP "Application Security Verification Standard for Web Applications (2009)", the security focused stories in SAFECode's "Practical Security Stories and Security Tasks for Agile Development Environments", and finally a review of the cards in EOP.

Lookups between the attacks and five resources are provided on most cards:

- Requirements in "Secure Coding Practices (SCP) - Quick Reference Guide", v2, OWASP, November 2010
  https://www.owasp.org/index.php/File:OWASP_SCP_Quick_Reference_Guide_v2.pdf
- Verification IDs in "Application Security Verification Standard (ASVS) for Web Applications", OWASP, 2009
  http://www.owasp.org/images/4/4e/OWASP_ASVS_2009_Web_App_Std_Release.pdf
- Attack detection points IDs in "AppSensor", OWASP, August 2012
  https://www.owasp.org/index.php/AppSensor_DetectionPoints
- IDs in "Common Attack Pattern Enumeration and Classification (CAPEC)", v1.7.1, Mitre Corporation, May 2012
  http://capec.mitre.org/data/
  http://capec.mitre.org/data/archive/capec_v1.7.1.zip
- Security-focused stories in "Practical Security Stories and Security Tasks for Agile Development Environments", SAFECode, July 2012
  http://www.safecode.org/publications/SAFECode_Agile_Dev_Security0712.pdf

A look-up means the attack is included within the referenced item, but does not necessarily encompass the whole of its intent. For structured data like CAPEC, the most specific reference is provided but sometimes a cross-reference is provided that also has more specific (child) examples. There are no lookups on the six Aces and two Jokers. Instead these cards have some general tips in italicized text.

It is possible to play Cornucopia in many different ways. Here is one way.

A - Preparations

A1. Print out a deck of Cornucopia cards (see page 2 of this document) and separate/cut out the cards
A2. Identify an application or application process to review; this might be a concept, design or an actual implementation
A3. Create a data flow diagram
A4. Identify and invite a group of 3-6 architects, developers, testers and other business stakeholders together and sit around a table (try to include someone fairly familiar with application security)
A5. Have some prizes to hand (gold stars, chocolate, pizza, beer or flowers depending upon your office culture)

B - Play

One suit - *Cornucopia* - acts as trumps. Aces are high (i.e. they beat Kings). It helps if there is someone dedicated to documenting the results, who is not playing.

B1. Remove the Jokers and a few low-score (2, 3, 4) cards from *Cornucopia* suit to ensure each player will have the same number of cards
B2. Shuffle the deck and deal all the cards
B3. To begin, choose a player randomly who will play the first card - they can play any card from their hand except from the trump suit - *Cornucopia*
B4. To play a card, each player must read it out aloud, and explain how (or not) the threat could apply (the player gets a point for attacks that work, and the group thinks it is an actionable bug) - don't try to think of mitigations at this stage, and don't exclude a threat just because it is believed it is already mitigated - someone record the card on the score sheet
B5. Play clockwise, each person must play a card in the same way; if you have any card of the matching lead suit you must play one of those, otherwise they can play a card from any other suit. Only a higher card of the same suit, or the highest card in the trump suit *Cornucopia*, wins the hand.
B6. The person who wins the round, leads the next round (i.e. they play first), and thus defines the next lead suit
B7. Repeat until all the cards are played

C - Scoring

The objective is to identify applicable threats, and win hands (rounds):

C1. Score +1 for each card you can identify as a valid threat to the application under consideration
C2. Score +1 if you win a round
C3. Once all cards have been played, whoever has the most points wins

D - Closure

D1. Review all the applicable threats and the matching security requirements
D2. Create user stories, specifications and test cases as required for your development methodology.

Alternative game rules

If you are new to the game, remove the Aces and two Joker cards to begin with. Add the Joker cards back in once people become more familiar with the process. Apart from the "trumps card game" rules described above which are very similar to the EoP, the deck can also be played as the "twenty-one card game" (also known as "pontoon" or "blackjack") which normally reduces the number of cards played in each round.

Practice on an imaginary application, or even a future planned application, rather than trying to find fault with existing applications until the participants are happy with the usefulness of the game.

Consider just playing with one suit to make a shorter session – but try to cover all the suits for every project. Or even better just play one hand with some pre-selected cards, and score only on the ability to identify security requirements. Perhaps have one game of each suit each day for a week or so, if the participants cannot spare long enough for a full deck.

Some teams have preferred to play a full hand of cards, and then discuss what is on the cards after each round (instead of after each person plays a card).

Another suggestion is that if a player fails to identify the card is relevant, allow other players to suggest ideas, and potentially let them gain the point for the card. Consider allowing extra points for especially good contributions.

You can even play by yourself. Just use the cards to act as thought-provokers. Involving more people will be beneficial though.

In Microsoft's EoP guidance, they recommend cheating as a good game strategy.

Development framework-specific modified card decks

At the end of 2012, the OWASP Framework Security Matrix was published which documents built in security controls in some commonly used languages and frameworks for web and mobile application development. With certain provisos it is useful to consider how using these controls can simplify the identification of additional requirements – provided of course the controls are included, enabled and configured correctly.

Consider removing the following cards from the decks if you are confidence they are addressed by the way you are using the language/framework. Items in parentheses are "maybes".

Internal coding standards and libraries

Add your own list of excluded cards based on your organisation's coding standards (provided they are confirmed by appropriate verification steps in the development lifecycle).

Your coding standards and libraries		
Data validation and encoding *[your list]*	Session management *[your list]*	Cryptography *[your list]*
Authentication *[your list]*	Authorization *[your list]*	Cornucopia *[your list]*

Compliance requirement decks

Create a smaller deck by only including cards for a particular compliance requirement.

Compliance requirement		
Data validation and encoding *[compliance list]*	Session management *[compliance list]*	Cryptography *[compliance list]*
Authentication *[compliance list]*	Authorization *[compliance list]*	Cornucopia *[compliance list]*

Frequently asked questions

1. Can I copy or edit the game?
Yes of course. All OWASP materials are free to do with as you like provided you comply with the Creative Commons Attribution-ShareAlike 3.0 license. Perhaps if you create a new version, you might donate it to the OWASP Cornucopia Project?

2. How can I get involved?
Please send ideas or offers of help to the project's mailing list.

3. How were the attackers' names chosen?
EoP begins every description with words like "An attacker can...". These have to be phrased as an attack but I was not keen on the anonymous terminology, wanting something more engaging, and therefore used personal names. These can be thought of as external or internal people or aliases for computer systems. But instead of just random names, I thought how they might reflect the OWASP community aspect. Therefore, apart from "Alice and Bob", I use the given (first) names of current and recent OWASP employees and Board members (assigned in no order), and then randomly selected the remaining 50 or so names from the current list of paying individual OWASP members. No name was used more than once, and where people had provided two personal names, I dropped one part to try to ensure no-one can be easily identified. Names were not deliberately allocated to any particular attack, defence or requirement. The cultural and gender mix simply reflects theses sources of names, and is not meant to be world-representative.

4. Why aren't there any images on the card faces?
There is quite a lot of text on the cards, and the cross-referencing takes up space too. But it would be great to have additional design elements included. Any volunteer

5. Are the attacks ranked by the number on the card?
Only approximately. The risk will be application and organisation dependent, due to varying security and compliance requirements, so your own severity rating may place the cards in some other order than the numbers on the cards.

6. How long does it take to play a round of cards using the full deck?
This depends upon the amount of discussion and how familiar the players are with application security concepts. But perhaps allow 1.5 to 2.0 hours for 4-6 people.

7. What sort of people should play the game?
Always try to have a mix of roles who can contribute alternative perspectives. But include someone who has a reasonable knowledge of application vulnerability terminology. Otherwise try to include a mix of architects, developers, testers and a relevant project manager or business owner.

8. Who should take notes and record scores?
It is better if that someone else, not playing the game, takes notes about the requirements identified and issues discussed. This could be used as training for a more junior developer, or performed by the project manager. Some organisations have made a recording to review afterwards when the requirements are written up more formally.

9. Should we always use the full deck of cards?
No. A smaller deck is quicker to play. Start your first game with only enough cards for two or three rounds. Always consider removing cards that are not appropriate at all of the target application or function being reviewed. For the first few times people play the game it is also usually better to remove the Aces and the two Jokers. It is also usual to play the game without any trumps suit until people are more familiar with the idea.

10. What should players do when they have an Ace card that says "invented a new X attack"?
The player can make up any attack they think is valid, but must match the suit of the card e.g. data validation and encoding). With players new to the game, it can be better to remove these to begin with (see also FAQ 9).

Score sheet 1/3 - Requirements

No	Card	Player	Notes on Requirement
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

No	Card	Player	Notes on Requirement
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			

Score sheet 2/3 - Requirements

No	Card	Player	Notes on Requirement
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
51			
52			
53			
54			
55			
56			
57			
58			
59			
60			

No	Card	Player	Notes on Requirement
61			
62			
63			
64			
65			
66			
67			
68			
69			
70			
71			
72			
73			
74			
75			
76			
77			
78			
79			
80			

Score sheet 3/3 - Players

Name	Requirements Tally	Sub-total	Rounds Tally	Sub-total	Total	Rank

DATA VALIDATION & ENCODING

A

You have invented a new attack against Data Validation and Encoding

Read more about this topic in OWASP's free Cheat Sheets on Input Validation, XSS Prevention, DOM-based XSS Prevention, SQL Injection Prevention, and Query Parameterization

DATA VALIDATION & ENCODING

(no card)

DATA VALIDATION & ENCODING

2

Brian can gather information about the underlying configurations, schemas, logic, code, software, services and infrastructure due to the content of error messages, or due to poor configuration, or due to the presence of default installation files or old, test, backup or copies of resources, or exposure of source code

OWASP SCP 69, 107-109, 136, 137, 153, 156, 158, 162
OWASP ASVS 4.5, 8.1, 8.2
OWASP AppSensor HT1-3
CAPEC 54, 224
SAFECODE 4, 23

DATA VALIDATION & ENCODING

3

Robert can input malicious structured or unstructured data because the allowed protocol format is not being checked, or the structure is not being verified, or the individual data elements are not being validated for format, type, range, length and a whitelist of allowed characters or formats

OWASP SCP 8, 9, 11-14, 16, 159, 190, 191
OWASP ASVS 5.2, 11.2, 11.3, 11.6
OWASP AppSensor RE7-8, AE4-7, IE2-3,CIE1,CIE3-4,HT1-3
CAPEC 28,48,126,165,213,220,221,257,261,271,272
SAFECODE 3, 16, 24, 35

DATA VALIDATION & ENCODING

4

Dave can input malicious data because it is not being checked within the context of the current user and process

OWASP SCP 8, 10, 183
OWASP ASVS 5.2, 11.1
OWASP AppSensor RE3-6,AE8-11,SE1,3-6,IE2-4,HT1-3
CAPEC 28, 31, 48, 126, 162, 165, 213, 220, 221,261
SAFECODE 24, 35

DATA VALIDATION & ENCODING

5

Jee can bypass the centralized encoding routines since they are not being used comprehensively, or the wrong encodings are being used for the context

OWASP SCP 3, 15, 18-22 168
OWASP ASVS 6.9
OWASP AppSensor -
CAPEC 28, 31, 152, 160, 468
SAFECODE 2, 17

DATA VALIDATION & ENCODING

6

Jason can bypass the centralized validation routines since they are not being used comprehensively on all inputs

OWASP SCP 3, 168
OWASP ASVS 5.2, 5.6, 6.9
OWASP AppSensor IE2-3
CAPEC 28
SAFECODE 3, 16, 24

DATA VALIDATION & ENCODING

7

Jan can craft special payloads to foil input validation because the character set is not specified/enforced, or the data is encoded multiple times, or the data is not fully converted into the same format the application uses (e.g. canonicalization) before being validated, or variables are not strongly typed

OWASP SCP 4, 5, 7, 150
OWASP ASVS 5.4, 5.8, 10.9
OWASP AppSensor IE2-3, EE1-2
CAPEC 28, 153, 165
SAFECODE 3, 16, 24

Data Validation & Encoding

8

Sarah can bypass the centralized sanitization routines since they are not being used comprehensively for all sanitization

OWASP SCP 15, 169
OWASP ASVS 6.9, 8.7
OWASP AppSensor -
CAPEC 28, 31, 152, 160, 468
SAFECode 2, 17

Data Validation & Encoding

9

Shamun can bypass input validation or output validation checks because validation failures are not rejected or sanitized

OWASP SCP 6, 21, 22, 168
OWASP ASVS 5.3
OWASP AppSensor IE2-3
CAPEC 28
SAFECode 3, 16, 24

Data Validation & Encoding

10

Jerry can exploit the trust the application places in a source of data (e.g. user-definable data, manipulation of locally stored data, alteration to state data on a client device, lack of verification of identity such as Jerry can pretend to be Colin)

OWASP SCP 2, 19, 92, 95, 180
OWASP ASVS 10.6
OWASP AppSensor IE4, IE5
CAPEC 12, 51, 57, 90,111,145,194,195,202,218,463
SAFECode 14

Data Validation & Encoding

J

Dennis has control over input validation, output validation or output encoding code/routines so they can be bypassed

OWASP SCP 1, 17
OWASP ASVS 5.5, 6.2
OWASP AppSensor RE3, RE4
CAPEC 56, 87, 207
SAFECode 2, 17

Data Validation & Encoding

Q

Geoff can inject data into a client or device interpreter because a parameterised interface is not being used, or has not been implemented correctly, or the data has not been encoded correctly for the context, or there is no restrictive policy on code or data includes

OWASP SCP 10, 15, 16, 19, 20
OWASP ASVS 6.1, 6.3, 6.8
OWASP AppSensor IE1, RP3
CAPEC 28, 31, 152, 160, 468
SAFECode 2, 17

Data Validation & Encoding

K

Gabe can inject data into an server-side interpreter (e.g. SQL, OS commands, Xpath, Server JavaScript, SMTP) because a strongly typed parameterised interface is not being used or has not been implemented correctly

OWASP SCP 15, 19-22, 167, 180, 204, 211, 212
OWASP ASVS 6.3, 6.4, 6.5, 6.6, 6.7, 6.8
OWASP AppSensor CIE1-2
CAPEC 23, 28, 76, 152, 160, 261
SAFECode 2, 19, 20

(no card)

(no card)

AUTHENTICATION

A

You have invented a new attack against Authentication

Read more about this topic in OWASP's free Authentication Cheat Sheet

AUTHENTICATION

4

Sebastien can easily identify user names or can enumerate them

OWASP SCP 33, 53
OWASP ASVS -
OWASP AppSensor AE1
CAPEC 383
SAFECode 28

AUTHENTICATION

(no card)

AUTHENTICATION

5

Javier can use default, test or easily guessable credentials to authenticate, or can use an old account or an account not necessary for the application

OWASP SCP 54, 175, 178
OWASP ASVS -
OWASP AppSensor AE12, HT3
CAPEC 70
SAFECode 28

AUTHENTICATION

2

James can undertake authentication functions (e.g. attempt to log in, log in with stolen credentials, reset the password) without the real user ever being aware this has occurred

OWASP SCP 47, 52
OWASP ASVS 2.12
OWASP AppSensor UT1
CAPEC -
SAFECode 28

AUTHENTICATION

6

Sven can reuse a temporary password because the user does not have to change it on first use, or it has too long or no expiry

OWASP SCP 37, 45, 46, 178
OWASP ASVS -
OWASP AppSensor -
CAPEC 50
SAFECode 28

AUTHENTICATION

3

Muhammad can obtain a user's password or other secrets such as security questions, by observation during entry, or from a local cache, or in transit, or by reading it from some unprotected location, or because it is widely known, or because it never expires, or because the user cannot change her own password

OWASP SCP 36-7, 40, 43, 48, 51, 119, 139-40, 146
OWASP ASVS 2.2, 2.8, 2.10, 8.10, 9.1, 9.4
OWASP AppSensor -
CAPEC 37
SAFECode 28

AUTHENTICATION

7

Cecilia can use brute force and dictionary attacks against one or many accounts without limit, or these attacks are simplified due to insufficient complexity, length, expiration and re-use requirements for passwords

OWASP SCP 33, 38, 39, 41, 50, 53
OWASP ASVS 2.3
OWASP AppSensor AE2, AE3
CAPEC 2, 16
SAFECode 27

AUTHENTICATION

8

Kate can by bypass authentication because it does not fail secure (i.e. it defaults to allowing access)

OWASP SCP 28
OWASP ASVS 2.5
OWASP AppSensor -
CAPEC 115
SAFECODE 28

AUTHENTICATION

9

Claudia can undertake more critical functions because authentication requirements are too weak, or there is no requirement to re-authenticate for these

OWASP SCP 55, 56
OWASP ASVS 2.6, 2.9
OWASP AppSensor -
CAPEC 21
SAFECODE 14, 28

AUTHENTICATION

10

Pravin can bypass authentication controls because a centralized standard, tested and approved authentication module/framework/service, separate to the resource being requested, is not being used

OWASP SCP 25, 26, 27
OWASP ASVS 2.11
OWASP AppSensor -
CAPEC 90, 115
SAFECODE 14, 28

AUTHENTICATION

J

Mark can access resources or services because there is no authentication requirement, or it was assumed authentication would be undertaken by some other system, or was performed in some previous action

OWASP SCP 23, 32, 34
OWASP ASVS 2.1
OWASP AppSensor -
CAPEC 115
SAFECODE 14, 28

AUTHENTICATION

Q

Jaime can bypass authentication because it is not enforced comprehensively across all entry points, modules, functions, content and other data, or is not applied with equal rigor for all types of authentication functionality (e.g. register, password change, password recovery, log out, administration)

OWASP SCP 23, 29, 42, 49
OWASP ASVS 2.1, 2.7
OWASP AppSensor -
CAPEC 36, 50, 115, 121, 179
SAFECODE 14, 28

AUTHENTICATION

K

Olga can influence or alter authentication code/routines so they can be bypassed

OWASP SCP 24
OWASP ASVS 2.4
OWASP AppSensor -
CAPEC 115, 207
SAFECODE 14, 28

(no card)

(no card)

SESSION MANAGEMENT

A

You have invented a new attack against Session Management

Read more about this topic in OWASP's free Cheat Sheets on Session Management, and Cross Site Request Forgery (CSRF) Prevention

SESSION MANAGEMENT

(no card)

SESSION MANAGEMENT

2

William has control over the generation of session identifiers

OWASP SCP 58, 59
OWASP ASVS 3.9
OWASP AppSensor SE2
CAPEC 31, 60, 61
SAFECODE 28

SESSION MANAGEMENT

3

Ryan can use a single account in parallel since concurrent sessions are allowed

OWASP SCP 68
OWASP ASVS -
OWASP AppSensor -
CAPEC -
SAFECODE 28

SESSION MANAGEMENT

4

Alison can set session identification cookies on another web application because the domain and path are not restricted sufficiently

OWASP SCP 59, 61
OWASP ASVS 3.12
OWASP AppSensor SE2
CAPEC 31, 61
SAFECODE 28

SESSION MANAGEMENT

5

John can predict or guess session identifiers because they are not changed when the user's role alters (e.g. pre and post authentication) and when switching between non-encrypted and encrypted communications, or are not sufficiently long and random, or are not changed periodically

OWASP SCP 60, 62, 66, 67, 71, 72
OWASP ASVS 3.6, 3.7, 3.8, 3.11
OWASP AppSensor SE4-6
CAPEC 31
SAFECODE 28

SESSION MANAGEMENT

6

Gary can take over a user's session because there is a long or no inactivity timeout, or a long or no overall session time limit, or the same session can be used from more than one device/location

OWASP SCP 64, 65
OWASP ASVS 3.3, 3.10
OWASP AppSensor SE5, SE6
CAPEC 21
SAFECODE 28

SESSION MANAGEMENT

7

Casey can utilize Adam's session after he has finished, because there is no log out function, or he cannot easily log out, or log out does not properly terminate the session

OWASP SCP 62, 63
OWASP ASVS 3.2, 3.4, 3.8
OWASP AppSensor -
CAPEC 21
SAFECODE 28

SESSION MANAGEMENT

8

Matt can abuse long sessions because the application does not require periodic re-authentication to check if privileges have changed

OWASP SCP 96
OWASP ASVS -
OWASP AppSensor -
CAPEC 21
SAFECODE 28

SESSION MANAGEMENT

9

Ivan can steal session identifiers because they are sent over insecure channels, or are logged, or are revealed in error messages, or are included in URLs, or are accessible un-necessarily by code which the attacker can influence or alter

OWASP SCP 69, 75, 76, 119, 138
OWASP ASVS 3.5, 8.10, 11.4
OWASP AppSensor SE4-6
CAPEC 31, 60
SAFECODE 28

SESSION MANAGEMENT

10

Marce can forge requests because per-session, or per-request for more critical actions, strong random tokens or similar are not being used for actions that change state

OWASP SCP 73, 74
OWASP ASVS 11.7
OWASP AppSensor IE4
CAPEC 62, 111
SAFECODE 18

SESSION MANAGEMENT

J

Jeff can resend an identical repeat interaction (e.g. HTTP request, signal, button press) and it is accepted, not rejected

OWASP SCP -
OWASP ASVS -
OWASP AppSensor IE5
CAPEC 60
SAFECODE 12, 14

SESSION MANAGEMENT

Q

Salim can bypass session management because it is not applied comprehensively and consistently across the application

OWASP SCP 58
OWASP ASVS 3.1
OWASP AppSensor -
CAPEC 21
SAFECODE 14, 28

SESSION MANAGEMENT

K

Peter can bypass the session management controls because they have been self-built and/or are weak, instead of using a standard framework or approved tested module

OWASP SCP 58, 60
OWASP ASVS 3.1
OWASP AppSensor -
CAPEC 21
SAFECODE 14, 28

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AUTHORIZATION

A

You have invented a new attack against Authorization

Read more about this topic in OWASP's Development and Testing Guides

AUTHORIZATION

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AUTHORIZATION

2

Tim can influence where data is sent or forwarded to

OWASP SCP 44
OWASP ASVS 4.1, 4.2, 4.3, 4.4, 4.6
OWASP AppSensor -
CAPEC 153
SAFECODE 8, 10, 11

AUTHORIZATION

3

Christian can access (read, write, update or delete) information, which they should not have permission to, through another mechanism that does have permission (e.g. search indexer, logger, reporting), or because it is cached, or kept for longer than necessary, or other information leakage

OWASP SCP 51, 100, 135, 139, 140, 141, 150
OWASP ASVS 3.5, 4.1, 8.7, 8.10, 9.1, 9.2, 9.3, 9.4, 9.5, 9.6
OWASP AppSensor -
CAPEC 69, 213
SAFECODE 8, 10, 11

AUTHORIZATION

4

Kelly can bypass authorization controls because they do not fail securely (i.e. they default to allowing access)

OWASP SCP 79, 80
OWASP ASVS 4.8
OWASP AppSensor -
CAPEC 122
SAFECODE 8, 10, 11

AUTHORIZATION

5

Chad can access resources (including services, processes, AJAX, Flash, video, images, documents, temporary files, session data, system properties, configuration data, registry settings, logs) he should not be able to due to missing authorization, or due to excessive privileges (e.g. not using the principle of least privilege)

OWASP SCP 70,81,83-4,87-9, 99,117,131-2,142,154,170,179
OWASP ASVS 4.1, 4.2, 4.3, 4.4, 4.6, 8.7, 10.7
OWASP AppSensor ACE1-4, HT2
CAPEC 75, 87, 95, 126, 149, 155, 203, 213, 264-5
SAFECODE 8, 10, 11, 13

AUTHORIZATION

6

Eduardo can access data he does not have permission to, even though he has permission to the form/page/URL/entry point

OWASP SCP 81, 88, 131
OWASP ASVS 4.1, 4.3, 4.4, 4.6, 4.7
OWASP AppSensor ACE1-4
CAPEC 122
SAFECODE 8, 10, 11

AUTHORIZATION

7

Yuanjing can access application functions, objects, or properties he is not authorized to access

OWASP SCP 81, 85, 86, 131
OWASP ASVS 4.1, 4.2, 4.3, 4.4, 4.6
OWASP AppSensor ACE1-4
CAPEC 122
SAFECODE 8, 10, 11

AUTHORIZATION

8

Tom can bypass business rules by altering the usual process sequence or flow, or by undertaking the process in the incorrect order, or by manipulating date and time values used by the application, or by using valid features for unintended purposes, or by otherwise manipulating control data

OWASP SCP 10, 32, 93, 94, 189
OWASP ASVS 4.1, 4.2, 4.3, 4.4, 4.6, 4.12
OWASP AppSensor ACE3
CAPEC 25, 39, 74, 162, 166, 207
SAFECODE 8, 10, 11, 12

AUTHORIZATION

9

Mike can misuse an application by using a valid feature too fast, or too frequently, or other way that is not intended, or consumes the application's resources, or causes race conditions, or over-utilizes a feature

OWASP SCP 94
OWASP ASVS 4.12
OWASP AppSensor AE3, FIO1-2, UT2-4, STE1-3
CAPEC 26, 29, 119, 261
SAFECODE 1, 35

AUTHORIZATION

10

Richard can bypass the centralized authorization controls since they are not being used comprehensively on all interactions

OWASP SCP 78, 91
OWASP ASVS 4.13, 4.14
OWASP AppSensor ACE1-4
CAPEC 36, 95, 121, 179
SAFECODE 8, 10, 11

AUTHORIZATION

J

Dinis can access security configuration information, or access control lists

OWASP SCP 89, 90
OWASP ASVS 4.10, 12.1, 14.1
OWASP AppSensor -
CAPEC 75, 133, 203
SAFECODE 8, 10, 11

AUTHORIZATION

Q

Christopher can inject a command that the application will run at a higher privilege level

OWASP SCP 209
OWASP ASVS -
OWASP AppSensor -
CAPEC 17, 30, 69, 234
SAFECODE 8, 10, 11

AUTHORIZATION

K

Ryan can influence or alter authorization controls and permissions, and can therefore bypass them

OWASP SCP 77, 89, 91
OWASP ASVS 4.9, 4.10, 4.11, 14.1
OWASP AppSensor -
CAPEC 56, 207, 211
SAFECODE 8, 10, 11

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CRYPTOGRAPHY

A

You have invented a new attack against Cryptography

Read more about this topic in OWASP's free Cheat Sheets on Cryptographic Storage, and Transport Layer Protection

CRYPTOGRAPHY

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CRYPTOGRAPHY

2

Kyun can access data because it has been obfuscated rather than using an approved cryptographic function

OWASP SCP 105, 133, 135
OWASP ASVS 7.7
OWASP AppSensor -
CAPEC -
SAFECODE 21, 29

CRYPTOGRAPHY

3

Axel can modify transient or permanent data (stored or in transit), or source code, or updates/patches, or configuration data, because it is not subject to integrity checking

OWASP SCP 92, 205, 212
OWASP ASVS 12.3, 13.2
OWASP AppSensor SE1, IE4
CAPEC 31, 39, 68, 75, 133, 145, 162, 203,438-9,442
SAFECODE 12, 14

CRYPTOGRAPHY

4

Paulo can access data in transit that is not encrypted, even though the channel is encrypted

OWASP SCP 37, 88, 143, 214
OWASP ASVS 4.7, 9.2
OWASP AppSensor -
CAPEC 185, 186, 187
SAFECODE 14, 29, 30

CRYPTOGRAPHY

5

Kyle can bypass cryptographic controls because they do not fail securely (i.e. they default to unprotected)

OWASP SCP 103, 145
OWASP ASVS 7.2
OWASP AppSensor -
CAPEC 97
SAFECODE 21, 29

CRYPTOGRAPHY

6

Romain can read and modify data in transit (e.g. cryptographic secrets, credentials, session identifiers, personal and commercially-sensitive data), in communications within the application, or between the application and users, or between the application and external systems

OWASP SCP 36, 37, 143, 146, 147
OWASP ASVS 9.2, 10.2, 10.3, 10.7
OWASP AppSensor -
CAPEC 31, 57, 102, 158, 384, 466
SAFECODE 29

CRYPTOGRAPHY

7

Gunter can intercept or modify encrypted data in transit because the protocol is poorly deployed, or weakly configured, or certificates are invalid, or certificates are not trusted, or the connection can be degraded to a weaker or un-encrypted communication

OWASP SCP 75, 144, 145, 148
OWASP ASVS 10.1, 10.2, 10.3, 10.5, 10.8, 10.9, V11.5
OWASP AppSensor IE4
CAPEC 31, 217
SAFECODE 14, 29, 30

CRYPTOGRAPHY

8

Eoin can access stored business data (e.g. passwords, session identifiers, PII, cardholder data) because it is not securely encrypted or securely hashed

OWASP SCP 30, 31, 70, 133, 135
OWASP ASVS 2.13, 2.14, 7.4, 8.10, 9.2
OWASP AppSensor -
CAPEC 31, 37, 55
SAFECODE 21, 29, 31

CRYPTOGRAPHY

9

Andy can bypass random number generation, random GUID generation, hashing and encryption functions because they have been self-built and/or are weak

OWASP SCP 60, 104, 105
OWASP ASVS 7.6, 7.7, 7.8
OWASP AppSensor -
CAPEC 97
SAFECODE 14, 21, 29, 32, 33

CRYPTOGRAPHY

10

Susanna can break the cryptography in use because it is not strong enough for the degree of protection required, or it is not strong enough for the amount of effort the attacker is willing to make

OWASP SCP 104, 105
OWASP ASVS 7.6, 7.7, 7.8
OWASP AppSensor -
CAPEC 97, 463
SAFECODE 14, 21, 29, 31, 32, 33

CRYPTOGRAPHY

J

Justin can read credentials for accessing internal or external resources, services and others systems because they are stored in an unencrypted format, or saved in the source code

OWASP SCP 35, 90, 171, 172
OWASP ASVS 2.14, 12.1
OWASP AppSensor -
CAPEC 116
SAFECODE 21, 29

CRYPTOGRAPHY

Q

Randolph can access or predict the master cryptographic secrets

OWASP SCP 35, 102
OWASP ASVS 2.14, 7.3
OWASP AppSensor -
CAPEC 116, 117
SAFECODE 21, 29

CRYPTOGRAPHY

K

Dan can influence or alter cryptography code/routines (encryption, hashing, digital signatures, random number and GUID generation) and can therefore bypass them

OWASP SCP 31, 101
OWASP ASVS 7.1
OWASP AppSensor -
CAPEC 207, 211
SAFECODE 14, 21, 29

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CORNUCOPIA

A

You have invented a new attack of any type

Read more about application security in OWASP's free Guides on Requirements, Development, Code Review and Testing, the Cheat Sheet series, and the Open Software Assurance Maturity Model

CORNUCOPIA

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CORNUCOPIA

2

Lee can bypass application controls because dangerous/risky programming language functions have been used instead of safer alternatives, or there are type conversion errors, or because the application is unreliable when an external resource is unavailable, or there are race conditions, or there are resource initialization or allocation issues, or overflows can occur

OWASP SCP 194-202, 205-209
OWASP ASVS 5.1
OWASP AppSensor -
CAPEC 25, 26, 29, 96, 123-4, 128-9, 264-5
SAFECODE 3, 5-7, 9, 22, 25-26, 34

CORNUCOPIA

3

Andrew can access source code, or decompile, or otherwise access business logic to understand how the application works and any secrets contained

OWASP SCP 134
OWASP ASVS -
OWASP AppSensor -
CAPEC 56, 189, 207, 211
SAFECODE -

CORNUCOPIA

4

Keith can perform an action and it is not possible to attribute it to him

OWASP SCP 23, 32, 34, 42, 51, 181
OWASP ASVS -
OWASP AppSensor -
CAPEC -
SAFECODE -

CORNUCOPIA

5

Larry can influence the trust other parties including users have in the application, or abuse that trust elsewhere (e.g. in another application)

OWASP SCP -
OWASP ASVS -
OWASP AppSensor -
CAPEC 89, 103, 181, 459
SAFECODE -

CORNUCOPIA

6

Aaron can bypass controls because error/exception handling is missing, or is implemented inconsistently, or is partially implemented, or does not deny access by default (i.e. errors terminate access/execution), or relies on handling by some other service or system

OWASP SCP 109, 110, 111, 112, 155
OWASP ASVS 8.4
OWASP AppSensor -
CAPEC 54, 98, 164
SAFECODE 4, 11, 23

CORNUCOPIA

7

Mwengu's actions cannot be investigated because there is not an adequate accurately time-stamped record of security events, or there is not a full audit trail, or these can be altered or deleted by Mwengu, or there is no centralized logging service

OWASP SCP 113-115, 117, 118, 121-130
OWASP ASVS 2.12, 4.15, 5.7,7.5,8.3,8.5-6,8.8,8.9,10.4,12.3
OWASP AppSensor -
CAPEC 93
SAFECODE 4

CORNUCOPIA

8

David can bypass the application to gain access to data because the network and host infrastructure, and supporting services/applications, have not been securely configured, the configuration rechecked periodically and security patches applied, or the data is stored locally, or the data is not physically protected

OWASP SCP
151, 152, 156, 160, 161, 173-177

OWASP ASVS
1.1, 1.2, 11.2, 11.3, 11.6

OWASP AppSensor
RE1, RE2

CAPEC
37, 220, 289, 310, 436

SAFECODE
-

CORNUCOPIA

9

Michael can bypass the application to gain access to data because administrative tools or administrative interfaces are not secured adequately

OWASP SCP
23, 29, 56, 81, 82, 84-90

OWASP ASVS
4.10, 14.1

OWASP AppSensor
-

CAPEC
225, 122

SAFECODE
-

CORNUCOPIA

10

Xavier can circumvent the application's controls because code frameworks, libraries and components contain malicious code or vulnerabilities (e.g. in-house, commercial off the shelf, outsourced, open source, externally-located)

OWASP SCP
57, 151, 152, 204, 205, 213, 214

OWASP ASVS 1.1, 1.2,
2.15, 3.13, 4.16, 5.9, 6.10, 7.10, 8.12, 13.1

OWASP AppSensor
-

CAPEC
68, 438, 439, 442

SAFECODE
15

CORNUCOPIA

J

Roman can exploit the application because it was compiled using out-of-date tools, or its configuration is not secure by default, or security information was not documented and passed on to operational teams

OWASP SCP
90, 137, 148, 151-154, 175-179, 186, 192

OWASP ASVS
12.1

OWASP AppSensor
-

CAPEC
-

SAFECODE
4

CORNUCOPIA

Q

Jim can undertake malicious, non-normal, actions without real-time detection and response by the application

OWASP SCP
-

OWASP ASVS
-

OWASP AppSensor
(All)

CAPEC
(All)

SAFECODE
1, 27

CORNUCOPIA

K

Gareth can utilize the application to deny service to some or all of its users

OWASP SCP
41, 55

OWASP ASVS
2.9

OWASP AppSensor
UT1-4, STE3

CAPEC
2, 25, 119

SAFECODE
1

WILD CARD

Joker

Alice can utilize the application to attack users' systems and data

Have you thought about becoming an individual OWASP member? All tools, guidance and local meetings are free for everyone, but individual membership helps support OWASP's work

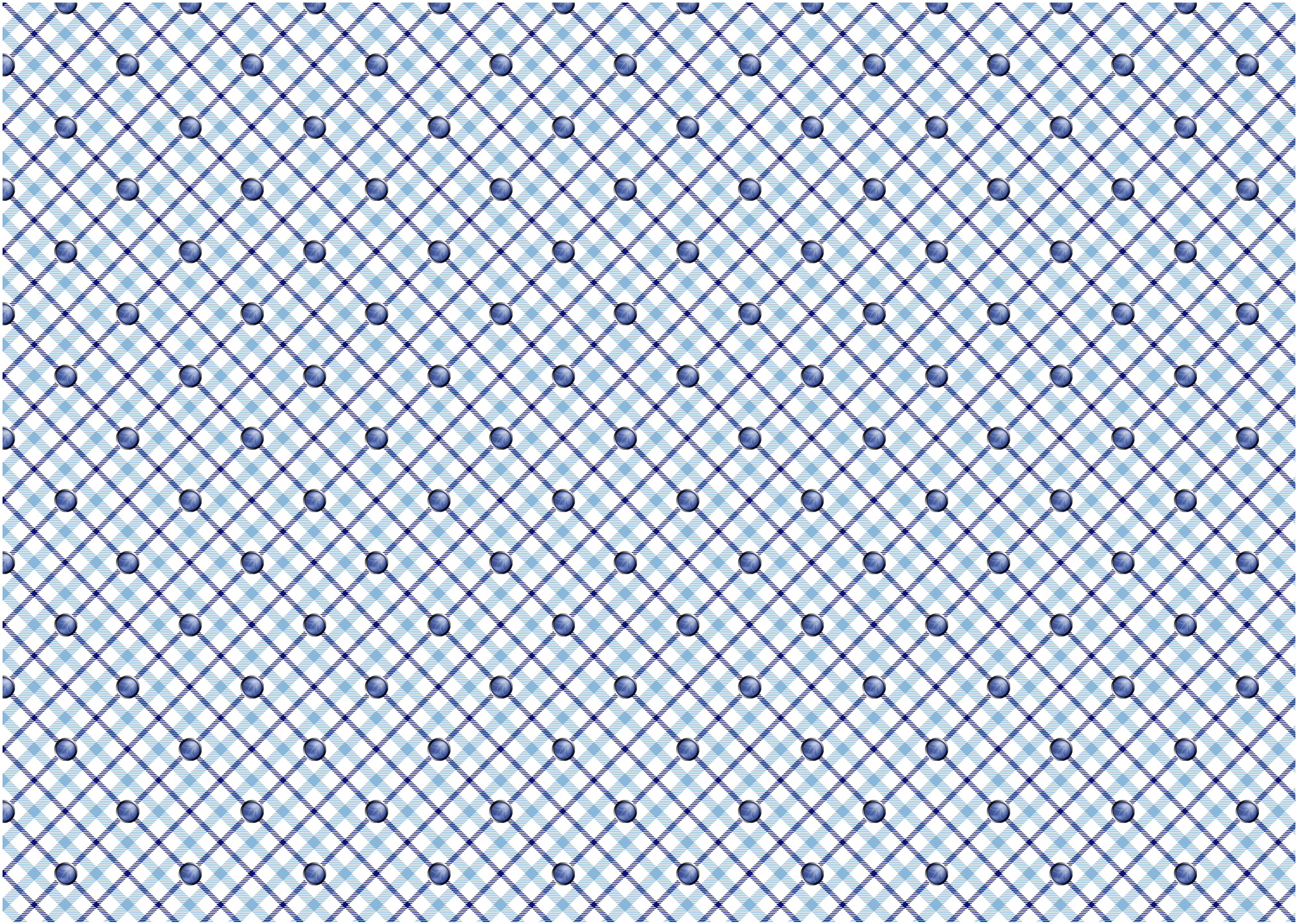
WILD CARD

Joker

Bob can influence, alter or affect the application so that it no longer complies with legal, regulatory, contractual or other organizational mandates

Examine vulnerabilities and discover how they can be fixed using training applications in the free OWASP Broken Web Applications VM, or using the online challenges in the free Hacking Lab

Cut here



Change Log

Version	Date	Comments
0.10	30 Jul 2012	Original draft.
0.20	10 Aug 2012	Draft reviewed and updated.
0.30	15 Aug 2012	Draft announced OWASP SCP mailing list for comment.
0.40	25 Feb 2013	Play rules updated based on feedback during workshops. Added reference to PCI SSC Information Supplement: PCI DSS E-commerce Guidelines. Descriptive text extended and updated. Added contributors section, page numbering, FAQs and change log.
1.00	25 Feb 2013	Release.
1.01	03 Jun 2013	Framework-specific card deck discussion added. Additional FAQs created. Descriptive text updated. New cover image, and previous cover image moved to back. Cut lines added. Alternative rules and deck subset descriptions added. Project website and mailing list added. Cornucopia King cross-reference to AppSensor updated.
1.02	14 Aug 2013	Warning about time to print added. Additional alternative game rules added (twenty-one, play a deck over a week, play full hand and then discuss). Compliance deck concept added. FAQs 5 and 6 added. Attack descriptions on cards with tinted backgrounds changed to black (from dark grey). Project contributors added.
1.03	18 Sep 2013	Minor attack wording changes on two cards. OWASP SCP and ASVS cross-references checked and updated. Code letters added for suits. All remaining attack descriptions on cards changed to black (from dark grey) and background colours amended to provide more contrast and increase readability.
1.04	01 Feb 2014	Text “password change, password change,” corrected to “password change, password recovery,” on Queen of Authentication card.
1.05	21 Mar 2015	Updates to alternative game rules. Additional FAQs created. Contributors updated. Podcast and video links added.

Project contributors

All OWASP projects rely on the voluntary efforts of people in the software development and information security sectors. They have contributed their time and energy to make suggestions, provide feedback, write, review and edit documentation, give encouragement, trial the game, and promote the concept. Without all their efforts, the project would not have progressed to this point.

- Simon Bennetts
- Tobias Gondrom
- Anthony Harrison
- Ken Ferris
- Jim Manico
- Mark Miller
- Cam Morris
- Stephen de Vries
- Colin Watson

Also:

- OWASP's hard-working employees
- Attendees at OWASP London, OWASP Manchester and OWASP Netherlands chapter meetings, and the London Gamification meetup, who made helpful suggestions and asked challenging questions
- Blackfoot UK Limited for gifting print-ready design files and scores of professionally printed card decks for distribution at OWASP chapter meetings

Please contact the mailing list or the project leader directly, if anyone is missing from the above lists.

Podcasts and videos

The following supporting OWASP Cornucopia resources are available online:

- Podcast interview, OWASP 24/7 Podcast channel, 21st March 2014 http://trustedsoftwarealliance.com/2014/03/21/the-owasp-cornucopia-project-with-colin-watson/
- Video of presentation, OWASP EU Tour2013 London, 3rd June 2013 https://www.youtube.com/watch?v=Q_LE-8xNXVk

See the project website for further information and presentation materials.