Finding security vulnerabilities

Matias Madou,
Security Researcher
At Fortify

About me

- Security Researcher @ Fortify Software
  - Focus on new techniques to find vulnerabilities (static and dynamic)
  - Find new ways to protect WebApps
- Contributor to BSIMM Europe
- Conference Speaker (academic and industry)
- History in Code Obfuscation (& Binary Rewriting)

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Setup

- Introduction to static analysis
- Demo:
  - Scanning a sample application
  - Going through issues
  - Fine tuning the analysis (custom rules)

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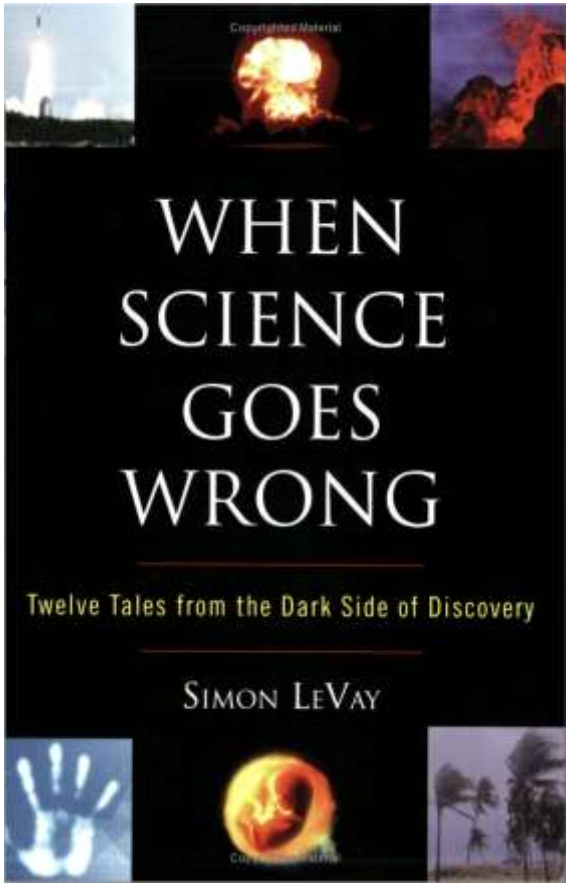

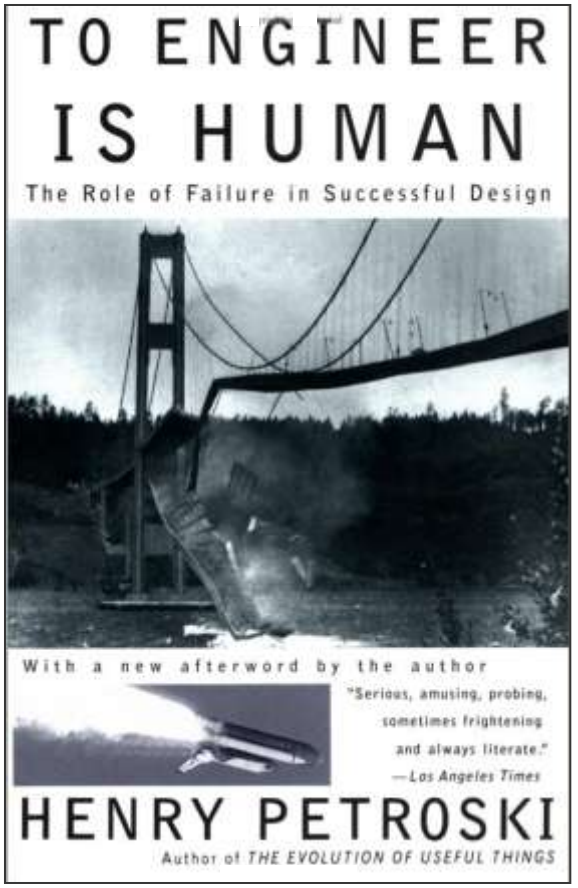

Success is foreseeing failure.

– Henry Petroski

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Security approach these days

Try Harder

- Our people are smart and work hard.
- Just tell them to stop making mistakes.

- Not everyone is going to be a security expert.
- Getting security right requires feedback.

Fix It Later

- Code as usual.
- Build a better firewall (app firewall, intrusion detection, etc.)

- More walls don't help when the software is meant to communicate.
- Security team can't keep up.

Test Your Way Out

- Do a penetration test on the final version.
- Scramble to patch findings.

- Pen testing is good for demonstrating the problem.
- Doesn't work for the same reason you can't test quality in.

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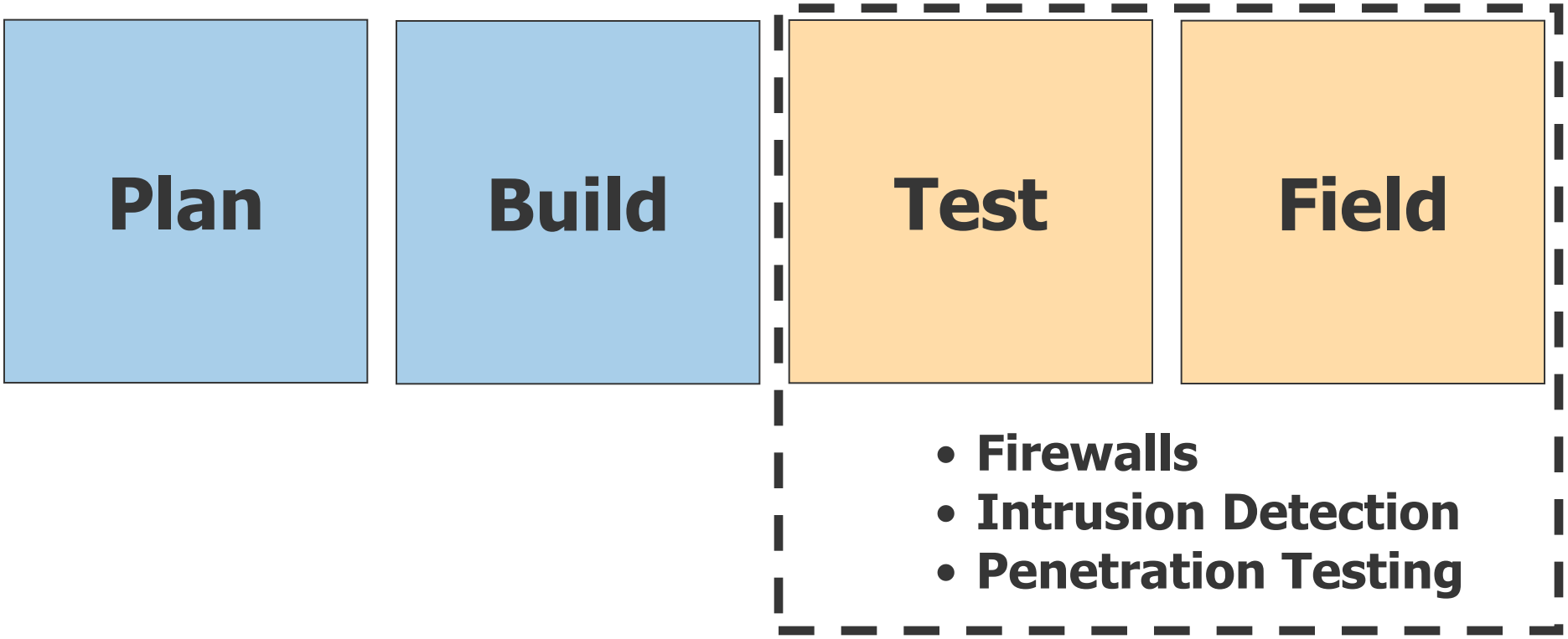
Security in the Development Lifecycle



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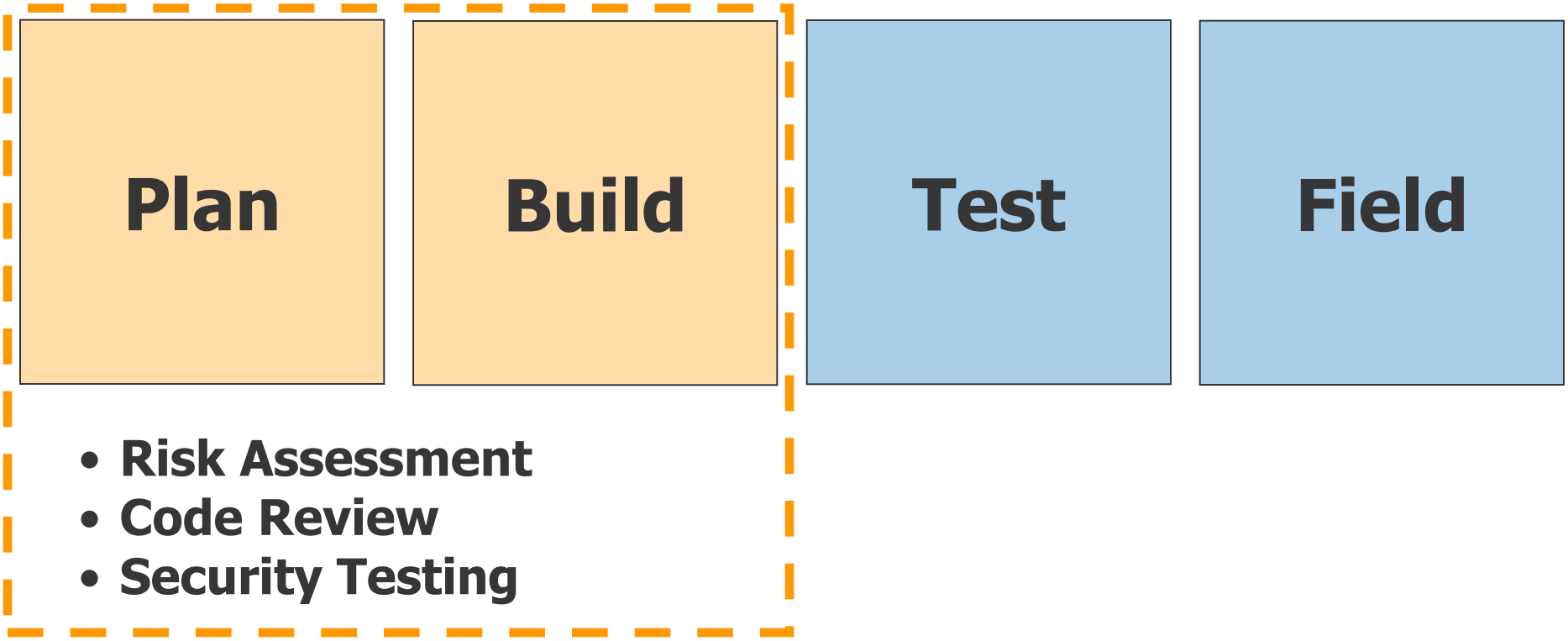
Security in the Development Lifecycle



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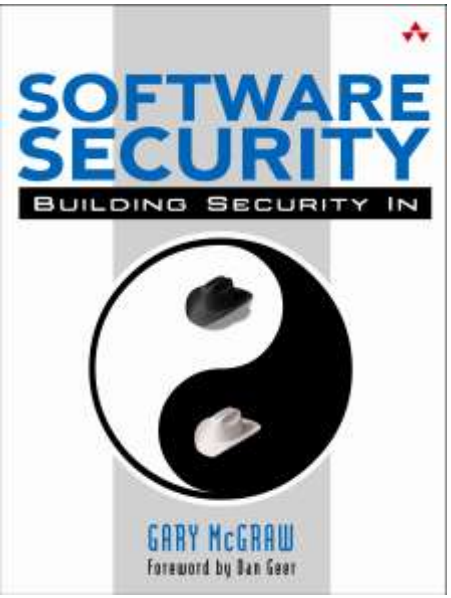

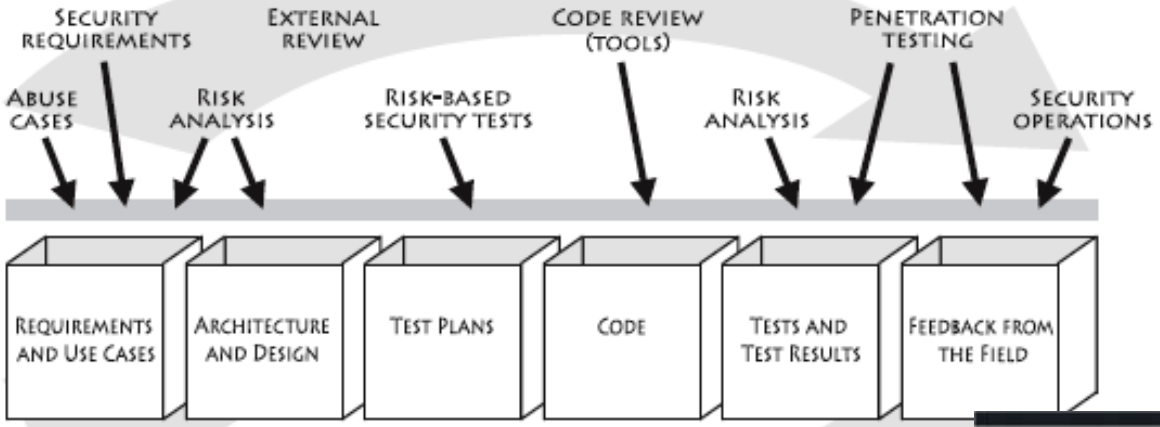

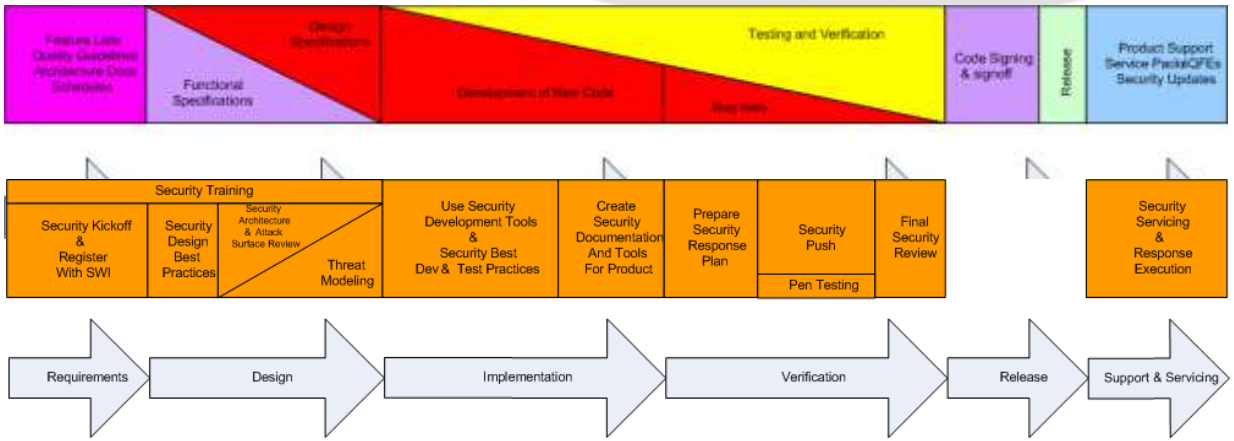

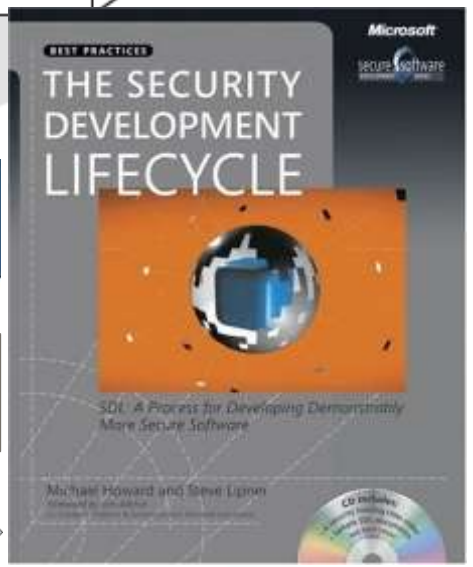

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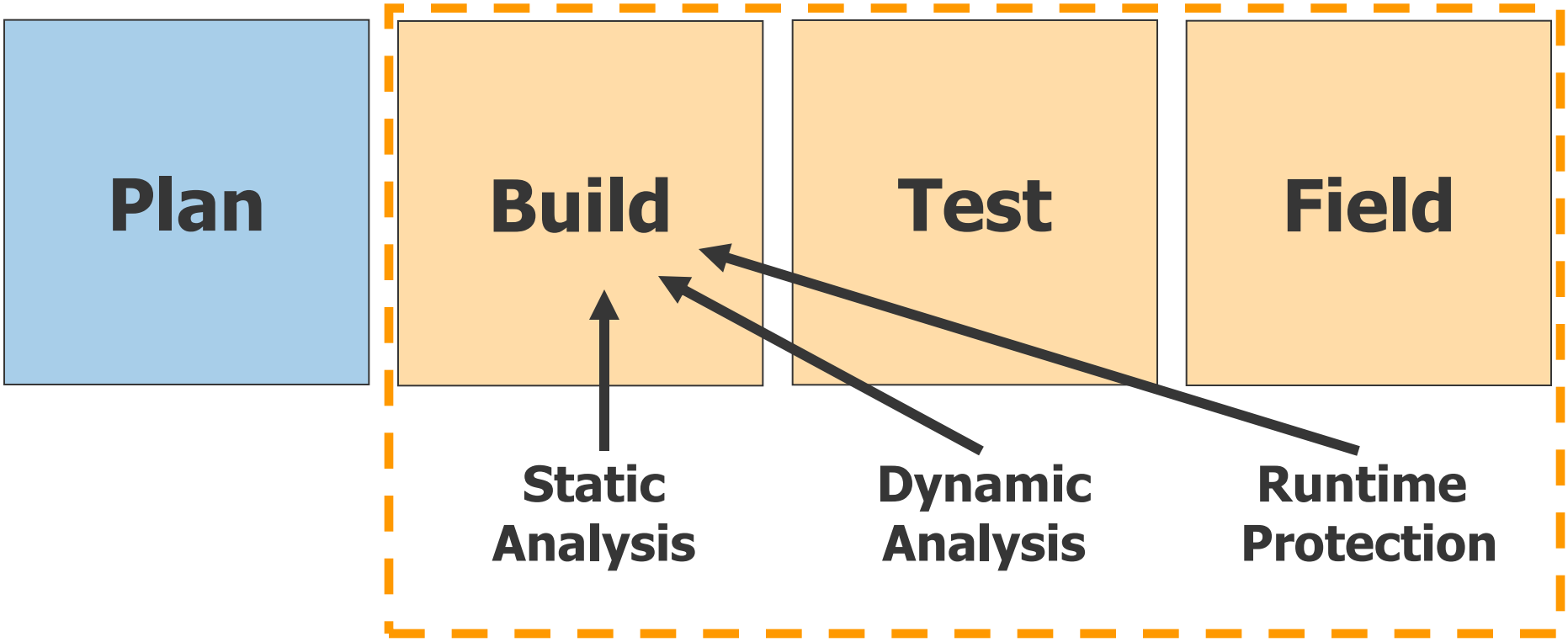
This Talk: Analysis during the Development Lifecycle



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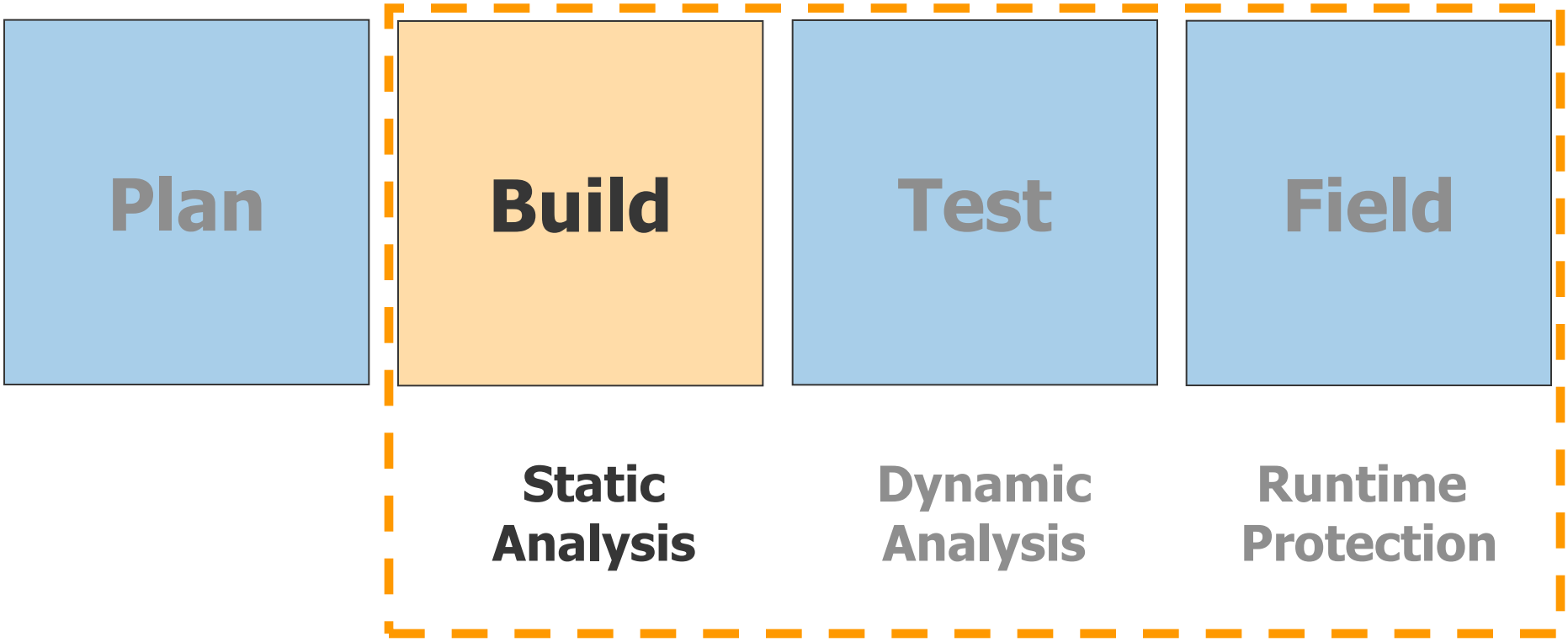
Security in the Development Lifecycle



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Static Analysis: Defined

- Analyze code without executing it
- Consider many more possibilities than you could execute with conventional testing
- Doesn’t know what your code is supposed to do
- Must be told what to look for

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Static Analysis: The Tool

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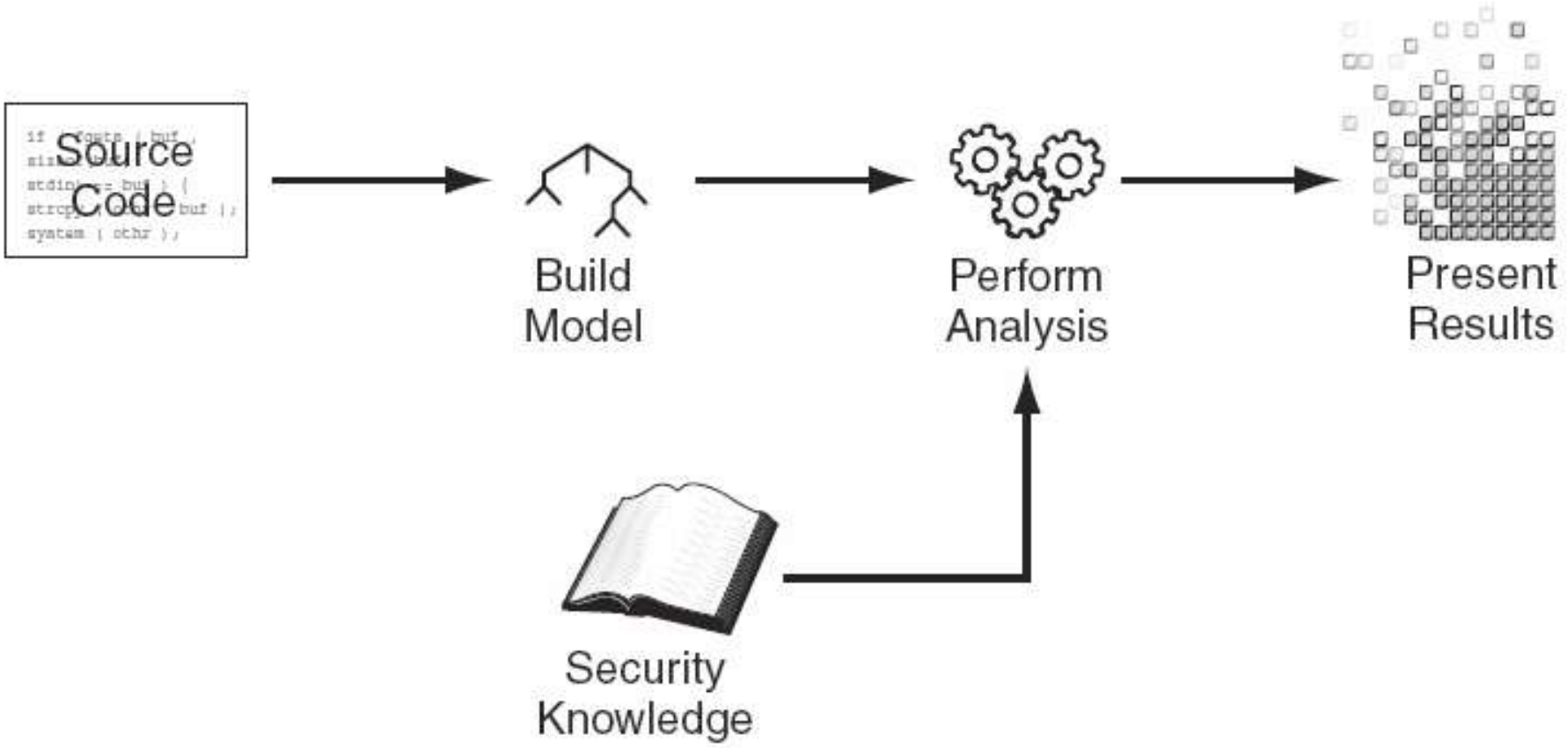
Under the Hood of a Static Analysis Tool



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Code Example: SQL Injection

```
...
user = request.getParameter("p_user");
       Class   Function

try {
  sql = "SELECT * FROM users " +
        "WHERE id='" + user + "'";

  stmt.executeQuery(sql);
  Class   Function
} 
...
```

1. Source Code
2. Model
3. Security Knowledge

Sources of taint:	Class: ServletRequest, Function: getParameter	return
PassThrough:	Class: String	return
Sinks	Class: Statement, Function: executeQuery	arg1

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...
```

1. Source Code
2. Model
3. Security Knowledge
4. Perform Analysis
5. Present Results

Sources of taint:	Class: ServletRequest, Function: getParameter	return
PassThrough:	Class: String	return
Sinks	Class: Statement, Function: executeQuery	arg1

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Critical Attributes

- Language support
  - Understands the relevant languages/dialects
- Analysis algorithms
  - Uses the right techniques to find and prioritize issues
- Capacity
  - Able to gulp down millions of lines of code
- Rule set
  - Modeling rules, security properties
- Results management
  - Allow human to review results
  - Prioritization of issues
  - Control over what to report

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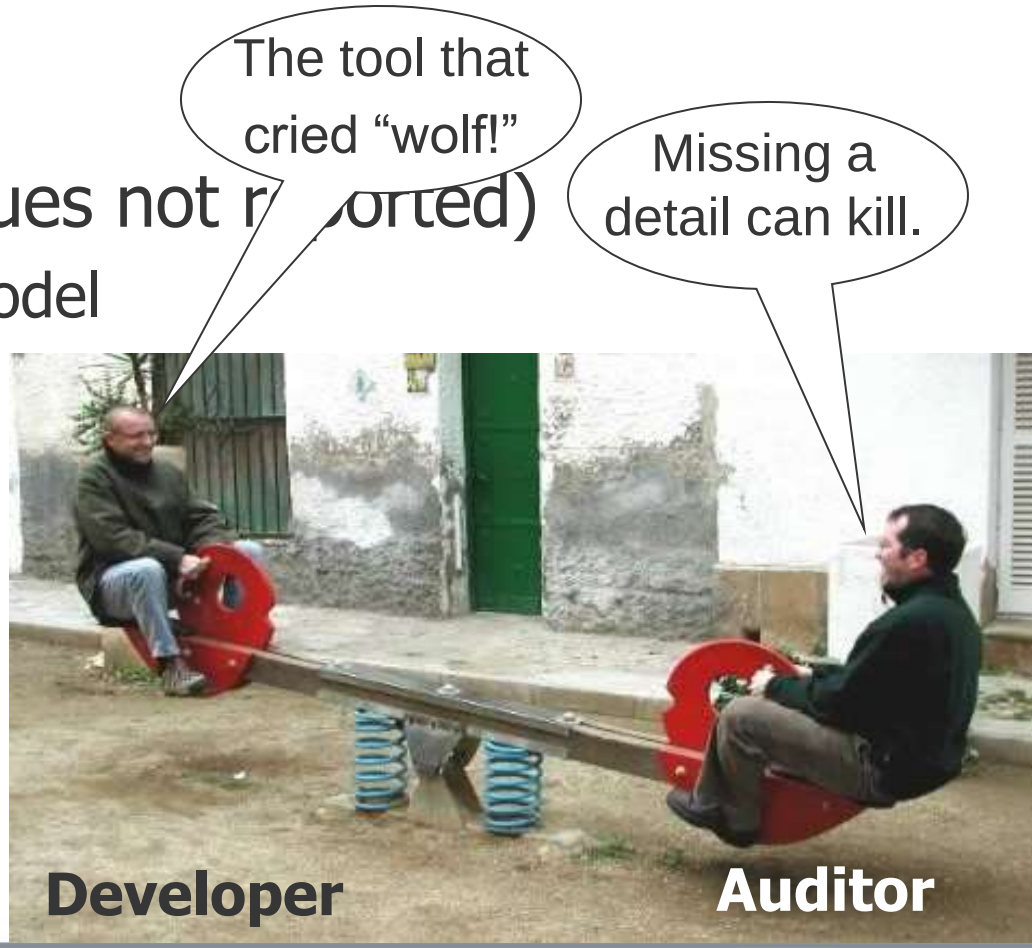
Only Two Ways to Go Wrong

- False positives (false issues reported)
  - Incomplete/inaccurate model
  - Missing rules
  - Conservative analysis
- False negatives (real issues not reported)
  - Incomplete/inaccurate model
  - Missing rules
  - Forgiving analysis



Two Ways to Use the Static Analysis Tool

1. Analyze completed programs
   - Large number of results
   - Most people have to start here
   - Good motivator

1. Analyze as you write code
   - Run as part of build
   - Nightly/weekly/milestone
   - Fix as you go

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Adopting a Static Analysis Tool

1) Some culture change required
   - More than just another tool
   - Often carries the banner for software security program
   - Pitfall: the tool doesn't solve the problem by itself

2) Define the playing field
   - Choose specific objectives
   - Build a gate

3) Teach up front
   - Software security education is paramount
   - Tool training is helpful too

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Adopting a Static Analysis Tool

4) Start small
- Do a pilot rollout to a friendly dev group
- Build on your success

5) Go for the throat
- Tools detect lots of stuff. **Turn most of it off.**
- Focus on easy-to-understand, highly relevant problems.

6) Appoint a champion
- Make sure there is a point person on the dev team
- Choose a developer who knows a little about everything

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Adopting a Static Analysis Tool

7) Measure the outcome
   - Keep track of tool findings
   - Keep track of outcome (issues fixed)

8) Make it your own
   - Investigate customization
   - Map tool against internal security standards.
   - Best case scenario is cyclic:
     - The tool reinforces coding guidelines
     - Coding guidelines are written with automated checking in mind

9) The first time around is the worst
   - Budget 2x typical cycle cost
   - Typical numbers: 10% of time for security, 20% for the first time

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Challenges of Static Analysis

1. Completed programs
   - Are not written with security in mind
   - Contain multiple paradigms and technologies
   - Exemplify varying developer skill and techniques
2. Which causes static analysis to produce
   - Large numbers of issues
   - Widely varying issues
   - Issues that are difficult to triage

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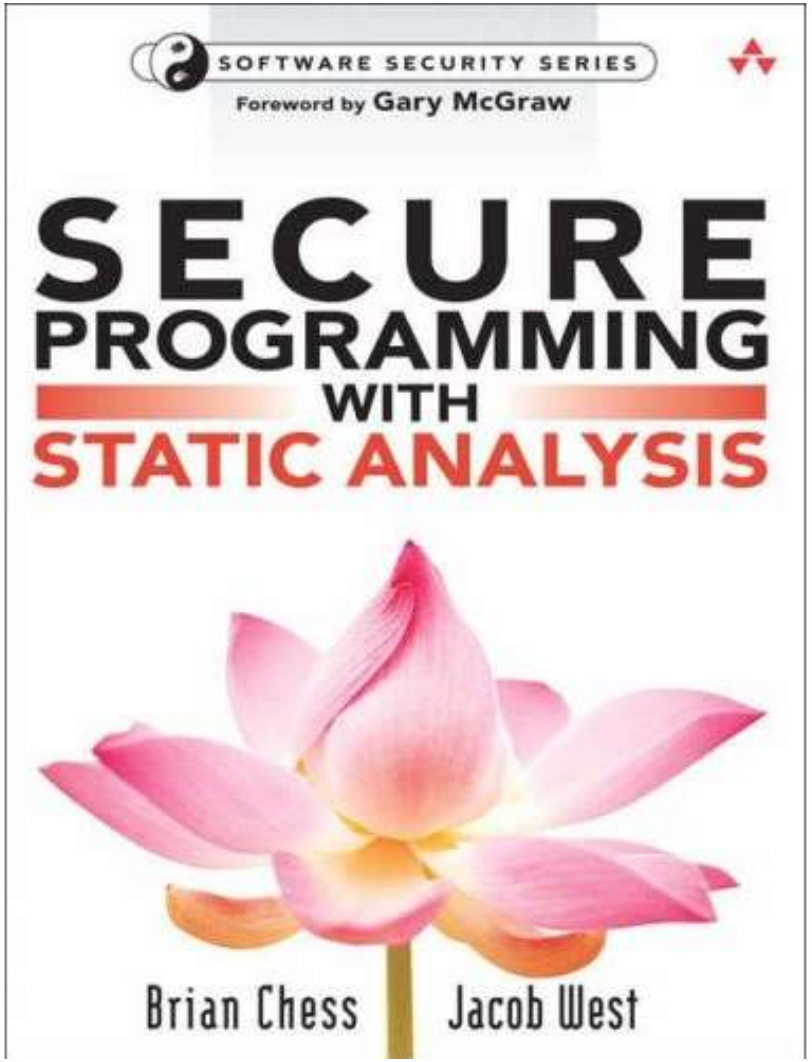
SOFTWARE SECURITY SERIES
Foreword by Gary McGraw
SECURE PROGRAMMING WITH STATIC ANALYSIS
Brian Chess
Jacob West

Demo Time!

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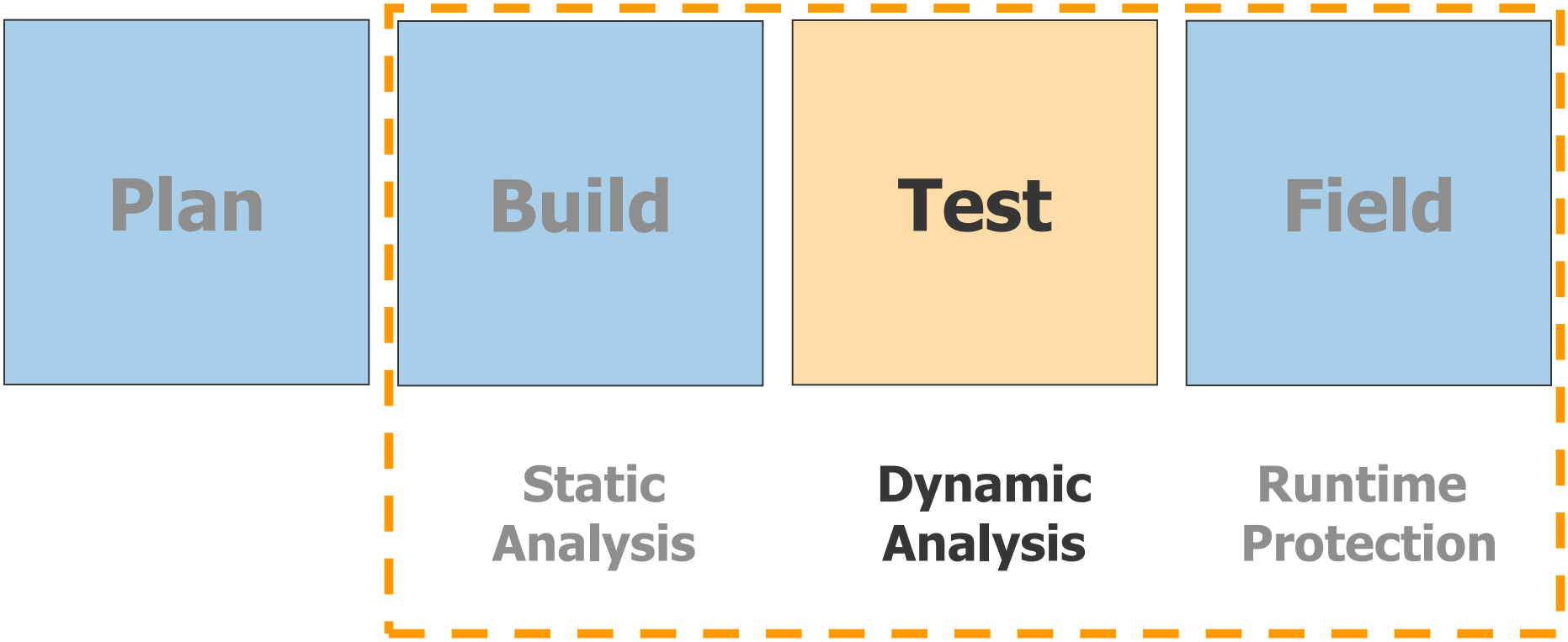
Security in the Development Lifecycle



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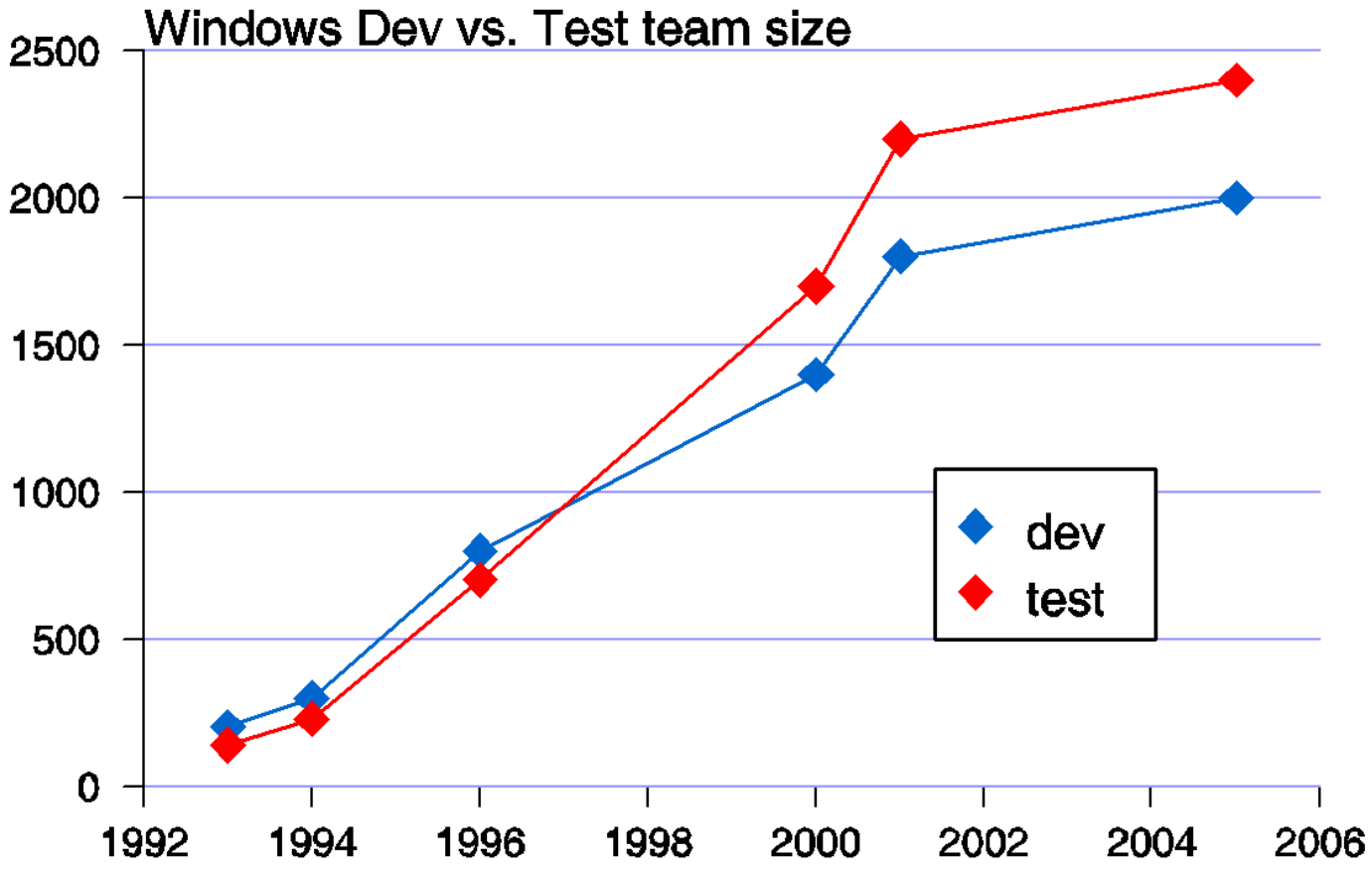
Team Sizes at Microsoft



From The Build Master: Microsoft's Software Configuration Management Best Practices (Maraia 2005)

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Problem

- QA people lack security understanding (and we will not force them to have that!)

Good:

- Have good test coverage
- Time and resources

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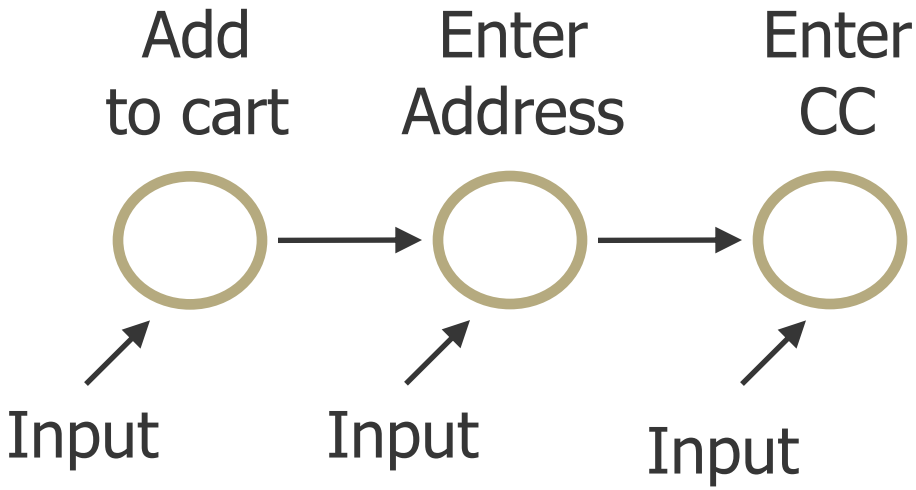
Why Fault Injection Fails

- Bad input derail the program
- Cannot mutate function tests and retain coverage



- Result:
  - Bad test coverage
  - Missed Vulnerabilities

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Example: SQL Injection

```
...
user = request.getParameter("p_user");
      TaintUtil.setTaint(user, 1);
try {
 sql = "SELECT * FROM users " +
         "WHERE id='" + user + "'";
TaintUtil.setTaint(sql,user.getTaint());

TaintUtil.checkTaint(sql);
 stmt.executeQuery(sql);
}
...
```


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Framework

- Instrument the program
  1. Methods that introduce input
     - HttpServletRequest.getParameter()
     - PreparedStatement.executeQuery()
     - …
  2. Methods to check for taint
     - Statement.execuetQuery()
     - JspWriter.print()
     - …
- Mechanism to track Taint
  - Modify the `java.lang.String` class
  - Modify `StringBuilder` en `StringBuffer`

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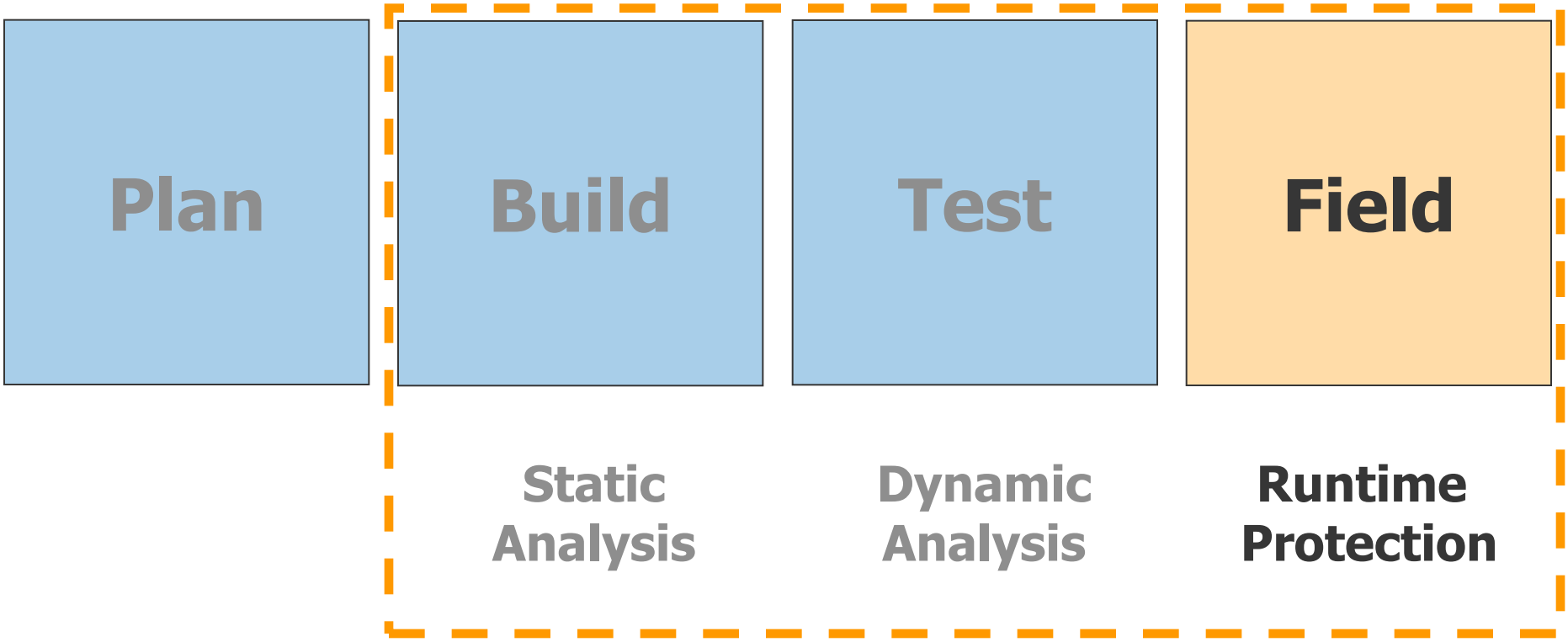
Security in the Development Lifecycle



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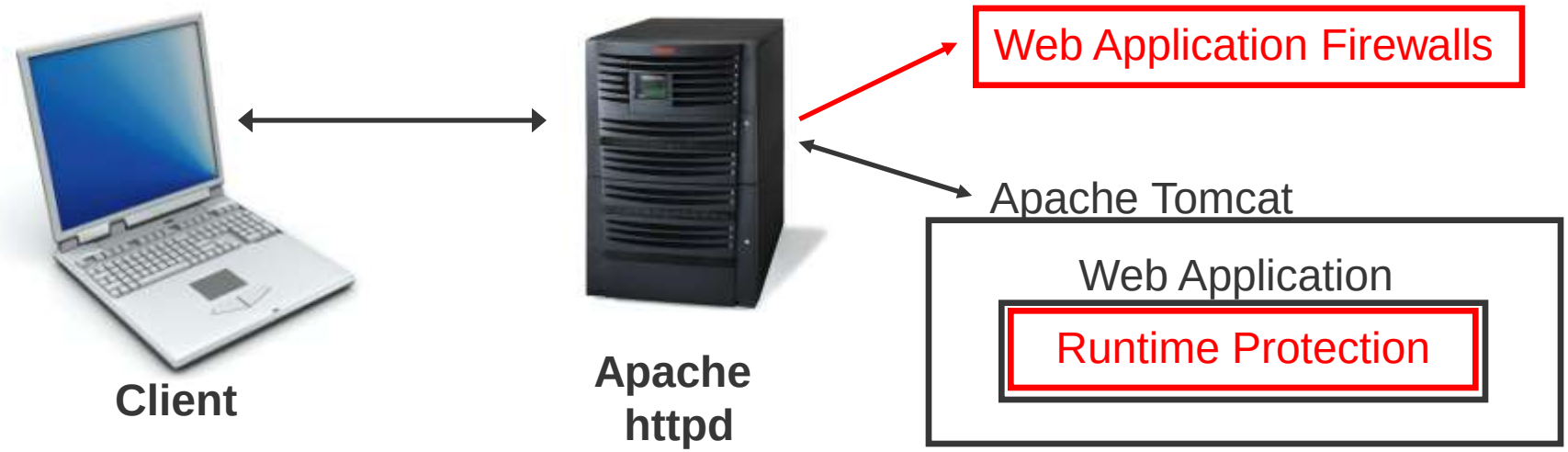
Protecting Programs at Runtime

- If you can find bugs: fix them!
- Additional layer of protection
- More context than external systems:



- Flexible response: log, block, etc
- Low performance overhead is a must
- Potential to detect misuse in addition to bugs

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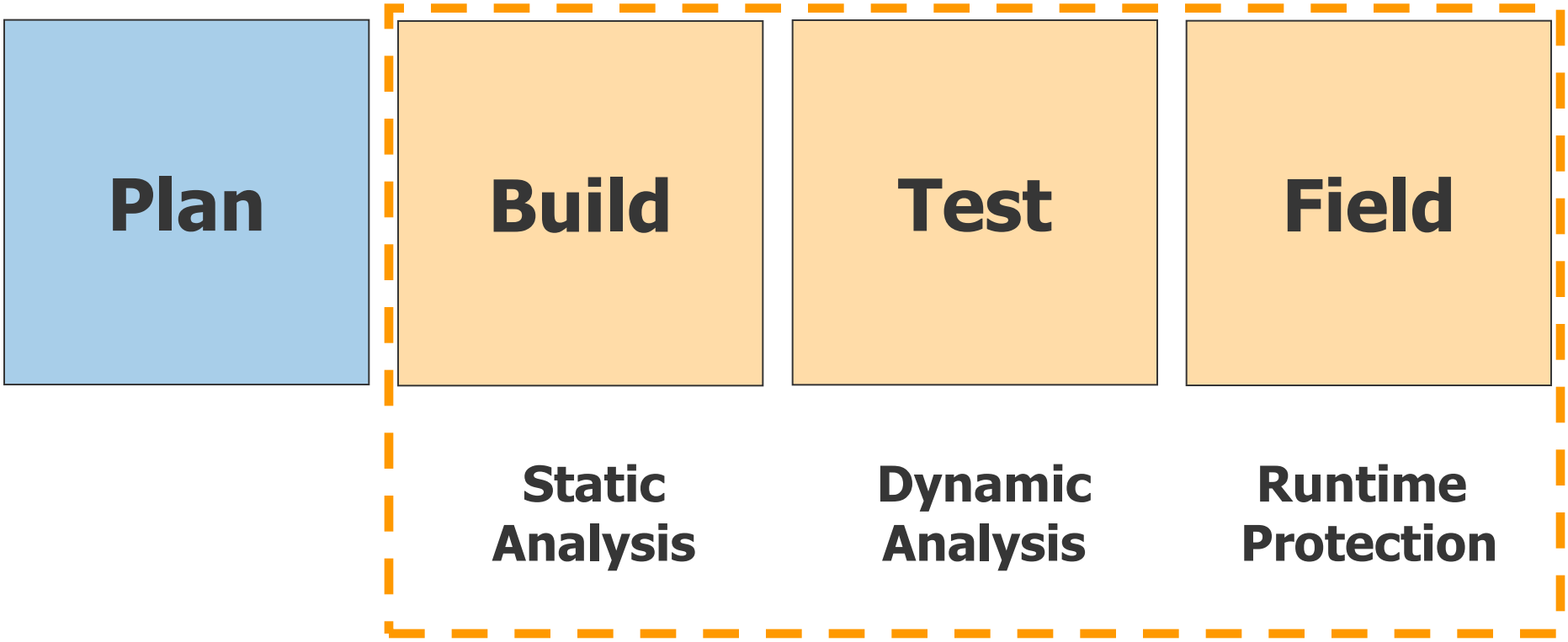
Security in the Development Lifecycle



So the 360 view of the program during the development cycle

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Summary

- Mistakes happen. Plan for them!
- Security is now part of the SDLC
- Tools bring security expertise
- Tools make code review efficient
- They are not an out-of-the box solution

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Thanks!

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