Using Third Party Components for Building an Application Might be More Dangerous Than You Think!

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Abstract

Today, nearly all developers rely on third party components for building an application. Thus, for most software vendors, third party components in general and Free/Libre and Open Source Software (FLOSS) in particular, are an integral part of their software supply chain.

As the security of a software offering, independently of the delivery model, depends on all components, a secure software supply chain is of utmost importance. While this is true for both proprietary and as well as FLOSS components that are consumed, FLOSS components impose particular challenges as well as provide unique opportunities. For example, on the one hand, FLOSS licenses contain usually a very strong "no warranty" clause and no service-level agreement. On the other hand, FLOSS licenses allow to modify the source code and, thus, to fix issues without depending on an (external) software vendor.

This talk is based on working on integrating securely third-party components in general, and FLOSS components in particular, into the SAP's Security Development Lifecycle (SSDL). Thus, our experience covers a wide range of products (e.g., from small mobile applications of a few thousands lines of code to large scale enterprise applications with more than a billion lines of code), a wide range of software development models (ranging from traditional waterfall to agile software engineering to DevOps), as well as a multiple deployment models (e.g., on premise products, custom hosting, or software-as-a-service).

About Us

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Part I:

Securing The Software Supply Chain
or
The Security Risk of Third Party Components

Secure Software Development

Start of development

Release decision

Preparation	Development	Transition	Utilization

Training
- Security awareness
- Secure programming
- Threat modeling
- Security static analysis
- Data protection and privacy
- Security expert curriculum

Risk Identification
- Security Risk Identification and Management (SECURIM)
- Data Privacy Impact Assessment
- Threat Modeling

Plan Security Measures
- Plan product standard compliance
- Plan security features
- Plan security tests
- Plan security response

Secure Development
- Secure programming
- Static code scan
- Code review

Security Testing
- Dynamic testing
- Manual testing
- External security assessment

Security Validation
- Independent security assessment

Security Response
- Execute the security response plan

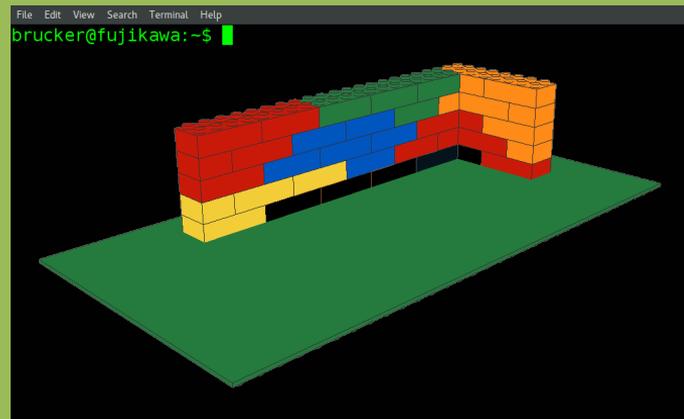APPSEC EUROPE

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Secure Software Development

How We Used To Develop Software
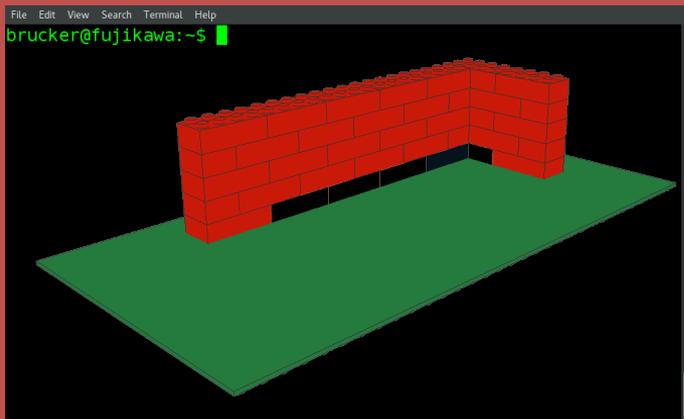
- Very few external dependencies
- Full control over source code

How We Develop Software Today

- Many external dependencies
- Only control over a small part of the source code
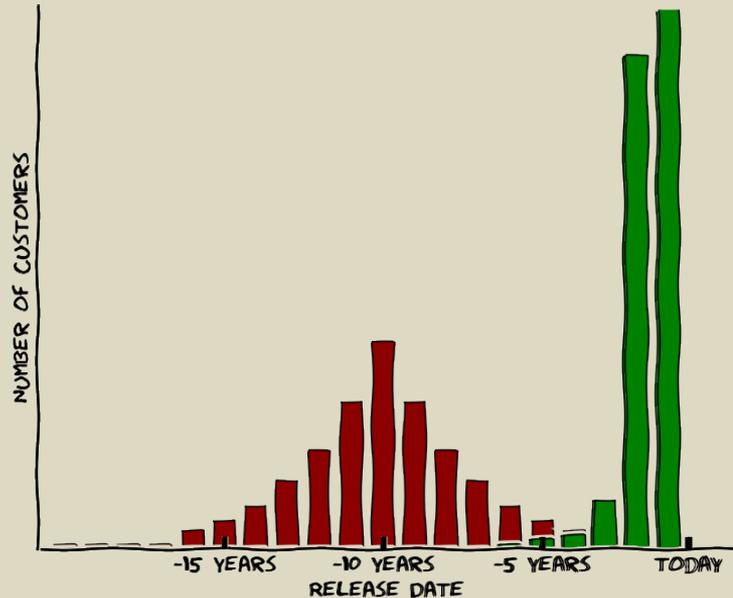
The Maintenance Challenge

- **> 90% of customers are using the latest two releases**

- **> 50 % of customers are using releases older 10 years**

Product	Release	EoL	Ext. EoL
Windows XP	2001	2009	2014
Windows 8	2012	2018	2023
SAP SRM	2006	2013	2016
Red Hat	2012	2020	2023
Tomcat	2007	2016	n/a

Secure Software Development

Start of development

Release decision

| Preparation | Development | Transition | Utilization |

Training — Risk Identification — Plan Security Measures — Secure Development — Security Testing — Security Validation — Security Response

- Security awareness
- Secure programming
- Threat modeling
- Security static analysis
- Data protection and privacy
- Security expert c...

Identify
- Risk and
- Mitigation strategies of third-party software

- Threat

Third-party
- Bill of material
- Licensing
- Maintenance

Plan product ...d ...ance ...curity ...s ...curity ...curity ...se

Plan third-party specific
- security response
- security tests

Secure ...

Secure consumption of third-party software (API usage, etc.)

Dynamic testing ...testing ...l security ...ment

Test secure consumption of third party software and act on found vulnerabilities

Independent se... as...

Assess secure consumption of third-party software

Execute the ...nse

Monitor vulnerabilities of third party software and fix/upgrade vulnerable versions

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Inbound Process

Types of Third-Party Software

	Commercial Libraries Outsourcing Bespoke Software	Freeware	Free/Libre Open Source Software (FLOSS)
	• Outsourcing • SAP HANA	• Jabra Device Driver • NVIDIA Device Driver	• Apache Tomcat • JQuery
Upfront costs	High	Low	Low
Ease of access (for developers)	Hard	Medium	Easy
Modification of Source Code	Depends on contract	Impossible	Possible
Support contract	Easy	Hard	Medium

Types of Third-Party Software

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		• Driver	• JQuery
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FLOSS is
- Widely used in industry
- Offers possibility for self-maintenance
- Vulnerability data is available

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Data Sources

Public

- **FOSS information repositories**
  - Open Hub (formerly Ohloh)
  - Core Infrastructure Initiative (CII) Census project
- **Public databases of vulnerabilities**
  - National Vulnerability Database (NVD)
  - Exploit Database website (ExploitDB)
  - Open Sourced Vulnerability Database (OSVDB)
- **Project data**
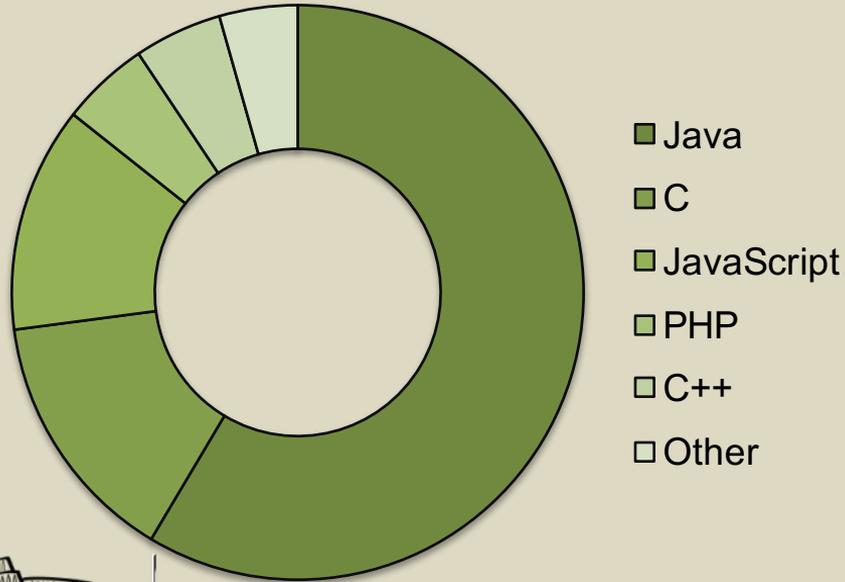 - Coverity FOSS scan service
  - Source code repositories

Internal

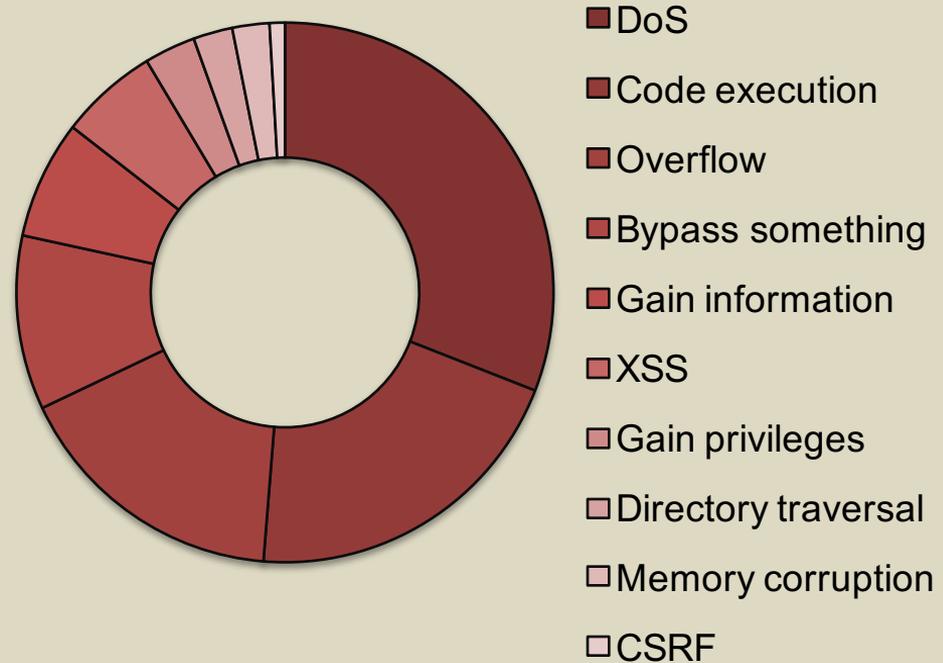- Software inventory (e.g., Black Duck Code Center as used by SAP)

FLOSS Usage At SAP

Programming Languages

- Java
- C
- JavaScript
- PHP
- C++
- Other

Vulnerabilities (CVEs)

- DoS
- Code execution
- Overflow
- Bypass something
- Gain information
- XSS
- Gain privileges
- Directory traversal
- Memory corruption
- CSRF

Based on the 166 most used FOSS components (as of autumn 2015)

Part II:

Security of Open Source Enterprise Frameworks
or
Assessing Risks and Planning Efforts of the Secure
Consumption of FLOSS

Inbound Process

- Scenario:

    many FOSS libraries are shipped with
    many proprietary applications

- Legal issues

    Identify licenses and check the compliance

- Security issues
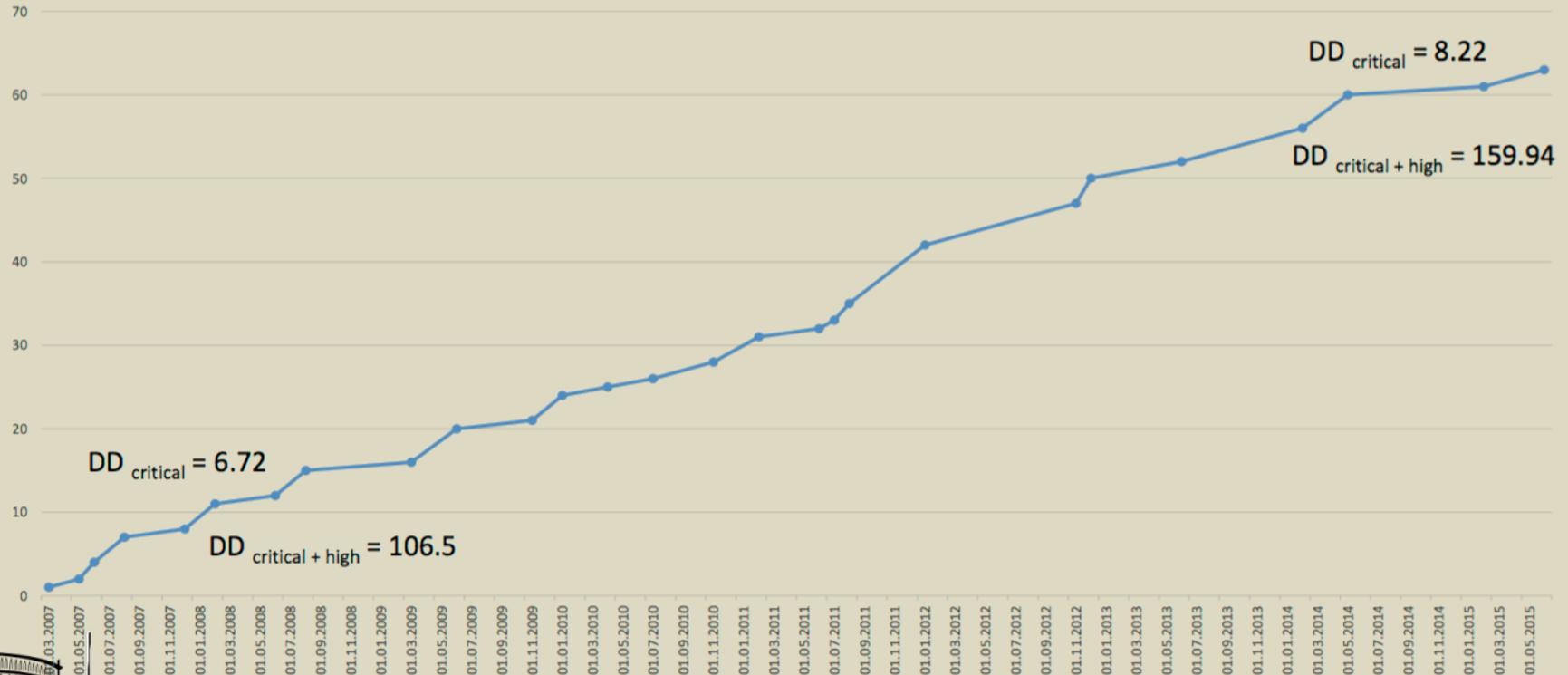
    Check FOSS for vulnerabilities

What We Want

1. How many vulnerabilities will be published next year for component X?

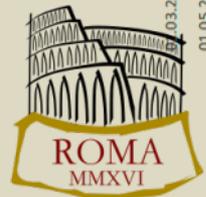2. How often do I need to ship a patch to fix a vulnerability caused by component X?
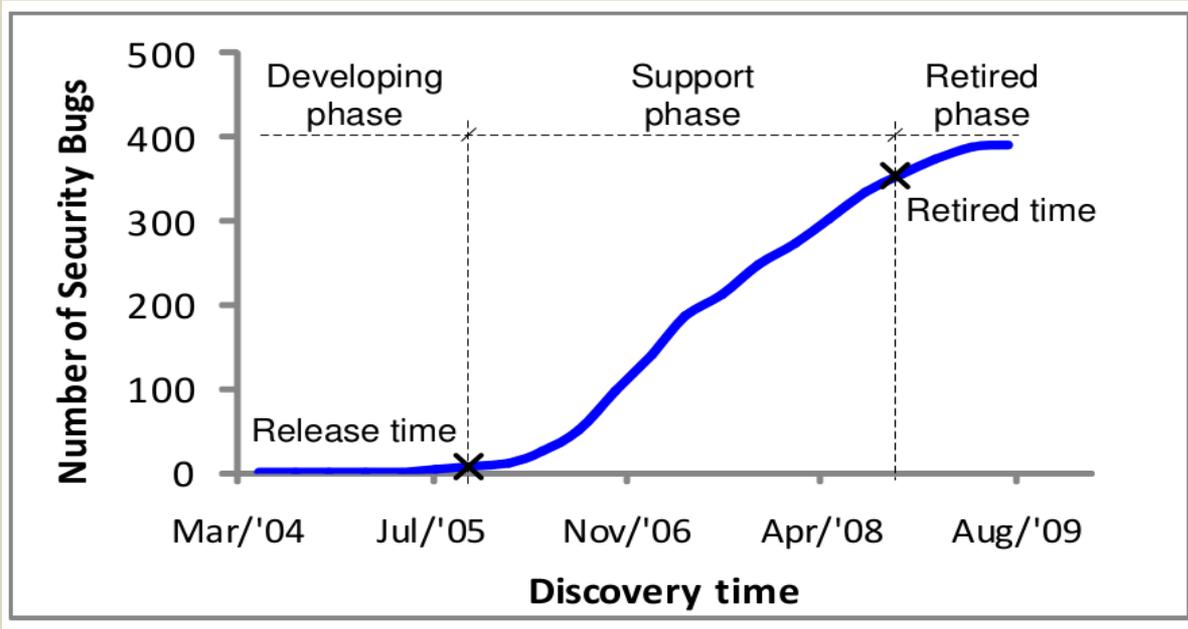

https://www.flickr.com/photos/fimbrethil/4507848067/

Vulnerability Prediction?

$DD_{critical} = 8.22$

$DD_{critical + high} = 159.94$

$DD_{critical} = 6.72$

$DD_{critical + high} = 106.5$

Tomcat 6.x publicly known vulnerabilities (CVEs)

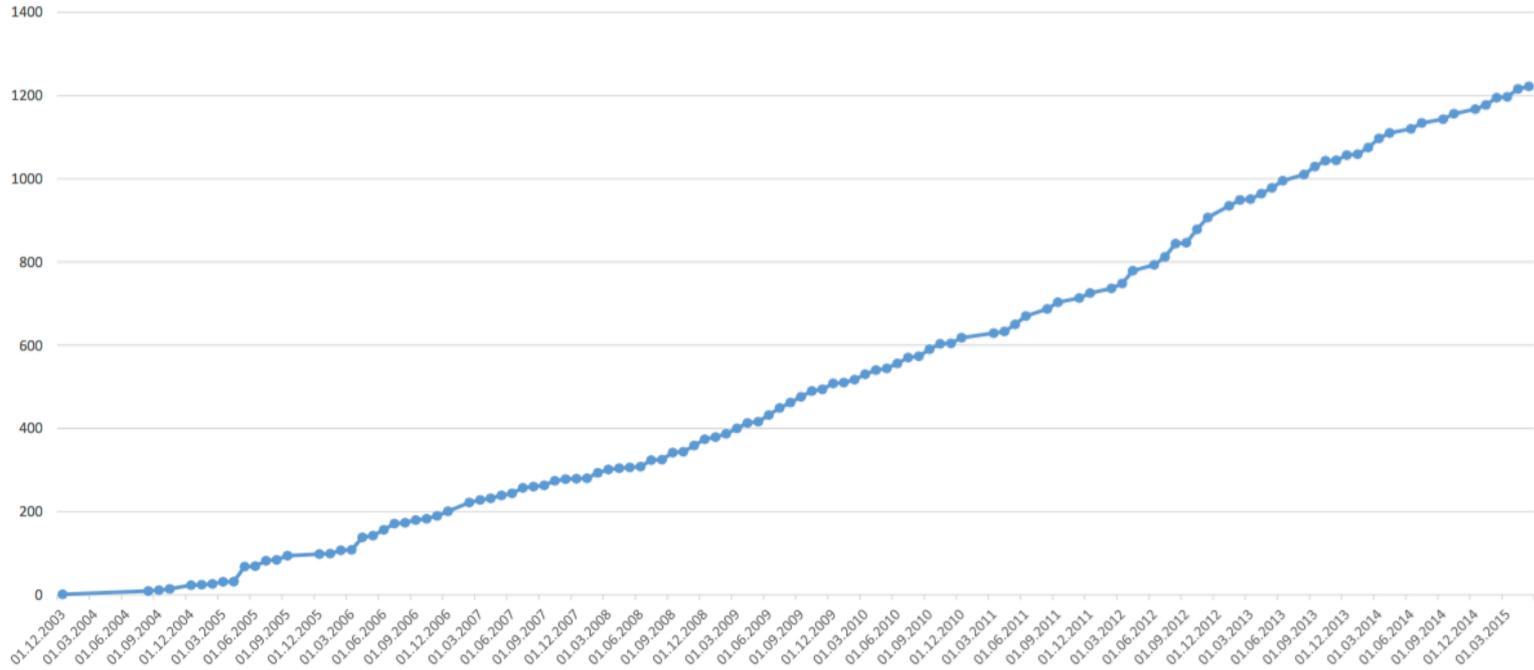# Vulnerability prediction?

Alhazmi & Malaiya & Ray. *Data Applications and Security, 2005*
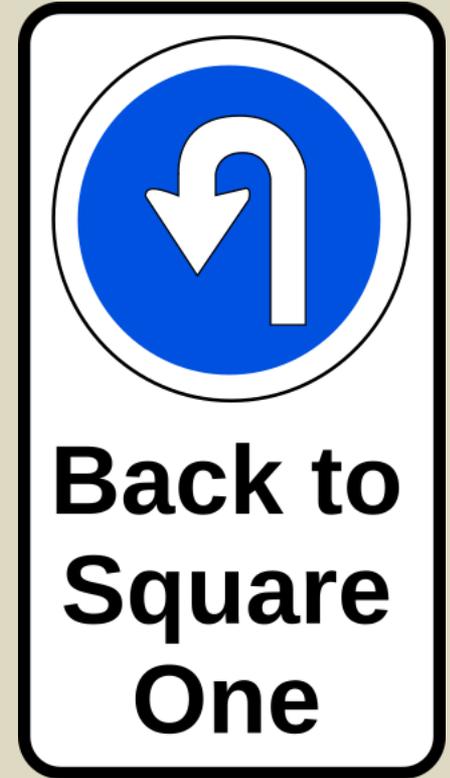**Massacci & Nguyen.** *MetriSec, 2010*

Vulnerability prediction?

Firefox public vulnerabilities

CVEs

Vulnerability Prediction: Problems

- **There is not enough data**

- **Number of vulnerabilities depends on:**
        Age of the project
        Number of users

- **Sometimes you simply have no choice…**

Back to Square One

Understanding Factors Is More Critical Than Predictions

- **When will a vulnerability appear in a FOSS component?**
  - We do not know

- **Can we distinguish features of projects causing "problems" for consuming software?**
  - We use maintenance effort of proprietary consumers to denote "problems"
  - Does the "security culture" of FOSS developers make a difference?
 - Does is make a difference which main language/technology is used?

Which Factors Are Interesting?

- **Collect all possible data, build a regression model to asses the impact of each factor**

- **Can we use all data that is available?**
  - Actual Total #LoCs of a component
  - Added Total #LoCs of a component
  - Removed Total #LoCs of a component
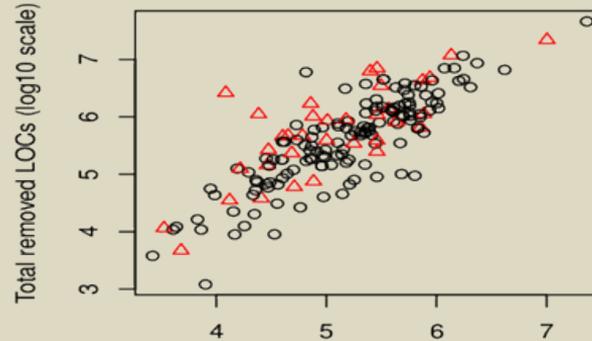 - Changed Total #LoCs (added, removed, etc.)...

Relationships Between Factors
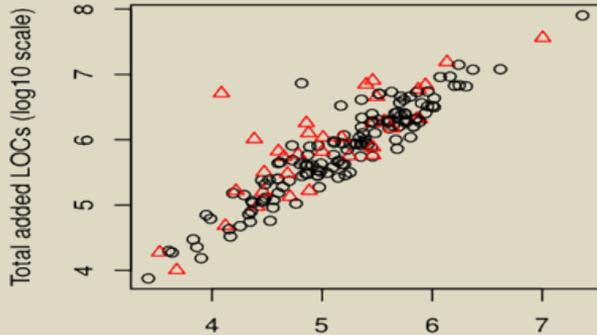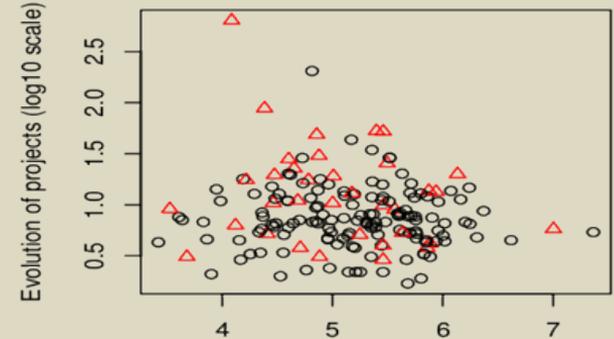
Different Maintenance Models
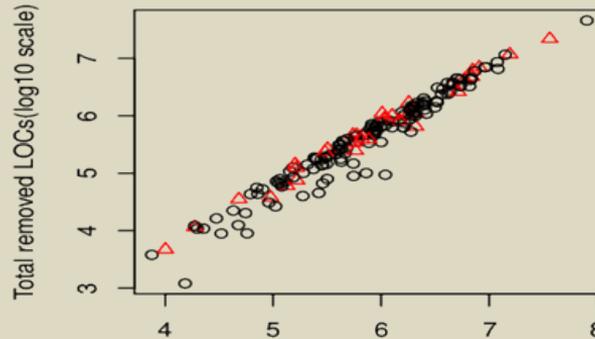
- **60 products are using Apache Tomcat**
  - Requires a lot of expertise to resolve security issues
  - It makes more sense to have a team of Apache Tomcat experts around

- **2 products are using a small JavaScript library**
  - This does not require any major expertise
  - However, if a company ends up using large number of products for which only the "local" expertise exists, it may be problematic

Centralized Security Maintenance

- Policy: dev. teams must select only components widely used and supported within a company

- A central team resolves vulnerabilities in all FOSS components and pushes changes to all consumers

- The security maintenance effort scales logarithmically with the number of products consuming a component

$$effort_i \propto \log\left(|vulns_i| * |products_i|\right)$$
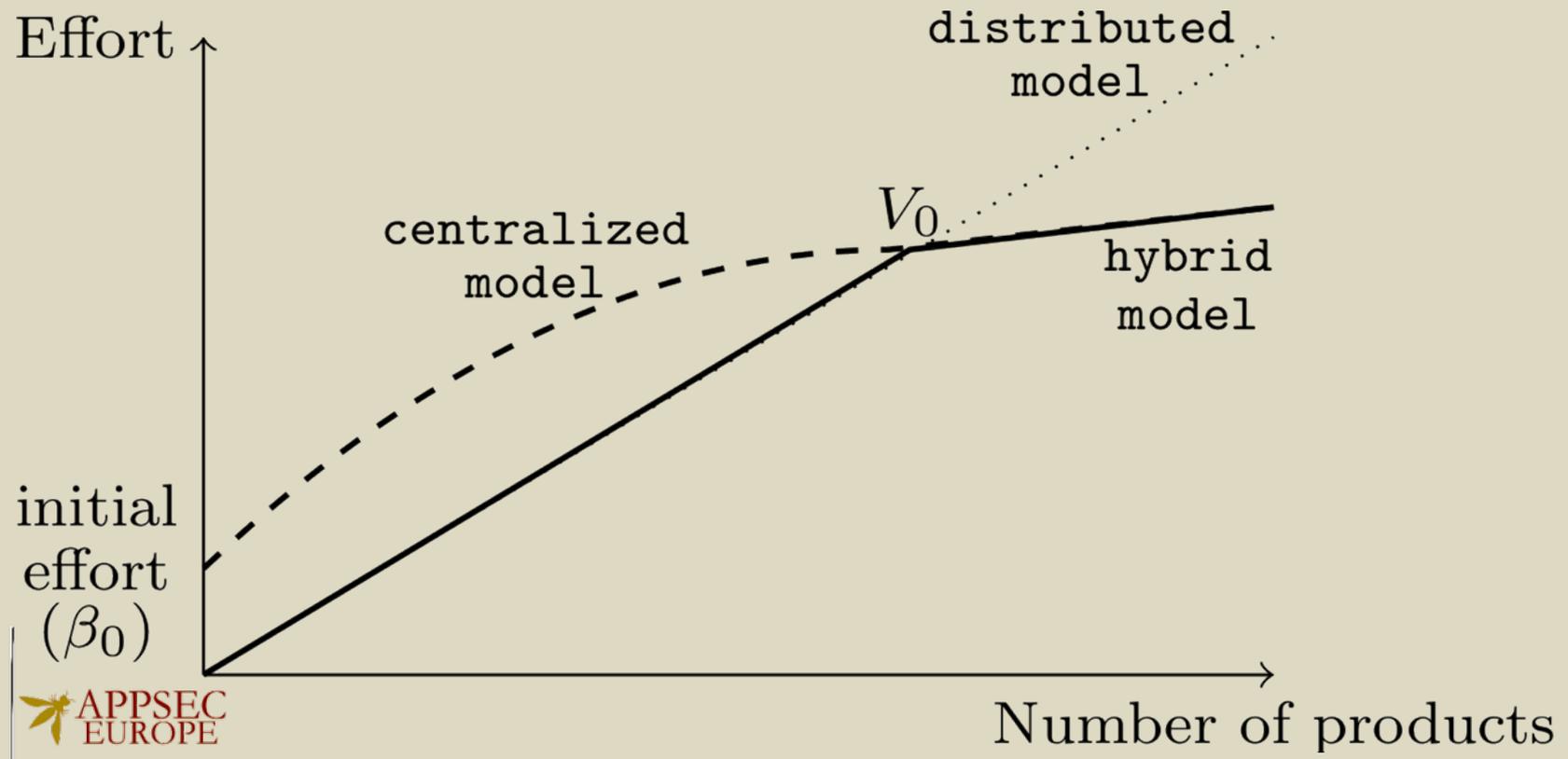
Distributed Security Maintenance

- Policy: each dev. team is free of selecting appropriate components

- Each team has to take care of security issues individually

- While this model should decrease the effort for organizational aspects (not considered by us), it adds up for the technical part of the effort

$$effort_i \propto |vulns_i| * |products_i|$$

Hybrid Security Maintenance

Part III:

Practical Recommendations On
Controling Risk & Effort Of Using Third Party Components

Strategies For Controlling Risks (1/2)

Secure Software Development Life Cycle
- Maintain a detailed software inventory
  (Do not forget the dependencies)
- Actively monitor vulnerability databases
- Assess project specific risk of third-party components

Obtaining components (or sources)
- Download from trustworthy sources
  (https, check signatures/checksums)

Project Selection

- Prefer projects with private bug trackers
- Evidences of a healthy/working SDLC
    - Documented security fixes/patches (no "secret" security fixes)
    - Documented security guidelines
    - Use of security testing tools

https://www.coreinfrastructure.org/programs

Strategies For Controlling Effort

Secure Software Development Life Cycle
- Update early and often
- Avoid own forks
  (collaborate with FLOSS community)

Project selection
- Large user base
- Active development community
- Technologies **you** are familiar with
- Compatible maintenance strategy/life cycle
- Smaller (in terms of code size) and less complex might be better

Part IV:

Conclusion

Conclusion

Do not waste time with unimportant questions!
(Is FLOSS more/less secure as proprietary software)

Implement a secure consumption strategy:
- Risk assessment of third party consumption (at least security & licenses)
- Plan for the efforts of secure consumption
- Plan the efforts/costs for response and maintenance

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Conclusion

Do not waste time with unimportant questions!
(Is FLOSS more/less secure as proprietary software)

Final advice:
- Accept that you can be hit by a "black swan" (e.g., heartbleed)
- If it happens:
    - Concentrate on understanding and fixing the issue
    - Understanding why you did not find the swan earlier should not be your first priority

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Thank you!

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