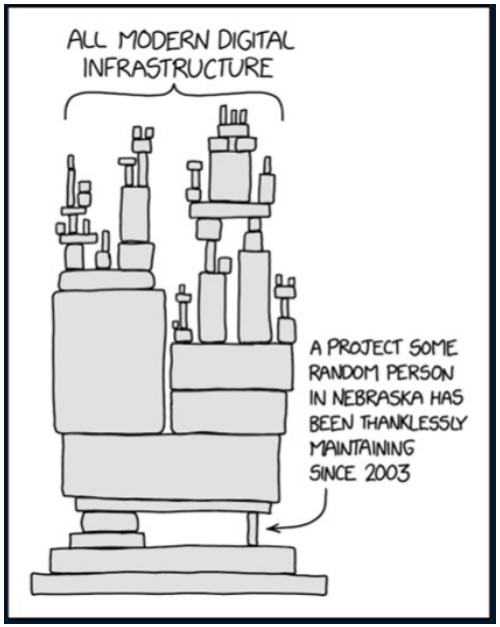
U.S. Open-Source Software (OSS) Security Initiative



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Context and Motivation

- Defense of the Software Supply Chain is a key component of the May 2021 Executive Order 14028 to Improve Nation's Cyber Security

The Office of the National Cyber Director (ONCD) Initiative

- Identified three lines of effort (LOE):
  - LOE 1: Enhance and Invest in Secure and Transparent OSS Development
  - LOE 2: Improve Transparency of Supply Chain Data through SBOM
  - LOE 3: Collaborate with Cyber Defenders to Understand and Mitigate Software Supply Chain Risk

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Expert Engagement

- Goals:
  - generate ideas and broad discussion around key approaches to invest in the security of open-source software

Expert Engagement

- Timeline:
  - April/May 2022: Steering Committee (SC) is formed and uncovers themes and challenges for further discussion
  - August 2022: two-day workshop for ~30 stakeholders informed by SC meeting take-aways
  - September 2022: public report guiding outcomes of LOE 1 and USG future investments

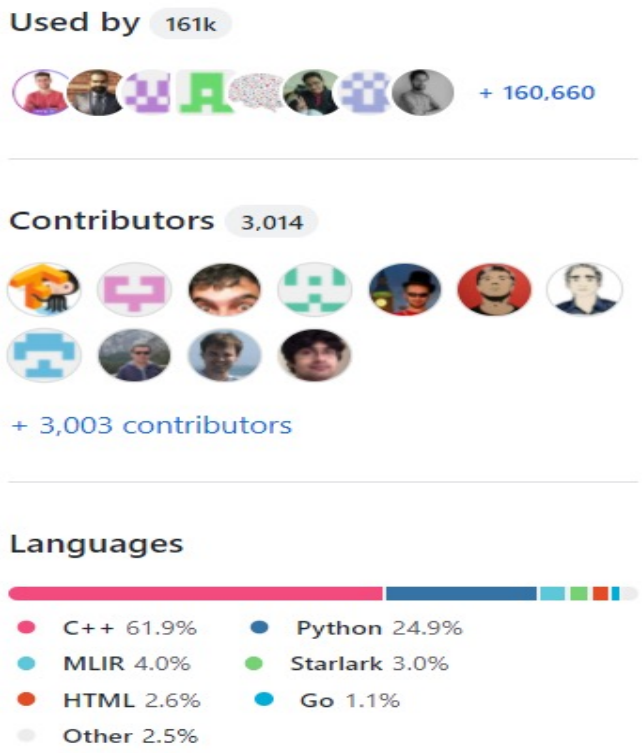
Main Themes

- Memory-Safe Programming Languages
- Dependency Management
- Behavioral and Economic Incentives to Secure the Open Source Software Ecosystem

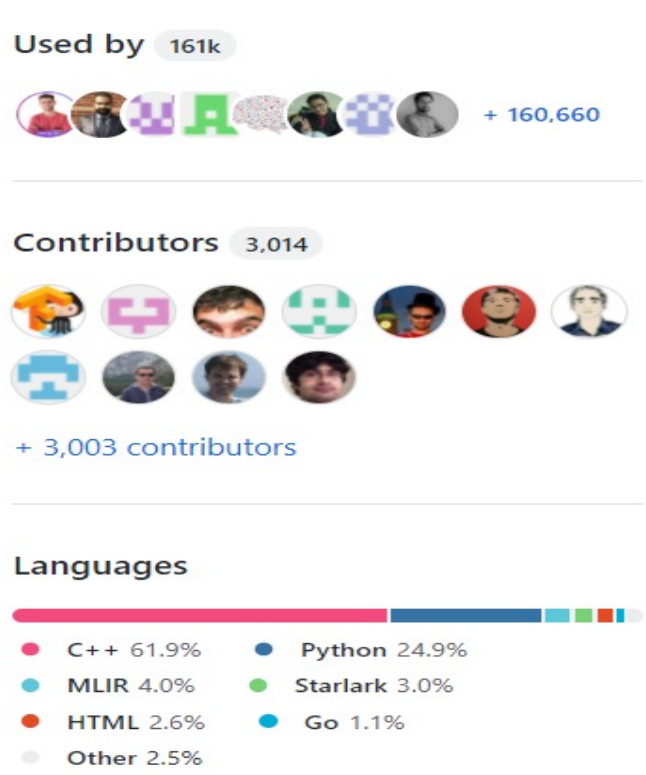
Behavioral and Economic Incentives to Secure the Open Source Software Ecosystem

The Issue

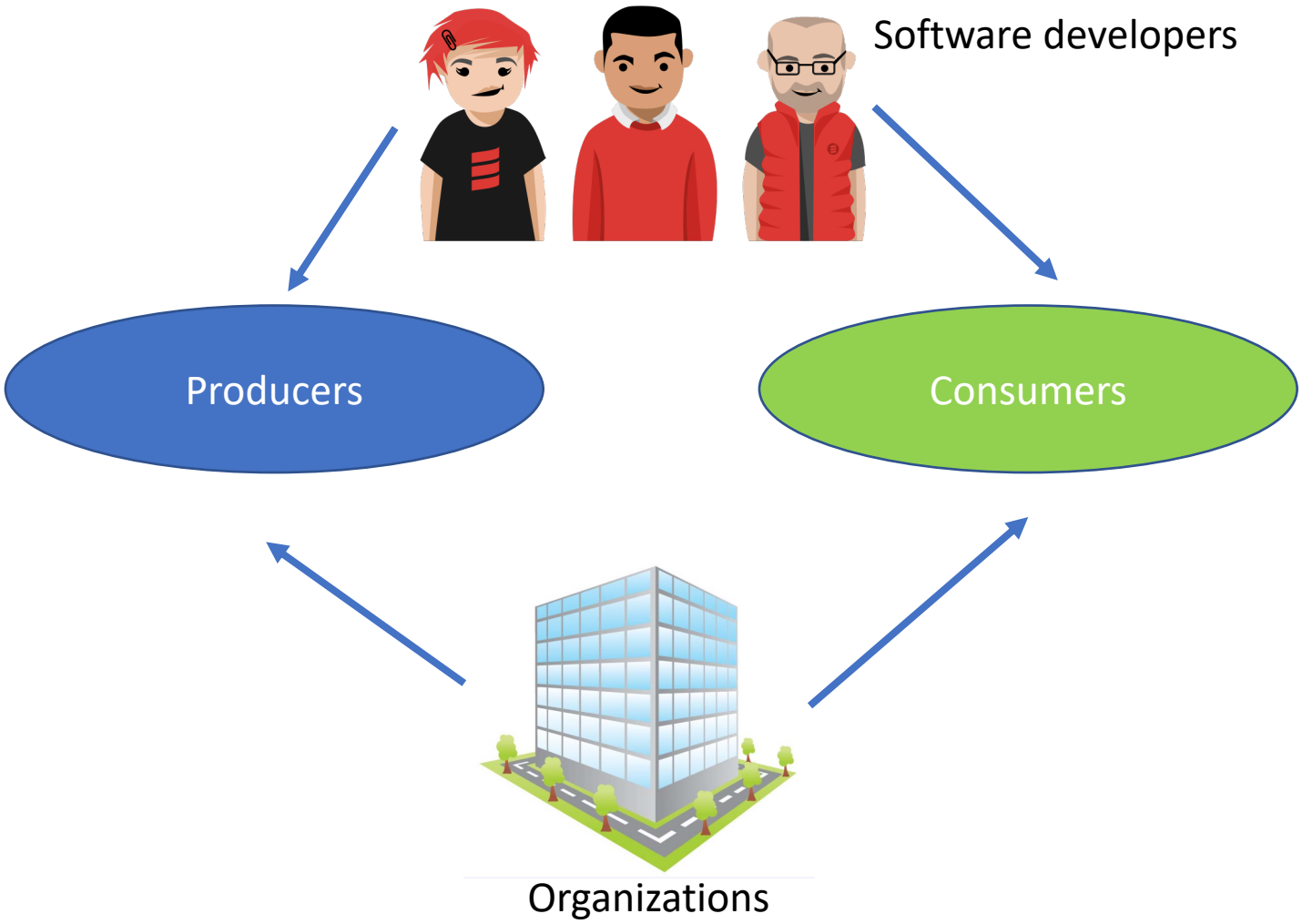
- Software is produced by humans and consumed by humans



Socio-technical issues



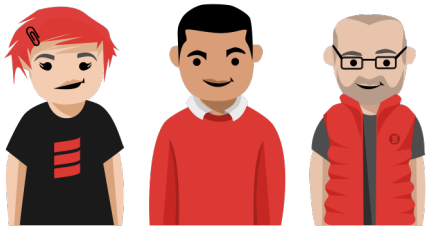
OSS Ecosystem: Who are the Participants?



Sources: https://freesvg.org/software-developers, https://vectorportal.com/vector/glass-building.ai/14492

Producers

Software Developers



- Humans who contribute (e.g., code, management) with the OSS ecosystem:
  - non-paid volunteers
  - compensated professionals
- Busy, overwhelmed
- Primary tasks is not necessarily security
- Lack incentives to operate with a security mindset:
  - *Is it even possible given the high cognitive demands of producing functionality?*

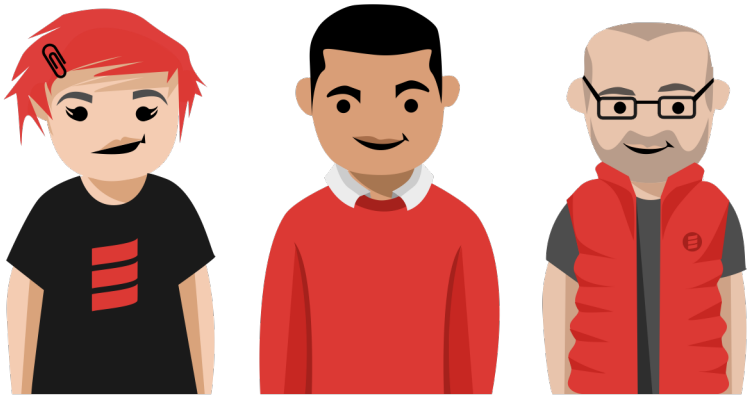
Organizations

- Companies that produce OSS
- Not liable for vulnerabilities in the code they produce

Consumers

Software Developers

- Humans who use OSS via dependencies in their own code



Organizations

- Have products and services that depend upon OSS code

Consumers Lack…

- **Trust** in the code they consume

Consumers Lack…

- **Transparency** on their dependencies

Source: https://www.amazon.com/https://www.amazon.com/Clear-Backpack-Through-Transparent-College-Pink/dp/B07X33M54J/ref=sr_1_11?crid=2CNAFEV3WMQUW&keywords=clear+backpack&qid=1663356069&sprefix=clear+backpa%2Caps%2C115&sr=8-11https://www.amazon.com/Clear-Backpack-Through-Transparent-College-Pink/dp/B07X33M54J/ref=sr_1_11?crid=2CNAFEV3WMQUW&keywords=clear+backpack&qid=1663356069&sprefix=clear+backpa%2Caps%2C115&sr=8-11

Consumers Lack…

- **Guidance** and **awareness** on how to consume third-party code in a trustworthy manner

https://en.wikipedia.org/wiki/File:Question_book-new.svg

Consumers Lack…

- **Situational awareness** for when trust is violated

Source: https://commons.wikimedia.org/wiki/File:Tamper_evident_seal_on_OTC_pharmaceutical.jpg

Key Question

How to create and maintain behavioral and economic incentives for these diverse stakeholders to operate in a way that foster a more secure OSS ecosystem?

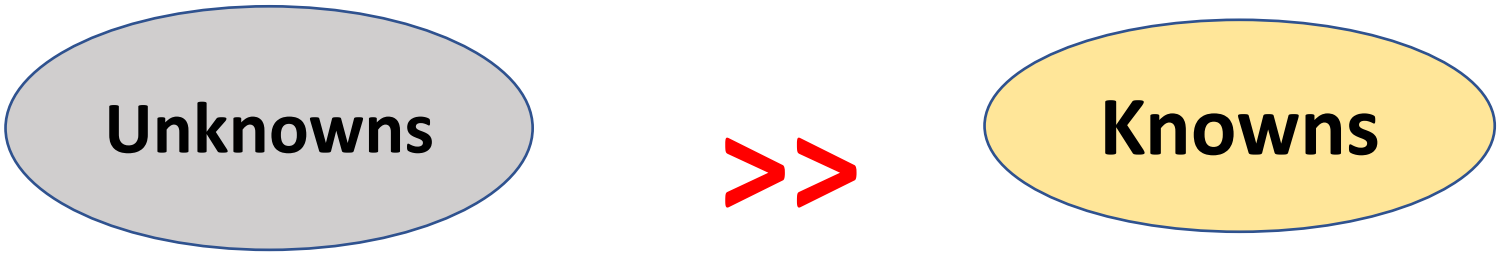
Challenges

- Diversity of stakeholders and roles:
  - Producers vs. Consumers
  - Developers:
    - Paid vs. unpaid
    - project/team size
    - security expertise
  - Organizations:
    - small vs. large
    - sector: industry vs. government

Challenges

- Incentives not aligned or at odds with one another:
  - Producers:
    - Time-to-Market
    - *"security is the consumer's responsibility"*
  - Consumers:
    - *"I want trustworthy code that does not break existing code"*

Main Take-Away for Theme



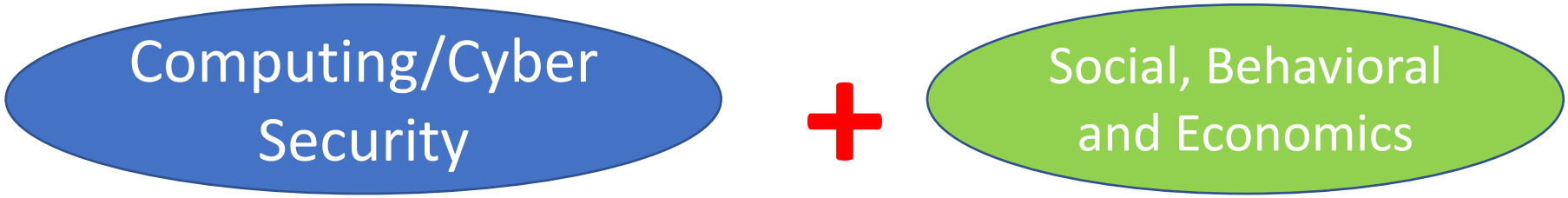
Potential Reason for Unknows

Socio-technical security issues of the OSS ecosystem

Source: https://www.alimed.com/optivisors-and-optivisor-magnifier-lens-plates.html?pid=58400&gclid=Cj0KCQjwvZCZBhCiARIsAPXbajt67fbRpbDMvO68P9XSDW3nwhV8yyARtAViOJk_KctU0i3oT6ZCq5UaAgDfEALw_wcB

Socio-Technical Security Issues of OSS Ecosystems

- Multidisciplinary problem



- We need to catalyze multidisciplinary research on these issues

Economics

Research Questions

1. What are the incentives driving each stakeholder?

   - How can we leverage and/or align these incentives among this diverse group to create a more secure OSS ecosystem?

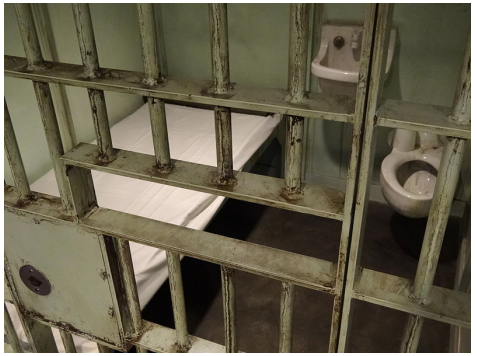
Research Questions

2. How to characterize/measure:
    - Project exposure to security risks
    - Trust (in developers, dependencies, projects)
    - Return of Investment (ROI) of implementing secure software development practices
    - Economic harm of keeping the status quo

Research Questions

3. To what extent accountability/liability helps in fostering security practices in software development?

- How to operationalize and implement accountability/liability?
  - Is it even possible and/or desirable?



Sources:https://freesvg.org/finger-pointing-v2, https://commons.wikimedia.org/wiki/File:Recreation_of_Martin_Luther_King%27s_Cell_in_Birmingham_Jail_-_National_Civil_Rights_Museum_-_Downtown_Memphis_-_Tennessee_-_USA.jpg, https://www.flickr.com/photos/pictures-of-money/17121925920

Research Questions

4. How to support the wide variety of project sizes, especially the very small contributor team on a very important project?

Software Development Practices

Research Questions

1. Why people decide to adopt or not a secure approach?
   - How to measure this quantitatively?

2. To what extent security audits help in preventing security risks and vulnerabilities?

Research Questions

3. In which conditions does monetary compensation translates into more secure software development practices?

4. How to include security training that is appropriate for everyone?

- seniority level
- security experience
- project size/type
- organization size/type

Research Questions

5. To what extent hiring security specialists for OSS projects translates into more secure software being developed?

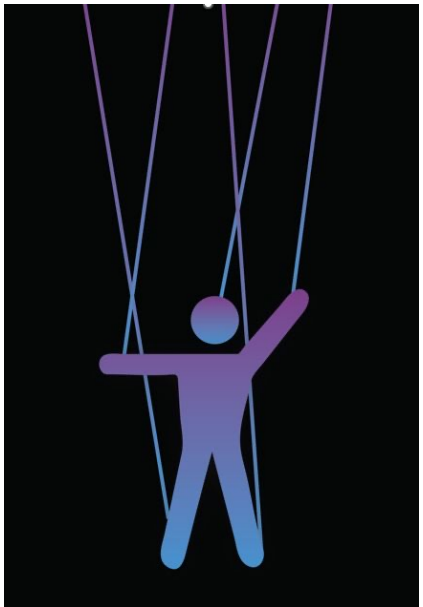
6. What type of usable security tooling is needed to streamline secure software development practices?

Team Dynamics

Research Questions

1. How to detect social engineering attacks in OSS projects?

   - How to identify attackers?
   - How to identify tactics of persuasion?



Research Questions

2. How to detect suspicious developer ascendency in projects?
   - How are people embedded into OSS projects?

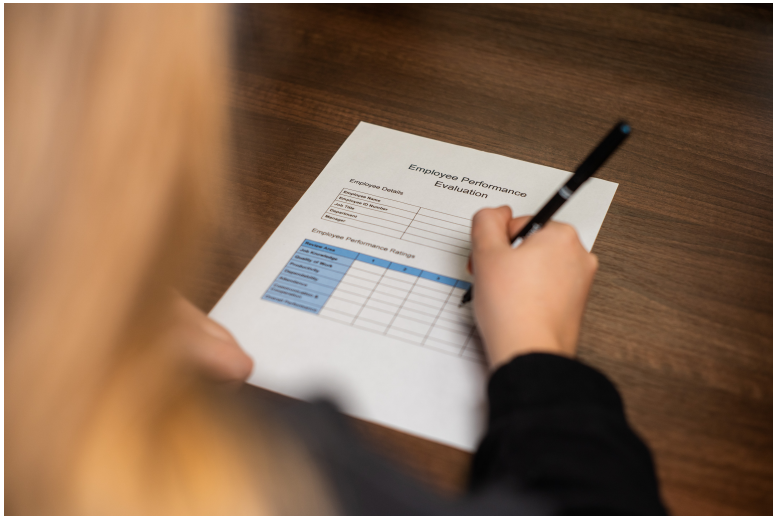
3. Is toxicity in team communications associated with less secure software development practices?

Source: https://freesvg.org/censored-swear-word-vector-image

Evaluation

Research Questions

1. What are the criteria to evaluate success in adopting socio-technical measures for a more secure OSS ecosystem?



Source: https://commons.wikimedia.org/wiki/File:A_woman_starts_to_fill_in_an_employee_evaluation_form_in_pen.jpg

Technical Recommendations

Concurrent with More Research…

1. Pay maintainers:

   - There should be requirements to pay into organizations that support community and/or security practices if one gets a government contract for projects that use OSS.

Concurrent with More Research…

2. Tooling to support dependency transparency:

- SBOM metadata:
  - including presence of code in unsafe languages
- To what extent project is depended on OSS
- Security/vulnerability score of OSS components that make up project
- Reporting of suspicious packages

Concurrent with More Research…

3. Metrics:

- Quantification of risk and dependency
- Mean time to remediation
- Criteria for a project to be defined as critical

Thank you!

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Image from: https://pixy.org/1281534/