



Susereum: Towards a Reward Structure for Sustainable Scientific Research Software

Omar Badreddin¹, Wahab Hamou-Lhadj²,
Swapnil Chauhan¹



1 University of Texas El Paso
2 Concordia University

Background

- Research has become inescapably Software-Dependent
- Developers of Research Software are
 - Untrained in Software Engineering
 - Transient Workforce
 - Adopt Discovery Driven Methodologies
 - Develop in absence of Requirements
- Research Projects are
 - Driven by scientific contribution
 - Have short funding cycles

Academic Eco-Systems

- Academic careers
 - Advanced by contributions of academic articles
 - Research software are not adequately recognized
- Little incentives to contribute high-quality research codes
- Academic eco system are dependent on peer reviews
 - Effective for static relatively short artifacts (papers)
 - Ineffective for large dynamic text (codes)

Sustainability Fundamental Challenge

- Software Sustainability is not unique to research software
- Professional spheres systematically undermine sustainability
- Prevalent practices
 - Reward engineers for feature development
 - Sustainability is uncertain and invisible
 - Systematic pressures to short-term goals

Price tag for fixing Phoenix pay system now tops original cost

Repair bill has risen to about \$402M — more than \$309.5M payroll implementation cost in the 1st place

CBC News | Posted: May 24, 2017 9:36 AM ET | Last Updated: May 24, 2017 5:54 PM ET



Parliamentary secretary to the Minister of Public Services and Procurement, says the government has many fixes. (CBC)

The cost to fix the federal government's troubled Phoenix pay system has risen above the original amount spent to implement it.

Steve MacKinnon, parliamentary secretary to the minister of Public Services and Procurement, announced on Wednesday a \$142 million investment to hire more people to help fix the ongoing Phoenix payroll issues.

"We have a capacity problem. It's very simple," said MacKinnon. "We are trying to rebuild that capacity, step by step."

With the additional money, the cost to fix Phoenix has risen to about \$402 million — more than the \$309.5 million it cost to implement the system. MacKinnon, a Liberal MP for Gatineau, said that the projected savings the Conservatives put forward "is now a bad joke."

Causes [\[edit\]](#)

There have been several causes put forward for Phoenix's problem with the new Miramichi pay centre.^[16] Federal unions have blamed IBM, which eventually cost \$1.2 billion.^[17] The former Conservative government

Dev Cost: **\$309.5 million**

Cost to fix (in Year 1 only): **\$402 million**

How to Address Sustainability

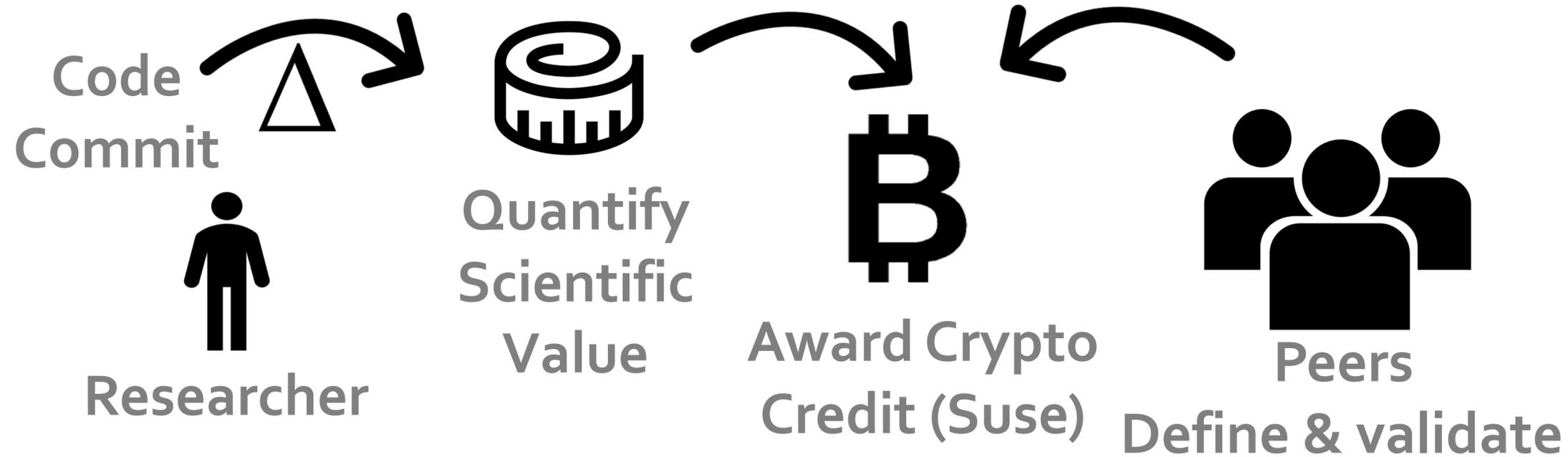
- Training and Education for Researchers and Scientists
- Policies and research funding structures
 - Hiring professional software engineers
- Understand the unique context and quality characteristics of research software.

Research Goal

- The goal of this research is to transform the prevalent incentive structures in academia.
- We aim to establish an ecosystem that systematically promotes contributions of scientific software. Software that is:
 - Sustainable over time to maximize returns
 - Disseminatable to other researchers for results extension
 - Reproducible for research results extension.
 - Attain broader longer-term impacts

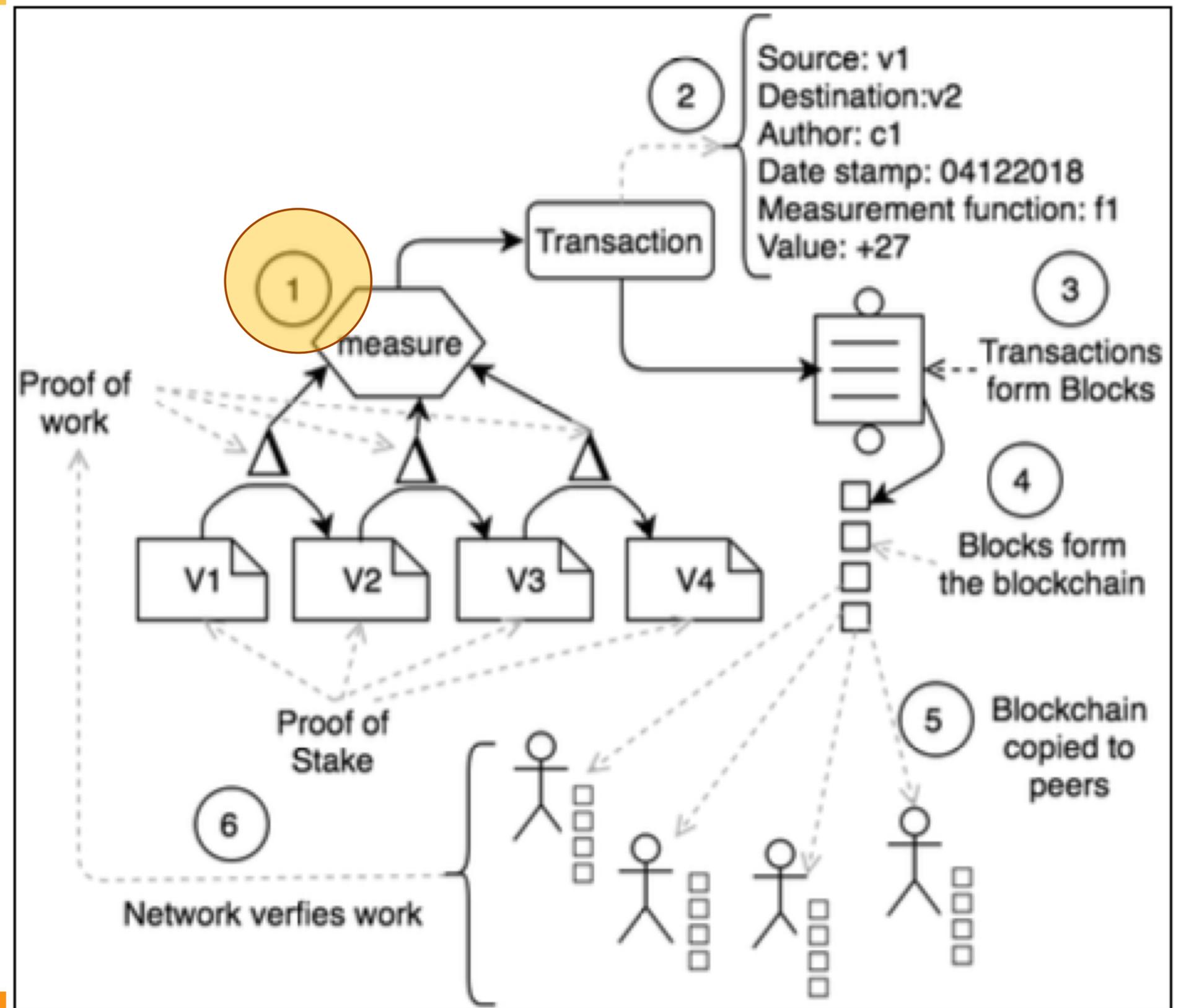
Susereum

- Susereum = Sustainability + Ether.
- Distributed Ledger
- Reward contributors of research codes with immutable, permanent, peer-recognized credit.



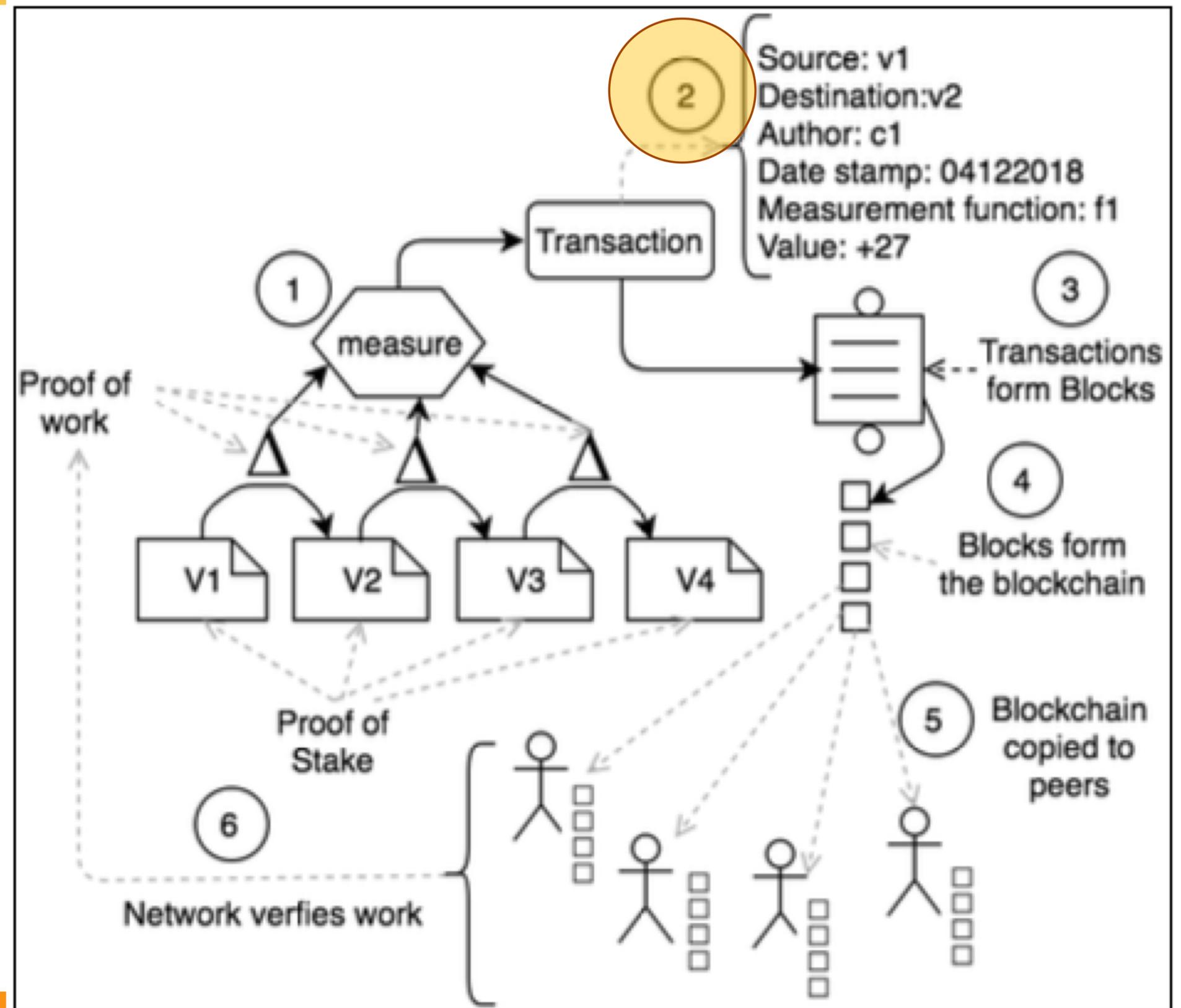
Susereum

Step One
Code Change
Event



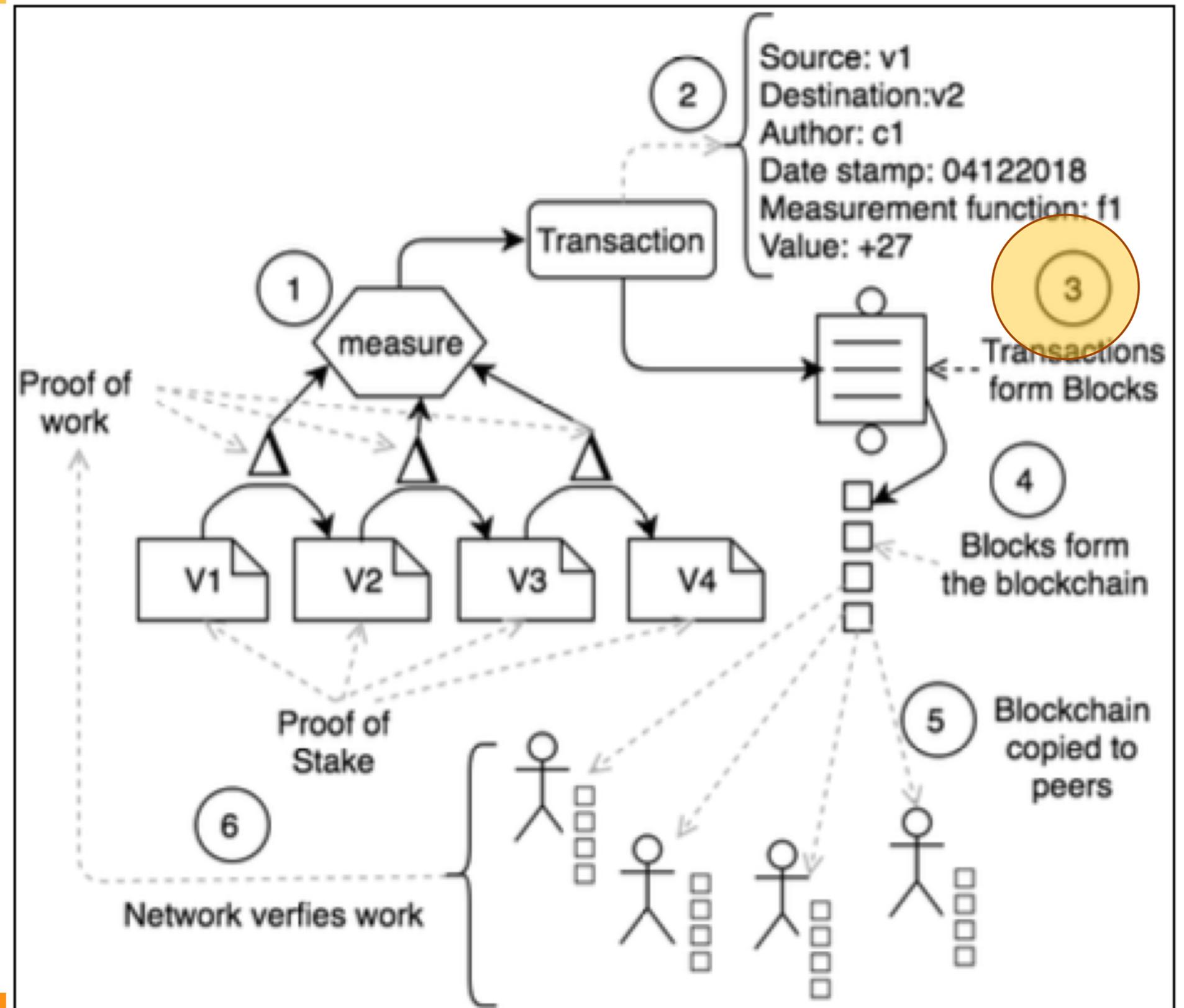
Susereum

Step Two Transaction Formation



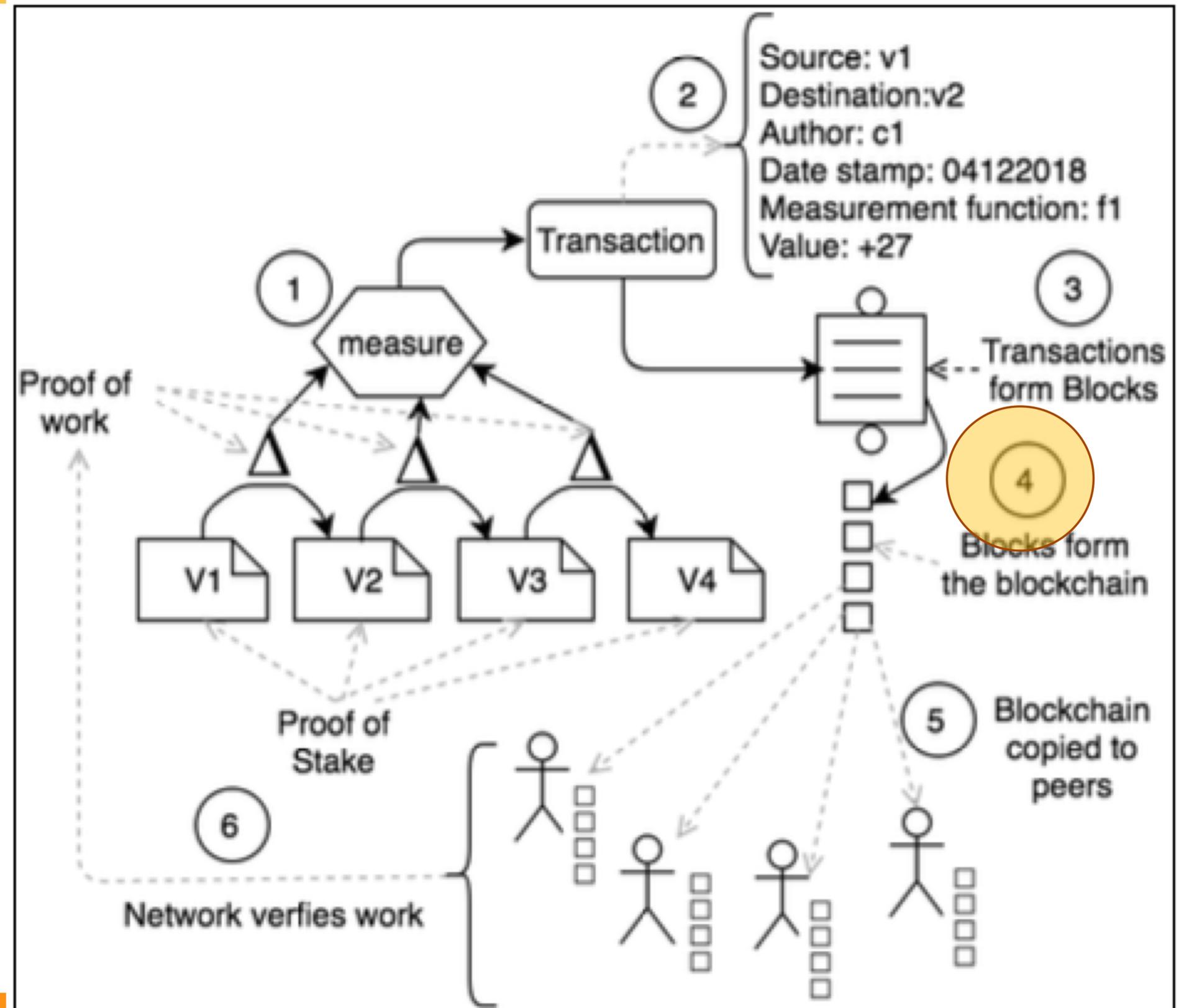
Susereum

Step Three Block Formation



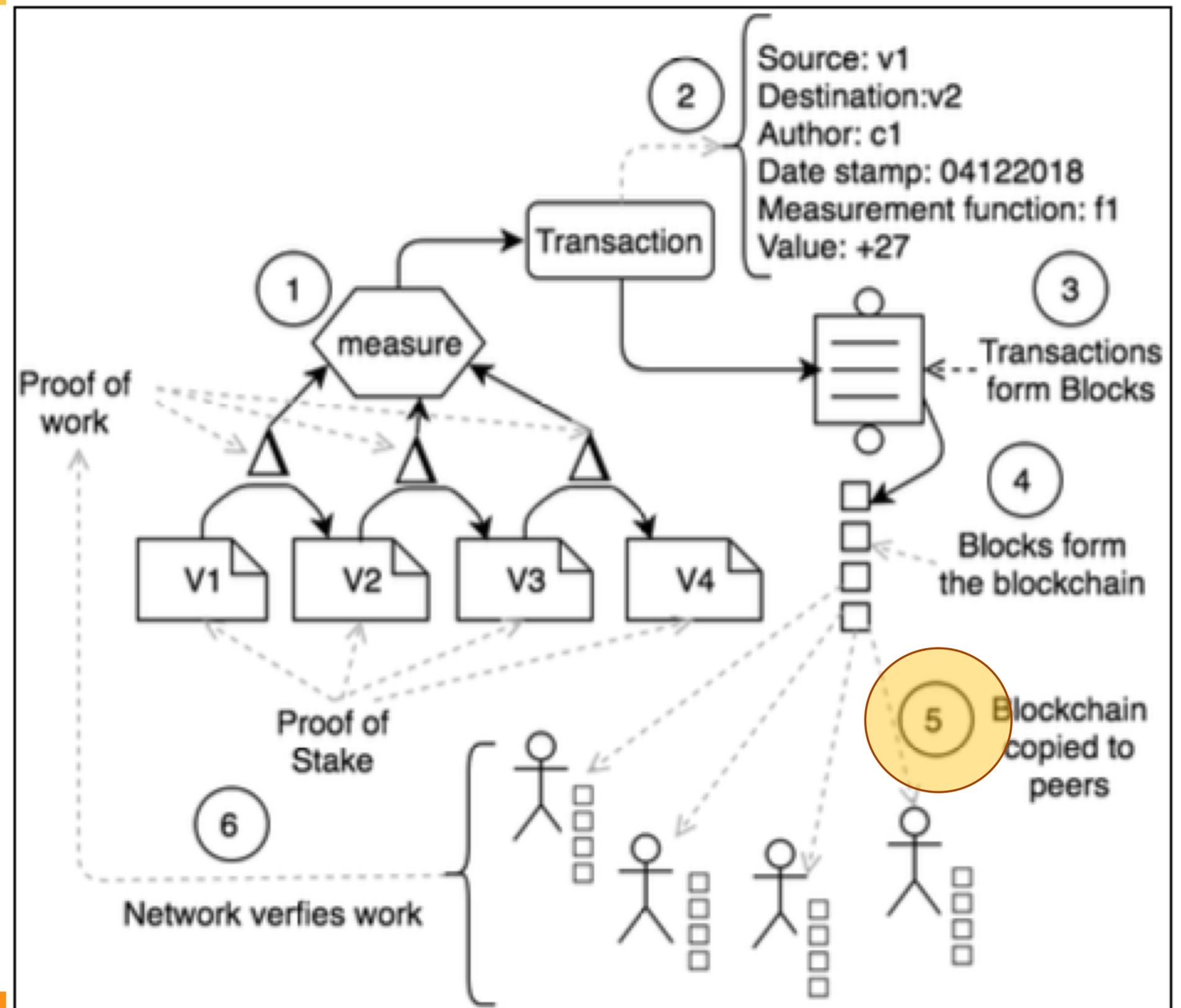
Susereum

Step Four Chain Formation



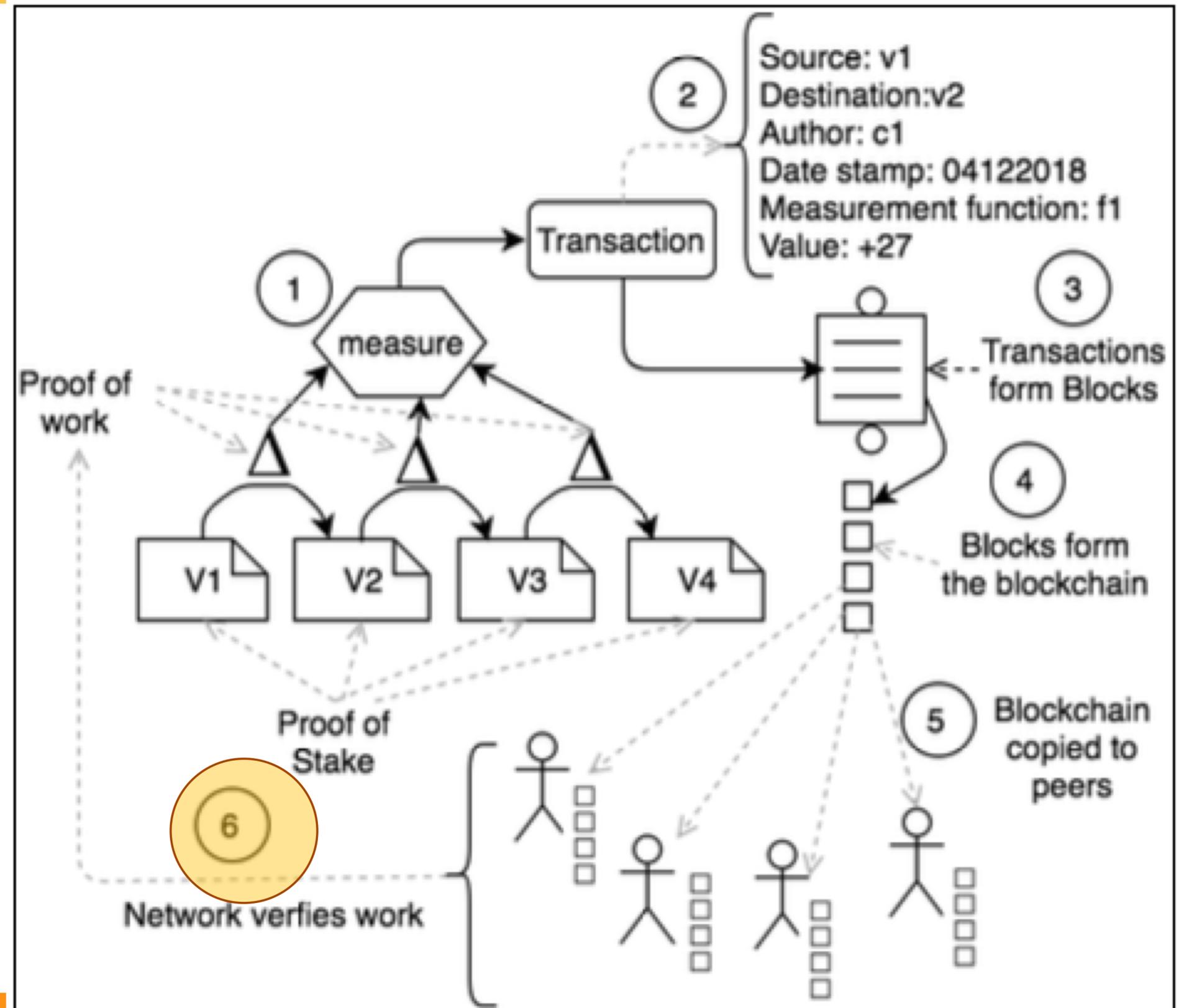
Susereum

Step Five Chain Propagation to Peers

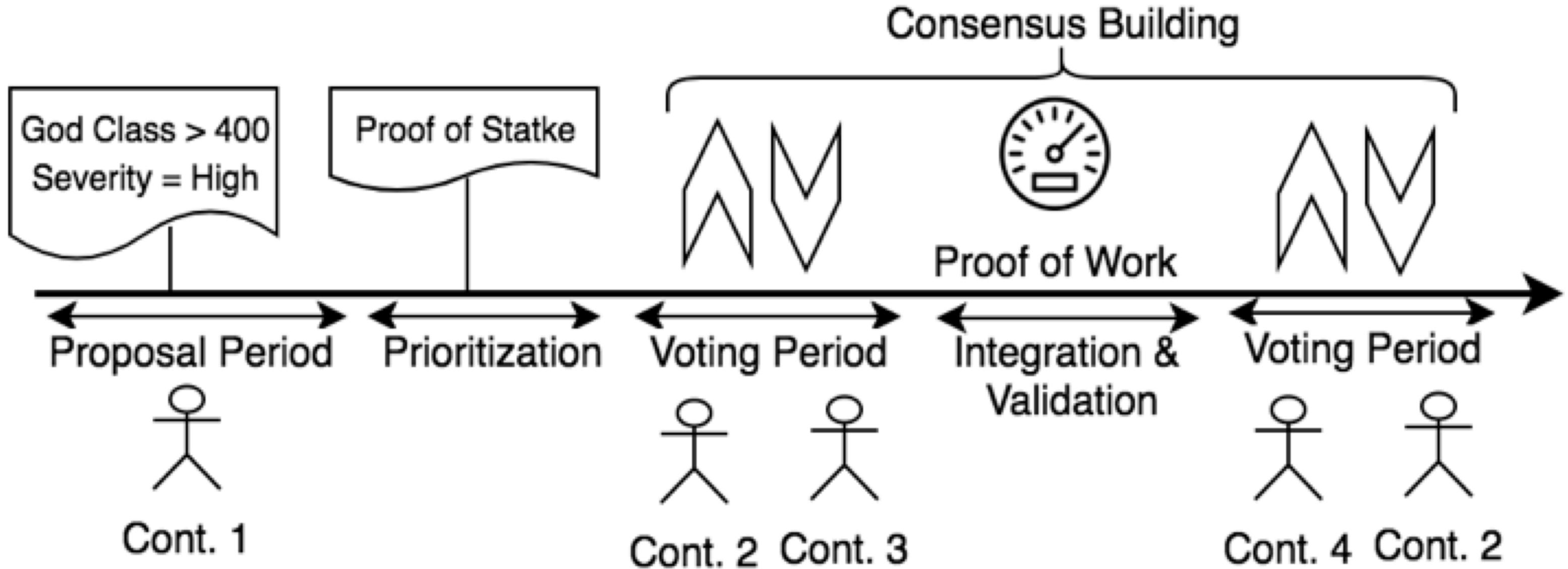


Susereum

Step Six Peers Verify Work



Consensus Protocol



Potential Impact

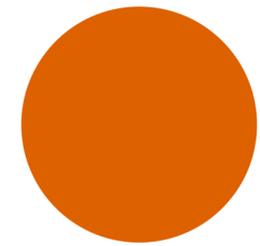
- Open Source and Professional Spheres
- Scientific and Research Software
- Discovering and Sharing of Novel Sustainability Measures
- **Decentralized Sovereignty** and Impacts Beyond Software Sustainability
 - Redefine development process, artifacts formalisms, conflict resolutions for artifacts, ..
 - Project task priorities, schedule, task assignments, effort estimates,..
 - Rewards for crowd-based software engineering

Open Questions

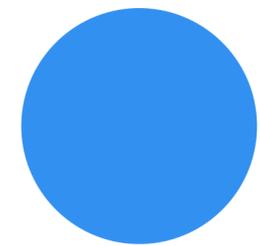
- To what extent do “Incentives” affect codebase quality and sustainability?
- How to measure the scientific value of code contributions?
- How to quantify codebase sustainability?

- Analyzing large-scale research codebases
 - QGIS case Study
 - Interviewing Developers
 - Uncover decision making processes for individuals and teams

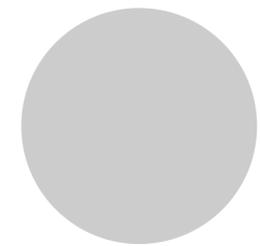
Summary



Restructure Incentives with Crypto Credit



Significant Potential Impact on Software Sustainability



Decentralization of Sovereignty