

Open Problems in DAOs

And... Why You Should Care.



*Research Collaboration
Facilitated by Metagov*

M. Zargham

Aug 9, 2024



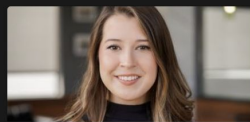
BLOCKSCIENCE



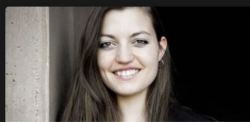
Joshua Tan
Oxford Metagov
joshuatan.com/research



Tara Merk
CNRS Metagov
University of Paris II
twitter.com/mpg_dd



Sarah Hubbard
Harvard
linkedin.com/in/...hubba/



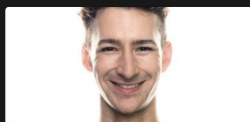
Eliza Riley Oak
Yale
linkedin.com/in/...92109/



Joni Pirovich
BADAS*L Metagov
linkedin.com/in/...ovich/



Ellie Rennie
RMIT University
linkedin.com/in/...97595/



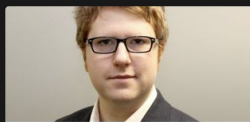
Rolf Hoefler, Ph.D.
Cultur3
linkedin.com/in/...oefler/



Michael Zargham
BlockScience Metagov
WU Vienna
linkedin.com/in/...argham



Jason Potts
RMIT University
rmitblockchain.io/jasonpotts



Chris Berg
RMIT University
chrisberg.org/



Reuben Youngblom
Stanford



Primavera de Filippi
CNRS Harvard
twitter.com/yaoeo



Seth Frey
University of California Davis
Metagov



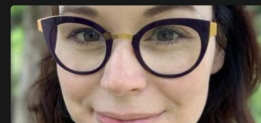
Jeff Strnad
Stanford



Morshed Mannan
European University Institute
twitter.com/Man...orshed



Kelsie Nabben
Metagov RMIT University
kelsien.github.io/



Silke Noa Elrifai
University of Paris II
twitter.com/silkenoa



Jake Hartnell
DAODAO Juno



Benjamin Mako Hill
University of Washington
com.uw.edu/peo...-hill/



Tobin South
MIT



Alexia Maddox
La Trobe University
alexiamaddox.com/



Woojin Lim
Harvard



Ari Juels
Cornell Tech IC3



Dan Boneh
Stanford
crypto.stanford.edu/~dabo/

Contents

1	Introduction	4
1.1	Who is this article written for?	4
1.2	Call for collaboration	5
1.3	The bigger picture	5
2	Computer science	6
2.1	Granular privacy	7
2.2	Private execution	8
2.3	New computational substrates	10
2.4	Secure voting	11
2.5	Modeling and formal verification for governance	12
2.6	Human-computer interaction for DAO interfaces	14
2.7	DAOs as social computing systems	15
2.8	Measures of decentralization	16
2.9	Democratic infrastructures for governing technology	17
2.10	Data sets and data standards	17
2.11	Automated testing and automated experimentation	18
3	Economics	20
3.1	Institutional economics	21
3.2	Case studies within institutional economics	23
3.3	Corporate governance and principal agent problems	24
3.4	Dynamics and strategy	25
3.5	Tokenomics and platform economics	26
3.6	Labor economics	28
3.7	Social choice	29

4	Ethics	31
4.1	Can DAOs be unethical?	32
4.2	Are DAOs moral agents?	33
4.3	Running an ethical DAO	34
5	Law	35
5.1	Legal definition	35
5.2	Legal liability	36
5.3	Financial regulation	37
5.4	Incorporation and legal recognition	38
5.5	Dispute resolution systems	39
6	Organizational science	40
6.1	Organizational imprinting	40
6.2	Evolutionary social science	41
6.3	Neo-institutional theory	43
6.4	Organizations as complex adaptive systems	44
6.5	Organizational methodology in the era of complete data	46
6.6	Organizational ethnography	47
7	Political science and philosophy	48
7.1	Institutions	49
7.2	Turnout	50
7.3	Real-time experimentation	51
7.4	Self-governance	51
7.5	Global governance	53
7.6	Political philosophy	54

*Computer
Science*

Economics

*Organizational_
Science*

Law

Political Science

Ethics

Philosophy



Why Should You Care?



BLOCKSCIENCE

Major Coordination Problems!

Sustaining Open-Source Software

— Addressing chronic underfunding and resource shortages in critical digital infrastructure, and unleashing the potential of collaborative production.

Democratic governance of artificial intelligence

— Developing bottom-up, decentralized approaches to AI governance (and training data governance) that are more responsive and representative

Regenerative Finance:

— Creating a sustainable and equitable planetary economy by aligning financial incentives with ecological restoration and social justice

(Section 8 of our paper)



BLOCKSCIENCE

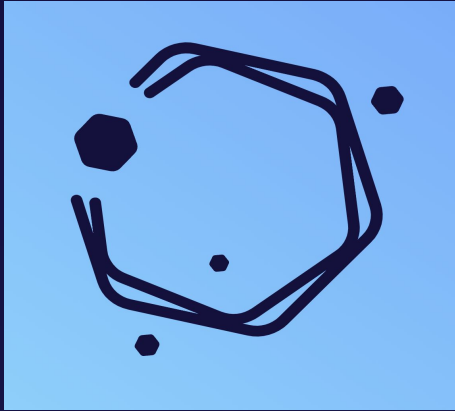
Who am I & My Perspective



BLOCKSCIENCE

Michael Zargham, PhD Electrical & Systems Engineering, UPenn 2014

Founder & Chief Engineer
(my day job)



BlockScience is a “digital”
civil engineering firm.

Board Member & Research Director
(volunteer roles)



A laboratory for digital
governance.



BLOCKSCIENCE

My Perspective: Blockchains & DAOs are Cyber-Physical Systems

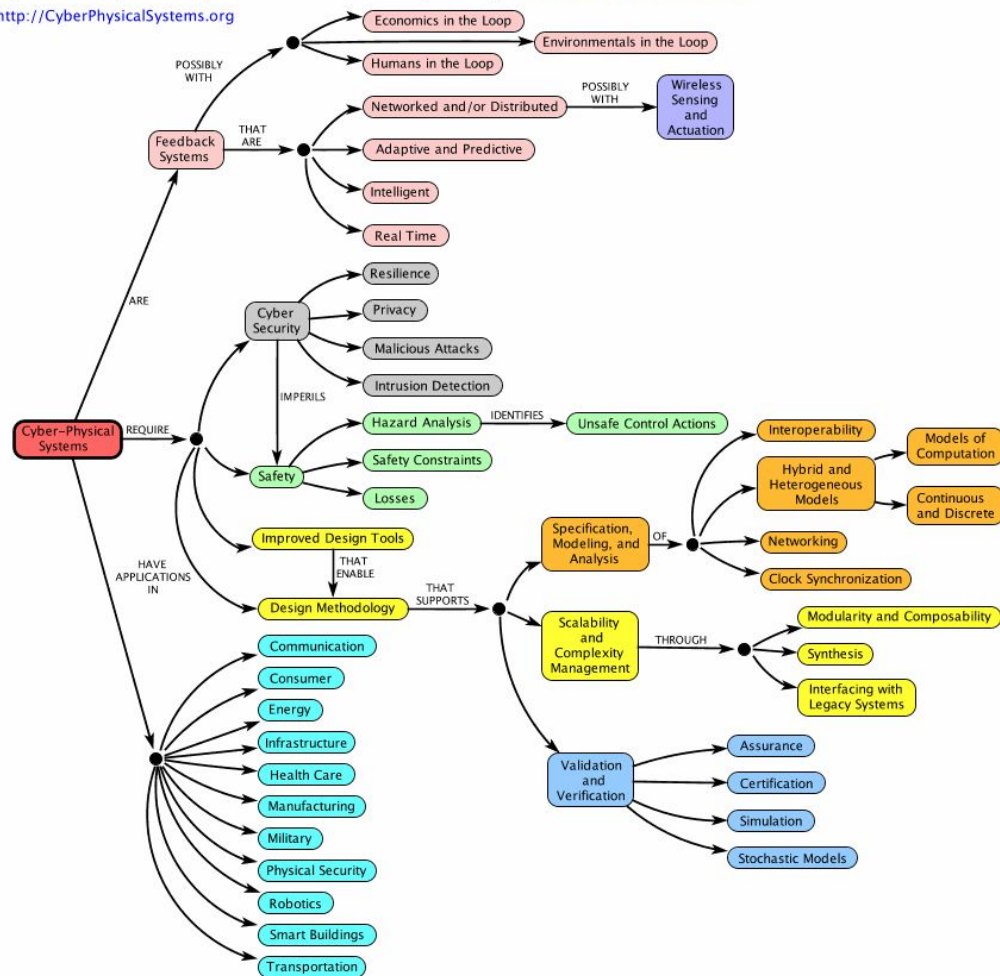
A cyber-physical system (CPS) is a collection of mechanisms that is controlled and/or monitored by computer-based algorithms, tightly integrated with the Internet and its users.



Cyber-Physical Systems – a Concept Map

See authors and contributors.

<http://CyberPhysicalSystems.org>



What are DAOs?

DAOs are organizations governed by a smart contract, typically deployed on a blockchain that autonomously enforces rules for interaction among the members. (Hassan & De Filippi, 2021)

DAOs also belong to a larger class of digitally-constituted organizations: organizations governed through computational artifacts such as software, hardware, and/or protocols.
(Tan et al, 2024)



Meme Credit:
Litigating the Ledger:
Civil Liability for DAO Controllers
(Alston, 2024)



Digitally-Constituted? "What Constitutes a Constitution?".

the function of a constitution is to

- delineate the boundaries of a particular organization or entity,*
- entrenching elements of its composition relative to that organization's regular processes of decision-making,*
- as well as against the broader array of legal, social, economic, and environmental forces that make up its context(s).*
- operates to reinforce the coherence of that entity*
- in the face of both internal and external pressures, ...*
- evolve through its interactions with both its members and its environment*
- while nonetheless retaining its identity.*

(Zargham M., Alston E., Nabben K., Ben-Meir I., 2023)

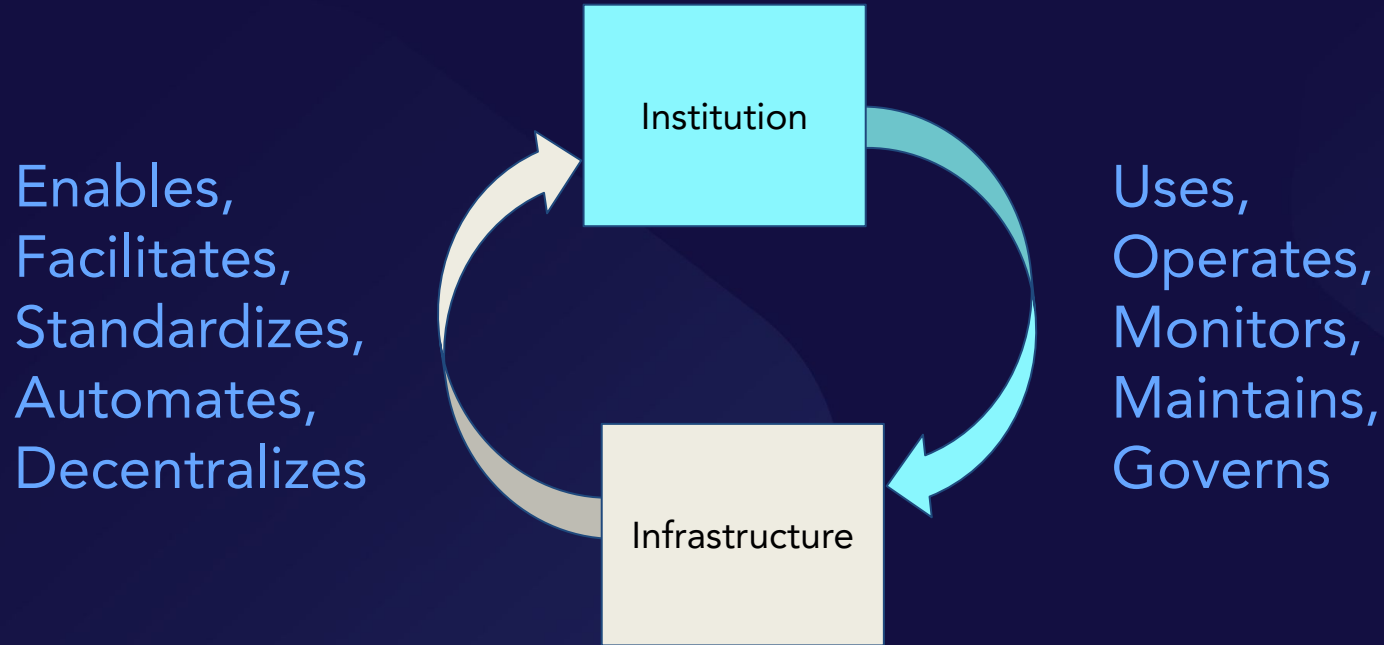


BLOCKSCIENCE

Meme Credit: Metalex Whitepaper (Shapiro, 2024)



Decentralized Networks, DAOs,
Protocol-Guilds, BORGs, etc



Blockchain Networks, Smart Contracts,
Oracles, Forums, etc



BLOCKSCIENCE

Meme Credit: Algorithms as Policy (Zargham & Nabben, 2020)



BLOCKSCIENCE

Constitutional Archetype from (Zargham & Nabben, 2022)

Table 1: Archetypes for Governance of Organizational Code

Archetype	Immutable	Constitutional	Mutable
Governance Surface	None	Small	Large
Variety	Low	Medium	High
Adaptive Capacity	None	Constrained	Unconstrained
Resilience	Low	High	High
Robustness	High	High	Low

Source

[Aligning 'Decentralized Autonomous Organization' to Precedents in Cybernetics](#)



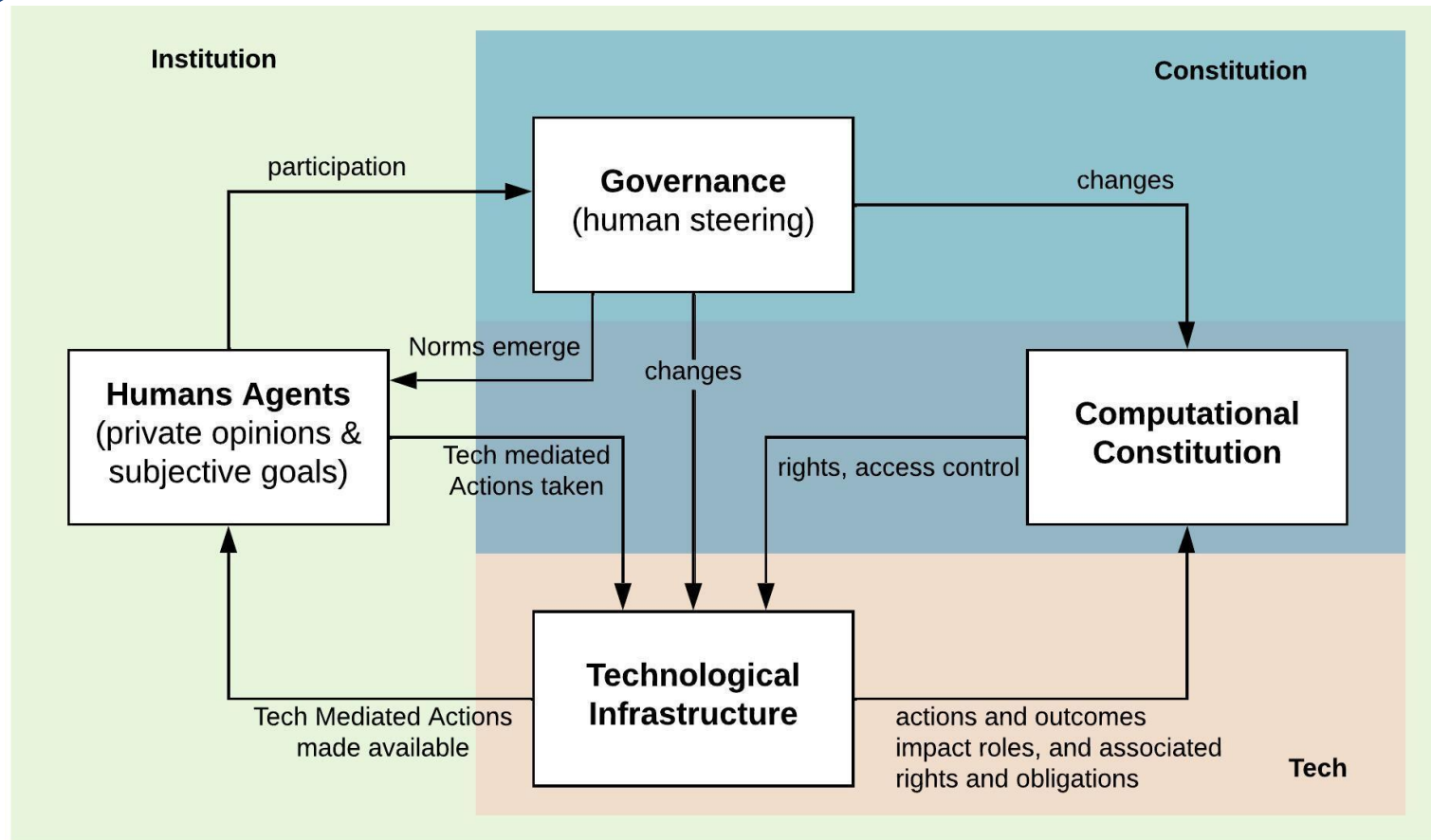
BLOCKSCIENCE

Meme Credit: The Human Side of DAOs (Case, 2023)



ENCE

Adapted from (Voshmgir & Zargham, 2019)



Implicates the Topics Explored in the “Open Problems in DAOs” Paper

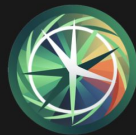
- **Computer Science:** Exploring Technical challenges faced in implementing operating DAOs; such as privacy, secure voting, standards, formal verification.
- **Economics:** Examining institutional dynamics, platform economics, labor economics, participation incentives, social choice and corporate governance.
- **Ethics:** Investigating moral agency, potential misuse, and ethical operation.
- **Law:** Addressing legal definitions, liability issues, and regulatory frameworks
- **Organizational Science:** Complex adaptive systems and their evolution, institutional evolution, and ethnographic methods.
- **Political Science:** Self-Governance and autonomy, political philosophy, empirical political economy, metrics and implications for global governance



Get Involved with DAO Science



<https://daoscience.org/>



DAO Science

DAO Science is a nonprofit project to catalyze impactful work on decentralized autonomous organizations (DAOs) and other digitally-constituted organizations. Hosted by [Metagov](#).

▼ 🧠 Open Problems



DAOs are a new, rapidly-growing class of organizations governed by smart contracts. In our paper, “Open Problems in DAOs”, we describe how researchers can contribute to the emerging science of DAOs and other digitally-constituted organizations. From granular privacy primitives to mechanism designs to model laws, we identify high-impact problems in the DAO ecosystem where existing gaps might be tackled. Below, you will find summaries of these problems, grouped by discipline.

📖 Disciplines



Computer science



Economics



Ethics



Law



Organizational science



Political science & philosophy

You can also view interactive summaries of all the problems by going to the page below:



Interactive summaries