REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE ***(DD-MM-YYYY)***
30-05-2022

2. REPORT TYPE
Research

3. DATES COVERED ***(From - To)***
18-09-2021 – 30-05-2022

4. TITLE AND SUBTITLE

In Pursuit of Ethical Thinking about Blockchain Technology for the DoD

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Yatsevitch, Michael, A

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Naval War College
686 Cushing Road
Newport, RI 02841-1207

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Distribution Statement A: Approved for public release; Distribution is unlimited.

13. SUPPLEMENTARY NOTES
A paper submitted in partial satisfaction of the NWC Ethics and Emerging Military Technology Graduate Certificate Program. The contents of this paper reflect my own personal views and are not necessarily endorsed by the NWC or the Department of the Navy.

14. ABSTRACT
Little has been written on blockchain ethics. Further, the strategic implications of blockchain technology are currently opaque and underestimated. This may lead to strategic surprise or unintended consequences. This paper provides the DoD with essential conceptual assessments and theory regarding the technology useful for operational art and determining ethical implications. Blockchain technology digitizes ethics because it manifests ethical values in a new form of governance of physical and digital objects across political, economic, and administrative domains. Since blockchains can govern both the digital and physical planes it has the capacity to cause harm to a person’s digital or physical form inadvertently or purposefully through governance. The technology is deconstructed in ways that supports future research into the measurement of global trust, the health of democratic systems, and methods to combat misinformation. Ethically commanding this technology will influence the outcome of great power competition as it is integral to the future of the internet, industry, and governance.

15. SUBJECT TERMS
ethics, blockchain, bitcoin, ethereum, cryptocurrency, DoD, AI, consensus, trust, distributed ledger technology, governance, digital transformation, web 3.0, ir 4.0, industrial revolution, society, global ethic, ideologies, quantification, measure, decentralization, cryptogogue

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
					Dr. Tom Creely EEMT Dir.
a. REPORT	b. ABSTRACT	c. THIS PAGE		69	19b. TELEPHONE NUMBER *(include area code)*
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED			401-841-7542

U.S. NAVAL WAR COLLEGE
Newport, RI

In Pursuit of Ethical Thinking about Blockchain Technology for the DoD

By

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Date Submitted: May 30, 2022

A paper submitted to the Faculty of the United States Naval War College Newport, RI, in partial satisfaction of the requirements of the Ethics and Emerging Military Technology Graduate Certificate Program.

Abstract

Little has been written on blockchain ethics. Further, the strategic implications of blockchain technology are currently opaque and underestimated. This may lead to strategic surprise or unintended consequences. This paper provides the DoD with essential conceptual assessments and theory regarding the technology useful for operational art and determining ethical implications. Blockchain technology digitizes ethics because it manifests ethical values in a new form of governance of physical and digital objects across political, economic, and administrative domains. Since blockchains can govern both the digital and physical planes it has the capacity to cause harm to a person's digital or physical form inadvertently or purposefully through governance. The technology is deconstructed in ways that supports future research into the measurement of global trust, the health of democratic systems, and methods to combat misinformation. Ethically commanding this technology will influence the outcome of great power competition as it is integral to the future of the internet, industry, and governance.

Acknowledgements

I am indebted to the Naval Sea System (NAVSEA) Dr. William F. Bundy Warfare Center Scholar Program for giving me the opportunity for residency at the U.S. Naval War College. This paper, developed as part of my participation in the Ethics and Emerging Military Technology (EEMT) graduate certificate program, has allowed me to think deeply about the ethical implications of technology for which I am grateful.

I would like to thank Dr. Thomas E. Creely and Dr. Timothy P. Schultz for their leadership with the EEMT program as well as Dr. Molly Jahn. Additionally, I thank my adviser Dr. Derrill T. Goldizen.

Dedication

This paper is dedicated to those that act with integrity. All decisions matter.

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Introduction

Purpose

The world is complex. Right now, blockchain technology is being used to bring order to this complexity by digitizing governance systems. This technology, despite the confounding maximalist or minimalist views often popularized, has a handful of key properties and principles that allow for structured thought. Nevertheless, because governance, technology, and humanity intersect with these properties and principles, the resulting events are difficult or even impossible to predict. This paper describes blockchain technology in ways relevant to military strategic thought to prevent conflict and advance U.S. and partner interests.

Blockchain technology digitizes ethics. Every blockchain project communicates ethical values by digitizing political, economic, or administrative governance at local, national, or global levels.[1] Blockchain projects also influence behavior by incentivizing certain actions. Consequently, unintended second- and third-order societal effects should be considered.

The 2008 financial crisis prompted the adoption of blockchain technology, which culminated in the successful introduction of Bitcoin in 2009. By 2021, a single Bitcoin had a value of nearly $67,000, and along the way inspired the launch of over 10,000 other blockchain implementations from individuals, corporations, and governments.[2] Brand-new, sometimes disorienting, terms filled the lexicon of popular media and online communities: cryptocurrencies, non-fungible tokens (NFTs), digital wallets, smart contracts, zero-knowledge proofs, and

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[1] This paper uses a definition of "governance" from the United Nations Development Program see Peter Blunt and Dennis Rondinelli, *Reconceptualising Governance* (Department of Public Affairs, UNDP, New York, 1997), ix.

[2] Paul Vigna Ostroff Elaine Yu andCaitlin, "Bitcoin Price Surges Past $66,000, Reaching New High," *Wall Street Journal*, October 20, 2021, sec. Markets, https://www.wsj.com/articles/bitcoin-price-surges-to-record-high-11634743244; Kevin Roose, "The Latecomer's Guide to Crypto," *The New York Times*, March 18, 2022, sec. Technology, https://www.nytimes.com/interactive/2022/03/18/technology/cryptocurrency-crypto-guide.html.

decentralized autonomous organizations. By 2021, nearly nine in ten Americans had heard of cryptocurrencies such as Bitcoin or Ethereum's token Ether.[3] Furthermore, blockchain technology is expected to be a significant contributor to the fourth industrial revolution and the next evolution of the internet.

On the DoD ethics front, much has been written and considered about the disruptive implications of autonomous weapons systems, Artificial Intelligence (AI), and cyber operations. The philosophical dilemmas that may result from the use of these technologies are often depicted in movies and novels, thereby making conceptualization and ethical debate more accessible. However, because the ethical implications of blockchain technology are more difficult to visualize and quickly articulate they may not be fully appreciated yet. Blockchain technology operates on political, economic, and administrative governance which reflects the cultural foundations of societies. Given that "culture determines and limits strategy," DoD decisionmakers should consider the possibility that blockchains could raise ethical issues or exacerbate operational environment tensions.[4] Complicating deliberations, the term "blockchain," like "cyber," "cloud," and "AI" lacks coherent use and is often used subjectively from the position of the speaker's world view.

Given all the fog in definition and resultant implications, how can DoD decision makers and blockchain practitioners think about the ethics of blockchain projects? This research paper describes blockchain technology and its implications in a way relevant to DoD thinking to guide solutions in line with national values and interests.

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[3] Andrew Perrin, "16% of Americans Say They Have Ever Invested in, Traded or Used Cryptocurrency," *Pew Research Center* (blog), accessed March 11, 2022, https://www.pewresearch.org/fact-tank/2021/11/11/16-of-americans-say-they-have-ever-invested-in-traded-or-used-cryptocurrency/.

[4] Edgar H. Schein, *Organizational Culture and Leadership*, 3rd ed, The Jossey-Bass Business & Management Series (San Francisco: Jossey-Bass, 2004), 411.

This paper was designed to be accessible for all military thinkers regardless of exposure to blockchain technology. The three chapters are a logical journey that walks through concepts, considers practical application, and finishes with an integrated conclusion. The first chapter, *Making Sense of Blockchain Technology*, frames the technology in ways useful for military members and civilians to conceptually understand the governance and ethical space that the technology excels at. The second chapter, *Military and Blockchain Ethics*, anticipates ethical dilemmas across the short- and long-term timeframes of force employment, force development, and force design of the DoD's Joint Strategic Planning System. The third chapter, *Ethical Intuition is Not Sufficient*, concludes the paper by integrating the previous two chapters to recommend that ethical assessments are needed for blockchain initiatives and that future work regarding the quantification of trust is possible. What follows now is a literature review and orientation on the vision and hype of blockchain.

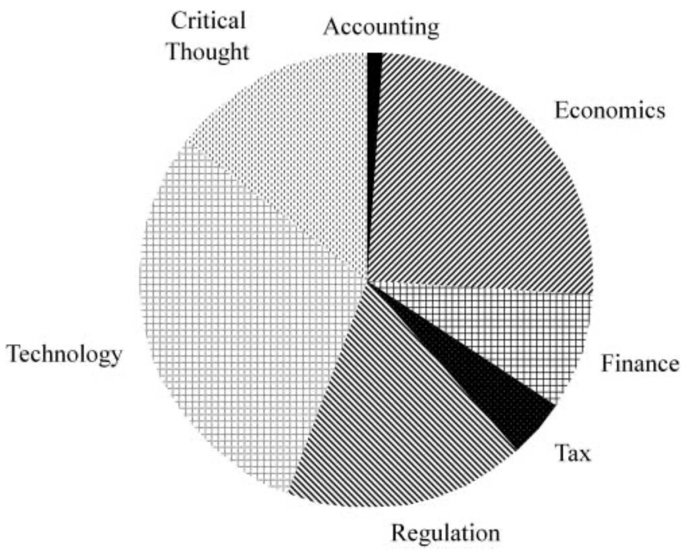
Literature Review

A literature review was conducted on ethical and technical material relevant to blockchain technology. Little has been written on blockchain ethics. There is significantly more technical material that exists in books, papers, and online in the form of computer code and technical specifications. The technology was popularized less than two decades ago, and the lack of ethical research papers indicates a lack of conceptual coherence relative to the implications of the technology. This lack of coherence is despite vast wealth creation.

By February 2022, the cumulative market cap of cryptocurrencies was nearly $2 trillion with a previous year growth of $1.5 trillion which compares to the $9 trillion rise of the S&P 500 over the same period.[5]

By 2016, less than a decade after Bitcoin's launch, 917 Bitcoin research papers were published with 30% (274) technology focused, 55.5% (510) financially related, and with only 14.5% (133) related to critical thought to include politics, philosophy, and ethics.[6]

Figure 1 – Breakdown of Bitcoin research papers topics through 2016[7]



Main category	2011	2012	2013	2014	2015	2016	Total	%
Technology	2	4	16	54	70	128	274	29.9%
Economics	0	3	11	55	69	90	228	24.9%
Finance	0	1	1	13	25	36	76	8.3%
Accounting	0	0	0	4	4	2	10	1.1%
Tax	0	0	5	13	10	11	39	4.3%
Regulation	1	3	12	53	49	39	157	17.1%
Sub-total	3	11	45	192	227	306	784	85.5%
Critical Thought	2	1	7	29	42	52	133	14.5%
Total	5	12	52	221	269	358	917	100.0%

In 2020, a systematic literature review found that only 3% of all blockchain published research focused on ethics with 26 discrete works identified.[8] The authors concluded that blockchain research is spreading fast into various industrial domains, but there is a lack of usable ethical approaches and that further ontological work is required.

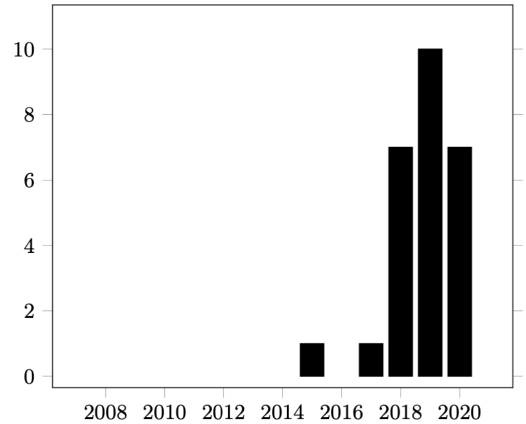
[5] "Crypto Investors Are Wealthier. No One Knows How Much They're Spending. - WSJ," accessed April 9, 2022, https://www.wsj.com/articles/crypto-investors-are-wealthier-no-one-knows-how-much-theyre-spending-11645180214.

[6] Mark Holub and Jackie Johnson, "Bitcoin Research across Disciplines," *The Information Society* 34, no. 2 (March 15, 2018): 114–26, https://doi.org/10.1080/01972243.2017.1414094.

[7] Holub and Johnson.

[8] Sami Hyrynsalmi, Sonja M. Hyrynsalmi, and Kai K. Kimppa, "Blockchain Ethics: A Systematic Literature Review of Blockchain Research," in *Well-Being in the Information Society. Fruits of Respect*, ed. Mirella Cacace et al., vol. 1270, Communications in Computer and Information Science (Cham: Springer International Publishing, 2020), 145–55, https://doi.org/10.1007/978-3-030-57847-3_10.

Figure 2 – Chart of blockchain ethics papers from 2008 to 2020[9]



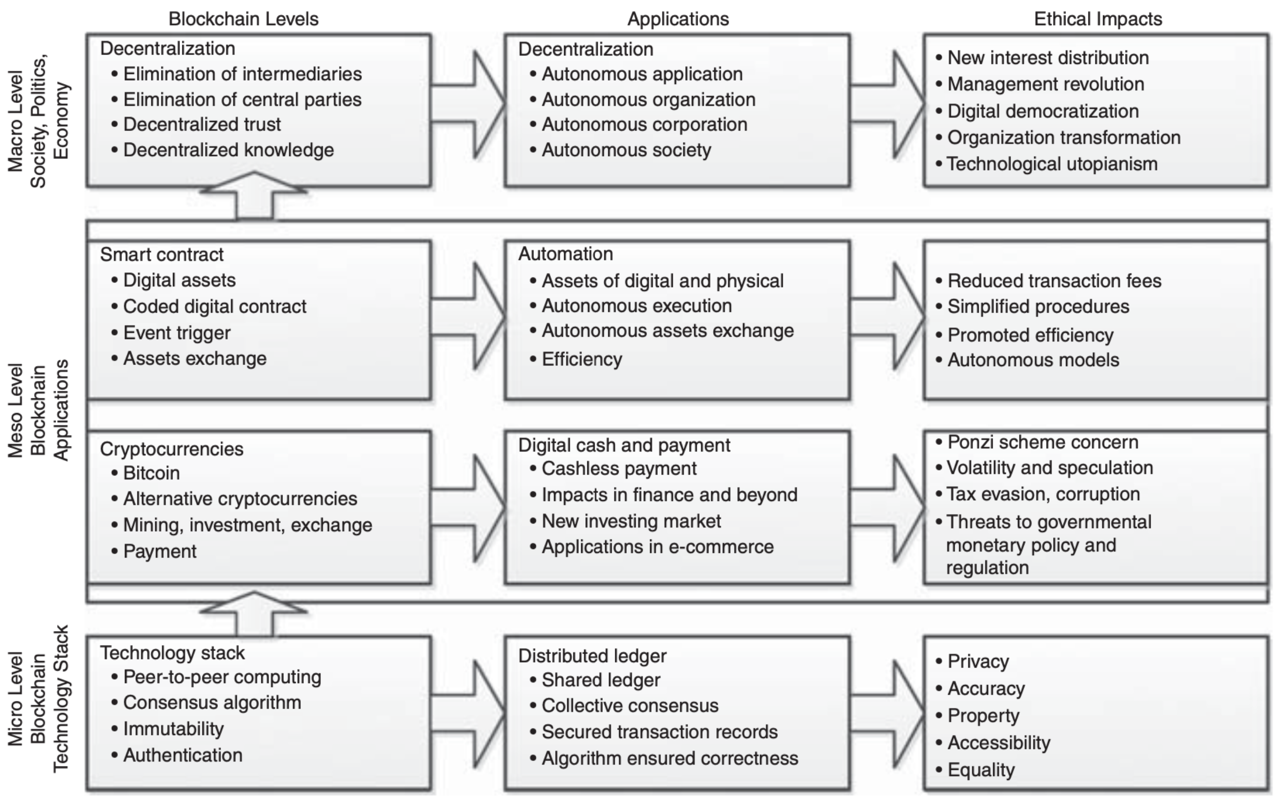
Two blockchain ethics works are summarized here, and aspects useful for thinking about blockchain ethics from the perspective of the military are highlighted. These two previous works were selected because they are freely available on the public internet. Global accessibility to blockchain ethical thought and discourse is vital since, as described in the next chapter, blockchains evolve via global consensus communications both in the physical and digital domains. Furthermore, the barrier to entry to create blockchain implementations is low with knowledge transfer occurring via traditional and non-traditional sources providing material for free on the public internet. Ethical works that require subscriptions via "paywalls" are a hindrance to assist those that are wishing to produce and design blockchain implementations more ethically, and those works within walled gardens likely do not have the ability to influence the discourse needed regarding this technology.

Tang et al.'s paper systematizes blockchain ethics across three levels of society. These societal levels are interlaced with the blockchain technology stack, blockchain functional

[9] Hyrynsalmi, Hyrynsalmi, and Kimppa.

applications, and corresponding ethical impacts.[10] In terms of military thought, this framework is useful for providing orientation when it comes to tactical technical approaches, but it may underrepresent the implications at an operational or strategic level. The paper noted that most of the academic research on blockchain is technical in nature which does not address business, management, or social implications.

Figure 3 – Tang et al.'s conceptual framework of blockchain ethics[11]



Lapointe and Fishbane present an approach focused on the ethical design of blockchain implementations.[12] The paper argues that intentionality of design matters. It also identifies

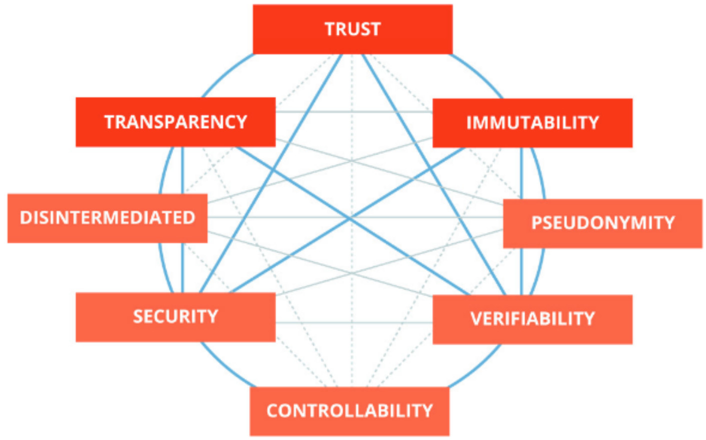
[10] Yong Tang et al., "Ethics of Blockchain: A Framework of Technology, Applications, Impacts, and Research Directions," *Information Technology & People* 33, no. 2 (August 30, 2019): 602–32, https://doi.org/10.1108/ITP-10-2018-0491.

[11] Tang et al.

[12] Cara Lapointe and Lara Fishbane, "The Blockchain Ethical Design Framework," *Innovations: Technology, Governance, Globalization* 12, no. 3–4 (January 2019): 50–71, https://doi.org/10.1162/inov_a_00275.

questions to ask, and provides a framework focused on social impact. They identify attributes of the technology with transparency, trust, and immutability being unique to the technology. Additional attributes include pseudonymity, verifiability, controllability, security, and a disintermediated structure. Their framework has three facets: the creation of foundational definitions for the desired outcome, a people-centric design spiral intended to reveal the impact of design choices, and then revisitations to the framework across the deployment lifecycle. From a military perspective, this paper presents an approach that would be attractive to organizations or individuals with benign intent. Of their identified attributes, trust and disintermediation are worth discussion relative to military thought due to social stability implications. Blockchains can be "trusted" due to their cryptographic structure which contrasts with trust mechanisms from traditional social power structures. The disintermediated property is key and worth understanding as it underpins ideological thinking regarding blockchain which differs from centralized power structures. Disintermediation, to proponents, refers to removing the middleman or eliminating levels of transactional friction between organizational boundary chokepoints where there is often a coordinating tax or fee taken by organizations occupying the boundary. Broadly speaking, disintermediation speaks to an agent-less future where self-determined individuals interact directly with a blockchain system to achieve a desired end without the need for a third-party to negotiate through.

Figure 4 – Key attributes of blockchain from Lapointe and Fishbane.[13]



Blockchain technology may seem overwhelming to those who are not familiar with it. However, technical books written for computer professionals can be very helpful for military professionals who would like to gain more insight into the technology.[14] Generally, the material is written with introductory conceptual material on common use cases for the technology and then transitions to technical details. It is worth browsing through the entry-level technical books, as these books set the common foundation for the industry from which lines of thought develop. The Bitcoin whitepaper is only nine-pages long and should be considered mandatory reading.[15] Historical summaries on blockchain also exist,[16] and are helpful in the same way that understanding world history assists military professionals. Additionally, some books are written by key individuals in the field and provide insight into their vision for the technology. For

[13] Lapointe and Fishbane.

[14] Melanie Swan, *Blockchain: Blueprint for a New Economy*, First edition (Beijing : Sebastopol, CA: O'Reilly, 2015); Andreas M. Antonopoulos, *Mastering Bitcoin: Programming the Open Blockchain*, Second edition (Sebastopol, CA: O'Reilly, 2017); Andreas M. Antonopoulos and Gavin Wood, *Mastering Ethereum: Building Smart Contracts and DApps*, First edition (Sebastopol, CA: O'Reilly, 2019); Siraj Raval, *Decentralized Applications: Harnessing Bitcoin's Blockchain Technology* (Beijing ; Boston: O'Reilly, 2016).

[15] Satoshi Nakamoto, "Bitcoin P2P E-Cash Paper," October 31, 2008, https://www.metzdowd.com/pipermail/cryptography/2008-October/014810.html.

[16] Alan T. Sherman et al., "On the Origins and Variations of Blockchain Technologies," *IEEE Security & Privacy* 17, no. 1 (January 2019): 72–77, https://doi.org/10.1109/MSEC.2019.2893730.

example, the *Mastering Ethereum* book, written by one of its co-founders, highlights Ethereum's strength in supporting governance functions like voting, property, assets, identity, and more.[17]

Finally, a key argument within this paper led to literature reviews of computer ethics, global ethics, and the global communication of ethics. The argument explicitly stated here is that blockchain technology, at the strategic and operational level, should be thought of as a medium for the communication and evolution of ethics on potentially global scales. When examining the broad field of computer ethics, the works of Bynum are especially helpful for orientation and observing the ethical discussions occurring during the initial boom years of the internet during the 1990's and 2000's.[18] Bynum's historical summarization of computer ethics is a gateway to the work of Norbert Wiener who coined the term "cybernetics" as "control and communication in the animal and machine" in 1948 after Wiener had developed better methods of solving fire control problems during World War II.[19]

This research paper uses the term "cybernetic consensus" in the spirit of Wiener's original definition of referring to the feedback that occurs between man and machine. For blockchain implementations to minimize the chance of ethical tensions leading to conflict, an understanding of prior approaches to global ethic thought is required. In 1998 Hans Küng published a significant global ethic work integrating politics and economics extending his prior collaboration with the international Parliament of the World's Religions which had resulted in a

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[17] Antonopoulos and Wood, *Mastering Ethereum*.

[18] Terrell Ward Bynum, "The Foundation of Computer Ethics," *ACM SIGCAS Computers and Society* 30, no. 2 (June 2000): 6–13, https://doi.org/10.1145/572230.572231; Terrell Ward Bynum and Simon Rogerson, "Introduction and Overview: Global Information Ethics," *Science and Engineering Ethics* 2, no. 2 (June 1996): 131–36, https://doi.org/10.1007/BF02583548; Terrell Ward Bynum, "Computer Ethics: Its Birth and Its Future," *Ethics and Information Technology* 3, no. 2 (2001): 109; Terrell Ward Bynum and Petra Schubert, "How to Do Computer Ethics: A Case Study--The Electronic Mall Bodensee," *Computer Ethics: Philosophical Enquiry--Proceedings of CEPE'97*, 1997, 85–95.

[19] Terrell Ward Bynum, "Computer Ethics: Its Birth and Its Future"; Norbert Wiener, *Cybernetics or Control and Communication in the Animal and the Machine*, 2. ed., reprint (Cambridge, MA, USA: MIT Press, 2007); Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society*, 1989, ix.

declaration of global ethical principles.[20] These principles exceed the Kantian inspired United Nations Declaration of Human Rights and show that common global agreement on ethical principles is possible. Since blockchains communicate ethics globally, compendium ethical reviews of intercultural communication, such as those by Collste,[21] are relevant to avoid unintended escalations in tensions.

The Vision of Blockchain

The meaning and purpose of blockchain technology are context-dependent, so there is no coherent vision. This is understandable, and to be expected, because the technology excels at technically underwriting governance across the political, economic, and administrative domains thus bringing it to the realm of human debate from differing interests. It is important to take this lack of coherence into account when discussing this technology or implementations. It suggests that there are probably biases among individuals, and hence that healthy discussion is necessary to discover the various ethical perceptions that different levels of society may attribute to implementations. While there are proponents, detractors, neutrals, and unawares, it appears that all have been impacted by this technology as it continues to diffuse through our increasingly globalized and technologically dependent society. Despite this lack of coherent vision, there is general acceptance that blockchain technology will become intertwined with the future of industry and the web.

[20] Hans Küng, *A Global Ethic for Global Politics and Economics* (New York: Oxford University Press, 1998); Berkley Center for Religion Affairs Peace and World, "The Global Ethic: Hans Küng's Lasting Gift to the World," accessed April 24, 2022, https://berkleycenter.georgetown.edu/responses/the-global-ethic-hans-kung-s-lasting-gift-to-the-world; "Global Ethic PDF - 2020 Update.Pdf," Google Docs, accessed April 24, 2022, https://drive.google.com/file/d/1wimdQFJ37HIOCumRfe2d5jdlPi5Z0kJ5/preview?usp=embed_facebook.

[21] Göran Collste, ed., *Ethics and Communication: Global Perspectives* (London ; New York: Rowman & Littlefield International Ltd. is an affiliate of Rowman & Littlefield, 2016).

Blockchain technology is generally broken down into flavors of three or four increasing levels of implementation. The third level may be split to create a fourth depending on the community's interest of signaling usage of blockchain technology for industrial purposes.[22] For this paper, the most accessible and oldest tiering is that of three levels numbered in a numeric form like the software versioning convention. Blockchain 1.0 is currency, Blockchain 2.0 is contracts, and Blockchain 3.0 are applications functioning across government, health, science, literacy, culture, and art (i.e. society).[23] These three levels, in particular Blockchain 3.0, are then used in discussions on the future direction of the internet known as Web 3.0.[24] Here, the internet has been broken down into three epochs of Web 1.0 for cognition, Web 2.0 for human communication, and Web 3.0 to support human cooperation.[25] Industry 4.0, or Fourth Industrial Revolution (4IR), is a term to bundle the significant emerging early 21st century technologies of our time to include blockchain, and was popularized when the World Economic Forum founder and chairman Klaus Schwab published a book titled *The Fourth Industrial Revolution* in 2016.[26] Industry 4.0 is distinct from previous epochs because of the speed it is evolving and that it fuses digital, physical, and biological technologies with potential for disruptive paradigm-shifts.[27]

The conventional view of both Web 3.0 and Industry 4.0 is that both trends are conglomerates of interacting technologies with blockchain technology being one of many piece-parts. However, the view of this paper is that the vision of Blockchain 3.0 is disruptive enough

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[22] Umesh Bodkhe et al., "Blockchain for Industry 4.0: A Comprehensive Review," *IEEE Access* 8 (2020): 79764–800, https://doi.org/10.1109/ACCESS.2020.2988579.

[23] Swan, *Blockchain*, sec. 1b.

[24] Gavin Wood, "Why We Need Web 3.0," *Medium* (blog), September 12, 2018, https://gavofyork.medium.com/why-we-need-web-3-0-5da4f2bf95ab.

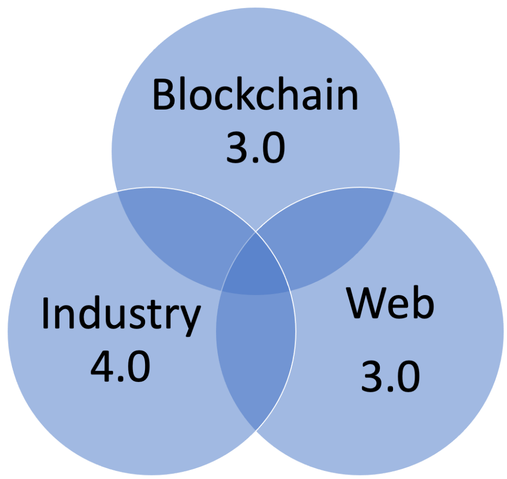
[25] Christian Fuchs et al., "Theoretical Foundations of the Web: Cognition, Communication, and Co-Operation. Towards an Understanding of Web 1.0, 2.0, 3.0," *Future Internet* 2, no. 1 (February 19, 2010): 41–59, https://doi.org/10.3390/fi2010041.

[26] Alexander L Vuving and Daniel K. Inouye Asia-Pacific Center for Security Studies, *Hindsight, Insight, Foresight: Thinking about Security in the Indo-Pacific*, 2020, 37, https://purl.fdlp.gov/GPO/gpo147233.

[27] Vuving and Daniel K. Inouye Asia-Pacific Center for Security Studies, 37.

to warrant peer status among these other trends. In a chapter dedicated to Industry 4.0 in *Hindsight, Insight, Foresight: Thinking About Security in the Indo-Pacific*, Watson concludes that the digitization of geopolitics will be disruptive, "rife with social, ethical, and legal conversations," and that existing geopolitical normative gray zones will continue through the digitization of politics.[28]

Figure 5 – Disruptive technology trend triad



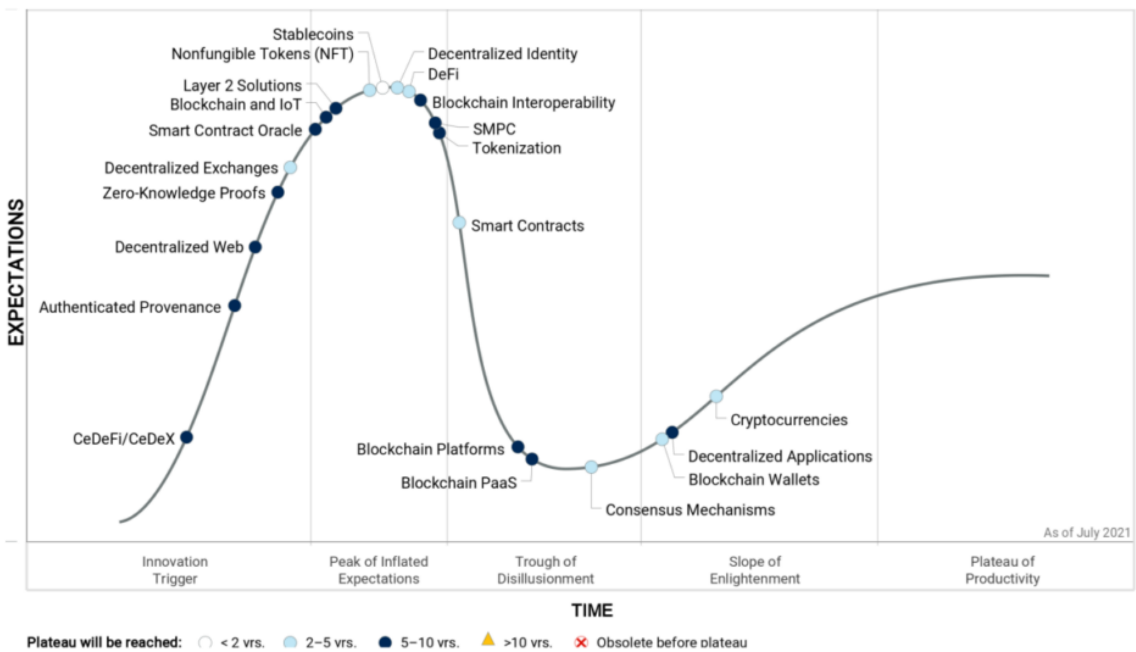
The Hype of Blockchain

Bitcoin's volatile rags-to-riches story of one Bitcoin having no value in 2009 to a high of nearly $67,000 in 2021 inspired consistent love-it-or-hate-it media attention.[29] Hype is a common attribute of new technology; however, because the vision of blockchain technology digitizes governance with a convergence of Industry 4.0 and Web 3.0, making sense or even communicating about any given implementation to a wide audience is challenging. The challenge is even greater because some blockchain implementations can evolve on their own without a centralized coordinating party. Cryptocurrency, just one flavor of blockchain

[28] Vuving and Daniel K. Inouye Asia-Pacific Center for Security Studies, 46.
[29] Ostroff, "Bitcoin Price Surges Past $66,000, Reaching New High."

technology, has been referred to satirically as "everything you don't understand about money combined with everything you don't understand about computers."[30] In the information technology field, analyst firms are often challenged with helping practitioners decipher through hype to make informed business decisions. One method is to break the hype cycle into phases where technologies have a meteoric rise resulting in inflated expectations until stabilization occurs as the technology becomes more widely understood.

Figure 6 – 2021 hype cycle for blockchain[31]



Regarding economic impact, analyst firms have taken note of the future of blockchain technology. It is estimated over twenty million jobs will be enhanced by the technology with a potential global gross domestic product increase of $1.76 trillion dollars and $3.1 trillion in new

[30] LastWeekTonight, *Cryptocurrencies: Last Week Tonight with John Oliver (HBO)*, 2018, https://www.youtube.com/watch?v=g6iDZspbRMg.

[31] "Hype Cycle for Blockchain 2021; More Action than Hype," *Avivah Litan* (blog), July 14, 2021, https://blogs.gartner.com/avivah-litan/2021/07/14/hype-cycle-for-blockchain-2021-more-action-than-hype/.

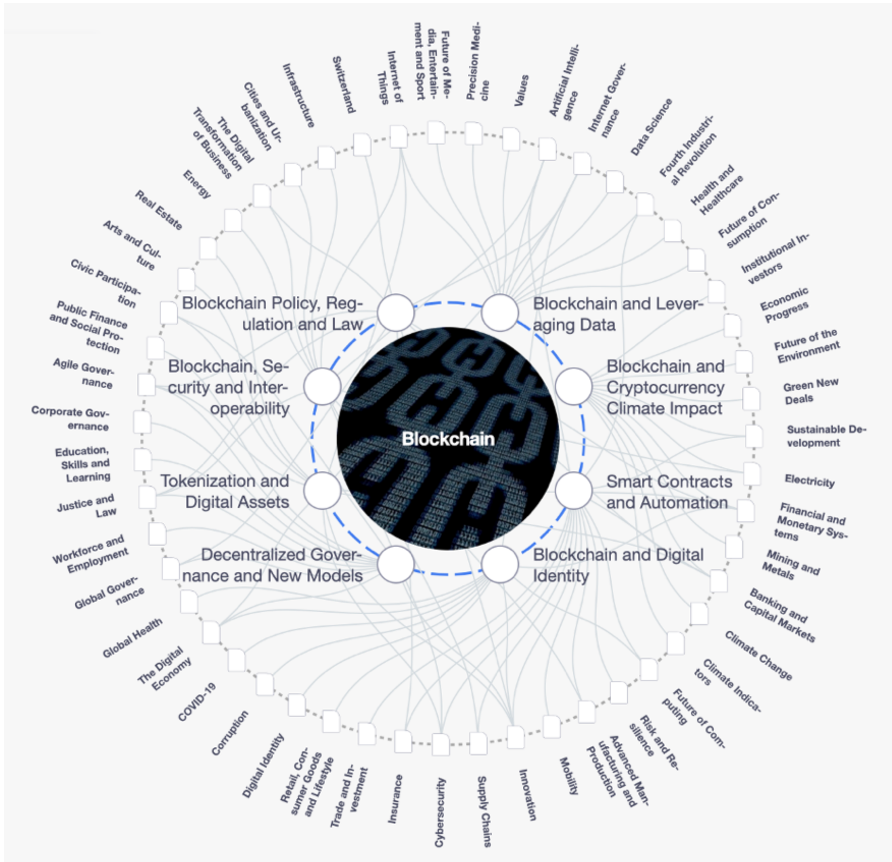
business value by 2030.[32] This economic value is based on anticipated blockchain application use-cases and corresponding economic sectors as shown in the next two figures.

Figure 7 – Map of blockchain applications based on a systemic literature review[33]

[32] "PwC | Guide to Blockchain Report - Download Now," 4,17, accessed April 19, 2022, https://cloud.email.pwc.com/blockchain-report-transform-business-economy-download-now.html; David Furlonger and Christophe Uzureau, *The Real Business of Blockchain: How Leaders Can Create Value in a New Digital Age* (Boston: Harvard Business School Publishing Corporation, 2019), 12.

[33] Fran Casino, Thomas K. Dasaklis, and Constantinos Patsakis, "A Systematic Literature Review of Blockchain-Based Applications: Current Status, Classification and Open Issues," *Telematics and Informatics* 36 (March 2019): 55–81, https://doi.org/10.1016/j.tele.2018.11.006.

Figure 8 – Map of blockchain functional properties to use cases[34]



I. Making Sense of Blockchain Technology

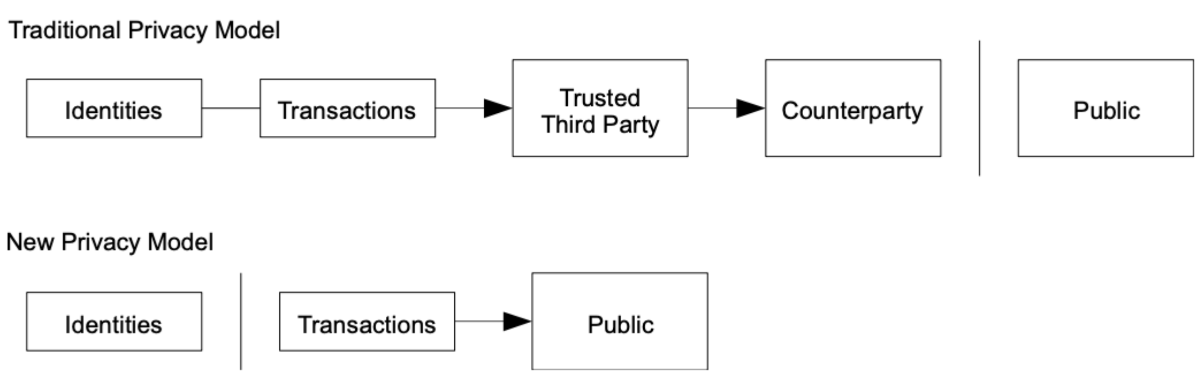
If you've used money, ledgers, and a computer you can understand blockchain technology. Furthermore, if you can appreciate that you live in a complex society in which public, civic, and corporate governance occurs across a range of political, economic, and administrative domains, you'll be able to see how this technology brings with it ethical challenges as well as opportunities. This chapter describes blockchain technology in a non-technical non-conventional manner to enable critical thinking. Four sections discuss the technology relative to social change, trust, machine governance, and the ethical dimensions and

[34] World Economic Forum, "Strategic Intelligence | World Economic Forum," Stategic Intelligence, accessed April 20, 2022, https://intelligence.weforum.org.

capacities that define blockchains. But first, the next two paragraphs provide a conceptual level understanding of blockchains necessary before the four sensemaking sections are presented.

Blockchains excel at decentralized management and distribution of transactional histories of digital and real objects leveraging cryptography for security and resiliency.[35] Bitcoin popularized blockchain technology and sowed the seeds for at least 10,000 other blockchain implementations. Bitcoin demonstrated that a decentralized internet-based system, where no single organization is in charge, could let users functionally trade digital cash without the permission or infrastructure of a central authority. Using blockchain terminology, this is accomplished using tokens, blockchains, and consensus mechanisms. Tokens get traded and recorded on a blockchain of technical consensus. Counterintuitively, Bitcoin-like blockchain infrastructure can provide trusted transactions between individuals who may not trust each other. This pivot from needing trusted third parties to approve a financial transaction to instead a system trusted to execute any transaction without judgment is shown in the following diagram from the original nine-page Bitcoin 2008 whitepaper.

Figure 9 – Bitcoin privacy model[36]

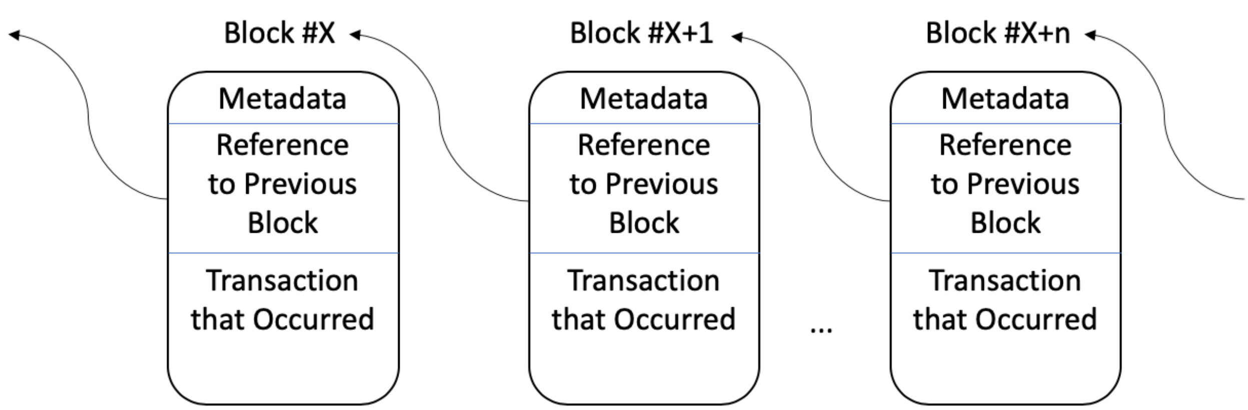


[35] Dylan Yaga et al., "Blockchain Technology Overview" (Gaithersburg, MD: National Institute of Standards and Technology, October 2018), 1, https://doi.org/10.6028/NIST.IR.8202.

[36] Satoshi Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System," October 31, 2008, https://bitcoin.org/bitcoin.pdf.

OK, so, what exactly is a blockchain? Conventionally, for programmers, a blockchain is just one of many different types of ways to structure data. Data structures are like tools, the right tool makes certain jobs easier and more efficient. "Blockchain" technology gets its name because transactions are stored in discrete groups or "blocks" that are linked together and form a "chain" of transactions. As time progresses, and more transactions occur, new blocks of transactions are added to the end of the chain. For Bitcoin, new blocks of transactions are broadcasted about every ten minutes. Over time, more blocks are added to the chain and consensus that a transaction has settled grows as each new block is added to the end of the blockchain. To secure the data, and allow the system to detect tampering, each block contains what is known as a cryptographic hash of the previous block. Cryptographic hashing algorithms are simply math formulas that can translate text of any non-infinite length into a unique identification known colloquially as the "hash." These hashes are one-way, in that generating and verifying a hash from text is computationally easy. However, the reverse - that is generating the source text from the hash - can be made to be computationally impossible. As a result, because the entire blockchain contains nested hashes of the previous blocks, it is possible for systems to quickly determine if any portion of the transaction history has been tampered with.

Figure 10 – Blockchain data structure



Blockchain, The New Media for Social Change

Critical analysis of technology requires conceptualizations and abstractions that are conducive to logical thought. Blockchain technology is triply-vexing conceptually as computers can be programmed to do nearly anything, some blockchains can evolve their rules, and the technology digitizes governance which spans from the trivial to integral elements of one's life. An appreciation for the difficulty in predicting outcomes of blockchain design approaches comes into focus when the technology is thought of as a new media for the communication of ethics that evolves via cybernetic consensus. Said another way, blockchain technology is an extension of human governance consensus into the digital domain. This is meaningful because much of historical human tension and conflict stems from difference in governance across political, economic, and administrative domains. Like the sea, internet, and space it is possible that the medium of blockchain governance would be considered a new form of competitive commons of geopolitical and transnational ideological importance.

To get oriented, it's helpful to remember that there are over 10,000 different blockchain implementations in existence from governments, civil society, and corporations. The barrier to entry is low, and Bitcoin is generally the point for conceptual departure for most people. Bitcoin is what is known as a decentralized and permissionless system. Generalizing greatly, this means that the system is sustained voluntarily by individuals or groups on the public internet, and that transactions are immutably executed without judgment to anyone with uncensored internet access. This contrasts with traditional physical or digital financial institutions which are centralized and where transactions are conditionally permissioned from authorities. These are the conventional dimensions of blockchain designs. That is, decentralized vs. centralized and permissionless vs. permissioned. Here, we can see that conventional blockchain design taxonomies are relative to governance structures.

The correspondence between blockchain design thinking and societal structures continues with the three conventional levels of blockchains described in a previous section (*The Vision of Blockchain*). As a refresher, Blockchain 1.0 is currency, Blockchain 2.0 is contracts, and Blockchain 3.0 involves applications that operate on society. Bitcoin could be thought as a Blockchain 1.0 implementation, Ethereum as a Blockchain 2.0 implementation, and Blockchain 3.0 being a fully actualized future state that is currently awaiting unforeseen advancements and further popularization of the technology. With that said, Blockchain 2.0 – contracts – warrants further discussion. Ethereum, the number two most valued blockchain implementation, popularized the concept of "smart contracts" which are digital rules that govern the management of tokens on the blockchain. Conceptually, Ethereum is a world-wide decentralized computer that executes smart contracts when pre-programmed conditions are met. While Bitcoin contains computer code to interlink decentralized nodes, Ethereum provides this as given infrastructure which allows developers to focus on creation of cryptocurrencies and smart contracts that the Ethereum system processes as a standardized service. Said differently, Ethereum is a decentralized permissionless smart contract infrastructure that allows for the creation of rules designed as bespoke or global solutions for physical and digital governance. Here, with Ethereum, we see the extrapolation of Bitcoin's popularized decentralized governance approach generalized to a higher level of abstraction from currency to contracts. The ethical implications continue as contracts are foundational to our normative rules-based order, and Ethereum has decentralized and digitized the creation, deployment, and execution of contracts using blockchain technology.

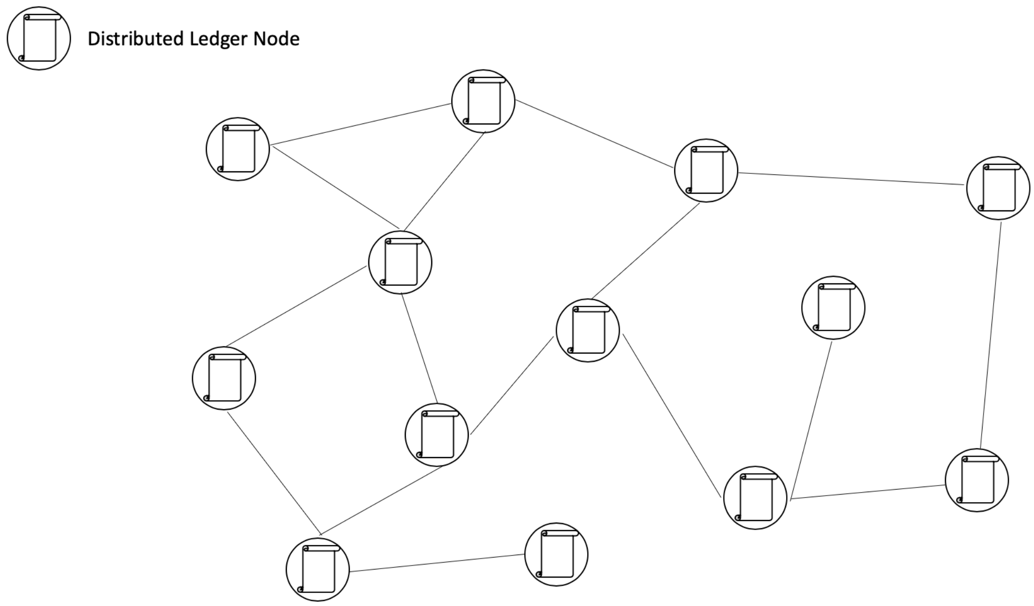
Consensus algorithms are required for blockchain systems whose ledgers are distributed such as Bitcoin and Ethereum. This is how the networks make their own respective "sense" of the rules to include the settlement of pending transactions and resultant storage onto the historical ledger of record. Recall that these are decentralized permissionless systems which means that it consists of computer equipment spread globally with transaction requests coming from potentially anyone or anything in the world with access to these blockchain networks. Consensus algorithms, like data structures or any other tool, are varied and performance tradeoffs are made when one is selected.[37] Some trade-offs for Bitcoin's consensus approach comes in the form of qualifiers. These conditionals when further explored show ethical and epistemological implications. The qualifiers are that blockchains are tamper evident not tamper proof, transactions occur on average every ten minutes, and over time enough consensus is generated to reasonably believe that the transactions have settled.

What is going on here with these three qualifications? The conventional technical reductionist response to these questions would be a description of the algorithmic mechanics of Bitcoin-like systems. Bitcoin uses what is known as a proof-of-work consensus algorithm, which is that over time 51% of the nodes eventually share a common view of transaction history that is underwritten by computational power from the "miners" on the network. However, thinking beyond the digital domain and technological description yields more profound thoughts which intersect with ethics and the social implications of the technology. Considering this consensus mechanism in terms of people instead of machines, we can understand that Bitcoin is

[37] Natalia Chaudhry and Muhammad Murtaza Yousaf, "Consensus Algorithms in Blockchain: Comparative Analysis, Challenges and Opportunities," in *2018 12th International Conference on Open Source Systems and Technologies (ICOSST)* (2018 12th International Conference on Open Source Systems and Technologies (ICOSST), Lahore, Pakistan: IEEE, 2018), 54–63, https://doi.org/10.1109/ICOSST.2018.8632190.

really underwritten by humans who have had behavior incentivized to either use or sustain the Bitcoin network by the rules of the system.

Figure 11 – Decentralized nodes



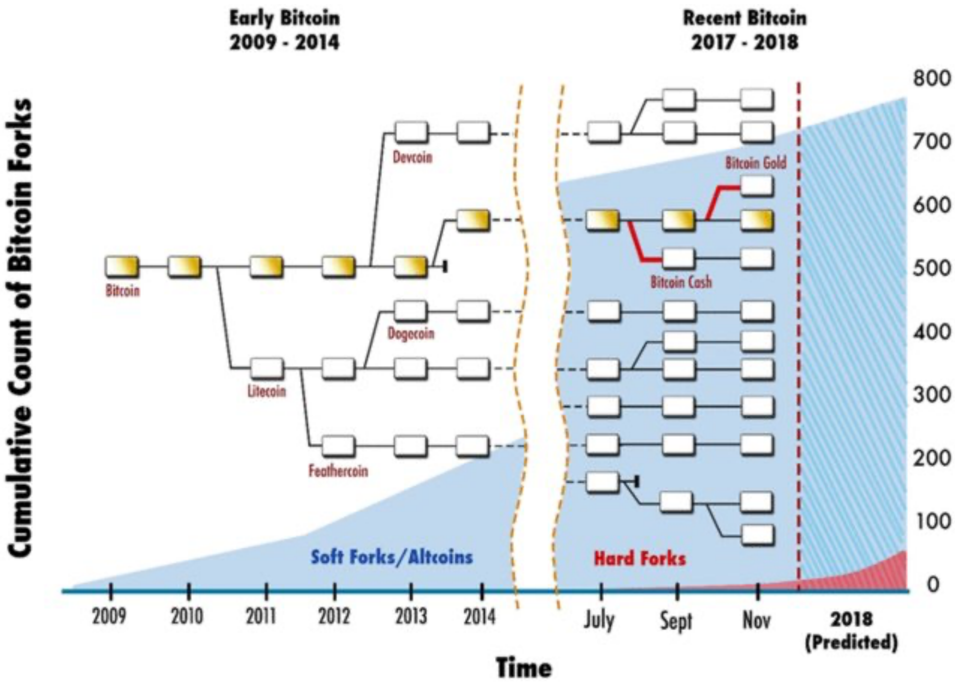
Things become more complicated epistemologically regarding what is "true." Nodes have a "belief" about the historical ledger based on what has been communicated to them, but it is possible for the network to become segregated, deceived, or attacked with falsely generated consensus. Furthermore, blockchains are tamper-evident in that it is possible to quickly verify that the data is coherent, but again it is possible to be presented with false coherent data. By default, Bitcoin nodes connect to 125 other nodes and as of May 2022 there are over 15,000 nodes.[38] As a result, it is not feasible to "know" the true state of the network.

Beyond epistemological questions as to the state of the network, what are the implications of humans being in a feedback loop with a blockchain? One way to frame this relationship is that a cybernetic consensus is occurring between people and the rules of the

[38] "Running A Full Node - Bitcoin," accessed May 13, 2022, https://bitcoin.org/en/full-node#reduce-traffic; "Bitnodes," accessed May 13, 2022, https://bitnodes.io/.

blockchain. The story of Bitcoin is that of cybernetic consensus of ethics via digital and physical negotiation of governance rules. In 2008 Bitcoin was proposed in a white paper, in 2009 the principles within the white paper were digitized into a program, the program was made available on the public internet, then people voluntarily began to run the software signaling human consensus which established an initial baseline of the digital consensus mechanism. From here, the cybernetic consensus feedback system was established, and allowed Bitcoin to evolve digitally due to humans being incentivized to use and sustain the network. Evolution for Bitcoin-like blockchain systems occurs via schisms in the community. Factions have different visions for Bitcoin, and the visions can be actualized through a process called forking. Forks create populations of people and machines that are providing physical and digital consensus to the history of the blockchain as well as how the rules by which the blockchain operates. Forks can be revolutionary or evolutionary changes, but their usage ultimately hinges on incentivizing humans to signal consensus to these new changes. Indeed, the rules by which Bitcoin operates have changed over time, and there are several offshoots that each have a different vision of the future.

Figure 12 – Blockchain forks[39]



As the above diagram shows, Bitcoin has forked hundreds of times which again begs the question "What is Bitcoin?" The Bitcoin the media refers to is not a monolithic specific thing, instead it is a reasonable approximation of digital and physical consensus on price and transaction history. It is reacting, evolving, changing topography, and in some ways its reality is relative to digital and physical perspectives. Blockchain implementations like Bitcoin succeed or die based on negotiated consensus and behavioral choices made by people to support their desired network. Furthermore, blockchains are often open source and as a result ideas are additive and persist. That means that blockchain implementations are ultimately optimized to real world events with hierarchies of ideas and approaches that have lineages. This is in the same manner that some academic papers, books, or first principles approaches inspire derivative thought and are considered foundational.

[39] Benjamin D. Trump et al., "Cryptocurrency: Governance for What Was Meant to Be Ungovernable," *Environment Systems and Decisions* 38, no. 3 (September 2018): 426–30, https://doi.org/10.1007/s10669-018-9703-8.

Because of this intertwining of physical and digital consensus, systems like Bitcoin can evolutionarily or revolutionarily evolve due to feedback from perceptions, laws, cybersecurity operations, behavioral incentives, economics, and ideologies. That is, blockchain systems like Bitcoin can evolve in response to real-world events in potentially unpredictable ways because the system is maintained by decentralized digital and physical consensus. For example, Bitcoin may evolve – or fork - into a “greener” approach in response to global warming concerns. Potentially this could become the colloquial “Bitcoin” of the future, or a “Bitcoin Green” could emerge in parallel. Likewise, the current 21 million Bitcoin issuance cap anticipated around 2140 could be changed if cybernetic consensus occurs.[40]

This cybernetic consensus mechanism created a portfolio of systems valued at $3 trillion in late 2021.[41] While blockchain technology is couched in economic disruption terms on par with precision agriculture and autonomous vehicles,[42] the overall disruption may be underestimated due to the popular understanding of blockchain technology being limited to the Blockchain 1.0 implementation of Bitcoin. Ethereum’s 2015 evolution of the technology to Blockchain 2.0 (i.e., contracts) allows for governance disruption in the same manner that Bitcoin disrupted economics. [43] Smart contracts are the digitization of traditional policy-like rules where tokens can represent objects in the physical or digital world. Policy is a vision of how aspects of the world should operate, and as a result contextual values are embedded within policy. When values are codified in policy they are transmuted into ethics. Said another way, Ethereum-like

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[40] Antonopoulos, *Mastering Bitcoin*, 2.

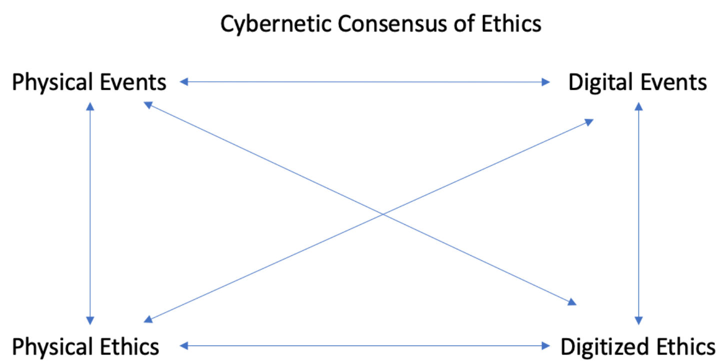
[41] “Cryptocurrency Market Cap Hits $3 Trillion for the First Time Ever,” Fortune, accessed May 13, 2022, https://fortune.com/2021/11/09/cryptocurrency-market-cap-3-trillion-bitcion-ether-shiba-inu/.

[42] “Table-of-Disruptive-Technologies.Pdf,” accessed April 30, 2022, https://www.imperial.ac.uk/media/imperial-college/administration-and-support-services/enterprise-office/public/Table-of-Disruptive-Technologies.pdf.

[43] “The History of Ethereum” (Ethereum Foundation, January 30, 2022), https://ethereum.org/en/history/.

systems provide the world with infrastructure to digitize and deploy new global or bespoke ethics. These ethics may become adopted or adapted by factions via cybernetic consensus.

Figure 13 – Cybernetic consensus of ethics



Two examples may assist in conveying the concept of cybernetic consensus. First, take the case of Bitcoin energy use concerns. Bitcoin energy use and concerns are physical events, which have influenced the creation of physical ethics (i.e., laws) in certain countries prohibiting Bitcoin mining. This in turn prevented computing equipment in affected countries from mining which eliminated some digital and physical consensus support for the Bitcoin algorithm (which is really a digitized ethic on how financial transactions should occur). Second, take the same example but expand it to a global ban on high-energy mining. Energy use is a physical event and laws are a physical ethic, but this change in the feedback loop will incentivize physical human developers to propose a new "greener" digitized ethic on how Bitcoin transactions should reach consensus. This new digitized ethic will only persist if it influences physical humans to take physical action to make modifications to mining equipment to signal consensus for a new digital ethic.

Further discussion on the interrelationship of blockchains and the real world is warranted to better anticipate the implications of technology but also of physical or digital policy actions. For most of human history, the digital domain did not exist. Events unfurled over the course of history, and societies created social structures, cultures, and laws that caused ethical approaches and thoughts to ebb and flow in response to events across all levels of society. With the advent of the digital domain, we see human ethics extending into this new realm sometimes with the assistance of physical laws but also independently in the case of digital ethics like Bitcoin. These complex interactions occur on a global scale via the internet. Because the internet is essentially a method of communication – potentially global and potentially beyond one's local physical laws and culture – it could be thought as a petri dish for ideas. Some ideas flourish, others fade, but nonetheless the ideas operate on their own methods of social consensus which has recently been facilitated and normalized by the American big tech companies.

Big tech companies such as Facebook, Apple, Microsoft, Google, and Twitter have dominated the digital social space and normalized communication paths on a global scale. As we know, events and social consensus that occur on these platforms shape population perceptions around certain topics which in turn changes behavior catalyzing geopolitical events in the real world. On these platforms people are communicating their values dialectically or emotionally and a social evolution of ideas occurs. Twitter, YouTube, and Facebook were all contributory to the fragmentation of centralized democratic ideologies in different ways. Interestingly, the modalities for change from these systems was based on design decisions. Twitter limited characters, YouTube allowed only video, Facebook connected people based on interests, and now blockchain is constrained to decentralized code that is negotiated through cybernetic consensus. While the modalities are different for big tech and blockchain, they all orbit around the functional transmission of memes. The formal definition of memes is "a cultural feature or a type of behavior that is passed from one generation to another, without the influence of genes."[44] Blockchains exist in the cultural blender of the internet and are valued based on social consensus, therefore it is a powerful new technology relative to digitizing governance memes. It may accelerate the creation of new forms of governance by giving a tool to rapidly codify approaches through the digitization of flash-mob, parodies, and long-term governance memes (e.g., buying the Constitution[45], Dogecoin, and Bitcoin respectively). Previously these governance memes only existed as ideas communicated on digital platforms, but blockchain allows for actualization.

These big tech platforms are considered "social media" because they digitized social communication. There has been a progression of digitization over the history of computers which has shown an ever-increasing growth starting with math, then text, images, music, movies, social networks, and now ethics through governance via blockchain technology networks. If this view is correct, and blockchain technology shows the same sort of undirected but ever-increasing technological growth of prior digitization epochs, then one should anticipate wide governance disruption in the same degree that social media and the internet disrupted the world.

A potential scenario of disruption may be illustrative. As stated previously, blockchain technology excels at digitizing governance. Unsurprisingly, terms used within the blockchain field have assimilated and extended the existing lexicon of governance. This conveys powerful contextual symbols that are further reinforced by the technology's actualized functionality. For example, within the blockchain lexicon are cryptocurrencies, smart contracts, and decentralized autonomous organizations which represent the concepts of money, laws, and governments

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[44] "Meme" (Cambridge Dictionary, January 2022), https://dictionary.cambridge.org/us/dictionary/english/meme

[45] Douglas Broom, "Explainer: What Is a DAO - and How Did One of Them Almost Succeed in Buying the US Constitution?" (World Economic Forum, November 30, 2021), https://www.weforum.org/agenda/2021/11/what-is-a-dao-cryptocurrency-group/

respectively. These symbolic properties make the technology available for political ends across the spectrum from left to right, from pragmatic to utopian, against short- or long-term timeframes, and local to transnational scope. Blockchains have typically been leaderless affairs, but one can imagine political leaders using the powerful imbued symbolism and promise of the technology to advance a vision. This could happen from utopian dreams, but perhaps more troubling are authoritarian visions from the left or right. For example, a new type of demagogue, a *cryptogogue*,[46] could emerge leveraging this new form of social value and communication of their desired ethic. In the 20th century we've seen rises of demagogues across the world who have used emergent methods of media to communicate and solidify their ideas (i.e., print, photos, movies, web, social media, etc.) and now here we have a new digital mechanism for the codification of social change supported by powerful symbolism on potentially global scales.

It is worth noting that this cybernetic consensus of governance generation is a new challenge and opportunity for the liberal international order to contend with in contrast to authoritarian regimes. On the one hand it could contribute to the fragmentation of democratic institutions and provide a vector for external influence. On the other hand, taking the view of economic prosperity and competition held by Western economies one could justify that blockchain innovation would outpace and benefit Western economies vs. autocratic regimes as people use the technology to govern what matters to them and optimize societal structures. In either case, this technology warrants critical ethical thought to consider the implications of

[46] The author is academically defining the term *cryptogogue* to mean a demagogue who uses blockchain technology as mechanism to rally support from the disenfranchised against existing power structures. The author, on 3 June 2022, did not find an instance of the term used on the Naval War College Primo Discovery portal, Google Scholar, or Cornell's arxiv. A cryptogogue.com was located on google search, but it is associated with a collectible card game.

creating or using blockchain implementations that are undirected and may evolve beyond original intent.

Toulmin, in a section of his book *Human Understanding*, provides a history on evolutionary philosophical and academic thought across sociology and biology juxtaposing it to human institutions and their change overtime.[47] He states that evolution has two separate ideas: the *fact of descent* and the *doctrine of progression*. Blockchain technology exhibits both these ideas. These systems have technical descent and progression (i.e., forks and open-source development) that is in feedback with human society and institutions which have their own descending lineages and progression. Furthermore, Toulmin provides a strong basis for beginning to think deeply about blockchain evolution and its future role in human governance. Currently blockchains are digitizing human institutions and evolving via cybernetic consensus, but the Blockchain 2.0 concept of decentralized autonomous organizations implies that these initial digital seeds of human institutions may transform into potentially AI-managed systems that evolve in response to data presented to the system (i.e., the "environment" relative to organic evolution). Interestingly, this paper itself could be considered a part of this cybernetic consensus generation process with blockchain technology.

The Blockchain Trust Triangle

For democratic and market economy countries, the 2008 financial crisis damaged people's trust in public institutions. Nearly ten years later, the levels of trust did not recover to pre-crisis levels.[48] From the transnational democratic economic perspective, trust in others and

[47] Stephen Toulmin, *Human Understanding* (Oxford: Clarendon Press, 1972), sec. 5.1-Evolution and Cosmic Progress.

[48] OECD, *OECD Guidelines on Measuring Trust* (OECD, 2017), 3, https://doi.org/10.1787/9789264278219-en.

institutions is viewed to be key for social and economic progress.[49] A mere six weeks after the bankruptcy of Lehman Brothers,[50] during the subprime mortgage crisis of 2008, the pseudonymous Satoshi Nakamoto emailed a cryptography mailing list introducing Bitcoin to the world: “I've been working on a new electronic cash system that's fully peer-to-peer, with no trusted third party.”[51] The whitepaper provided an alternative mechanism of trust to that of public institutions through cryptography, digital consensus, and giving individuals direct peer-to-peer transactional agency without fear of sanction or rollback.

Trust is the foundation for Federal cybersecurity thought and provides a useful departure point for blockchain trust. While cybersecurity regulations and procedures do not address philosophical considerations regarding “what is trust,” the cybersecurity trust triad has empirically withstood the test of time with roots back to 1972.[52] For DoD thinkers, the existing foundational cybersecurity trust triangle of confidentiality, integrity, and availability (CIA) can be adjusted for blockchain’s model of thought. Exchanging “integrity” for “consensus” in the trust triangle assists in revealing the ethical capacities of blockchain initiatives. It should be noted that cybersecurity “trust” is not comparable in gravitas to the “Trust” created by blockchain technology. Blockchain technology’s “Trust” is akin to that of psychological “safety” generated from governments or societal organizations. As a result, for the military, it is key to understand this new digital mechanism of Trust.

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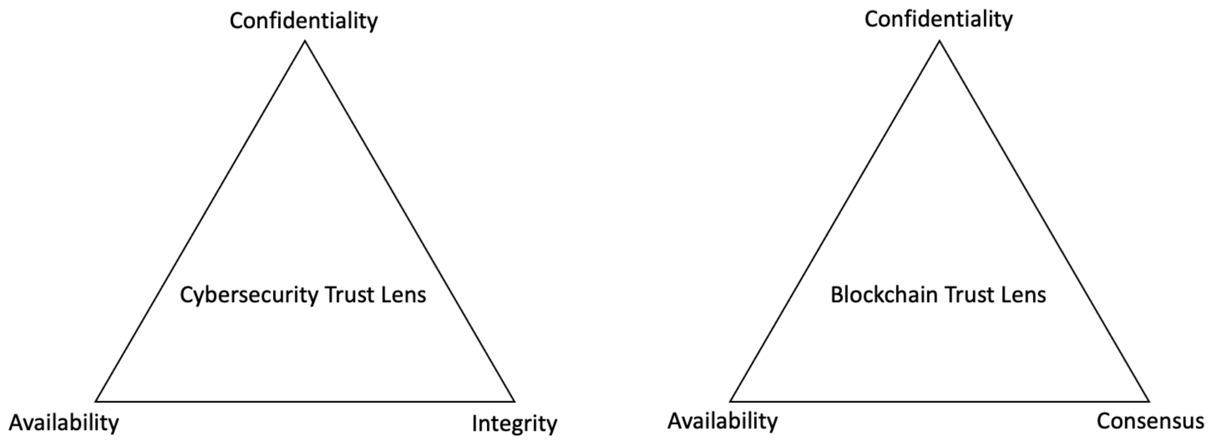
[49] OECD, 3.

[50] Andrew Ross Sorkin, “Lehman Files for Bankruptcy; Merrill Is Sold,” September 14, 2008, https://www.nytimes.com/2008/09/15/business/15lehman.html.

[51] Satoshi Nakamoto, “Bitcoin P2P E-Cash Paper,” October 31, 2008, https://www.metzdowd.com/pipermail/cryptography/2008-October/014810.html

[52] Kevin Macnish and Jeroen van der Ham, “Ethical Approaches to Cybersecurity,” in *The Oxford Handbook of Digital Ethics*, by Kevin Macnish and Jeroen van der Ham, ed. Carissa Véliz (Oxford University Press, 2022), 6, https://doi.org/10.1093/oxfordhb/9780198857815.013.28; James P. Anderson, “Computer Security Technology Planning Study” (ANDERSON (JAMES P) AND CO FORT WASHINGTON PA FORT WASHINGTON, October 1, 1972), https://apps.dtic.mil/sti/citations/AD0758206.

Figure 14 – Existing cybersecurity model of trust updated for blockchain technology



Federal cybersecurity standards and frameworks are developed by the National Institute of Standards and Technology (NIST) under the U.S. Department of Commerce. Information security trust is ensured via contextually appropriate levels of confidentiality, integrity, and availability.[53] Confidentiality preserves authorized access to personal and proprietary information, integrity preserves authenticity of the data, and availability preserves resilience and access.[54] Then depending on the criticality of the system, scalable security controls relative to the CIA are applied commensurate to the requirements.[55]

While the CIA trust model has been traditionally used pragmatically by cybersecurity practitioners, the confidentiality, consensus, and availability (CCA) model presented here for blockchain in this paper can be used to assist in critical thought. The CCA model could be used pragmatically and to assist with comparative studies, but at this early point in the technology conceptual thought is warranted to help orient and debate implications. Looking through the CCA trust lens at blockchain relative to ethics immediately yields profound and enduring

[53] Michael Nieles, Kelley Dempsey, and Victoria Yan Pillitteri, "An Introduction to Information Security" (Gaithersburg, MD: National Institute of Standards and Technology, June 2017), 2, https://doi.org/10.6028/NIST.SP.800-12r1.
[54] Nieles, Dempsey, and Pillitteri, 2–3.
[55] Nieles, Dempsey, and Pillitteri, 3.

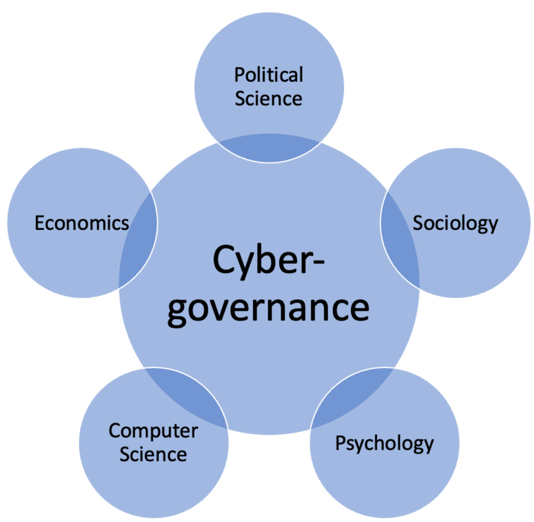
dilemmas which is amplified now with our understanding that blockchain is digitized governance. Confidentiality raises questions on government or organizational transparency and individual privacy. Consensus raises questions about the subjective and contextual nature of information and the mechanisms by which consensus is generated (e.g., machine, democracy, autocracy, etc.). Availability raises questions about equality of access and free-will or compulsion of use for a blockchain.

Previously we examined cybernetic consensus occurring based on the interaction of people in societies and blockchains. Likewise, this blockchain trust model of CCA, must be extended into physical and digital domains (i.e., cybernetic) to better consider the ethical capacities of blockchain implementations. For example, with Bitcoin regarding physical confidentiality, the media often speaks to the anonymous nature of the system implying absolute confidentiality. It is not so simple. The system is pseudo-anonymous because digital events can be correlated by states to unmask individuals, however individuals would not be able to easily unmask states attempting to make clandestine or corrupt Bitcoin transactions. Furthermore, the balances for each pseudo-anonymous user along with all transactions are public. Public transaction histories are practiced by some governments for transparency, but public transaction histories for individuals is likely undesirable from a confidentiality perspective. For consensus, Bitcoin uses proof-of-work where 51% of certain machines on the network must agree. However, this allows factions to develop which could jeopardize what initially appears to be a pure democratic consensus, and the subsequent incentivization to expend energy for the proof-of-work algorithm comes with collective climate concerns. Lastly for availability, the decentralized blockchains networks are accessible from the public internet. However, this raises ethical concerns regarding equality of access due to government restriction, socio-economic constraints, or compulsion (i.e., blockchains that achieve primacy).

Machine Governance

The conventional view of blockchain technology focuses heavily on economics and computer science advancements. This scoping of use obscures broader future ethical dilemmas and possibly deemphasizes critical thought that could assist in normative design decisions. Blockchain technology excels at governance which spans political, economic, and administrative domains. At a high-level, blockchain's potential impact is made clearer by considering fields concomitant with governance and blockchain. Following that discussion, notable AI developments are converged with properties of blockchain tokens to show that machine governance is possible.

Figure 15 – Intersecting fields for cybergovernance



Each of these fields of endeavor have a different relationship with blockchain technology as a disruptor to the field or in understanding the interplay of the human condition and blockchain. Blockchain will influence political science as it digitizes existing structures, allows for the creation of new political structures previously unimagined, and may be used for voting and government transparency. For sociologists, blockchain may create structures that will allow for greater transnational cohesion but also difficult to predict re-organization of societies due to changes in power relationships. Psychology, from behaviorist and psychoanalytical perspectives, is needed as blockchains incentivize behavior that likely operates on powerful symbolic unconscious structures regarding human hierarchies and "Trust." Computer science advancements in communications, virtual worlds, consensus algorithms, and AI will heavily influence the future by continuing to create the digital domain but also provide tools by which to control it. For economics, cryptocurrency has disrupted the field, but more thought will be needed relative to economic incentivization, and organizational structures become more digitized and potentially decentralized which is at tension to the current centralized financial structure and primacy of the dollar.

Computer science may play an out-sized role with blockchain technology. Anticipated developments related to computation, storage, and AI will play critical roles in driving the order of emergent capabilities from the intersection of Blockchain 3.0, Industry 4.0, and Web 3.0. State and civil automated governance capabilities may begin to emerge which will have implications for competition between states over short and long-timeframes. States generate power through the extraction and management of resources.[56] The era of great power competition could be viewed as a competition of governance systems. Because of this, AI command and control-like governance systems will be developed that will utilize blockchain to form interconnected conduits of governance. Of course, different states will use blockchain differently, but nonetheless it will be used as part of global power competition. Furthermore,

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[56] Aaron L. Friedberg, *In the Shadow of the Garrison State: America's Anti-Statism and Its Cold War Grand Strategy*, Princeton Studies in International History and Politics (Princeton, N.J: Princeton University Press, 2000), 64.

computer science is trending towards a “no-code” environment where humans would no longer generate computer code in the way that programmers do now.[57] This would enable AIs to generate or recommend fit-for-purpose smart contracts and organizational structures. Likewise, the fit-for-purpose systems will be able to be informed about the real-world using decentralized oracles. Examples of Federal centralized oracles include information provided from the National Weather Service, the DoD’s Global Positioning System (GPS), and the U.S. Naval Observatory’s master clock. Civil oracles exist for sports scores, news feeds, stock pricing, etc. In the future AI oracles will be able to provide “Trusted” information about the physical or digital world, which in turn, blockchain implementations will use as inputs to trigger smart-contracts based on real world events.

Blockchain is the Digital Backbone for Machine Governance

Recall that the Blockchain 2.0 vision is the transformation of traditional contracts to smart contracts. Smart contracts are simply logic that is triggered when certain conditions are met. Logic is executed which performs operations on tokens which are the most fundamental component of blockchains.

The use of “token” to serve as a sign or symbol traces back to at least 890, and now its frequency of use in modern English is comparable to the words “dog,” “machine,” and “army.”[58] In fact, Merriam-Webster updated the definition of token to include “a unit of cryptocurrency” as in “Bitcoin tokens.”[59] In particular, *Mastering Ethereum*’s discussion on the conceptual properties of tokens is telling for an understanding of the governance potential of the

[57] Mark Chen et al., “Evaluating Large Language Models Trained on Code,” 2021, https://doi.org/10.48550/ARXIV.2107.03374.

[58] Oxford English Dictionary, “‘token, n.’.,” n.d., https://www.oed.com/view/Entry/202947?rskey=OlhcXx&result=1.

[59] “Definition of TOKEN,” accessed April 20, 2022, https://www.merriam-webster.com/dictionary/token.

technology.[60] Worth contemplating are the two dichotomies of tokens known as fungibility and intrinsicality. Bitcoin or Ethereum tokens, like dollars, are fungible in that swapping one for another makes no difference in value or function. Non-fungible tokens, on the other hand, represent objects like artistic pieces that are valued for their uniqueness or function. Intrinsicality is a nuanced concept related to counter-party risk meaning that tokens intrinsic to the blockchain operate within blockchain consensus rules and are not contingent on non-blockchain rules. Bitcoin would be an example of an intrinsic system since Bitcoins can be traded without counter-party risk by interacting directly with the blockchain and not through a cryptocurrency exchange. In contrast, a physical house for sale would be considered to have an extrinsic token on a blockchain because there is third-party risk related to the closing as it is governed by physical laws and registries. This is a new way of thinking about systems that is strikingly different from physical world approaches and shows the teleological progression of going from extrinsic to intrinsic processes.

The progression of blockchain intrinsicality, or said differently, the digitization of societal governance, comes into better focus now. Tokens can represent physical or digital objects or functions where possibly evolving rules are applied in an automated fashion. These rules and the progression of intrinsicality in the Bitcoin and Ethereum model are described as decentralized applications (DApps) or decentralized autonomous organizations (DAOs). DApps and DAOs are versions of applications and traditional organizations (i.e., corporations, governments) that utilize decentralized blockchain infrastructure in contrast to traditional centralized commercial infrastructure. The barrier to entry on DApps and DAOs is low, and DApps and DAOs operate in a developer-defined rules-based way. Tokens and blockchains are

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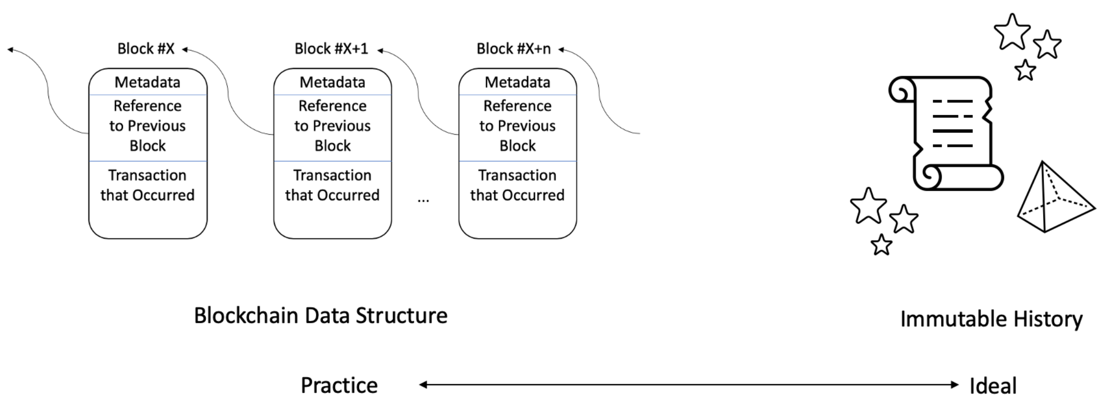
[60] Antonopoulos and Wood, *Mastering Ethereum*, chap. 10.

the fundamental backbones for DApps, DAOs, and other future constructs of governance. Even within the names of these concepts is the word "autonomous," where one can imagine the autonomy in the biggest sense leveraging AI to do governance command and control for states or civil purposes.

Blockchain Data Structure Reduced Then Idealized

It should be emphasized that tokens may represent profoundly meaningful physical or digital objects, including property, voting, identity, access to rights, and more. Further, because the blockchain data structure actualizes and governs these tokens, the blockchain data structure itself deserves further exploration. This will facilitate a more thorough conceptual analysis of the technology from ethical perspectives. This may provide a foundation for logical ethical reasoning since the blockchain data structure and its rules are deterministic. To accomplish this, the blockchain data structure will be reduced to a practical description and then imagined in its ideal form. Then, it will be compared against three traditional idealized ethical lenses.

Figure 16 - Blockchain from practice to ideal



In the reductionist perspective, the blockchain data structure is one of many different data structures that computer scientists use for different tasks; this one happens to be useful for distributed and decentralized ledger data. Blockchains could be practically imagined as stacks of paper that are ordered chronologically. Each piece of paper represents a certain block of time over which a list of token transactions is recorded showing token trades between parties. Each piece of paper also creates a unique cipher based on the paper's transactions, but that cipher also depends on the previous paper, which depends on the previous paper, etc. Interestingly, the common cipher used across many blockchains is not mathematically proven to be infallible or invulnerable.

While a blockchain data structure exists in the real world like tables and chairs, its properties and popular use can guide us to considering its form ideally. Recall that, practically, blockchains are made up of ordered blocks which store events in bundles representing slices of time. Due to today's computational, storage, and bandwidth limits blockchain data structures are constrained in the amount of information they can store or reference. However, in an idealized form, blockchains could store or represent (via tokens) information about any type of event across any number of ordered blocks. Regarding ciphering, the idealized version would be perfect, unlike the practical version, and thus intrinsic coherence across the blockchain would be guaranteed. This would result in an immutable record of history.

In summary, idealized blocks store tokens (representing any object or property) that are governed by rules, then the results (i.e., history) are recorded in blocks like pages in a book. But, for this exemplar book you would perfectly know if any recorded history on any page was modified so that it is no longer intrinsically coherent. Interestingly, however, you may not know if the entire book before you were modified such that the ciphers were adjusted to be intrinsically coherent. To determine if one is being deceived in idealized blockchain terms, one would have to idealize the blockchain concept of consensus which is outside the intent of this example.

The purpose of this idealization of the blockchain data structure here is to set a foundation to begin to reason ethically about blockchain writ large. While the practical application of blockchain implementations – like any other technology - naturally creates ethical dilemmas by mere fact of their operation on the complexities of the real human world, a conceptual approach is needed for blockchain implementations because of their potential global application and digitization of governance rules (i.e., ethics). More specifically, a conceptual basis on blockchain ethics will be needed to find common practical points of agreement on implementations of this technology across global societies. If one is creating a blockchain implementation for an intended purpose, how does one know or reconcile with others from across the world? For the DoD, thinking about ethical perspectives is quite important to avoid undesired increases in tensions, and further would likely contribute to better understanding of the actors in an operational environment which in turn would better inform planning.

With that said, how might the three classical ethical frameworks (i.e., consequentialism, duty, and virtue) view an immutable record of history? A consequentialist, who sets out to maximize the good for all those who will be directly or indirectly affected by an action, would use an immutable historical record to choose their perceived best course of future action. Duty ethicists, who examine moral obligations that existed prior to a situation to inform behavior, would be interested in the truthfulness of the data and whether the data conflicts with moral obligations or rights. Virtue ethicists, who seek to determine motivating character traits in a situation relative to normative virtuous behavior, would map the historical information onto virtues or vices to plot the right type of action to bring all virtues to their mean. The following table is part of a larger ethical lens framework publicized by Brown University that is straight-forward and allows for elicited thinking regarding technology and ethics.[61]

Figure 17 –Viewing an immutable historical record through three ethical lenses

	Consequentialism	Duty	Virtue
Deliberative process	What kind of outcomes should I produce (or try to produce)?	What are my obligations in this situation, and what are the things I should never do?	What kind of person should I be (or try to be), and what will my actions show about my character?
Motivation	Aim is to produce the most good.	Aim is to perform the right action.	Aim is to develop one's character.
Perspective on the idealized blockchain data structure	An immutable and trusted historical record can be used as trusted information to optimize actions to produce the most good.	Duties would exist independent of the trusted immutable historical record, and as such would not inform future behavior.	The events within a trusted immutable historical record would be used to map past actions to virtues, and to inform future goals to realize a balanced harmony of virtues for the

[61] "A Framework for Making Ethical Decisions | Science and Technology Studies," accessed May 5, 2022, https://www.brown.edu/academics/science-and-technology-studies/framework-making-ethical-decisions.

			individual and community.

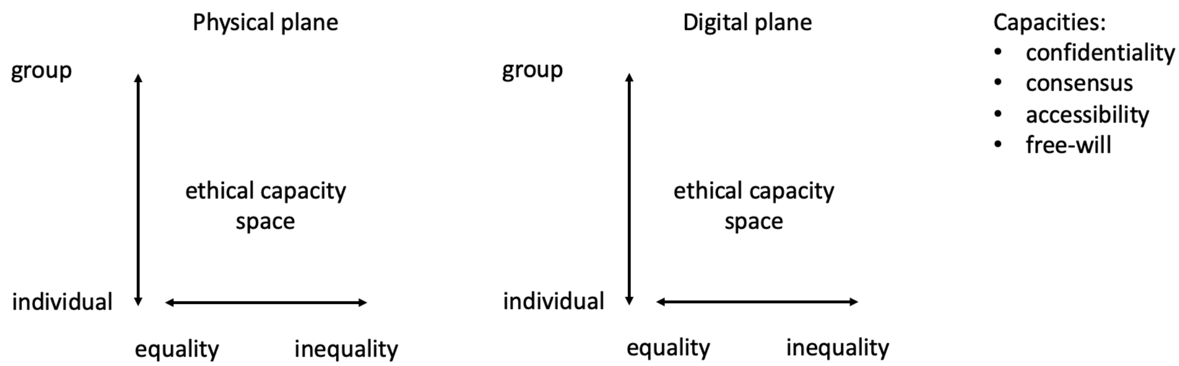
This brief and overgeneralized comparison of the three core ethical frameworks against the idealized blockchain data structure shows that there is a path possible for future sophisticated idealized ethical reasoning related to blockchain systems.

Blockchain Ethical Dimensions and Capacities

Blockchain implementations can and will affect the ways and means people use to reach their goals. Furthermore, all segments and levels of society operate and interact through pathways of communication and rules. Over human history, these interactions – violent and peaceful - have created the state of the world today manifesting as norms, laws, and sovereignty. Now, due to the internet, some blockchains will interact globally across cultures and others will be aimed at a specific sector or group of society. This wide, but alternatively focused, ethical communication via blockchain requires ways of thinking that are broad and general. Furthermore, because blockchain technology excels at governance which intersects directly with cultural norms, laws, and sovereignty the DoD will need ways to assess potential implications of the use of this technology by itself but also with interagency or foreign partners. To that end, three universal dimensions are proposed which bound the ethical space of blockchain technology. That is, digital vs. physical; inequality vs. equality; and individual vs. collective.

Within these three dimensions, ethical capacities can exist. Capacities could be thought of as functions that operate within dimensions. Four initial capacities are proposed for consideration. The initial capacities are trust (discretely articulated as confidentiality, consensus, availability) and free-will. While not exhaustive, these universal dimensions and capacities capture much of the human condition, and the differences in ethical values (i.e., governance) that have historically led to conflict. The addition of the digital dimension is noteworthy in reflection upon its absence throughout most of human history, but also the growing trend of reliance and extension of ourselves into this new dimension.

Figure 18 – Blockchain ethical dimensions and capacities



Out of the box, these dimensions provide useful ways of thinking about blockchain design choices. Two examples follow, then a broader discussion on the dimensions occurs.

Consider the ethical capacities of Bitcoin's proof-of-work consensus model within some of the dimensions. In the physical plane, there may be group global warming implications of an individual's desire to run Bitcoin hardware. In the digital plane, consensus now occurs via factions of pooled operators using specialized equipment as opposed to the early days of Bitcoin where individuals were able to use their home computers in a manner that was a quasi-democratic approach to digital consensus.

Another Bitcoin example can be performed for the confidentiality capacity where there is inequality of confidentiality across individuals and groups for both the physical and digital plane. States can remain anonymous for transactions in comparison to citizens due to ability to correlate internet activity; additionally, states have enacted know-your-customer laws on cryptocurrency brokerages. In the digital plane for Bitcoin confidentiality, all transactions are transparent which seems ideal for government accountability but at the individual level having your transactions public is likely not desired by most of the population.

Individual and Group Dimension

All governance actions rebalance individual and group interests simply because there is an implicit competition for finite global resources. Indeed, some actions may have minute implications on this dimension, other actions inspire healthy debate, and some create fissures in society. For example, global warming, gun rights, taxation, vaccination, and security policy decisions around the global represent a selection on this spectrum. In blockchain lingo, this is captured by the decentralization and centralization models. This dimension will grow in relevance as Blockchain 2.0 implementations continue to create "smart contracts" and decentralized autonomous organizations manifest. Again, because the technology supports governance – which provides rules by which resources are distributed – it is reasonable to anticipate that this dimension will become a source for future tension and debate across all levels of society regarding blockchain technology.

Equality and In-Equality Dimension

Many political ideologies and movements orbit around equality of rights and resources. The UN charter of human rights provides an international normative consensus on equality, but at the state level – just one tier removed from the idealism of the UN - governance and societies quickly transition to realist political approaches and selectively make practical what should be a point of human family agreement. As a globe, if even these seemingly core principles are up for debate and discussion, tensions will escalate quickly along the other factors of equality across sex, race, and religion. Again, because blockchains excel at governance the DoD and partners must be careful to consider what ideological stance a given blockchain implementation may be espousing.

Further, in representative democracies and hierarchical organizations there is in-equality on decision making which is essentially how the liberal international order is structured. Blockchains can be implemented in any type of governance structure ranging from pure democracies to representative democracies, to communism, or even new forms of governance. A design choice on blockchain decision making could have unintended consequences and send messages not in line with traditional policy. Blockchain technology should be considered an extension of government and evaluated to see if what is being deployed is actually a policy-decision appropriate for an elected official.

Digital and Physical Dimension

Humanity's reliance on information communication technology continues to accelerate. Recent metaverse developments, long-time prognostications from science fiction, and economic growth needs imply that humanity is teleologically headed toward a duality of digital and physical forms and representations. As computer systems continue to gather and store more and more information about our daily lives and as we rely more on that technology, we must admit and account for the fact that people have digital lives in addition to the physical. There is potential for bi-directional harm to occur between a person's digital form and their physical form due to events in either plane. Since blockchain operates in both the digital and physical planes it has the capacity to cause harm to a person's digital or physical form inadvertently or purposefully through governance.

II. Military and Blockchain Ethics

In March 2022, President Biden issued an executive order on *Ensuring Responsible Development of Digital Assets*.[62] The order is the first whole-of-government approach to address the risks and opportunities of digital assets.[63] However, the military, blockchain technology, and cryptocurrencies are mentioned but not integrated within this order. Instead, the focus, rightfully so in this era of great power competition, is on digitizing the dollar. The order is part of a global trend of central bank digital currency (CBDCs) development and is an effort to continue U.S. leadership in the global financial market.[64] This order will functionally define the Federal role and ethics towards centralized digital assets which in turn will influence how the Federal government approaches blockchain technology over the coming years.

This chapter begins with a discussion on the executive order's implications for the military along with a warning on technological surprise due to mass media narratives. Then, four sections follow which weave blockchain technology ethical considerations across the DoD's short and long-term strategic planning process.

Ensuring Responsible Development of Digital Assets has six focus areas: consumer and investor protection; financial stability; illicit finance concerns; U.S. global financial leadership and competitiveness; financial inclusion; and responsible innovation.[65] It highlights the importance of designing digital assets so that human rights can be exercised, and to avoid design choices that may contribute to human rights abuses through "arbitrary or unlawful surveillance."

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[62] "2022-05471.Pdf," accessed May 27, 2022, https://www.govinfo.gov/content/pkg/FR-2022-03-14/pdf/2022-05471.pdf.

[63] "FACT SHEET: President Biden to Sign Executive Order on Ensuring Responsible Development of Digital Assets," The White House, March 9, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/03/09/fact-sheet-president-biden-to-sign-executive-order-on-ensuring-responsible-innovation-in-digital-assets/.

[64] "R46850.Pdf," 10–13, accessed May 29, 2022, https://crsreports.congress.gov/product/pdf/R/R46850.

[65] "FACT SHEET."

This order makes it clear that there is a strategic objective to extend national values and a rules-based international order into the realm of digital assets. While the order mentions blockchains and cryptocurrencies implying competition for the dollar, the unstated aim of the order is to create a credible alternative to authoritarian CBDCs.

Blockchain technology's ability to govern digital assets will also play a part in great power competition, and it is important for the military to have clarity in understanding the technology. The conflation of CBDC's and blockchain technology is a sign of the broader and persistent challenge of communicating about the ethical implications of blockchain technology. Bitcoin's success and media appeal has biased collective understanding and strategic underestimation of the technology.

Between 2012 and August 2021 nearly 18,000 news articles in major English newspapers were written on Bitcoin.[66] Like the conflation of CBDCs and blockchain technology, a similar conflation occurs between Bitcoin and blockchain technology. Many of today's critical views around the technology can be traced to a cluster of 2011 reporting from *MIT Technology Review*, *New York Times*, and *Wired* magazine.[67] Since then, it has been reported that Bitcoin has "died" 450 times across every price point from five cents to its all-time high of nearly $70,000.[68] The conclusion that blockchain technology is "dead" because of Bitcoin's price volatility masks the power of the technology. For the military, it is vitally important to avoid the apparent global

[66] Niranjan Sapkota, "News-Based Sentiment and Bitcoin Volatility," *International Review of Financial Analysis* 82 (July 2022): 102183, https://doi.org/10.1016/j.irfa.2022.102183.

[67] "Cryptocurrency | MIT Technology Review," accessed May 28, 2022, https://www.technologyreview.com/2011/08/23/191860/cryptocurrency/; "Golden Cyberfetters," *Paul Krugman Blog* (blog), September 7, 2011, https://krugman.blogs.nytimes.com/2011/09/07/golden-cyberfetters/; Richard Beales and Robert Cyran, "Some Faint Praise for Mr. Ballmer," *The New York Times*, May 30, 2011, sec. Business, https://www.nytimes.com/2011/05/30/business/economy/30views.html; "The Rise and Fall of Bitcoin | WIRED," accessed May 28, 2022, https://www.wired.com/2011/11/mf-bitcoin/.

[68] "Bitcoin Obituaries" (99 Bitcoins, January 2022), https://99bitcoins.com/bitcoin-obituaries/.

cognitive bias that has persisted relative to this technology and understand that actions taken or projects initiated may be novel and set ethical norms for better or worse.

To that end, four short sections follow reflecting on blockchain technology relative to the President's National Security Strategy (NSS) and the three National Military Strategy (NMS) time horizons.[69] The NMS is the Chairman of the Joint Chief of Staff's strategic document that is executed continuously and drives organizational change across three time horizons: force employment (0-3 years), force development (~2-7 years), and force design (~5-15 years).

Strategic Alignment

NSSs are issued by each presidential administration, and the NSS feeds the generation of institutional policy and strategy by all executive branch agencies. Recent NSSs have been designed to accomplish four objectives: protection of the homeland, economic prosperity, support of allies and partners, and upholding values.[70] As described in a previous section, *Blockchain, The New Media for Social Change*, this technology excels at digitizing values via governance over physical and digital domains. From an aspirational position it has the potential to become a new form of international commons for governance, and if realized the technology will cut across the traditional objectives of NSSs.

More practically, blockchain technology is still developing, but it is clear that it has properties like traditional policy. Therefore, it is critical that DoD blockchain efforts be evaluated for the governance rules and political ideologies that they may be communicating. For instance, the creation of a decentralized transnational anonymous digital currency might be regarded as a threat to the dollar's hegemony. Or the establishment of a strictly democratic

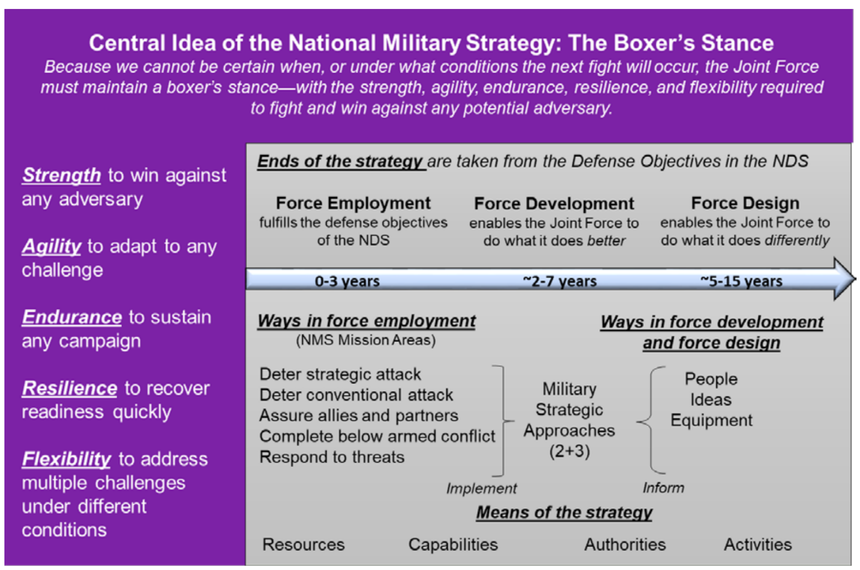
[69] "CJCSI 3030.01.Pdf," A-1 to A-2, accessed May 10, 2022, https://www.jcs.mil/Portals/36/Documents/Library/Instructions/CJCSI%203030.01.pdf.

[70] "National Security Strategy," accessed May 29, 2022, https://history.defense.gov/Historical-Sources/National-Security-Strategy/.

voting process could be seen as in ideological conflict with representative democracy and rules-based order. To mitigate unintended consequences, end states should be clearly defined, and evaluated for alignment with national values, interests, and the spirit of *Ensuring Responsible Development of Digital Assets*. Then once deployed, the progress and aim of the blockchain effort should be continuously evaluated relative to the desired end state.

While many blockchain efforts will be benign and mirror commercial and civil application there is potential for societal disruption. This technology, and significant implementations, should be regarded with the same respect and care as international policy or kinetic action.

Figure 19 - National Military Strategy with the three time-horizons[71]



Force Employment (0-3 years) Considerations

Force employment is action taken by the DoD to fulfill objectives, and are the result of the overall joint planning process.[72] This planning process is how the military contributes to the

[71] "CJCSI 3030.01 - IMPLEMENTING JOINT FORCE DEVELOPMENT AND DESIGN," December 3, 2019, A-2, https://www.jcs.mil/Portals/36/Documents/Library/Instructions/CJCSI%203030.01.pdf.

[72] "CJCSI 3030.01 - IMPLEMENTING JOINT FORCE DEVELOPMENT AND DESIGN," A-2; "Joint Publication 5-0 Joint Planning," June 16, 2017, https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp5_0.pdf.

elements of national power available to the President, generally categorized as the Diplomatic, Informational, Military, and Economic (DIME) dimensions.

At some point, if not already, forces will be required to defend, sustain, create, observe, or attack blockchain implementations to achieve some desired end state. This is exemplified in a list of vignettes that follow shortly. Blockchain implementations span from bespoke fit-for-purpose to global designs and application. Every scenario will be different requiring serious and unique thought to deconstruct the environment and plan force application. To assess situations and develop options the military uses a cognitive planning approach known as operational art.[73]

Understanding the operational environment is a key element within operational art. To mitigate unintended second- and third- order effects of force employment relative to blockchain infrastructure it is recommended to take a global systems view. Coupling the following two Joint Publication figures with the wide variety of future blockchain applications makes clear the military and ethical challenges in assessing, planning, determining authority, and mitigating collateral damage. What societal impact will a blockchain operation or initiative have, and does it support the goals and values of the U.S.?

[73] "Joint Publication 3-0," October 22, 2018, xii.

Figure 20 - A Systems Perspective of the Operational Environment[74]

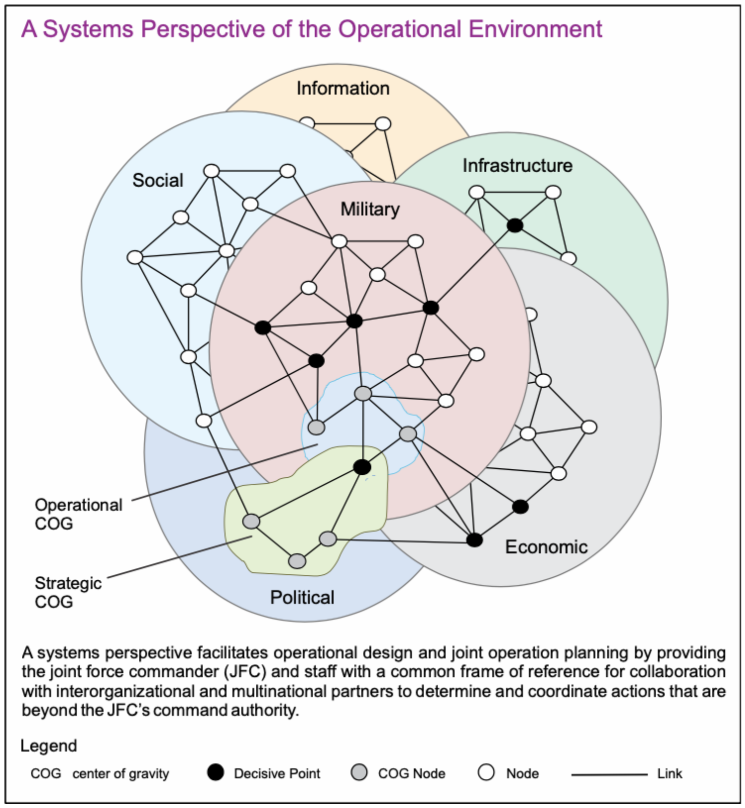
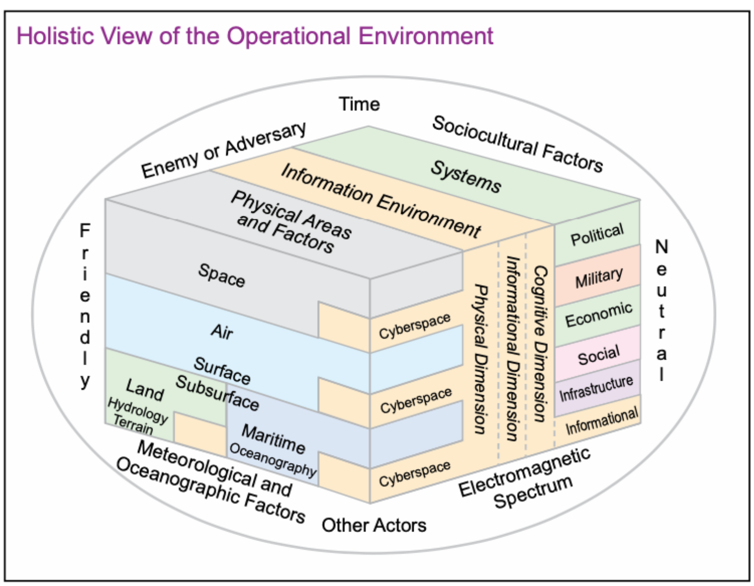


Figure 21 - Holistic View of the Operational Environment[75]



[74] "Joint Publication 3-0," IV–4.
[75] "Jp5_0.Pdf," IV–8, accessed April 24, 2022, https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp5_0.pdf.

To illustrate the ethical complexity that blockchain technology may bring to the military some hypothetical ethical dilemma vignettes are provided:

- Collateral damage – Smart contracts, on a popular blockchain system, have been deployed by an authoritarian regime to automate the incentivization of insurgent-supporting behavior in an unstable country the U.S. is based in. How can this automation be stopped without causing undue collateral damage to the overall blockchain system?
- Targeting – A transnational technocratic ideology begins to gain popularity. It uses decentralized blockchain systems and AI that appeals to the disenfranchised or disillusioned. The ideology grows with revolutionary and terrorist acts in its name. Could a transnational developer of a smart contract or AI algorithm be a target? What if there is no human developer because it's a collection of automated systems?
- Information Warfare – A cryptocurrency gains popularity as an alternative to a partner's inflationary currency. This weakens the partner's government. To what degree and scope should information warfare be used to dissuade populations against blockchain technology?
- Benign Intent – During a reconstruction effort, an interagency partner has developed governance blockchains to minimize corruption, automate access to rights, and expose vote tampering. These blockchains codify U.S. values as a "government-in-a-box." To what degree should the military be involved in this effort?
- Insurgent Training – Should insurgents be trained in using blockchain technology to make pseudo-anonymous financial transactions or communication?

- Gray Zone Behavior - A foreign actor incentivized citizens worldwide to submit unique biological identifiers using blockchain technology to provide "seamless and secure" authentication to a new viral social media platform. Should the military respond?
- Incentivizing Behavior – A series of smart contracts are available to incentivize whistleblower and reconnaissance behavior in an adversarial state. The contracts leverage blockchain technology to provide decentralized communication, payment, data retention, and transparent worldwide publication. Is it "right" for the military to incentivize behavior on a mass-scale, and could it incentivize this behavior beyond the intended nation?
- Containment – A cryptogogue, in a non-aligned country, comes into power legitimately via a political platform that leverages public distrust and disillusionment of the existing global security, economic, and human rights orders. Their promised ideological goals and publicly available blockchain infrastructure are growing in popularity globally. This infrastructure allows for external support but also game theory-based consensus manipulation. Great powers take an interest due to the potential inflection point for global political order. To what degree and when should alternative governance structures be contained? Due to the implications of digitized governance, what adjustments should be made to U.S. military partnership approaches to increase trust in global security order?

Force Development (~2-7 years) Considerations

Force development adapts the DoD's functions, capabilities, and concepts through assessments, acquisition, and budgeting actions.[76] In any given year, these administrative actions steward the business plans needed to manifest desired forces over ~2-7 years into the future.

[76] "CJCSI 3030.01 - IMPLEMENTING JOINT FORCE DEVELOPMENT AND DESIGN," A 1-2.

This timeframe horizon raises different ethical considerations that are more strategic and structural. For blockchain technology, this is where funding decisions would occur to structurally integrate blockchain technology into DoD initiatives and programs. Since blockchain technology is still relatively new, decisions made in this phase today will likely set the DoD down certain paths. But, since blockchain technology excels at governance with potentially unpredictable consequences, a question raises for strategy, policy, or funding decision makers. Am I making an informed decision about this technology and aware of the ethical implications?

To assist with investment decisions regarding blockchain technology, and to mitigate unintended results the following questions are put forward. These questions are in response to a common desire, identified during literature review, of the necessity of practical approaches to identify ethical concerns related to blockchain technology. These questions were designed to elicit potential ethical concerns through a dialectic approach integrating concepts put forward in the previous sections of this paper.

- What problem are you trying to solve?[77]
- What are your short-term and long-term intentions?[78]
- Is blockchain the best technology to solve this problem?[79]
- Do you have a bias relative to the technology?[80]

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[77] Alignment check to national values, authority, and organizational ethics.

[78] Allows determination if intentions are rational and ethical.

[79] Much hype surrounds blockchain technology, and inappropriate financial expenditure is not ethical. For appropriate use see Yaga et al., "Blockchain Technology Overview," 42; Tomader Abduaziz Almeshal and Areej Abdullah Alhogail, "Blockchain for Businesses: A Scoping Review of Suitability Evaluations Frameworks," *IEEE Access* 9 (2021): 155425–42, https://doi.org/10.1109/ACCESS.2021.3128608.

[80] The technology allows for new forms of governance, is disruptive, and may have an ideological basis in cryptoanarchism. See Usman W. Chohan, "Cryptoanarchism and Cryptocurrencies," *SSRN Electronic Journal*, 2017, https://doi.org/10.2139/ssrn.3079241.

- Does your implementation govern political, economic, and/or administrative functions?[81]
    - Is there already governance occurring in this problem set?[82]
- How is your blockchain distributed?[83]
- What are the user roles?[84]
- How is consensus generated?[85]
- Is the use of the blockchain compelled or free-will?[86]
- How could your implementation increase tensions?[87]
- Once released, can it be controlled?[88]

These open-ended questions are needed because blockchain implementations are different from traditional DoD platforms. As stated before, blockchain implementations have properties like policy, alternative governance structures, or the digitization of ethics and by proxy values. This is fundamentally different than traditional acquisition that is driven by quantifiable operational requirements relative to anticipated threats and environments. As a result, the current acquisition process may result in unintended consequences relative to blockchain initiatives.

[81] Safeguard against inadvertent policy creation, and determination of organizational authority.
[82] Determination of operational environment societal disruption.
[83] Are there issues related to human rights and national values from a data privacy perspective?
[84] Elicits governance hierarchies, checks and balances, and inequalities.
[85] Who or what is in control? How are decision made? Energy implications? Can it be manipulated?
[86] Is there equality to access if the technology is used for finance, voting, or rights? Will it have primacy? For analogy to the dollar, See Henry Farrell and Abraham L. Newman, "Weaponized Interdependence: How Global Economic Networks Shape State Coercion," *International Security* 44, no. 1 (July 2019): 57, https://doi.org/10.1162/isec_a_00351.
[87] Elicits who the stakeholders are, challenges to success, and potential for conflict.
[88] Some blockchain architectures, once released, cannot be controlled and evolve based on incentives

Force Design (~5-15 years) Considerations

Force design operates on the longest time frame and is used to ensure that the DoD retains a competitive advantage over any adversary.[89] Decisions made on this timeframe establish strategies relative to geo-political, societal, and technological trends. Where and what will be the future source of tensions? How will wars be fought? What technologies will be used? Will the right instruments of national power exist to generate the required forces?

For blockchain technology, the vision and current observed trend is a continued diffusion throughout society and entanglement with the visions of Web 3.0 and Industry 4.0. In looking at global strategy trends for 2040, from the National Intelligence Council (NIC), governance will be a key area of tension.[90] Additionally, the intersection of AI advancements with all these trends in an era of great power competition, climate change, and global demographic shifts makes the specific prediction of political and military events impossible. However, it can be assumed that blockchain technology will play a part in shaping the global future, but the question is how it will advance and be integrated with other technologies and environments.

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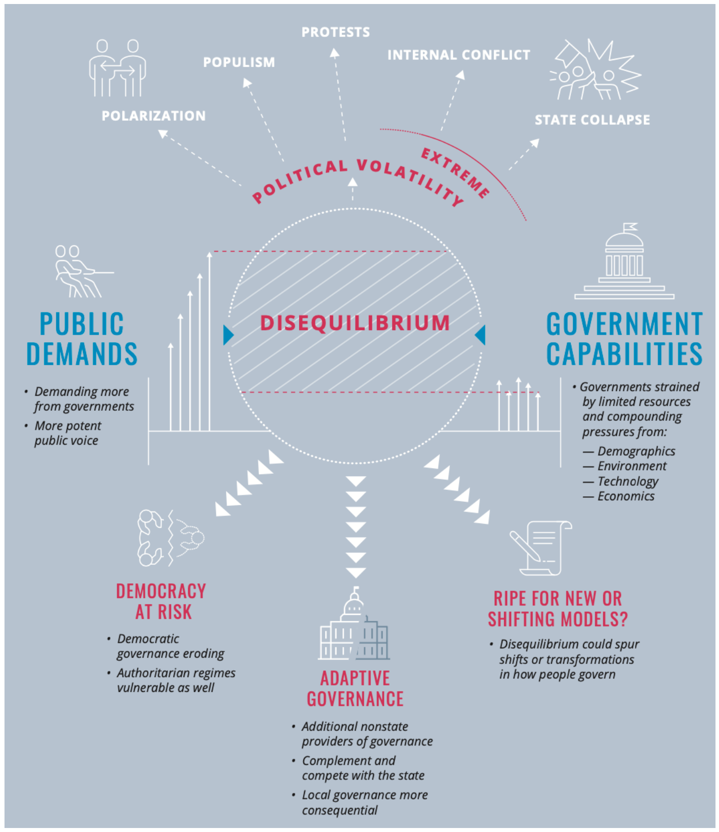
[89] "CJCSI 3030.01.Pdf," A-2.

[90] National Intelligence Council, "Global Trends 2040: A More Contested World" (National Intelligence Council, March 2021), https://www.dni.gov/files/ODNI/documents/assessments/GlobalTrends_2040.pdf.

Figure 22 - Governance Trend for 2040[91]



Blockchain technology, and perhaps other disruptive technologies, appear to be underestimated in favor of the implications of AI. There was no mention of "blockchain" within NIC's 2040 Global Trends report. However, governance and AI were mentioned around 70 times each. Despite this one prognostication of the 2040 future, the DoD will need to design forces in anticipation of future force operations related to blockchain infrastructure. More complicated ethical scenarios and societal impacts can be anticipated using forward-looking wargames and research. These actions can be used to establish signposts to monitor the progression of blockchain and other interacting technologies that will govern and control many aspects of people's physical or digital lives.

[91] National Intelligence Council, 79.

III. Conclusion: Ethical Intuition is Not Sufficient

Blockchain technology has changed how future societies will reach consensus on governance rules across political, economic, and administrative domains. These digitized rules and design choices are not just a series of computer statements of "if this condition occurs, then execute this action." The profound implications of the technology are made opaque by the widespread misunderstanding that Bitcoin is the limit of blockchain technology. Indeed, this paper has shown that blockchain rules and design choices represent the digitization and automation of ethics. These rules can be created by individuals or groups, gain traction through cybernetic consensus, and exact real control over physical and digital lives.

The technology is popularly less than 15 years old, but what happens today relative to the norms and ethics of fielded blockchain implementations is critical because computer technology compounds and persists. Traditionally, ideas and ideologies gain hold and accrete via societal consensus (either compelled or negotiated). At one point there were singular ethical consensus decisions regarding governance, but overtime they became "baked in" to the society and influence its operation along with control on individuals. Here, for better or worse, blockchain technology will accelerate the creation and digitization of governance across all levels of society.

Furthermore, it will digitize these rules, causing persistence and allow interconnection with other systems that are aware of physical and digital events. Dependencies and entanglements will be created that will solidify early rules and design choices made. Critical and ethical thinking advanced in this early phase of the technology will mitigate future long-term tension.

With this and the entire paper taken into consideration, two high-level conclusions have come into focus. The first is that the global governance implications of blockchain technology as it intersects with other technologies and ideologies is not understood. The second is that, to avoid strategic surprise, it should be viewed as a technology that globally communicates and digitizes ethics on par with international policy. Given this complex global and contextual environment, using one's own ethical intuition on the societal integrity of blockchain implementations is not sufficient nor is the other extreme, ethical coherence, practical for the DoD.[92]

Realizing this gap of critical thought for the DoD, this paper has reframed blockchain technology in ways relevant to operational art, policy, and the National Military Strategy time-horizons. It has shown that blockchain technology has an important, perhaps underestimated and unpredictable, role to play during this era of great power competition. Further, since blockchain technology acts upon human governance across political, economic, and administrative domains ethical thinking is normatively required. Blockchains operate through the capacities of trust (i.e., confidentiality, consensus, and accessibility) and free-will. Comparisons of blockchain implementations can occur across ethical capacities that operate on the contemporary human condition dimensions of digital vs. physical, in-equality vs. equality, and individual vs. collective rights. Finally, it has shown that computer data structures, in this case blockchain, can be functionally idealized to perform ethical reasoning.

Further research regarding the quantification of trust is possible using the ethical dimensions and capacities presented in this paper. Global rules-based order is maintained because there is trust that it can generate consensus. Since blockchain technology digitizes ethics via governance rules, forensically analyzing these networks may provide a new avenue

[92] James Griffin, "How We Do Ethics Now," *Royal Institute of Philosophy Supplement* 35 (September 1993): 159–77, https://doi.org/10.1017/S1358246100006317; Richard T. De George, "Ethics and Coherence:," in *American Philosophical Association Centennial Series* (Philosophy Documentation Center, 2013), 717–32, https://doi.org/10.5840/apapa2013197.

into measuring global trust, the health of democratic systems, and methods to combat misinformation. This forensic analysis will require its own ethical approach due to the potential for abuse. Finally, the conceptual and analytical approaches described in this paper likely translate to any physical or digital technology used to govern.

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