Abstract: Trust can best be understood as a relational attribute between (1) a social actor and other actor(s) (interpersonal trust) and / or (2) actors and institutions (institutional or systemic trust) and (3) institutions and (trusting) actors (trust as shared expectations), where institutional frameworks define the nature and strength of trust relationships between different actors.
Definition

Trust can best be understood as a relational attribute between (1) a social actor and other actor(s) (interpersonal trust) and / or (2) actors and institutions (institutional or systemic trust) and (3) institutions and (trusting) actors (trust as shared expectations), where institutional frameworks define the nature and strength of trust relationships between different actors.

Conceptual background

The notion of trust is of key significance, with a broad literature spanning from social sciences via law to computer science (Blöbaum, 2016; Bodó, 2020; Botsman, 2017; (Clarke et al., 2006), 2006; Fukuyama, 1995; Gambetta, 1988; Giddens, 1990; Hardin, 2002; Luhmann, 2017; McKnight et al., 2011; Putnam, 2001; Schneier, 2012; Sztompka, 1999). This leads to substantial confusions when it comes to discussing trust in the context of digital technologies in general, and in the case of distributed technologies in particular (Baldwin, 2018; Bellini et al., 2020; Dingle, 2018; Jacobs, 2020; Werbach, 2018a). We do not try to represent all aspects of these different disciplinary discussions, instead, we used a simplified model of trust adapted from the work of McKnight et al. (2011) to give a basic overview, point out the most relevant issues, and provide a working definition of trust in the context of blockchain and other distributed techno-social systems.

Trust relationships always involve a number of actors: (1) a trustor, with his or her individual attitudes, trusting beliefs, stands towards trusting, and “generalized faith in humanity”, (2) a trustee, that can be an individual, in which case we talk about interpersonal trust (Hardin, 2002), or an institution, the government, or a profession, in which case we talk about institutional, or systemic trust (Giddens, 1990). Trust is the instrument with which the trustor manages the contingencies that relate to trusting the trustee to act competently, in the interest of the trustor in concrete given contexts.

The emergence of trust has three prerequisites. First, it depends on the attitudes, beliefs of the trustor. Second, it is a factor of the (perceived) trustworthiness of the trustee: its past actions, reputation, objectively verifiable, or faith based qualities to be competent, benevolent, and maintain integrity (Mayer et al., 1995). Third,
both sides are embedded in wider, institutional environments, which create shared knowledge, a shared understanding of general, and context specific rules of the game (Shapiro, 1987; Zucker, 1985), and which can provide structural assurances on the behaviour of the trustee for the trustor. These latter include legal instruments, such as laws (Balkin, 2016; Hall, 2002), contracts (Foorman, 1997), government regulatory and oversight bodies, professional codes of conduct, governance and quality assurance, or market-based functions, such as insurance against risk.

**Trust and distributed technologies**

Within the context of trust and distributed technologies, therefore, the question of trust can have many dimensions. If the role of the distributed techno-social system is to connect people, if it allows, or relies on the collaboration of individuals, in the interpersonal trust dimension, the question is how can we (or: do we need to) trust the (often anonymous) stranger with whom we use the same distributed system. On the other hand, we also need to have some level of confidence in the system itself, and in that case we need to look at the institutional aspects of trust. Here, the main question is whether the technologies we rely on are trustworthy (Bodó, 2020). We can define technology in a narrow way, and thus the questions of trust in and trustworthiness of technical systems, and artefacts is simplified into the question of technical reliability: the security of computer systems, them being free of errors, and bugs, working as intended and advertised (Clarke, 2006). A broader definition would also consider the human and institutional elements which develop and operate those technical systems, and therefore give them agency. In such an approach, the question of trust becomes more akin to more traditional forms of institutional trust. The governance of technology covers these human and institutional elements, and the impact of the governance on the trustworthiness of technical systems turned this issue into a rapidly developing research field (Campbell-Verduyn, 2018; Elkin-Koren & Perel, 2019; Katzenbach & Ulbricht, 2019; Mattila & Seppälä, 2018). Finally, some technical systems mediate and produce trust relationships themselves (Bodó, 2020). For example, online reputation systems are designed to facilitate interactions that require trust. In these cases, the trustworthiness of these "trust producing systems" becomes an important issue in itself. The following remarks use blockchain as a case study to take a closer look at the controversies and questions associated with it from the perspective of trust.

**The academic discussion on blockchain and trust**

Blockchain technology—which was first introduced in 2008 in the context of the
digital currency Bitcoin—is often seen as a trust producing technology that might make trustworthy intermediaries such as banks obsolete. Instead, it is often said to replace human-based intermediaries by a “system based on cryptographic proof instead of trust” (Nakamoto, 2008, p. 1) i.e., a network in which all interactions between network participants are coordinated by mathematical and cryptographic code instead of human actors (Dodd, 2018, p. 37; Swartz, 2016). As a consequence, the technology takes a major role in the current public and academic discussion on trust and distributed technologies: some see it as a “machine for creating trust” (Berkeley, 2015), as reducing the cost of trust (Shahaab et al., 2020) or as an enabler of new technology-based modes of trust—“trustless trust” (e.g., Werbach, 2018a, 2018b; Hoffmann, 2015) or “distributed trust” (Botsman, 2017)—that might have a revolutionary impact on social coordination even outside the realm of distributed systems.

These academic discussions on blockchains and trust span across multiple disciplines such as computer science, economics, law and social sciences. Within these discussions, two key controversies can be identified: the first refers to the conceptual question of what is actually meant when referring to the term trust. The second controversy refers to the substantive question of how blockchain technology and trust are related: does blockchain increase trust, decrease trust, make trust obsolete, or represent a shift in the nature of trust?

Regarding the conceptual controversy, different understandings of trust can be identified. While some works understand trust as an attribute of the technological system itself (as e.g. suggested by ‘trust models’ rooted in computer sciences, see Harz & Boman, 2019), others rather understand trust as a system of intersubjective expectations between individuals that is not necessarily determined by technology (more often so in the social sciences, e.g. Vidan & Lehdonvirta, 2018). From the perspective of trust research, it is vital to recognise these conceptual differences, as these might have a significant impact on the substantive conclusions taken in respect to the nature of trust. Moreover, many academic works provide no precise and theoretically-informed definition of trust (e.g., Davidson et al., 2018; Flood & Robb, 2017; Beck et al., 2016), leaving its meaning vague and ambiguous.

In addition to these conceptual differences, academic works also exhibit substantial differences regarding how blockchain and trust are related. Two dominant views can be identified. Proponents of the first view stress the “trust-free” (Beck et al., 2016) or “trustless” (Harz & Boman, 2019; De Filippi & Hassan, 2016; Davidson et al., 2018) capabilities of blockchain technology, assuming it to enable coordination without requiring interpersonal trust between network participants (Maurer et
al., 2013, p. 261). In contrast to this view, the second line of academic works emphasises that blockchain networks are—in fact—not completely trustless and that trust enters the network at many levels and contexts (e.g. Corradi & Höfner, 2018, p. 203; Dodd, 2018; Vidan & Lehdonvirta, 2018). Rather than assuming it to abolish (interpersonal) trust, this line of studies rather argues for a shift of the nature of trust by blockchain, replacing interpersonal trust with trust (or: confidence, see De Filippi et al., 2020) in the distributed ledger itself (miners, consensus mechanisms, nodes), software developers (Walch, 2019) or new intermediaries (e.g. crypto-currency exchanges in Brekke, 2019, pp. 83-84).

A similar conclusion of a shift in the nature of trust has been drawn in the academic discussion on “smart contracts” and their application in a legal context (Yeung, 2019; Finck, 2019; De Filippi & Wright, 2018). While, at first glance, smart contracts might offer new potentials of making trust obsolete due to the guaranteed execution of encoded legal obligations (Finck, 2019, pp. 72 ff), their real-life-application always requires trusted third parties (O’ Hara 2017, p. 99), e.g. in the form of an “oracle” that supplies the smart contract with information from the outside world (De Filippi & Wright 2018, p. 75).

**Takeaways for future research**

Against the background of these controversies, two things can be learned for the study of trust in distributed systems: firstly, they corroborate the insight that finding a common theoretical language of the technological aspects of trust among multiple academic disciplines is of utmost importance. Secondly, the oft-quoted finding that blockchain resulting in a shift of trust rather than its abolishment leads to new empirical follow-up questions:

For instance, do network users put trust in the technology itself or in the humans behind it (Walch, 2019, p. 59)? What are sources of trustworthiness of distributed (blockchain) systems, particularly in the case of legal (un-)certainty? How do users behave vis-à-vis a system which may or may not be trustworthy, e.g. in the case of the blockchain-based venture capital fund “The DAO” (DuPont, 2018)? Are the technical aspects of a blockchain system enough to establish their trustworthiness

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1. Which components of a blockchain system require trust is largely dependent on its technological architecture. Major differences lie between public / permissionless and private / permissioned blockchain-systems, whereby the latter are usually not considered “trustless”, as they afford one or more organisations in a maintaining role that need to be trusted (De Filippi et al., 2020, p. 2).
2. The importance of human actors for the perceived trustworthiness of a system has e.g. been recognised by academic works dealing with the interrelationship of trust and governance (e.g. De Filippi and Loveluck 2016).
(e.g. in the case of crypto-investors against questionable financial products)? How do past accounts of the trustworthiness of institutions (e.g. Sztompka, 1999) compare in relation to blockchain technology?

Addressing these questions should be an important objective for future academic research which might foster our understanding of blockchain technology and trust as well as the role of trust in distributed systems more generally. Important steps into this direction are for instance empirical studies on specific networks using blockchain technology (e.g., Woodall & Ringel, 2019; Meijer & Ubacht, 2018; Vidan & Lehdonvirta, 2018; Lustig & Nardi, 2015) as well as theoretical works that situate the case of blockchain within the broader discourse on trust and technology (e.g., Bodó, 2020; Jacobs, 2020). Moreover, as most empirical studies on trust and blockchain technology concentrate on the Bitcoin blockchain (e.g., Vidan & Lehdonvirta, 2018; Lustig & Nardi, 2015), it would be particularly interesting to see how this case compares to other blockchain applications.

**Conclusion and working definition**

In conclusion, we face the following fundamental question: How can we (or: do we need to) trust the (often anonymous) stranger on the other side of a screen? The case of blockchain illustrates that the answer to this question is subject to the changes in our techno-social environment. Blockchain technology can be viewed as exemplifying a change in mediation structures of trust from interpersonal trust mediated by human-based intermediaries to technological intermediaries. Developing new terms of trust that can account for this institutional change by blockchain technology and conducting empirical studies on this topic are therefore essential for further research on trust and distributed technologies. Based on our theoretical reflections above, we propose the following working definition of trust that might serve as a reference point for future studies on trust in the context of distributed technologies:

Trust is a complex social phenomenon with interrelated individual (psychological, attitudinal, informational), and systemic (economic, legal, technological, social) aspects. It is best understood as a relational attribute between (1) a social actor and other actor(s) (*interpersonal trust*) and / or (2) actors and institutions (*institutional or systemic trust*) and (3) institutions and (trusting) actors (*trust as shared expectations*), where institutional frameworks define the nature and strength of trust relationships between different actors. In essence, trust refers to expectations of the trustor made towards the trustee about the occurrence of future actions and / or events (under specific external / environmental conditions) which are often con-
nected to a risk for the trustor. Trust denotes the reliance on the trustee despite this risk and can thus be understood as a way of managing contingencies of modern life. It involves both emotional and cognitive elements and is thus to be distinguished from (blind) faith and confidence (Lewis & Weigert, 1985). In the face of recent technological change, we claim that the technological environment has played an increasingly important role in setting the conditions of trust relationships, as evident in the case of blockchain. Future research is needed to not only address the technical aspects of these technologies, but also study their broader social and cultural contexts shaping their emergence and production.

References

Baldwin, J. (2018). In digital we trust: Bitcoin discourse, digital currencies, and decentralized network fetishism. Palgrave Communications, 4, Article 1. https://doi.org/10.1057/s41599-018-0065-0

Balkin, J. (2016). Information fiduciaries and the first amendment. UC Davis Law Review, 49(4), 1183–1234. https://lawreview.law.ucdavis.edu/issues/49/4/Lecture/49-4_Balkin.pdf

Beck, R., Stenum Czepluch, J., Lollike, N., & Malone, S. (2016). Blockchain—The Gateway to Trust-free Cryptographic Transactions. ECIS 2016 Proceedings Research Papers. Twenty-Fourth European Conference on Information Systems, Istanbul. https://aisel.aisnet.org/ecis2016_rp/153/

Bellini, E., Iraqi, Y., & Damiani, E. (2020). Blockchain-Based Distributed Trust and Reputation Management Systems: A Survey. IEEE Access, 8, 21127–21151. https://doi.org/10.1109/ACCESS.2020.2969820

Berkeley, J. (2015). The trust machine—The technology behind Bitcoin could transform how the economy works. The Economist. https://www.economist.com/leaders/2015/10/31/the-trust-machine

Blöbaum, B. (Ed.). (2016). Trust and Communication in a Digitized World. Springer International Publishing. https://doi.org/10.1007/978-3-319-28059-2

Bodó, B. (2020). Mediated trust: A theoretical framework to address the trustworthiness of technological trust mediators. New Media & Society. https://doi.org/10.1177/1461444820939922

Botsman, R. (2017). Who can you trust? How technology brought us together and why it might drive us apart (1st ed.). Public Affairs.

Brekke, J. K. (2019). Disassembling the Trust Machine—Three cuts on the political matter of blockchain. Durham University.

Campbell-Verduyn, M. (Ed.). (2018). Bitcoin and Beyond: Cryptocurrencies, Blockchains, and Global Governance (1st ed.). Routledge. https://doi.org/10.4324/9781315211909

Clarke, K., Hardstone, G., Rouncefield, M., & Sommerville, I. (Eds.). (2006). Trust in Technology: A Socio-Technical Perspective. Springer Netherlands. https://doi.org/10.1007/1-4020-4258-2

Corradi, F., & Höfner, P. (2018). The disenchantment of Bitcoin: Unveiling the myth of a digital
currency. *International Review of Sociology, 28*(1), 193–207. https://doi.org/10.1080/03906701.2018.1430067

Davidson, S., De Filippi, P., & Potts, J. (2018). Blockchains and the economic institutions of capitalism. *Journal of Institutional Economics, 14*(4), 639–658. https://doi.org/10.1017/S1744137417000200

De Filippi, P., & Hassan, S. (2016). Blockchain technology as a regulatory technology: From code is law to law is code. *First Monday, 21*(12). https://doi.org/10.5210/fm.v21i12.7113

De Filippi, P., & Loveluck, B. (2016). The invisible politics of Bitcoin: Governance crisis of a decentralised infrastructure. *Internet Policy Review, 5*(3). https://doi.org/10.14763/2016.3.427

De Filippi, P., Mannan, M., & Reijers, W. (2020). Blockchain as a confidence machine: The problem of trust & challenges of governance. *Technology in Society, 62*. https://doi.org/10.1016/j.techsoc.2020.101284

De Filippi, P., & Wright, A. (2018). *Blockchain and the law: The rule of code*. Harvard University Press.

Dingle, S. (2018). *In Math We Trust: Bitcoin, Cryptocurrency and the Journey To Being Your Own Bank*. Tracey McDonald Publishers.

Dodd, N. (2018). The Social Life of Bitcoin. *Theory, Culture & Society, 35*(3), 35–56. https://doi.org/10.1177/0263276417746464

DuPont, Q. (2018). Experiments in algorithmic governance: A history and ethnography of “The DAO,” a failed decentralized autonomous organization. In M. Campbell-Verduyn (Ed.), *Bitcoin and Beyond: Cryptocurrencies, Blockchains, and Global Governance* (pp. 157–177). Routledge. https://doi.org/10.4324/9781315211909-8

Elkin-Koren, N., & Perel, M. (2019). Algorithmic Governance by Online Intermediaries. In E. Brousseau, J.-M. Glachant, & J. Sgard (Eds.), *The Oxford Handbook of Institutions of International Economic Governance and Market Regulation*. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780190900571.013.9

Finck, M. (2019). *Blockchain regulation and governance in europe*. Cambridge University Press. http://doi.org/10.1017/9781108609708

Flood, J., & Robb, L. (2017). *Trust, Anarcho-Capitalism, Blockchain and Initial Coin Offerings* (Research Paper No. 17–23). Griffith University Law School. https://doi.org/10.2139/ssm.3074263

Foorman, J. L. (1997). Trust and Contracts: Are They Mutually Exclusive? *Business & Professional Ethics Journal, 16*(1/2/3), 195–203. https://doi.org/10.5840/bpej1997161/2/32

Fukuyama, F. (1995). *Trust: The social virtues and the creation of prosperity*. Free Press.

Gambetta, D. (1988). Can we trust trust. In D. Gambetta (Ed.), *Trust: Making and breaking cooperative relations* (pp. 213–237). Basil Blackwell.

Giddens, A. (1990). *The consequences of modernity*. Polity Press.

Hall, M. A. (2002). Law, Medicine, and Trust. *Stanford Law Review, 55*(2), 463–527. https://doi.org/10.2307/1229596

Hardin, R. (2002). *Trust and trustworthiness*. Russell Sage Foundation.

Harz, D., & Boman, M. (2019). The Scalability of Trustless Trust. In A. Zohar, I. Eyal, V. Teague, J.
Clark, A. Bracciali, F. Pintore, & M. Sala (Eds.), *Financial Cryptography and Data Security* (pp. 279–293). Springer. https://doi.org/10.1007/978-3-662-58820-8_19

Hoffmann, R. (2015, May 15). Why the blockchain matters. *WIRED*. https://www.wired.co.uk/article/bitcoin-reid-hoffman

Jacobs, M. (2020). How Implicit Assumptions on the Nature of Trust Shape the Understanding of the Blockchain Technology. *Philosophy & Technology*. https://doi.org/10.1007/s11097-020-00410-x

Katzenbach, C., & Ulbricht, L. (2019). Algorithmic governance. *Internet Policy Review, 8*(4). https://doi.org/10.14763/2019.4.1424

Lewis, J. D., & Weigert, A. (1985). Trust as a Social Reality. *Social Forces, 63*(4), 967. https://doi.org/10.2307/2578601

Luhmann, N. (2017). *Trust and power*. Polity.

Lustig, C., & Nardi, B. (2015). Algorithmic Authority: The Case of Bitcoin. *2015 48th Hawaii International Conference on System Sciences*, 743–752. https://doi.org/10.1109/HICSS.2015.95

Mattila, J., & Seppälä, T. (2018). Distributed Governance in Multi-sided Platforms: A Conceptual Framework from Case: Bitcoin. In A. Smedlund, A. Lindblom, & L. Mitronen (Eds.), *Collaborative Value co-creation in the Platform Economy* (pp. 183–205). Springer. https://doi.org/10.1007/978-981-10-8956-5_10

Maurer, B., Nelms, T. C., & Swartz, L. (2013). "When perhaps the real problem is money itself!": The practical materiality of Bitcoin. *Social Semiotics, 23*(2), 261–277. https://doi.org/10.1080/10350330.2013.777594

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An Integrative Model of Organizational Trust. *The Academy of Management Review, 20*(3), 709–734. https://doi.org/10.2307/258792

McKnight, D. H., Carter, M., Thatcher, J. B., & Clay, P. F. (2011). Trust in a specific technology: An investigation of its components and measures. *ACM Transactions on Management Information Systems, 2*(2). https://doi.org/10.1145/1985347.1985353

Meijer, D., & Ubacht, J. (2018). The governance of blockchain systems from an institutional perspective, a matter of trust or control? *Proceedings of the 19th Annual International Conference on Digital Government Research Governance in the Data Age, 18*, 1–9. https://doi.org/10.1145/3209281.3209321

Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system* [White Paper]. https://bitcoin.org/bitcoin.pdf

O’Hara, K. (2017). Smart Contracts—Dumb Idea. *IEEE Internet Computing, 21*(2), 97–101. https://doi.org/10.1109/mic.2017.48

Putnam, R. D. (2001). *Bowling alone: The collapse and revival of American community*. Simon and Schuster.

Schneier, B. (2012). *Liars and outliers: Enabling the trust that society needs to thrive*. Wiley.

Shahaab, A., Maude, R., Hewage, C., & Khan, I. (2020). Blockchain: A Panacea for Trust Challenges in Public Services? A Socio-technical Perspective. *The Journal of the British Blockchain Association, 3*(2), 6. https://doi.org/10.31585/jbba-3-2-(6)-2020

Shapiro, S. P. (1987). The Social Control of Impersonal Trust. *American Journal of Sociology, 93*(3),
Swartz, L. (2016). Blockchain dreams: Imagining techno-economic alternatives after Bitcoin. In M. Castells (Ed.), Another economy is possible (pp. 82–105). Cambridge Polity Press.

Sztompka, P. (1999). Trust: A sociological theory. Cambridge University Press.

Vidan, G., & Lehdonvirta, V. (2019). Mine the gap: Bitcoin and the maintenance of trustlessness. New Media & Society, 21(1), 42–59. https://doi.org/10.1177/1461444818786220

Walch, A. (2019). In Code(rs) We Trust: Software Developers as Fiduciaries in Public Blockchains. In P. Hacker, I. Lianos, G. Dimitropoulos, & S. Eich (Eds.), Regulating Blockchain: Techno-Social and Legal Challenges (pp. 58–82). Oxford University Press. https://doi.org/10.1093/os o/9780198842187.003.004

Werbach, K. (2018a). Summary: Blockchain, The Rise of Trustless Trust? (No. 3; Wharton PPI B-School for Public Policy Seminar Summaries). University of Pennsylvania.

Werbach, K. (2018b). The Blockchain and the New Architecture of Trust. MIT Press.

Woodall, A., & Ringel, S. (2019). Blockchain archival discourse: Trust and the imaginaries of digital preservation. New Media & Society, 22(12). https://doi.org/10.1177/1461444819888756

Yeung, K. (2019). Regulation by Blockchain: The Emerging Battle for Supremacy between the Code of Law and Code as Law. The Modern Law Review, 82(2), 207–239. https://doi.org/10.1111/1468-2230.12399

Zucker, L. G. (1985). Production of Trust: Institutional Sources of Economic Structure, 1840 to 1920. In L. L. Cummings & B. Staw (Eds.), Research in Organizational Behavior. JAI Press.