European Commission

SCANNING THE EUROPEAN ECOSYSTEM OF

DISTRIBUTED LEDGER TECHNOLOGIES FOR SOCIAL AND PUBLIC GOOD

What, Why, Where, How, and Ways to Move Forward

Joint research centre

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SCANNING THE EUROPEAN ECOSYSTEM OF DISTRIBUTED LEDGER TECHNOLOGIES FOR SOCIAL AND PUBLIC GOOD

What, Why, Where, How, and Ways to Move Forward

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ABSTRACT

Distributed Ledger Technologies (DLTs), such as blockchains, are primarily tamper-resistant and time-stamped databases. They allow multiple parties to record, verify and share data on a peer-to-peer basis across a network, in decentralised, synchronised and transparent ways, with limited human intervention and reduced intermediate steps. These technologies are mostly known for business use cases, from cryptocurrencies to asset track and tracing. But there are numerous organisations nowadays searching for alternative ways to harness the potential of DLTs in the pursuit of public and social good, from local to global challenges, and towards more inclusive, cooperative, sustainable, ethical or accountable digital and physical worlds. This Science for Policy report explores the current status of this particular field both theoretically and empirically, in the framework of the project #DLT4Good: Co-creating a European Ecosystem of DLTs for Social and Public Good. Part One offers a conceptual overview of the connections between main features of DLTs and their potential for social and public good goals. Emphasis is placed on different approaches to decentralisation, and on core building blocks of DLTs linked with values such as trust, privacy, self-sovereignty, autonomy, inclusiveness, transparency, openness, or the commons. Part Two comprises a scanning of the current European ecosystem of DLT projects with activities in this field. It contains a summarized version of a database published online with 131 projects, and a quantitative review of main trends. It also includes a qualitative assessment of 10 projects selected from the larger sample to showcase this field and its diversity. Part Three concludes with six independent position papers and recommendations from experts and advisors of the #DLT4Good project. The main topics addressed range from decentralized governance to collaborative economies, with highlights on issues such as trust, verifiability, transparency, privacy or bottom-up coordination.

EXECUTIVE SUMMARY

Distributed Ledger Technologies (DLTs), such as blockchains, are primarily tamper-resistant and time-stamped databases that allow multiple actors in a network to record, verify or share data on a peer-to-peer basis, in decentralised, synchronised and transparent ways.

These technologies are often associated with commercial use cases, from cryptocurrencies to asset track and tracing. But a number of organisations are looking into **alternative ways to harness the potential of DLTs to address social and public good challenges**, from tackling specific **local or global issues at digital and physical levels**, to enabling **more sustainable, ethical, inclusive, cooperative, transparent, or accountable worlds.**

This report explores this field in the framework of **#DLT4Good: Co-creating a European Ecosystem of DLTs for Social and Public Good**, an interdisciplinary project grounded on anticipatory innovation concepts and tools to **envision and test use cases of DLTs in this context**. #DLT4Good is coordinated by the European Commission's Joint Research Centre (JRC), in collaboration with the Directorate-General for Communications Networks, Content and Technology (DG CONNECT). It is supported by the European Parliament (EP) as part of a Pilot Project.

The main objective of the report is to shed light on **why this topic deserves attention from research to policy, which are its defining features and key principles, how is it developing through concrete initiatives**, and last, but not least, **what ideas can be be put forward for decision-makers to reflect about and act upon** at this moment.

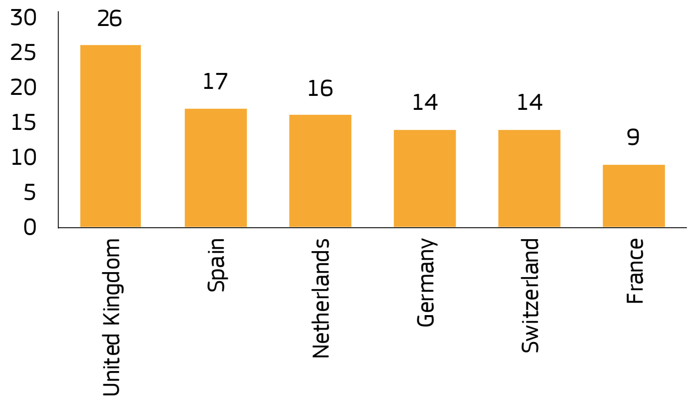
In an overview of DLTs in the field of social and public good, and how their current use can be further explored for positive impact, the following insights can be presented:

- We should look into how **DLT projects can strengthen civil society or the public space in contexts as financial inclusion, fair supply chains, or sustainable environment**. But the general role of DLTs here must be assessed through more than just the identity or purpose of specific applications. There is also **need to understand how DLT features such as decentralisation can be generally approached, and in which ways this heightens the impact of these technologies**.
- Main differences in **uses of DLTs for social and public good often come attached with drivers for decentralisation.** Multiple motivations and approaches generate impact, not tied to institutional layouts or market orientations. **But broader effects can be linked with investing in decentralisation beyond technical structures, such as at governance and other levels, combined with principles as autonomy, openness, privacy, or commons-based implementations**.
- The expansion of **decentralisation offers other possibilities when we observe for instance current and upcoming financial or organisational territories of experimentation**. This is crucial as a testbed for wider and more inclusive innovations necessary for larger DLT spaces, with examples such as **new collaboration platforms for resource distribution and management, which allow for alternative forms to allocate value and decision-making powers**.

Scanning through the current European ecosystem of DLT projects for public and social good, a **qualitative sample of 131 projects was selected to showcase the field. This was based on predefined criteria and a collective stewardship process supported by external experts and DLT communities**. No inferential reading should be made on these projects as statistical representatives of this ecosystem, as they are part of a diffuse and fast-changing context.

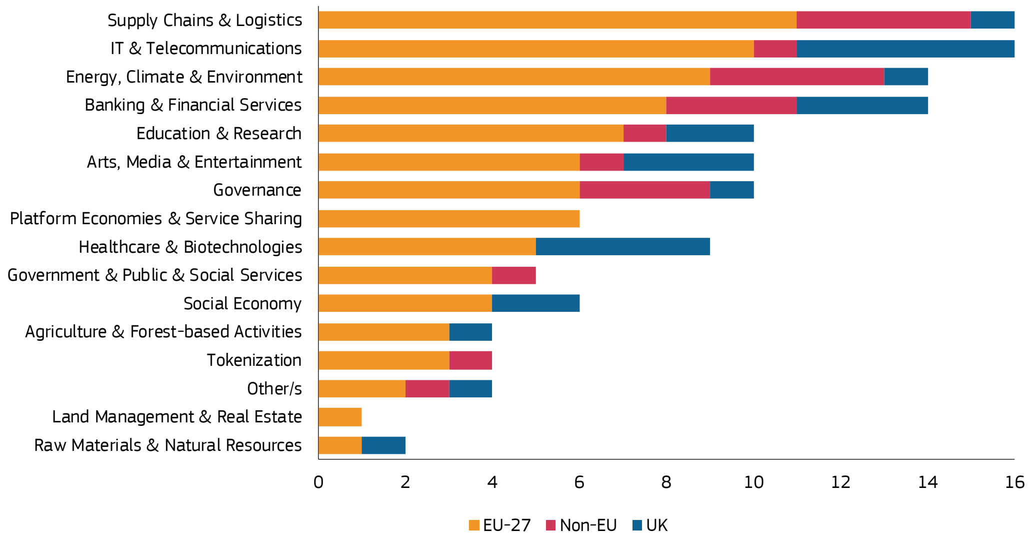
Detailed **information on the projects can be found online via the #DLT4Good Scanning tool of the Competence Centre on Foresight** published on the Knowledge4Policy platform of the European Commission. Below are some of our main findings:

- **68% of the projects analysed emerged between 2016 and 2018, with a spike of 40% in 2017. 66% of projects have their operations in an EU-27 country.**



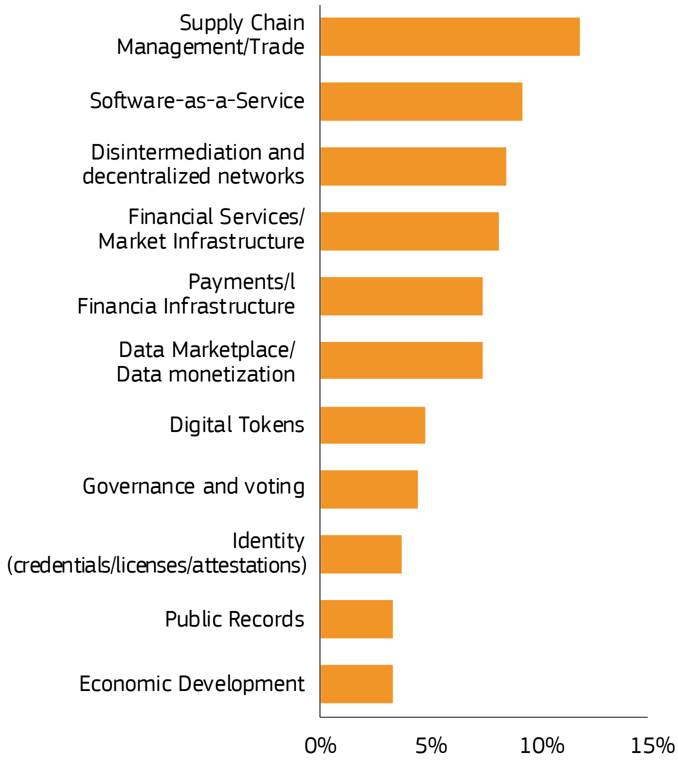
(Fig. 01 – Main country of origin)

- **Seven sectors of activity are the most represented, with 69% of the projects.**



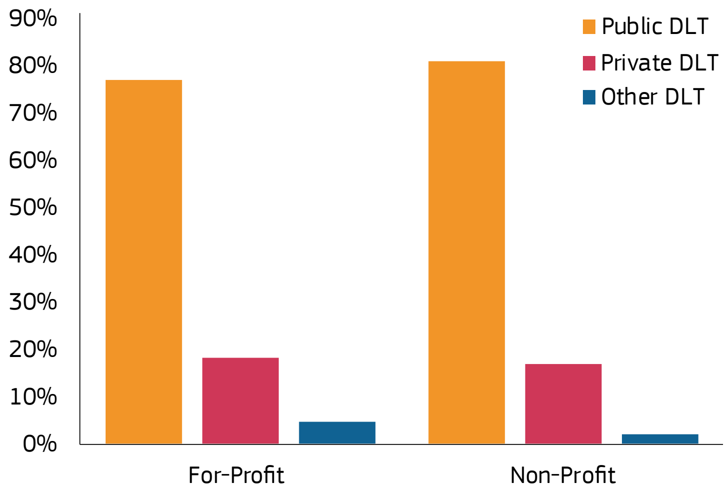
(Fig. 05 – Relation between sectors of activity and region)

- **Eleven types of applications are operated by 71% of our total sample of projects.**



(Fig. 06 – Types of applications in all projects)

- **22% of all projects are in live mode, while 53% is now in a pilot stage. 10% claim to have developed a new DLT. 73% are built on an existing public blockchain, without significant differences between for-profit and non-profit projects.**



(Fig. 13 – Relation between types of DLTs / Blockchains and profit orientation.)

A **deeper dive into ten of these projects** was also produced. It is aimed at better exploring and showcasing the existing **heterogeneity in approaches to decentralisation, impacts, geographies, sectors, applications, technical and governance structures, funding models, and more**. In a combined reading of the projects two reflections emerge:

- Looking to commonalities, it is perceivable that **all projects share a criticism of current network structures and the centralization they embody**. DLTs emerge as opportunity to counter it via experimentation, with changes in not only technical, but also governance and economic models. There is an aspiration that vast adoption of DLTs will lead to bottom-up empowerment, through more transparent and open networks, better command over data, or transference of resources to communities.
- But looking into diversity, **various stances exist between ambitions to achieve radical complete transformations, and improvement or reform of the network structures**. This is observed from large scope projects, wanting to create a novel decentralized internet with a wide set of applications, to more targeted projects, aiming to boost social resilience by combining existing local operations with DLTs.

To conclude this report, seven **high-level experts and advisors of the #DLT4Good project were invited to produce position papers**. They reflected upon and offered their independent perspectives on multiple issues regarding the use of DLTs such as blockchains towards the pursuit of social and public good objectives.

The topics addressed range from the **prospects of DLTs for decentralised governance, to their role for alternative collaborative economies**. Moreover, several discussions are also set in these papers regarding **current and future intersections of DLTs with matters of trust, verifiability, transparency, privacy or bottom-up coordination**.

This exercise benefited from feedback loops to guarantee that the papers were complementary and also relevant for the intended audiences of the report. What follows are the main **recommendations on DLTs for social and public good aimed at EU policy-makers and other relevant decision-makers**, also produced by these experts and advisors:

- Marcela Atzori focuses on a **need to avoid fragmentation and to develop convergent approaches to DLTs among EU Member States**, to advance mutual learning and achieving technical standardisation, and dissemination of good practices and policies. She also recommends **promoting social inclusion and user-centric technological design to generate social value and increase autonomous digital accessibility** through these technologies.
- Balász Bodó centres his advice on the idea of trust, exploring how **traditional institutions can help DLTs to overcome some issues related to trustworthiness.** He also states that **trust-minimizing architectures such as those of DLTs should not replace interpersonal trust**, or prevent its emergence, and warns that these architectures could crowd out and replace mechanisms that produced high levels of trust in our institutions.
- Sarah Meiklejohn suggests to **consider all ledger technologies, not just distributed ones,** if the goal is to tackle social and public good problems in near-term futures,

as some might be functional at a much faster pace. She also recommends to **work backwards from these problems to produce contextualized solutions and avoid 'one-size-fits-all' frameworks.**

- Jaya Klara Brekke directs our attention to the idea that **DLTs for social and public good should take a 'minimum viable proof' approach to traceability and transparency**, meaning that only that which is relevant, adequate, and absolutely necessary should be in a DLT. As a follow-up, she suggests that **privacy should be promoted as a main principle and use case in this field to increase future democratic control.**
- Samer Hassan and David Rozas advocate for investments in research and development of **free / open source decentralised technical infrastructures, where DLTs could be ground for customized organisational alternatives** in current innovation ecosystems. They also argue for **strengthening EU hubs on decentralised technologies with diverse and not-just-for-profit projects**, and promoting platform co-ops as emerging governance and business models.
- Primavera De Filippi discusses DLTs for bottom-up coordination in global governance. She encourages, on the short term, the **adoption of DLTs as a means to provide technological guarantees, and for regulatory compliance to promote innovation**, on the medium term. She also recommends fostering implementation and progressive **adoption of shared DLT infrastructures for future services that extend beyond national boundaries.**

1. INTRODUCTION

1.1 Perspectives on Distributed Ledger Technologies (DLTs)

Standard definitions of Distributed Ledger Technologies (DLTs), the most recognizable being blockchains, take us to their existence as tamper-resistant and time-stamped databases. With primary origins in cryptocurrencies such as Bitcoin, they now allow for an ample range of digital or digitized assets to be recorded, updated, validated or replicated, across one or more networks, in a decentralised, synchronised and, presumptively, transparent manner.

DLTs enable parties who are physically distant, or have no particular trust in each other, to record, verify or share data on a peer-to-peer basis with reduced need for intermediate steps or even the intervention of other actors. Moreover, when combined with specific automation attributes, such as smart contracts, some DLTs support the execution of complex procedures and agreements with limited to zero requirements of external or internal human participation.

Their development grows as a trend, something noticeable in international initiatives as the EU Blockchain Observatory and Forum[1] (Courcelas, Lyons and Timsit 2020), the OECD Global Blockchain Policy Forum (OECD 2019)[2] or the Strategic Intelligence Platform of the World Economic Forum (WEF 2020)[3]. Not only that, but functional use cases are largely more diverse now than we could observe a few years ago (Pólvora et al 2018)[4].

The hype around DLTs also continues. It has peaks and it has plunges. But these technologies still get most of the attention that made them visible in recent years, from media to policy. Perhaps most significantly, they still benefit from what are deemed as less publicly visible moves from investors, developers, managers, researchers, and several other actors. They are searching for novel or alternative technological, economic, financial, social, and governance possibilities, to carry out their own agendas, or pursue wider collective goals (Nascimento et al 2019).

Nonetheless, after early promises of muscled revolutions in a multitude of sectors, DLTs have not fully delivered what was frequently forecasted and announced. In this, they are not as unique or disruptive, considering the pace and adoption of other emerging technologies, as some of its most devoted supporters preach. Criticisms emerge typically around DLTs such as blockchains for being slow (Mearian 2018), wasteful (Truby 2018), expensive and inefficient (Odiljon and Gai 2019), unscalable (Bano, Al-Bassam, and Danezis 2017; Chu and Wang 2018), and possibly most strikingly, for supporting or allowing at times a centralization of power and resources, opposite effects of what this class of technologies was originally envisioned for (Torpey 2019).

All these criticisms are relevant and most DLTs have also to emerge as stable, appropriated and integrated solutions for the most part (Nascimento, Pólvora and Sousa Lourenço 2018). But coupled with the last point above, we see more and more organisations searching for alternative ways to explore and harness the potential of DLTs, while having more intersections with the spaces of public and social good. There is now a growing interest in reflecting about and experimenting with DLTs beyond original financial or commercial use cases, towards different applications and operational models, and deeply connected with possibilities of more inclusive, convivial, cooperative, ethical, sustainable or accountable digital and physical frameworks.

1.2 Searches and intersections in alternative spaces

Beyond the most expectable territories of non-profit, third-sector or governmental

1 https://www.eublockchainforum.eu/initiative-map

2 https://www.oecd.org/finance/oecd-blockchain-policy-forum.htm

3 https://intelligence.weforum.org/topics/a1Gb00000038qmPEAQ?tab=publications

4 https://blogs.ec.europa.eu/eupolicylab/blockchain4eu/

organisations, a considerable and diverse set of DLT projects is drawing, for instance, on heterodox economic and governance models, and a vast history of open source technologies, peer-to-peer production or commons-based approaches, to develop alternative solutions for structures that are mainly centralized at its core, even if technically distributed (Ostrom 1990; Oram 2001; Rozas et al 2018; De Filippi and Hassan 2015; Brekke forthcoming). By following these or similar routes, most DLTs can impact the social and public good with concrete technical applications that deliver specific results in more distributed ways to local or global challenges.

Moreover, some DLTs might also have a different impact if opening up the larger field of possibilities for individual and collective action, crossing largely into wider movements as those of appropriate technologies, civic tech, digital social innovation, and akin. Some DLTs can help to decentralise and disintermediate decision-making in a system through enabling participants to better access, operate or build that system. Gains could be observed for instance in collective infrastructures not taken by centralizing actors that own, control, or enforce conditions of engagement.

> It is now relevant for decision-makers first, to have an evidence-based perspective on which benefits DLTs can generate through projects targeting social and public good, and second, to start anticipating how far DLTs can move us, envisioning permanent changes from digital to physical structures.

We are now in a crucial moment to understand what this space is, and why, where and how this type of alternative searches takes place. On top of that, we are in a moment where it is especially relevant for decision-makers first, to have an evidence-based perspective on which benefits DLTs can generate through projects targeting social and public good, and second, to start anticipating how far DLTs can move us, envisioning permanent changes from digital to physical structures.

Numerous explorations of this trend were carried out in recent years. They have been produced by consultancies such as Accenture to expand their services beyond traditional business use cases, and target non-governmental or social innovation organisations with strategic advice on adoption and implementation of DLTs for issues such as fighting human trafficking or transparency in land registration (Podder 2017)[5]. We observed them emerging from within big market players and technology providers such as IBM with ambition to position their own infrastructures as problem-solvers for societal problems, from sustainability on plastic waste to microfinancing in local food systems (Wieck and Cuomo 2019)[6]. Most substantially perhaps, we saw such explorations drafted by international organisations looking to assess the potential of these same technologies for their own challenges on the ground, as in the recent brief by the UNHCR on the use of DLTs in refugee and displacement contexts (Lee 2020)[7], or even the practical internal developments outlined by the UN Innovation Network. This last one goes from a transparent supply-chain program managed by the WFP between Djibouti and Ethiopia, to

5 https://www.accenture.com/us-en/insights/technology/blockchain-for-good

6 https://www.ibm.com/blockchain/for-good

7 https://www.unhcr.org/innovation/connectivity-for-refugees/

a cryptocurrency investment fund managed by UNICEF worldwide to target start-ups dedicated to the social and public good (UNIN 2020)[8].

The current report intends to carry yet another perspective into this DLTs discussion space. A considerable investment was placed on an empirical scan of the current European ecosystem of projects in a broad field of public and social good. The goal is to know what they are, which are their main configurations, and namely, how can we show at least part of their diversity.

We equally directed our collective efforts into other developments at conceptual levels. This elaborates on what higher intersections might also exist between DLTs and the notions of public and social good, with emphasis on the decentralisation effects that DLTs can and do enable. As mentioned before, such effects happen not simply at a technical level through features as disintermediation. And we also looked into what they could entail in more specific terms, considering alternative distributions of power, resources and more, as well as into what they could signal on more abstract layers, linked with values as trust, privacy, self-sovereignty, autonomy, inclusiveness, transparency, openness, or cooperativeness and the commons.

1.3 #DLT4Good: Co-creating a European ecosystem of DLTs for social and public good

The European Commission has supported this broad field of DLTs on numerous occasions already, through funding programmes such as the Collective Awareness Platforms for Sustainability and Social Innovation (CAPSSI)[9], and projects as Decentralised Citizens Engagement Technologies (D-CENT)[10] or Decentralised Citizens Owned Data Ecosystem (DECODE)[11]. Most recently, this support was elevated to a higher stage in terms of resources and outreach with a European Innovation Council (EIC) Horizon Prize[12] of five million euros, which awarded directly the next generation of innovators in blockchains and other DLTs dedicated to the pursuit of social and public good.

The current report exists in this same territory as a part of the project #DLT4Good: Co-creating a European Ecosystem of Distributed Ledger Technologies for Social and Public Good[13]. #DLT4Good is coordinated within the European Commission by the Joint Research Centre (JRC)[14], through the Competence Centre on Foresight and the EU Policy Lab, in collaboration with the Directorate-General for Communications Networks, Content and Technology (DG CONNECT)[15], the Next Generation Internet Unit. It is supported by the European Parliament as a Pilot Project[16].

This project emerges from the need to envision and test new policy strategies to support the co-creation of a robust and cooperative European ecosystem of organisations and experts working on, or interested in, DLT applications for social and public good. #DLT4Good outputs will inform DLT initiatives supported or coordinated by the European Commission, other EU institutions, and numerous public and third-sector institutions from international to local levels. Learnings from this project should also serve to lay down guidelines for anticipatory experimentation with other emerging technologies that could benefit from targeted investments in similar fields.

8 https://www.uninnovation.network/blockchain

9 https://ec.europa.eu/digital-single-market/en/collective-awareness

10 https://dcentproject.eu/

11 https://decodeproject.eu/

12 https://ec.europa.eu/research/eic/index.cfm?pg=prizes_blockchains

13 https://blogs.ec.europa.eu/eupolicylab/dlt4good/

14 https://ec.europa.eu/info/departments/joint-research-centre_en

15 https://ec.europa.eu/info/departments/communications-networks-content-and-technology_en

16 https://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_ATA%282019%29640130

Our efforts in #DLT4Good are simultaneously placed on scanning and researching the potential of DLTs for social and public good, and on stimulating and backing the production, uptake, and even scaling up of DLTs in this context. These are two streams that run in parallel with feedback loops between them, and they constitute a new integrated approach in knowledge support to policy-making, going from technological foresight to the development of innovative public funding.

The first stream is where this report emerges from, and it relies on evidence-based primary and secondary research, encompassing an increasingly ample group of external experts and advisors alongside activities of stakeholder outreach. It aims at increasing the anticipatory capacity of policy-making, and it stands on a continuous mapping of current and potential applications, sectors, actors, and configurations of DLT projects for social and public good.

The second stream is grounded on co-design and support to an external accelerator program to stimulate not only the advancement of promising DLT applications for social and public good, but also its matchmaking with potential beneficiary organisations to increase results. This program is led by the #DLT4EU consortium[17], which was chosen via a competitive call for proposals built on top of knowledge generated by this project, and its activities are continuously supported by our research, together with the competences of our advisors.

1.4 What, why, where, how and ways to move forward

This report is edited and produced by the Joint Research Centre (JRC) with valuable support and contributions by external experts and high-level advisors. Its primary objective is to offer independent evidence-based advice for a more informed and robust EU policy-making on blockchains and other DLTs, considering in particular applications for social and public good.

The contents are, however, not restricted to this domain. They were created in ways that can and should be explored and used by other actors. Secondary audiences for this report include for example policy-makers and political agents from other internal organisations, national, regional or local bodies, business leaders and decision-makers in the broader space of DLTs or that interested in its development, or researchers and practitioners in a wide range of disciplinary backgrounds, from computer scientists to science, technology and society scholars, and in a wide set of topics, from distributed networks and cyber-physical systems to sustainability and social innovation.

The report is divided in three main parts, each focused on a specific research output.

Part One offers a conceptual overview of the connections between main features of DLTs and the possibilities they enable for the pursuit of social and public good goals. Emphasis is placed on three different approaches to decentralisation and core building blocks of DLTs in this field.

Part Two comprises an empirical scanning on the current European ecosystem of DLT projects with activities in the fields of social and public good. It contains a summarized version of a database with 131 projects published online in its entirety. It also includes a closer look into 10 projects.

Part Three concludes with six position papers and recommendations by experts and advisors of the #DLT4Good project. The topics range from decentralized governance to collaborative economies, with highlights on issues such as trust, verifiability, transparency, privacy or coordination.

17 https://www.dlt4.eu/

PART ONE

This first part offers a conceptual overview of the connections between features of DLTs and their potential to accomplish social and public good objectives. The focus is set initially on different approaches to decentralisation and some of the drivers behind them. Key principles related to technological and governance decentralisation, or autonomy, openness, privacy and data commons are also explored as building blocks in DLT applications for social and public good, with attention to experimentations in organisational and financial territories.

2 FRAMING DLTS AND THE SOCIAL AND PUBLIC GOOD

2.1 What do we mean by DLTs?

Distributed Ledger Technologies (DLTs), the most well-known being blockchains, are essentially databases in which multiples types of data or transactions can be added, synchronised and run almost simultaneously across distributed networks of multiple nodes of peers. The idea behind DLTs is not entirely new, and we can trace their filiation to past and current technologies, or even thought experiments in economic and social realms. But DLTs are a particular and rather novel type of databases due to their combination of features and the possibilities these indicate (Nascimento et al 2019).

For example, DLTs have characteristics such as a single source of truth arranged in a linear succession of blocks of verified data, with internal and external trust on that truth based on rules followed by users to verify, validate and add transactions – a 'consensus mechanism'. DLTs are mostly tamper-resistant, with no central entity in control of the database, which results in strong resilience against single point-of-failure flaws, and makes it extremely hard to modify or delete data. They have embedded properties based on time-stamping, which means that any data they contain, such as details about a payment, a contract, transfer of rights, and others is publicly linked to a precise date and time. And ultimately, some DLTs support the existence of 'smart-contracts', which enable agreements between parties to be executed and enforced without need for human coordination or intervention, and attached to information contained in the DLT.

> DLTs are essentially databases in which multiples types of data or transactions can be added, synchronised and run almost simultaneously across distributed networks.

It is critical to observe, however, that there is no singular DLT architecture or a main standard, even if there are some DLTs more renowned, such as the blockchains of Bitcoin or Ethereum platforms. There are instead many protocols and applications with distinct prospects that represent the wider set of DLTs (Jeffries 2018). Differences are often attached to technical architectures and governance mechanisms, but we tend to distinguish DLTs by looking to the open, closed or hybrid access or verification rights users have on data and transactions, or yet to the different permissions they need to execute and validate data and transactions within the DLT (Nascimento et al 2019).

Furthermore, it is also crucial to understand that DLTs currently have a broad set of unresolved challenges, which among other issues still hamper uptake or other developments, as integration with legacy or other emerging technologies. We can highlight here the limited scalability and performance of some DLTs, often related to a low volume of transactions, or the high-energy consumption of others when operating specific consensus mechanisms. On another level, we can also refer to security vulnerabilities, such as key management protocols highly dependent on human actions, as storing information in devices susceptible to attacks, or the high dependency of running the network on a limited number of participants. The latter enhances the perils of collusion between users who may corrupt governance mechanisms in specific DLTs and overrun its network to reach results without consensus approval. As a last example, we can also pinpoint that other key issues emerge through the links between data immutability and transparency for instance. Debates may be warranted on higher levels considering potential conflicts between some DLTs and regulatory frameworks such as the

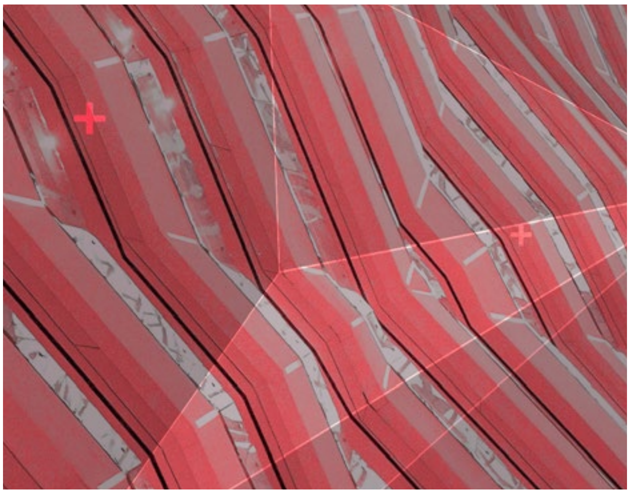
European General Data Protection Regulation (GDPR). More discussions that are practical are needed on the safeguarding of personal, sensitive or confidential data in DLTs, when some data is not meant to be available for everyone publicly, or when parts or the entirety of this data needs changes due to inaccuracies or problems in its original entries.

The Joint Research Centre (JRC) has produced multiple technical and scientific outputs on DLTs and blockchains in the past years that offer diverse perspectives on the topic with different entry points for different audiences. This work was conducted in collaboration with other European Commission services and EU institutions to better inform and support EU policies with evidence-based advice, and relied on partnerships with research, businesses, industry, public authorities, civil society organisations and other relevant stakeholders.

As our intention here is not to explore this topic in depth, these JRC outputs can be consulted for a broader understanding of DLTs and blockchains.

To point to a few examples, a technical report such as "Blockchain in Energy Communities: A Proof of Concept" (Kounelis et al 2017) dives into the challenges and opportunities of implementing blockchains in particular infrastructural contexts. A science for policy report as "#Blockchain4EU: Blockchain for Industrial Transformations" (Nascimento, Pólvora and Sousa Lourenço 2018) offers a sectorial summary of these technologies with a forward-looking view that moves from multi-stakeholder engagement to speculative prototyping. The flagship report "Blockchain Now and Tomorrow: Assessing Multidimensional Impacts of Distributed Ledger Technologies" (Nascimento et al 2019), provides a full outlook on DLTs, from introductory aspects to policy developments and empirical analyses of different sectors, and ultimately lays down a foresight pathway for debates on potential impacts, bottlenecks and ways ahead.

The focus on DLTs that permeates and structures this report takes a different turn and is placed on the use of these technologies for social and public good. Throughout the report we intend to shed some light on why this is a topic meriting attention from research to policy, how it is being developed empirically through projects on the ground, where its main deployments are taking place, and last, but not least, what kind of questions should we ask right now, and which expert recommendations can be put forward for decision-makers to reflect about and act upon?



The focus on DLTs that permeates and structures this report takes a different turn and is placed on the use of these technologies for social and public good.

> This field tends to blur some boundaries between public and third sector, private enterprise and civic tech, and often features organisational arrangements across the board.

2.2 Connecting DLTs and the social and public good

It is crucial to understand here that blockchains and other DLTs are not the same as crypto-currencies, which is only one type of application with its own set of issues. It is also important to recognise that DLTs are not limited to the financial applications that are usually at the core of discussions focusing on trading bubbles or initial coin offerings (ICOs), for instance. Amid unfolding developments and uncertain futures, DLTs have potential applications in numerous sectors, certainly from currencies to finance, but also from advanced manufacturing to healthcare, from education to public and third-sector engagements with citizens, and above all from emerging sectors known or anticipated now to those still to be imagined .

It is in this large territory that we observe DLT projects targeting social and public good goals. It happens in terms of specific applications, their purpose and what they can offer for broader societal benefits. But it also happens through what DLTs enable in terms of infrastructural reorganisation, from topics as better governance of the projects themselves, to those that imply or fully enable a more equitable distribution of resources to direct stakeholders or to numerous other collective and individual actors that can be brought into their sphere.

We scan through specific projects, their organisations, and their main configurations, in Part Two of the report, to make this field more tangible. This includes applications in prominent spaces as financial inclusion, fair supply chains, energy and environment, identities and vulnerable populations, or skills and education, just to name a few. There, we also see how this is a field that tends to blur boundaries between the public and third sector, private enterprise and civic tech, and often features organisational arrangements across the board. Due to the emerging characteristics of the field, most projects still seem to be looking for institutional insertions in the larger ecosystem, with preponderance of specific organisations yet to emerge.

The exploration of DLTs for social and public good is sometimes distinct from their exploration by corporate actors and others that mainly deploy this set of technologies for competitive advantages at commercial level. But even here we observe a shifting field with relevant DLT initiatives for social and public good ranging from projects led by grassroot workers cooperatives or established by politically motivated network platforms, to projects tied to corporate social responsibility frameworks or conglomerate impact investment funds.

To better explore conceptually how DLTs can contribute to the public and social good, we chose not to offer upfront any definition built on top of specific sectors, such as humanitarian aid, nor on top of where DLT applications could stem from, such as civil society or governmental organisations. Even if not an easy task given the frontier characteristics of the ecosystem, we attempt to conceptually and empirically build a framework to encompass DLT projects that can emerge from any possible sectoral or organisational spaces. Our focus is placed above all on what projects can do for instance to strengthen civil society and reinforce elements such as public and social commons, while also opening up new or renewed collaboration paradigms and alternative forms to generate and distribute value.

By this token, elements that matter the most in our exploration are how DLTs can help to foster solutions for pressing environmental, economic or social challenges, by addressing global agendas such as the United Nation's Sustainable Development Goals (SDGs) (Voshmgir et al. 2019; Maupin, Kahlert, and Weizsäcker 2019). Or yet, elements touching upon how these technologies can help to expand such agendas at the local level, from citizen empowerment to sectoral developments, profiting from other takes such as the Four Pillars of Sustainability (Dessein et al. 2015), as in cultural activities that act as robust intervention spaces for the decentralisation capacities of DLTs (Catlow 2019; Catlow and Vickers 2019; Potts and Rennie 2019).

For the purpose of the #DLT4Good project and goals of this report, this is where we chose to primarily explore how DLTs can strengthen the pursuit of social and public good objectives. This also is where we notice that core properties of DLTs such as decentralisation can generate even more benefits, by enabling not only new technical architectures, as DLTs do in any other context, but also by fostering new territories of experimentation where the notion of decentralisation itself can be taken to other degrees .

2.3 Three approaches to decentralisation and what they can imply

On a technical level, decentralisation is a defining feature of DLTs and is used as an engineering method for achieving specific information security properties, such as infrastructural resilience and privacy (Troncoso et al. 2017; Buterin 2017). Data or any other information contained in DLTs is stored and verified in a decentralised manner, meaning it is not controlled by any single, or subset of nodes. The motivation for this is to ensure DLTs cannot be easily manipulated, attacked, or shut down. This is what is meant by the typically repeated statement that DLTs as blockchains solve the 'trust' problem: no node in the network needs to be 'trusted' in order to be sure that the ledger is secure and valid (Antonopoulos 2014; Sel 2015). However, there are significant differences between trust as an information security concept and its effects in practice. It has even been pointed out that DLTs might largely contribute to diminishing trust by transferring it from traditional social actors to algorithmic structures (Mallard, Méadel, and Musiani 2014; Vidan and Lehdonvirta 2019; Dickson, Delight, and Diakomichalis 2019; De Filippi 2019).

DLTs employ decentralised network topologies, cryptography and economic concepts in order to make centralised control of data and computation both technically and economically unfeasible by design (Brekke, forthcoming). But beyond technological aims and features of decentralisation, understandings of the term vary largely and are often not explicitly defined (Schneider 2019). Some attempts to overcome this exist and can be found for instance in distinctions between architectural, political and logical dimensions (Buterin 2017). Even so, the lack of a more or less solid recognition of what decentralisation is, or how it can be achieved, brings adverse consequences to fields as the one of DLTs for public and social good.

This means for instance that people with very different world views within the DLT space are able to project their own ideas onto the notion of decentralisation and end up diluting its effects or yet converting it into something outside the field. It can also mean that otherwise centralising effects of DLTs can be obscured among the blank spots of conceptualization, whereby even if technical architectures are decentralised in specific projects, their models of governance or value distribution might still be highly centralised (Azouvi, Maller, and Meiklejohn 2018; De Filippi and Loveluck 2016).

Decentralisation is not easy to achieve in practice. Technical decentralisation, for instance, needs a large enough network, which is why new DLT projects sometimes decide to operate on top of existing networks as Ethereum in order to achieve architectural decentralisation. And governance decentralisation is even harder to achieve by any measure, as it implies politically opening the protocol itself and decision-making mechanisms that are often too complex to implement. Moreover, the same people and the same projects can draw from across different concepts and tendencies on their pursuit for decentralisation, which can even lead to discord and confusion about it in practical terms (Swartz 2018; Azouvi, Maller, and Meiklejohn 2019).

Despite best intentions towards decentralisation, namely considering a large majority of DLT applications for social and public good, we can state that most projects do not manifest it entirely. Technical decentralisation in itself is easily conflated with supposed social, political or economic effects by many actors in the wider DLT landscape, which largely remains questionable.

As stated before, the goal of DLTs in this field is to enable not only new technical architectures in a decentralised way, but also organisational and financial ones, in order to open up activities such as governance or allocation of resources to more distributed models. Therefore, it is significant to understand not only how different approaches to DLTs can nurture this disposition to decentralisation beyond technical realms, but also what they can imply in terms of broader impacts for the field of social and public good. Drawing on recent literature that has traced different ideas and trends in the general field of DLTs we may arrive at three broad approaches to how decentralisation is pursued, which are the main motivations behind them, and what they can ultimately imply for our field.

First, 'incorporativism' where decentralisation is linked with new options for competitive advantage and tied to existing commercial or institutional arrangements (Swartz 2017). Second, 'automatism' where decentralisation implies that code, protocols, algorithms and markets take a bigger role in coordination between humans. Third, 'infrastructural mutualism' where decentralisation is strongly attached to value-laden frameworks and issues as democratisation, co-ownership, or commons (Swartz 2018).

2.3.1 Incorporativism

Incorporativism denotes the adoption of DLTs by sectors these were intended to disrupt through decentralisation. It entails the use of these technologies in ways that do not seek to change the status quo from an economic, political or social perspective; instead, they seek to incorporate DLT properties into existing systems to make them more efficient (Swartz 2017).

Decentralisation in incorporativist approaches to DLTs is employed mainly in terms of technical decentralisation, while letting other dimensions, such as governance, in centralised mode. A concrete example is when a given blockchain protocol is run across a number of different servers, but is essentially controlled by a centralised corporation or institution, such as a commercial bank or a governmental registry service. This form of decentralisation can have practical benefits in terms of resilience, automation and tracking or authenticating data, for example proving actors are who they say they are, or ensuring products are where they're claimed to be from and things took place when they were claimed.

There are numerous attempts here to use the technological properties of DLTs to innovate within existing systems and positively impact the social and public good, namely through fintech or regtech projects, following a continued relationship with cryptocurrencies and automation of contracts. But incorporativist approaches to DLTs do little to shift underlying structures of infrastructural and informational ownership and control. Instead, DLTs tend to be used to strengthen and automate existing ownership, management and legal structures. This implies that organisations that own or run DLTs grant less control over information and data to its users or other actors, as well as less control over protocols that determine these.

2.3.2 Automatism

In automatist approaches, trustlessness is taken to an extreme. The assumption is that if DLTs such as blockchains can be mathematically proven to be beyond manipulation, then they are the only thing that can be trusted. With this approach, technical decentralisation is somewhat understood to be a solution to governance decentralisation. Code is frequently interpreted as more objective than natural languages on the basis that it executes as it is written (Wood 2014; De Filippi 2019). Humans can often be perceived as biased, egotistically-motivated and with limited knowledge, that therefore require the coordination of a system that is often seen as embodying more neutrality. In these cases, decentralisation is motivated by the aim to reduce control by humans as much as possible, such that an increasing number of processes are automated through a trustless system (Antonopoulos 2014; Swan 2015).

This approach comes from network subcultures of crypto-anarchism alongside broader techno-libertarian tendencies that are generally inclined to consider traditional institutions as an illegitimate and obsolete depository of power (O'Dwyer 2015; Swartz 2018; Scott 2014; Brunton 2019). It often draws on rudimentary ideas of markets as neutral information processors and the most effective means for coordination and encourages the use of new information technologies as liberating forces against authority (Manski and Manski 2018).

Furthermore, this approach is also linked with paradigms such as 'digital metallism' that draw on ideas of gold as a material determination of value that is not tainted by human or institutional biases (Maurer, Nelms, and Swartz 2013; Karlstrøm 2014). The idea is that gold, or more specifically cryptocurrencies such as Bitcoin as digital gold, can have intrinsic value instead of one determined by any traditional institutions (Golumbia 2016; Scott 2014).

Numerous DLT projects in the field of social and public good manifest this approach and can have wide positive impacts, both in terms of their specific purposes to tackle global or local issues, or in terms of generating decentralisation effects that easily surpass restricted technological domains. But there is ultimately a downplay of traditional public and social organisations, coupled with a primacy of economics over politics, and a quantification of citizens into network agents, that can taint these effects, with promises of freedom, efficiency, and quality that can hide processes of excessive corporatization in governance (Atzori 2015).

2.3.3 Infrastructural mutualism

Infrastructural mutualism, a term coined by Swartz (2018), describes a broad tendency that also includes commons and mutual credit approaches to DLTs (De Filippi and Hassan 2015; Rozas et al 2018; Bass, Sutherland, and Symons 2018; Berlant 2016; Brock et al. 2017; Trustlines Foundation, n.d.). The term was first used to distinguish those who emphasised Bitcoin as a peer-to-peer mutual network from those who driven primarily by profit lead to increasingly centralised big mining operations (2018). Swartz traces elements of the infrastructural mutualist tendency to the 'cypherpunk' internet political movement formed around the possibility to use cryptography and peer-to-peer networks as a means to address imbalances of power (2018). Furthermore, this trend can also be traced to a longer history of peer-to-peer technologies that has continuously sought to advance the decentralisation of internet from its early stages (Oram 2001).

> It is significant to understand not only what nurtures this disposition to decentralisation beyond technical realms, but also which tendencies are more prone to delivery in the fields of social and public good.

In contrast with incorporativism or automatism, infrastructural mutualism emphasises a form of decentralisation whereby more, rather than less, control is granted upfront over technical architectures and the information they contain and process, often tied to concepts such as co-production or shared utility. In addition, decentralisation here is also related with opening up governance in a wider sense, as it tends to exist here through peer-to-peer systems that distribute numerous resources in more democratic ways, while also organising new commons within networked structures where information and other elements are more accessible.

Decentralisation in infrastructural mutualism is chiefly employed to decentralise the technical control of the network, as a strategy to achieve principles such as privacy, while governance decentralisation, through political and logical dimensions, is emphasised to achieve principles as self-determination, understood mostly as the ability for communities to determine and run their infrastructures. By the same token, this approach often emphasises the benefits of openness in terms of software, meaning that people can adopt and build on each other's work, and also the ability of individuals and groups to determine their infrastructural arrangements and equally benefit from any value or resources involved. When in place, this cuts across DLT projects within public, private or civil society sectors and addresses questions of infrastructural control in wider frameworks (Swartz 2018; Campbell-Verduyn 2018).

Although not exclusively, it is often closer to this approach that most DLT applications in the fields of social and public good explore decentralisation across a larger spectrum, with all this can imply in terms of impact. But there are however still numerous challenges that arise here, including technical issues such as ensuring continued availability of data as well as specific types of information security concerns (Troncoso et al. 2017), and political issues in terms of governance and accountability structures, which tends to be ad hoc, informal and vary significantly (Meiklejohn 2018). Moreover, projects in this space are also not invulnerable to co-optation and can be absorbed or diluted by strictly oriented commercial ventures, which is clearly one more signal that no possible approach to decentralisation is without challenges.

2.4 Decentralisation and other key principles for social and public good

DLTs such as blockchains are explored in this field not only to transform technical structures, but also to transform other arrangements from organisational to financial dimensions, as for instance towards more equitable network governance or distribution of value and resources (Kouhizadeh, Zhu, and Sarkis 2019; Allen, Berg, and Novak 2018). Numerous projects reach for this kind of impact by exploring DLT properties such as decentralisation through different approaches. But it is perhaps by looking at how such a property can be explored in its larger spectrum, combined with, or augmented by other value-laden elements or frameworks, that we can better frame both how DLTs can effectively contribute to the social and public good, and which key principles might be some of the most appropriate building blocks for such a process.

The following concepts represent some of these principles more in depth. They are not static and mainly illustrate core ambitions and claims of DLT applications seeking systemic change towards a more equitable distribution of decision-making, benefit and value, on and off chains. Critically, they are principles rather than features, and often times DLT applications for social and public good do not to entirely live up to them, or fail to embody its substance in their day-to-day operations, even when showcasing best intentions to explore decentralisation. Moreover, this is not an exhaustive description. Here we mostly aim for an epistemological exercise around these principles as building blocks in DLTs for social and public good, instead of crystallising any kind of representative empirical observation of selected projects.

2.4.1 Technological decentralisation

DLTs came around as a disruption to centralised institutional and infrastructural control, initially in response to major financial crises (Faria 2019; Campbell-Verduyn and Hütten 2019), and later, more explicitly, in response to the centralisation of network infrastructures by major players, in cloud computing, platform economies and others (Guyer 2016; Langley and Leyshon 2016; De Filippi and McCarthy 2012). They reflect the history of a wider group of peer-to-peer technologies where decentralised architectures were used to achieve network resilience and certain forms of information security properties (Troncoso et al 2017; Oram 2001). But as the excitement for decentralisation expanded, so has the understanding of what it means (Schneider 2019).

The degrees to which DLT infrastructures and applications stand close to the varied promises of decentralisation has been under scrutiny. Technological decentralisation has benefits in terms of information security (Troncoso et al 2017), but there is no major evidence that it triggers other effects such as a democratisation of control at larger scale. As mentioned before, infrastructures and protocols might have centralising traits or are simply not decentralised in implementation. On another level, DLTs might be technically decentralised but their social and economic effects are centralising, as for example in the case of Bitcoin mining, or in situations where a single organisation or small group of people holds the majority of tokens (Swartz 2018). And there is also always a danger that technical decentralisation, rather than empowering actors of a given system, merely decentralises its risks and exacerbates its existing inequalities (Manski 2017). For example, holding one's own cryptographic keys might be empowering to some people, but can entail losing access to funds for others. Also, decisions about how, when and where to invest can equally represent an opportunity for some, while others will experience it as risk or anxiety.

> Debates on governance, such as who gets to decide, what and how, are instrumental to the maturation of DLTs, as governance determines questions of access, use and benefit.

2.4.2 Governance decentralisation

As stated earlier, some DLT projects work towards decentralisation of governance based on limitations of mere technological decentralisation. Two major events shifted some focus from DLT applications to how protocols themselves are maintained, corrected and governed: 'who decides on how things are decided' (Kreutler 2018). What is now framed as the Bitcoin scaling conflict (Wirdum 2016; 2015; Musiani, Alexandre, and Cécile 2018; Narayanan 2015), along with the Ethereum DAO exploit (Dupont 2018), caused significant splits in the Bitcoin and Ethereum networks, which at a specific time were the most visible representations of DLTs. These conflicts highlighted how seemingly technical issues can be of core relevance, at social, economic and political levels, thus requiring robust governance processes. In sequence, decentralised governance can be set both as a potential application (Field 2020; Honigman 2019), as well as in terms of how the protocols themselves are, or can be, governed (Dupont 2018; Azouvi, Maller, and Meiklejohn 2018). These processes are emergent, entailing new vocabularies, power divisions and forms of deliberation and signalling (De Filippi and Loveluck 2016; Islam, Mäntymäki, and Turunen 2019).

Efforts to address the ambition of decentralised governance draw on a wide spectrum of ideas,

> Openness is a catalyst for more socially beneficial innovation as more people can also build and develop from existing work, and it allows advances in democratisation of DLTs, with their inner works being more easily scrutinised and debated.

from commons to market design approaches (Rozas et al 2018; Posner and Weyl 2018; Brekke forthcoming). They also sit alongside other initiatives to change the ownership and management models of internet and other computing infrastructures, such as 'platform cooperativism' and 'prosumer' networks (Schneider 2018; Viñas, n.d.; Morell 2010). Commons based approaches emphasise deliberative democratic decision, where people retain control over the data and infrastructures affecting their lives. While market design approaches tend to emphasise the use of economic incentives and game theory in order to achieve desirable behaviours. In practice, networks such as Bitcoin and Ethereum entail a little bit of both, although deliberative processes have tended to be more informal (Swartz 2017). Debates on governance, such as who gets to decide, what and how, are instrumental to the maturation of DLTs, as governance determines questions of access, use and benefit. Nonetheless, there can be a disposition to want to preempt and resolve all problems within specific DLTs through governance only, which can be costly and ineffective, or hamper alternative actions (Kreutler 2018; Schneider 2018; Field 2020).

2.4.3 Autonomy

DLTs targeted at social and public good can aim to enable autonomous infrastructures, meaning being run and governed by those who use them (Clippinger and Bollier 2014). This ambition is not exclusive to the field in question of DLTs, and long precedes its existence with roots in many other protocols and systems. Autonomy in the overall context of DLTs has often come to mean autonomy for the systems themselves, beyond the control of any single individual, company or institution. Autonomy here implies particular forms of automation, as for example the execution of code through 'incentive-driven' decentralised networks (Boucher et al 2017; W. Wang et al. 2018) with the intention of minimising human control over processes (Filippi and Wright 2015). But this largely contrasts with other ideas of autonomy mostly present in DLTs for social and public good, taken mostly as self-determination, or ability for individuals and communities to run and govern their own network infrastructures (Oram 2001; Viñas, n.d.; Manski 2017).

On another level, autonomy and self-determination in DLT applications aimed at broader social and public benefits can also imply an ability to control one's own digital identity. There is growing awareness of how personal data informs scoring, ranking and reputation systems and helps to create digital profiles of people with very little recourse to understand or control these. Human digital identities are beyond their immediate control, and for the most part are barely transparent to people themselves. To counter this, some DLTs contribute towards the notion of self-sovereign identities, where individuals retain more control over their digital identities (F. Wang and De Filippi 2020; Kondova and Erbguth 2020; Mühle et al 2018). This includes for instance advanced cryptographic techniques, such as Attribute Based Credentials or zero-knowledge proofs, to allow people to reveal only what is required to access a given service (Sonnino et al 2018).

2.4.4 Openness

Openness as a principle in DLTs is manifested in a number of ways, among them transparency of software and hardware (Gaba 2018), ability to join and add to the network (Kadiyala 2018), and ability to adopt, modify and fork it (Andrews 2019). General features of the larger set of DLTs such as trustlessness depend on this trait, and they are often linked with open source that allows code and protocols to be audited and understood by external actors at any given stage.

This is also core in DLTs for public and social good. If openness allows for better security, more people can check the quality of what is encoded and which architectures are adopted (Clarke and Dorwin 2009). But it is also a catalyst for more socially beneficial innovation as more people can also build and develop from existing work, and it allows advances in democratisation of DLT technologies, with their inner works being more easily scrutinised and debated.

Apart from this conception of openness related with code, the notion is also linked to the network itself. The early protocol layer blockchains and DLT projects are open in this sense of the word. They are now described as permissionless, which means there are no permissions required in order to join as a peer and contribute to such networks (Neudecker and Hartenstein 2019). The notion of permissionless blockchains should not be mistaken as neutral, as all possible protocols will prioritise specific kinds of uses or require particular skills in order to be able to contribute, such as computational power as in the case of cryptocurrency mining (Kwon 2014; Paul, Sarkar, and Mukherjee 2014).

But of main significance to DLTs for social and public good is at least the notion that, in principle, such architectural choice has lower entry levels in terms of access and participation, with often less conditions imposed to execute or validate operations. On one hand, this allows for larger and more diverse sets of participants to have a stake in this kind of DLTs. On the other hand, such easiness can be countered by permissioned chains sensible for smaller networks of communities, who might instead create safer spaces of participation in DLTs, or adopt non-technical forms of verification based on shared values, for example, in order to join the network (König 2015).

> Privacy in this context of DLTs is part of the particular goal to regain democratic controls in the production and use of data within the age of digital networks.

2.4.5 Privacy

Privacy in this context of DLTs is part of the particular goal to regain democratic controls in the production and use of data within the age of digital networks (Monsees 2019). As an increasing amount of activities take place via digital networks and applications, these activities leave data trails that inform data processing often beyond people's immediate knowledge and control (de Vries 2010; Acar et al 2014). For example, one of the main impulses for the invention of Bitcoin, and with it the blockchain as most well-known DLT, was a response to the production and capture of economic data as a consequence of the rise in digital payments (Nakamoto 2008).

Nowadays numerous DLT use cases in the field of social and public good are strongly linked with privacy and the search for less intrusive requirements for accomplishing tasks in the digital world. On top, techniques linked to cryptography and zero-knowledge proofs, fine grained enough to reveal only necessary information for a given digital interaction, also allow for a wider respect of privacy (Gurses, Troncoso, and Diaz 2011; Sonnino et al 2018), with fair information practices at least partially enabled by the confidentiality these techniques facilitate (Kshetri 2017).

Privacy protections have been reinforced for digital contexts through the European General Data Protection Regulation (GDPR), and expanded to give more control to individuals over their data. Nevertheless, even considering DLT applications with the best intentions, at least for now there is still little escape from tensions between GDPR and DLT architectures at large (Finck 2019).

First, GDPR depends on the existence of identifiable 'data processors' in relation to which anyone can enforce their rights, and in DLTs with wider decentralisation properties there is not any one particular data processor. Second, much of GDPR rests on the ability to delete data if and when requested, while one of the main features of DLTs is immutability of the ledgers which hampers the right to data erasure, best known as 'the right to be forgotten' (Finck 2018). Nevertheless, some DLTs in our scope have potential as means for extending the aims of GDPR by making advanced cryptography more broadly available (Truong et al. 2019) and enabling more control over personal data and more transparency of who can access data (Wirth and Kolain 2018).

2.4.6 Data commons

Coming back to what it means to partake in infrastructural mutualism tendencies, data commons approaches to data governance contrast with what can be classified as the techno-determinst or market-driven paradigms that still dominate the main debate spaces on DLTs (Rozas et al 2018). Data commons emphasises the relational production, shared value and collective governance of data (Morell 2010; De Filippi and Hassan 2015). Data commons approaches also open up for different ways of addressing questions such as privacy, as a collective issue rather than an individual concern. Instead of treating data as private property, whether owned by individuals or groups such as commercial corporations, a commons approach to data recognises its collective nature (Mantelero 2016; Mahieu, Asghari, and van Eeten 2018). By this token, even personal data is at nearly all the time related to someone else's data, with elements as names indicating family ties, or location data implying proximity or behaviours more easily categorised (Véliz 2019).

Repeatedly linked with the privacy issues discussed before in DLTs aiming at having impact for the social and public good, the collective nature of data also has a number of implications where the disclosure of specific elements might unwittingly identify someone else, and individual choices can have collective implications. This affects market approaches to personal data in particular, where one person's personal data might be more or less valuable than another, for instance. But as most of the value of data in our time lies in the interrelations of larger data sets (Steel et al 2013; Williams 2019), and given centralised DLTs often imply more and not less connectedness, it is crucial how projects and applications choose to manage and control their data, especially if they emphasise and enable the collective utilisation, governance and ownership of data.

The argued benefit of this latter approach is that it recognises consequently how the nature and value of most information lies in its aggregated and relational uses. Appropriated technical and governance DLT frameworks can contribute towards this end in the context of social and public good applications, where for example people would be able to determine what personal data they want to keep private and what data they want to share as a data commons governed through 'Data Trusts' or even by respected public sector organisations (Symons and Bass 2017).

2.5 Current and upcoming territories of experimentation

As explored until now, we can choose to define DLTs in this field in a general way through its intentions to decentralise and some of the approaches followed in that process. Such choice largely implies looking at decentralised architectures, but it also points us towards other effects, such as the distribution of control and value at the protocol layer. It is here that we find current and upcoming territories of experimentation worthy of a preliminary review before moving into its empirical illustration with several of the projects scanned in Part Two.

Although not exclusively, we can point to these territories as being predominantly based on a disposition to tackle organisational and financial challenges, with current and upcoming innovation streams that cut across numerous sectors, applications, and more (Ostrom 1990; Oram 2001; Rozas et al 2018; De Filippi and Hassan 2015; Brekke 2019; Posner and Weyl 2018). Nevertheless, even here we find a propensity for some debates to still be focused on individualised narratives, such as stories around crypto-currencies such as Bitcoin and akin, or even others about DAOs, meaning that much of the otherwise alternative acts of sociotechnical disruption and experimentation can be missed out on or ignored (Maddox et al 2016).

In the midst of all the distinctiveness in this field of DLTs for social and public good, we also see influences of a moral economy widely extended to all DLTs, and where a majority of failures tend to be individualised in detriment of structural critiques (Campbell-Verduyn and Hütten 2019). A crucial point is that a significant problem emerges here due to the still immature and alternative characteristics of this field, as it seems to allow for heavier disputes in terms of immaterial occupation in this regard. Glitches potentially attributed to specificities of one or more limited projects seems to be more easily pushed here, than in any other context, into shocking narratives of general failure. This, in turn, serves to counter less conventional or frontier experimentation endeavours for instance, and to render some institutionally sanctioned acts as more being legitimate, such

> DLT experimentation for social and public good is still risky and with unproven assumptions, but it serves as an innovative testbed for broader and more inclusive innovations necessary for larger DLT spaces.

as experimenting within the organisational confines of simulatory sandboxes (Faria 2019).

But the potential missteps or errors emerging from experimentation in a field where DLT applications target social and public purposes appears as normal and needed as in other alternative experimentation fields with social and public innovation (Pólvora and Nascimento forthcoming). DLT experimentation for social and public good is still risky and with unproven assumptions, but it serves as an innovative testbed for broader and more inclusive innovations necessary for larger DLT spaces. We believe this can be made visible by observing and discussing at least some territories with developments between organisational and financial dimensions. They can provide indications about the most mature possibilities, while simultaneously displaying signs of anticipatory innovation prone to foresight explorations.

2.5.1 Organisational territories

DLT protocols aim to enable agreements and coordination across local and global scales. This has led to organisational innovation that enables people to establish and run networked organisations that are less bounded by geographical location and emphasise autonomy in digital processes (Zwitter and Hazenberg 2020). The idea is that verifiable ledgers might serve as a shared reference point to form communities in which people can easily determine their own terms of engagement. This includes enabling people to design and set up voting and decision-making systems, issuing tokens and creating binding agreements that can work across location or legislative contexts.

Some of the most notorious cases of organisational experiments with DLTs include Decentralised Autonomous Organisations (DAOs). These are constructed as platforms that enable people to set up internal governance for nearly any organisation, with main claim on code as replacing other forms of enforcement of agreements. DAOs have been defined as 'organisations where rules are coded and run on a public, permissionless blockchain with 'rules automatically applied and enforced when the conditions specified in the software are met' (Honigman 2019).

A major criticism of DAOs is that they are solutions looking for a problem, and the claims around them often seem over the top, from becoming the ultimate organisational model for companies, to fully replacing geopolitical infrastructures (Swan 2015). But experiments are still in process, with ambitions on DAOs going through major changes, and more

> Commons organisational experiments with DLTs also build on broader efforts towards what some call commons-based peer production, emphasising the potential of digital networks to radically transform productive processes towards large-scale collaborative models outside of market contexts.

emphasis placed on governance since the first explicit DAO launched in 2016, as a type of Ethereum venture capital fund, was hacked for ETH 12.7M, or around EUR 135M (Zamfir 2018; Dupont 2018; Brekke 2019).

Another approach on organisational experimentation with DLTs focuses less on automation and more on autonomy and self-determination. DAOs tend to exist on DLTs where automation occurs by enforcement through their execution across a single ledger. Other DLT protocols enable actors in peer-to-peer networks to retain their own cryptographic ledgers rather than the network being determined by a single blockchain ledger. Blockchains take a 'data centric' approach, for example with Bitcoin every node of a network maintains the same state of the network, the consensus is protected by a lot of work, which makes it possible to think of Bitcoin as one global database.

For example, protocols as Holochain can use what is called an agent-centric approach, focused on the digital autonomy of actors engaging with one another (Luck 2018; Brock et al 2017). Each actor maintains their own history, and their own tamper proof chain of cryptographic hashes storing that actor's history. This personal ledger is controlled by the actor themselves through their private cryptographic keys. Nevertheless, there is not a major practical implementation of organisations using this kind of protocols so far, as these DLT networks are to a large extent still being built out. In addition, they also face some of the same issues as DAO platforms in terms of wider adoption, being significantly new ways of approaching and describing organisations.

Other DLT projects draw on the histories and frameworks of the commons at large in order to develop organisational and economic models that do not rely on state nor market frameworks (Rozas et al 2018; Bollier 2014; Catlow 2019). The commons in DLT networks are also distinct from private property and rights tied to markets or central institutions as nation states.

Instead, resources are shared, maintained and governed by a community as a matter of interdependence, with principles for successfully governed commons in physical worlds frequently transported into digital contexts (Ostrom 1990; Rozas et al. 2018; De Filippi and Hassan 2015), and often able to even maintain democratic principles at scale within highly complex contexts (Morell 2010).

Commons in DLTs enable prosumer relations where anyone can partake in online communities both as producers and consumers of value within that community. But commons organisational experiments with DLTs also build on broader efforts towards what some call commons-based peer production, emphasising the potential of digital networks to radically transform productive processes towards large-scale collaborative models outside of market contexts (Benkler and Nissenbaum 2006). And there are even concrete experiments based on alternative views of data economies, with the adoption of commons enabling management of personal data and capture, storage and use of data as public good rather than private property (Vercellone et al 2018).

Yet, organisational innovation within DLTs can also be focused on design of economic incentives building on the notion of markets as organisational and coordination tools (Ossandón 2019; Ossandón and Ureta 2019). Some experiments claim to be distinct from capital markets by suggesting that markets can be designed to achieve outcomes for the social good (Posner and Weyl 2018). This radical approach puts forward market design theories that aim to solve issues such as economic inequality, stagnation, and political instability (Posner and Weyl 2018; Buterin, Hitzig, and Weyl 2018). The idea is that market incentives can be designed in order to achieve broader desirable outcomes for society (Ossandón 2019; Posner and Weyl 2018). One such design idea is that all asset owners would have to name the price they would sell their asset and taxed accordingly. The intention is that ownership would thereby also function as form of public auction that provided social and public dividends. The proposal would imply quadratic voting to allow allocation on issues according to what mattered the most (Lalley and Weyl 2018).

2.5.2 Financial territories

On the side of financial experimentation, it is nearly impossible to not start with currencies. They were in fact the first use for DLTs such as blockchain and simultaneously functioned as a way to finance first DLT infrastructures, with Bitcoin introducing the idea of a network that would pay for itself, through miners who while securing the ledger would at the same time be rewarded for doing so through the creation of new cryptocurrency. This created a huge momentum but at the same time opened the way for speculation, scams, and a fluctuating currency market with many dubious effects on organisations and individuals. Initial Coin Offerings (ICOs) were a result of this trend and while they functioned as a means to facilitate independent fundraising for blockchain infrastructure adding tokens with cryptocurrencies, they also led to scams and speculative uses that marked the initial DLT spaces of cryptocurrencies as nothing else (Alexandre 2018).

Recent financial experiments aimed at enhancing social and public good have been focusing on solving some of the problems of ICO scams and speculation for the internal fundraising of DLTs. What are called curation markets is yet an unproven market design approach that is popular in the blockchain builders' community to establish alternative finance mechanisms as further away as possible from speculative practices. The concept is that tokens are bought and sold according to an automated market maker contract or bonding curve, with the goal of providing liquidity and access to finance. A continuous bonding curve is a type of bonding curve that issues its own tokens through buy

> We can look at the worlds of transfers and lending with new DLT peer-to-peer models emerging among the major fintech players also using DLTs for their gain.

and sell functions. This price increases as token supply grows (Titcomb 2019; Balasanov 2018), with the intention that this would incentivise early support for good ideas.

Within this territory of financial experimentation, tokens can be minted and bought at any time according to a price set by a smart contract. The cryptocurrencies used to pay for tokens are kept in a smart contract, often deemed as reserve pool, and tokens can be burned and sold back to the contract at any point (Balasanov 2018). The designs of token minting and the protocols for its valuation in these schemes can be designed in a more fine-grained manner than ICOs. This allows the idea that incentives can therefore be better aligned to serve the financing needs for the public good of a project, a community, or even a whole system, rather than for speculation.

For another financial example we can look at the worlds of transfers and lending with new DLT peer-to-peer models emerging among the major fintech players also using DLTs for their gain. The ubiquity of smartphones has given rise to a number of projects and companies extending financial and payment services to unbanked and other service deprived populations via mobile apps and text messages. Financial inclusion agendas often motivate these kinds of applications. Nonetheless this space is ruled by large network operators and other sizeable market players with other motives beyond the social and public good. Concrete examples can be found where these operations give rise to new forms of debt or monopolistic financial data economies (Donovan and Park 2019). And while extensions of financial or payment services might grant some freedom, they are also prone to allow for new limitations and dependencies, establishing intermediaries that separate deprived groups from their funds (Donovan 2018).

A number of DLT projects have sprung up with the intention of tackling some of these problems by disintermediating remittance payments, enabling peer-to-peer lending, or even transparent donations to charities and aid projects. Some of these do it by enabling payment and financial services through peer-to-peer platforms operated by a community of users. However, even here there are risks that need to be factored when using blockchain without significant research and limited involvement with intended users, as within some contexts where these applications exist they can easily become a form of 'techno-colonial solutionism from above' (Scott 2016).

Economic autonomy and other issues such as financial privacy remain one of the main ambitions in the development of DLT projects that push for broader decentralisation, which at times can take the form of libertarian anti-central bank sentiments, and at others seek to enable economic empowerment of communities. Blockchain as DLT was initially invented in Bitcoin with the goal of enabling cash-like direct transfers between people, and without the creation of additional data and intermediation of payment providers. In terms of financial experimentation within this field of DLTs such purpose is still one of the most chased ones. The road ahead remains even so paved by commercially oriented agendas as the cashless approaches to finance and banking. Some of these can open the way for a wider impact of DLTs on the ground, but they could also help to concentrate even more financial power with payment providers and financial institutions if data does not become more than just technically decentralized (Scott 2018). Ultimately, it can even entail an expansion of economic surveillance at larger scales, with potential geo-political consequences in terms of economic sovereignty for individuals and groups (Arauz 2019).

PART TWO

This part comprises an empirical scanning of the current European ecosystem of DLT projects pursuing social and public good goals. It contains a summarized version of an online database with 131 projects and an aggregated quantitative analysis of its trends and patterns. It also includes a qualitative review of ten projects to showcase heterogeneity in the field, regarding approaches to decentralisation, impacts, geographies, sectors, applications, technical and governance structures, funding models, lessons learned, and anticipatory outlooks.

3 COMPILING A DATABASE OF DLT PROJECTS FOR SOCIAL AND PUBLIC GOOD IN EUROPE

The current European ecosystem of Distributed Ledger Technology (DLT) projects on public and social good is not boundless. It is however composed of a diffuse and fast-changing set of initiatives, organisations, platforms, with varying governance models, goals, and more.

This resulted in challenges when scanning for projects, when choosing which criteria were essential when reviewing them, and ultimately when deciding which projects could be selected as potential representatives of the ecosystem in terms of what they offer, although never as potential representative examples of this universe in statistical terms. However, this also allowed us to build more than just a plain collection of projects assembled with no thorough examination. The database published with this report embodies a stewardship process of structuration and indexation where some projects were deliberately incorporated while others were not.

Following conceptual developments, like those explored in Part One on what defines DLTs in this field, plus a combination of specific analytical criteria outlined below, we compiled a database with 131 projects, from January to April 2020. This was achieved through numerous rounds of review and validation conducted on an initial sample with more than 180 projects.

> The current European ecosystem of Distributed Ledger Technology (DLT) projects on public and social good is not boundless. It is however composed of a diffuse and fast-changing set of initiatives, organisations, platforms, with varying governance models, goals, and more.

This is primarily an exploratory exercise to inform and support decision-makers, practitioners, researchers, and other relevant stakeholders, in laying down foundations for future endeavours. In addition, by this token, this is an output fully open to updates with new data on currently listed projects, or even to new projects, provided they fit our framing.

The full version of the database is published on the European Commission's Knowledge4 Policy platform as '#DLT4Good Scanning', a tool of the Competence Centre on Foresight . This report provides a summarized listing of the 131 projects with core information on each of them and a statistical analysis of overall patterns and trends related to this compilation of projects. Moreover, the current report also offers a deeper dive into ten of these projects, created via primary and secondary research with remote interviews, content analyses, and technical assessments.

Any reference to any project, or organisations, activities, products, services, and related technical, economic and governance configurations, does not constitute or imply endorsement, recommendation, or favouring of the European Commission, any of its departments, or any person acting on their behalf. Moreover, neither the database nor the deep dive into the selected projects entail a stamp of approval with quality recognition for commercial or other purposes. The European Commission takes no responsibility for any use that might be made of the information collected and presented in this report and all its derived online outputs.

This is a research overview conducted for policy advice by the JRC in collaboration with DG CONNECT and can only be interpreted as such. All data presented is made available under this assumption. All efforts were made to ensure accuracy and completeness of the information at the time of data collection and analysis for this report but no guarantee is given, nor do we warrant external elements provided by the projects, such as hyperlinks or code repositories.

3.1 Methodological outline

3.1.1 Sources for the database

Adding to the diffuse and fast-changing characteristics of this ecosystem of DLTs, another challenge was the unavailability of official, public and accessible records on the vast part of the selected projects. If the larger blockchain and DLT spaces are already characterised by an absence of extensive information on most projects and organisations, this field can take it to higher levels, for example when considering projects only supported by non-profit structures with no major commercial presence, or when looking into projects that depend mostly on extremely small communities of users and developers.

The creation of this database had to resort to different alternative data sources and other resources for this reason. On one hand, this added multiple layers of complexity in the obtention and verification of specific data. But on the other hand, it also increased the reach, diversity and robustness of the information analysed and now published.

The first entry point was secondary desk research on outputs already published in this and contiguous fields, from scientific papers to institutional reports. This was complemented by extensive primary online research, which led to a preliminary identification of projects and experts and subsequently to a snowball exploration of other information sources.

> This is primarily an exploratory exercise to inform and support decision-makers, practitioners, researchers, and other relevant stakeholders, in laying down foundations for future endeavours.

The second entry point was previously engaged experts and key informants who provided references from projects and other relevant initiatives. Research through personal networks or communication channels from collaborators in this report was also used here, including social media scanning on hashtags as #Blockchain4Good or #Blockchain4SocialGood.

The third entry point was public databases and lists already produced by researchers and practitioners within and around the field of blockchains and other DLTs for social and public good. These all had different geographical scopes, purposes or depth from ours, and often had different or non-disclosed criteria for inclusion of projects. They were mainly used for triangulation purposes regarding visibility or significance of projects, with our main sources being the EIC Horizon Prize 'Blockchains for Social Good'[18], EU Blockchain Observatory and Forum[19], Positive Blockchain[20], Ledger (H2020 Project)[21], Illinois Blockchain

18 https://www.ngi.eu/event/blockchains-for-social-good/

19 https://www.eublockchainforum.eu/initiative-map

20 https://positiveblockchain.io/

21 https://ledgerproject.eu/

Initiative[22], Blockchain for Humanity[23], Center for Biomedical Blockchain Research[24], Blockchange[25], Blockchain / Web3 Open Science Ecosystem Telegram group[26], Clean App report on Clean-[Block]-Tech[27], and the Blockchain-Unica curated list on Blockchains for social good[28].

The fourth and last entry point was an online survey designed with a similar structure to the final version of the database. This survey was open throughout four weeks to any project, organisation or initiative that wished to add themselves to our initial pool of projects for later review. Notwithstanding a wide dissemination campaign, only 21 projects replied to the survey with information enough to merit review, which we attributed both to lack of reach and to the small size of the overall universe. After the publication of this report and the online database, the survey will be reopened to additional contributions on a rolling basis so that we can update the currently listed projects and include new relevant ones[29].

3.1.2 Criteria for the selection of projects

A combination of multiple criteria determined the inclusion of the selected projects in the database. Specific projects were analysed beyond such criteria for extra validation.

First, based on our conceptual understanding of DLTs for social and public good anchored in the potential of these technologies to generate decentralisation, projects had to illustrate how this could have effects at much more than just technical levels. To the extent of our capacities to fully evaluate this point in all projects, we considered elements from supporting better governance models at internal levels, to promoting a wider or better distribution of values, resources, and other benefits to external stakeholders.

Second, projects included in this database also had to rely on a specific use of DLTs with a clear aim to positively impact social and public sectors. This meant broadly that their existence attempted to tackle at least relevant issues at local levels, and at most, to follow socially or publicly significant larger mission-driven frameworks, or yet contribute to global agendas such as the Sustainable Development Goals (SDGs).

Third, projects had to be established in one or more European countries, with special attention given to those inside the European Union (EU-27) or the European Economic Area (EEA). For all purposes, projects in the UK were still analysed in this framework as all of them were founded prior to January 2020. In the case of projects developed in countries outside Europe, we only considered those with operations also taking place in at least one European country and whose outputs have visible ocurrence in Europe.

Fourth, projects had to use DLTs with credible degrees of functionality, quality, complexity, activity, or innovation considering non-DLT solutions. This was set as a criterion to discard copycats, fakes, vaporware, or projects with non-verifiable operations. Possible criteria such as Technology Readiness Levels (TRLs) were not considered due to the limitations in scope of the project and the challenges in verifying them beyond the information each project would provide directly. Projects are in the database if they have functional software, either in proof of concept demo, pilot, or in production and live stages. Projects in whitepaper stages or projects only developed

22 https://airtable.com/universe/expsQEGKoZO2lExKK/blockchain-in-government-tracker?explore=true

23 www.b4h.world

24 https://db.biomedicalblockchain.org/companies

25 https://blockchan.ge/

26 https://hackmd.io/QTaG8S3LQAeBfnCT-EFFfQ#

27 https://medium.com/cleanapp/clean-block-tech-83a130417721

28 https://github.com/blockchain-unica/social-good

29 https://ec.europa.eu/eusurvey/runner/dlt4goodscanning

for fundraising through ICOs but abandoned afterwards have not been included. Regarding permanent activity, meaning projects not abandoned or stalled, this was bypassed in some cases where projects were particularly relevant and had a significant amount of prior development. In addition, the existence of publicly accessible and updated code repositories, such as Github, with the software developed as open source has been positively evaluated, although it was not considered an exclusion criterion.

3.1.3 Categories of the database

Below is a summarised explanation for each category used during the processes of data collection and review of the projects included in the database. The majority were created prior to the empirical exploration, while some emerged or were modified during our assessment.

In some of the categories, it was not possible to collect or generate relevant information for a significant number of projects, which led to its exclusion from the final database. Nonetheless, based on available data there was still an effort to analyse all categories in all projects, and all categories contributed to our general understanding of the field.

The following categories compose the database and constitute the basis of our analysis:

- Name: open response on official or most known designation of project;
- Description of project: open response according to information provided by the project itself in websites, documentation, or through direct contacts;
- Main sectors: multiple choice response with up to maximum of 3 options in pre-coded list of 21, as for example 'Arts, Media and Entertainment' or 'Energy, Climate and Environment';
- Application: multiple choice response with up to maximum of 3 options in pre-coded list of 38, as for example 'Asset Registry' or 'Digital Currencies / Cryptocurrencies';
- Year: numeric response on the year of the project's foundation, with focus on the introduction of DLTs if project existed previously;
- Implementing organisation: open response on the legal name of organisation(s) leading the project, or main organisation in case more than one exists;
- Type of organisation: single choice response in pre-coded list with options including 'Companies (for-profit)', 'Companies (non-profit)', 'Organisations (not companies), 'Research Institutions', 'Public Administration' or 'Consortium';
- Sub-type of organisation: single choice in pre-coded list dependant on previous response, with options including 'Startup', 'SME', 'Enterprise' in case the options 'Companies (for-profit)' or Companies (non-profit) were chosen previously; 'Foundation', 'NGO / Non-profit, 'Association' in case the option 'Organisations (not companies) was chosen previously.
- Team size: numeric response on the number of people in the core group;
- Gender diversity: numeric response on the number of women or other non-male members of the core group;
- Founders: open response on personal names of founding members according to information provided by the project itself in websites, documentation, or through direct contacts;
- Partners: open response on associate, collaborator, user or other stakeholder organisations in the project, according to information provided by the project itself in websites, documentation, or through direct contacts;
- Country/ies: single choice response on the

country or multiple countries where the project is established, or operates if more relevant;

- City: open response on the locality where physical headquarters are established, if they exist;
- Geographical reach: single choice response in pre-coded list with options including 'International', 'National', 'Local', and 'N/A'
- Expected impact: single choice response on the estimated number of people the project planned to reach, in pre-coded list with options including 'Above 1M', '100k-1M', '1k-100k', and 'Below 1k';
- Timeframe for impact: numeric response on the estimated year the project planned to reach its expected impact;
- Stage: single choice response on the current status of the project in pre-coded list with options including 'Demo', 'Pilot', and 'Live'.
- Type of DLT / Blockchain: originally multiple choice response in pre-coded list with 5 options including for example 'Existing public blockchain (eg. Bitcoin or Ethereum)' or 'Private or permissioned blockchain (whitelisted access eg. Hyperledger)', which were later modified in the review stage to 'Public', 'Private', and 'Other'.
- Name of DLT / Blockchain: open response on which DLT / Blockchain platform, protocol, or other related technical architecture is used by the project;
- Other technologies: multiple choice response with up to maximum of 3 options in pre-coded list of 16, including for example 'IoT / Smart Appliances / Wearables' or 'Virtual / Augmented Reality';
- Additional information such as: existence and accessibility of a code repository, such as Github; Repository URL, Whitepaper URL; Twitter URL; and contact email.

3.1.4 Data collection, validation and analysis

The main stages that allowed us to have a robust process to collect, validate and analyse the projects were the following:

- First, continuously searching and selecting potential projects that met the criteria.
- Second, filling in all possible categories in all possible projects with information available through the main sources already detailed.
- Third, technically assessing projects to validate functionality, quality, innovation, or more, via code repositories, white papers, or other publicly available elements.
- Fourth, reaching out directly to projects as much as possible, not only to collect primary data, but also to verify information gathered through other sources.

The steps occurred frequently in parallel, with feedback loops between them, and multiple rounds of each, which allowed for better quality control on the collected information and continuous refinement of the database until the final decision on inclusions or exclusions.

Based on publicly available information, it was possible to fill in data of 7% of the projects. In the remaining set of projects, it was necessary to establish direct communication once with 53% of the projects, twice with 32%, and three times or more with 8%. In these cases, communication was mostly done through email or telegram, but there were also projects where it was required to rely on alternative channels or personal networks.

Nevertheless, despite best efforts to reach out to projects, not all those contacted were responsive or provided the required information for their inclusion in the database. This means that a small number of projects were not included in the final database even if they apparently met criteria, due to the shortage of sufficient data for empirical verification.

3.2 Summarized database[30]

#	NAME	COUNTRY	SECTOR	APPLICATION	WEBSITE
1	**Agora**	CH	Governance; Tokenization	Voting/Elections; Software-as-a-Service; Public Records; Governance and voting;	https://agora.vote
2	**Agriledger**	UK	Agriculture and Forest-based Activities; Supply Chains and Logistics; Food and Drinks	Supply Chain Management/Trade	http://www.agriledger.io/
3	**Aidcoin**	CH	Tokenization	Digital Tokens; Financial Services/Market Infrastructure; Payments/Financial Infrastructure	https://www.aidcoin.co/
4	**Akropolis**	UK	Banking and Financial Services	Payments/Financial Infrastructure	https://akropolis.io/
5	**Alice.si**	UK	Banking and Financial Services	Financial Services/Market Infrastructure; Payments/Financial Infrastructure	https://alice.si/
6	**Ambrosus**	IE; EE; CH	Supply Chains and Logistics; Food and Drinks; Healthcare and Biotechnologies	Supply Chain Management/Trade; Disintermediation and decentralized networks	https://ambrosus.com/ https://tech.ambrosus.com/
7	**APPII**	UK	Arts, Media and Entertainment	Software-as-a-Service; Public Records	https://appii.io/
8	**Aragon**	CH	Governance; IT and Telecommunications	Governance and voting; Payments/Financial Infrastructure; Regulatory; Disintermediation and decentralized networks	https://aragon.org/
9	**Arcadia**	EE	Social Economy	Software-as-a-Service; Payments/Financial Infrastructure	https://www.arcadiablockchain.com/
10	**Auxilium**	NL	Banking and Financial Services	Financial Services/Market Infrastructure	https://auxilium.global/
11	**BetterChain**	ES	Supply Chains and Logistics; Energy, Climate and Environment	Supply Chain Management/Trade; Tracking of goods, supply chain, IoT	https://www.bcha.in/
12	**BitDegree**	LT	Education and Research	Business Formation/Licensing	https://www.bitdegree.org/
13	**Bitdust**	NL	IT and Telecommunications; Social Economy	Public Utilities; Cybersecurity; Disintermediation and decentralized networks; Self Sovereign - digital identity	https://bitdust.io

30 https://ec.europa.eu/knowledge4policy/foresight/topic/dlt4good-scanning_en

#	NAME	COUNTRY	SECTOR	APPLICATION	WEBSITE
14	**BitHope**	BG	Platform Economies and Service Sharing	Software-as-a-Service; Financial Services/Market Infrastructure	https://bithope.org/
15	**Blockchain My Art**	FR; DE	Arts, Media and Entertainment	Disintermediation and decentralized networks; Software-as-a-Service; Payments/Financial Infrastructure; Economic Development; Supply Chain Management/Trade; Digital Tokens; Disintermediation and decentralized networks; Payments and international transactions	https://www.blockchainmyart.org/
16	**Bloomio**	CH; MT; RU	Banking and Financial Services	Financial Services/Market Infrastructure	https://www.bloomio.com/
17	**Bloxberg**	DE	Education and Research	Research/Standards; Strategy/Research	https://bloxberg.org/
18	**Centrifuge**	DE	Supply Chains and Logistics	Data Marketplace/Data monetization; Supply Chain Management/Trade	https://centrifuge.io/
19	**CHOOOSE**	NO	Energy, Climate and Environment	Software-as-a-Service	https://chooose.today/
20	**Circles UBI**	DE	Social Economy; Platform Economies and Service Sharing	Digital Tokens; Payments/Financial Infrastructure	https://www.joincircles.net/
21	**Circularise**	NL	Supply Chains and Logistics	Supply Chain Management/Trade	https://www.circularise.com/
22	**CLIMATETRADE**	ES	Energy, Climate and Environment	Financial Services/Market Infrastructure; Digital Tokens	https://climatetrade.com/
23	**COIN (Coffee Source Information)**	CH; CN; SG	Supply Chains and Logistics; Raw Materials and Natural Resources; Food and Drinks	Supply Chain Management/Trade; Financial Services/Market Infrastructure	https://www.scantrust.com/
24	**CoinSence**	DE; TN	Banking and Financial Services	Data Marketplace/Data monetization; Financial Services/Market Infrastructure; Payments/Financial Infrastructure; Economic Development	http://www.coinsence.org
25	**Colendi**	CH	Banking and Financial Services	Financial Services/Market Infrastructure; Payments/Financial Infrastructure	https://www.colendi.com/
26	**Colony**	UK; KY	IT and Telecommunications	Software-as-a-Service; Supply Chain Management/Trade	https://colony.io/
27	**Com'Chain**	CH; FR	Social Economy; Energy, Climate and Environment	Digital Currencies/Cryptocurrencies; Voting/Elections; Supply Chain Management/Trade	https://com-chain.org/
28	**CommonsHood**	IT	Tokenization	Digital Tokens; Economic Development	https://www.commonshood.eu/

#	NAME	COUNTRY	SECTOR	APPLICATION	WEBSITE
29	**Content Blockchain**	NL; DE	Arts, Media and Entertainment	Supply Chain Management/Trade; Disintermediation and decentralized networks	https://content-blockchain.org/
30	**Creary**	ES	Arts, Media and Entertainment	Digital Tokens; Asset Registry	https://creaproject.io/creary/
31	**Cudo Donate**	UK	Social Economy; Platform Economies and Service Sharing	Software-as-a-Service; Loyalty Rewards	https://www.cudodonate.com/
32	**DAO IPCI**	RU	Energy, Climate and Environment	Carbon markets	https://ipci.io/
33	**DAOStack**	UK	Governance; IT and Telecommunications	Disintermediation and decentralized networks; Governance and voting	https://daostack.io/
34	**DAppNode**	ES; CH	IT and Telecommunications	Disintermediation and decentralized networks; Internet of Things; Public Utilities; New Products/Services	https://dappnode.io/
35	**Datafund**	SI	IT and Telecommunications	Data Marketplace/Data monetization; Software-as-a-Service; Identity (credentials/licenses/ attestations)	https://datafund.io/
36	**DECENT**	CH	Supply Chains and Logistics	Supply Chain Management/Trade; Disintermediation and decentralized networks; Payments/Financial Infrastructure	https://decent.ch/
37	**Decentralized Science**	ES	Education and Research	Software-as-a-Service; Research/Standards; Disintermediation and decentralized networks	https://decentralized.science/
38	**DECODE**	ES; NL	IT and Telecommunications	Internet of Things; Disintermediation and decentralized networks	https://decodeproject.eu/
39	**Decred**	N/A	Tokenization	Disintermediation and decentralized networks; Digital Tokens	https://decred.org/
40	**District0x**	SK; BG; KY	Governance; Tokenization	Governance and voting;Financial Services/Market Infrastructure;Voting/Elections	https://district0x.io
41	**Empower plastic**	NO	Energy, Climate and Environment	Tax collection/Credits; Digital Tokens	https://empower.eco/
42	**Energimine**	UK	Energy, Climate and Environment; Tokenization	Disintermediation and decentralized networks	https://energimine.com/
43	**Energy Web**	DE	Energy, Climate and Environment	Research/Standards	https://www.energyweb.org/

#	NAME	COUNTRY	SECTOR	APPLICATION	WEBSITE
44	**Etherisc**	DE; CH	Banking and Financial Services	Disintermediation and decentralized networks; Financial Services/Market Infrastructure	https://etherisc.com/
45	**EthicHub**	ES	Agriculture and Forest-based Activities; Financial Services	Financial Services/Market Infrastructure; Payments/Financial Infrastructure; Economic development	https://ethichub.com/
46	**EthKids**	NL	Other/s; Social Economy	Benefits/Entitlements/Donations	https://ethkids.io/
47	**Everledger**	UK	Supply Chains and Logistics	Supply Chain Management/Trade; Tracking of goods, supply chain, IoT	https://www.everledger.io/
48	**Evertrace**	DE	Supply Chains and Logistics	Supply Chain Management/Trade	https://www.evertrace.io/
49	**E-Women**	NL; EE; BE; UA	Governance; Education and Research; IT and Telecommunications	Governance and voting; Public Records; Strategy/Research	http://dli.websoftdev.net https://www.instingov.org/projects/e-women
50	**Exonum**	NL	Land Management and Real Estate; Retail and Consumer Goods; Supply Chains and Logistics	Supply Chain Management/Trade; Purchasing/Procurement/ Contracting; Payments and international transactions	https://exonum.com/
51	**Fairbike**	NL	Platform Economies and Service Sharing; Social Economy; Local Economy	Public Transportation; Public Utilities	https://the-incredible-machine.com/fairbike.html
52	**Fairfood**	NL	Agriculture and Forest-based Activities	Supply Chain Management/Trade; Asset Registry; Economic Development	https://fairfood.nl/en/
53	**FlexiDAO**	ES	Energy, Climate and Environment	Self Sovereign - digital identity; Software-as-a-Service	https://www.flexidao.com/
54	**Give Bytes**	UK	IT and Telecommunications; Platform Economies and Service Sharing	Data Marketplace/Data monetization; Software-as-a-Service; Economic Development	https://givebytes.com
55	**GIVE Nation**	UK	Education and Research	Digital Tokens	https://givenation.world/
56	**GivethDapp**	ES	Platform Economies and Service Sharing	Supply Chain Management/Trade; Public Utilities; Software-as-a-Service	https://giveth.io/
57	**GoHelpFund**	RO	Banking and Financial Services	Financial Services/Market Infrastructure	https://gohelpfund.com/
58	**Gradbase**	UK	Education and Research	Software-as-a-Service; Public Records	https://gradba.se/en/
59	**Grapevine World**	AT	Healthcare and Biotechnologies	Data Marketplace/Data monetization; Personal Records (Health, Financial, etc)	https://www.grapevineworld.com/ https://grapevineworldtoken.io/

#	NAME	COUNTRY	SECTOR	APPLICATION	WEBSITE
60	**Hiveonline**	DK	Banking and Financial Services	Payments/Financial Infrastructure	https://www.hivenetwork.online/
61	**Holochain**	DE; UK	Governance; IT and Telecommunications; Supply Chains and Logistics; Platform Economies and Service Sharing	Disintermediation and decentralized networks; Data Marketplace/Data monetization; Supply Chain Management/Trade; Identity (credentials/licenses/attestations)	https://holochain.org/
62	**Humaniq**	UK	Social Economy; Tokenization	Payments/Financial Infrastructure; Financial Services/Market Infrastructure	https://humaniq.com/
63	**Idbox**	UK	IT and Telecommunications	Self Sovereign - digital identity	https://www.idbox.io/
64	**Iden3**	CH; ES	IT and Telecommunications	Identity (credentials/licenses/attestations); New Products/Services; Software-as-a-Service	https://iden3.io/
65	**Imagjn**	NL	Arts, Media and Entertainment	Identity (credentials/licenses/attestations); Disintermediation and decentralized networks	https://imagjn.datafloq.com/
66	**Infrachain**	LU	Education and Research; Governance	Research/Standards; Strategy/Research; Governance and voting	https://infrachain.com/
67	**Iomob**	ES; EE	Platform Economies and Service Sharing	Software-as-a-Service; Disintermediation and decentralized networks	https://www.iomob.net/
68	**IPCHAIN**	NL	Arts, Media and Entertainment	Copyright and intellectual property protection	https://ipchain.eu/org/
69	**Iryo Network**	SI	Healthcare and Biotechnologies; Tokenization	Public Records; Identity (credentials/licenses/attestations); Digital Tokens	https://iryo.network
70	**iVoting**	PL	Governance	Governance and voting; Voting/Elections;	https://ivoting.pl/en/kontakt/
71	**Ixo**	CH	Banking and Financial Services	Financial Services/Market Infrastructure; Payments/Financial Infrastructure; Economic Development	http://ixo.foundation/
72	**Jolocom**	DE	IT and Telecommunications	Self Sovereign - digital identity; Software-as-a-Service	https://jolocom.io/
73	**Kleros**	FR	Platform Economies and Service Sharing; Tokenization	Disintermediation and decentralized networks; Law/Legal Enforcement/Courts	https://kleros.io/en/
74	**Mattereum**	UK	Arts, Media and Entertainment; Retail and Consumer Goods	Supply Chain Management/Trade; Regulatory	https://mattereum.com/

#	NAME	COUNTRY	SECTOR	APPLICATION	WEBSITE
75	**Medibloc**	UK	Healthcare and Biotechnologies	Personal Records (Health, Financial, etc); Data Marketplace/Data monetization	https://medibloc.org/en/
76	**MEDICALCHAIN**	UK	Healthcare and Biotechnologies	Identity (credentials/licenses/attestations); Personal Records (Health, Financial, etc)	https://medicalchain.com
77	**Medichain**	UK	Healthcare and Biotechnologies	Data Marketplace/Data monetization	https://medichain.online/
78	**Meditect**	FR	Healthcare and Biotechnologies; Supply Chains and Logistics	Supply Chain Management/Trade; Disintermediation and decentralized networks; Data Marketplace/Data monetization	https://www.meditect.com/
79	**Mimirium**	BG	Government and Public and Social Services; Healthcare and Biotechnologies; IT and Telecommunications	Data Marketplace/Data monetization; Software-as-a-Service; Identity (credentials/licenses/attestations); Personal Records (Health, Financial, etc); Voting/Elections; Data Marketplace/Data monetization; Cybersecurity	https://mimirium.io/
80	**Minespider**	DE; CH	Raw Materials and Natural Resources; Supply Chains and Logistics	Public Records; Supply Chain Management/Trade	https://www.minespider.com/
81	**Minexx**	UK	Raw Materials and Natural Resources; Supply Chains and Logistics	Supply Chain Management/Trade; Disintermediation and decentralized networks; Data Marketplace/Data monetization	https://minexx.co/
82	**Modum**	CH	Supply Chains and Logistics	Supply Chain Management/Trade; Internet of Things	https://modum.io/
83	**Monnaie Libre**	FR	Education and Research; Platform Economies and Service Sharing; Local Economy; Social Economy	Digital Currencies/Cryptocurrencies; Disintermediation and decentralized networks; Personal Records (Health, Financial, etc); Self Sovereign - digital identity; Strategy/Research; Governance and voting	https://axiom-team.fr
84	**Mosoly Project**	HU	Governance	Governance and voting; Disintermediation and decentralized networks	https://www.mosoly.live/
85	**MyBit**	CH	Banking and Financial Services	Financial Services/Market Infrastructure; Payments/Financial Infrastructure	https://mybit.io/
86	**NutraSign**	ES	Agriculture and Forest-based Activities; Supply Chains and Logistics	Supply Chain Management/Trade; Tracking of goods, supply chain, IoT	https://www.nutrasign.io/

#	NAME	COUNTRY	SECTOR	APPLICATION	WEBSITE
87	**ODEM**	CH	Education and Research	Data Marketplace/Data monetization	https://odem.io/
88	**Open Source University**	BG	Education and Research; Tokenization	Payments/Financial Infrastructure; Economic Development	https://os.university/
89	**OPUS**	UK	Arts, Media and Entertainment	Software-as-a-Service; Data Marketplace/Data monetization	https://www.opus.audio/
90	**OriginalMy**	EE; BR	Government and Public and Social Services; Other/s; Cybersecurity	Self Sovereign - digital identity; Cybersecurity; Governance and voting	https://originalmy.com/
91	**OriginTrail**	SI	Supply Chains and Logistics	Supply Chain Management/Trade	https://origintrail.io/
92	**Orvium**	EE	Education and Research	Research/Standards; Software-as-a-Service; Compliance/Reporting	https://orvium.io/
93	**PharmaTrace**	DE	Healthcare and Biotechnologies; Supply Chains and Logistics	Supply Chain Management/Trade; Data Marketplace/Data monetization	https://www.pharmatrace.io/
94	**Pharmeum**	UK	Healthcare and Biotechnologies	Personal Records (Health, Financial, etc); Data Marketplace/Data monetization	https://pharmeum.io/
95	**Polkadot**	DE; CH	Governance; IT and Telecommunications	Disintermediation and decentralized networks; Governance and voting	https://polkadot.network/
96	**PolloPollo**	DK	Other/s	Benefits/Entitlements/Donations	https://pollopollo.org/
97	**Prosume**	IT	Energy, Climate and Environment	General Infrastructure; Supply Chain Management/Trade	https://prosume.io
98	**Provenance**	UK	IT and Telecommunications	Supply Chain Management/Trade; Software-as-a-Service; Asset Registry	https://www.provenance.org/about
99	**PUBLIQ**	CH	Arts, Media and Entertainment	Disintermediation and decentralized networks	https://publiq.network/
100	**Pylon Network**	ES	Energy, Climate and Environment	General Infrastructure; Supply Chain Management/Trade	https://pylon-network.org/
101	**Rec (Real Economy Currency)**	ES	Social Economy; Local Economy	Economic Development; Digital Tokens	https://rec.barcelona/en/home/
102	**RIGHT MESH**	CH	IT and Telecommunications	Software-as-a-Service; New Products/Services; General Infrastructure; Public Utilities	https://www.rightmesh.io
103	**Safe Haven**	BE; SG	IT and Telecommunications	Identity (credentials/licenses/attestations); Payments/Financial Infrastructure	https://safehaven.io

#	NAME	COUNTRY	SECTOR	APPLICATION	WEBSITE
104	**Sandblock**	FR	Tokenization	Payments/Financial Infrastructure; Financial Services/Market Infrastructure	https://sandblock.io/
105	**SERATIO (CCEG)**	UK	Banking and Financial Services; Tokenization	Digital Tokens; Financial Services/Market Infrastructure; Payments/Financial Infrastructure	https://www.seratio-coins.world/
106	**Slavefreetrade**	CH	Supply Chains and Logistics; Social Economy	Supply Chain Management/Trade	https://slavefreetrade.org/
107	**Slock.it**	DE	Supply Chains and Logistics	New Products/Services; Tracking of goods, supply chain, IoT	https://slock.it/
108	**Smilo**	NL	Government and Public and Social Services; Healthcare and Biotechnologies; IT and Telecommunications	Financial Services/Market Infrastructure; Supply Chain Management/Trade; Software-as-a-Service	https://smilo.io/
109	**Solar Bankers**	CZ	Energy, Climate and Environment; Tokenization	Disintermediation and decentralized networks; Digital Tokens	https://solarbankers.com/main_block.html
110	**SolarCoin**	US	Energy, Climate and Environment	Digital Tokens; Research/Standards; Data Marketplace/Data monetization	http://solarcoin.org/
111	**Spectral**	NL	Energy, Climate and Environment	Software-as-a-Service; Data Marketplace/Data monetization; General Infrastructure	https://spectral.energy
112	**Sunchain**	FR	Energy, Climate and Environment	Public Utilities; General Infrastructure	https://www.sunchain.fr/
113	**SunCore**	IE	Banking and Financial Services; Healthcare and Biotechnologies; IT and Telecommunications; Tokenization	Public Records; Data Marketplace/Data monetization; Personal Records (Health, Financial, etc); Digital Tokens; Process digitization; Tracking of goods, supply chain, IoT	https://suncoretech.net https://suntoken.io https://wakeup.zone
114	**Synergy**	EL	IT and Telecommunications; Social Economy	Financial Services/Market Infrastructure; Economic Development; Loyalty Rewards	https://idea.synergatika.gr/
115	**TE-FOOD**	DE; HU; VN	Supply Chains and Logistics; Food and Drinks; Agriculture and Forest-based Activities	Supply Chain Management/Trade; Internet of Things; Disintermediation and decentralized networks	https://tefoodint.com/
116	**The Commons Stack**	CH	Other/s	Disintermediation and decentralized networks;	https://commonsstack.org/
117	**The Democracy Notary**	MK	Government and Public and Social Services	Public Records	https://democracynotary.org/en.html

#	NAME	COUNTRY	SECTOR	APPLICATION	WEBSITE
118	**ThreeFold Network**	BE; CH; ES; AE	IT and Telecommunications	Economic Development; Cybersecurity (Critical Infrastructure); General Infrastructure; Internet of Things	http://threefold.io/
119	**TiiQu**	UK	IT and Telecommunications	Identity (credentials/licenses/attestations); Self Sovereign - digital identity	https://tiiqu.com/
120	**Tykn**	NL	Government and Public and Social Services	Self Sovereign - digital identity; Personal Records (Health, Financial, etc)	https://tykn.tech
121	**Unbiased**	SE	Platform Economies and Service Sharing; IT and Telecommunications	Data Marketplace/Data monetization; Digital Tokens; Governance and voting	https://unbiased.cc/
122	**Uniris**	FR	Banking and Financial Services; IT and Telecommunications; Tokenization	Financial Services/Market Infrastructure; Identity (credentials/licenses/attestations); Governance and voting	https://uniris.io/
123	**Usody**	ES	Supply Chains and Logistics; Raw Materials and Natural Resources	Asset Registry; Supply Chain Management/Trade; Compliance/Reporting; Disintermediation and decentralized networks	http://www.usody.com/
124	**We Power**	LT; EE; ES; AU	Energy, Climate and Environment; Social Economy; Tokenization	Financial Services/Market Infrastructure; Supply Chain Management/Trade	https://wepower.network/
125	**Weeve**	DE	Supply Chains and Logistics; Manufacturing and Engineering Industries; Banking and Financial Services	Supply Chain Management/Trade; Internet of Things	https://weeve.network/
126	**Vidchain**	ES	IT and Telecommunications	Self Sovereign - digital identity; Disintermediation and decentralized networks	https://www.validatedid.com/vidchain/
127	**Vigicard**	FR	Healthcare and Biotechnologies	Software-as-a-Service	https://vigicard.eu/
128	**Vinturas**	NL	Supply Chains and Logistics	Supply Chain Management/Trade; Data Marketplace/Data monetization; Identity (credentials/licenses/attestations)	https://www.vinturas.com/
129	**Vocdoni**	ES	Governance	Governance and voting	https://vocdoni.io/
130	**Wordproof**	NL	Arts, Media and Entertainment	Software-as-a-Service; Identity (credentials/licenses/attestations)	https://wordproof.io/
131	**ZINC**	UK	Other/s	Public Records	https://zinc.work

3.3 Quantitative analysis

The following output is based on a statistical analysis of the database after a final review of all projects. Based on the unavailability of official, public and accessible data on the majority of selected projects, our assessment relies mainly on data provided directly or indirectly by the projects themselves through interviews or other sources. For example, 91 projects (69% of our universe) have a whitepaper or at least more or less detailed information sheets about their project with links available for public consultation. In addition, a total of 94 projects have an accessible Github (72%). But the remainder have a private repository, declared not to have one, or the information was not available through primary or secondary sources.

Whenever possible this information was triangulated not only with some of the secondary sources mentioned before, but also other external sources. This included data sets curated by third parties with commercial or investment focus, such as Crunchbase[31] or AngelList[32], data obtained via media outputs in which projects were featured, such as articles published in FT Alphaville[33], Cointelegraph[34], or Coindesk[35], or yet information obtained via public events in which projects participated, such as the finalists day of the EIC Prize on Blockchains for Social Good [36].

These results are by no means representative considering possible European and global universes of DLT initiatives targeting social and public good. They should also not be interpreted as proportional in any way in relation to larger universes of blockchain or DLT organisations, projects, applications, or use cases at large. Any major considerations or conclusions coming from this analysis are solely referring to this specific database of projects.

Overall, this is a small field that remains relatively unexplored, and there is a significant degree of analytical uncertainty that comes with it.

As much as we strived to produce the most comprehensive knowledge up to now of this field at European level, on one hand, the information amassed is still limited in scope, fragmented or overall insufficient to generate any basis for extrapolation. On the other hand, it depends highly on elements such as the qualitative features of our research with its inherent biases, flows and timings of data gathering, and criteria chosen for inclusion or exclusion of projects, etc. Nevertheless, we aim for these results to shed light on what is still an unknown territory for the most part.

The results emanate from a univariate analysis on the main frequencies in percentages, always indicating in each variable analysed the calculation base (n). Significance tests and bivariate contrasts were performed depending on the level of measurement of variables (correlations using Pearson's R, cross-tabulation using Chi2 and means contrasts using t-Student).

Some independent variables were considered for cross-analysis, and despite the low statistical significance of any contrasts, it was possible to find interesting relations in the percentage distributions. However, it was chosen not to perform any multivariate analyses considering more than two variables as no dominant or major trends warranted it.

31 https://www.crunchbase.com/

32 https://angel.co/

33 https://ftalphaville.ft.com/

34 https://cointelegraph.com/

35 https://www.coindesk.com/

36 https://www.ngi.eu/event/blockchains-for-social-good/

3.3.1 Countries, regions and geographical reach

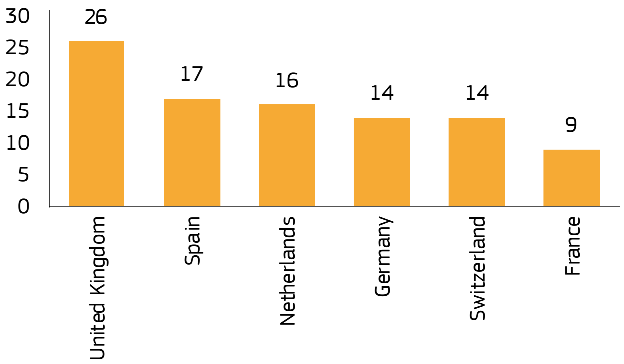


Fig. 01 - Main country of origin (N[37]=131)

All projects in the database have their main headquarters in at least one European country. But numerous projects have collaborative activities across countries, and this leads to some projects being linked to from more than one country, even outside Europe.

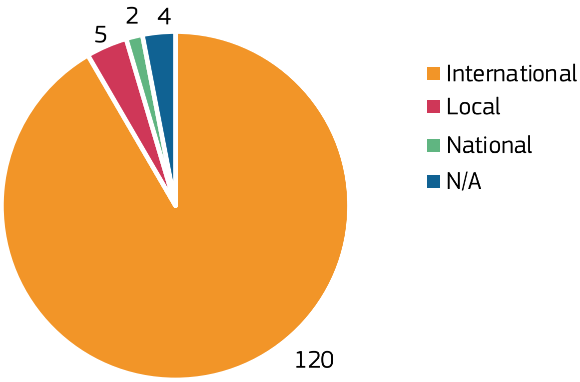


Fig. 02 - Geographical reach of the projects (N=131)

37 'N' refers to the number of cases that have been used for calculations, such as percentages, in each category. The number may be inferior to the total number of projects (131). This can happen because it was not possible to obtain data for all cases, there are variables not applied to all cases, or the number of cases can be reduced when there is a cross variable analysis. In addition, in a small number of cases, the number can be much higher than 131, as for example when all answers in multiple-choice questions are taken into consideration.

The majority of projects are developed in a single country, (78,5%), while 13% are developed in two countries, 5% in three countries, and finally 3% in four countries, and this information can be consulted for each project in the online database.

For statistical purposes, we counted the main country where the project is developed, or yet the first country the projects themselves declared in our primary research.

The main countries with the largest number of projects considered in our review are the United Kingdom 20% (26), Spain 13% (17), Netherlands 12% (16), Germany 11% (14), Switzerland 11% (14), and France 7% (9). There are 23 other countries with projects included in the database, but these only encompass 3 or less each.

The projects within the EU-27 are 66% of all projects (86), within the United Kingdom are 19% (25), and the projects in other countries are 15% (20), with Switzerland having the most as detailed before, with 11% (14).

In terms of their geographical reach, the vast majority of projects are internationally oriented (92%), with the remainder having a local (4%) or national (2%) focus.

3.3.2 Years of origin

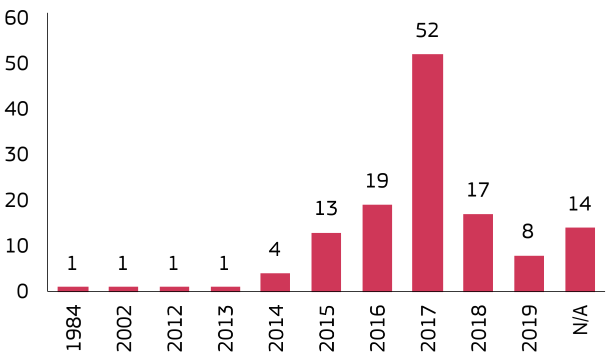


Fig. 03 - Years when projects were established (N=131)

The majority of the projects in our database have their origins in between 2016 and 2018 (68%), with special incidence in 2017

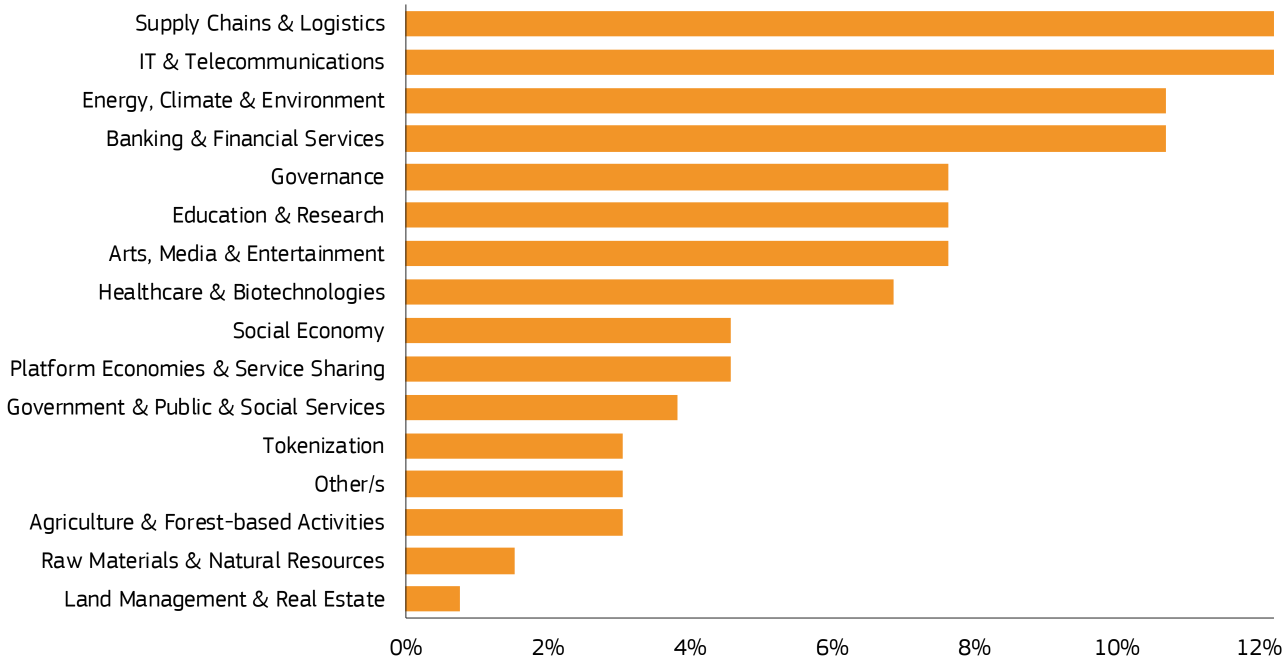


Fig. 04 - Main sectors of activity of all projects (N=131)

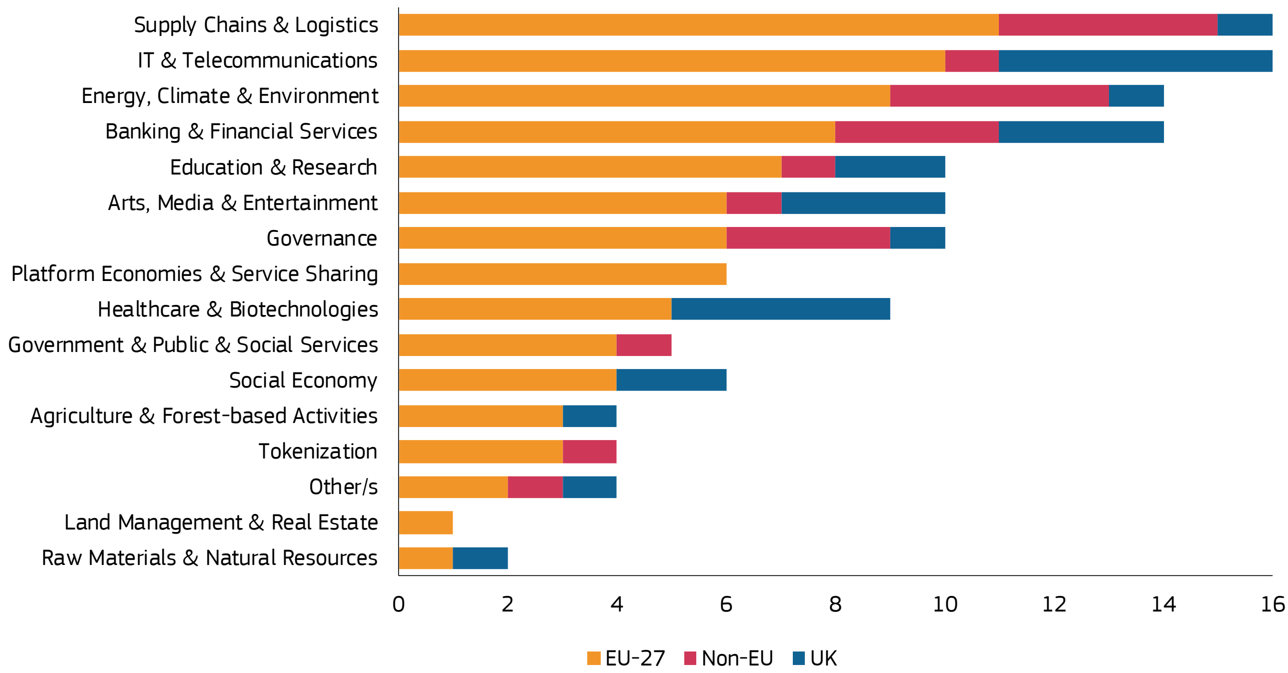


Fig. 05 - Relation between sectors of activity and region (N= 131)

(40%). Only 8 were established in 2019 (6%). Some projects adapted DLTs to some of their previously existing solutions, but there are two projects with origins even older than this set of emerging technologies, one dating to 2002 and the other back to 1984.

3.3.3 Activity sectors

Looking at the distribution of projects by main sectors of activity, we observe that in a total of 16 sectors there are 7 which account for 70% of the 131 projects in our research. Up to 3 options were possible by project, but the first response given was the one considered for statistical purposes after final data assessment. Information on the remainder of sectors for each project can be found in the online database.

The distribution by sector is of: 16 projects in 'Supply Chains and Logistics' (12%); 16 in 'IT and Telecommunications' (12%); 14 in 'Energy, Climate and Environment' (11%), 14 in 'Banking and Financial Services' (11%), 10 in 'Education and Research' (8%), 10 in 'Governance' (8%) and 10 in 'Arts, Media and Entertainment' (8%).

When crossing data between activity sectors and EU-27, UK and other countries, there are no statistically significant differences with similar concentration levels. But we can see for instance the UK with a higher volume of projects in some sectors, such as IT and Telecommunications compared to the EU and other countries. Breaking it down, our analysis shows the following.

The main sectors in EU-27 projects are 'Supply Chains and Logistics' (13%), 'IT and Telecommunications' (12%), 'Energy, Climate and Environment' (10%), 'Banking and Financial Services' (9%) and 'Education and Research' (8%). Although with lower numbers, we can also mention 'Governance' (7%) and 'Platform Economies and Service Sharing' (7%) and 'Arts, Media and Entertainment' (7%). All these sectors account for 73% of the EU-27 cases (86 in total).

The UK concentrates 76% of their total 25 projects in the 6 sectors of 'IT and Telecommunications' (20%), 'Healthcare and Biotechnologies' (16%) 'Banking and Financial Services' (12%), 'Arts, Media and Entertainment' (12%), 'Education and Research' (8%) and Social Economy (8%).

Other European countries concentrate 70% of their projects (14 in total) in the 4 sectors of 'Supply Chains and Logistics' (20%), 'Energy Climate and Environment' (20%), 'Banking and Financial Services' (15%), and 'Governance' (15%).

3.3.4 Applications

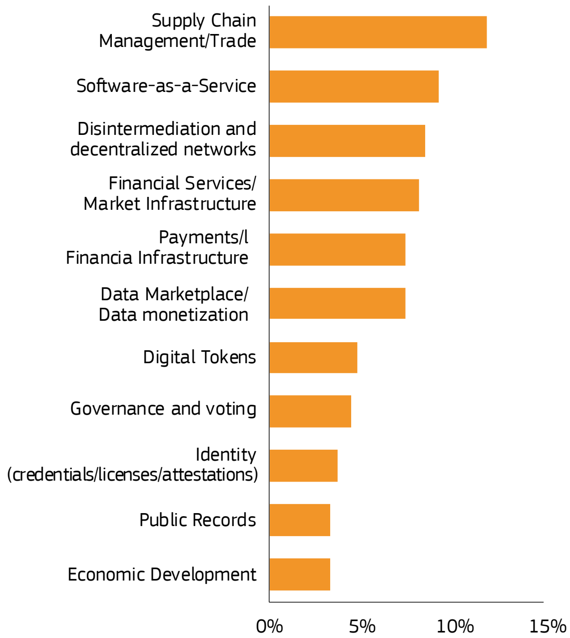


Fig. 06 - Types of applications in all projects (N=273)

In terms of applications, each project classified itself, or was classified in, up to 3 options within 38 possible applications. The first variable was not selected as the most representative, such as in the previous category, and percentages were calculated from total number of responses not projects. More information on applications for each project can be found in the online database.

After our final analysis, 11 options included 71% of the 131 projects. Supply Chain

Management / Trade' has 32 answers (12%); 'Software-as-a-Service' shows up 25 times (9%); 'Disintermediation and Decentralized Networks' and 'Financial Services / Market Infrastructure' have 23 and 22 options respectively (both 8%); 'Payments / Financial Infrastructure' and 'Data Marketplace / Data Monetization' were mentioned 20 times (both 7%); 'Digital Tokens' has 13 options selected (5%); 'Governance and Voting' is an application for 12 projects, while 'Identity (credentials / licenses / attestations) is chosen by 10 (both 4%); last, 'Public Records' and 'Economic Development' have the same number of projects, 9 (3%).

3.3.5 Types of organisation

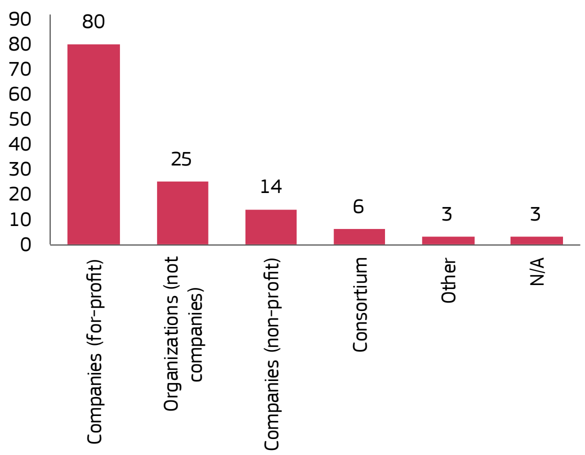


Fig. 07 - Types of organisations leading the projects (N=131)

The majority of the organisations leading the 131 projects in the database can be defined as companies (72%). 61% of the total are companies for profit and 11% are non-profit. 19% are organisations (not companies), followed by 5% in consortiums of multiple types, including research groups. There are 2% with other types of organisations with heterogeneous definitions, including one research institution.

Projects coordinated by other organisations than companies, can also have a for profit orientation. In this case, running a cross-variable analysis of all projects we can observe that 89 are working for-profit, while 36 are non-profit oriented.

3.3.6 Profit orientations by regions and sectors

In all cases, for-profit projects are more than non-profit projects. But with a closer look we find EU-27 projects being 66% for-profit projects and 28% non-profit projects, with a ratio of 7 to 3, UK projects being mostly profit oriented with 84% in this bracket, and the other countries with a more equal proportion regarding profit orientation.

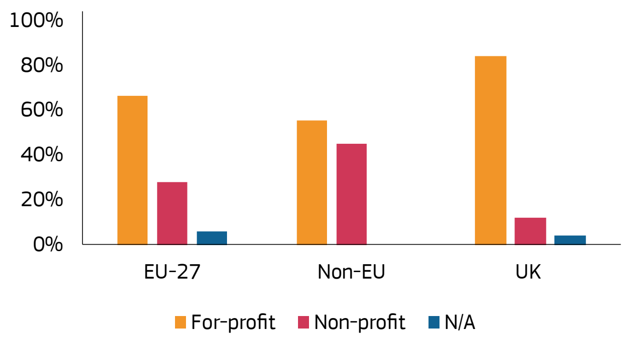


Fig. 08 - Relation between profit orientation and region (N=131)

Regarding relationships between for-profit or non-profit orientations and main sectors, we observe no statistical significance and can point out that the for-profit approach is dominant in nearly all sectors. Nonetheless, three main observations merit a note.

Sectors where for-profit projects are in the majority and there are hardly any non-profit projects are 'Energy Climate and Environment' and 'Healthcare and Biotechnologies'.

Sectors that are the most significant for having both for profit and non-profit projects are 'Supply

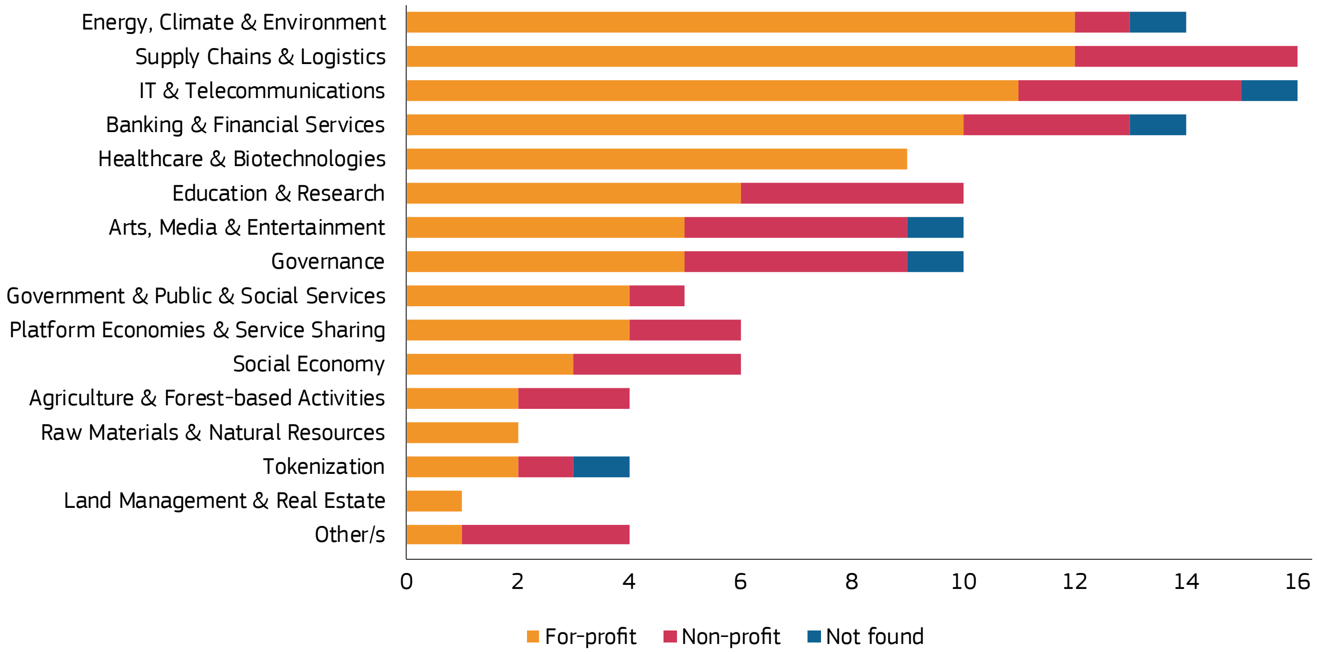


Fig. 09 - Relation between profit orientation and sectors of activity (N=131)

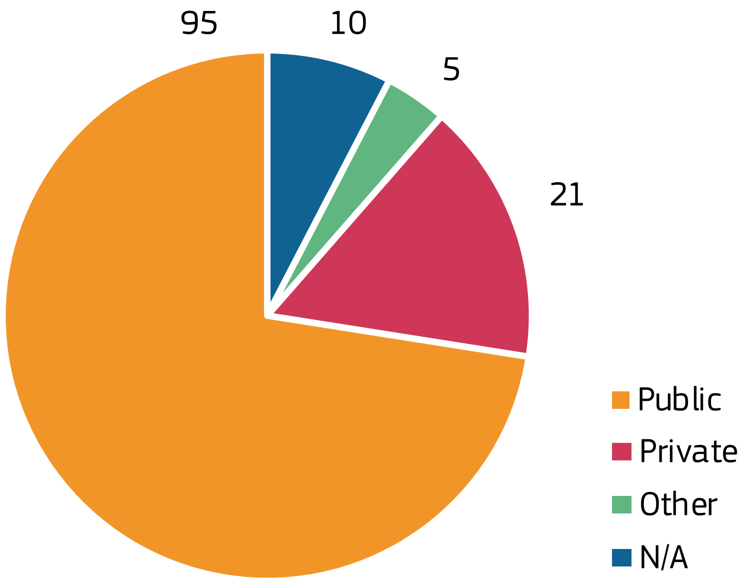


Fig. 10 - Types of DLTs / Blockchains used by the projects (N=131)

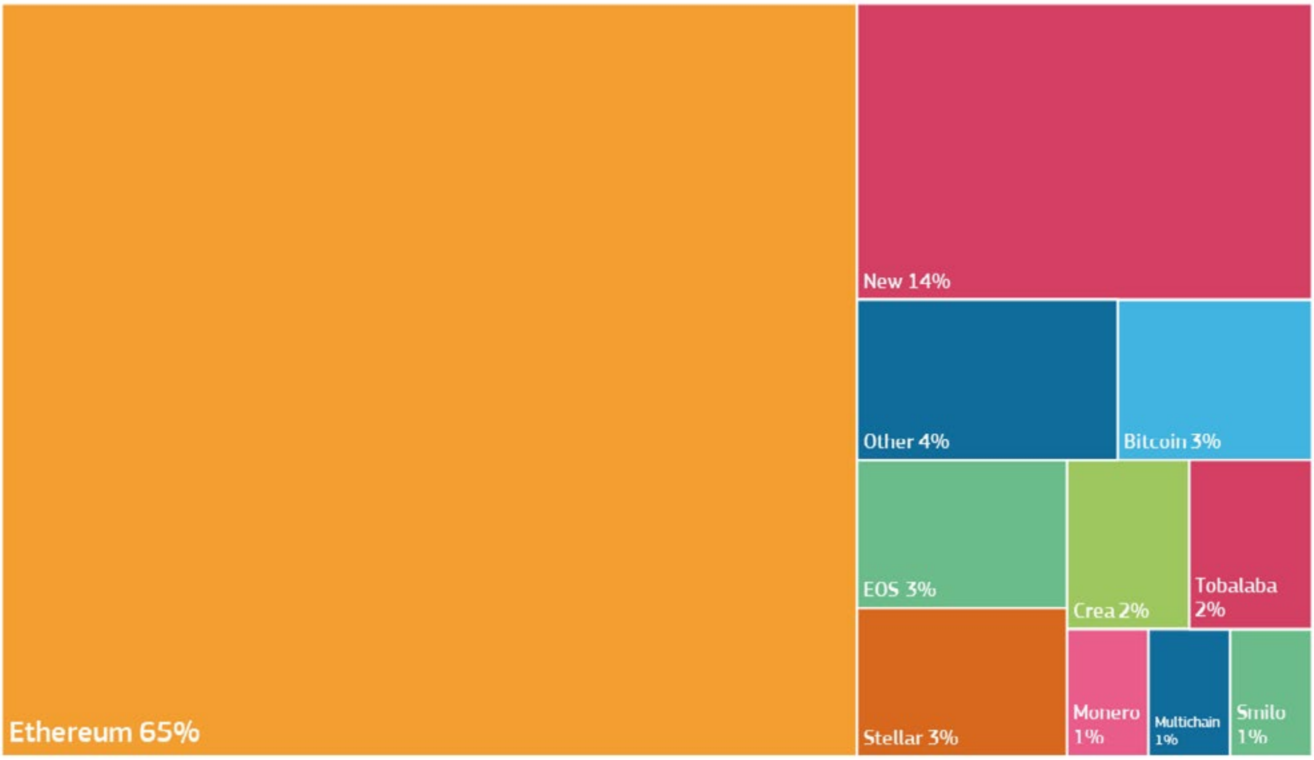


Fig. 11 - Types of public DLTs / Blockchains used by the projects (N=95)

Fig. 12 - Types of private DLTs / Blockchains used by the projects (N=21)

Chains and Logistics', 'IT and Telecommunications' and 'Banking and Financial Services'.

The most significant sectors for non-profit oriented projects are 'Governance, Education and Research', 'Social Economy', 'Government and Public Services' and 'Agriculture and Forest-based Activities'

3.3.7 Types of DLTs / Blockchains

Most projects (73%) have a well-known public blockchain, such as Ethereum. 16% have private or permissioned technology. 4% have another type of DLT, such as less popular blockchain, or their own chains or DLTs.

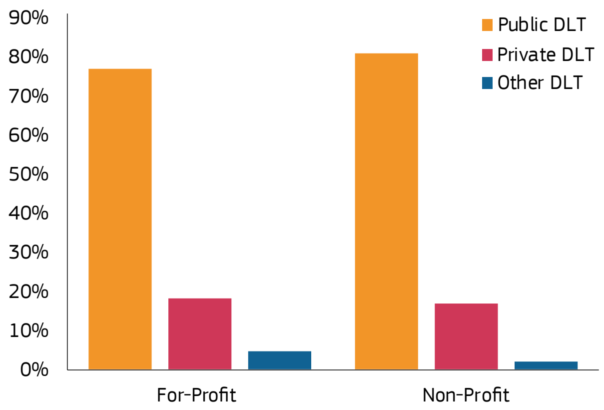


Fig. 13 - Relation between types of DLTs / Blockchains and profit orientation (N=116)

Among the projects with a well-known public DLT / blockchain (95) we find that they mostly use Ethereum (62 projects). 13 of these projects state they have a "new" blockchain, although in a majority they are essentially forks of other platforms, such as Ethereum[38]. Bitcoin, EOS and Stellar are a choice for 3 projects each. CREA and Tobalaba for 2 projects each. Monero, Multichain and Smilo have 1 project each.

Within the private DLTs / blockchains we find 21 cases: 12 use DLT Hyperledger, together with variations of public blockchains in order to adapt them to private use, such as Ethereum (5) or Bitcoin (1). Finally, other DLTs reach 3.

Both for-profit and non-profit oriented projects mostly use blockchains and public DLTs. However, it should be noted that we can observe a significantly greater use of private DLTs in projects oriented towards profit.

3.3.8 Project stages

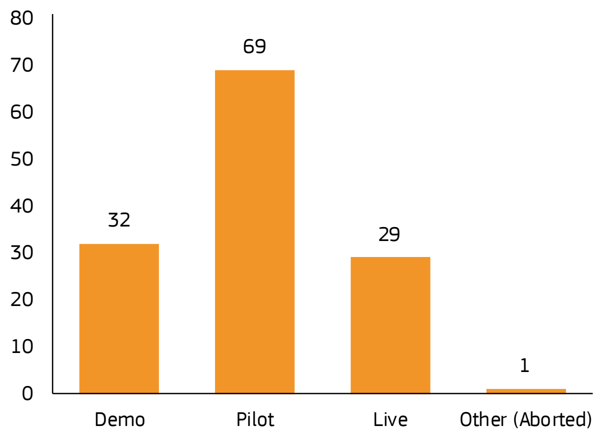


Fig. 14 - Stages of the projects (N=131)

Projects in whitepaper stages, or projects just developed for ICO launches were not included here for statistical purposes. Only projects with functional software, either in demo, pilot, or live stages have been taken into consideration.

The majority of the projects within a functional mode is in pilot stage (53%) or has at least reached the demo or equivalent proof of concept stage (24%). One in five projects (22%) has surpassed the pilot phase and was already live or in full production mode at the time of this analysis.

38 There are chains or DLTs that can be classified either as part of the Ethereum category, or with the name of their modification, which usually is the name of the project. In order to proceed with our analysis, we chose to reproduce the definition and explanations provided directly or indirectly by the projects, without further assessments on its belonging to Ethereum branches or a unique or novel class. Whenever the same denomination has obtained two scores it has been considered as a category of its own.

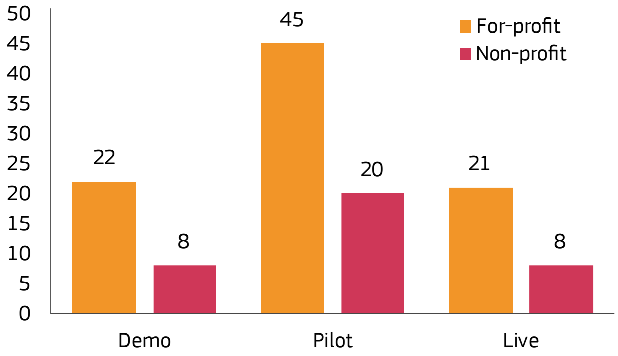


Fig. 15 - Relation between stages of the projects and profit orientation (N=124)

Considering possible relations between stages and profit orientation, we found no statistical significance. Apart from the profit oriented projects doubling the non-profit ones in all stages, there is a similar distribution, with a large number of projects in pilot stages, and almost the same proportions between demo and live.

In relation to project stages and types of blockchain, the situation is similar with minimal to absent quantitative relevance, apart from an observation on the existence of more demo projects with private DLTs (30%) than public DLTs (23%).

3.3.9 Convergence with other technologies

Fig. 16 - Convergence with or use of other technologies by the projects (N=78)

One of our departure questions was on the concrete recognition of convergence with other technologies by some of these DLT projects. We found limitations in both the reply rates to this question, and in the information we were able to collect through secondary sources. Even so, we found that in 78 projects, 47% of the answers are concentrated on 'AI / Machine Learning / Deep Learning', followed by 'IoT / Smart Appliances / Wearables' with 23%, 'Social Media / Social Networking' with 15% and 'Renewables' with 4%. In the category others with 47% we have limited data, but can highlight the use of 'Additive Manufacturing / 3D Printing', 'Virtual / Augmented Reality', or Robotics / Physical Automation'.

3.3.10 Workforce and gender composition

Within a sample with numerous projects based on fluid communities or collaborative efforts with sporadic, informal, or no contractual bonds, it is somewhat difficult to gather quantitative data on elements such as workforce or its gender composition.

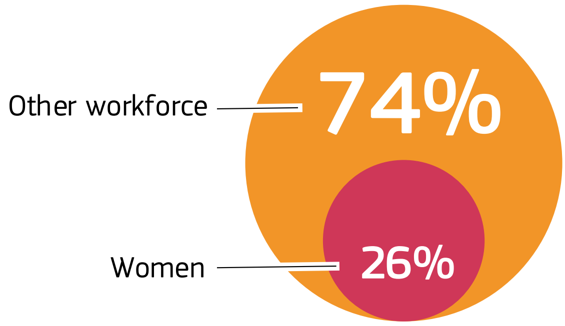


Fig. 17 - Relation between number of women and rest of workforce in projects (N=103)

Even so, with information gathered from 103 projects, we observed the following distribution of workers or core team members per project. 14 projects have 1 to 4 workers or team members, 44 projects have 5 to 9, 29 projects have 10 to 19, 11 projects show a workforce of 20 to 49 people, 3 projects have from 50 to 99 workers or team members, and 1 project has from 100 to 199, while another has more than 200. This generates an average of 14.6 workers or team members per project.

In terms of gender composition, of the 104 projects where information was provided or available on this category, 88 have female workers. In the EU we observed an average of 2.4, in the UK 3.0, and in the other countries, 3.7 women per project.

3.3.11 Expected impacts

The inclusion of this topic in our data collection and analysis presupposed a certain level of complexity and subjectivity. On one hand, it is inherently difficult to estimate the impact of emerging technologies, in particular those that are still in demo or pilot stages for the most part. On the other hand, this is a forward-looking topic attached to the ambitions each project has, and beyond any models or forecasts, this depends highly on the anticipatory capacity of the subjects working within the projects. On top, all of the answers provided are shots in time and are fully subject to change due to internal developments of the project or external and conjectural circumstances.

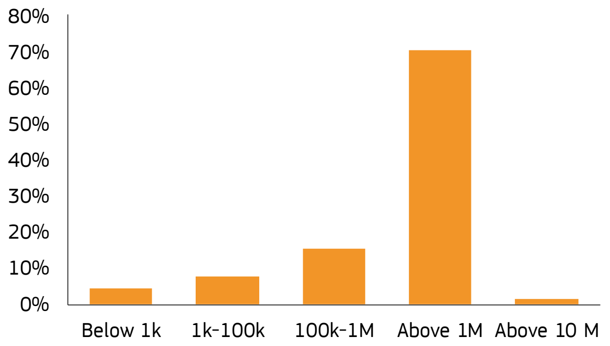


Fig. 18 - Number of people the projects estimate to reach (N=65)

Our review was mainly qualitative and based on information directly provided by the projects, with no secondary sources used for verification of plausibility. All average and discrete values were added up and the resulting values divided by the total number of cases with valid answers to obtain estimated averages for each.

A possible measurement to evaluate perceptions on expected impact concerns the number of people each project believes it will reach at full capacity, even if a large part is still in demo or pilot stages. Only 65 projects provided an answer in this category, with an average expected reach of 942,331 people. The highest frequency of answers falls in between 71% of the projects pointing to a scope more than 1 million people and 15% to a scope between 100 thousand and 1 million people. This offers us at minimum an estimation of a collective perceived potential, not only on the projects, but also of DLTs applied to this field, as observed by these projects.

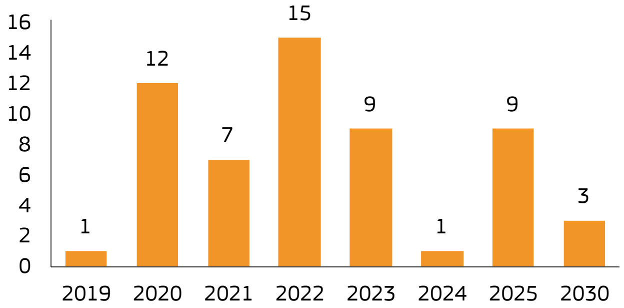


Fig. 19 - Expected timeframe to reach maximum impact (N=57)

A key dimension we also wanted to observe in terms of perceptions on impact was the expected timeframe to reach it, with a starting point in 2019. Once more, the reply rate to this question was low with information provided by only 44% of the full sample of projects. Average ranges were calculated based on more detailed replies, and according to their own prospects, a vast portion of the projects expect results in at least 5 years. The majority (59%) foresees reaching estimated impact up and until, while 34% of the projects point to up until 2025. Finally, there are three projects that envisage 2030 as the time by which they will reach their goals, and one project that considers it has reached its expected impact already in 2019.

4 TEN DIVERSE PROJECTS UNDER A CLOSER LENS

Based on the broad range of projects present in the database, and on the challenge to showcase some of their most particular traits through this kind of indexation, we opted to approach ten of these projects with a closer lens. Similarly to the database, this smaller sample of projects should not be seen as representative of any larger universe, and neither should their main characteristics be interpreted as proportional to the database itself.

The ten projects are Polkadot (#095), Creary (#030), Pylon Network (#100), Alice (#005), Bloxberg (#017), Holochain (#061), Com'Chain (#027), Wordproof (#130), Giveth (#056), and Origin Trail (#091).

Our main purpose with their selection and their deeper exploration is above all else to depict the diversity in this field considering intersections with social and public good, general goals and origins, funding models, governance structures, technical structures, and even diversity in lessons learned and their considerations for the future.

To ensure this smaller set of projects was as diverse and as comprehensive as possible we grounded our decision processes in the following qualitative sampling criteria:

- Diversity in focus and solutions of the projects, considering both their approaches to decentralisation and ways to positively impact the social and public good;
- Diversity in terms of geographical implementation and reach of the projects, mostly at European level but also considering other potential territories;
- Diversity in sectors, applications, implementation and funding models, with special focus on originality of main use cases from commercial to research spheres;
- Diversity in blockchain or DLT platforms and development stages, although looking for technological robustness consolidated by significant milestones;
- Diversity in communities and pathways for engagement, prioritizing open source, horizontal, participatory or gender-inclusive frameworks.

Our research on these projects relied simultaneously on interviews conducted remotely, content analyses, and technical assessments. All the streams were kick-started during the data collection and analysis for the database but continued beyond its completion.

In the first stream, an open script was created for the interviews with all projects, and then adapted according to each project. In the second stream, secondary research was performed on relevant documentation and media made available by the projects or published by other sources. The third stream relied partially on data obtained through the interviews but also depended on an assessment of specific structures and code elements each project has publicly available in their repositories or has granted us access to them.

The resulted in ten deep dives published in the next section with an analytical synthesis of topics that run across all projects. This aims to provide summarized and accessible information on each project and their diversity in several analytical dimensions. Nevertheless, this is also a way to facilitate a collective exploration of the projects whenever possible or appropriate.

Given the qualitative attributes of our sample, it was decided not to conduct a structured comparative analysis, even when identifying commonalities or trends among some or all projects. However, there are still various hints that we can extract from this exercise when grouping them. The ten fiches can and should be read separately to capture the diversity of the projects. What we offer here are cross-references for a possible combined reading.

4.1 A possible combined reading

4.1.1 Goals and intersections with social and public good

Relating to goals and intersections of the projects with social and public good, we can

> DLTs emerge in all these projects as opportunity to counter centralisation, and to bring changes to technological architectures and governance or economic models, incorporating values linked with the commons, autonomy, openness, privacy, data protection, and more.

highlight as a general point their shared criticism of current network structures and the centralization these structures embody at multiple levels. DLTs emerge in all of them as an opportunity to counter it through organisational to financial experiments, and to bring changes to technological architectures and governance or economic models, incorporating values linked with the commons, autonomy, openness, privacy, data protection, and more.

These projects have different positions between radical complete transformations and improvement or reform of current network structures. But analytically they all seem to value positively both the means and ends enabled by DLTS to achieve their main goals through the use of these technologies.

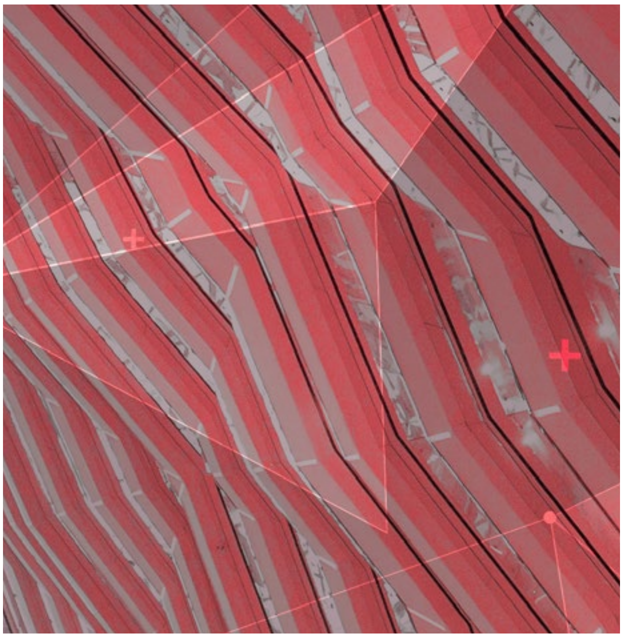
Amongst the ten projects, we have large scope projects that aspire to transform society as a whole via decentralized solutions, projects that want to create a new decentralized internet with novel applications, or yet to transform energy systems while empowering communities. We have projects that operate with a more focused approach to guarantee data integrity through copyright and fight against misinformation, or projects that aim to improve relationships and value distribution in cultural and research sectors by empowering creators and scientists with new tools. We have projects that focus on particular issues such as donations, with initiatives to ensure control mechanisms via smart contracts, or others that want to generate new economies with new benefits assigned to the acts of donating. Moreover, we have projects on the ground investing in the improvement of communities of producers and consumers, aiming to boost social and local markets via social currency mechanisms, or providing solutions to ensure local traceability of products and the information associated with their exchanges.

4.1.2 Organisational origins and gender diversity

When looking at the starting points of these ten projects, they can be divided by those that emerged already within the specific field of DLTs, and those that adopted previously existing solutions to include DLTs in general, or specific DLT properties that fulfil their goals. Some projects are created by organisations that already worked in technical fields and embraced DLTs as an opportunity, some by entirely new organisations or consortiums, and others have emerged from informal groups that started DLT structures to work on new solutions for common problems.

A special note is merited here on the gender diversity of these organisations, as it seems to constitute a deficit in the majority of projects, despite some sensitivity and openness to the topic revealed in the interviews. Technological domains are still largely male-dominated, and the spaces of blockchains and other DLTs are not immune to this, this smaller space dedicated to positive impacts on the social and public good alike. We found that project founders and coordinators were overwhelmingly male, and it was only possible to interview two women in the projects. Moreover, development communities are also largely male, a trend that equally seems to occur in user communities, although this is impossible to verify empirically beyond what is captured in the interviews as the projects have more or less fluid communities and do not register this type of personal data.

Governance is essential for any DLT initiative and here it emerges connected with specific models of community building or engagement, from plain vertical transmission channels to new participatory platforms that should be able to sustain organisational overhauls.



4.1.3 Funding models

Assess to funds in these projects, expectations and needs are diverse and highly dependent on financial and technical maturity, but all projects are relatively successful with access to their own capital, to external investors, or to other financial resources as ICOs. This allowed them to sustain activity until now, even if one project relies mainly on voluntary work, and other projects are not yet profitable or do not have that ambition. When looking into business models we find common points in these projects for instance when some offer their technology as a service or charge for specific network transactions. But perhaps the most relevant point is when projects rely on a blend of profit and not-for-profit activities, meaning a separation between operations with revenue from technical development and those without, with the first funding the second and often supporting the open source choices.

4.1.4 Governance structures

Governance is essential for any DLT initiative and here it emerges connected with specific models of community building or engagement, from plain vertical transmission channels to new participatory platforms that should be able to sustain organisational overhauls.

All projects have communities, such as managers, workers, developers, users, beneficiaries, or even investors or speculators in some cases, as governance stakeholders. In some projects, this means top-down relations with reduced participation of stakeholders in technical or management processes. But we see trends towards more horizontal forms of involvement in the majority of projects, with assemblies, online meetings through Telegram and Discord, or tools such as Loomio, and also wider roles and voting powers, linked to financial or technical capitals. Moreover, there are also more complex models with codified mechanisms through which decision powers are allocated, and how these can be exercised or delegated runs on the DLT through tokenized processes and smart contracts.

4.1.5 Technical architectures

In terms of DLTs or blockchains used, we note a prevalence of Ethereum-based structures, together with so-called agnostic blockchains or even new DLT platforms and protocols. This is often signalled by the projects as influencing their forms of participation and governance, as some of these DLTs or blockchains, as Ethereum, provide more possibilities connected to smart contracts and wider or more engaged communities. On the other hand, motives such as the need for scalability or overcoming the large amounts of energy involved in DLTs such as Bitcoin or Ethereum itself, led some projects to build their own solutions. A trend worth noticing here is the existence of projects that embrace direct connection or integration with different blockchains and DLTs, not only for interoperability but also for broader outreach and impact of the project itself. On a more extreme end of the spectrum, we also have one specific project where the main argument for its existence is specifically tied to the search for completely alternative DLT protocols aimed at total internet decentralisation through an interconnected system of applications where all contain their own rules.

The ways tokens are used within these projects are diverse, and it ranges between their existence as a form of initial financing through crowdfunding such as ICO, as a gatekeeping and anti-spam measure with a minimum value aimed at preventing fraudulent operations, to having it as a reward for community involvement.

Looking at GDPR compliance, to remark this still intricate issue in the world of DLTs, one finds different approaches that these projects take to address it. In some of them, there is an intentional effort not to collect any personal data, and in others, this data is not stored at all in the project's blockchains or DLTs but instead in higher layers so that public data exists elsewhere in the network. In others yet, DLTs are permissioned with limited access rights and allegedly comply with EU data protection regulations.

4.1.6 Lessons learned and future scenarios

Last but not least, our combined reading of some lessons learned by these projects brings us to shared spaces where communities of users and others are as important as the internal organisation. Furthermore, some of their thoughts on the future highlights shared visions of a better tomorrow, not only for the projects through the realization of their organisational objectives but also for the fields of social and public good with impacts on several societal domains, all enabled by the decentralizing powers their DLTs embody.

In the lessons learnt, we find better engagement and commitment strategies regarding users and other beneficiaries, with highlights on early relationships and deeper interactions to counter some adoption challenges. But we can further capture general learnings regarding internal workings of the projects, such as the need for full commitments to open source models from the beginning, or the necessity for the establishment of adequate collaboration and interoperability structures.

As regards best future scenarios, we observe commonalities around the desire for the widespread adoption of DLTs leading to high levels of individual empowerment, obtained through more transparent and open networks, better control over data structures, or yet the full transference of DLT governance and outputs to communities at large. This is taken to a next level by some of these projects with larger ambitions to create new social and economic patterns of organisation, extraction and distribution of value. DLTs emerge in their view as structures that could replace centralized and hierarchical network formations and major players that currently dominate the internet, and above all as autonomous and common structures in which to build more just and fair social systems by inherence.

4.2.1 POLKADOT (#095)

https://polkadot.network/

Polkadot.

Polkadot plans to enable a new web where users are in control and individual sovereignty is prioritized over centralized control. It is built to connect private and consortium chains, public and permissionless networks, and future technologies yet to be created. It aims to facilitate an internet where multiple DLTs can exchange information and transactions in a trustless way, and make it easier to create and connect decentralized applications, services, and institutions.

ORGANISATION	HEADQUARTERS	ESTABLISHED	GENDER COMPOSITION
Non-profit. Startup (Parity Technologies). Foundation (Web3 Foundation)	Germany (Berlin) and Switzerland (Zug)	2018	27 women in a group of approximately 200 people

Overview and goals

Polkadot is presented as a next-generation blockchain platform that will connect multiple DLTs into one unified network, enabling interoperability between them regardless of features or permissions. It can be considered a set of independent chains, containing Ethereum, Bitcoin or other DLTs in itself, and allowing multiple protocols to communicate with each other to build a more comprehensive and inclusive web. As they claim, if blockchains are to enable a better internet for everyone, they have to talk to each other in what is deemed by Polkadot to be a Web 3.0.

Their interoperability should allow any actor to take public or private chains and link them with a shared connectivity layer, whether deciding to maintain their original validation systems or rely on a new pooled security system. It should also support trust-free interchain transactability for diverse chains to deal with all kinds of assets in the same system, from text messaging to the exchange of value and resources.

Polkadot declares itself heterogeneous and flexible as it claims to make no assumptions on nature or structure of chains. Even non-blockchain systems or data structures may be hosted and become parallelized chains if they fulfil criteria.

Final users of Polkadot are currently developers that want to build better solutions on top of a large universe of blockchains or other DLTs. But the end beneficiaries should be users of the internet at large, given the potential for new decentralized services that can return ownership and governance of data to individuals or communities. According to Polkadot, this will happen over larger organisations that force reliance on what is now a broken internet where they can violate trust.

Intersections with social and public good

Polkadot's main purpose is stated as resetting interactions and economic incentives of the internet, and giving people tools that are inherently attached to the pursuit of social good. The project expresses its intentions to press restart in the current internet so that they can provide the infrastructure to build a new one which anyone can trust.

The scalability and interconnectivity of their proposal could ultimately mean that all possibilities of one DLT can be leveraged by another DLT and lead to sharing and decentralisation levels never observed before. Moreover, the project is thought to release network control to the community, and these effects could transpire to places where innovation for one becomes innovation for many, if a strong focus on fairness is placed beyond technical dimensions.

How it started

Gavin Wood, the founder of Polkadot, wrote the Polkadot white paper in 2016, which prompted a bigger group to be involved.

He left the Ethereum Foundation, after having co-founded it, to found Parity Technologies, and him, Peter Czaban, now Technology Director of the Web3 Foundation, and Robert Habermeier, a Thiel Fellow, launched a model for a sharded blockchain to allow several chains to be connected in a single network.

The research, development and roadmap were done by Wood, Web 3 Foundation and Parity Technologies. The project as it exists now came to light in July 2019. The Web3 Foundation began running the initial nodes that are now live and stable.

Funding models

Polkadot held an initial crowdsale (ICO) and there have also been some public and private token sales. Parity Technologies supports part of Polkadot and has a wide range of commercial clients.

The other supporter, the Web 3 Foundation has a grant program where teams around the world apply to deliver core components for Polkadot. Parity Technology has been contracted to build the core of the code. More than 60 projects have received $4.4 million from the Web3 Foundation to build their solutions on the Polkadot blockchain.

There is a Polkadot Ecosystem Fund operating with the support of Polychain Capital, and Polkadot has its own digital economy. The idea is that in the future it will have its own community treasury. Someone, using his Polkadot account, will make a proposal to the treasury stating their needs and the developing proposal, and then all parties can vote.

Governance structures

Polkadot has a tricameral governance model that is housed on the blockchain and relies on holding of DOT tokens. People vote for council members, for the technical committee and on proposals, and topics such as network upgrades can be proposed and voted on All DOT holders can vote for proposals, council members, and the technical committee.

The Council has between 12 and 24 seats and is voted by the entire community of DOT holders. Non-contentious obvious upgrades can be moved forward by the council managing the proposals on topics like treasury or upgrades. The council rotates on a regular basis, and anyone can be part of it.

The technical committee is a body mainly composed of developers and researchers with technical competence on the Polkadot protocols. A combination of a majority vote of the technical committee and the council can fast track an upgrade in order to provide a quick fix within Polkadot. There will be other supportive governance entities like an oracle committee.

For Polkadot, governance is about decision-making processes and how to codify such decision-making processes, formalised discussion, stakeholders voting, etc. In their perspective, blockchains are social coordination tools and the governance they build is indicative of what they propose at large. Also, according to them, not having structured governance is sometimes seen as decentralisation, but in reality, it is often a construction that can serve to maintain a few people in control.

Technical configurations

Polkadot relies on a new blockchain designed from the ground up named Substrate and associated with Parity. It is public and permissionless, but a private permissioned network can be built on top, for example for the healthcare data of a hospital.

The main technical challenges in the blockchain are interoperability, scalability and governance. Polkadot has solved scalability. Regarding interoperability, Polkadot has taken a big step with the parachain bridge architecture.

The DOT token is critically important for the operation of the network, with four main functions.

First, it is used for security. Validators have to stake DOTs in order to run their nodes, to get rewards and if they misbehave their DOTs get removed.

Second, it is important for the funding of the network. In order to deploy what is called the parachain on Polkadot, the shards are heterogeneous, thus highly customizable and connected through a process called bonding. People require DOTs to participate in a parachain auction, and those who win a parachain auction, use those DOTs to participate in the validation and get rewards.

The third use is interoperability and message passing, to send a message from one parachain to another or to another network. It is charged with a fee (this point is under discussion, but the fee still exists).

The fourth function is governance, as participants in the network can use DOTs to let their voice be heard. Having tokens means voting power. But there are also ways to empower the voices of minority groups. Timelock voting avoids the vote-buying issue.

Thinking about the future

As learning, Polkadot manifests a will to observe less tribalism in the blockchain world.

As best future scenario, they would like the project to be well received and recognized, delivering tools that allow the building of a more just and fair internet. They also wish to provide a key historical step towards the future of a Web 3.0. According to them, this is a crucial moment to get us to a point where “network systems work for us instead of us working for them”, implying that democratization of the internet means democratization of social systems at large.

4.2.2 CREARY (#03)

https://creaproject.io/creary/

Creary is a decentralized social network of creative portfolios on the blockchain that rewards creatives and curators. In Creary, authors can register the copyright of a creation and distribute their work directly to their fans, share creative works and rewards. Content can be sold directly to followers without intermediaries or commissions, with an algorithm distributing tokens constantly to authors and curators as rewards according to the vote of all users in the community.

ORGANISATION	HEADQUARTERS	ESTABLISHED	GENDER COMPOSITION
Non-profit. Foundation (Creativechain).	Spain (Barcelona)	2016	1 woman co-founder in a core group of 12 people.

Overview and goals

Creary is defined as a 3.0 social media portfolio network on a new blockchain technology which attributes rewards to users that share their digital creations with the community. It is built on the CREA Network blockchain, an open source network specially designed for the creation of decentralized applications and social networks of digital content on the blockchain.

The project instigates authors and curators alike to publish their work and make their community of followers grow, but also to follow other creators in the network to earn rewards in digital tokens getting votes from the community. It is both a P2P social network and a marketplace in this sense, where users can post, comment, give likes, and also sell their work.

According to Creary, anyone can post digital content and be rewarded for their work based on votes received from the community. The reward distribution system is governed by the community itself, and any user can vote freely and in real-time on how they want the development of the network to evolve.

The Creary rewards are made with the platform's own token called CREA, which can be converted into any other currency, be it digital or fiat. An algorithm distributes the tokens according to the vote of all users in the community. Anyone that creates interaction in the network can be rewarded. All users have wallets which they can use to manage earnings inside the platform, and with which they can sell and change their tokens, or even transfer them to other users.

Creary seems to offer a public and transparent alternative of intellectual property registration, with a blockchain platform that automatically creates incorruptible timestamps. The network then issues a certificate of authorship and a distribution license for any digital work, with different options suited to frameworks such as creative commons licenses which they offer upfront. This feature is designed to protect the work of artists, designers, and multimedia creatives who share on the platform, and can ultimately be used as evidence in conflict resolution around intellectual property or other disputes.

Intersections with social and public good

Their decentralized ecosystem has been designed to distribute power and resources among all users, who are the ones who add value to the community. Their aim is to become one of the largest networks of this type to empower creators and avoid traditional data use such as personal information mining and misuse attached to most conventional social networks.

In decentralizing this space for the exchange of digital goods, Creary also provides tools for creative actors who may have difficulties accessing financial resources through other means, so they can have the possibility to monetize their creativity and participate in a community-based economy with fewer restrictions.

How it started

Creary began as a common interest in a group of friends active within the arts sector. They believed this sector is dominated by intermediaries who decide, control and research data of users under abusive conditions. This group was also in the Bitcoin world, so they realized blockchain or other DLT technologies could address the problem of trust and content distribution.

The three co-founders engaged developers to create the blockchain and the platform Creary. They were inspired by Steemit, which is a blogging network.

The final phase of the project has been achieved and now it is a matter of scalability. In the past year since launching their Beta version, the project team and the community have used the network in a real environment, detecting potential spaces for improvement and also some additional user needs. They are currently working on the next stage and functionalities.

Funding models

This project has been financed by contributions, donations, and a small crowdfunding system up until now. Recently Creary has also been interested in applying for external funding such as grants, or to partner up with other entities. In addition, generating revenue through the creation of challenges for network users is a possibility.

Different products are offered by Creary to achieve self-sufficiency, such as technology audits, and they also provide solutions to other projects that want to be connected with Creary. The expectations of the technology are growing, not only in financial self-sufficiency. They will look for external financial partners to achieve the technology they want.

Governance structures

Two types of groups compose Creary's ecosystem: developers and users, which are typically artists and curators. They have 18.000 users, but the number of users seems to be growing and they will try to reach 100.000 users by the end of 2020.

An algorithm called Delegated Proof of Stake (DPOS) is used. Users vote for the proposals of developers. The developers are in terms of governance classified as witnesses. There are no miners as the blocks are created by the witnesses.

Witnesses can decide on the control of the network in terms of code, as they issue the block and decide which is the best option on how the network has to be developed. The witnesses are not fixed, they vary quite often depending on the votes, and only the 20 most voted take part in the decisions and how the network evolves. Witnesses make proposals to the rest of the community. The other way around, in the case users (artists, curators, others) want the network to be developed, they need to make a proposal to a witness already elected by the community.

The system does not follow the rule 1 user equals 1 vote, but 1 user equals 1 witness of nodes, through voting. Creascan.net is the block explorer where anything can be verified, from votes to donations, with full transparency for the community.

Technical configurations

Creary runs a new blockchain and after having started with a Proof of Work protocol, they recently changed the protocol into Delegated Proof of Stake (DPOS). The change of protocol was relatively easy according to their team, as the community was already used to it because of using other platforms such as Steemit.

DPOS is presented as fairer for the community, as it allows everyone to take part in decisions. Richer nodes, those with more tokens, do not have more voting power. People can choose witnesses that represent their vote.

This protocol is also presented as faster for transactions. They have 1000 transactions/interactions per second, including data, tokens, likes, comments etc. Data and metadata are stored in the blockchain. But content such as designs or videos is stored in an IPFS file storage system.

CREA is the main unit of accounts in the Creary blockchain. The number of CREA tokens is infinite as they are not a pre-issued token. All other tokens gain their value from this main asset. CREA is a liquid currency, and it works like Bitcoin (BTC) or any cryptocurrency, so it can be traded in exchanges, sent to other users or directly used as a payment method.

Users can be rewarded tokens for activity in the platform: such as publishing content, being a witness node, holding coins in the wallet and getting a percentage of interest, and participating in the social platform. In addition to the CREA tokens, there are also CREA Dollars and CREA Energy. Tokens can be used to buy digital goods inside the platform.

There are no fees in the network, and tokens can be bought or earned by interacting in the network. There is nonetheless a promotion section where users can put their work on the top of a list to get more visibility, but this ‘costs’ tokens.

Thinking about the future

Their main lesson would be to start using Delegated Proof of Stake (DPOS) protocol from the beginning so that their network had a different ground from the beginning.

The best future scenario for Creary is that all users of centralized networks migrate to decentralized ones because they understand the benefits and are empowered users. They would like to create a network of decentralized networks, not only for creative sectors, always using open source public technologies.

4.2.3 PYLON NETWORK (#100)

https://pylon-network.org/

Pylon Network has developed a neutral database based on blockchain technology where energy data, like consumption and production, from energy market stakeholders, are stored and shared. Pylon Network database allows the user as data owner to be in control and decide who they share their energy data with, hence actively participating in the market.

ORGANISATION	HEADQUARTERS	ESTABLISHED	GENDER COMPOSITION
For-profit. Startup.	Spain (Benicarló)	2015	1 woman in a core group of 10 people.

Overview and goals

The Pylon Network database stores and shares energy data such as consumption and production volumes. This database allows users to remain the owner of their energy data and to take part in the market on a different stakeholder level, as well as to keep control over who their data is shared with.

Their proposal implies that consumers, prosumers or producers as individual actors or communities can decide how their information is used. They can also choose which third-parties, such as energy service companies or other energy retailers, can access this information and offer back digital services, leading to direct savings, better energy management, and other gains.

This idea comes attached to the concept of data neutrality, which under Pylon's rationale can play the role of enabler for a new level of innovation and competition capacity in the energy markets from the moment it promotes unlocking of data.

The blockchain developed for the Pylon Network became available as one of the first DLTs designed to decentralise the energy sector not only from a technical perspective. Their investment in a fully open source protocol seems to bring also added value to an overall decentralisation of the market, from economic to governance dimensions.

They aim to tackle lack of communication between stakeholders through open source, which among other challenges results in unequal access to data, and generates a lack of trust not suited for cooperation between different actors such as cooperatives or municipalities. This should generate benefits for a wide set of stakeholders, from consumers to producers, with Pylon claiming it as both a strategy and a statement for fast and scalable adoption of smart sustainable technologies.

Intersections with social and public good

The framework proposed allows local communities to participate in the energy system and creates a path to avoid leaving them behind when it comes to the energy transition, in what Pylon defines as a fast-evolving era of decentralisation, digitalization, customer engagement and transparent cooperation in the energy sector.

Their stake in open source is strongly related to this point and emerges as the backbone of an inclusive protocol accessible to stakeholders with different needs. According to Pylon, this is not only something in line with the inherent values and incentive mechanisms DLTs were originally created for, but it also allows their system to have long-term viability which they deem crucial in the longer time-horizon needed to deal with global sustainability problems such as climate change.

How it started

The primary motivation was to accelerate the decentralisation of the energy model, with common users being able to produce electricity. They looked into dollar panels and started with storage solutions in the form of a battery, but the market was too challenging. They later went into software and data and realized this could be key to deal with inefficiencies.

From there, blockchain emerged as a potential solution to work with energy and the data it generates, namely the way it is handled, stored, shared, and they found data digitization and management as the bridge for DLT development.

Simultaneously, Pylon also learned about Goiener, an energy cooperative in Spain, got inspired by its model of a shared network where the owners are also users, and decided to pilot their solutions in this context.

They grew to offer a blockchain consensus algorithm for the energy sector after collaboration with the development teams of Entropy Factory, CREAtivechain and Faircoop.

Funding models

On top of their open source database and blockchain, Pylon develops commercial tools for profit to finance their operations and support the whole ecosystem.

They currently offer 3 tools which are not on their blockchain but are integrated. Other tools are in development but are dependent on regulation at the national level to be established before they can be used.

Governance structures

In terms of technology, official energy players can participate by becoming a node, validate data or become shareholders of the database. In terms of data, Pylon offers individual users or collective ones the possibility to manage their energy data and to enact actions from cost renegotiation in an aim to tackle energy poverty.

Nevertheless, none of these individual or collective actors has governing power in the Pylon network, such as access to decision-making, even if there are feedback loops namely when dealing with information.

Pylon has a number of tokens that belong to the federated nodes, which represent ownership, but also a way of becoming a stakeholder in the database without needing to install an actual node. For being a federated node, the nodes receive Pylon Coins, which are premined by a predetermined amount per block.

The uses of the token are still under validation, not fully implemented yet. The launch of the token comes with the launch of the mainnet. Moreover, the use of these tokens is not imposed by Pylon as they offer all services commercially, but it is available for interested parties for internal use in exchange for something, such as energy or data services.

Technical configurations

The whole Pylon network is open source and the code is free to copy, edit, modify or be integrated with any smart meter or any other energy tool or platform. Nevertheless, the database is not public and has different levels of access.

The blockchain developed is a new permissioned protocol that uses Proof of Cooperation. It has elements from other DLTs such as CREA, Litecoin and Faircoin, but it was created to avoid dependency on other platforms and developers, and also to better deal with problems of speed, scalability and network energy consumption.

The energy sector is highly regulated and compliance is key for any innovation. Pylon has certificated nodes that should allow adaptation to current and new regulations.

Thinking about the future

As lesson Pylon underlines is fostering more synergies and collaborations from the beginning, including with academics and public institutions. But a core learning was also that the best way to create engagement is through cooperatives or municipalities, as direct paths are difficult in the energy sector with consumers opting mainly for easy and friendly solutions. As they state, just because the technology is free and trendy it does not mean that people will use it, and their main example is that in a pilot with 10.000 potential participants only less than 100 downloaded their app. Moreover, Pylon also points out numerous challenges they had to learn from, including blockchain still having a bad reputation that creates commercial problems, or the adaptation to energy, financial, and data privacy regulations that are currently complex.

As best future scenario, they would like to have the issue of interoperability solved, meaning the existence of not single blockchains, or Pylon's blockchain, but rather something that has become a common infrastructure, a public good that works for the whole energy sector, with potential standards created by the EU. This could be crucial, between the convergence of different technologies, including blockchain, different products inside the blockchain, and numerous sectors looking at all of it.

4.2.4 ALICE (#005)

https://alice.si/

Alice is a decentralised platform for measurable impact projects in the social finance sector. Alice helps impact investors, governments and non-profits fund projects with fully tracked impact data and low transaction costs. Its operations make payments conditional to verified impact, and they allow anyone to create and monetise transparent social funding.

ORGANISATION	HEADQUARTERS	ESTABLISHED	GENDER COMPOSITION
For-profit. Startup.	UK (London)	2016	2 women in a core group of 6 people

Overview and goals

Alice points towards the decentralisation of impact funding and its management. It allows social organisations, impact investors, family funds and even governments to fund social and environmental projects and transparently track the impact of their fundings. They want impact data to be shared with the public, to be able to design better projects and actually help those people rather than gather funds that do not generate some probable impact.

Its operations imply upfront the evaluation of needs and the measurement of goals of funders and beneficiaries. Alice then incorporates the funders' capital into an Alice account, and every time a goal is achieved and validated, they transfer the funds out of this account and into the account of beneficiaries.

Alice creates a smart contract on the blockchain which states that once a goal is achieved and validated, the money can be taken out and put into these beneficiary accounts. This is how they ensure transparency and impact tracking because a percentage or even the full amount of the funds is received by the charity only when it is seen that the action was achieved.

The charities need to establish concrete impact goals and Alice also supports the whole process. The flux usually implies first that impact investors release money for a concrete goal. Second, that the goal is measured, such as in the delivery of 50 homes to homeless populations with total costs of EUR 10 000, broken down by units. Third, that the work is completed by the charity, audited and evidenced. And fourth, depending on the outcome, that the funds are released to pay back the investors plus any potential interest.

Intersections with social and public good

The proposal that Alice puts forward is to run projects transparently, using smart contract-based incentives to ensure their impact is independently verified and accessible to everyone, while reducing due diligence, reporting and other transaction costs. Ultimately, their system should allow everyone to automatically see what amount of money achieves which impact.

Their vision points towards the use of blockchains to help restore trust in the charity sector, by creating a decentralised system that incentivises charities to innovate and take risks with promising but untested approaches to social issues, considering the needs of all parties involved, from beneficiaries to managing organisations and funders.

How it started

Alice has its roots in the necessity to avoid recent funding scandals in the third sector, as for example the case of the Haiti earthquake and the Red Cross. In their view, people need to account for all the billions that go to targeted projects, and above all, they need to account for individual achievements rather than generating reports at the end of the year. Blockchain track and tracing properties seemed fit for purpose, also considering the need to bring impact investors into spaces once occupied only by philanthropic donors, who are now not as active as before because of motives such as the lack of transparency and high transaction costs.

Funding models

Alice began with a government grant for which they had a partnership with Imperial College London, a grant from Gnosis which is another blockchain project, as well as a partnership in an accelerator structure with funding coming from 7 investors, both individuals and companies.

This project is already generating revenue and has expectations of becoming self-sufficient in the medium term. Their current business model is based on charging for building applications and protocols for new third sector or governmental clients upon their framework, as well as associated fees for software maintenance, transactions, and management. In terms of funding of the charitable projects themselves, Alice allows for money donations without a blockchain wallet, as it offers operations through debit and credit cards or bank transfers.

Governance structures

Alice has what can be considered a normal governance model for a non-profit organisation, based on stakeholders and voting rights attributed accordingly to the percentage they own. There is a board of directors where founders have a seat.

Technical configurations

Alice runs on top of Ethereum, with a public, permissionless and open source architecture that relies on Proof of Stake. They already have implemented a second version of their protocol, that allows external actors to decentralized apps, and are currently looking into Substrate as a framework to improve their network and its governance. They chose Ethereum mainly for its ability to enable smart contracts. Another reason for their choice was that it is often seen as an inclusive community with the largest group of developers in the DLT space, and it is compatible with other open source blockchains, with wide availability of development tools. This ultimately fits their interest in interoperability and should allow them to explore connections with other DLTs.

The network allows updating a smart contract and implementing a majority voting mechanism through stakeholders' participation. If the vote is in favour, the smart contract becomes updated. On top, they offer off-chain ID verification and have a marketplace for legal matters that are bound to smart contracts' code and it provides governance tools. Their team has plans to implement a token-based voting system, for the token holders to be able to vote on whether specific goals in the projects are good, if they can have long term effects, or other project features. Alice has also created the Etheroscope in partnership with Imperial College London to take raw data of the blockchain and convert it into a readable graph. Etheroscope takes the smart contract legible, and converts the hash of the blockchain into simple data visualisations that can better showcase the allocation of funds and goal achievements.

Thinking about the future

Multiple lessons are highlighted by Alice. On user relationships, establishing continuous feedback loops and avoiding assumptions is one. On a commercial level, establishing an engagement platform for stakeholders instead of a door-to-door approach, is another. On team-building, aligning individual with collective goals is something they also underline. As best future scenario, Alice would like to become the standard platform and protocol used by and for charities, funding agencies, and governments around the world.

4.2.5 BLOXBERG (#017)

https://bloxberg.org/

The bloxberg consortium aims to foster collaboration among the global scientific community, empowering researchers with robust, autonomous services that transcend institutional boundaries. With the bloxberg infrastructure, research claims need not be limited to one institution alone but can be confirmed by the whole trusted network.

ORGANISATION	HEADQUARTERS	ESTABLISHED	GENDER COMPOSITION
Non-profit. Research consortium	Germany (Munich)	2018	N/A

Overview and goals

The bloxberg infrastructure offers a blockchain established by a consortium of leading research organisations to provide services worldwide to researchers. The focus is placed on a wider autonomy and decentralisation for scientific outputs.

Researchers can leverage the bloxberg blockchain to create a transparent footprint of their research work. Their research can be confirmed by a whole trusted network instead of relying on validation by centralizing actors, may it be publishers or review boards. This network can have the participation of organisations and other researchers with excellent reputation which will encourage the use of the network and the applications built on top of its infrastructure.

Additionally, multiple organisations in the field can integrate bloxberg into existing institutional services for their scientists, and therefore open up their centralized services to decentralized components such as DLT timestamping. The network can be used to validate research outputs autonomously by researchers themselves without revealing content. They can generate a certificate that proves specific data was uploaded at a certain time, thus protecting their results.

By establishing the permissioned public blockchain, the network is safeguarded against the cryptographic power of third entities, with the credibility of research organisations in the network allowing trust in the system to be generated. Also, starting with a research data certification system, the bloxberg infrastructure is destined to be extended and enhanced with tools and myriad decentralized applications as needs grow and shift.

Intersections with social and public good

By putting science back in the hands of researchers, bloxberg expects the public to receive more benefits from what science produces. The goal is decentralisation of knowledge beyond centralised gatekeepers. The idea is that science production and dissemination revolve around a few central parties, and this blocks innovation, with publishers having the monopoly on what is made public, what other actors see as scientific advancement, and ultimately what type of research is funded.

Following the work previously done to expand Open Access in science by leading institutions in the bloxberg consortium, they are now building an infrastructure to reinforce this mechanism and offer it to a larger universe. This appears to come with a robust set of guarantees for quality assessment, which should also incentivise Open Access at large.

How it started

In February 2019, with coordination of the Max Planck Society, leading research organisations from around the world came together to formally constitute the bloxberg consortium. With the 11 bloxberg founders, 9 different countries are represented with at least one renowned research organisation.

Several researchers inside the consortium, namely at Max Planck, claim they often fear having data stolen, that someone else publishes that data first, and also that it is impossible to claim the data was stolen until after its publication. With in-depth knowledge of the groundbreaking possibilities of DLTs for science, many inside these institutions saw blockchain as a potential solution to tackle these challenges.

They began a pilot and tested different blockchains, like Bitcoin, but because of its negative reputation, the consortium opted for a blockchain maintained only by research organisations worldwide, which are recognized as trustworthy and normally funded by public capital. Thus they are also avoiding speculative DLT frameworks.

Funding models

Bloxberg is often presented as a research project with resources shared between universities. In this model, all organisations in the consortium bring something, such as server capacity or technical developers, and all also run a node of the network.

There is no current financial structure formalized. But the consortium is looking for additional internal capital, as well as external funds from European RandD calls or even from the Ethereum Foundation. They are also working with other institutions that can use bloxberg as infrastructure for their projects, thus bringing potential additional resources.

All transactions in the bloxberg blockchain are free of charge. There is no trading of coins since the funding they receive comes from the public and they want to give it back to the public. The use of the blockchain is not only for the universities but also for the students and for commercial parties.

There are companies that provide applications on top of bloxberg, which are commercial as bloxberg cannot build all the infrastructure. Those companies that are building, for example, user interfaces on top of bloxberg are charging for use of this interface. However, on the base distributed layer there are no fees involved.

Governance structures

At the time of kickstart, Max Planck engaged organisations worldwide with the idea that there was no initiative like this. The founding 11 research organisations agreed, and besides deciding to start on a small scale, they also decided to discuss the governance model upfront.

The original organisations met in Germany for 3 days of internal discussion about the governance model and how to shape the infrastructure. This was done through participatory methods. They voted on which governance rules should be put in place and they have continued this voting process on-chain with often monthly votes on new ones. Candidate institutions are supposed to be vetted through a peer-review process from entities already part of the network.

A meeting is held once a year in the bloxberg Summit where normally many of the most substantial decisions are taken. Everybody can make any proposal there and everybody can vote on it.

The consortium has recently introduced bloxberg improvement proposals: anybody can suggest an improvement, technical- or governance-related, and people can discuss in an open way.

Those that can vote are the institutions, not the developers making suggestions. These developers may belong to start-ups, or enterprises, etc.

Technical configurations

The bloxberg infrastructure consists of the two main components, first the bloxberg technology (nodes, smart contracts, etc.), and second the governance model which defines the ground rules of the network.

The bloxberg infrastructure is developed on top of a permissioned public blockchain network driven by a Proof of Authority algorithm called Aura, forking Ethereum. They believe Ethereum has one of the strongest communities out of any blockchain network and it has been shown to be resilient and stable against many attacks while running on the mainnet.

Each of the validating nodes, or authority nodes, corresponds to a research organisation and they are selected through the voting process. In other networks, the stake is on the computational capacity, but bloxberg stakes it on reputation, because if a research organisation does not deliver, then everybody can see it on the blockchain and identify them.

Efficiency is achieved as the amount of Authority nodes processing transactions is kept relatively low, so block confirmations happen quickly, without the long confirmation times commonly seen in other blockchains. Security is guaranteed through the fact that nodes are distributed among entities and are numerous enough to prevent malicious attacks. Technical decentralisation is realized through limited control of the chain from any single institution with voting powers also divided.

Their token is called Berg and is used to pay network transactions but without real monetary costs. There is an application allowing someone who wants a few tokens to request them for free. Transaction fees exist only to limit spam. If someone wants to create a token on the top layer for profit it is possible, but not on the basic layer.

Regarding GDPR, no data is stored on the blockchain itself, but on a top layer which they claim to be GDPR compliant.

Thinking about the future

One of bloxberg's main learnings pertains to having everybody synchronized, which involves robust networking, and in the case of research organisations, it entails a lot of bureaucracy that creates additional barriers to success.

Their best future scenario is to create a global network with one consortium member in every country in the world, and that blockchain gives power to people to actually take control of their data, security or privacy, and this is vital.

4.2.6 HOLOCHAIN (#061)

https://holochain.org/ - https://holo.host/

Holochain is an open-source data-integrity engine that enables the self-hosting of P2P apps on a distributed web with user autonomy built directly into its architecture and protocols. Holochain avoids the need for global consensus and aims for massive scalability, as well as user-control of identity and data. Distributing the storage and processing of this information can change how people coordinate and interact and gives back control on digital integration.

ORGANISATION	HEADQUARTERS	ESTABLISHED	GENDER COMPOSITION
Non-profit. Foundation (Holochain). For profit. Startup (Holo)	Gibraltar	2017	9 women in a core group of 30 people

Overview and goals

Holochain positions itself by asking what comes after blockchain? It offers a new type of open-source development framework and networking protocol, where the goal is to provide a seamless experience to web users, that operates in similar ways to a normal web App but without the need of a central entity.

Holochain applications (hApps) are held entirely by users with no trusted third parties as mediators. They enable direct architectural consent and cryptographic communication. This lets people provide value into a sharing framework, not into a centralized one where gatekeeper organisations usually extract all financial and other resources.

Every user runs the application on their own device, creates and stores their own data, and talks directly to other users. The proposal is compared to lightweight, secure decentralized computing possible on mobile devices. Main use cases are decentralised governance and collaboration, sharing economy and platform co-ops, supply chain wins and social communities, and social media, social networks and vendor links.

Intersections with social and public good

Holochain allows its end users as ordinary users of the internet to experiment with new decentralised organisational structures and build upon them, helping people control and own their data towards what is deemed as a new regenerative economy and a more human internet.

It also aims to provide decentralized capacities at scale that improve DLT sustainability arguments by requiring reduced amounts of energy consumption compared with other DLT architectures like the major blockchain platforms.

How it started

Holochain emerged as part of the Ceptr project. Ceptr is a rebuild of a technology communications currency stack, mimicking natural patterns of coordination. With a wide variety of features in terms of protocols, its main purpose is a “quantum of deep in human coordinative capacity”.

The main work came from the Metacurrency project. This project looks at currencies not just as money but more as current-sees. Not just flows of exchanges of goods and services, but as elements that help to manage flows as means of caring, sharing and giving, which is how the intended uses for currencies are ultimately modelled in this context.

When blockchain emerged, the initial Ceptr team wanted to take a small piece of it and make a new version that could interface with more contemporary systems. An internal group met regularly to discuss developing their ideas from concept to implementation, and create the shift from a visionary project to a more practical one. They named it Holochain, to compete with blockchain and show a viable model for scaling that blockchain was not suited to accomplish in their view.

Funding models

Metacurrency came first. It is a non-profit initiative that does not have any funding. Ceptr began similarly, but someone showed interest in funding and made it possible to create Holochain and Holohost.

Holohost was created to sustain Holochain. The former is a for-profit company that operates as a hosting network. This is the revenue strategy for maintaining the open source infrastructure of Holochain. Holochain is currently a non-profit foundation that owns Holohost.

Holohost began an initial community offering on Ethereum of a token that was a placeholder for the holofuel: the currency run in Holochain.

Governance structures

There is no formalised governance in the Holo ecosystem. Multiple participatory channels are in place, and decision making emerges as an ongoing dialogue between numerous actors. Nevertheless, the governance of Holochain aggregates several more or less decentralized layers, from investors and fund managers to developers and other core team members.

Holochain enables a set of agreements encoded in the application, with each node being compared to an organic cell which can mutually direct action and ensure that rules are being followed. No node has special power over any other nodes.

Contrasts between roles, capacities, and the concept of having limited to none hierarchical elements have created tensions. Furthermore, as Holochain tries to be initiative driven by both the community and team members, they recently pulled back and focused on core efforts to get the Holohosting and Holochain live and functioning.

The communities around Holochain are: developers that hold camps and houses, the host community composed of less technical people who can also participate by buying into the system in plug and play, the fan community who supports the vision in terms of building the next internet as participatory, equal and decentralized, and also the speculators, who are the people that buy the token and nourish the credit system.

Discord and Telegram are used for regular communication, as well as for more complex discussions on projects and visions. But there are also other sub communication channels for specific applications such as Slack chats by invitation only.

Technical configurations

There is no single Holochain DLT. Every Holochain application has its own P2P encrypted network and these cover the spectrum from public and permissionless DLT to private and permissioned depending on the rules of the application. The Holochain has an open source approach while Holohosting contains elements that are not open source. To access Holochain's chain the user signs in with a private key which is what allows the user to write to her/his chain. Once that is done, the chain gets sharded to the distributed hash table and other nodes validate it. If someone finds that rules are broken, then they will mark users' data as rejected. For an application everybody has the same copy of the core, which means the same data and the same rules.

The sharded data store works as a distributed hash table. Data can be sharded across all the nodes but users can still be routed to the nodes that are holding the data, very sensibly. This is how the Holochain DLT works. It is not a single chain, but each user has their own chain of only the state changes they have made and the actions they have taken, and then they are published to a shared space at a distributed hash table. It works like an index across millions of nodes.

Holochain runs a specific type of apps (hApps). This is maximizing individual sovereignty as the user can choose which Holochain apps to run or install. Each Holochain application is a separate P2P network, but when the user is running an application she/he is constrained to the rules of that application.

Holohosting's main mission is to host Holochain applications. With Holohosting, the user is their own server that is using a distributing data engine underneath to break up and synchronize the data with the other nodes, that also are their own servers. Holohosting allows some nodes running Holochain to share excess capacity with web users who are not self-hosting and they are paid to share this excess capacity. It is a distributed hosting business. Instead of paying companies like Amazon, users pay P2P networks of host providers.

Holofuel is an asset-backed currency by hosting power. The issuers of the currency become the producers of the value. It is a counting based approach; a mutual credit system. They use REA (resources event agent accounting) which is a cross-organisational accounting between different economic agents exchanging resources. This REA sits on top of the Holochain which means it is cryptographically signed, immutable, auditable and has the potential that every unit of accounts in a business becomes a cryptocurrency by virtue of being able to borrow against your future production.

Holochain claims to be in line with GDPR as users can be the full owners and custodians of their data, which is always hosted on their own computers, and which they can selectively and temporarily share or revoke the share at any time.

Thinking about the future

A lesson learned at Holo is to keep smaller and focus, while managing the growth slowly.

A best future scenario would be where a majority of P2P initiatives create new social patterns for organizing and will be able to out-compete the old centralized commanding hierarchy-controlled structures of the industrial age, because these cannot keep up with integrating information fast enough for a network age.

4.2.7 COM'CHAIN (#027)

http://com-chain.org/

http://monnaie-leman.org/

https://laracine-monnaie.fr/

Com'Chain is a group of local and/or complementary currencies such as Monnaie Leman and La Racine that pool their resources and skills to develop shared IT solutions. It is a non-profit and self-organized consortium blockchain.

ORGANISATION	HEADQUARTERS	ESTABLISHED	GENDER COMPOSITION
Non-profit. Association (Société Coopérative Com'Chain - Blockchain des communs)	Switzerland (Geneva) France (Vallée de la Chevreuse)	2015 (local currency), 2017 (blockchain solution)	7 women in a core group of 12 people.

Overview and goals

Com'Chain is a cooperative with the main goal to create an electronic version of Leman, a local currency of the Leman lake area around Geneva. Their main challenge was to create two types of currency in one: a mutual credit currency and pledge money (IOU, promise currency). These two versions of the same local currency remain separate, and the technical solution still needs to remain simple.

At first, Com'Chain created two local currencies: e-Leman (the pledge currency) and the Leman (the mutual credit currency) and both are in the same wallet. Further, Com'Chain wants to be a global solution for other local currencies, such as La Racine already inside their platform. The purpose is to provide a door for currencies which seek an electronic solution.

As next steps, Com'Chain aims to establish other connections with new or already existing currencies, and create something bigger which will also take into account the user management and the localisation of the shops accepting local currency.

Furthermore, Com'Chain also intends to create other applications such as voting systems for local communities, as for example housing cooperatives, and tracking mechanisms to check ethical compliance of specific organisational pledges.

Intersections with social and public good

Com'Chain fosters local economies and could contribute to more economic, social and ecological resilience both locally and globally with biodynamic practices applied to the whole project. A large portion of their decentralisation potential is placed on its currencies allowing for a larger and more distributed circulation of resources between local actors without intermediaries or monetary commissions.

The solutions offered by Com'Chain also stimulate more sustainable practices, on consumption and production dimensions. It promotes for example localised buying with companies that show interest in the territory where they are located, and it simplifies provenance tracking in localised supply chains with direct relationships between actors.

How it started

Com'Chain implements local currencies and they decided to use blockchain because they see it as the most universal tool to develop local currencies as well as universal solutions.

An initial group of three people decided to launch the project. They had exchanges in four previous years around the possibility and decided to launch the currency part of the project in September 2015 at the mobilization of COP21 in Paris.

They have been inspired by two types of projects: local currencies launched after the 2008 economic crisis and the Swiss complementary currency WIR.

The currency was originally set in paper money but the group planned to create an electronic version. After checking several options, they got a support offer to develop it in on a blockchain as one of the people involved in the local currency was an IT security developer.

Funding models

The whole project has functioned on a voluntary basis until now, and they have already funded a group of developers. The main business model is a fee on B2B transactions, but never on B2C. Fees are collected every year through the system.

Governance structures

Com'Chain has two levels of governance. The governance of the Com'Chain, organised as a cooperative, which has decision powers over the blockchain. And the governance of the consortium composed by the local currencies using the wallet that govern the wallet. In this scheme, the consortium is a customer of the blockchain services provided by the cooperative.

The cooperative part functions based on a cooperative type assembly and board model, with no technical developers having a seat.

The consortium has no structured decision making at the moment, and decisions are based on informal interactions. Every local currency has its own strong rules of governance, and no governance model rules the code of their existence on the blockchain which allows it to remain a system for payments above all.

Technical configurations

Com'Chain runs on an Ethereum-based blockchain, which is permissioned for the different local currencies. Cassandra is used as the distributed database and IPFS as the distributed file system.

Ethereum was chosen because they wanted to use smart contracts, and it appeared as the most efficient solution.

Com'Chain is a consortium blockchain. Not completely public, nor private. The consortium of organisations gives permission to others to enter in the blockchain. The different currencies belong to the organisations in the consortium. Each currency has to bring some nodes.

They opted for a consortium solution because they did not want speculation with the currencies like with Bitcoin (BTC). The mining on their blockchain has no value. If a local currency adds a node, the node has no advantages over other users. The local currency can decide how many nodes they need so they can have control over the power consumption of the full system. This solution requires a very low energy consumption.

Each local currency is responsible for the link with the users, but the blockchain has no link with the users of the local currencies specifically, thus not capturing personal data from its users beyond payments.

The application can be linked to a computer or to a phone so the user can create a file or a paper copy of the wallet. Thus, the blockchain is not linked to a device.

Each local currency is a token. The value depends on the local currency. In the case of Lemanit: it is 1 Leman = 1 Swiss Franc. Each currency has a different smart contract for tokens and these define the characteristics of the currency in that contract.

Thinking about the future

Main lesson for the future is that even though objectives can be clear, how to get there may not be so clear, and thus more planning is always good.

A best future scenario includes different communities building their own currency and using the Com'Chain application.

4.2.8 WORDPROOF (#130)

https://wordproof.io/

WordProof gives content creators the tools to protect copyright and website visitors the tools to verify information. Content, combined with its date, time, and URL is transformed into a unique string of characters called the hash. This is then published on a blockchain and through Wordproof timestamping content owners can show they did not tamper with their content. Also, as content changes and develops over time, history becomes verifiable for both humans and machines.

ORGANISATION	HEADQUARTERS	ESTABLISHED	GENDER COMPOSITION
For-profit. Startup.	Netherlands (Amsterdam)	2019	2 women in a core group of 8 people

Overview and goals

The Wordproof ecosystem is building a layer of trust into the internet, assuming it is fundamentally built on insecure tracks given the amount of content that is currently false, not verified, or that was changed without permission. It offers tools for timestamps and tools for verification, and has two main objectives: ensure content protection and counter fake news.

On content protection: Wordproof has a timestamp for the content which is a unique fingerprint, a hash. With this timestamp, anyone can prove that the content existed at a specific moment in time, and there is also the possibility of walking through the history of the content.

On fake news, through Wordproof a blockchain account can be connected to an identity. Wordproof has a TIER level system that goes from no identification (TIER 0) to connecting government-issued identities to your blockchain account (TIER 6).

Wordproof aims to be adopted at large by search engines, e-commerce, newspapers. etc. it is not only people that can read blockchain with timestamp certificates but also search engines and social media. For example, social media platforms use languages as schema.org to check how content is structured. If a blockchain timestamp is added in the source, search engines can check the authenticity of the content.

Intersections with social and public good

Wordproof claims a space of inclusiveness and trustiness on the internet by working to provide authenticity of online information and content and making it verifiable through open source protocols.

Its decentralisation efforts are mainly placed on opening up blockchain as a technology to the needs of laypeople, diverting power concentration from bigger players to smaller actors, and extending accountability and consumer protection online.

How it started

Wordproof's origins are linked with its founder's background in open source content management systems. The founder also created one of the first Wordpress companies in The Netherlands.

Wordproof founder's first encounter with DLTs was in 2013 through the Bitcoin blockchain. By then he thought about how to combine his knowledge of WordPress, legal and regulatory frameworks that later would integrate GDPR, and ultimately blockchain, coming up with the idea of a timestamp content system to bring a new layer of integrity to the internet.

Funding models

Wordproof was created by its founder within his existing successful company and needed no extra funding given original investor resources. At a later stage, one grant was obtained from a blockchain venture organisation, and a local innovation fund also attributed a loan to the project.

Wordproof is not fully sustainable in terms of financial operations yet, but that is also not the wish stated by the founder.

Governance structures

The biggest shareholder in Wordproof is the previous company owned by its founder, with a stake of around 70%, and another major investor around 20%. This structure determines a big part of the project's institutional governance.

There is a community of users, a community of developers, and developers on the payroll. The community shows strong engagement with the project, providing feedback that is often used for new developments or even developing features themselves.

300 people are usually engaged in this community through Telegram. This is considered a relatively small community by Wordproof which could possibly be explained by the absence of value tokens and speculatory activities. There is one token, nevertheless, but there are no monetary credits attached to it, and it is used by the system as an anti-spam measurement.

Technical configurations

Wordproof is currently blockchain agnostic as their standards can run on multiple blockchains, with planned integration in Ethereum soon. They began with the EOS blockchain nevertheless, which is a public, permissionless DLT, considered fast on operational terms.

EOS was chosen due to multiple reasons in the Wordproof ecosystem. Among them, its easiness for adoption, as setting up the surface could take 10 minutes, and allowed Wordproof to pay fees for their users, thus staking their resources. Also, its low environmental impact, as it does not require proof of work but proof of stake, and according to Wordproof it registers substantially less energy consumption than Bitcoin for example.

With EOS, Wordproof states that it can also stamp on behalf of users through an API without them losing control over their accounts. This could be a big risk because Wordproof is timestamping on behalf of the users and there is no decentralisation, but for instance, in EOS there are advanced permission systems and users can give consent to timestamps without forgoing control from their identities.

Thinking about the future

Main lesson for Wordproof is that it should not be possible to go halfway in open source, as this is a mindset and not purely a technical issue. They consider that going open source means doing it all the way. As added advice, something the founder wants to highlight is contacting influential people in the industry and working all together from the beginning.

As best future scenario, Wordproof wants to build a social media where all users are shareholders. In that way, all the value in the ecosystem could be redistributed to all the people who use the software, and a universal basic income could be created with the value that is not going to shareholders.

4.2.9 GIVETH (#056)

https://giveth.io/

Giveth is a community focused on bringing new governance models into the non-profit space through blockchain technology. The flagship Giveth Donation Application (DApp) will be an integral part of the Commons Stack project, which will allow realigning incentives for public good by creating microeconomies around causes anyone can support. The Giveth Galaxy will foster a larger network of organisations to help build the future of giving that Giveth envisions.

ORGANISATION	HEADQUARTERS	ESTABLISHED	GENDER COMPOSITION
Non-legal entity. Goal is to become a Decentralized Autonomous Organisation (DAO)	None	2016	2 women in a core group of 6 people

Overview and goals

Giveth wants to build a new system to provide value and the provision of non-excludable economic goods. As part of the Commons Stack, its major purpose is to support the creation of new economic models to sustain public goods through incentive alignment, continuous funding and community governance.

At a technological level they have the Giveth Donation Application (DApp). This works through the creation of a currency that incentivises a specific behaviour. The currency then creates a financial asset as well, and on the back of this, participants in the ecosystem create a demand for that asset.

In the offline world, donors usually donate directly to the community, but in this scheme donating to the "X" commons and receiving a voting token in return has a speculative value. If more people come into the project, the price of the token goes up. And if donors move their donations to another cause, the price will go down and participants will start to lose money.

The ultimate goal of the participants in this model is to curate applicants or decentralized grant foundations for example. If they create value for their cause, people will see that the community is doing a good job, so other people will donate.

Intersections with social and public good

Giveth aims to decentralize governance and distribution of donation resources, within a wide network of organisations in the non-profit space where they also aim to ensure high levels of transparency and accountability towards donors.

As part of the Commons Stack framework, the project also works towards public goods being valued for the benefits they deliver to the communities that use them, and operates in a larger ecosystem to build commons-based microeconomies to sustain public goods through incentive alignment, continuous funding and community governance.

How it started

The beginnings were very fluid. The original goal was to build the future of giving and to create economies around causes. To do that, infrastructure and Decentralized Autonomous Organisations (DAOs) are needed as well as a transparent accountability layer. The Giveth community started with a donation platform.

At the very beginning, Giveth had a donor. Things were transformed when the people within the project changed and decided to pursue more accountability of donations for new economies. The project turned into a social non-profit system.

Giveth and the Commons Stack are now the same thing. The original mission of Giveth is the current mission of Commons Stack, which is to create a very high level of change in the economic layer of society instead of trying to create business models. Giveth and Commons Stack are building a win-win situation, where people supporting a good cause are rewarded.

Funding models

Giveth is a non-profit and has relied on donations over the last 3 years. On one level, the project currently does not count with high donation amounts from large donors. Donations seem to work mainly towards Giveth maintenance and daily operations so they can build the Commons Stack.

On another level, the Commons Stack has more opportunity to raise funds and support Giveth, therefore assuming the future role of being the economic engine for Giveth.

Governance structures

No governance rules exist in Giveth code, as they have no governance code. They recur to a Spreadsheet DAO. Governance decentralisation works through open source protocols and horizontal decision-making processes where 1 person equals 1 vote.

Governance meetings take place in open conference calls periodically through Loomio. Anyone can join the calls, and between 8 and 20 people are regular participants in these meetings.

Technical configurations

At a technological level the project has the Giveth Donation Application (DApp). It needs a particular level of user experience, but overall it seems to function with 15 different projects currently using it.

Giveth uses Ethereum mainnet, proof of work, and testnet. They created a bridge between the two. When donations are sent, this occurs through the mainnet, and the tokens are created in the testnet. They move tokens around on the testnet, and when donations and accountability happens, then the token goes across the bridge again and payout happens on the mainnet. All this works towards cost reductions in terms of technical operations.

Giveth states it wants to make it easy for people to donate and avoid value retention in Ethereum for instance. Giveth uses a sidechain called rinkeby to bypass transaction fees, and also because there were no other sidechains with block explorers except rinkeby at the time of development.

Giveth uses its c-stack token to identify c-members. The c-stack token holders are part of the trusted seed and they are invited to help other communities to launch their tokens. People can deploy their own tokens since Commons Stack is an open source platform.

C-stack tokens have no value, are not transferable and they are not attached to the bonding curve. C-token is for people working for the Commons Stack and people who donate to the Common Stack.

It does have access privileges since with the token, you are able to initialize other economies and you have the opportunity to participate in a c-round investment in other non-profit ventures.

Regarding data protection frameworks as GDPR, Giveth claims to not collect any relevant data.

Thinking about the future

As lessons for the future, Giveth states being more focused on issue solving, keeping eyes on the core mission, guaranteeing individual goals are aligned with collective goals, and ensuring previous knowledge of things such as the Elinor Ostrom principles to be able to set clear boundaries before full engagements.

As best future scenario, the project would like that anyone who wants to create a non-profit would have three options: they could go to a government and get funding, go to donors and get funding, or create an entrepreneurial venture around the non-profit. In their perspective, instead of creating a business model, it is possible to create an economic model with the creation of commons attached to it. Afterwards community building can happen around a cause, with economic alignment, but also with broader value alignments.

4.2.10 ORIGINTRAIL (#091)

https://origintrail.io/

OriginTrail is an ecosystem dedicated to making global supply chains work together by enabling a universal, collaborative and trusted data exchange (interoperability), connecting rather than replacing legacy IT systems (interconnectivity), and ensuring data immutability through blockchain (integrity). The ecosystem builds on principles of neutrality, inclusiveness, and usability and contributes to more transparent, collaborative, fair, and trusted global supply chains.

ORGANISATION	HEADQUARTERS	ESTABLISHED	GENDER COMPOSITION
Non-profit. Project (OriginTrail). For-profit. Startup (Trace Labs).	Slovenia (Ljubljana).	2013 (company), 2017 (blockchain solution).	6 women in a core group of 20 people.

Overview and goals

The OriginTrail protocol is designed to enable trusted data exchanges in fragmented supply chains. It started by searching for solutions for traceability in organic beef, dairy, poultry, and vegetable supply chains, and is now able to certify final consumers that want additional trust in their products.

Main goals are related to supply chain data fragmentation, centralization, and protection to guarantee distributed benefits across the chain.

On fragmentation with data silos and low data interoperability, they want to overcome it through collaborative applications that establish end-to-end supply chain transparency.

On centralisation, their key push seems to be through data integrity and accountability through technical decentralisation, with efforts put on scalability and adequate database functionalities attached to permissionless architectures.

On the protection of data, their aim is to set up decentralisation as an answer to reluctances to exchange data due to competitive positions, and they point towards new economic models that do not imply data exchanges with other stakeholders only for regulatory reasons or when forced by power asymmetries.

OriginTrail is also led within Trace Alliance through TraceLabs, a collaboration partnership hub connecting businesses, startups, academics, business leaders and technology vendors in the field of supply chains and provenance. The collaborative effort of the alliance addresses different organisational challenges towards decentralisation.

There is an OriginTrail academy, as an open programme for developers with the goal to promote the knowledge of their technology. It is located in Belgrade as the majority of developers is placed there.

Intersections with social and public good

Support of provenance and sustainability should provide results not only for businesses and consumers, but also for the environment through practices such as the tracking of food sources and their contexts of production and distribution.

Part of their decentralisation is focused on transferring the ecosystem to the community, as the project is open source and is actively working on bringing aboard stakeholders from diverse contexts so they can build it according to their needs.

How it started

The three founders met on a student exchange project. A local agricultural cooperative was looking for innovative marketing ideas. They created a traceability system based on QR codes so anyone could check for example the proximity of the production. It was a success in Slovenia and gained awareness on a national level.

Other cooperatives got interested in traceability and in 2013 the founders created a company to set up more traceability systems, many for the food industry. The main challenge was to help local producers to stand out in the market and each producer wanted to highlight something. In some cases, it was that all the food was locally produced, or there were no GMOs, etc. The three co-founders embraced the decision to set up their company based on this market niche.

Funding models

The project is self-sufficient for protocol development and had a token generation event in 2018. It generated around EUR 18.000, which was declared as enough by then to initially fund the protocol according to the roadmap.

As a core team OriginTrail has a separate entity called TraceLabs, a for-profit company which is the core developer of this open source protocol and offers other kinds of implementations and products, which constitutes the main business model.

OriginTrail as a protocol was designed not to have a business model, and they still state their intention of giving the project back to the community after depletion of the funds raised in the Initial Coin Offering (ICO).

Governance structures

The decisions are made by the main core development company Tracelabs which is controlled by the founders. But there are plans on expanding this as they would like to introduce the community more in the development and decision-making. They use Discord to connect to the development community, which has more than 1000 members. The focus is to develop discussions there. The members are not formally involved but their suggestions are taken into account.

Some governance rules are encoded, such as how a person can run a node or the kind of stake they need to provide to do it, but as this is not entirely run as a blockchain it does not need consensus. They are enabling similar functionalities as the blockchain but since data is not stored on all the nodes there is no need for traditional governance mechanisms.

Technical configurations

OriginTrail runs an open source protocol that can connect with several blockchains. They work on the mainnet and are one layer above blockchain. They have integrations available with Ethereum, because it is the one that has more use cases and is the most adapted for interoperability, as well as with Hyperledger since some corporate users prefer not to be public.

Anyone can run a node on the network. There are around 200 nodes and the system is essentially not a blockchain but a network of nodes that store copies of data. When the companies want to store some data they can publish it on the network and these data can be stored on at least 2 or 3 nodes. This is how the use of the their DLT platform is optimized and the hash is on the DLT.

The data is not stored in all the nodes and users can designate for how long and the price they want to pay. All the data are in graph format that assures the interconnectivity of the data. Different applications can be built on top of all these data. For example, for traceability, certification, or perhaps internal applications.

The used token is Ethereum-based and is named Tracetoken. It is used for compensation for services on the network.

The project deems Ethereum as expensive with transaction variable costs which are hard to cover. That is how they justify only data fingerprints are stored in the blockchain, not full data sets. Also, they deem hashes to be costly, and that is why they store the data in their network, with nodes able to choose when they publish data in blockchains like Ethereum.

Thinking about the future

As a lesson for the future, OriginTrail would like to have more community contributions to the protocol, even if they identify challenges in the creation of adequate frameworks for collaboration. In their view, an open source protocol is a huge process and involving the community from the beginning is very important as user grounded approaches offer different outlooks on possible or needed features.

As best future scenario, their angle is on the protocol to become a global standard for trusted data exchange between organisations, and to be able to transfer the governance and the development of the project to the general community.

PART THREE

This part concludes the report with six independent position papers by high-level experts in the field and advisors of the #DLT4Good project. The topics range from the prospects of DLTs for decentralized governance to their potential role in strong collaborative economies. In addition, several discussions are set on current and future intersections of DLTs with issues of trust, verifiability, transparency, privacy or coordination. Each of these papers ends with a set of recommendations targeted at EU policy-makers and other relevant decision-makers.

5 REFLECTING ON WAYS TO MOVE FORWARD

5.1 Towards a decentralised governance model for public administration

by Marcella Atzori

Marcella Atzori, Ph.D., is an academic researcher affiliated to the UCL Center for Blockchain Technologies. She is specialized in decentralized models of governance, with a focus on public administration. Appointed by the Italian Ministry for Economic Development as High-Level Expert for the drafting of the Blockchain National Strategy.

Public administrations play a crucial role in the innovation processes of any country, and therefore in the promotion of economic growth and social and public good on a large scale. They can indeed adopt solutions and approaches with potential positive cascading effects on citizens, business, and the society as a whole.

As also pointed out by The Tallin Declaration (2017), in an increasingly interconnected and fast-changing world, citizens and business need public services to be easy to access, efficient, integrated and digital by default, with increased transparency and accountability, but also available at any time and independently of location.

Emerging technologies such as DLTs open new opportunities for public administrations to meet those needs, build a more innovative and secure digital society, and increase public trust.

In particular, DLTs can enable the creation of a decentralized model for public administration, based on smart processes and self-sovereign digital identities. These are the fundamental building blocks, upon which it is possible to generate even further disruptive services in public administration.

From traditional services to smart processes: the Once-Only Principle.

The Once-Only Principle provides that "businesses and individuals only have to communicate their data once to public administrations" - as envisioned by the Digital Single Market Strategy in 2016, namely considering Action 16. The principle aims at promoting data re-use and integration of services in national administration, to reduce the administrative costs, improve efficiency and prevent fraud. Importantly, it also establishes grounds for cross-border data exchange among the Member States, so to maximize the digital market growth potential.

Even today, however, the data re-use is in practice hardly to be obtained. In most cases, the European public administrations still provide their digital services in a fragmented way and through a multitude of isolated data silos, which are costly, inefficient, with no interoperability and unable to optimize the use of available resources.

Blockchain and other DLTs have the potential to enable a new organisational paradigm for public administration, achieving the goals of a decentralized and integrated management of services, and at the same time the factual implementation of the Once-Only Principle.

A private / permissioned blockchain protocol, for example, could be used to integrate all the different entities within the national administration. The traditional services provided by each governmental entity could then be re-engineered and translated into a corresponding set of automated workflows based on smart contracts (Marchoni 2018). These would self-execute when preset conditions occur, in respect of the specific correlations or interdependences between public entities, as required by the public administration and the law. The result would be that traditional centralized services – as well as the need to issue "documents" - would simply disappear, replaced by smart process flows instead (Marchoni 2018). The integration of services among different entities would also make the duplication of data no longer necessary.

The transformative impact of such a decentralized model on public administration would be enormous, in terms of improved time and cost-efficiency, security and public trust. Also, through the setting of adequate interoperability standards at international level, this model would improve the access to public records and the exchange of administrative data throughout Member States and thus facilitate the cross-border mobility of citizens and goods - in due respect of data protection and other legal requirements.

Self-sovereign identity (SSI)

The SSI consists in the possibility for the users to create, manage and control their own identity without relying on any centralized authority. In their digital interactions, users are enabled to choose which specific pieces of their own information, claims or credentials they can disclose to third parties. In particular, Verifiable Claims are credentials such as educational degrees, business licenses, citizenship, etc., which are issued by an authority or verifiable through a signature of an attestation issuer, who can attest its validity.

The SSI architecture is entirely user-centric and its application in public administration can have disruptive effects in the delivery of services and more broadly in the way institutions, citizens and businesses interact, manage and share data. Indeed it ensures full individual control on data and portability, avoiding data to be locked in silos, reducing reliance on central authorities and reinforcing citizens' privacy by design.

The main challenges ahead

The availability of technology is not sufficient per se to ensure the modernization of public services, nor to put into practice the potential of DLTs in terms of social and public good. The implementation of DLTs in public administration may require indeed major structural change and raise different challenges under social, technical and regulatory point of view.

Promoting Broader Digital Innovation Policy

Many factors may prevent the adoption of DLT-based innovative solutions within public institution and the relative creation of social value. The most frequent are:

- the lack of a systemic approach to digital innovation, due to the fragmentation of national policies and initiatives;
- obsolete modes of thinking, outdated approaches to regulation and bureaucratic entanglements;
- low investments in public infrastructure;
- majority of processes still based on data which are not digital native nor machine-readable.

The adoption of DLTs and the social and public good potentially generated will remain partial and limited in scale in absence of a broader and effective strategy for digital innovation at national level, which demands deep understanding of problems, adequate investments and long-term engagement.

Cybersecurity and the risk of relative immaturity of technology

Public administration is a sensitive sector and the levels of security, privacy and scalability required for digital services are higher as compared to other industry. It is essential, for example, to ensure the functionality and the continuity of key infrastructures on which depend the strategic services and operations for a large number of users. Even if they are start-of-art, DLTs still present a certain degree of immaturity, which may lead to insufficient levels of security for data and processes involved. As a consequence, any possible applications of DLTs for public service must be evaluated through a strict risk and benefit assessment, taking into account the actual levels of technology readiness achieved and the long-term stability of the infrastructures used.

Regulatory frameworks for DLTs

To speed-up DLT adoption in public sector, it is crucial to establish a clear common legal base for the deployment of smart contract and digital signatures, with appropriate coordination and convergence among all the Member States.

Inclusiveness and equal opportunities

In the provision of digital services and public administrations must always ensure observance of the principles of equal treatment to all citizens. That means that the adoption of DLT-based services should always be accompanied by adequate safeguards with respect to principles of inclusiveness, non-discrimination and sustainable innovation. The protection of individual rights is particularly important in the deployment of SSI architectures, which may entail complex social, ethical and legal issues for the most vulnerable groups, as related for example to the creation, storage, management and secrecy of the private keys.

Recommendations

Avoid fragmentation and develop a convergent approach to DLTs among all the Member States.

DLTs are strongly context-sensitive and several major factors have to be taken into account at organisational and societal levels in order to generate real social value. It is crucial to promote a joint approach to DLTs among all Members States, with the view to advance mutual learning and achieving technical standardization, convergence of policies and dissemination of good practices among different institutions. In this context, it is of particular importance the role played by the European Blockchain Partnership. Also, the uses cases set out within the European Blockchain Services Infrastructure (EBSI) and e-SSIF can work as solid building blocks for the rapid development of further services and proof-of-concepts.

Promote social inclusion and a user-centric technological design to generate social value.

Specific initiatives and social programs should necessarily be put in place to ensure that everyone has the opportunity (and is motivated) to access digital services and benefit from innovation, improving their well-being. It is a priority to narrow the digital divide in the provision of services, especially in consideration of the aging population and the low level of digitization of many European societies. Technology is not an end in itself: end-users' needs must be clearly targeted and services must adapt to such needs, taking into account factors such as user age, awareness, technical and non-technical skills, capacity to operate autonomously, etc. Transition to new services should also be gradual and in some cases the coexistence of both traditional and disruptive services may be necessary.

5.2 Trust, blockchain-based technologies, institutions, and the social good

by Balázs Bodó

Balázs Bodó is the PI of the European Research Council funded Blockhain and Society Policy Research Lab. Balázs is associate professor, and a research scientist at the Institute for Information Law, University of Amsterdam. He is a 2 time Fulbright Scholar (2006-7, Stanford University; 2012 Harvard University), and a former Marie Skłodowska-Curie fellow (2013-15). He has a degree in Economics (MSc, Corvinus University, 1999), and a PhD in Media Studies (ELTE, 2011).

Trust

Trust is a basic fact of social life. It enables strangers to cooperate across wider social, economic, political, cultural distances, in face of uncertainty, contingencies, and potential harm. Trust is a way we deal with the uncertainty of the future, and act, despite the fact that we may suffer negative consequences by engaging with each other (Giddens 1990; Luhmann 2017; Misztal 1996).

We develop and nurture trust in our interpersonal relationships through familiarity, established routines, and habits, and maintaining reputations (Misztal 1996). But such interpersonal trust is not always available. Living in a society means that we often need to interact across larger cultural, social, economic, geographic, cultural distances beyond the reach of interpersonal networks. How can we trust a stranger? The answer is simple: we rely on various institutions to do so (Giddens 1990).

Let's suppose we go to see a doctor, step on a plane, or sit into a taxi. In all these situations we put our lives into the hands of a stranger. The reason that we can make this leap of faith is that a large number of institutional practices ensure the trustworthiness of professionals. In case of the doctor, a medical school has provided professional training and certified his or her competences. Various mechanisms maintain the trust in the quality of education. Medical professionals are regularly tested, reviewed, trained, re-certified by their employers and professional associations. Patients can turn to online services, and share their experiences with each other. In some countries, patients can sue doctors and hospitals for medical malpractice, creating an extra layer of incentives for the former to do their best. Doctors, institutions and patients can buy insurance, to compensate (at least in monetary terms) for the harms the patient should suffer. In short, we do not need to trust an unknow doctor, if we can be reasonably confident that a number of checks and balances are there to guarantee his or her trustworthiness.

In modern societies we rely on all kinds of such expert systems: schools, food supply, local and national governments, economy, health, journalism, architecture are all providing us essential services which we need to trust, but most of us cannot assess their trustworthiness directly. In all of these cases, we rely on a dense network of institutions to produce trust in these systems through mechanisms of mutual oversight, accountability, control, insurance, and competition.

In some societies such institutional trust is higher than in others. Various empirical studies have shown that high trust societies tend to perform better in social, economic, political terms (Fukuyama 1995; Inglehart 1999; Nye et al 1997; Sztompka 1998). We can also witness how the decline of trust in various public or private institutions, such as government, science or journalism can both be a sign of crisis, and contribute to the deepening of a crisis in itself. For example, a free, trustworthy news media is essential for societies, democracies to work. If trust in news, news media, and journalism declines, that can have devastating effect on social cohesion, on politics, on the public debates (Nielsen et al 2020).

The trust in / by blockchain

One of the novel, and unique technological features of blockchain technologies is their approach to trust (Nakamoto 2008; The Economist 2015; Werbach 2018). The first blockchain applications grew out of the crypto-libertarian ideological corners of the internet, which can be characterized by a deep mistrust of public and private institutions, a strong commitment to individual liberty, and a strong opposition to any concentration of private or state power which could unilaterally impose its will on the individual (Golumbia 2016). The first wave of blockchain technologies implement the technological conditions of such a libertarian ideal. In blockchain networks none of the participants is trusted, and various algorithms, and crypto-economic incentive mechanisms guarantee that transactions can still take place (Narayanan et al 2016).

Though there are a plethora of different blockchain designs and implementations, they all share some trust related assumptions:

- No party is trusted in the network,
- No party should be in the position to unilaterally control and alter the transactions on, or the design and operation of the network,
- No trust should be required (between transacting parties, or among the members of the network) to successfully conduct a transaction, or participate in the operation of the network.

Blockchain technologies are therefore technical architectures that:

- Assume a general lack of trustworthiness of all network participants,
- do not require trust to operate, and
- may not allow trust to develop (if they allow anonymous parties to transact).

There are, of course some exceptions to these generic rules. There are blockchain based systems, such as Colony[39] which are designed to facilitate repeated, long term collaboration among individuals (Bellini et al 2020). To achieve their goal, they implement reputation systems, which enable individual users to accumulate reputation scores for their pseudonymous online persona. Other blockchain based designs hope to achieve trustworthy behavior by requiring parties to underwrite their trustworthiness by staking a certain amount of value, as a form of insurance, to the transaction or service they provide.

However, both ex ante, stake-based, and ex post, reputation-based trust producing technologies suffer from a number of possible limitations. Staking limits participation, and reputation is vulnerable to gaming. The trust-minimizing architectures rely on the trustworthiness of those who design and implement such trust-minimizing systems (Davidson, De Filippi and Potts 2016; De Filippi and Loveluck 2016). One does not need to know or trust the counterparty to a transaction, or a transaction validator, but still need to have faith in that the code is free of bugs, that the cryptographic algorithms are quantum-safe, or they do not contain backdoors.

Trust in public institutions and services

Blockchain-based technologies operate under the conditions of distrust, and may actively prevent the emergence of trust. Permissionless systems are engineered to resist institutional control and oversight.

On the other hand, public and private institutions rely on trust to operate effectively. They need to be seen as trustworthy, they need citizens, customers to have confidence in the competence of the organisation and its staff; they need to be able to seen as acting in the best interest of their clients, and their goodwill is dependent of their perceived integrity (Mayer et al 1995).

39 https://colony.io/

They achieve such trust by being embedded in a rich network of institutional control, oversight, transparency and accountability (Sztompka 1998).

Therefore, the trust assumptions of some blockchain applications, and those of public and private institutions seem to be diametrically opposed. This apparent incompatibility of trust needs and assumptions forces institutional actors to find answers for the following two questions: (1) can the stark value antagonism between the institutional and technological approaches be reconciled? and (2) what form that compromise will take?

The value antagonism takes many forms. Legal compliance is one dimension, which, on the one hand, produces trust and trustworthiness, and on the other, blockchain systems are struggling with. Public and private institutions are bound by institutional constraints, and non-negotiable legal obligations, such as the GDPR compliance regarding their data gathering and processing practices (Bodó and Giannopoulou 2019; Fink 2018), or the Anti-Money Laundering / Know Your Customer (AML/KYC) requirements for financial intermediaries (Ferrari forthcoming). In the meanwhile, legal compliance is often seen at best a cumbersome hurdle for blockchain technology developers, and as a result, blockchain systems are surrounded by serious compliance issues, and fundamental, architectural incompatibilities between technical design, and legal obligations.

Compliance is a significant source of trustworthiness. A legally legible, compliant party can enter into enforceable contracts, can be brought to court, can be obliged to honor its legal or contractual obligations, therefore it is accountable. That being said, legal compliance is a necessary, but not sufficient condition of trustworthiness.

Even fully compliant blockchain designs need to take into account the relationship between their trust minimizing approach, and the pre-existing trust in, and around the institutions, communities, settings, procedures to which they are being applied to.

Blockchain and other DLTs minimize the need for trust by replacing human subjectivity, flexibility, and arbitrary use of power with rigid, standardized, self-enforcing, and immutable software architectures, and rules hard-coded into various layers of the technology. In small-scale, interpersonal settings, such rigid architectures may block the emergence of trust, hinder the processes of self-governance, and may lead to socially undesirable outcomes.

Similar questions arise in institutional settings. What happens if a trust minimizing technology is introduced into a high-trust institutional environment? There is a chance that the new trust-minimizing systems will not be used, because there is no clear benefit over pre-existing trust-based approaches. But if institutions mandate the use of such systems, pre-existing trust may be destroyed. Technologies of control prescribe and enforce behavior, spell out penalties in case of a breach, limit the freedom of the transacting parties. Such structures may lead to the emergence of trust in the long run, but they can also easily signal distrust, and thus destroy existing trust among institutions, or institutions and individuals. (Foorman 1997).

Conclusions

Our interpersonal and institutional settings are ripe with their own pre-existing trust and distrust relations. The introduction of novel, trust minimizing technological systems in these contexts should be done with extreme caution. On the one hand, we should not try to replace a high trust environment with a trust minimizing technology. Pre-existing trust is very valuable, and no policy should endanger what is extremely hard to build, but very easy to destroy. On the other hand, in low trust environments we must ask: What is the best way to deal with the harms produced by a low-trust environment? Is it to implement a technology which is able to operate in such low trust settings? Or, do we try to implement technologies, policies, which foster the emergence of trust? What is more preferable: replacing distrusted entities with trust minimizing technologies, or improve their trustworthiness? Should we implement a trust minimizing architecture, or a trust maximizing one?

There are many components of trustworthiness. Transparency, accountability, fairness are key concerns. Blockchain and other DLTs might score high in terms of transparency, but because of their low institutional embeddedness, lack of legal legibility, complex design, and decentralized nature, they lack the same level of accountability as other social, institutional actors. Our institutions may be imperfect, often produce arbitrary outcomes, and sometimes they are outright oppressive. But at least there are clear lines of social, pubic, institutional, political, economic accountability and oversight. Such mechanisms of trust are yet to mature with regard to blockchain and other DLTs. Unless they can be brought into the fold, they remain largely unaccountable, thus fundamentally untrustworthy.

This should warn well-intentioned public servants, institutions, private actors who wish to implement blockchain or other DLT systems because they want to better their domain, want to be seen as innovative, or simply fear to miss out on a supposedly revolutionary technology development. It may worth not to rush. It is OK to be slow and cautious. Disruptive digital innovation that targets trust should be treated with extreme caution.

Recommendations

Traditional institutions can support the trustworthiness of trust minimizing DLT / blockchain systems.

Traditional, institutional systems of accountability and oversight can help DLT / blockchain ecosystems to overcome some of their trustworthiness issues. For example, voluntary submission to regulatory oversight (in case of financial service providers); code audits, and bug bounties; compliance with existing regulations, such as the GDPR; or the legal legibility of DLT / blockchain stakeholders create legal certainty. Regulatory sandboxes are key instruments in such institutional support.

Technological trust, or trust minimizing architectures should not replace interpersonal trust, or prevent its emergence.

Closely knit social groups build trust through shared routines, repeated interactions, a sense of familiarity, reputation, which are constantly negotiated, and renegotiated, balanced, and adjusted to the highly fluid internal and external dynamics of the group. Usually there is much flexibility in the application of the rules. Internal procedures, practices tend to be continuously adopted to the internal and external challenges the group needs to address. Such subjectivity, flexibility, malleability or irregularity is not a bug of such interpersonal relationships, but a feature, and it can be a substantial source of trust as it proves that the community is responsive both to the needs of its members, and to the changes in the external conditions the group faces as a whole. Such trust is extremely valuable and should not be replaced by inflexible, external, technological, mechanical modes of trust minimization.

Trust minimizing technical tools may completely crowd out and replace the mechanisms that produced high levels of trust in institutions.

Though institutions are much more formalized, structured, and standardized as informal groups, still, some high levels of trust in institutions may originate in the institutions' flexibility, sensibility. When various institutions, such as law enforcement, welfare administration, or customer service replace human discretion, oversight and control with fully automated decision-making systems, this trust may be destroyed (Ananny 2019; Eubanks 2017). Blockchain and other DLTs systems are designed to reduce human subjectivity and arbitrariness, but humans are also important point of control in procedures, and a potential source of trust and accountability. At the moment there is no clear, unequivocal, long term evidence, that would suggest that the benefits of a supposedly objective automated systems are superior to the actual and potential harms of the computer just saying "no".

5.3 DLTs for social and public good: how do we move forward?

By Sarah Meiklejohn

Sarah Meiklejohn is an Associate Professor in Cryptography and Security at University College London. She has broad research interests in computer security and cryptography, and works on topics such as anonymity in cryptocurrencies, privacy-enhancing technologies, and bringing transparency to shared systems.

In the years since Bitcoin was introduced, the landscape of cryptocurrencies has changed significantly. After years in which discussions focused entirely on Bitcoin, people began to realize the more abstract potential of its underlying technology, the blockchain, and "next-generation" platforms such as Ethereum and Zcash were launched; indeed, there are thousands of alternative cryptocurrencies deployed today. Others have repurposed some of the features of the Bitcoin blockchain to create an even wider class of technologies called Distributed ledger technologies (DLTs).

In addition to the basic usage of blockchains to support cryptocurrencies, people are also now building other applications on top of them. There are services that draw on the immutability of a blockchain to securely notarize documents, or to issue and transfer licenses for digital art. Platforms like Ethereum support the ability to store not only atomic transfers of funds but entire stateful user-defined programs known as smart contracts that execute autonomously. The greatly expanded functionality this provides has enabled developers to provide services for things like crowdfunding and identity management.

Indeed, blockchains have the potential to solve a broad class of social problems, by allowing people to work together without requiring trust. This simple property creates many possibilities:

individual donors could instantly send money to or volunteer with aid organisations to support only a specific effort or humanitarian crisis (Elsden 2019). Refugees could prove their identity without needing a piece of paper. A father working in Dubai could send payments to his family in India, without any of them needing a bank account.

As one concrete example from the non-profit sector, the AIRS project at Cornell University aims to integrate satellite data into the Ethereum blockchain in order to reward people who take care of their local forests. Organisations can fund a smart contract, and if the satellite data provides evidence that the forest has been conserved well (and maybe even expanded), this money can be paid out to the local residents responsible for that conservation effort. This incentivises responsible stewardship, and the use of smart contracts provides a form of disintermediation that enables organisations to deploy this in a scalable way.

As an example from the public sector, central banks around the world have discussed with increasing frequency the idea of a central bank digital currency (CBDC). This asset would essentially function as a hybrid between a bank deposit and cash: it could be used digitally, backed by the central bank in the way that banknotes are today, but would be free of any credit risk. As observed by the Bank of England (BoE 2020), it also has the potential to lower the barrier to entry (allowing people to use CBDC who may be unable to open bank accounts), which is crucial as we see more and more payments move online and businesses moving to a cashless operation. In addition, if central banks coordinate their efforts this could set the stage for easier and more transparent cross-border payments.

The point of distributed ledgers: verifiability and disintermediation

In terms of understanding the value in distributed ledgers, it is important to acknowledge that being distributed is not always an end in itself. In fact, a common end for distributed ledgers is verifiability, meaning anyone can be assured of the contents of the ledger. Authenticated data structures such as Merkle trees, however, already make it difficult for a participant to lie about the contents of a ledger they possess (e.g., saying a transaction is in the ledger when it isn't), even if no other participants know its full contents.

It is thus already possible to achieve verifiability even with a single participant holding the ledger, but this makes it impossible to achieve a form of disintermediation: if this participant decides they want to censor certain types of transactions, or that they don't want to accept transactions from specific users, then those users have no recourse and are essentially barred from using the system. Thus, while the participant maintaining the ledger would not need to be trusted to tell the truth about the contents of the ledger, they would need to be trusted to stay online and accept transactions from anyone and everyone. Avoiding these middlemen, in the form of traditional financial institutions like commercial banks, is often regarded as one of the core motivations behind the creation of Bitcoin and blockchains more generally.

Having multiple participants who are responsible for adding transactions to the ledger creates the opportunity for this form of disintermediation, but to actually achieve it requires a guarantee that these participants are not themselves coordinating or colluding. This lack of coordination between potentially mutually distrusting participants also helps to provide verifiability: if a majority of them agree on a given piece of information (e.g. the inclusion of a transaction in the ledger), then it is reasonable to assume that this information is true. On the other hand, if a majority of these participants are colluding then they can censor transactions at will and lie arbitrarily about the contents of the ledger.

The problem in any distributed ledger thus comes down to guaranteeing the absence of any coordination or collusion. This is ultimately a human-centered problem, however, that clearly cannot be solved by technology alone. Indeed, in most cryptocurrency blockchains today there are only 2-5 participants (in the form of mining pools) who are responsible for adding transactions to the ledger. Furthermore, most users of these cryptocurrencies do not even know who these participants are, let alone have any reason to trust them.

The question of trust is thus at the heart of distributed ledgers, even those that claim to be "trustless". In considering the use of DLTs for social and public good, it becomes essential to explore whether or not some application contexts do have a natural set of participants in which a significant number of users might be willing to place some trust; i.e., would trust this fixed and identifiable set of participants to not coordinate or collude. Crucially, this is not an extra trust assumption that users would have to make when using cryptocurrencies or blockchains; they are already implicitly trusting mining pools to do this. Rather, this would attempt to provide known entities that could be held accountable if things went wrong. What's more, it could give rise to more efficient solutions that could also be deployed in the shorter term, such as the Certificate Transparency project. This is especially important given the inefficiencies of current blockchains, which are at odds with many social and public good challenges, such as the current climate emergency.

In the CBDC example, it is likely that many of the citizens in a given country do trust the central bank to act in their best interest, even if they wouldn't necessarily trust a set of commercial banks to act in a non-exclusionary way. Furthermore, it is expected that the central bank would like commercial banking to continue in some form (to, e.g., enable lending), meaning complete disintermediation is a non-goal of a CBDC. This suggests that more centralized approaches would be well suited to this application.

The AIRS example, in contrast, is essentially impossible without complete disintermediation, albeit of a different form than discussed thus far. Here, it is more about helping organisations be able to fund and reward conservation efforts without having to identify everyone who might be involved in one (and then register them, get their bank details, personally monitor their progress, etc.). The main challenges are thus more technical than human-centered and involve finding ways to integrate authoritative information, like satellite data, into a ledger that has no inherent notion of authority.

Conclusions

There is no doubt that experimental technologies such as DLTs can have an enduring impact on some of the world's greatest challenges. Despite their broad potential, however, distributed ledgers are still very much an experimental and evolving technology. Indeed, in settings where the full decentralisation and disintermediation of blockchains is needed, it is clear that a serious overhaul is needed in many different aspects of their operation (Meiklejohn 2018). The AIRS use case, for example, would likely scale better if instead of storing every data point on one monolithic ledger, the ledger was sharded by region. In the CBDC use case, privacy is an essential property of any payment system designed to capture the qualities of cash, yet existing blockchains are known to not achieve any meaningful notions of privacy. In the short-term future, it seems essential to consider all ledger technologies, some of which may be ready much faster than distributed ledgers, and to work in partnership with organisations engaged in social and public good to understand their requirements and the trust assumptions they make about participants, which ultimately not even blockchains can avoid.

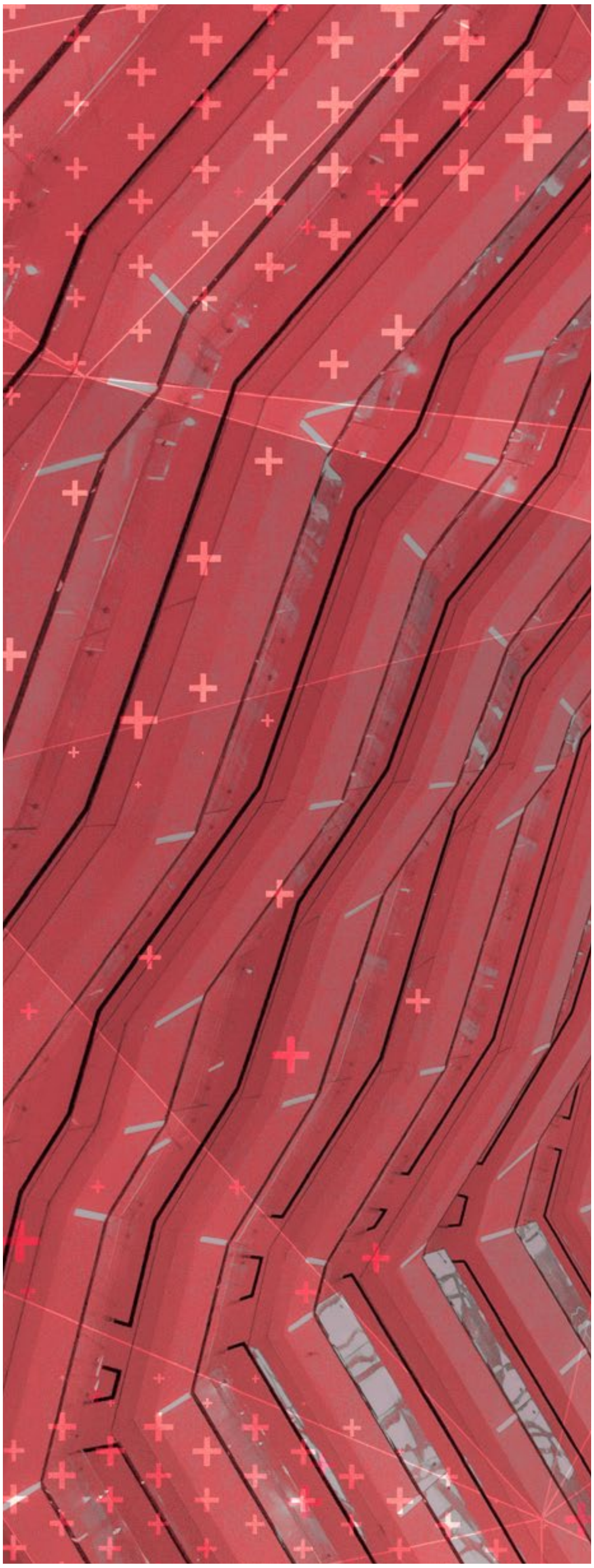
Recommendations

Consider all ledger technologies, not just distributed ones.

If the goal is to tackle social and public good problems in the near-term future, it seems essential to consider all ledger technologies, some of which may be ready much faster than distributed ledgers (or are even ready today). Examples include the infrastructure underlying the Certificate Transparency project, or Google's Trillian framework. These do not involve adding any trust assumptions, but rather make explicit the trust that is already inherent in distributed ledgers.

Work backwards from the problem.

Different application settings have different requirements (e.g., disintermediation, full public verifiability), and come with different sets of participants in different trust configurations. Deploying workable DLT solutions for social and public good (or any context) requires being aware of all of these properties and then coming up with the solution that fits those best, not the other way around. In particular we should not expect a "one-size-fits-all" solution that would work everywhere.



5.4 Getting the balance right: transparency and privacy in DLTs / blockchains

by Jaya Klara Brekke

Jaya Klara Brekke is Assistant Professor and ESRC Postdoctoral Fellow at Durham University Geography Department with research on authority and economics in decentralised systems, cryptographic geographies and political economies of disruptive technologies. She is also co-founder of Magma Collective 'Think and Do Tank' currently building a social key recovery system and p2p infrastructure for data sovereignty.

"But how can we know with certainty if it is not on the blockchain?" This sentiment was expressed at a recent policy-related meeting on DLTs / blockchains for social and public good. The exclamation reveals what research into the social implications of blockchain technology has noted: that rather than solving the 'trust problem' blockchain can at times lead to further social and institutional mistrust, creating the problem which it is intended to solve (Vidan and Lehdonvirta 2019). If only that which is recorded 'on chain' can be trusted, then everything that happens 'off chain' by effect becomes suspicious, giving rise to the impulse to trace and run an increasing number of things through blockchains.

One of the main promises of blockchain is to provide a tamper-proof ledger of events, agreements and applications. This promise can lead to the temptation of recording ever more things, relationships and processes on to the ledger in ways that can erode instead of strengthen privacy and trust. It is important to know when the forms of transparency and traceability enabled by blockchain technology is beneficial and when it merely exacerbates mistrust and undermines privacy. This is a particularly sensitive question for projects that seek to use DLTs / blockchains for 'social and public good', because the protocols and DApps developed in this realm are often aimed at the most vulnerable in society and include civic technology initiatives that shape the digital public realm.

The following provides a brief update on the importance of transparency and privacy in the context of digital network technologies and DLTs / blockchains, two cases and examples of privacy strategies in DLTs / blockchains, and a discussion of the importance of privacy for social and public good going in the future.

Why transparency?

Transparency is a means for holding people, companies, organisations or governments accountable. Transparency is important for information and processes that are of collective concern in society: from political decision-making and public spending, to supply-chains, product ingredients and code. Transparency on its own does not guarantee accountability. It is a strategy for achieving the normative aim of holding powerful people or systems to account (Ananny and Crawford 2018). For cases where there is a clear understanding of roles and relationships of power there is also an understanding of when transparency is appropriate.

When 'transparency' merely becomes surveillance depends on questions of power. Transparency is when the powerful is made visible. When someone or something significantly determines and influences the lives of others they should be considered to be in a position of power. 'Decentralisation', whether real or imagined, can confuse this. With blockchain and Distributed ledger technologies, roles become somewhat reconfigured: private citizens are enabled to become 'prosumers', communities are enabled to provide financial services to one another and decisions are outsourced to algorithms and smart contracts. New actors emerge with different forms of responsibilities and spheres of influence – for example core developers of blockchain protocols, miners and nodes. Such roles and relationships in DLTs / blockchains are still consolidating. When relationships across sectors and industries are reimagined as a horizontal networks, it is easy to lose track of who or what is in a position of power, and should be held accountable, and who is not and needs privacy protection.

Giving Streets states that it is a blockchain-based donations platform that promises 'full public transparency on all donations via the Blockchain.' The project suggests that there is a lack of transparency in charity and that increased transparency will translate into more trust and therefore more donations. It is intended to help buskers, charity workers and homeless people to collect donations as societies move towards cashlessness. The project website states that people can donate money by scanning a recipients QR code and see how their donation has been spent; while charity organisations can receive donations, trace their spending and demonstrate their impact to funders. The website does not give further details of what kind of information is made transparent on the blockchain and to whom. But the details matter: for example, the traceability of spending, if not done carefully, could compromise the privacy of a homeless person. While tracing the spending of a charity could benefit the visibility of the issues they are addressing and serve towards accountability. The difference lies in the question of what data is made visible to whom and what they are enabled to do as a result. The balance between the two can be struck by for example abstracting and only gathering aggregate data while making the rest unlinkable. DLT's / blockchains for social and public good projects should aim towards highest standards of transparency on their technical architectures, as it is these that enable and enact the transparency and privacy features that they advertise.

Why privacy?

Privacy decisions should be considered an important aspect of active participation in democracies. Social, civic and even intimate life is increasingly taking place through and via digital platforms and networks. In recent years, major technology companies turned online life into datasets for commercial and political exploitation, significantly eroding democracy in the process. The GDPR was a regulatory response, aiming to strengthen privacy and return the control of personal data to individuals. Blockchain was a technological response, with the promise that data and applications would no longer be in control of major companies, but instead distributed across the network, curated and controlled through cryptographic keys.

Privacy is important in order to safeguard people from persecution and to allow people and communities to experiment, make mistakes, learn and grow. But with the continued expansion of digital networked technologies there is more to it than that. Data, including personal data, increasingly informs not only policy, commercial and political profiling, but also Machine Learning algorithms and thereby the technologies of the future. This implies that privacy preferences are inadvertently also choices that influence policy and technological developments going forward. This is one of the current limitations of GDPR: privacy is strengthened as an individual right and yet the consequences of individual decisions on privacy are decidedly collective. In this context, privacy should not just be considered an individual right to be protected through encryption. Encryption should be considered an increasingly essential tool for active democratic participation in shaping the digital systems, infrastructures and policies of the future.

Coconut is a protocol developed for the Ethereum and Chainspace blockchains to enable what is called 'selective disclosure credentials' (Sonnino et al 2018). The protocol was developed to enable people to prove specific things about themselves without having to reveal anything else. For example, one would be able to prove ones age without needing to show name, photo or any other information. Taking inspiration from the GDPR Art. 5 stipulation of 'data-minimisation', this approach enables fine-grained balancing of transparency and privacy. Only the necessary information is revealed while everything else remains hidden. Coconut is an example of a number of different projects that are building on cryptographic advancements of what are called zero-knowledge proofs. These utilise mathematical probability in order to prove a statement without having to reveal the associated evidence. Municipalities and civic platforms in Holland are exploring the use of such techniques for secure identity authentication with Attribute Based Credentials. Advancements in cryptography and privacy engineering are opening up novel ways to balance transparency and privacy concerns.

But these engineering solutions can be seductive and sold as silver bullet solutions. The balance between transparency and privacy remains a normative decision that depends on understandings of power relations and assessment of what is for the social and public good. Cryptographic techniques can be powerful tools to design fine-grained means to achieve these.

Transparency and privacy strategies for DLTs for Social and Public Good

DLTs / blockchains brought about a new wave of interest and experimentation with cryptographic techniques that can be used to balance transparency with privacy. Bano et al (2017) have translated GDPR guidance into strategies for engineers towards this end. These can also serve as pointers for regulators about what is possible. The authors state that privacy engineers can:

- Abstract, so that no personal information is processed, only grouped and aggregate information. In the case of Giving Streets, this implies that no individual spending is made visible, only aggregate information.
- Separate, whereby different data cannot be correlated, such that for example an action is not associated with a name.
- Hide, whereby personal data is made inaccessible or unobservable to the public, where for example access is determined by cryptographic keys.
- Minimise, whereby only the absolutely necessary data for a given purpose is gathered and processed.

Furthermore, they suggest strategies for enhancing the transparency of technical architectures:

- Inform those using the systems what personal data is gathered and how it is being processed.
- Control, so that people can control how their personal data is used.
- Enforce, so that privacy is enforced by default, by design.
- Demonstrate that privacy is being enforced, by providing evidence.

Getting the balance right between transparency and privacy requires an understanding of power dynamics. Understandings of the roles and relationships of power can be complicated by DLTs / blockchains and other decentralised systems. New cryptographic techniques can help balance transparency and privacy in fine-grained and context specific ways.

Privacy in the digital age was one of the main motivations that led to the invention of blockchain (Nakamoto 2008; Swartz 2018) and features frequently in discussions of DLTs / blockchains. But privacy continues to be understood as an individual right to private life, realised as a personal choice. As research has shown, personal choice about privacy is rarely felt as meaningful given that the consequences and effects are abstract (Symons and Bass 2017).

Foregrounding the collective, societal effects of such choices can make for a much more empowering case for privacy decisions. In order for DLTs / blockchains for social and public good move forward in this day and age, privacy needs to be significantly updated: from an individual right, to a means for active participation in deciding on how, when and for what one's personal data is used in the shaping collective technological futures.

Transparency and privacy, through regulation and engineering, are important aspects of functioning democratic societies. But transparency and privacy cannot be treated as fixed values. Rather, they are a means to achieve normative aims of balancing power, enabling accountability and deepening democratic participation. Ideally, DLTs / blockchains will in the future be part of a movement to democratise technological development more broadly by opening up new possibilities for data governance through infrastructural mutualism.

Recommendations

DLTs / blockchains for social and public good should take a 'minimum viable proof' approach to traceability and transparency.

Transparency and traceability can be useful, but not always appropriate as a method for achieving normative aims and can generate social and institutional mistrust rather than trust. Because blockchains promise the certainty of cryptographic proofs, it is tempting to want to trace an increasing amount of things. Similarly to GDPR Art.5c 'data minimization', only that which is relevant, adequate, and absolutely necessary should be traced using blockchain.

Privacy should be promoted as a main principle and use-case in DLTs / blockchains for social and public good.

Data, including personal data, informs policy, has economic value and determines access. Many of these processes, from credit rating to border controls are becoming increasingly automated through data processing and profiling algorithms. They are also feeding into Machine Learning and Artificial technologies of the future. DLTs / blockchains can enable new forms of data governance so that these processes can be democratised going into the future, and controlled by the people they affect.

5.5 Research informing policy: an analysis of an emerging blockchain-enabled collaborative economy

By Samer Hassan and David Rozas

Samer Hassan is an activist and researcher, Faculty Associate at the Berkman Klein Center for Internet and Society (Harvard University) and Associate Professor at the Universidad Complutense de Madrid (Spain). Focused on decentralized collaboration, he was awarded an ERC grant for the "P2P Models" project, to build blockchain-based, democratic and economically sustainable organisations for the collaborative economy.

David Rozas is a postdoctoral researcher at the Universidad Complutense de Madrid (Spain), currently involved in the P2P Models project. David's previous research as a PhD student at the University of Surrey (UK) focussed on individual involvement and group dynamics of Commons-Based Peer Production communities, studying the Free/Libre Open Source Software community Drupal, in the context of the FP7 EU project P2Pvalue.

Blockchain and DLTs are commonly associated with cryptocurrencies, new markets around emergent currencies, and overall with the disruption of Finance. However, the untampered potential of blockchain and other DLTs lies in its capacity to enable the implementation of novel properties at an infrastructural level in a fully decentralized manner, impacting the governance of technological tools. We are currently witnessing the early stages of these emergent decentralized structures, and thus their future potential beyond the financial world is just starting to be explored. In the last years, there has been an emergent body of both projects and literature around the role of new forms of blockchain-based governance.

Two confronting standpoints dominate the emergent debate on blockchains / DLTs and governance, which we may refer to as techno-solutionist and market-driven approaches, vs approaches supporting existing centralized institutions.

The first group often aims to solve social problems through the creation of new markets driven by their proposed cryptocurrencies. They show perspectives characterised by a high degree of techno-determinism. These perspectives envisage the emergence of new forms of blockchain-based governance on the basis of the potential of these technologies for decentralisation and trustlessness. These discourses typically inherently embed the idea of "market" and tend to ignore the complexity of social organisation. For example, they commonly assume that hierarchies between the participants in decision-making processes vanish thanks to the disintermediation enabled by blockchain technologies (e.g. Swan 2015; Hayes 2016; Heuermann 2015). Overall, they tend to provide reductionist accounts with regards to the distribution of power, failing to acknowledge issues such as the generation of oligarchies or power dynamics (Freeman 1972; Shaw and Hill 2014; De Filippi and Loveluck 2016). There are abundant examples of techno-solutionist projects aiming to tackle social problems through new markets, such as Steemit commodifying social media interactions, the KodakCoin cryptocurrency to license Kodak photographs, or Mercury Protocol rewards to tackle online harassment.

The second, smaller group, opposes the first aiming to use blockchains / DLTs to strengthen centralized traditional institutions. Their critical stand against these techno-determinist perspectives has successfully identified and criticised the limitations of such approaches (e.g. Atzori 2015; Atzori and Ulieru 2017). Nevertheless, this critique is built upon the reinforcement of the role of central authorities, resembling traditional responses against unregulated markets. In other words, these views consider traditional central authorities as inherently necessary to enable democratic governance and, as a result, ignore the potential for communities to successfully self-organise. By drawing on this assumption, the potentialities of blockchains / DLTs are envisioned in non-transformative ways: to support the control required by traditional centralised forms of governance. For example, providing more transparency to their central institutions (Nguyen 2016), more efficient mechanisms to avoid tax fraud (Ainsworth and Shact 2016), or several banking consortiums such as R3.

Still, beyond this reductionist dichotomy, there is a third approach worth exploring: the one followed by Nobel laureate Elinor Ostrom, on the governance of commons. Ostrom's work demonstrated that communities managing common pool resources were more efficient than both Market and State managers, as long as they followed certain governance principles. Thus, this third approach relies on previous studies on the self-governance of common goods, enabling a perspective that does not rely on the logic of private markets, as implicitly assumed by the hegemonic blockchain / DLT perspectives, neither on the logic of centralised institutions, which the emergence of the blockchain originally reacted against. The current debate is evolving to welcome this third approach, as we can see in both recent research (Rozas et al 2018, Calcaterra 2018, Shackelford and Myers 2017, Howell et al 2019), journalistic articles (Wong 2019, Anderson 2019) and emerging blockchain / DLT projects embracing it, of which the most relevant is the Commons Stack project (Emmet 2019), with the support of Giveth (Decoodt 2019).

This line of work explores essential questions such as: which are the transformative potentials of blockchain or other DLTs for more participatory forms of governance? Can we define relevant uses of DLTs beyond techno-deterministic, market-driven scenarios and traditional centralised control? And overall, how can DLTs facilitate large scale cooperation?

These questions regarding blockchain-enabled governance directly relate to one of the blockchain promises: the emergence of Decentralized Autonomous Organisations, or DAOs. A DAO is an organisation where the interaction of members (humans or machines) is mediated by a blockchain application, controlled only and exclusively by a set of immutable and incorruptible rules embedded in its source code. The notion of organisation here points to an entity comprising multiple people (or distributed applications) with a specific goal, not a legally registered organisation. A DAO can be regarded as a digital organisation mediated by a software agent, whose code is in the blockchain. As a decentralized organisation, a DAO can *provide services* (or resources) to third-parties, or even *hire* people to perform specific tasks. Hence, individuals can transact with a DAO in order to benefit from the service it provides, or to get paid for a contribution they made. As opposed to traditional online platforms, DAOs do not rely on any central server and cannot be arbitrarily shut down by any single party (unless specifically provided for in their code). Thus, DAOs may be considered fully *autonomous,* to the extent that they do not need their original creator. Besides, a DAO may be considered *self-sufficient*, to the extent that they can charge users for their own services (or assets) in order to pay for the services they need. A theoretical example could be a DAO-Couchsurfing (Couchsurfing is a hospitality network where members stay in each other's house couches), which provides a public directory of places, and users can interact and even reward the hosts with reputational tokens.

A lot has been written on how the Web 2.0 has facilitated new forms of social organisation and cooperation. At the same time, it has raised unparalleled control to a few large multinational corporations which act as owners of the enabling infrastructure. This has caused multiple issues around surveillance, privacy, accountability, exploitation, exclusion and monopolistic practices (Benkler 2016, Greenwald 2014, Anderson and Wolff 2010). DAOs provide a new way for building online software platforms, in which the technical infrastructure is shared, enabling higher levels of democratization, transparency and accountability. Thus, the promise of a Web 3.0 enabled by blockchain governance could potentially enable the benefits of boosting cooperation from Web 2.0 without several of its main core caveats.

Such promise has attracted multiple activists, non-profits and 'well-intentioned' actors to the field, and in particular to the creation of DAO-like organisations supported by DLTs. It is true that, if such potentials were untapped, we can envision ecosystems of small organisations connected through automated systems, with DAOs automating some of the burdens of large-scale organisation and facilitating the emergence of new International Organisations, Federations and Confederations. In such scenario, it would be possible, for instance: to have public institutions using freedom-respecting software providing services without compromising user's privacy (e.g. through the mathematical method of zero-knowledge proofs); to have large-scale cooperation across non-profits validated by a network of trust in which each vouches for their known 'friends'; to have new crowdsourced metrics of the multiple forms of value created by communities and social actors; to customize services beyond the current uniformity imposed by monopolistic software platforms, lowering the barriers for competition and opening the door to new forms of innovation by multiple non-profit and for-profit actors; appropriate automatic rewarding of work, including previously invisible reproductive work. And all these forms of cooperation would be facilitated without having an owner of the infrastructure with absolute control over the network and its resources.

However, such beautiful utopic scenarios, brought by both techno-deterministic and commoners in different degrees, confront a reality in which decentralized infrastructure, especially for DAOs, are not yet ready for large-scale deployment. Ethereum, with its DAO concepts, was first proposed in 2013, and had its initial release in 2015. Since then, three large blockchain projects have promised to make DAOs a reality: Aragon, DAO Stack and Colony. They are undoubtedly moving forward, and e.g. Aragon has 1,300 prototype DAOs. Still, these projects development is slower than initially projected, and have suffered from multiple issues. In fact, the technical and social challenges have been greater than anticipated, including: scalability of Ethereum, that these projects rely upon; standardization and interoperability across blockchains and with existing systems; usability for non-geeks; large-scale fair governance issues which have challenged political scientists for centuries and free/open source communities for decades; legal issues such as GDPR-compliance; a profound lack of trained blockchain developer supply; environmental concerns with Proof of Work algorithms, etc. These challenges have slowed down development and expectations, and eventually caused that, 12 years after Bitcoin and 7 years after Ethereum, we still do not have widely successful DAO cases to look into.

Still, we cannot despise the whole field, since there is a wide diversity of worthwhile projects that can be considered DLTs for social and public good, i.e. aiming for social and public impact. The current report throws some light on the current state of this field, and enables us to see points of intervention for Europe to facilitate the work of the emergent field of DLTs for good that it is brewing within its grounds. It would be sensible to reinforce existing trends, as in: promoting free/open source projects and digital open commons in general; funding research to solve the infrastructural problems; supporting both for- and non-profit entrepreneurship (and not just the former); incentivizing diversity in technical teams; and aiding the consolidation of the emerging hubs already appearing in several European countries.

Recommendations

Investing in the research and construction of free/open source decentralized technical infrastructure.

The current Collaborative Economy is overwhelmed with monopolistic corporate US-based platforms causing a large number of issues (e.g. Facebook, Uber, Google, Airbnb). Europe is currently putting efforts in trying to have their own “European Unicorn”. However, barriers for competition are very high in the current playing field, so it may be more sensible to change the rules of the game. That is, support the emergence of decentralized interoperable open source infrastructure where new ecosystems can thrive, providing customized services which are unthinkable nowadays. There are multiple technical and social challenges with respect to developing decentralized tech, and today there is a window of opportunity for Europe to boost the field and strengthen their position. It is already happening, with e.g. “Bloxberg” providing blockchain research infrastructure after an initiative from the Max Planck Library.

Strengthen EU hubs on decentralized tech, including not-just-for-profit, open and diverse projects.

The mapping of the European ecosystem of DLTs for social and public good published with this report has provided insights on the existing trends and projects already ongoing. Public institutions now have the chance to strengthen this ecosystem, aiding in the consolidation of the emerging hubs already appearing in several European countries. This should be done not just focused on for-profit entrepreneurship, but also on non-profit entrepreneurship, as the data shows has a strong presence in the EU. In fact, this has happened in the free/open source software world for decades in the USA (e.g. Mozilla Foundation, Apache Foundation, Free Software Foundation). In the same line, strengthening the existing trends on openness and diversity will give a clear advantage to teams aligned with European values in the international arena.

Promoting Platform Co-ops as emerging governance and business models.

The Collaborative Economy facilitated by the centralized Internet has enabled large US-centric monopolies which act as central data hubs for the world population private data. However, as the Sharing Cities Declaration states, when considering policy, not all platforms are the same. With the emerging decentralized web, new possibilities open up concerning governance and business models. As opposed to the US, in Europe people are more used to participatory businesses and co-ops, and a 17% of Europe's population are members of a cooperative business. Today, there is an opportunity to support an emerging business and governance model, in line with decentralized tech: Platform Co-ops, i.e. platforms in which the users have a voice and a share of the profits, such as the German Fairmondo. There are already public initiatives to support, incubate and accelerate such projects, such as Barcelona City Council's "La Comunificadora".

5.6 Blockchain technology as a mechanism for global bottom-up coordination

by Primavera De Filippi

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The need for trust in governance

The COVID-19 pandemic has shown the limitations of the current global governance system. Existing governance institutions, both on a national and international level, have been unable to address this global health challenge in an efficient and concerted manner. Lack of strong political leadership in the early days of the pandemic was in part due to a tendency to focus more on the short-term rather than on the long-term implications of such a crisis. Political interventions in the latter stages of the pandemic have been elaborated at the national level—often in a non-concerted manner—rather than seeking to collectively come up with large-scale interventions to address the pandemic in unison. Interventions have been geared mostly on individual confinements and national lock-downs, including international travel bans, without appropriately acknowledging the growing interdependence of modern societies, populated by transnational corporations and organisations, whose long-term sustainability depends on a considerable flow of capital, goods, services, and people across borders.

Finally, many governments around the world (e.g. China, Singapore, Israel) introduced measures for authorities to track down the journeys of infected people as a means to reduce the spread of the virus. These measures—although successful to some extent in promoting better practices of social distancing—raise important privacy challenges, and are often regarded with skepticism as they may lead to the establishment of a new surveillance regime that may persist even after the pandemic. Hence, the current responses to the pandemic are likely to undermine the trust that people put in governments and public institutions, regarded as either ineffective or too oppressive in their actions. This is particularly problematic in a period where self-discipline and social commitment —which both require trust— have become crucial elements to overcome this global crisis.

Increasing trust through confidence

The impact of blockchain technology on institutional and corporate governance has already been explored by a variety of scholars (De Filippi and Wright 2018, Werbach 2018, Reyes 2019) seeking to better understand how blockchain technology could contribute to increasing transparency and accountability in a variety of sectors. Major banks (e.g., the R3 consortium) have already been experimenting with blockchains and DLTs for the settlement of inter-banks transactions, in ways that are more secure and efficient (Eyal 2017). In 2015, Nasdaq created the first blockchain-based system for the trading of private companies shares (Rizzo 2015), and securities brokers are currently exploring the technology's potential to expedite the trading of securities by reconciling settlement and clearing into one single step (Trautman 2016). In the public sector, while Estonia was the first to recognize the potential of blockchain and other DLTs for securing the operations of governmental agencies, in the past few years, several governments have begun to explore the potential of these technologies to improve the transparency, integrity, and even the efficiency of public administrations (Ojo and Adebajo 2017, Maupin 2017).

Finally, at the international level, some use cases have already been identified for the use of blockchain technology as a means to increase transparency and traceability in the supply chain (Francisco and Swanson 2018). Several initiatives are emerging, using blockchain technology to improve real-time tracking and logistics[40] or to guarantee the traceability and the provenance of specific goods or services[41]. The same technology could be deployed as a global and decentralized database where countries could log and trace the spread of the pandemic, and potentially even to keep track of the various tests (and, eventually, vaccines) delivered to people, allowing them to prove they have been tested without excessively impinging upon their privacy.

Overall, by contributing to greater transparency and accountability, blockchain technology can ensure a higher level of predictability in the operations of public or private institutions. In fact, to the extent that these institutions are constrained by a series of technological guarantees—which they cannot deviate from — it is impossible for them to act in an opportunistic manner. Moreover, because they do not have the power to unilaterally modify or influence the operations of a blockchain-based system, there is less of a need for third-party's scrutiny and oversight. The adoption of blockchain technology is enough to guarantee that these institutions will not be able to act in ways that go counter to people's own interests or expectations.

Accordingly, by enhancing the confidence and reliability in public and private institutions, blockchain technology reduces the level of risk

40 As for example OriginTrail http://origintrail.io

41 As for example Provenance http://provenance.org

or vulnerability that is generally associated with trust.[42] As such, the technology could indirectly contribute to increasing the level of trust that people may be willing to confer in these institutions, because of the higher degree of predictability associated with their actions. Indeed, thanks to blockchain technology, people would no longer need to trust these institutions in toto, but only to the extent necessary for them to carry on these specific operations that cannot be codified into the formal and deterministic language of a blockchain-based system.

Addressing interdependence

The greater transparency and higher predictability provided by blockchain technology could contribute not only to increase the confidence (and trust) in public or private institutions, but also to support more cooperation among institutions that do not trust each other, without the need to establish an overarching entity or organisation in charge of coordinating the activities of multiple parties. This could have important implications for global governance. However, as of now, while the benefits of blockchain technology have been studied from a sectoral perspective (in terms of e.g., financial applications, supply chains management, impact assessment, philanthropy, etc.), too little attention has been given to analysing whether the principles of distributed consensus and bottom-up coordination elaborated within the blockchain space could be transposed in the global arena to support the resolution of global challenges in a more concerted and coordinated manner.

We live in an interconnected world, and yet we lack a proper mechanism of international or even transnational coordination (Biermann et al 2009). While global interdependencies provide many opportunities for cultural and economic growth, they also introduce multiple points of failure that might propagate errors across multiple social and economic systems (Balsa-Barreiro et al 2020). Accordingly, global challenges cannot be addressed individually, from the perspective of a single entity or nation state. They require a more holistic approach involving all relevant parties, both public and private actors (Hewson and Sinclair 1999), with an in-depth analysis of their mutual interdependencies, so that they can be addressed collectively and on a global scale.

One solution would be to create a centralized global governance system to better manage these interdependencies, with the establishment of a dominant superpower that can actually exercise coercion to enforce its decision on a global level. Yet, such a solution would introduce a single point of failure and control, which may go counter the established principles of global governance and international law. On the opposite side of the spectrum, an alternative solution would be to “deglobalize”, cutting down connections and closing up borders, while progressively strengthening resilience at the local level. Such a solution would entail some level of decentralisation, albeit a form of decentralisation driven solely and exclusively by a lack of trust.

The most appropriate solution probably lies in between these two extremes. The challenge is to figure out how we can create a more resilient and trustworthy governance system that actually embraces (rather than rejects) interdependence; one that supports and encourages cooperation amongst multiple

42 Drawing from Luhmann’s distinction between “trust” and “confidence” (Luhman 2000), we refer here to “confidence” as a set of expectations about the operations of a person or system, based on personal experiences or inductive knowledge about the way the world works. We refer instead to “trust” as the act of delegating power to a third party as a result of insufficient knowledge or excessive complexity for carrying on the task at the individual level. Hence, as opposed to confidence—which is based on rational expectations and predictability—trust necessarily involves some degree of risk or vulnerability, as it requires taking a leap of faith as regard the trustee’s good intentions to act in the trustor’s best interest.

interrelated parts, so that global challenges can be addressed collectively, through a decentralized yet coordinated approach.

The blockchain solution

As Ostrom (2000) would point out, decentralized yet coordinated action is hard without monitoring or enforcement. Blockchain and other DLTs provide a decentralized solution to precisely both of these challenges: monitoring can be achieved in a decentralized manner via a distributed ledger used to record information in a transparent and tamper-resistant manner; whereas enforcement can be achieved through a system of smart contracts for the trusted execution of specific agreements, automatically executed by the underlying technology (De Filippi and Hassan 2016).

In light of that, the benefits of blockchain and other DLTs for global governance are essentially twofold. On the one hand, the use of blockchain technology by public and private institutions could lead to a higher degree of confidence in their operations, increasing the trust level conferred to these institutions while simultaneously reducing the need for global scrutiny and oversight. On the other hand, the adoption of a shared database and execution platform based on a decentralized blockchain infrastructure could facilitate new forms of cooperation amongst these different institutions, providing for a trusted and coordinated mechanism of bottom-up collaboration that does not rely on any centralized superpower or other trusted authority.

While there is currently a lack of empirical data on the actual benefits of blockchain technology in the field of corporate and institutional governance (due to the relatively limited adoption of blockchain technology in existing institutional settings), insight from international law and global governance scholars could help us investigate the extent to which existing blockchain-based solutions for institutional governance—such as public blockchains, consortium blockchains, or even permissioned blockchains—could be adapted to support the coordinated actions of a variety of public and private actors (e.g. market players, governmental agencies, civil society organisations, etc.) participating in a global and polycentric system of governance (Polanyi 1951, Ostrom 1999).

Recommendations

Short term: Encourage public and private institutions to adopt blockchain / DLTs as a means to provide technological guarantees.

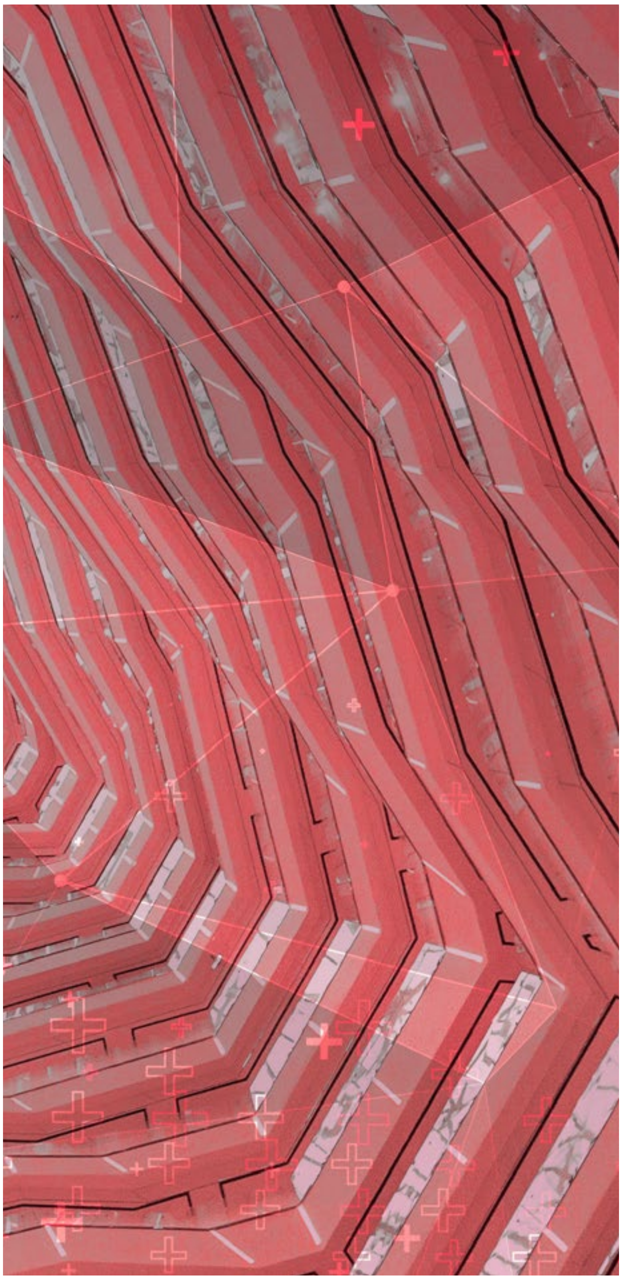
The adoption of blockchain technology could help re-establish public confidence and trust in existing governance institutions by providing a series of technological guarantees that they cannot deviate from. By enhancing the transparency, accountability and predictability of these institutions, blockchain technology makes it easier for people to trust them to act in their own interest.

Medium term: Promote innovation in the blockchain space via the use of blockchain / DLTs for regulatory compliance.

Policy-makers could promote innovation in the blockchain space by inviting the private sector to come up with new usages of blockchain technology as a regulatory technology (regtech) through a series of technological guarantees designed to achieve specific regulatory objectives. Provided that these solutions are recognised by regulators as being "functionally equivalent" to existing legal formalities, regulators would let anyone who adopts them benefit from a lower regulatory burden.

Long term: Foster the implementation and progressive adoption of shared blockchain / DLT infrastructures for public services that extend beyond national boundaries.

If global challenges are to be addressed in a coordinated manner, it is crucial to have a common infrastructure which constitutes the backbone of selected public services. The European Union is already working on the implementation of such a solution with the European Blockchain Partnership. Ideally, similar initiatives would emerge from different regions of the world, all sharing a common infrastructure that is controlled and governed in a distributed manner by all relevant stakeholders.



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