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Civic Blockchain: Making blockchains accessible for social collaborative economies

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ABSTRACT

Social sciences are investigating the societal implications of using blockchains for social collaborative economies and participatory practices. This article contributes by advancing an original approach to blockchain-based applications defined as Civic Blockchain. It is implemented with a wallet app currently experimented upon in local communities.

Our approach is informed by an analysis of the critical literature on ethical and design dilemmas concerning blockchain for social impact. The conceptual framework revolves around three principles (Internet of Values 2.0, disintermediation of services, and local adaptation), that are reflected in our technical choices. The approach makes blockchains accessible to local community members, leveraging some of their core affordances and advancing new interpretations with a focus on technical and economic accessibility. Blockchain technology can support new socio-economic practices on a local level when intentional actions are undertaken by developers and users to address the societal challenges.

1. Introduction

Blockchain technology is gaining ground in technical and political debates concerned with finding new models for managing assets and coordinating actors and processes. It offers an alternative paradigm for storing, validating and transferring information and values compared to established ICT technologies (Viano et al., 2022). The core innovation of the technology is the safe and secure transfer of digital property such as currencies, data, assets and certificates in a trustless and decentralised way i.e. without relying on third-party intermediaries.

Blockchain technology emerged in 2008 to enable Bitcoin transactions (Nakamoto, 2009). It has been applied to fields such as cryptocurrencies, finance, trade, logistics, food traceability and other business domains. Then, it began to be experimented with in e-government and co-production of public services within the public sector (Cagigas et al., 2021) and activities targeting societal needs, defined as blockchain for social good or blockchain for social impact (Galen et al., 2018; Polvora et al. (eds), 2020; PositiveBlockchain, 2022; Voshmgir et al., 2019). The latter includes innovations in agriculture, energy production, trade, health, and digital certificates (Bartoletti et al., 2018). In the realm of civil society, on the other hand, NGOs, associations, social enterprises and activists are experimenting with this technology in the framework of social collaborative economies (see for instance Howitt et al., 2021; Circles Coop eG.; Mattson et al., 2023, and Section 4 for other examples). We mean social collaborative economies as a set of diverse economic practices and models including collaborative or sharing economies, social and solidarity economies, commoning, and related participatory and civic organisation processes. Many of these experiences are based on horizontal, decentralised, peer-to-peer governance and business models (see references in Section 2.1). These are the characteristics that make blockchains, with their disintermediation logic and tokenised economies, an interesting supporting technology. Differently to other ICTs widely used to support collaborative work (e.g. social media, collaborative editing and wiki tools, crowdsourcing platforms, opinion formation software), which mostly concern the transfer of information, blockchain's potential lies in the digital representation and safe transfer of values and the disintermediation of transactions (Viano et al., 2022). This is expected to expand the possibilities for implementing peer-to-peer socio-economic models and creating financial instruments for solidarity and inclusion purposes. Therefore, blockchain applications

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are being tested to implement social finance (microcredit, crowdfunding, donations, peer-to-peer (p2p) payments), local currency schemes, peer-to-peer production and exchanges, decentralised organisation management and decision-making, purpose-driven tokens for collective value creation.

Even if there are multiple experimentations, there is still a lack of empirical evidence on how to implement blockchain-based tools that comply with the desired collaborative, participatory or emancipatory processes for social and political outcomes (see references in Section 2.3). Recent contributions (Elsden et al., 2019; Gloerich et al., 2020) have drawn attention to the goal of 'making the blockchain civic' (Elsden et al., 2019), which has inspired much of the reflections presented in this article. We advance an original approach to designing and developing applications of blockchain technology to enable people to actively participate in social and collaborative economies at the local level. This approach is called Civic Blockchain and has been implemented in practice in an experimental research project involving a blockchain-based wallet app named CommonsHood. The aim is to bring the advantages of this technology – digital representation and transfer of values – back to the local level and accessible to all users. This is rather different to speculative cryptocurrencies in global financial markets, which usually demand fairly advanced technical or financial skills. Our approach is based on an interdisciplinary empirical work of co-design, technical development and iterative testing guided by the following research questions:

- What affordances of blockchain technology can be made accessible to community members to strengthen civic practice, and how?
- To what extent does this approach answer ethical dilemmas that emerge for civic applications of blockchains?

We will show that this approach makes blockchain affordances (Rozas et al., 2021, section 2.4) available to community members by leveraging some of its core technical properties and advancing new interpretations of its potentialities with a focus on technical and economic accessibility.

This article starts with a conceptual clarification of social collaborative economies and a review of the literature on ethical and design dilemmas (Cila et al., 2020) and challenges in applying blockchain in the civil society and financial inclusion sectors. After a section on methodology, we propose three principles that address these challenges which together constitute the Civic Blockchain approach (Internet of Values 2.0, disintermediation of services, local adaptation). We then show how these principles are achieved in the features of the experimental app. We discuss strengths and open issues concerning this approach based on evidence from co-design sessions with potential users of the app. We conclude with some reflections on the conditions that make blockchains relevant for collaborative exchanges.

2. Literature review

2.1. Social collaborative economies

In this article, the term *social and collaborative economies* means diverse and overlapping economic practices and models including: collaborative or sharing economies, social and solidarity economies, commoning, and related participatory and civic organisation processes. Each of these groups is in turn composed of a variety of practices, political visions, and social and economic goals which include both market-oriented business models and alternatives to them. The specific definitions referred to below are drawn from recent work on the potential of digital technologies for different socio-economic models.

The *social and solidarity economy* encompasses organisations that have social and environmental objectives beyond economic ones, prioritising the collective or general interest over profits. They involve different forms of distribution of surpluses and participatory governance (ILO, 2022; EC, 2021; Krlev et al., 2021). This broad definition includes formal organisations (social enterprises, cooperatives, foundations) as well as informal or grassroot communities. As regards the latter, *solidarity economies* (see the work of Miller (2010) for the history of the concept) are defined by Valchokyriakos et al. (2017) as self-organised and participatory practices that represent an answer to inadequate welfare public services and austerity policies. Initiatives such as time banks, goods distribution networks, work cooperatives, social clinics, social schools, alternative currencies, self-help groups, and collectives represent an alternative to capitalism. They have socio-political and socio-economic emancipatory goals and operate between reciprocity, redistribution and the market (Laville, in Vlachokyriakos, 2017).

Commoning refers to processes where actors cooperate with decentralised coordination and the absence of traditional hierarchical organisations to produce and/or manage shared resources and common goods (Bollier & Helfrich, 2019) such as natural resources, urban commons, shared knowledge. In the digital domain, *commons-based peer production* (Benkler & Nissenbaum, 2006) is a field where blockchains are increasingly experimented with for enabling disintermediated transactions (see for instance Rozas et al., 2021).

Collaborative or sharing economies are characterised by peer-to-peer exchanges and collaborations and by the use of digital platforms, to enable direct matching with minimum intermediation (Como & Battistoni, 2015). We distinguish between *business and market-oriented* collaborative economies on one hand and *civic and social* collaborative economies on the other hand (Como & Battistoni, 2015). An analogous distinction between mainstream global commercial platforms within the for-profit sharing economy and location or community-oriented platforms can be found in the work of Lampinen et al. (2022). In our work, we look at civic and social collaborative economies. These rely upon mutual and solidarity collaboration (Como & Battistoni, 2015) for consuming, producing, learning, finance and governance (Stokes et al., 2014; Wosskow, 2014).

In this article, the term *social and collaborative economies* are intentionally used as a general concept focusing on the following recurring features of these models: the advancement of alternative economic models to capitalism; the focus on solidarity and collaboration rather than market competition; implementation on a local scale. There are usually elements of gratuities or gifts, non-monetary exchanges, sharing and mutuality but market exchanges are not excluded (Vlachokyriakos et al., 2017).

2.2. Digital technologies in support of social collaborative economies

Beyond the sharing platforms adopted by civic and social collaborative economies (Como & Battistoni, 2015; Lampinen et al., 2022), a broad set of digital technologies for horizontal collaboration is being experimented with in the initiatives mentioned above (Peacock et al., 2022; Saldivar et al., 2019). Messaging, teleconference applications and social media are widely used for daily communication while crowdsourcing/crowdmapping platforms are used for more complex sharing and organisation of information. Applications for collaborative editing of documents, open software repositories, wiki tools and e-learning platforms are used for collaborative management, knowledge building and sharing. Crowdfunding platforms are adopted to get financial support for grassroots initiatives. More complex software for opinion formation and e-voting are recently being tested in direct democracy processes. Digital social innovation (Certomà, 2021) and digital civic (Olivier & Wright, 2015; Vlachokyriakos et al., 2016) projects strive to adopt or develop tools that are economically accessible, easy to use, and developed according to open-source, open-access, technological sovereignty approaches. Most of these digital technologies are ICTs that support consolidated models of interaction that revolve around the sharing, organisation, transfer of information (Lember, 2019; Yuan, 2019). Conversely, peculiar affordances of the blockchain are the representation and transfer of digital values, and the disintermediation and

full traceability of transactions (Viano et al., 2022). This is what makes this technology interesting: it enables fully open, decentralised management and value accounting systems for cooperatives, p2p production systems, commons, energy communities, social finance and fundraising via alternative or complementary currencies. Section 4 below provides an overview of such blockchain-based tools in the field of social economies and social finance.

2.3. Debates concerning blockchain social impacts

The reason for the great hype surrounding blockchain technology is its potential to disintermediate and decentralise long-established modes of business and governance. Advocates consider it as the foundation for: a true peer-to-peer sharing economy, automated decisions, self-organisation, secure accounting, and management of resources (Elsden et al., 2018). Critics consider it an overhyped technology (Glaser, 2017) or argue that by providing a techno-institutional framework for the general commodification and financialisation of relationships, it could actually reproduce power imbalances rather than disrupt them. Others warn that trustless forms of exchange overlook the complexity of social life, that there are difficulties and risks involved in attempting to engineer governance and encode social contexts in smart contracts (Garrod, 2019).

Social sciences are starting to investigate the societal effects and risks of blockchains in more depth, and its political implications for the public and social sectors. Research on public management and policy analysis focuses on: blockchain compliance with societal needs and public values (Olnes et al., 2017), related benefits and risks (Cagigas et al., 2021), and policy dilemmas (Clifton & Pal, 2022) arising from a technology originally conceived as trust-minimising (Szabo, 2014;). Most applications in the public sector so far are primarily aimed at increasing the efficiency, transparency and security of public services (Bustamante et al., 2022) rather than supporting co-production processes where citizens are actively involved. Conversely, the role and agency of individuals, civil society and private actors is more relevant in the literature on Blockchain for Social Impact, which studies whether these initiatives improve and transform existing processes or allow new processes (Galen, 2019), with the societal and political implications of such initiatives. Generally speaking, there are multi-stakeholder systems of actors and there may or may not be public actors involved, depending on the case. Within this body of research, two interrelated strands are of interest to our work.

The first strand is current studies in the fields of design, human-computer interaction, media studies, and science and technology studies about blockchain initiatives for social and collaborative economies, with a critical approach that investigates to what extent the technology's design complies with desired social and political outcomes (Cila et al., 2020; Elsden et al., 2019; Giorgino, 2018; Gloerich et al., 2020; Pazaitis et al., 2017; Rozas et al., 2021). For each blockchain affordance, they highlight not only their potential for implementing specific socio-economic models but also the risks they pose in undermining public and societal values. These ambivalences are expressed in the form of ethical and design *dilemmas* (Cila et al., 2020; Gloerich et al., 2020; Lapointe and Fishbane, 2019) or *risks* (Rozas et al., 2021) to social models of interaction, power relations and social justice. The second strand studies blockchain applications that address financial inclusion problems through the provision of access to financial services for the unbanked, charity donations, and community currencies (Mqamelo, 2022; Ozili, 2020). Some studies (Pisa & Juden, 2017; Scott, 2016) raise additional questions which are of particular interest for our case study as they focus on the blockchain affordance of transferring values and its potential for truly empowering social finance.

2.4. Dilemmas about blockchains for civics

Integrating the two strands of literature mentioned in the previous section, we obtain a comprehensive overview of the criticalities and challenges to be considered when developing blockchain applications that target social and collaborative economies, civic contexts and local communities. We have grouped them into three categories of dilemmas which we consider in relation to some of the distinctive affordances of this technology, i.e. the potential uses and applications that the specific properties of the technology enable in relation to the context of their use (Rozas et al., 2021, p.4) following the definition of affordances advanced in the STS domain by Hutchby (2001) and Gibson (1979).

(a) One of the most discussed dilemmas of blockchains concerns the property of tokenisation[1] (i.e. a process that converts the right to an asset into its digital representation as a token) and the related affordance of digitally representing and transferring values, rights and incentives and keeping detailed accounts and tracking. *Formalisation and quantification of values* are necessary for that, but they can clash with or overlook the *informal nature of social relations*. Questions arise such as what has to be valued and tokenised and to what extent. This is often discussed in parallel with the relationship between *financial and economic logic* and *social logics* that regulate the exchanges of tokens, and the risk of commodifying the latter (Cila et al., 2020; Gloerich et al., 2020; Scott, 2016).

(b) Other dilemmas address the affordance of disintermediated or trustless interactions enabled by consensus algorithms. Firstly, as regards *disintermediated modes of governance*, and therefore the *systems of actors in place*, some authors warn of a paradox that emerges with a *new centralisation of powers* in the hands of those who decide the rules to be encoded and ultimately the coders (Parkin, 2020). Another debate focuses on *different views of trust*. Blockchain-enabled interactions were originally conceived as *trustless* (Werbach, 2018) or at least *trust-minimising* (Bodó & Janssen, 2022) when it came to trusting a third party. Some authors specify that trust or confidence have rather shifted to the technical infrastructure, and therefore ultimately to those who design and develop the infrastructure (Filippi et al., 2020). Others hold that there is a positive connotation to blockchain as a *trust-enabling* technology that can provide people with an alternative trustworthy means to interact (Gloerich et al., 2020; Scott et al., 2017).

(c) A third set of dilemmas opposes on the one hand the *automation and self-enforcement* enabled by smart contracts and decentralised autonomous organisations (DAOs), and on the other hand *human interpretation, freedom, and exceptions.* Consequently, the design phase is critical to ensuring that the *social negotiation of rules takes place* before they are encoded, not only to avoid them being inadequate for different social and cultural contexts, but also to avoid the risk of encoding discrimination or inequality (Lapointe and Fishbane, 2019). The *relationship between digital technology and its context* can also be considered from a spatial perspective. Scott (2016) asks what is the proper scale for blockchain-enabled collaborative systems (e.g. local currencies) to be sustainable. Rozas (2021) and Pazaitis (2017) observe a trade-off in commons-based and peer-to-peer systems between scaling up and relationships of a horizontal, personal character.

[1] The term *tokenisation* should not be confused with *tokenism* used in diversity and inclusion domains to indicate actions that are presented as being favourable to people or groups treated unfairly that do not really ameliorate their conditions or provide them with opportunities for substantial participation. This can be the case for the political representation of minorities, of inclusion of specific categories of workers, or even the supposedly active role of people in general in processes such as participatory research, or co-production of public services, when this merely results in consultation or provision of information.

3. Methodology

3.1. Experimental research on local civic technologies

This contribution stems from an interdisciplinary research project about the development of new conceptual and technical blockchain solutions, and is part of a wider research approach to the development of civic technologies (Saldivar et al., 2019) for applications at the local scale. Without addressing in detail the debate concerning the visions and narratives behind the term civic technologies (Certomà & Corsini, 2021; Shrock, 2019), we intend that term to mean digital tools designed in order to reshape systems of governance and powers (Shrock, 2019) rather than simply oriented towards the ends of collective and public interests.

We adopt an approach to digital innovation that focuses on the dimension of human relations (Calzada & Cobo, 2015; Cardullo et al., 2019), local technological sovereignty, and participatory management of digital platforms (Mello Rose, 2021; Morozov & Bria, 2018). We do not develop totally new architectural solutions, that would take a long time to establish due to the limited network effect. We re-deploy mainstream blockchain-based solutions and technological metaphors (e.g. the crypto wallet), designing them from the outset as open access, open source. Moreover, for blockchains, accessible, local, less energy-consuming and less costly applications are needed.

Software development in this project is complemented by research lines carried out by social scientists. Namely, economists and sociologists are focusing on the relational dimensions of distributed ledger technologies (DLT) users (Giorgino & Walsh, 2018); urban and digital geographers study the mutual relationships between the technology and the socio-spatial dynamics of the local contexts of application (Certomà, 2021). Thus social scientists, as insiders in the software development project, gather evidence on the societal effects of the app under consideration, and contribute to its iterative improvement. Moreover, the research addresses the need, on the part of social sciences that study digital transformation, for more engagement with specialist computational studies (Ash et al., 2018; Iapaolo et al., in press; Kitchin, 2017; Lember et al., 2019). Furthermore, relevant inputs are taken from other research projects on the blockchain from a human-computer interaction and design perspective (Cila et al., 2020; Eldsen et al., 2019; Murray-Rust). Indeed, the design of digital technology in that it reflects political visions in the functionalities of the technology (Iapaolo et al., in press), especially for blockchain-based processes that, once set up and coded, are characterised by different extents of immutability and automation.

3.2. Analytical and conceptual framework

This paper proposes analytical and conceptual frameworks that place our experimentation within a wider debate on the societal implications of Blockchains for Social Impact.

The analytical framework used for reviewing recent literature on blockchain design dilemmas (section 2) organises these dilemmas and risks into three macro categories, based on the core affordances of the technology, in order to ground the social science analysis on thorough knowledge of the technology (Iapaolo et al., in press).

Based on the same three categories, we advance a conceptual framework that substantiates our approach to the design and development of civic blockchains for local communities and social and collaborative economies, and that revolve around the principles of a) *Internet of Values 2.0*, b) *disintermediation of services* and c) *local adaptation* (Section 4). We illustrate how these principles represent possible answers to the above-mentioned dilemmas; how they are reflected in the design choices made for the experimental app; where the approach leverages well-known blockchain properties, where it advances novel interpretations, and what issues remain open for further research. Table 1 summarises the conceptual structure of this article.

Table 1
Conceptual framework.

Blockchain properties / affordances	Blockchain design dilemmas (section 2)	Civic Blockchain approach (section 4)	CommonsHood core features (section 4.d) (*How*)
Tokenisation and secure transfer of values	Formalisation and quantification of social values	Internet of Values 2.0 (*What*)	Tokenisation in the hands of users; simple interface
Disintermediated interactions	Trustless vs trust-enabling	Disintermediation of services (*Who*)	Token transfers, crowdsales for social economies
Self-enforcement	Automation vs social negotiations	Adaptation to local and civic contexts (*Where*)	Synergies among different tokens; interaction functionalities

3.3. Empirical analysis

The Civic Blockchain approach is implemented with an app representing the experimental case study for our research project. The findings on the relevance, strengths and open issues of the approach are based on qualitative data. Data were collected during the co-design and first testing phase. The data sources and collection methods were:

(i) Two testing sessions with 97 graduate students of economic sociology, and of ethics and computer science, in April 2020 and May 2021 (questionnaires and participant observation).
(ii) Demonstrations for visitors to the 2021 European Researchers Night in Turin (semi-structured interviews).
(iii) Online project design meetings together with partners of 4 local pilots of the app[2] between May 2020 and December 2021 (analysis of projects documents and participant observation).

On each occasion, we presented an introduction to blockchains, followed by a demonstration of the app. In *i)*, students were asked to test the app based on scenarios proposed by the researchers, and were then asked to propose other possible use cases. In *ii)*, people were asked for their first impressions of the tool and to imagine possible use cases in their daily lives. In *iii)*, people already active in piloting the tool were involved in more in-depth analysis of requirements.

The different collection methods selected are functional to the diversity of contexts where potential users were met. The following questions were used as a common analytical framework in order to assign data to the three categories of the conceptual framework. *What value(s) would be tokenised and transferred* (a - Internet of Values 2.0)*? How is the creation and use of tokens disintermediated, and what are the roles of the main users* (b – disintermediation of services)*? In which concrete situations would the app be used* (c – local adaptation)*?*

4. The Civic Blockchain approach

The app we implemented is a blockchain-based wallet app, named CommonsHood, whose general purpose is to 'empower local communities and sustain their economies' (Balbo et al., 2020). It allows users to create tokens (i.e. digital representations of assets, rights, or resources) and to distribute them to other wallets. Associations, local institutions and retailers can create instruments to finance themselves (e.g. prepaid cards, crowdfunding mechanisms), tickets providing access to shared tools and structures, complementary currencies, and loyalty instruments such as discount coupons, purpose-driven tokens to reward civic behaviours (Viano et al., 2022). The app is an Ethereum-based wallet decentralised application (dApp) which is fully operational (TRL7) to

[2] see footnotes 6, 7, 8, 9.

run on-site experiments in a real environment.

Similar blockchain tools for social economies in local communities include tokens for prosocial behaviours (Colu, Changers Co2 fit, Buck-e), local currencies (Leman, La Racine, Circles, Cirklo, Sarafu), social finance (Trustline, Manna, WeTrust), and DAO prototypes that include one or more of the above-mentioned tools (e.g. Sinergatika). New protocols and open-source tools for social cryptocurrencies and social DAOs are being advanced e.g. FairCoin, Celo, MakerDAO and SourceCred. Other prototypes are used by HCI and design researchers to get more knowledge about how people perceive the potentialities and risks of blockchain (for an overview see Murray-Rust et al., 2022). This short list is merely illustrative and does not include projects mapped by Polvora et al. (2020) and (PositiveBlockchain.io 2022) that are not active anymore. Other initiatives just use existing cryptocurrencies for so-called social impact ends via decentralised donations (AntLove, GiveTrack, Giveth and Aidcoin), money transfer (BitPesa and Rebit) and crowdfunding services (EtherInvest and CreditFund). CommonsHood is different to most of these in that it groups different token-based tools in one wallet, lets users choose what to tokenise, and is strongly oriented to local contexts.

Below, we introduce core principles of the app's design that address the three categories of design dilemmas identified in the literature (section 2) by focusing on: *what* the application allows to be exchanged, i.e. the content of the transactions (section 4.a); *who* is involved and how, i.e. the actors involved, their trust and governance relationships (section 4.b); and *where* the exchanges take place, i.e. the local socio-spatial contexts (section 4.c). We then show *how* these principles are embedded in the app's features and functionalities (section 4.d).

a) Internet of Values 2.0

The risk of excessive formalisation and quantification inherent in many tokenisation mechanisms is characteristic not only of cryptocurrencies but also applications that rely on highly automated traceability, accountancy, certification, and management of peer-to-peer systems. From a technical perspective, tokens are usually developed and deployed by the owner and by his/her technology experts only before being distributed. This happens also in most blockchain for social good projects.

The app under consideration aims to mitigate the above risk by letting users choose what to tokenise and the terms of their use. Some of the latter are encoded in smart contracts while others are actuated off-line by the participants. We define this as the Internet of Values 2.0[3] approach in analogy with the Web 2.0 revolution in the world of information. That revolution transformed the World Wide Web from an IT tool reserved for programmers to a tool that allows everyone to produce and publish content online. Internet of Value 1.0 (a.k.a. Web3) is intended to mean the online space where, thanks to blockchains (Tasca, 2020; Treiblmaier, 2022) and DLT in general, assets or values can be transferred in a cheap and reliable way and without middlemen. With the Internet of Values 2.0, the blockchain property of tokenisation is leveraged to not only make the affordance of secure and immutable transfer of property and rights available to any user but also to put the creation of cryptographic tokens in their hands. The wallet is meant not only as a place to collect tokens issued by others but also as a tool for creating them, similar to what the browser has become for the Web. Only coders can act on the blockchain itself e.g. add further smart contract templates. But decisions and criteria regarding what to tokenise, and rules about how the tokens can be used, are not established at the code level. We use 'values' in the plural to refer to different kinds of values rather than just the monetary value, including (im)material resources such as time, skills, and digital twins of physical objects. These value(s) are assigned to tokens by their creators rather than allowing exchange platforms to determine their market price.

b) Disintermediation at the level of services

One of the most overhyped affordances in the blockchain narrative is disintermediation from middlemen and elimination of the requirement of trust in relationships.

Strictly related to the Internet of Values 2.0, the principle of disintermediation in this approach is neither related to blockchain infrastructure (on the technical side) nor bypassing institutions entirely (on the governance side), but rather pertains to the services that the app supports. Indeed, the blockchain infrastructure itself is permissioned and is maintained by a public-private consortium. Users do not act as block miners or validators, and they do not obtain and transfer tokens directly. They do not just join a network and accept its functioning rules, as happens with crypto exchanges. On the contrary, the Internet of Values 2.0 approach requires the active contribution of community members, and processes of facilitation and social negotiation of rules. In fact, the purpose is not to avoid intermediaries indiscriminately, but rather to enable exchanges of values without relying on big commercial players' expensive platforms or complex management and control procedures. For instance, local associations and urban commons can start local crowdfunding campaigns (through the *crowdsales* functionality, see section 4.d) or issue tickets for cultural events without resorting to online services that have high intermediation costs, and that provide advertising that is not customised to their local audience. Similarly, small retailers, artisans or local tourism operators can implement group buying initiatives or issue prepaid cards and other loyalty tools, avoiding the fees of commercial platforms which would make the operation unprofitable (Viano et al., 2022). Another advantage is avoiding giving users' data away to commercial players.

c) Adaptation to local and civic contexts

The third category of dilemmas confronts automation on the one hand and on the other hand human interpretation and the socio-spatial specificities of the local contexts of application.

In the app under consideration, we drastically reduce the risks associated with prioritising automation over human interpretation. Indeed, the transactions at stake are focused by default on daily microtransfers. Daily objects (rewards, coins, coupons) and mechanisms (crowdfunding, group buying) are all digitalised rather than relying on complex administrative layers in platforms to manage resources (Gloerich et al., 2020). As already mentioned, the collaborative rules of interactions are only partially encoded. In most cases, they depend on the values and rules defined in each token's manifesto, which are decided and managed off chain.

The general aim of the app is to foster new possibilities for exchange in local economies at the neighbourhood/district/city level. Since the tokenisation process makes illiquid assets liquid and reduces intermediation costs, the tool is expected to produce a local multiplier effect by linking local unused resources to corresponding unmet needs and, consequently, foster local aggregate demand based on a similar logic to that of complementary currencies.

We define these use scenarios as *civic*. From a governance perspective, this means initiatives where civil society, small-scale economic actors and local institutions interact in different configurations. These range from digitally-enabled co-production of services between public adnistrations and citizens (Lember, 2019) to self-organisation of civil society or local economic actors to generate services of collective interest (Vlachokyriakos et al., 2016). From an economic perspective, these are socio-economic microtransactions that demonstrate the core features of the social and collaborative economies defined above (section 2.1). In particular, note that economic incentives and market logic coexist with social values and solidarity practices. This is what makes blockchain-based tokenised economies interesting, even if it increases the risks associated with commodifying social processes (see section

[3] The definition must not be confused with the distinction between Blockchain 1.0, Blockchain 2.0 and Blockchain 3.0, which addresses the technical evolution of a technology that initially enabled cryptocurrencies, then more complex interactions based on the digitalisation of other assets and smart contracts, and then decentralised forms of organisation and governance (Swan, 2015).

2.4).

As regards the scale of application, many blockchain projects for financial inclusion (e.g. Faircoin, WeTrust, Manna) are aimed at the global level, looking for the network effect that benefitted Bitcoin. Conversely, CommonsHood is designed to be used at the local level and adapted to the needs and particularities of different contexts.

d) Technical features and functionalities

The principles described above are reflected in the following technical features and functionalities.

- The users interact with the blockchain ledger using virtual representations of assets, actors and interactions via the intuitive interface of the wallet (Fig. 1), designed with particular attention to usability following a lean-UX approach.
- So far, accessibility for people without digital skills, smartphones or network connection is achieved by enabling them to receive and transfer tokens using a card with a Quick Response (QR) code representing the address of the account on the wallet.
- The underlying Ethereum-based blockchain network stores and runs the business logic that regulates the assets and behaviour of interactions via three types of smart contract: Ethereum Request for Comments 20 (ERC-20) tokens, crowdsales, and DAOs. Users can create these contracts using the smart contract factory.
- The tokens are second-layer (or utility) tokens (Voshmgir, 2019) designed to give access to products as services, as opposed to currency tokens that are designed for financial speculation.

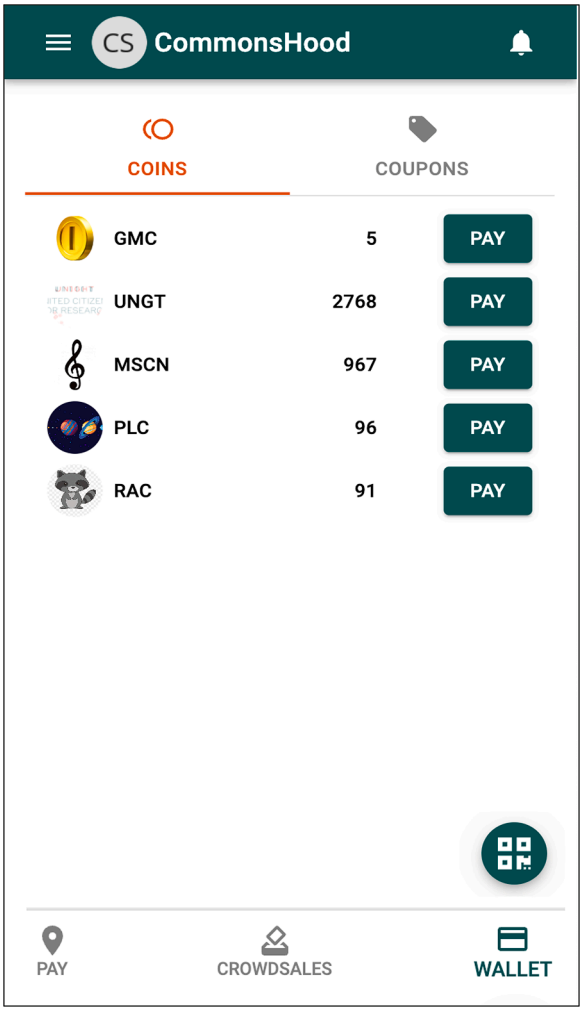

Fig. 1. CommonsHood Wallet containing coins and coupons.

- Three kinds of assets and financial instruments can be created: *coins*, *coupons* (Fig. 1) and *crowdsales* (Fig. 2) (Balbo et al., 2020). The issuer decides which specific asset they represent, sets a quantity, and attributes a value in terms of currency, time, rights, temporary ownership, vouchers, subsidies, etc. This is all specified in the 'manifesto' token: a PDF file with a description of the terms of use in plain language (Fig. 3).
- The 'payment' function activates the direct transfer of tokens between two wallets (Fig. 1). The underlying blockchain ensures that the records are immutable.
- A public permissioned[4] blockchain platform based on Ethereum has been created and is maintained by a consortium of public administrations, universities and private companies (Viano et al., 2022). This makes the Internet of Values 2.0 economically accessible to a variety of social actors that would otherwise be excluded from main permissionless blockchains due to the high cost of transactions.

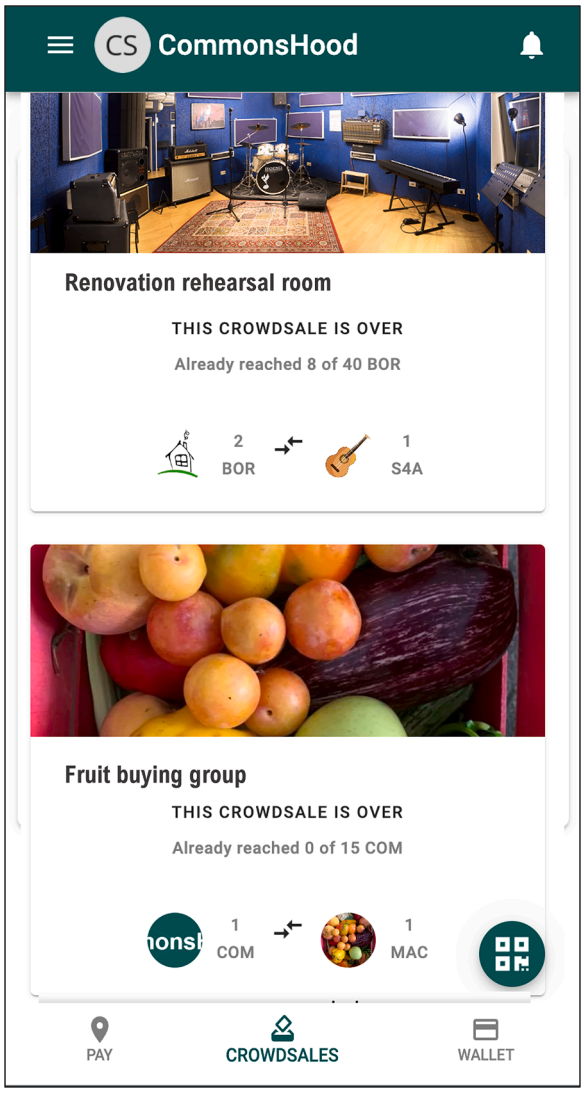

Fig. 2. List of crowdsales.

[4] Each member of the consortium contributes to the infrastructure by running a validator node, but any participant can connect and send transactions to the blockchain using a simple node. The consortium members can accept new participants through a voting mechanism.

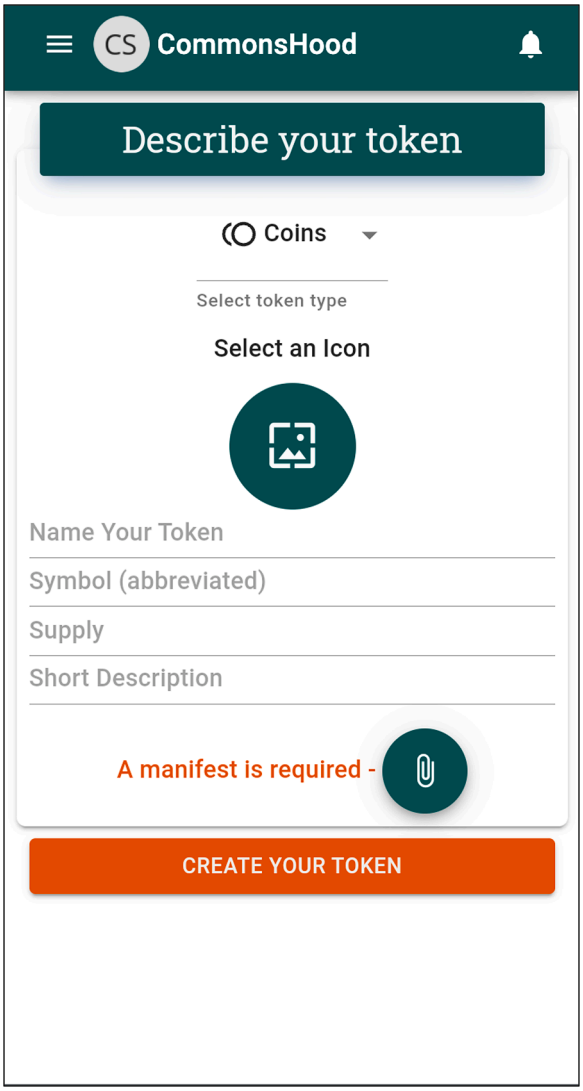

Fig. 3. Token creation functionality.

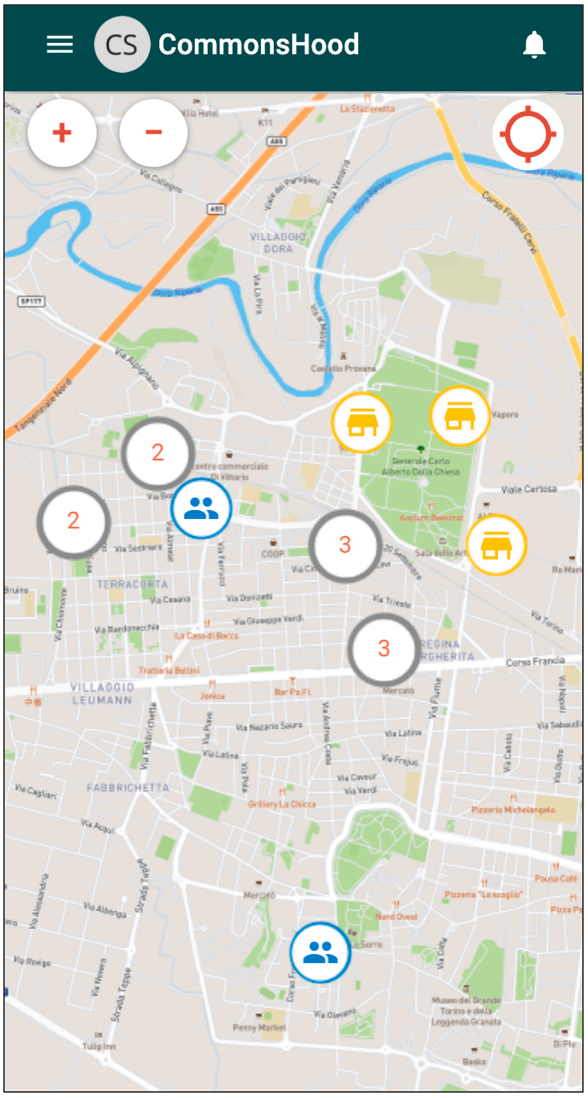

Fig. 4. Integrated geolocated map.

- The app seeks openness also on the technical side, and not only in the sense of being open source. The longer-term goal is to have an open platform where new kinds of smart contract templates can be added by other developers. The first version of the architecture was based on ERC-20 second-layer fungible tokens, and it has been extended to support non-fungible token standards such as ERC-721 and ERC-1555. The app is designed to potentially interact with any blockchain network based on Ethereum, and is aligned with the European Blockchain Service Infrastructure project.
- Users can store in one wallet multiple financial tools, fostering complementarities and synergies between local activities.
- DAO smart contracts allow user accounts to be used as organisation-level accounts.[5]
- Geolocation functionalities and integration with a geolocated social network (Boella et al., 2019) foster users' awareness of places and proximity (Fig. 4).
- There are functionalities for social interaction. Asynchronous notifications make users aware of transactions, since it takes only a few seconds to complete a blockchain transaction. Each wallet can issue and read QR codes, thus enabling interactions with nearby wallets.
- Wider Proof-of-Authority solution for consensus mechanisms takes into account the wider public interest by minimising the computational power and energy required (Sedlmeir et al., 2020).

5. Findings

This section reveals findings from qualitative data concerning the perceptions, expectations and concerns expressed by potential users of the app. Table 2 provides an overview on findings.

5.1. Application contexts and scenarios for tokenisation

The first and third principles of the approach (see 3.a and 3.c) are considered together because the question of *what value(s) to tokenise* and for which *local application contexts and scenarios* are strictly interrelated issues.

When asked in which *contexts* they would most like to use the application, graduate students and those who attended demonstration events mentioned the following: microeconomies for exchanges with relatives and friends in the school, condominium or neighbourhood, including both monetary exchanges (collective purchases,

[5] DAOs in the app under consideration differ from DAOs as traditionally defined, i.e. those that rely on smart contracts as their main or exclusive source of governance (De Filippi and Wright, 2018).

Table 2
Overview on findings.

Data source, collection method	Scenarios given by researchers	Uses imagined or discussed, value(s) of tokens (section 5.1)	Actors and roles (section 5.2)	Limitations (section 5.1, 5.2)	Recommendations (section 6)
i) TESTING SESSIONS WITH GRADUATE STUDENTS. 2020: 62 students. 2021: 36 students. Questionnaire, participant observation	Rewarding volunteering. Retail loyalty tools. Welfare schemes. Crowdsales in support of local retailers (booking) and artists (crowdfunding).	*Ordered by declared interest, from the most quoted to the least:* Microeconomies at friendships/street/ neighbourhood level: monetary (collective purchase, micropayments) and non monetary (exchange of goods/ services). P2P lending. Welfare subsidies. Loyalty tools for local retail. Rewards/incentives for participating in the local community. Funding charities. Creative productions: authorship on creative contents.	Coordination roles are frequent in microeconomics (e.g. for issuing and distributing tokens, when a unique currency is needed) and in welfare schemes. Autonomous issuing of tokens by individuals in local retail and the creative industry.	No ideas about possible uses, or no perceived need for such an app. Perceived lack of security. Transfer of only small amounts. Risk of excluding people who do not have digital devices. Crowdsales are not immediately understandable, or they are perceived as less performant than other intermediary services.	It is necessary to put some effort into explaining not only the technology and the tool's functionalities but also the socio-economic models addressed. Need to provide physical (e.g. printed) support for people without smartphones. Need for more research on the use contexts with greater benefits.
ii) DEMONSTRATION at RESEARCHERS' NIGHT. (2021, Turin) 11 persons. Semi-structured interviews.	Demonstration of the functionalities with generic examples on: complementary currencies, coupons, certificates, crowdsales.	Local currencies in support of microeconomies at neighbourhood/town level. Monetary (e.g. micropayments) and non-monetary exchanges (e.g. libraries of things, time banks). Mutual funds for schools and groups of residents. Supplementary income or subsidies (e.g. for students). Loyalty tools for local retailers and producers. Incentives for civic participation in social streets and neighbourhoods. Alternative currencies in times of crisis.	(Same as above). Both grassroot and institutional initiatives are considered.	Lack of clarity about practical applications. Need for social contract, critical mass, and community of reference. Concerns about token certification. Need for physical support for people who don't have (or are unfamiliar with) digital tools.	Put some effort into explaining (see above). The existence of a community already active on the social challenge help introduce the tool. Promotion of the app by local authorities can establish more trust in it.
iii) PROJECT PARTNER MEETINGS. 4 projects Analysis of project documents, Participant observation.		1) Reciprocal incentives for retail and volunteering. 2) Local currency and group buying. 3) Prepaid cards for sociocultural activities. 4) Loyalty tools for local tourism circuits.	Issuing a mix of centralised core local currency tokens, and related decentralised coupons.	We need a critical mass of actors to issue/accept tokens. Decentralised issuing of tokens is complex to manage during the start-up phase.	Clear definition of "social collaborative" or "civic" economies. More research on the flexible adaptation of functionalities to local contexts and norms, and on the optimal scale.

micropayments) and non-monetary (time banks, libraries of things); peer-to-peer lendings and mutual funds; rewards and incentives for care work and for volunteering and active participation in social causes (e.g. social streets); loyalty programmes for proximity retail. Students privileged kinship and friendship groups over market relationships. More specific proposals concerned: the cultural economy whereby tokens would be used to acknowledge authorship, reward sharing, and allow use of creative content; and supplementary income or welfare subsidies schemes. Donations to not-for-profit organisations were mentioned, even if less frequently. When introducing the app, the researchers provided as many diverse examples as possible in order to minimise the possibility of conditioning the answers given. However, it proved to be less of an issue than expected as the participants often showed high creativity in suggesting different scenarios. This happened especially when more time was provided for in-depth reflection, such as during graduate seminars. The first pilots confirmed interest in testing: local systems of reciprocal incentives between the volunteering and retail sectors in Turin[6] and Vilnius[7]; local currencies and group buying[6]; prepaid cards and local currencies to provide liquidity in advance for socio-cultural hubs in Turin.[8] Other scenarios were considered together with local administrations: decentralised promotional programmes for local tourism operators,[9] and prepaid cards to be distributed to the beneficiaries of social services. As regards the *meaning and value of tokens*, complementary currencies and loyalty tools (e.g. discount coupons) were often mentioned. When people were introduced to the proximity and collaboration logics that the app aims to support, they were interested in systems where both economic and social incentives and values are generated (e.g. rewarding volunteering in the neighbourhood with tokens that can be spent on local goods and services).

The following limits were detected. A critical point emerged regarding the need for a minimum number of retailers or services willing to accept or issue the tokens in order to make the system sustainable. Monetary transfers via the tool were considered meaningful mostly for small amounts. Crowdsales appeared to be less of an immediate consideration unless applied to actual cases of crowdfunding or group buying. Or it was perceived as less performant than other existing intermediary services that are integrated with fiat money payment

[6] Project N.E.O.N. https://www.volontariatotorino.it/giovaniecittadini/neon-not-excluded-from-our-neighbourhood-2/
[7] Design phase of the project "Solidares".
[8] Pilot within the "CO3" H2020 research project, http://www.projectco3.eu/
[9] Project "Blockchain for Visitpiemonte" [link]

systems. About one fourth of respondents in group i) and ii) found it difficult to figure out concrete use cases. This happened also in group ii), where people showed quite a high level of awareness of digital innovations and the basics of blockchain.

5.2. Actors and roles

We attempted to understand more deeply what this approach to disintermediation would actually mean in practice and, in particular, *what activities the actors are involved in and what are their roles*. The following expectations and limitations emerged.

The above-mentioned complementary currency cases, mentioned by both students and event visitors, imply a single type of coin issued and distributed by a coordinator (e.g. community manager, local socio-cultural hubs). However, this does not prevent other actors in the system from issuing different tokens that rely on the main coin to function. Conversely, it is expected that in retail-oriented scenarios, mutual funds, and arts collectives, each actor would design and issue tokens autonomously. However, it is recognised that this is more complex to manage during the start-up phase of some tests, as observed, for instance, by project managers and retailers in one of the pilots.[10] From graduate seminars and demonstration events, it emerged that there is growing interest in peer-to-peer and collaborative models and for financial exchanges without fiat money for the purpose of community cooperation. Still, the fact that there aren't many well-known institutions involved made people concerned that there was a lack of security on transfers and certifications. Similarly, worries emerged about how to guarantee the truthfulness and authenticity of the content of the manifestos attached to the tokens. Respondents to interviews with some competencies in social policies pointed out that a preexisting "social contract" is needed. Moreover, these models are not easy for many people to figure out on a practical level, which was also confirmed in co-design efforts when preparing the pilots.

As regards opinions on the app functionalities, the high flexibility offered by the app on what to tokenise turned out to be disorientating somehow for people that encountered the tool for the first time. Often the envisaged use case tended to bring the application back to well-known digital payment systems that do not necessarily imply autonomous tokenisation. The first pilot studies indicated that the tool can be used for simple interactions, but in some cases requests have been made to integrate it with other management, accounting and decision systems (e.g. clearing mechanisms for time banks, or registers of volunteer effort), as well as with fiat money payment systems. Moreover, concerns were expressed about a possible digital divide due to a lack of suitable devices.

6. Discussion

This session discusses the extent to which the Civic Blockchain approach implemented in the app under consideration resolves some design dilemmas related to the use of blockchain in social and collaborative economies, and whether some issues remain open. The following insights refer expressly to the three domains discussed so far. However, there are overlapping issues.

6.1. Achieving Internet of Values 2.0

One distinctive feature of our approach is that it both leverages well-known blockchain affordances and proposes novel interpretations. This applies not only to technical solutions but also the meaning attributed to the tokenisation mechanisms and the social norms that govern the use of the digital tool. Rather than introducing increasingly complex disintermediation and automation features, the development strategy adopted focuses on the technical and economic accessibility of blockchains. Technical accessibility crosscuts the three principles of the Civic Blockchain approach and guides the development of the functionalities and the interface. Economic accessibility for local communities is achieved by the governance model behind the blockchain infrastructure (see Section 4).

The app under consideration is of general interest for the creativity and diversity of application allowed by the Internet of Values 2.0 approach, and also for the collaborative socio-economic use scenarios that have been suggested. However, both these aspects turned out to be disorientating to some extent. When introducing the app to possible users, it is necessary to explain properly the blockchain's particularities as well as the socio-economic models they can support. The app itself can therefore become a tool to help people familiarise themselves with collaborative socio-economic models, and with the blockchain and the token economy (Nissen et al., 2018). More empirical data is needed to evaluate how effectively "tokenisation in the hands of users" avoids or mitigates the risk of commodification of community resources, or of crowding out intrinsic motivations and social incentives with material incentives (van Stekelenburg, 2022) e.g. when rewarding volunteering or care work.

6.2. Enabling trust-based exchanges and services in communities

Users are not offered automated and impersonal transactions but are asked to actively contribute to token creation, thus expanding their digital agency in shaping and using technologies for the public interest. More research is needed to understand how disintermediation of services actually takes place in any given scenario. For instance, which actors actually contribute to defining tokenisation criteria and rules, and how this influences the rules themselves. Or whether coordination roles are necessary, and if so, which powers do they exert. Do issuers of coins also get to decide how to distribute them? Contrary to much rhetoric on the decentralisation enabled by the blockchain, autonomous creation of tokens by users does not mean fully decentralised governance. Some roles can still be centralised.

As for the concerns expressed about the new technology's perceived lack of security, promotion of the tool by public institutions for implementing local social policies, rather than data extraction, could help establish trust (Scott, 2016).

An open issue is the type of local communities the tool targets. The need for relationships based on trust emerges from the requirements collected, while technology without interpersonal relationships is viewed with strong reservations. In other applications concerned with artificial material commons, blockchain allows users to track participants' contribution and consumption via anonymous relationships (Cila et al., 2020). Conversely, our app appears to be suitable for situations where actors do not necessarily know each other but have a certain degree of intrinsic motivation to cooperate. Still, some incentives or help can further enhance social collaborative economies and pro-social behaviours: trust is already there to some extent, and use of the app should enhance that. In this sense, the technology is intentionally understood as *trust-enabling* (Scott et al., 2017; see Section 2.3).

6.3. Adapting to local contexts

The app is expected to be adapted to different localised value systems (Gloerich, 2020). On the social aspect, the first-hand opinions of potential users and more in-depth discussion during pilots both confirmed the necessity for sound negotiation on the social rules to be encoded in smart contracts. The pre-existence of a community of reference with a social contract is of help in this direction. In cases where some smart contracts do automatically regulate simple token exchanges (e.g. crowdsales), further experimentations will show whether conflicts could arise between self-enforcement of rules and the unpredictability of social dynamics.

[10] See footnote 6.

On the side of the digital tool, it is necessary to consider more in depth whether the design is flexible enough, or whether the diversity of the socioeconomic models addressed requires more differentiation in the tools offered. This also includes the possible integration with existing technologies used by the communities. On one hand, requests emerged from the pilots for integration with more traditional accounting and management softwares. On the other hand, the research group is exploring interoperability among the blockchain wallet and other civic technologies: the integration with a civic social network (see 3.d above) is a first step in this direction.

Some open issues are related to the broad definition of *civic,* referred to the type of socio-economic interactions supported by the app. The current state of the art does not yet make it possible to identify the scenarios to which it can bring more added value and the effects it would have on social relationships and resource flux.

From a spatial perspective, there are open questions about scale and scalability: whether there is a minimum or optimal scale in terms of the number of users and values transferred; whether to start from or work towards full capacity; and whether integration with other technologies is required to support sustainability and replicability. As regards the latter, further questions concern possible issues arising from scaling up: excessive formalisation or hierarchies (Pazaitis, 2017; Rozas et al., 2021), or conflicts with the location-based nature of collaborative economies (Lampinen et al., 2022).

6.4. Further research

The data collected refer to the initial testing of the app and will be complemented by empirical observations when the tool is fully operational. Contributions from the fields of economics, sociology and policy analysis can shed light on what are the most relevant use scenarios, their socio-economic benefits and costs, the risk of commodifying social dynamics and the possible trade-off between material and social or moral incentives related to tokenization (see 5.1), and possible target local communities (5.2). A digital geography perspective can address specific issues such as scale (5.3) and provide a unifying framework for analysing a tool which, being intentionally locally oriented, raises questions about how the technology shapes and is shaped by local socio-economic spaces and spatialities (Ash et al., 2018). All this context and requirements analyses will ground the design and development of new functionalities and the interoperability with other civic digital tools (5.3). Future research will also have to consider some blockchain-related issues that are not addressed in this article. These concern the trade-off between transparency and the immutability of data on blockchains on the one hand, and data ownership and personal data protection on the other hand. As regards data, such a technology could also produce bottom-up data which are of interest for local policy makers, but whose ownership remains in the local community. Some observations concerning data-related issues were made by (Viano et al., 2022).

7. Conclusions

This article advances an approach to the development of blockchain-based applications designed to support local social collaborative economies. We defined this approach as *Civic Blockchain,* following proposals recently advanced by HCI and design scholars for multi-disciplinary efforts to 'mak[e] the blockchain civic' (Elsden et al., 2019). We introduced a conceptual framework that grounds this approach on three principles (*Internet of Values 2.0, disintermediation of services* and *local adaptation*) related to the core affordances of the technology, and we explained how they translated to design choices in the app CommonsHood that was the subject of our experimental case study. We then discussed the extent to which this approach addresses dilemmas identified by social sciences in the design of 'blockchain for social impact', and which questions remain open.

This approach makes the affordances of blockchain technology accessible by allowing users to represent and transfer digital assets of value via cryptographic tokens. It leverages some of the core technical properties of blockchain, and advances new interpretations on their potentialities. This interpretation focuses on the tool's technical and economic accessibility, which is necessary to enable trust for participation in social collaborative economies, rather than using trustless automated interactions as in the mainstream imaginaries of the blockchain.

Blockchain technology can support new collaborative social and economic practices in that it allows not only information exchange and similar coordination mechanisms to ICTs, but also has the ability to represent and transfer digital values. However, intentional action on the part of developers and users is necessary to address the societal challenges that this technology raises.

The open issues that have been identified can inspire further research on how the technology shapes and is shaped by local contexts at different levels.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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