

## Context-based civic blockchain: Localising blockchain for local civic participation.

Cristina Viano <sup>a,b,\*</sup>

<sup>a</sup> Interuniversity Department of Regional and Urban Studies and Planning, University of Turin and Polytechnic of Turin, Viale Pier Andrea Mattioli 39, 10125 Turin, Italy

<sup>b</sup> Department of Computer Science, University of Turin, C.so Svizzera 185, 10149 Turin, Italy

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### ABSTRACT

Experiments in alternative forms of urban digitalisation include blockchain-based applications as enablers of civic action in local communities, inspired by different visions than blockchain-based speculative cryptocurrencies. This article investigates how blockchain technology can be oriented towards locally embedded applications. It explores the case of a blockchain-based wallet app that aims to support social collaborative economies and civic participation in urban communities by tokenising social and economic assets. Building on studies on the embeddedness of urban digital platforms with a local character, this article studies how the app under consideration is shaped by, and adapted to, the needs and resources of local socio-economic contexts. Two pilot experimentations on the app are considered, concerning systems for rewarding civic participation and urban sharing economies. The empirical analysis concerns the methodology for introducing the app into local socio-economic contexts, the way in which local actors interpret its properties, and the resulting iterative co-design of its functionalities. The article defines and discusses the extent to which the civic blockchain is rendered context-based by this methodology, and highlights similarities and differences with other urban digital platforms. The empirical evidence drawn from this research contributes to the debate on how community members, researchers and digital experts together can realise alternative forms of urban digitalization.

### 1. Introduction

Civic participation and social collaborative economies in local and urban communities increasingly rely on digital technologies. Alternative forms of digital urbanisation question mainstream digital platforms, their business models, their power inequalities and the uneven urban geographies they produce. Experimentations in this field concern not only the adoption, but also the development of alternative digital tools. Their functionalities are intended to encode the principles of technological sovereignty, shared ownership, and/or democratic participation. Blockchain technology has only recently emerged in this field, and research in digital geography on blockchain-based application at the local scale, and in different domains to cryptocurrencies, is still initial. This paper addresses this gap and focuses on experimentations with blockchain as an enabler of social collaborative economies and related civic actions in local communities as opposed to blockchain-based

speculative cryptocurrencies. This article refers to social collaborative economies as a set of economic practices that take place at the local and community level, and the related participatory and civic organisation processes. They include, on one side, social and solidarity economies ranging from self-help groups and commoning to mutuals and cooperatives (Yi, 2023), that take place at the local level and are characterised by the elements of gratuitousness, non-monetary exchanges, and mutuality, which coexist with market exchanges but are generally meant as alternatives to capitalist models (Vlachokyriakos et al., 2016). On the other side, collaborative economies meant as the community-oriented form of sharing economies, that differ from the market-oriented ones that rely on global commercial platforms (Como & Battistoni, 2015; Klimczuk, Česnuitytė, & Avram, 2021).

The main innovation introduced by blockchain is the possibility of digitally representing values and property rights in the form of cryptographic tokens,<sup>1</sup> and its ability to transfer them in a safe and transparent

\* Corresponding author at: Interuniversity Department of Regional and Urban Studies and Planning, University of Turin and Polytechnic of Turin, Viale Pier Andrea Mattioli 39, 10125 Turin, Italy.

E-mail address: [cristina.viano@unito.it](mailto:cristina.viano@unito.it).

<sup>1</sup> Cryptographic tokens are the digital representation of a value or right (property, access) over an asset.

manner without relying on third parties as intermediaries. Moreover, with smart contracts,<sup>2</sup> it is possible to program the way in which tokens are transferred, thus automatising the processes of transferring values, recording data and managing organisations. The potential for disintermediating consolidated governance models has resulted in a lively technical, political and economic debate on the socio-political impacts of this technology (see for instance Glaser, 2017; Elsdén et al., 2018; Garrod, 2019; Husain, Franklin, & Roep, 2020; Zook, 2023). Following the success of Bitcoin and other cryptocurrencies, blockchain has been introduced into sectors such as trade, logistics, supply chain traceability, and later public sector notarization and voting procedures. More recently, a strand defined as *blockchain for social impact*, or *social good*, has emerged, addressing diverse productive and service sectors: agriculture, energy communities, fair trade, health, identities management, and financial inclusion (Bartoletti et al., 2018; Galen, 2019; Galen et al., 2018; Voshmgir, et al., 2019; Brekke, et al., 2020; Fines Schlumberger, 2022). The terms “social good” and “social impact” are used in a fairly uncritical way (Semenzin, 2023). Approaches to blockchain technology in these fields range from simple orientation of mainstream solutions towards so-called social ends to radical redesign of blockchains in accordance with democratic and digital sovereignty principles. The former is exemplified by platforms that rely on established cryptocurrencies for decentralised donations, money transfer and crowd-funding services. The latter concern experiments where blockchain's affordances of tokenisation, and of disintermediation and automation of interactions are leveraged to enable solidarity and financial inclusion such as with basic income or mutual lending schemes (see, for instance, Circles Coop eG. nd; and Howitt, 2019), community or complementary currencies (see, for instance Mattsson, Criscione, & Takes, 2023; Balaguer Rasillo, 2023), commons-based peer production networks (see, for instance, Roza et al., 2021)).

This article analyses one of these experimentations, which advances the civic blockchain approach (Viano, Avanzo, Boella, & Schifanella, 2023) and realises it by developing and testing the CommonsHood wallet app (Balbo et al., 2020) in real contexts.

The app aims to support local community economies by facilitating the circulation of local economic and social resources. Citizens, economic actors, associations and local institutions can create in their own wallet cryptographic tokens that represent valuable assets for the local community: local coins, prepaid cards, discount coupons, tickets providing access to shared tools and structures, and purpose-driven tokens to reward civic behaviours. Users decide the tokens' values and rules of exchange when implementing schemes such as complementary welfare measures, time banks, loyalty schemes for proximity retail, and management of access to urban commons. The CommonsHood project provides interdisciplinary and experimental research in computer science, geography, economics and pedagogy. Its starting point was the aim of making complex blockchain technologies accessible to the general public and bringing to the local scale some benefits of the blockchain which are often associated with global, virtual, delocalised dimensions (Balbo et al., 2020). The author of this paper is an active member of the CommonsHood research project, and contributes with a geographical perspective for a critical appraisal of the project's efforts to orient the blockchain technology towards locally embedded applications.

In particular, the research presented in this paper adopts a digital geography approach. In their discussion on the “digital turn” in geography Ash, Kitchin, and Leszczynski (2018) identify possible relations between geography and the digital: geography *of* the digital, *through* the digital, and *by* the digital. The latter analyses how digital tools are shaped by the socio-spatial contexts where they are developed and used,

and how in turn they shape (mediate, augment, and transform) the production of space and socio-spatial relations. Therefore, the digital-space relation is understood as bidirectional. This article addresses one side of the bidirectional relationship, focusing on how the digital tool is *shaped* by the local socio-economic contexts. The research question is: how is the app under consideration made adaptable to the needs and resources of different socio-economic contexts? More specifically, what is the methodology adopted to introduce the app into local communities? What is the resulting reshaping of its functionalities and affordances?

Previous contributions (Viano et al., 2022; Viano et al., 2023) presented the civic blockchain approach and described how it informs the conceptualisation and technical design of the CommonsHood app. This article focuses on the actual introduction of the wallet app in specific socio-geographic usage contexts, which so far involve mainly urban communities. Therefore, the case study is analysed as an instance of alternative urban digitalisation (Lynch, 2020; Vadiati, 2022) with respect to mainstream platform urbanism. Building on the literature on urban digital platforms (Chiappini, 2020). The contribution of this article to the literature on urban digital platforms is to widen its scope to include blockchain technologies. It provides empirical evidence on experimental interdisciplinary research and its co-design methodologies, and is intended to contribute to the debate on how community members, researchers and experts can together realise alternative forms of urban digitalisation through blockchains.

Section 2 of this article reviews the above-mentioned literature and discusses how blockchains for civic domains are not extensively considered in this field. Section 3 presents the civic blockchain approach and provides the analytical framework for studying its implementation as a context-based civic blockchain. Section 4 presents findings regarding two experimentation cases. Section 5 discusses how the app is shaped by local contexts with social and technical co-design processes, in ways that are somewhat similar to other participatory digital tools and somewhat typical of a civic blockchain. Section 6 concludes this article and provides hints for future research on blockchain and other paradigm-changing technologies in the civic participation field.

## 2. From alternative urban digitalisation to blockchain for civics

### 2.1. Alternative urban digitalisation

Experimentations with digital technologies in support of civic participation and social collaborative economies take place at different scales from local to global. However, many of these processes are related to a specific geographical location (Ozman & Gossart, 2018). They often take place in cities due to factors such as: the high density of socio-economic relations, the greater availability of skills and funds for experiments, or the presence of an innovation culture or active civil society (Certomà, 2021). This is the case for the experimentation with blockchain under consideration in this study: its first pilots took place in urban contexts. This, together with the fact that it advance blockchain solutions that are different to mainstream speculative cryptocurrencies, has led us to placing this research under alternative modes of digitalization in cities. These projects challenge mainstream models of smart cities and platform urbanism based on neoliberal and technology-led paradigms, by advocating the fostering of digital tools that are more participatory and human-centred (Vadiati, 2022). Urban scholars and digital geographers are advancing different and partially overlapping conceptual frameworks that analyse their diversity in terms of actors, application domains, and digital tools. Some concepts focus on the socio-technical processes at work, which are labelled as *alternative smart cities* (McFarlane & Söderström, 2017) or *alternative digital urbanism* (Di Bella, 2015; Vadiati, 2022), or on overall political discourses that inform their actions, such as the principle of *technological sovereignty* (see (Lynch, 2020) for a socio-spatial perspective on this movement), or the principle of *smart citizenship* (Cardullo & Kitchin, 2019). As for leading actors,

<sup>2</sup> Smart contracts are computer programs that operate over a blockchain, automatically executing the terms of a contract when certain conditions are met.

specific attention is given to grassroots or citizen-led initiatives such as *urban forms of digital activism* (Luque-Ayala et al., 2020) and *grassroots digital urbanism* (Vadiati, 2022), or to *digital civics* (Shelton, 2019) when the digital tools enable democratic participation within institutional frameworks and local authorities are more directly involved. It is worth mentioning briefly that the same subject is studied in other disciplines from different angles. For instance, research in the fields of design, human-computer interaction and computer-supported collaborative work focus on *digital civics* (Olivie & Wright, 2015; Vlachokyriakos et al., 2016), *civic interactions* (de Waal, 2021) and *civic technologies* (Saldivar et al., 2019). Policy analysts focus on *digitally enabled co-production of services* (Linders, 2012) where citizens and local governments collaborate (for instance, on recent technological evolutions including the blockchain, see (Allen, Tamindael, Bickerton, & Cho, 2020; Clifton, Fuentes, & García, 2020; Lember, Brandsen, & Tönurist, 2019; Yuan, 2019). This interdisciplinary perspective recurs in the literature below ranging from digital geographies to policy analysis and design.

Other perspectives are more focused on the digital tools, defined as *digital participatory platforms* (Falco & Kleinhans, 2018), *urban digital platforms* (Chiappini, 2020), and *local non-corporate platforms* (Mello Rose, 2021). Broadly speaking, the following (overlapping) application domains are addressed. *Collaborative governance platforms* (see, for instance, the work of Temmerman, Veeckman, and Ballon (2021) and Ansell and Miura (2019)) are used for government-citizens co-production of services, consultations, participatory urban planning, or for the coordination of citizen-led or volunteering initiatives. In this domain, crowdmapping and volunteered geographic information tools, crowdsourcing and databases are leveraged to share information about an urban topic or area. *Urban democracy platforms* (Smith & Prieto Martín, 2021) support more complex e-democracy processes with opinion formation, e-deliberation and e-voting tools. *Digitally-enabled collaborative/sharing economies* (e.g. Lampinen et al., 2020; Lekan & Rogers, 2020; Leontidou, 2020) make use of *digital sharing platforms* (Santala & McGuirk, 2022) that leverage social networks, crowdsourcing and databases to match and exchange material or immaterial resources, thus enabling the operation of non-monetary micro-economies or complementary welfare measures. Or they leverage crowdfunding platforms for community monetary transactions. More complex technical solutions in terms of horizontal governance models and financial schemes developed for enabling commons-based peer production (Benkler & Nissenbaum, 2006), *digital commoning* (see for instance Balaguer Rasillo, 2023) and *community or complementary currencies* (see for instance Balaguer Rasillo, 2021). Most often, studies concerning this last domain are focused on grassroots actions rather than initiatives led by public actors.

In what follows, this article adopts *urban digital platforms* (Chiappini, 2020) as a comprehensive term to refer to this literature. Two clarifications are needed in this regard. Firstly, while our case study is closer to the domain of digitally-enabled social economies, referring to urban digital platforms in general provides a more complete framework to build on when observing the relationship between a digital tool and local contexts, as explained in section 2.3. Secondly, most of the digital technologies referred to above are defined as *platforms*. Without going into the merits of the different characters of platforms highlighted within the debate on platform urbanism (see for instance Artioli, 2018; Barns, 2019) and platform society (van Dijck, Poell, & de Waal, 2028), here we broadly refer to virtual spaces where resources are collaboratively gathered, matched and (re)distributed (Chiappini, 2020), mainly in the form of *information*. On the other hand, digital applications in the form of *wallets*, as in the case study under consideration here and as in many other blockchain applications, enable the exchange of *values* and are expected to be used on an individual basis. Aware of these specificities, we use the term urban digital platform to describe the CommonsHood app for the following reasons. The notion of platform as ecosystem of multisided interactions, facilitator of participation and enabler of microtransactions (Barns, 2019), and ultimately as intermediary, still fully applies to blockchain-based wallets. Specifically,

similarly to what urban digital platforms do compared to the profit-oriented maximisation of interactions and capturing of value of global urban platforms (Barns, 2019), the app under consideration intentionally reinterprets mainstream approaches to cryptographic wallets by orienting them towards collaborative rather than competitive exchanges in an urban community. Moreover, it integrates functionalities for social interactions and geolocation.

## 2.2. Embeddedness and adaptability of urban digital platforms

This article builds on urban studies and digital geography literature about urban digital platforms, that investigates the relationship between digital tools and the urban socio-economic contexts where they are used in terms of how the digital platforms are place-based, embedded in, rooted in, or adaptable to local contexts. This means understanding how they are nurtured and maintained by local networks and how they contribute to generating resources for communities, in contrast to the (dis)embeddedness and extractive strategies of mainstream urban platforms (Wood et al., 2019; Graham, 2020; Hardaker, 2021). There are four recurring dimensions through which the local embeddedness of the digital platforms is analysed:

- a. the *digital mediation* the technologies are expected to provide in order to serve their collaborative or participatory aims: more efficient organisation, increased visibility of information, pooling and matching of resources to co-create knowledge, reconfiguration of relationships (Chiappini, 2020; Smith & Prieto Martín, 2021), redistribution of (im)material goods and services (Lekan & Rogers, 2020; Mos, 2021), or encouraging social actions (Lampinen et al., 2022).
- b. the *ecosystems of actors* that take part. There are different initiators – citizen groups, digital activists, researchers, local authorities, which influences the scope and persistence of the digital platforms. Different relationships across civic, government and market domains coexist and are interdependent even if non-profit orientations prevail. The political and financial support of local governments is often relevant, even if they have ambiguous roles (Chiappini, 2020; Mello Rose, 2021; Santala & McGuirk, 2022; Smith & Prieto Martín, 2021). Digital experts are active either as providers of technical support or as activists/insiders involved in civic actions (Mello Rose, 2021). As for users, the aim is to have decentralised networks and distributed actions, but this still requires coordinators and significant human effort. (Chiappini, 2020; Lampinen et al., 2022; Mos, 2021).
- c. *Online and offline interactions in relation to urban physical spaces*. Face-to-face encounters are necessary to embed digital interactions (Leontidou, 2020; Lynch, 2020; Mello Rose, 2021; Smith & Prieto Martín, 2021). Platforms are expected to help citizens to (co)produce rather than just make use of urban spaces. Whether or not they are spatial media with geolocation functionalities, they directly refer to proximate urban spaces and users engage directly with them (Chiappini, 2022; Lynch, 2020).
- d. *Flexibility of the design*. This refers to the extent to which the technical features are adaptable to different needs, thereby facilitating adoption in different contexts. This can be achieved through, for instance, modular functionalities, open-source code, and granting data ownership to users (Smith & Prieto Martín, 2021; Mello Rose, 2021).

Four major limits to the embeddedness of the platforms are pointed out. First, their accessibility can be hindered by low media literacy and the overrepresentation of tech-savvy or politically motivated people, or by scarcity of funds and infrastructures, all of which can result in uneven geographies (Chiappini, 2020, 2022; Chiappini & de Vries, 2021; Mello Rose, 2021). Second, digitally mediated coordination can result in new forms of centralised powers which could be in contrast with the goal of wider participation (Chiappini, 2020; Lampinen et al., 2022). Third, the transactional logic of platforms risks crowding out social encounters and

collective ownership of social causes (Mos, 2021). Fourth, there is often a mismatch between digitally-enabled experiments and the slower pace of traditional administrative or participatory processes (Smith & Prieto Martín, 2021). Most authors contest that digital public or collective engagement is primarily driven by digital technologies; the motivation to participate should already be there (Lynch, 2022; Santala & McGuirk, 2022).

### 2.3. Blockchain for urban civics

The literature on urban digital platforms has not yet covered blockchain-based applications extensively, with some exceptions mentioned below. In general, literature in economic and political geography deals with the socio-political and environmental implications of blockchain mainly by looking at relevant applications for cryptocurrencies on a global scale (Caliskan, 2020; Parkin, 2020; Zook & McCannless, 2022), and challenging their potential for decentralisation (Zook, 2023) and algorithmic governance. The rhetoric about algorithmic governance is criticised for being based on simplistic expectations on how technology, society and spaces are co-constituted and how computer architectures are socially embedded (Zook, 2023; Zook & Blankenship, 2018). Other scholars focus on the imaginaries and discourses underpinning blockchain projects in both the financial and public domain (Husain et al., 2020; Sotoudehnia, 2021). In the social sciences in general, and in geography in particular, there are still few studies on the socio-spatial effects of blockchain at the local level and in more recent application sectors, least of all civic participation and social economies. On the other hand, researchers in the design, HCI and media studies field have studied the extent to which the technology design of blockchain initiatives in civic and commoning domains comply with desired socio-political participatory or emancipatory outcomes projected onto the blockchain (Elsden et al., 2019; Lapointe & Fishbane, 2019; Cila et al., 2020; Gloerich, De Waal, Ferri, Cila, & Karpinski, 2020; Rozas et al., 2021; Nguyen Long, Graaf & Votsis, 2023; Semenzin, 2023). They investigated their potentials and risks regarding public values, social justice, power relations, and resulting ethical and design dilemmas in weighing up: *i*) quantification and commodification vs informal social relations; *ii*) transparency vs privacy; *iii*) complex normative/nudging vs individual freedom; *iv*) coding rules, algorithmic governance and automation vs interpretation; and *v*) trustlessness vs new centralisation of powers. However, these contributions need to be complemented by empirical studies with actual experiments. Examples in this direction have analysed blockchains for citizen engagement with proposal tracking and voting (Ietto, Rabe, Muth, & Pascucci, 2023), deliberative processes (Tan & Rodriguez Müller, 2020), complementary welfare measures (Chiappini, 2022), digital commoning (Balaguer Rasillo, 2023; Pazaitis, De Filippi, & Kostakis, 2017).

This empirical research complements the aforementioned literature on the embeddedness of urban digital platforms, helping to clarify the peculiarities of the blockchain that must be considered when analysing blockchain-based applications for urban civics. Specifically, and with reference to the four dimensions presented in Section 2.2, blockchains are expected to (a) enable secure transactions of digital values or secure tracking of information and (b) disintermediate from traditional financial or commercial third parties. Open issues concerns (c) the online and offline interoperability of tokenised economies with existing urban regulatory, administrative, and participatory frameworks, and (d) the need for the digital interfaces to make this complex technology understandable. A recurring observation is the fact that core pillars of the mainstream narrative on blockchains (disintermediation, automation, transparency) are not necessarily good per se (Cila et al., 2020), especially for civic participation and the social economy.

## 3. Experimenting with a context-based civic blockchain

### 3.1. Analytical framework

This article is based on an exploratory case study of the CommonsHood blockchain-based wallet app, which has the goals of making blockchain *accessible, civic and local*, as mentioned in Section 1. The app has three distinctive features. First, communities choose the value(s)<sup>3</sup> to tokenise and the tokens' terms of use. Second, users interact with the blockchain ledger via an intuitive interface. Third, the envisaged use scenarios concern civic, social and collaborative economies at the local urban scale, meant as practices where: economic and market incentives coexist with social and solidarity values, and civil society, small-scale economic actors and local institutions interact in different governance configurations. The application uses a consortium blockchain based on the Ethereum Virtual Machine technology. Its nodes are run by a consortium of public administrations, private companies and the University department that coordinates the CommonsHood project.<sup>4</sup> The application is made available free of charge to local actors. As a web application, it can be used from any device. Authentication through username and password and the visual interface simplify the users' interaction with the cryptographic wallet. In a previous article (Viano et al., 2023), we analysed how this approach addresses the ethical and design dilemmas of the civic blockchain, and this is summarised in Section 2.3 above. We looked, in particular, at how the app's conceptualisation is informed by political visions of blockchain potential that are different to those of speculative cryptocurrencies, and how these visions are embedded in the design of the technical features and functionalities of the digital artefact, fully acknowledging the non-neutrality of these technologies (Iapaolo, Certomà, & Giaccaria, 2023).

In order to deepen the analysis of the app's implementation in specific socio-spatial contexts of use, we introduce the concept of *context-based civic blockchain*. In line with contextual accounts in human and economics geography (for an overview see Gong and Hassink, 2020; Gregory, et al., 2009) the term *context* is used to refer to the set of geographical and socio-cultural factors that characterise the local community where the app is being experimented with. It is intended to have a broader meaning than *place-based*, and goes beyond geographically bounded and physical places in the urban realm. Even if the geographical dimension plays a primary role, as it does in most urban digital platforms, in the experimentation under consideration the relationship between the digital tool and the physical space is more nuanced than, for instance, in map-based participatory platforms (Falco and Kleinhans, 2018). Namely, the adaptation of the app to different local communities goes beyond visualisation of and geolocation in different geographical areas, and involves customization of the functionalities for creating and exchanging tokens, and of the values of the token themselves. While the context-based orientation of the tool could be considered implicit in the concept of *civic blockchain*, referring to it explicitly aims at critically investigating the actual capacity of the civic blockchain approach to deploy tools that are embedded in diverse local socio-spatial contexts, with attention to their particular socio-economic needs and resources.

Two pilot experimentations of the CommonsHood app are analysed through the lens of the context-based civic blockchain approach, with reference to the aforementioned four analytical dimensions of urban digital platforms (see Section 2.2) and taking into account the peculiarities of blockchain technologies (Section 2.3). Specifically, the study focuses on:

<sup>3</sup> The plural is used to indicate that not only monetary values are at stake.

<sup>4</sup> It is compatible with Ethereum-based blockchains and with the European Blockchain Services Infrastructure (EBSI). The proof-of-stake consensus algorithm, on which Ethereum-based blockchains rely, reduce power consumption in comparison to blockchains that are based on proof-of-stake, such as Bitcoin.

- a. *Digital mediation*: the goals of the desired socio-economic model, the related negotiations and decisions regarding what to tokenise, and the exchange rules.
- b. *The ecosystem of actors* and their roles in the exchange system: who is active in the co-design phase and who negotiates the rules; whether their networks are more decentralised than usual governance models.
- c. *Offline/online interactions*: which components of the socio-economic exchange are tokenised, and which ones remain “off chain”; how digital mediated interactions relate to physical urban spaces.
- d. *Design flexibility*: the requests and/or opinions of local actors regarding the flexibility and understandability of the app’s functionalities.

In particular, the analysis addresses the research group’s co-design methodology for introducing the app into local contexts, the way in which local actors interpret its technical properties, and the resulting reshaping of both its functionalities and affordances. Some insights are also provided on the specific benefits and changes *expected* from using the application (how it *would shape* the urban contexts). Indeed, these expectations and goals influence the way the app is designed and implemented.

### 3.2. Methods

The CommonsHood app was conceptualised, co-designed with potential users,<sup>5</sup> developed as a standard version (Balbo, 2019) and tested for its usability in five European and local projects in the period 2019–2022. In 2022, four pilots commenced in real-life environments in the metropolitan area of Turin (Italy). The empirical study presented in this paper refers to two out of these four pilots: the Collegno Local Lab and the C.O.S.O project. They allow to gather evidence on different models of blockchain-enabled collaborative economies, since they differ in terms of: socio-economic goals, system of actors, urban setting, core technical functionalities. Table 1 summarizes their key features, which are described in detail in Section 4.

The study adopts an action research methodology. The way in which the action research has been conducted is strongly related to the position of the author as an insider in the computer science-based research group: organising the experimentations, liaising between the developers and users and other local actors, and observing its socio-spatial implications. Hence, the data collection methods are in close synergy with the

**Table 1**

Key features of the two pilots under observation.

	Collegno Local Lab	C.O.S.O. Library of Things
Social collaborative economy model	Reward schemes and loyalty tools	Community circular/sharing economy
System of actors	Co-production of public services (municipality, civil society organisations, local businesses, citizens)	Community-based initiative (local associations, citizens)
Urban setting/scale	Satellite town of the city of Turin	Neighbourhood of the city of Turin
Tokenized assets	Fungible tokens as rewards and as fidelity tools	Non-fungible tokens as digital twins. Fungible tokens as local currency
Core functionalities	Tokens/coupons exchange	Booking system
Geolocation functionalities	Integrated map	N.A.

<sup>5</sup> In the framework of the research project “Co-City”, funded by the European Union (UIA Initiative).

implementation cycle of the pilot experimentations. For each experimentation, the broad aims are defined together with core local actors (e.g., active citizen groups or local authorities). Further *context-based* co-design is then carried out together with other actors on the socio-economic interaction model and on the app’s technical features and functionalities (see Fig. 1). The app is first tested in simulation workshops and then experimented upon in real environments. Participants/users provide their feedback about the functionalities that are available through the interface. This feedback in turn informs the development or adaptation of smart contracts and of the related code on the side of the technical team.<sup>6</sup> All these steps refer to context-based instances of the app, and provide iterative feedback for improving the set of modular functionalities of the standard version of the app.

The qualitative methods adopted rely mainly on participant observation (Watson, 2021) conducted throughout all the project meetings and activities, with both local actors and the development team. Generative focus group techniques (Cameron, 2021) were used in some of the meetings with core stakeholders to address analytical dimensions in a more structured way (see Section 3.2). The analysis of field notes and memos (Watson, 2021) were guided by a set of operational questions concerning the same analytical dimensions. The findings in this article are related to the introduction phase of the app (context-based co-design and initial tests, see Fig. 1). Details about the type and number of co-design sessions and project meetings in each of the two pilots are provided in the next session. In what follows, findings from the two experimentations are reported based on the four analytical dimensions.

## 4. Introducing civic blockchains in local contexts

### 4.1. Reward schemes and loyalty tools: The collegno local lab

Collegno Local Lab is an urban living lab (Marvin et al., 2018), supported by an EU-funded research project,<sup>7</sup> situated in the city of Collegno (a suburban area of the city of Turin, Italy, with 48,000 inhabitants). A service is being tested that promotes youth volunteering and provides young people with access to local commercial and cultural services. Young volunteers take part in civic actions organised by local associations and receive *reward tokens* in their wallet, which have been issued by a social cooperative in charge of educational activities on behalf of the municipality. Through a dedicated *exchange* functionality, volunteers use their tokens to obtain digital *coupons* issued by local commercial and cultural services. The benefits or discounts represented by the coupon are redeemed by going to the local shop or service provider in person and transferring the coupon to the retailer’s wallet. Organisations offering opportunities for volunteering are mapped as *participation places* (“luoghi di partecipazione” in Italian) in a geolocated map integrated in the CommonsHood application (Boella et al., 2019) (Fig. 2. Local services offering coupons are mapped as *exchange places* (“luoghi di scambio” in Italian). During the pilot, the terms *participation places* and *exchange places* have been adopted to figuratively identify not only the physical urban places, but also the related organisations, projects and social or economic actors. The same terminology is used in what follows.

*Digital mediation* – The overall purpose is to encourage new forms of interaction among actors that would not otherwise cooperate. The reward token is considered by neither the municipality nor the social cooperative as compensation or reimbursement of expenses or as a prize that might trigger competition. It is intended as an acknowledgement of youth participation in social activities at *participation places*, and as an

<sup>6</sup> The code is open source. At present, new developments are done by the members of the research team. In the longer term, new kinds of smart contract templates will be added by other developers.

<sup>7</sup> NLAB4CIT – Network of laboratories for civic technologies co-production (<https://nlab4cit.eu/>)

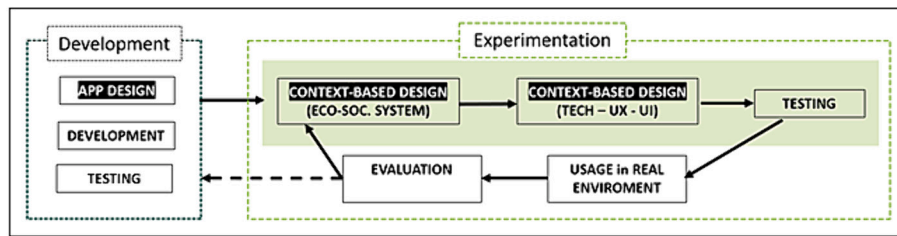


Fig. 1. Development and experimentation cycle of the CommonsHood application.

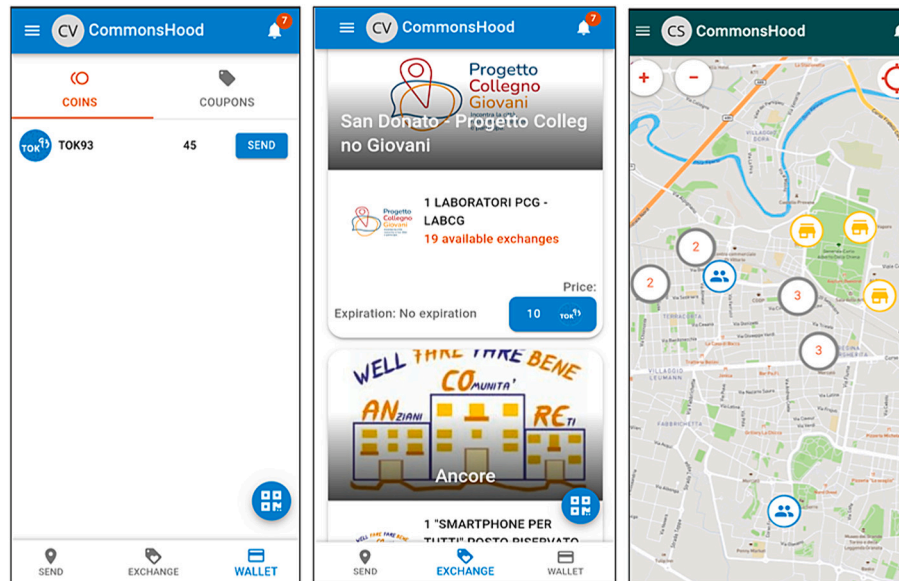


Fig. 2. CommonsHood interface for the Collegno Local Lab pilot: personal wallet with reward tokens; token/coupon exchange functionality; integrated maps with participation places and exchange places.

encouragement for them to access services in their city at *exchange places* that are threatened by mass distribution, e-commerce, and competition from the Turin metropolitan area.

However, one of the most debated issues is the value of the tokens and the clarity and transparency of the criteria for awarding them. Fixed equivalence between hours of volunteering time and the number of tokens was rejected to avoid excessive quantification of social actions. Rather, relevant actors agreed to adjusted accounting of volunteering time, with an adjustment that also encourages small commitments. It was decided that whoever owns these tokens can also donate them to friends. As regards the value of the coupons, they provide benefits not only in terms of purchases at local shops, but also access to cultural services. Those responsible for the latter found it difficult to think of incentives that are not strictly economic, such as using coupons as invitations to discover local activities (for instance: the owner of the coupon can ask a cultural centre to make a dedicated appointment for them to get to know its socio-cultural activities and events, in case such appointment are not already organised among the ordinary activity of the association).

To simplify the first activation of the pilot, it was decided that tokens, once transferred to *exchange places*, are no longer in circulation. More complex cycles (e.g. retailers using tokens themselves or sending them to the municipality to get other benefits) have been postponed to subsequent phases.

**Actors** – The initiators of the project are the municipality and the CommonsHood research group of the University of Turin as partners of the wider European project. The local actors involved are representatives of a local social cooperative in charge of educational services, about ten civil society organisations, young people aged 14–20 and their

representatives in the municipal Youth Council, and representatives of local socio-cultural and commercial services. As regards the co-design process, the social cooperative and the research team were the principal interlocutors. There were fewer youth representatives than envisaged in the original work plan, but this was partially compensated by the in-depth knowledge of the subject by the educators of the cooperative. It was more difficult to engage representatives from *participation places*, and many design choices were made on their behalf in order to simplify their tasks. While representatives of local associations were active in co-design workshops<sup>8</sup> and in the implementation phase, the municipality's attempt to involve retailers was not effective.

As regards the app and the user rights of the different actors, an initial design issue regarding the interaction model was who is responsible for issuing the reward token(s). A decentralised model where each *participation place* issues its own reward tokens was rejected in favour of the cooperative issuing unique tokens. However, decentralisation of coupon creation is only partially limited: each *exchange place* gets to autonomously decide the value of the benefit (e.g., the percentage of the discount) within the context of pre-defined common rules on the number of tokens to be exchanged with each coupon.

**Online/Offline interactions** - The pilot initially referred to a limited geographical area corresponding to a public garden and surrounding streets earmarked for revitalisation. It was later decided to widen the scope to encompass the entire municipal area in order to increase opportunities for exchange. This action weakened a tight connection with

<sup>8</sup> 7 co-design and organisation sessions with the social cooperative, and 3 co-design sessions open to the other local actors.

one highly specific area, but it maintained a strong relation with historically rooted youth initiatives in the local area and with the municipal identity, as exemplified by naming the reward tokens Token 10095, derived from the postal code of the city. To reinforce the reference to the municipal area, relevant places are visualised on an integrated map in the app. Naming them *participation places* and *exchange places* made the expectations of the core actors explicit, as regards the type of social and economic interactions that the project should encourage in those spaces.

The digital interactions are intended to both encourage and reward in-person social activities. All coupons have to be redeemed in person, and there are no exchanges that involve remote interactions only. With their limited economic value, the incentive effects of tokens are probably not enough to lead to a significant increase in the number of volunteers. However, it is expected that coupons will promote local services, by giving providers benefits in terms of visibility and reputation and (small) economic gains from having additional customers. While policy officers and educators have stressed the initial goal of encouraging young people to take part in the economic life of the municipality, many of the participating teenagers stated that they would prefer to have access to exchange places in the metropolitan area as well.

*Design flexibility* - While acknowledging the need to prevent counterproductive uses of the application, the cooperative staff have asked for a digital tool that is not too heavily regulated and for some constraints to be relaxed, in order to be open to citizens' initiative: for instance, that they wish to be free to donate tokens. Following these criticisms, users' roles and permissions have been modified accordingly.

Initially, users considered not effective the way in which the interface conveyed information on the goods/services offered with the coupons: this first digitally mediated interaction could fail to make young people fully aware of the opportunities available. Therefore, it was decided to make the *manifesto* feature also available for the exchange coupons functionality, as it is for tokens in the standard version of the app. The manifesto is an attached document that explains the value, rules and benefit of the tokens or coupons in plain language.

As regards the lexicon of the interface, representatives of the local association asked for words that are typical of blockchain and economic transactions to be substituted with words more evocative of social interactions. For instance, when sending tokens, the word *pay* was substituted with *transfer*. The labels *participation places* and *exchange places* were chosen to identify local actors while stressing on the local (places) and social (participation, exchanges) nature of the interactions, even if mobile applications usually adopt more concise and concrete wording than this one.

#### 4.2. (Im)material circular economies: Library of things

C.O.S.O.<sup>9</sup> - Library of Things is a grassroots project initiated by a group of citizens in the neighbourhood of Borgo Campidoglio in the city of Turin, Italy. A library of things is a circular micro-economy in which participants lend and borrow objects of daily use. Each object is univocally represented in the app as a *non-fungible token*<sup>10</sup> created by the lender. NFT transfers between wallets allow users to reserve objects and track exchanges. Whoever borrows an object must give community coins represented with *fungible tokens*. For all actions that contribute to the exchanges (joining the community, making an object available, accepting a loan, concluding a loan), smart contracts automatically send community coins to the wallets of the participants involved.

*Digital mediation* - The Library of Things functionality in CommonsHood is designed to enable decentralised management (see below) of a sharing system through NFTs. This is functional to the ultimate purposes

of the project: on one hand, to reduce waste and consumerism, and on the other hand, to foster proximity relationships in a neighbourhood. Hence there are also fungible tokens that reward any action which contributes to keep relationships vital.

Differently from a rental system, the participants decided to give value to reciprocal trust and non-market exchanges as follows. All objects have the same price in community coins, in order to avoid the situation that some participants cannot afford some objects. There are no deposits or penalties if objects are damaged: reparative actions are left to personal relationships and individual compliance with the written ethical regulations of the project, and not to smart contract mechanisms. In-depth debates were held on other proposals such as issuing fines to be paid to a "community wallet" for redistribution purposes.

*Actors* - The pilot started on the initiative of a local association. It received a small fund from a local banking foundation, and is endorsed by the administrative city district. About 10 persons actively participated in the initial co-design. Most of these people are already active in other community initiatives in the neighbourhood and are strongly motivated to adopt alternative economic practices to consumerism and capitalism. Together with the researcher, they dedicated a relevant amount of time to designing the system.<sup>11</sup> Numerous proposals and objections were made concerning community-building aims; the concepts of price, value, prize, reward, deposit, penalty and compensation; and how to adapt tokenisation mechanisms accordingly.

The blockchain-enabled library of things is decentralised insofar as it does not require a "librarian" to register the transactions or a physical place to store the objects. The NFT system allows autonomous registration of objects, their visualisation in a virtual showcase, reservations via a calendar, and tracking of transactions. Owners keep the objects at home so that they can continue using them when they're not on loan.

*Online/Offline interactions* - The geographic context addressed is the neighbourhood where proximity relationships can take place. In terms of spatialities, the main consequence of the absence of a physical library is that objects are not exchanged through asynchronous interactions pivoted on a unique public space, but through direct in person meetings, that aim at preserving and encouraging personal relationships.

It was regarded as necessary to have face-to-face and offline community activities in urban public and private spaces to embed digital one-to-one interactions. Repeated co-design sessions with a restricted group allowed in-depth negotiation of the social rules of the model. The project community has planned a six-month programme of local cultural events (e.g. street parties) in order to introduce the digital tool and engage neighbours on a gradual basis, and to conduct offline testing of the interaction model (Fig. 3).

*Design flexibility* - The initial concept of the CommonsHood Library of Things was based on a rental system and on typical mechanisms of online communities where trust among participants is limited: purchase of objects in a marketplace, deposits, gamification and reputation scores. Subsequently, most of the functionalities were adapted to community-rather than market-based mechanisms. Moreover, the user experience has been simplified when compared with NFT creation in existing NFT marketplaces.

In order to safeguard the app's adaptability to other communities that could make different value choices on giving objects a price, using deposits, redistributing coins etc., the relevant functionalities have been developed to cover different cases, and they can be (dis)activated or set up differently.

The lexicon of the interface was also debated in order to ensure that it uses words that are evocative of reciprocity within a community rather than individual utility. Contested words such as *prize* or *reward* have been avoided. Moreover, instead of the typical lexicon of NFT exchanges which recalls commercial and virtual exchanges, they chose words that

<sup>9</sup> Italian acronym meaning Organised Communities for the Exchange of Objects.

<sup>10</sup> Non-fungible tokens (NFT) represent unique digital or material objects with a unique digital identifier.

<sup>11</sup> 6 co-design and organisation sessions together with the core group of neighbours.



Fig. 3. C.O.S.O project: community engagement actions.

recall the physical materiality of the relevant resources (e.g. suggesting a storage place with the term *shelf of objects* instead of *NFT collection* or *NFT marketplace*) (Fig. 4).

### 5. Challenges of localising a civic blockchain

In the process of introducing the app into the local contexts of experimentation, certain strengths and criticalities were observed. Some are similar to those observed for urban digital platforms. Some depend on the specific properties of blockchain technologies or the civic blockchain approach. Some are due to the experimental character of the research project. This section discusses our findings in the light of these

similarities and differences.

#### 5.1. Similarities with urban digital platforms

The following dynamics observed with urban digital platforms apply also to app under consideration (see Section 2.2). The digital component is not the primary driver for participation in civic, social and collaborative economies, but it can facilitate interactions and redistribution of resources when a certain level of individual motivation and collective commitment is already there. The presence of pre-existing and committed groups of community members facilitates the process, and face-to-face community activities in the urban spaces help to embed

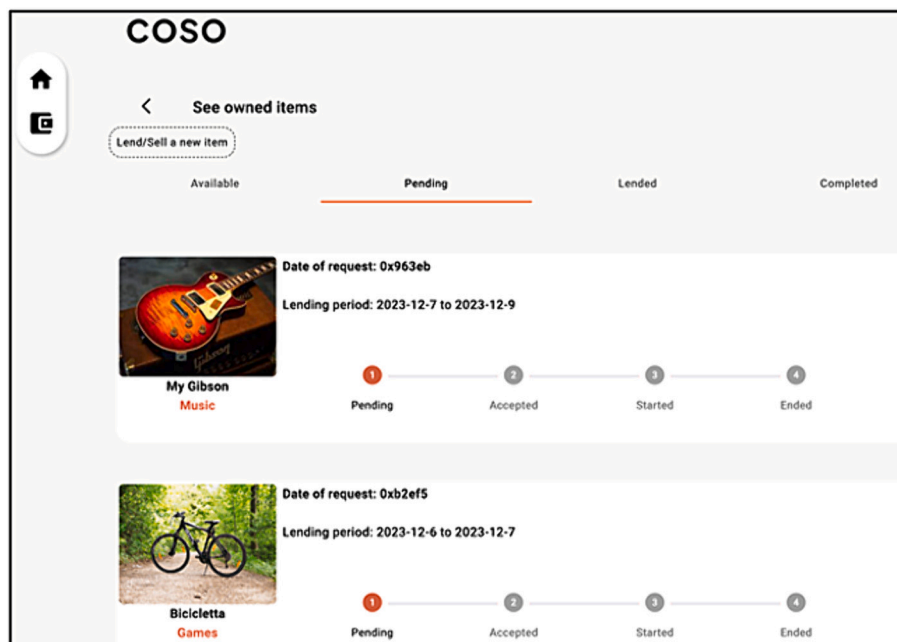


Fig. 4. CommonsHood interface for the C.O.S.O Library of Things pilot: management of user's lended objects.



digital one-to-one interactions, as shown in the C.O.S.O pilot. However, the C.O.S.O. pilot is characterised by a very high participants motivation and by a significant proportion of offline and engagement activities, which could be difficult to replicate in other contexts.

Based on these observations, we can make some remarks for action research and experimentations on alternative urban digitalisation. On the one hand, such experimentations question mainstream imaginaries on the immediateness and disruptiveness of digital technologies. The processes under consideration constitute socio-technical transformations that require incremental changes and intentional actions by all the actors involved, from developers to users. On the other hand, the imaginaries of tech-sovereignty movements (Lynch, 2020) and common-based peer production (Benkler and Nissenbaum, 2006) are also challenged to a certain extent. Indeed, distributed and disintermediated actions are not inherently valued by many local actors (for instance, the retailers in Collegno). This fact can impede their willingness to allocate time for such collaborations. Participatory and community economies require coordination and different types of mediation. Therefore, on a methodological level, there is a need, especially in the activation phase, to have actors with a facilitation role, like the social cooperative in Collegno and the local association in C.O.S.O. Transdisciplinary and interdisciplinary research across technical and social sciences can play a relevant role in this facilitation.

### 5.2. Peculiarities of the (civic) blockchain

As a blockchain-based platform, CommonsHood is aimed at facilitating new forms of circulating values, by making them liquid in the form of tokens, and by allowing secure disintermediated transactions. The meaning and purposes of tokens are specific to the civic blockchain approach. Specifically, these values are not meant to be (only) monetary but include any asset deemed relevant by the local community. Civil society actors are increasingly interested in the possibility of using tokens as combined material (monetary or not monetary), social and moral incentives (Van Stekelenburg, 2013) to strengthen civic participation. For instance, they can be used to recognise volunteering and care work (as in Collegno), to activate relationships (as in C.O.S.O), and to encourage behaviours that are regarded as positive for the local community or the environment (e.g. buying goods in local shops, or avoiding the waste of under-used objects).

In the app under consideration, enabling communities and users to decide what to tokenise and how is the main driver for making the app adaptable to local needs. Co-designing both the socio-economic interaction model and the tokens requires significant effort, time and negotiations, which should in turn avoid that logics of algorithmic governance simplify the society-technology-space co-constitution (Zook & Blankenship, 2018). The main challenge is representing immaterial community assets in the form of tokens and modelling socio-economic exchanges through smart contracts, while taking into account the diverse value judgements on these assets and the mutability of social relationships (for instance, see the debate in Collegno on the value of the reward token). Applying tokenised economies to social dynamics brings with it the risk that transactional, commodification and utilitarian logics prevail over relational ones (Cila et al., 2020; Sotoudehnia, 2021). For instance, decoupling the financial imaginaries associated with tokens from social goals (Semenzin, 2023) has turned out to be challenging for many social actors. Another related risk is that economic incentives crowd out the social motivation to participate. Local stakeholders in the two pilots do not seem to be worried about this, since the low (in Collegno) or symbolic (in C.O.S.O.) economic value of the reward tokens indicate that they are intended as recognition rather than payment. A further risk is that self-executing smart contracts constrain spontaneous social actions. This was demonstrated, for instance, by the requests in Collegno that people should not be prevented from donating their tokens, and in C.O.S.O. that tokens should not be withdrawn as penalties.

As regards the actors involved, the aforementioned need for

facilitators requires further clarification given the hype of blockchain narratives on disintermediation (see for instance Bodó, Brekke & Hoepman, 2021; Husain et al., 2020). What CommonsHood disintermediates is control over the uniqueness and ownership of the digital assets, which is a technical role enabling transactions. The intention is not to eliminate steering and coordination roles, both institutional and community-based. On the contrary, they are fundamental for activating and maintaining different types of civic participation. In the pilots, compromises were necessary to balance the particular requirements of the autonomous or decentralised initiatives of the local actors with the general requirements of uniform rules and ease of use.

As regards urban spaces, another peculiarity of the app is that digital interactions between wallets are designed to encourage encounters and actions in the physical urban spaces. In the models that have been co-designed during the two experimentations, online and offline exchanges appear balanced, with only-digital interactions limited to aspects where practicality and visibility are better served by digital tools (e.g. the virtual showcase of objects in C.O.S.O., or the list of all the available exchanges in Collegno). Conversely, as mentioned before, in person encounters in urban spaces are necessary to embed civic blockchain in the local social relationships. Especially when mapping functionalities are integrated with the wallet, the way in which the urban space is envisaged in CommonsHood resembles more to geolocated urban platforms than to the "City as a Licence" paradigm provocatively advanced by Gloerich et al. (2020) for civic blockchains. The findings presented in section 4 relate to the co-design and initial testing phases (see section 3.2). Further evidence is needed from the subsequent phases of usage and evaluation of the app, to delve into how the app usage shapes urban spatialities. Relevant topics in this regard are: how tokenized incentives encourage different ways of accessing, using, producing urban spaces; the scale (neighbourhood, city, metropolitan area) at which a tokenized collaborative economies is relevant; the way in which digital interactions provide continuity to the physical ones.

In terms of the application's design, the starting point in each local context is a standard version of CommonsHood, which is highly customisable at different levels: modular functionalities, type and value of tokens, users' roles. This high level of flexibility makes clear the co-constitution of digital and social dimensions in digitally-enabled social innovation processes (Ozman & Gossart, 2018; Cenero & Certomà, 2022; Zook & Blankenship, 2018) and it stimulates reflections on that aspect. However, it seemed to be rather disorientating for some users. Conversely, as already mentioned above, local actors sometimes perceived the programming of smart contracts as too vinculating with respect to social requirements. Compromises were also needed as regards the lexicon of the interface: while the local actors often proposed changing the techno-financial crypto-jargon (*token, payments, NFT collections, decentralised autonomous organisation (DAO)*), developers and researchers in some cases suggested keeping the original words. They did this to be more evocative of the peculiarity of the exchange enabled by the app (e.g. *tokens* instead of *coins* so as to include different kind of values), and also as a strategy for raising awareness among the wider public about the civic potential of blockchain. This also relates to a further issue: whether to keep the English words widely adopted in the blockchain community or translate them into the local language (Italian in the cases under consideration) as was done for most of the components of the interface.

The civic blockchain approach implemented in CommonsHood offers methods and tools for embedding blockchain-based wallets in civic and urban contexts. It mitigates, but does not eliminate, some of the societal pitfalls of tokenised economies. So far, practical solutions have been found in ongoing experimentations. Namely, some interactions are kept offline and off chain when tokenisation logics clash with social goals (Nguyen Long, Graaf & Votsis, 2023). This is significant in terms of gaining awareness of the potential and limits of blockchain-based tools for supporting civic interactions.

### 5.3. Experimental research on the civic blockchain

Further remarks relate to the experimental nature of the research and the early stage of implementing the app in real-life contexts. The latter also represents the main limitation of this article. Since the experimentations started with simplified interactions and governance models, further research is needed to assess whether this step-by-step approach should be the standard methodology for effectively embedding the app in local contexts. The challenge is dealing with the complexity of social economies that do not exist yet, but are co-constituted together with the digital processes. More evidence from the next steps of the experimentations (see Section 3.3) is required regarding the actual effects of the app on urban spaces and spatialities: the benefits and costs for the different actors; the activation, consolidation (or crowding out) of spaces of exchange, and the restructuring of governance models and powers. So far, tests and pilots have been done in the metropolitan area of the city of Turin, Italy. Once the core functionalities for different collaborative socio-economic models are consolidated, their adaptability to different socio-geographical contexts and scales must be investigated, not only in urban domains.

In the pilots under consideration, the University as an institutional actor has initiated the experimentations, administers funds, and bears the cost of the blockchain infrastructure. Researchers play an important facilitation role. Open questions concern whether the local communities will appropriate the app and use (more) autonomously; and to what extent digital experts will remain core actors providing either occasional technical assistance or continuous adaptation of the app. The extent of their commitments could be one of the context-dependent variables. Compared to other experiences of alternative digital urbanism that are strongly focused on technological sovereignty (Lynch, 2020), the CommonsHood approach currently focuses on control over data ownership (Viano et al., 2022) and the customisation of tokens, while the technical infrastructure is not owned by the local communities. However, local authorities and private actors could potentially host new nodes of the blockchain.

## 6. Conclusions

The civic blockchain approach and CommonsHood research project explores how blockchain technology can be oriented towards civic and local applications. This article introduces the concept of context-based civic blockchain and analyses how the CommonsHood app is implemented as such, i.e., embedded in local social and economic contexts. The analysis is focused on the first phase of experimentation. Insights are provided on the co-design methodology adopted by the research group together with the local actors, and on the resulting reshaping of functionalities and affordances. The embedding processes are characterised by strengths and challenges that are sometimes similar to those of other urban digital platforms, and that are sometimes technology-specific. Regarding the latter, some relate to features that are typical of the blockchain while others relate to the reinterpretation of the same technology that the civic blockchain approach advances.

In the civic blockchain approach, what potentially makes blockchain technology not merely oriented towards civic collaboration, but also context-based, is the fact that typical blockchain properties (tokenization, smart contract, disintermediation) are significantly reinterpreted and re-designed. This means that some traits of the wallet app under consideration are more similar to urban digital platforms than to crypto wallets. Typical tokenisation mechanisms are also made adaptable to context-specific decisions by the local community. This does not eliminate the risk that tokenised economies conflict with social goals, but it does show two important strengths. First, local actors can become more aware of the possible conflicts, and can contribute towards orienting the app design towards social goals. Second, this kind of experimentation sets the ground for matching tokenised economies with social collaborative economies, where the coexistence of social and economic

mechanisms is already in place. However, more empirical evidence is needed to assess which specific community economies (local currencies, time banks, reward systems, etc.) can benefit the most from this technology.

The findings presented in this paper are specific to the CommonsHood app and the two pilots, but they offer examples of conceptual and methodological approaches to widen the field of alternative urban digitalisation to blockchain technology. The empirical results demonstrate effective practices but also highlight potential obstacles. Blockchain and other technologies such as artificial intelligence and extended reality are changing ethical, governance and spatial paradigms, but the rapid changes brought by digital innovation may not align with the needs and timescales of social transformation. A two-fold strategy can contribute to overcoming techno-solutionist approaches. First, we can redeploy technical infrastructures and functionalities to encode participatory principles in these digital technologies, assuming their non-neutrality. Second, we can build on the strengths of consolidated urban digital platforms and related socio-technical processes that make digital technologies more understandable and accessible.

### CRedit authorship contribution statement

**Cristina Viano:** Methodology, Investigation, Data curation, Conceptualization.

### 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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