CommonsHood: Blockchain tools for socio-economic interactions in local communities

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Blockchain tools for socio-economic interactions in local communities

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Abstract

Blockchain technology is generating interest in novel applicative fields such as co-production of public services. Our CommonsHood project is a "wallet app" that uses the Blockchain as a tool to support sustainability of the local economy. Its tokenization mechanism allows everyone to create new types of cryptographic tokens on the Blockchain in order to digitalize assets, augment the availability of local liquidity, and incentivize cooperative socio-economic interactions. This article analyzes a concrete application of CommonsHood for innovating local development policies and service co-production in the tourism sector. We examine this application using Linders's analytical framework for information and communications technology (ICT)-enabled co-production of services (2012). We show the advantages our project brings for local policies on tourism development, and we discuss the benefits and costs of using the Blockchain in that context. We argue that the observed case study covers different types of digitally enabled co-production of services, and that it can be defined as a case of Governance as a Platform. We also argue that well-established analytical frameworks for ICT-enabled co-production of services need to be expanded in order to account for the new affordances enabled by the Blockchain technology, namely the creation and transaction of digital values, which represent a paradigm change in how we understand the Internet and digital co-production.

Keywords: Blockchain; co-production; Governance as a Platform; tourism

Blockchain is an emerging technology that offers a new paradigm for storing, validating, and transferring not only information but also values. It is part of the broader class of distributed ledger technologies (DLTs) which, as opposed to centralized servers, are used to create and maintain a untamperable set of records without the control of a centralized entity, and to certify information ownership through cryptography.[1] Blockchain creates decentralized platforms that guarantee immutability of the information, non-repudiation of the data, transparency and auditability (Yli-Huumo et al., 2016; Zheng et al., 2018), as well as the absence of a need for trust between all parties (Werbach, 2017). After its invention in 2008 (Nakamoto, 2009) to enable bitcoin, and its subsequent application in fields such as finance, trade, logistics, food traceability, and other business applications, it is now being experimented with in different sectors of public administration (Ølnes et al., 2017; Cagigas et al., 2021). Besides digitalization of public

[1] A set of methods for secure communication through the use of code.

administration, other fields of possible application include the production and management of public and common goods by means of public/citizen co-production processes (Linders, 2012; Lember et al., 2019) or digital social innovation initiatives (Antoniadis & Martignoni, 2018; Rozas et al., 2021).

Research in computer science on the one side, and in social sciences on the other, has not yet studied extensively Blockchain applications for the public sector regarding: the potential and risks of radically changing social, economic, and organizational models (Tomor et al., 2019); the regulatory issues that it raises, the trade-offs in terms of cost and energy consumption, and the possible policy impact and policy solutions (Ølnes, 2017; Shen & Pena-Mora, 2018). The distinctive features of the Blockchain (such as openness, transparency and immutability, disintermediation and trustless[2] interactions, and the centrality of smart contracts[3] that automatically execute transactions) are seen by many as promising to activate collaborative, verifiable, and decentralized participatory processes, but they can also be controversial and in contrast to the uncertain and relational nature of social exchanges (Cagigas et al., 2021). Experiments are being carried out by activists, professionals, non-governmental organizations, and local institutions with the declared aim of supporting decentralized, inclusive, and collaborative models of economy and welfare (Cila et al., 2020; Elsden et al., 2018).

The authors are developing and testing CommonsHood, a Blockchain-based app that aims to support financial inclusion and models of collaborative welfare and economy in local communities. Applications cover both digital social innovation and co-production of public services. This paper focuses on the latter, analyzing a concrete application of CommonsHood as a tool for innovating local development policies and co-production of services in the tourism sector.

Our research questions are as follows. How can Blockchain technology enable co-production of public services and promote the direct participation of citizens? How can it be used within policies for local economic development? What are the advantages of Blockchain-based platforms in terms of enhancing the participation of citizens, local economic actors, and public officers in co-producing public services and private initiatives?

We provide the CommonsHood application program (app) for the tourism sector as a concrete example of Blockchain-enabled co-production. We examine it through Linders's (2012) analytical framework for co-production of services enabled by information and communications technology (ICT), we show the advantages it brings to local policies for tourism development, and we discuss the benefits and costs of using the Blockchain. We argue that the case under consideration covers different types of ICT-enabled co-production of services. In particular, we define it as a case of Governance as a Platform (GaaP), referring to the definition provided by Linders and by other authors (Cordella & Paletti, 2019; Millard, 2013; O'Reilly, 2011). We also ask whether well-established analytical frameworks for ICT-enabled co-production of services need to be expanded to account for the new functionalities enabled by the Blockchain technology, such as transactions of digital values and property rights. This entails a change of paradigm in how we understand the internet and digital co-production.

The Section "Literature about digital co-production and Blockchain for public services" grounds the concept of the app in the relevant literature on co-production, on Blockchain for public purposes and for tourism, in order to highlight the conceptual and empirical gaps we address. Section "The case study: a Blockchain-based wallet app for supporting local economies" illustrates the methodology and introduces the CommonsHood concept and its functionalities. It describes our pilot application in the field of tourism in the Piedmont region of Italy. Section "Analysis of a Blockchain-enabled co-production process" analyzes it as a digital co-production tool and as an application of the GaaP approach. The Conclusions highlight some of the innovations that Blockchain brings to digitally enabled co-production and makes conclusions on the evidence and policy implications drawn from the case study.

Literature about digital co-production and Blockchain for public services

As part of an interdisciplinary research project, this article draws on different strands of literature from the fields of policy analysis, ICT studies, management, economics, and computer science.

[2] Meaning that transactions can happen among parts that do know or trust each other, and without a third party as a trusted intermediary.

[3] A smart contract is defined by as an "executable code that runs on top of the Blockchain to facilitate, execute, and enforce an agreement between untrusted parties, without the involvement of a trusted third party" (Alharby & van Moorsel, 2017).

Digitally enabled co-production

Co-production of services is a process in which citizens are involved, together with public actors, in the delivery of services of public interest, even if with different degrees of active involvement. In the past, co-production was constrained by the limited ability of governments to effectively coordinate the actions of citizens and the difficulty of enabling ordinary citizens to self-organize. Scholars have seen in the advent of the Internet's many-to-many interactivity and resulting ubiquitous communications the potential to rethink the evolution of the citizen–government relationship (Bertot et al., 2010; Johnston & Hansen, 2011). The literature on digitally enabled or ICT-enabled co-production processes (Clifton et al., 2020) has focused on how technologies enable more active participation and on whether this leads to improvement in the quality of services (Allen et al., 2020). Various co-production models have been identified (Allen et al., 2020; Linders, 2012). We claim that the interactivity and coordination most of the literature refers to is that enabled by the Web, and that Blockchain technology brings a change of paradigm. Indeed, Blockchain technology allows us not only to exchange information and coordinate but also to directly create and transfer digital values, which can have major implications for co-production.

Recent works address new typologies of digitally enabled collaboration (Moon, 2018; Yuan, 2019), thereby deepening the reflection on the effects of digitalization on co-production as a barrier or enabler, and as something that can augment or diversify, but also substitute, citizen–government interactions (Cardullo and Kitchin, 2019; Clifton et al., 2020). There is wide-ranging research on theoretical frameworks and technological potential, while there is a lack of empirical evidence about the outcomes, actual impacts, critical drivers, and barriers to application (Lember, 2019). This is due to the continuous evolution of relevant technologies, particularly the most recent ones such as Blockchain, hence the suggestions for more experiments.

Governance as a Platform

The concept of Government as a Platform was introduced in Lathrop and Ruma's (2010) wider reflection on collaborative and participatory practices within open government models. It refers to *reorganization of the work of governments around a network of digital components, and open-standard and canonical datasets, so that civil servants, businesses, and others can deliver radically improved services to the public more safely, efficiently, and accountably.* Citizen engagement is bigger in GaaP than in e-Government: the government becomes a "convener and an enabler rather than the first mover of civic action" (O'Reilly, 2011) and provides resources such as data, applications, knowledge, content, service building, blocks, shared infrastructures, and processes. The "platform" *means an open environment and ecosystem with clear frameworks, guidelines, resources, and support, which invites all actors*. This mechanism for orchestration between different actors is expected to facilitate collaboration in the production of public value, since it increases the ability to respond to variegated needs (Cordella & Paletti, 2019; Millard, 2013).

Recently, researchers have been studying the GaaP approach as part of wide-ranging reforms for the digitalization of public administration at a national level (Cordella & Paletti, 2019). Others have focused on the nature of government–citizen collaboration and on the respective degree of initiative. In this sense, GaaP is more broadly defined as the intermediate level in the citizen–government relationship, between *Citizen Sourcing* and *Do It Yourself Government*, and the level where the government makes its information technology (IT) infrastructure available to the public, helping citizens to improve their day-to-day productivity, decision-making, and well-being (Linders, 2012). We will refer to this definition in order to describe the digital co-production enabled by the Blockchain application under consideration. We also add that, due to the paradigm change the Blockchain technology brings, the orchestration at stake is not only about coordination, for which the Web is sufficient. It also entails a possibility for the different actors to create and transfer digital values.

Blockchain for public services

Research on Blockchain for the public sector addresses its potential for innovating both government administration and service co-production processes. Ølnes (2017) and Shen and Pena-Mora (2018) advocate more research on political understanding of the technology and pledge to shifting from a technology-driven to a needs-driven approach based on interdisciplinary research. Cagigas et al. (2021) provide a comprehensive review of the potential costs, benefits, and risks of Blockchain for governments, civil servants, and citizens. This literature is in its initial phase and is still limited in terms of the

number and extent of empirical cases concerning how the Blockchain can actually shape co-production processes, how their peculiar technical affordances can relate to different policy objectives, and what roles citizens can play (Tan & Rodriguez Müller, 2020). Differently from most other work, we build our own Blockchain application and analyze it, rather than focusing on applications developed by others.

Blockchain for tourism

The past 4 years has seen a sharp increase in the scientific community's interest in the adoption of the Blockchain in the tourism industry (Caddeo & Pinna, 2021). Önder and Treiblmaier (2018) were among the first authors to discuss the potential impact of the Blockchain on tourism. In their view, the technology will enable more trustworthy evaluation of products and services, widespread adoption of cryptocurrencies,[4] and disintermediation of the tourism industry supply chain. Others have analyzed the adoption of decentralized applications[5] for the involvement of citizens and travelers in smart tourism ecosystems enabled by integrated and co-creative platforms (Nam et al., 2021). More recent studies (Caddeo & Pinna, 2021; Joo et al., 2021) focus on applications aimed at making business processes more efficient and effective (e.g., baggage tracking, reservations and ticketing, and traveler loyalty systems). Other studies revealed that the complexity of the investments required and lack of expertise and knowledge of the technology currently limit its adoption in the sector (Cheriyan & Tamilarasi, 2021; Treiblmaier & Önder, 2019).

This shows, in our view, that increasing the accessibility of the Blockchain in tourism-related business practice is of primary importance. Our work contributes by examining an application aiming to reduce socio-technical and economic barriers to the creation and exchange of tokens. Furthermore, our application contributes to the study of disintermediation in tourism by focusing more on co-creative and integrated systems (Allen et al., 2020) than on efficiency (Caddeo & Pinna, 2021, Joo et al., 2021).

The case study: a Blockchain-based wallet app for supporting local economies

Methodology: an interdisciplinary research on the Blockchain for local economies

This contribution is part of an interdisciplinary research project in computer science, economics, and social sciences concerning the development of new conceptual and technical approaches to the Blockchain. In particular, it is focused on the development of CommonsHood, a Blockchain-based app aimed at supporting financial inclusion as well as models of collaborative welfare and economy at the local community level. We aim to gather empirical evidence from its actual experimentations, in order to move forward from identifying the potential and critical aspects to observation of concrete societal outcomes (Cagigas et al., 2021, Ølnes, 2017). The Blockchain development research project started in 2017 and resulted in the concept and functionalities presented in Section "CommonsHood: concept and functionalities" (Balbo et al., 2020). From 2020 onward, the project started piloting the technology in different applications fields: urban commoning, social and solidarity economies, active citizenship, volunteering, welfare, financial inclusion, and local economic development. As regards the latter, the experimentation used as a case study for this article ("CommonsHood-VisitPiemonte"), described in Section "The case study: Blockchain for tourism", deals in particular with tourism and related local policies. It addresses some of the issues and gaps highlighted in the above-mentioned literature on digital co-production, Blockchain for public services and for tourism.

Our empirical work is guided by the following research questions. How can Blockchain technology enable the co-production of public services and promote the direct participation by citizens? How can it be used within policies for local economic development? What are the advantages of Blockchain-based platforms for enhancing participation by citizens, local economic actors, and public officers in co-producing public services and private initiatives to support local tourism? From a theoretical perspective, we ask whether well-established analytical frameworks for ICTs enabled co-production of services need to be expanded in order to account for the new functionalities enabled by the Blockchain technology, such as transactions of digital values and of property rights. This entails a change of paradigm in how we understand the internet and digital co-production.

[4] Digital currencies that prevent counterfeiting through cryptography.
[5] Applications that run on distributed–decentralized systems like Blockchains.

During the design and pilot phases of the experimentation (2018–2020), the research group undertook co-design and requirements analysis together with the local administration involved and representatives of the local economic actors, and we developed the app's concept and functionalities. The app has been tested and piloted with users in order to gather feedback on its usability and on their inclination to use the app. As such, this article is mainly based on observations from the preliminary phases of the work. The related findings are relevant for orientating the successive research phase and are already providing relevant evidence about policy implications.

CommonsHood: concept and functionalities

CommonsHood[6] is a Blockchain-based wallet app developed by the Computer Science Department of the University of Turin. It started from a co-design process together with participants from citizen grassroots initiatives and municipal officers in Turin. The goal of CommonsHood is to provide communities with instruments for financial inclusion to support the sustainability of the local economy. It allows users (citizens, economic actors, associations, and local institutions) to create and exchange digital tokens representing assets of value.[7] The vision behind CommonsHood is the creation of an "Internet of Values 2.0" revolution, rather like the Web 2.0 revolution in the world of information. Web 2.0 transformed the World Wide Web from an IT tool reserved for programmers and enthusiasts to a tool allowing everyone to produce and publish content online. "Internet of Value 1.0" refers to interoperability among different Blockchains to allow the transfer of values instantly and without intermediaries. "Internet of Values 2.0" allows everyone to issue new types of tokens to represent assets of value and to distribute these tokens using a wallet app. The wallet app is analogous to what the browser has become for the Web and overcomes the steeper digital divide generated by the complexities of the crypto world. We use the plural "values" to refer to the many different values that people can attribute to material and immaterial resources, rights, and not just the monetary value.

Through the wallet app, urban commons and associations can create instruments to help finance themselves (e.g., with tokens representing prepaid cards), organize crowdfunding, develop complementary currencies, and share tools and infrastructures (using tokens representing access rights). Small retailers can issue tokens as loyalty tools, while institutions can issue purpose-driven tokens to reward civic behaviors such as volunteering to recycle. It allows for the dematerialization of tickets, lunch coupons, physical objects, and intangible assets in a single wallet app. All tokens can be distributed to the wallet app of other users, either directly or via websites, QR codes, or proximity marketing using geolocalization, the latter thanks to integration with the FirstLife[8] civic social network (Boella et al., 2019). Using the Blockchain allows an infrastructure to be constructed that is open, decentralized, and disintermediated from big commercial players, thus avoiding the fees and data control that is characteristic of services such as crowdfunding websites. Moreover, it enables users to use a general-purpose single app, rather than having to use different apps for different associations and retailers.

There are two main kinds of tokens. "Currency" (a.k.a. "native" or "protocol") tokens such as Bitcoin or Ether are built on their own independent Blockchains. They are not based on assets, and their values are directly linked to their very distribution mechanism. "Second-layer" (a.k.a. "application level" or "utility") tokens, such as the ERC20 standard coins created on Ethereum, can be created by designing suitable smart contracts on the Blockchain with various purposes or meanings, with their transactions paid in native tokens. The CommonsHood architecture is based on ERC20[9] "second-layer" tokens. It can be easily extended to support other token standards. In fact, different services based on ERC721 and ERC1555 standards are under development. The support of token standards is crucial for the interoperability of the CommonsHood platform with existing token-based platforms, from classic exchanges to the most sophisticated financial instruments at the basis of decentralized finance (DeFi). CommonsHood is a project that runs on a public permissioned Blockchain platform based on Ethereum and the Proof-of-Authority consensus algorithm,[10] which has been created and is maintained by a consortium of public administrations, universities and private companies. The University of Turin is one of the founders of the infrastructure. Each member of the consortium contributes to the infrastructure by

[6] https://www.commonshood.eu.
[7] Tokens are the digital representation of assets, rights, or resources. Tokenization is the method that converts rights to an asset into a digital token.
[8] https://www.firstlife.org.
[9] https://ethereum.org/en/developers/docs/standards/tokens/.
[10] Consensus algorithms are the protocols through which the nodes of a Blockchain reach an agreement on the state of the ledger and on the validity of transactions, thus maintaining the ledger synchronized.

running a validator node, while anyone can connect and send transactions to the Blockchain by using a simple node. Moreover, the consortium members can accept new participants through a voting mechanism. Currently, the Blockchain infrastructure is used as a platform for different Blockchain projects in different domains. Technical information on features and functionalities are addressed in Balbo et al. (2020).

CommonsHood is an innovative case of Blockchain experimentation because it is centered by default on the local community level while other Blockchain projects for financial inclusion (e.g., Faircoin, WeTrust, Manna) have a rather more global ambition of reaching the network effect of Bitcoin. To date, CommonsHood has been tested in local urban commoning projects (such as those associated with the "collaboration pacts" of the City of[11]), as well as in wider co-production processes together with other disruptive technologies (augmented reality, geolocation, e-democracy tools, and gamification) in a Horizon 2020 project called CO3 in Athens, Turin and Paris.[12] It is used in Turin in a project,[13] which fosters youth civic participation and promotes local economic activities. Other experimentations are being planned about community care services for the elderly, incentivization of circular economy practices, and corporate welfare.

The case study: Blockchain for tourism

Our case study is an experimentation of the CommonsHood app in the Piedmont region, as part of a wider platform for implementing policies for the growth of tourism at the regional level. The region of Piedmont has a law (N.14/2016) concerned with promoting tourism, which affirms the necessity of *coordinating* the activities of public and private actors, building *promotional* tools, and *monitoring* requests to improve what is on offer. The region has its own agency, a Destination Management Organization (DMO) called VisitPiemonte, which works with local tourism agencies and consortia to implement the region's strategies. Since the region's current digital strategy for tourism is fragmented, the design of a coordinated policy can be enhanced with a single digital platform for coordination, promotion, and monitoring.

The "Blockchain for VisitPiemonte" experimental project implements the CommonsHood Blockchain technology in the VisitPiemonte tourism portal.[14] The actors involved are the tourism department of the Piedmont region, the VisitPiemonte DMO and other local tourism agencies, the University of Turin (Department of Computer Science), and private IT companies. About 1,500 tourism-related operators will be involved in the experimentation altogether; the potential impact of the service when fully operational would be on 15,000 operators in the region. Visitors to the website can register and, by clicking on a button of a local operator on the portal, obtain commercial offers in the form of discount coupons. These coupons are tokens that arrive in their personal wallet app, and which give them the right to discounts or other advantages. The operators register on the portal and get access to a personal wallet where they can create, transfer, upload, and receive tokens, acting autonomously from intermediary services. The wallet is built on the CommonsHood platform and has the following functionalities: the creation of personal wallets; the creation of digital twins of tourism-related businesses via the implementation of Decentralized Autonomous Organizations; interfaces for managing the wallet and the coupon tokens (for the visitors), and for creating and managing the coupons (for the operators); and geolocation of tourism activities through integration with the FirstLife geolocation-based social network.

Benefits, risks, and costs of using the Blockchain

Having presented how the platform works, we discuss the benefits and costs of using the Blockchain. The project leverages upon the ability of the Blockchain to satisfy the following requirements: digitalization of physical assets; automation of processes; interaction of different actors who do not trust one other directly; overcoming the need for intermediaries; and certification of information. In the context under consideration, the project address, respectively, the need to dematerialize tickets and coupons; the need to reduce the cost of intermediaries; the need for smooth coordination among operators and between operators and tourists even before, or in the absence of, a physical meeting; and the need for data on tourism fluxes and transactions for evidence-based policymaking. The transaction history of a coupon is traceable as is data concerning navigation on the portal, and aggregated data are available

[11] http://www.comune.torino.it/benicomuni/co-city/index.shtml.
[12] https://www.projectco3.eu.
[13] https://www.firstlife.org/en/projects/n.e.o.n.not-excluded-from-our-neighbourhood/.
[14] www.visitpiemonte.com.

for improving the same services, data which are owned by the territory and not by Internet operators. The tourism businesses can coordinate and agree on community initiatives, such as community token that can be issued and accepted by the actors of a community, thereby generating reciprocal promotion mechanisms. From the visitor's perspective, besides getting discounts, they are facilitated by a portfolio of offers and incentives presented in uniform ways, and they do not need further cards or devices.

The benefits of using a DLT as compared to a centralized server are related to the fact that the latter centralizes control of the data, while with the Blockchain, there is not a single external controller: everyone who sets up a node, and therefore contributes to maintaining the data on the Blockchain, can access this information. If a dispute arises on the state of a wallet, everyone can verify the state. However, a related disadvantage is the fact that the data owner can lose control of his/her own data and is at risk of malicious actions. In the case under consideration, this risk is managed by adopting the Proof of Authority consensus instead of the Proof of Work algorithm: the former allows the identification of people who write contents on the Blockchain. As regards data protection, permissionless Blockchains (where anyone can join in with setting up a node) can conflict with laws such as the General Data Protection Regulation 2016/679 (GDPR), since no single subject has direct responsibility for the data. Conversely, the CommonsHood Blockchain is a permissioned Blockchain and is therefore not fully trustless: sealer nodes (that can write on the Blockchain) are pre-authorized. However, the CommonsHood Blockchain is GDPR-compliant since it does not record personal data, only data regarding the coupons and the status of their exchanges. As regards the costs of introducing such a novel and complex technology, the experimentation adopts a sustainability strategy where the initial investment is borne by the public actor and by a public research institution, and the technical output is put at the disposal of the local actors in accordance with the Government as a Platform approach (see below). The costs in terms of the end user's necessary skills and learning process are negligible due to the design of the app itself, which makes the Blockchain accessible to people with basic skills on mobile devices and applications.

Analysis of a Blockchain-enabled co-production process

In order to study how the Blockchain technology in our CommonsHood app can enable co-production of public services and promote direct participation by citizens, this section analyzes the case through the framework elaborated by Linders (2012) for classifying ICT-enabled processes of co-production of public services. Building on this, we focus more in depth on "Government as a Platform" as an approach to collaboration between citizens and public administrations.

Analysis of the case's accordance with ICT-enabled co-production models and definition of GaaP

Linders (2012) observed the ways in which technology expands the viability of and capacity for citizen co-production through a matrix model based on two dimensions:

- Government–citizen relationships: *citizen sourcing* (whereby citizens influence the direction of government services, improve the government's awareness of situations, and may provide resources for executing parts of those services), *Government as a Platform* (whereby the government informs, assists, and enables private actions, and makes its IT infrastructure available to the public, who then become responsible for production), or *do-it-yourself government* (citizens help one another, with IT used as a vehicle for collective action).
- the three phases of the service delivery lifecycle: design of the service, *day-to-day execution* with citizen contribution, and *monitoring* of the results of the services with feedback from citizens.

Cross-cutting these variables, the framework identifies nine types of ICT-enabled co-production (Table 1).

Two considerations are necessary. Firstly, more recent frameworks have refined their analysis of the dimensions that define co-production (Lember et al., 2019). Still, we consider this to be an appropriate starting point for considering, in a comprehensive and concise way, the two fundamental dimensions of the service lifecycle phases and citizen–government relationships.

Secondly, our aim is not to classify the Blockchain system under consideration as belonging to one or more of Linders's typologies of co-production, since the novelty of the technology means it cannot

Table 1. ICT-enabled co-production types, by citizens/government relationship and by phase of the service delivery cycle adaptation from Linders (2012).

	Citizens to gov.: Citizen Sourcing	Gov. to citizens: Government as a Platform	Citizens to citizens: Do It Yourself Government
Design	Consultation	Informing and nudging	Self-organization
Execution	Crowdsourcing and co-delivery	Ecosystem embedding	Self-service
Monitoring	Citizen reporting	Open-book government	Self-monitoring

Table 2. ICT-enabled co-production types in the experimentation "CommonsHood-VisitPiemonte".

	Citizens to gov.: Citizen Sourcing	Gov. to citizens: Government as a Platform	Citizens to citizens: Do It Yourself Government
Design	Consultation	Informing and nudging	Self-organization
Execution	Crowdsourcing and co-delivery	Ecosystem embedding	Self-service
Monitoring	Citizen reporting	Open-book government	Self-monitoring

Types of co-production described by Linder and covered by the case study.

Types of co-production partially matching Linder's description, or not yet implemented in the case study.

Types of co-*production described by Linder and not covered by the case study.*

be classified in such a strict way for two reasons. First, we see overlaps across the typologies. Second, new affordances are emerging that cannot be placed in the matrix. We will see that the case studied only partially aligns with Linders's typologies.

The case under consideration is an intersection of six of these types to different extents, as explained below and represented in Table 2.

- *Ecosystem embedding*: the regional administration becomes a stronger part of the social ecosystem, embedding in it its own capabilities for enabling the development of private goods by making the Blockchain platform available (O'Reilly, 2011; Linders, 2012). Through the platform, tourism-related businesses can obtain visibility and can autonomously create new types of tokens to distribute to the visitors as incentive and fidelity tools. Ecosystem embedding is the foundation that enables what follows.
- *Self-organization*. The operators can coordinate among themselves in order to issue a "community token" in addition to creating individual tokens. With community tokens, the same token is accepted by different retailers so that joint initiatives can be performed. For instance, tourists get a reward for purchasing a service from operator A in the form of further discount tokens that can be spent at activity B. Or tourists get a cashback that they can decide to pool in a crowdfunding initiative that will fund a third-party local initiative, such as social or environmental projects financed in cash by local operators on the basis of the collected tokens.
- *Self-service*. The availability of the promotional website and wallet app reduces the cost of turning to intermediary services for both operators and tourists. Here, the intermediary replaced is not the government, as in Linders's definition, but rather commercial services such as big commercial platforms that could drain resources from local contexts and exploit the data that they only would obtain.
- *Self-monitoring*. The platform gathers real-time data on tourists' choices, making it possible to get correlations between users' behavior on the website and the tokens and coupons used. In return, the administration and the operators get information to help improve the coordination and promotion of their services, from the coupon offers at the micro-level to the general promotion strategy at a district/regional level. Data on individual choices that the user agrees to share when registering are not shared with any third party and remain in the local ecosystems. This is in contrast to many

co-production services running on platforms and technologies owned by private companies that re-allocate control of data away from citizens.

Even if with only partial overlapping with the definition provided by Linders, a fifth aspect is of relevance:

- the project is oriented at re-designing the promotional initiatives themselves, and this, to a certain extent, cross-cuts the *consultation* typology, if we consider policy design by regional administrations, as well as the *self-organization* typology, if we consider the design of specific promotional actions initiated autonomously by the operators. It is important to clarify that the citizens that are actively involved in self-monitoring and consequent re-design are the operators/retailers. Tourists passively provide usage data by agreeing to be profiled when they register on the platform, but they also actively contribute with their token transactions, e.g., when selecting from different local offers or deciding to transfer tokens to other users.

One more type of co-production from the framework is envisaged for further developments to the app:

- *Informing and nudging*. Providing tourists with data so that they can make informed decisions, or encouraging socially optimal options via, e.g., discount coupons for less visited locations, is important for tourism. It can bring to the forefront attractions that are less known, avoid overcrowding in the most highly rated attractions, help in the setting up of booking systems to avoid pollution, or help enable compliance with public health regulations such as the COVID-19 regulations.

As such, the Blockchain affordances exploited with the approach advanced by the project under consideration support a co-production model that covers different and overlapping typologies of interactions between citizens and public administrations.

Among the typologies of government–citizen relationships mentioned, we claim that the one that best grasps the specificities of the CommonsHood Blockchain is "Governance as a Platform." With reference to the definition of GaaP provided above, we define the VisitPiemonte Blockchain platform as a local and sector application of the "GaaP" model, since it is a digital service offered by a regional public administration to tourism operators and visitors, so that they can participate to support related local economic activities, by actively creating and using digital tokens. There are no added costs for beneficiaries while it allows local services for tourism promotion to get useful data for improving their own services.

Furthermore, we observe that the different ways in which co-production can be realized all, directly or indirectly, revolve around creating and transferring digital values. In our opinion, this represents further expansion of capacity for co-production compared to what was enabled by digital technologies prior to the Blockchain.

Relationship with policy objectives

The case study aims to improve quality of service against the three regional policy functions mentioned above: coordination, promotion, and monitoring. For each of these objectives, different types of co-production are in place:

- Coordination between the public actors (the Piedmont region and its agencies) and the tourism stakeholders, and among the different tourism stakeholders, is expected to improve thanks to the *ecosystem embedding* and *self-service* mechanism of co-production, enabled by distribution of tokens among operators and tourists. Furthermore, the integration of the wallet app with the promotional website converges different resources and offers in a single place.
- The promotion of the local tourism network is expected to be enhanced mainly through *self-service* and, in a later development phase, *informing and nudging* mechanisms of co-production: local actors create digital assets without necessarily having expertise in Blockchain and without having to pay for intermediary services.

- External monitoring of the public and private services provided will be enhanced by *self-monitoring*, which can turn into a more informed *consultation* (to the advantage of decision makers) and *self-organization* by the local economic actors. This relies on the traceability of transactions enabled by the Blockchain, coupled with geolocation of the information and integration with a data analysis platform.

Conclusions

In this article, we have positioned the different co-productions mechanisms in CommonHood, the enabling Blockchain affordances, and the policy objectives addressed by analyzing the experimentations using Linders's framework and integrating his concept of GaaP with other definitions. This has allowed us to advance theoretical contributions regarding the relationship between the Blockchain technology and digital co-production, describe an innovative concept of a Blockchain application, provide empirical examples of its use in the tourism sector, and point out some policy implications.

The novelty of Blockchain as a tool for co-production

In analyzing the Blockchain technology for the co-production of public services, we have seen that its functionalities cover more than one of the co-production typologies defined by a well-established analytical framework, and that they affect different service delivery phases.

Moreover, some peculiar technical properties and affordances are not covered by traditional schemes. This is in line with the analysis of Lember et al. (2019), who argue that the debate on co-production and digital technologies so far does not yet account for the continuous technological development in sensing, communication, processing, and actuation technologies. New typologies of ICT-enabled co-production redefine categories such as citizen sourcing, automatic co-production, and government as a platform (Yuan, 2019). Still, we argue that additional new dimensions or typologies should be defined depending on the new affordances brought by the Blockchain. DLT technologies enable new models of interaction based on the creation and transfer not only of information but also values. What distinguishes the Blockchain from other co-production enabling technologies are creation and transfer of digital values; turning illiquid assets into liquid assets; disintermediation of transactions; and full traceability of transactions.

We also claim that, in order to support co-production processes, the Blockchain technology needs to be made accessible through platforms, apps, and interfaces that mediate its technical properties so that the wider public can experiment with tokenization and disintermediated transfer of values. We call this approach "Internet of Values 2.0" and advance it as the next phase in the development of the Blockchain technology from the user's point of view.

The case study: an application of the Internet of Values 2.0

We analyzed the "CommonsHood-VisitPiemonte" pilot as a concrete experimentation of the Internet of Values 2.0. The case study aims to innovate the way in which public agencies, economic actors, and tourists interact in the delivery cycle of tourism promotion services on a local level (in an administrative region of Italy). Regarding citizen–government dynamics, it is necessary to specify how we envisage the "citizen's" part. In this case study, rather than addressing civic participation in local democracy processes, our attention was focused on the interests of small local economic actors and their ability to be active in initiatives for local economic development. The VisitPiemonte Blockchain project has concluded its co-design and technical phases and the engagement of local tourism-related businesses in testing the functionalities. Design sessions with local stakeholders contributed to refining the app concept, as defined in Section "CommonsHood: concept and functionalities".

The project is part of a wider research program concerning the CommonsHood platform that has adopted an interdisciplinary methodology involving the disciplines of computer science, economics, and more recently urban studies, and which is running diverse pilots in parallel in the fields of urban commoning, volunteering, local retail, active citizenship, and community welfare. The general aim is to contribute to filling some gaps emerging in the literature on digital co-production and on the Blockchain: the scarcity of evidence on the actual outcomes in different contexts (Tan & Rodriguez Müller, 2020; Tomor et al., 2019) and the need for social sciences to engage more with specialist technological studies (Ash et al., 2016; Lember et al. 2019).

Initial evidence[15] collected in the early design and testing phases of the main CommonsHood app, from which the VisitPiemonte instance has emerged, shows that citizens are open to exploring both co-creation models and new technologies. There are some concerns and difficulties about using digital wallets, but young people are less hesitant and more inclined to imagine possible applications to support their daily transactions. Usability and availability on low-cost devices are crucial issues. There are some interesting indications of the possible use of CommonsHood for educational activities, bringing the complexity of the Blockchain closer to daily life. The Internet of Values 2.0, as implemented in CommonsHood, responds to both cultural and technical gaps in accessing the Blockchain technology by enabling easier interactions with the Blockchain through an app that has an intuitive interface and runs effortlessly on standard mobile phones, and by stimulating creative creation of digital tokens that address daily needs.

Policy implications

As regards the case study of CommonsHood-VisitPiemonte, empirical evidence on the effectiveness of the tool for improving the quality of services will be collected in a further phase of the experimentation. However, the co-design, development, and testing phases have already generated some findings that have policy implications.

We have explained that the Piedmont tourism strategy is based on three functions: coordination, promotion, and monitoring. For each of these, through the Blockchain properties, coupled with the functionalities of the CommonsHood platform and integrated with related services in a GaaP logic, the public administration can enable different types of co-production. Local operators can issue and coordinate their own tokens independently from intermediary agencies: networks of offers can be created based on geographical clustering of the activities. Visitors can be supported on customizing their visit. Regional agencies can get more precise data so that they analyze the value exchange between visitors and operators and correlate their provenance with preferences. Data control remains with the users and local administrations.

The distinctive cross-cutting feature is disintermediation, by which we refer to disintermediation from private commercial actors rather than public actors. Indeed, through the platform, the public administration acts as a promoter of disintermediation, acting in favor of local economic actors. If small retailers resorted to a commercial intermediator for implementing services such as discount coupons, they would pay fees of up to 8% of the value of transactions. By overcoming some of the rigidities of commercial intermediaries, each operator can create its own offers and can link these offers to other services via digital tokens. New models of disintermediated interactions between tourists and operators in the local area can also emerge.

Also of relevance to this article are lessons learned from other pilots (mentioned in Section "CommonsHood: concept and functionalities"), on which we make observations that pertain more generally to the introduction of Blockchain-based platforms as a policy tool in co-production processes. The complexity of the Blockchain technology requires that adequate resources and time are dedicated to initial training for public officers, economic actors, and citizens in order to address cultural and technical gaps as well as possible resistance to changes. Continuous support is also necessary, and new professional roles such as "digital facilitators" can help ensure smooth familiarization with new types of digital interaction. However, more strictly technical expertise and related costs for setting up, or customizing, and maintaining the new technological infrastructure have to be allocated. Legal and fiscal studies are necessary to assess whether and how Blockchain transactions impact on existing national accountancy and fiscal legislation and to ensure that administrative procedures are updated accordingly. In this respect, it is worth noting that existing fiscal pieces of legislation are often at a very initial phase when it comes to frameworks that include the token economy. Finally, the digital divide can hamper the adoption of digital tools by end-users, mainly as unavailability of smartphones or complex user experience. We have suggested an approach in which the app is easy to use by design, but we have also set up alternatives such as access to the wallet via a browser on a laptop, or the even more radical option of using printed QR codes to access some of the functionalities.

[15] http://www.projectco3.eu/wp-content/uploads/2021/03/D6.7-Policy-Briefs-II.pdf.

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Conflict of interest

None declared.

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