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Blockchain Adoption in Local Governments: The Case of Lugano

Lorenzo Barisone [1], Edoardo Beretta [2,*], Robert Bregy [1], Vincenzo Carbone [1], Roberto Gorini [3] and Giacomo Zucco [4]

[1] City of Lugano, 6900 Lugano, Switzerland; lorenzo.barisone@lugano.ch (L.B.); robert.bregy@lugano.ch (R.B.); vincenzo.carbone@lugano.ch (V.C.)
[2] Institute of Economics, Università della Svizzera Italiana, 6900 Lugano, Switzerland
[3] Noku SA, 6900 Lugano, Switzerland; roberto.gorini@noku.io
[4] Plan ₿ Network, 6900 Lugano, Switzerland; me@giacomozucco.com
* Correspondence: edoardo.beretta@usi.ch

Abstract

The present article examines the pioneering case of blockchain adoption in local government by the City of Lugano and discusses how Distributed Ledger Technology (DLT) may support institutional innovation beyond pilot experimentation. The Swiss municipality of Lugano has developed an integrated strategy that combines permissioned blockchain infrastructure (SwissLedger), a municipal payment token (LVGA), digital literacy and payment innovation initiatives (Plan ₿), and the issuance of fully digital municipal bonds. By adopting a case study methodology, the analysis draws on quantitative indicators of platform usage, operational data, and a sentiment analysis of media coverage to document technological developments and socio-economic patterns correlated with the initiative. SwissLedger has been adopted as an infrastructural experiment for secure document notarization, public administration digital services, open-finance interoperability with optional compliance tools, and sector-specific applications. Furthermore, the Plan ₿ initiative emerges as a communication catalyst, generating international visibility and positive sentiment, alongside descriptive statistics consistent with local economic activity. Lugano's digital bond issuances also attracted attention to the potential of how DLT could support settlement processes and transparency in public finance. Overall, the evidence gathered suggests that DLT adoption in local government is not merely a technological upgrade, but rather part of a broader organizational transformation process. The case findings also outline a set of potentially transferable elements for municipalities seeking to align innovation with public value creation.

Keywords: blockchain; digital bond; digital public services; Distributed Ledger Technology (DLT); Lugano; municipal digital currency

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1. Introduction

In recent years, blockchain and Distributed Ledger Technology (DLT) have been increasingly discussed as potential enablers for the modernization of public administration and smart cities. These technologies are often associated with goals such as transparency, auditability, and process integrity, and may support new models of service delivery. Switzerland is a pioneering country in this field, building a favorable regulatory framework since 2016 and consolidating its reputation as a jurisdiction attentive to innovation in the area of digital assets [1]. Within this national environment, Lugano stands out for having adopted:

- A systematic approach that goes beyond traditional pilot projects;
- Developed a multifaceted strategy that integrates institutional blockchain infrastructures, innovative payment systems, digital literacy initiatives, and the issuance of fully digital municipal bonds.

The city's experience provides an opportunity to examine how a local government can use DLT as part of a broader institutional innovation effort involving technological choices, governance arrangements, and stakeholder engagement.

In this specific regard, the academic and policy debate on DLT in the public sector has highlighted potential applications of these technologies to improve transparency, reduce fraud, and increase efficiency in managing public records and financial flows [2]. However, most documented experiences are confined to small-scale experiments, proof-of-concept projects, or sectoral applications that are weakly integrated into a broader governance framework [3]. As a result, there is still limited empirical evidence on how local governments can incorporate blockchain into their institutional architectures in a stable way, coordinate multiple applications on a shared infrastructure, and align technological innovation with public value objectives such as digital inclusion, civic participation and local ecosystem development. We believe that the case of Lugano offers an opportunity to fill this gap.

In this context, this study addresses the following research question: how can a local government design and govern a DLT-based ecosystem that supports public value creation? In doing so, the paper does not aim to establish causal effects; instead, it develops mid-range propositions derived directly from the City of Lugano's experience, and, thus, grounded in a rich case study framework.

The City does not treat blockchain as an isolated experiment, but as a central element of a coherent strategy connecting infrastructure, payments, education, and financial markets. At the infrastructural level, SwissLedger functions as an institutional, permissioned blockchain supporting document notarization, open-finance solutions, and sector-specific applications [4]. On this layer, the municipality has introduced the LVGA token as a local digital currency that aims to incentivize expenditure within the territory and strengthen the commercial ecosystem, and it is used as an instrument for civic participation, tourism promotion, and cultural inclusion [5]. In parallel, the Plan ₿ initiative combines interoperability of payments in digital assets, educational activities, and a major international event [6], while the issuance of natively digital municipal bonds tests how DLT can transform the processes of managing and settling public debt [7].

From an analytical perspective, Lugano can therefore be interpreted as a pioneering case of an urban blockchain strategy, in which different applications share a common technological infrastructure and contribute to a broader vision of digital transformation. The case is particularly relevant for municipal and regional governments aiming to move beyond isolated pilot projects and to understand how DLT can be used simultaneously as public infrastructure, policy instrument, and communication lever. Moreover, Lugano's practical experience lies at the intersection of the literature on digital public services, local currencies, and smart-city governance, demonstrating how these dimensions can converge into a single urban innovation agenda [8,9].

By means of a case study methodology, we analyze Lugano's approach and document its technological and socio-economic patterns. The analysis draws on technical documentation and operational data on platform usage, which are indicators relating to the diffusion of the LVGA token, sentiment and social listening analysis of media coverage of the yearly Plan ₿ Forum. By combining institutional description and empirical evidence, the paper contributes to the debate on:

- Institutional blockchains as digital commons;

- The design of municipal digital currencies;
- The role of large-scale events in legitimizing and disseminating local innovation [10].

The article is structured as follows: Section 2 presents the methodological framework; Section 3 illustrates the main cases of DLT adoption in Lugano, focusing on SwissLedger, LVGA, the Plan ₿ and digital bonds; and Section 4 concludes with the analysis of the implications for public administration and urban development but also with avenues for future research.

Selected Literature Review

The analysis of the case of Lugano contributes to the existing literature on Blockchain adoption by municipalities.

From an urban perspective, Ref. [11] highlights that Blockchain might "enable sustainable future cities and empower citizen co-creation and participation", which is further confirmed by its application in smart sustainable cities (SSCs) [12,13]. A main obstacle to its more widespread adoption is often represented by the lack of "strong visionary leadership and training to overcome knowledge deficiencies" [14], although Ref. [15] remarks that "advantages in terms of transparency, integrity, immutability, traceability, and efficiency, blockchain could be exploited to provide and manage public services without the intervention of third parties, thus contributing to enhancing people's perception of public administration". Concretely, its contribution could range from enhancing cadastral systems [16] to improving "local development policies and service co-production in the tourism sector" [17], with Switzerland being already a particularly interesting case of study in the literature [18]. Moreover, Ref. [19] highlights that "relatively decentralized political systems may have an advantage" and, especially, federal systems. In general, the newest literature by [20] analyses Blockchain's "effectiveness through real-world examples in areas such as health care, smart cities, property rights, supply chain management, and identity systems". As also highlighted by Cagigas et al. (2023) [21], the introduction of DLT in local government has "technological, socioeconomic, organizational-cultural, and institutional (legal and political)" implications which further confirm the interdisciplinarity as well as the continuous evolution of the topic.

In the light of these ongoing efforts to map and understand institutional innovation by means of digitization, the case of Lugano (representing the third financial hub in the Swiss economy [22]) is of particular interest for the current debate.

2. Methods

This article adopts a qualitative case study methodology to examine how a local government can design, govern, and use a DLT-based ecosystem for public-sector applications. Lugano was selected as an information-rich case because it represents a unique and integrated municipal strategy that combines permissioned infrastructure (SwissLedger), a municipal payment token (LVGA), a set of public–private initiatives for payments and digital literacy (Plan ₿), and the issuance of natively digital municipal bonds.

The unit of analysis is the municipal DLT ecosystem and its core components, with attention to their technical architecture, governance arrangements, and descriptive operational indicators. Data collection includes documentary and technical sources, on-chain operational indicators retrieved from the SwissLedger public explorer and administrative and platform metrics provided by the City of Lugano and project partners for LVGA and Plan ₿ initiatives. On-chain indicators cover the period from the launch of the platform (2021) to November 2025, including transaction counts and wallet-address activity as reported by the public explorer. Additionally, we report monthly transaction volumes of SwissLedger and MyLugano, derived from the same explorer data and summarized in

Figure A1 Appendix A. For LVGA, we use administrative platform metrics (users, participating merchants, circulation and usage indicators) produced within the MyLugano ecosystem. We explicitly distinguish between blockchain-level addresses and user-level accounts, and we define "active users" using behavioral criteria (e.g., at least one LVGA transaction within a given time window). This distinction reduces the risk of over-interpreting infrastructure-level metrics as adoption by individuals. In addition, we conduct a media monitoring and sentiment analysis of the Plan ₿ Forum (representing one of the main initiatives associated with the Plan ₿ itself) using Talkwalker, namely a media intelligence and social listening platform. Specifically, the entire months of October 2024 and October 2025 have been analyzed through keyword-based queries, drawing on content indexed by the platform across online news outlets and newspapers, blogs, forums, and social media channels (e.g., X, Instagram, LinkedIn) in several languages. We report on the metrics provided by the platform, including the:

- Total number of mentions;
- Temporal distribution of mentions;
- Potential reach (i.e., the estimated upper bound of possible exposure based on the aggregated audience of the sources generating the mentions);
- Level of engagement (i.e., the number of interactions such as comments, shares, and reactions);
- Sentiment shares (positive, neutral, and negative);
- Net sentiment (i.e., the difference between positive and negative mentions relative to their sum).

Data collection and web scraping are handled through Talkwalker's proprietary infrastructure, which also applies automated de-duplication of replicated content and filters spam or automated activity. Finally, sentiment classification relies on Talkwalker's proprietary Natural Language Processing (NLP)-based and supervised machine learning model. To ensure replicability and traceability of the analysis, the complete query strings are documented in Appendix B.

For digital municipal bond, the paper focuses on transaction-level and issuance-level information that can be verified through public sources.

As with most qualitative single-case studies in innovation settings, the present analysis is subject to several methodological constraints. Firstly, on-chain indicators such as wallet addresses and transaction counts may not correspond one-to-one to individual users and may overstate effective adoption if interpreted without contextual qualification. Secondly, sentiment analysis based on proprietary NLP models may involve classification errors, language-specific biases, or differential coverage across media channels, potentially affecting the robustness of the interpretations. Thirdly, as the case concerns an ongoing institutional initiative, temporal proximity may limit the ability to assess long-term socio-economic effects. Finally, the Swiss regulatory and federal context, characterized by comparatively high municipal autonomy and legal clarity for digital assets, limits the external validity of the findings to jurisdictions operating under different legal or fiscal constraints.

To mitigate these risks and enhance internal validity, the study adopts a structured triangulation strategy combining multiple data sources, methodological approaches, and analytical levels. Firstly, source triangulation is implemented by cross-referencing blockchain-level indicators (e.g., transaction volumes and address counts from the SwissLedger explorer) with user-level administrative metrics from the MyLugano ecosystem and publicly verifiable information regarding digital bond issuances and SIX Digital Exchange (SDX) settlement. Secondly, methodological triangulation is achieved by integrating quantitative descriptive statistics (platform usage data, transaction volumes, wallet activity), com-

putational text analysis (media monitoring and sentiment analysis via Talkwalker), and institutional-qualitative documentation (technical architecture, governance arrangements, regulatory positioning). Thirdly, in the context of the Plan ₿'s analysis, temporal triangulation is partially addressed through the comparison of multiple observation windows (e.g., October 2024 and October 2025 for the Plan ₿ Forum), allowing for consistency checks across editions. Finally, analytical triangulation is applied by interpreting technological, financial, and communication indicators within a coherent conceptual framework of public value creation, thereby reducing the risk of over-interpreting isolated metrics. While these strategies do not eliminate inherent case-study limitations, they strengthen the robustness and transparency of the empirical assessment and support the cautious formulation of mid-range propositions rather than causal claims.

3. Results: DLT Adoption in the Public Sector

3.1. DLT Infrastructures as Public Goods: The Case of SwissLedger

3Achain was launched in 2021 as an experimental initiative promoted by the City of Lugano together with the Ticino Blockchain Technologies Association. Its purpose consisted in exploring the functioning of a permissioned blockchain within a regulated institutional environment, offering a controlled setting to assess consensus mechanisms, governance models and potential applications for public services. The initial denomination of 3Achain reflected three guiding principles—being accessible, accountable and authoritative—and stood for a network open to multiple participants but operated under shared rules and institutional responsibility. During its initial phase 3Achain was used for concrete use cases, including the tokenization of the LVGA municipal payment token, digital document notarization and experimental payments in stable coins for public services [23,24].

The experience collected through 3Achain led in 2025 to the development of SwissLedger, a new blockchain infrastructure project designed to operate at national scale and to support the digitalization of finance and public administration in Switzerland [25]. More precisely, SwissLedger is a public, permissioned blockchain that maintains the architectural foundation of the pilot phase and relies on a Quorum-compatible environment, using both the Ethereum Virtual Machine (EVM) and a Proof-of-Authority (PoA) consensus mechanism in which validator nodes are run by legally recognized institutions. This configuration ensures predictable behavior and low energy consumption, while embedding institutional accountability into the validation process [26]. SwissLedger extends the pilot project also by introducing a broader and structured governance framework that brings together public authorities, regional financial institutions, technology providers such as Avaloq or Var Group, and academic partners including the local Università della Svizzera italiana (USI). All nodes share the same architectural structure, although only a subset is granted block-validation capabilities. Simple nodes function primarily as relayers, resubmitting transactions to the network, while validator nodes both relay and aggregate transactions into blocks. The addition of a new validator requires approval from a majority of existing validators, whereas the onboarding of any node must be authorized by the SwissLedger consortium managed by the City of Lugano. Each validator is further subject to clearly defined compliance obligations, which prevents unilateral control and reinforces the integrity of the network. In this specific regard, Table 1 compares the main features of centralized systems vs. SwissLedger.

Table 1. Centralized systems vs. SwissLedger as a distributed model.

Indicator	Centralized Systems	SwissLedger
Ownership and Control	Single Owner (e.g., Bank, BigTech)	Consortium Ownership by Public/Private Stakeholders
Data Management	Siloed Databases and Limited Data Sharing	Built-In Data Sharing across Institutions
Single Point of Failure	Dependency on Central Servers or Intermediaries	Multiple Nodes Provide Insurance to Failure
Security and Trust	Security Relying on Each Entity's Silo	Mutual Security and Trust Mechanism
Innovation Speed	Low: Closed System and Entrance Difficulty	APIs and Common Infrastructure Allow for Integration
Compliance and Audit	Independent Compliance and Audit Rules	Network-Based Audit and Compliance Rules
Interoperability and Integration	Bilateral or Third-Party Integration	Achieved by Default with Shared Ledger
Cost Efficiency	Duplicated Systems with High Costs	Shared Infrastructure with Economies of Scale

Source: own elaboration based on [27].

Based on this comparison, SwissLedger can be defined as a public, permissioned blockchain network. A central design trade-off in distributed ledger systems concerns the choice between permissioned and permissionless architectures and the degree to which transaction validation is centralized versus decentralized. Permissionless blockchains, such as Bitcoin and Ethereum, rely on decentralized consensus mechanisms (e.g., Proof of Work or Proof of Stake) to ensure trust through broad participation, censorship resistance, and economic incentives, but at the cost of lower data protection, higher energy consumption, and weaker institutional control [28,29]. In contrast, permissioned ledgers restrict write access to a set of validators and often adopt centralized or federated updating models, which yields higher performance and governance accountability but requires trust in designated authorities [30,31]. Theoretical work shows that the optimal balance between decentralization and centralization depends on the institutional environment and the nature of the applications: decentralized consensus enhances robustness in open systems facing adversarial actors, whereas permissioned models are often described as more suitable for regulated markets where compliance, privacy, and latency are paramount [32,33]. Empirical studies of blockchain adoption in institutional settings further suggest that hybrid architectures, where decentralization is limited to a trusted consortium and governance rules are codified institutionally, can support both innovation and regulatory integration [34]. In the case of SwissLedger, the choice of a permissioned infrastructure with centralized updating among trusted nodes responds to these trade-offs: by limiting write access to institutional participants, SwissLedger prioritizes throughput, legal compliance, and integration with existing financial market infrastructure, reflecting findings in the literature that permissioned ledgers are often better aligned with public sector and regulated private sector use cases than decentralized, permissionless alternatives.

SwissLedger can be regarded as an example of digital commons, which provide a trustworthy, energy-efficient and transparent alternative to fully public or entirely private blockchains [35]. Moreover, it proposes to treat blockchain as a common infrastructure or a shared "railroad" on which many can ride rather than each institution building its closed system [36].

A distinctive technical feature is the network's anchoring mechanism: at regular intervals, SwissLedger records cryptographic proofs of its state (Merkle roots) onto public blockchains such as Bitcoin and Ethereum. This provides an additional guarantee of auditability and long-term data integrity, offering a means of verification even in the event of operational failures or partial compromise of the permissioned network [37,38]. Through this combination of permissioned consensus, institutional governance and public anchoring, SwissLedger offers a hybrid approach that joins the transparency of open blockchains with the operational reliability required in regulated environments. This compromise is necessary since ledger visibility does not automatically translate into meaningful or trustworthy information for all market participants. While distributed ledgers make transaction records auditable in principle, there could be still several limitations; for instance, on-chain data can suffer from interpretability issues when contextual information resides off-chain, leading to opacity rather than clarity [39,40]. For these reasons, SwissLedger's hybrid approach has the potential to enhance certain aspects of transparency relative to siloed legacy systems, considering in its architecture that transparency's full informational value requires careful integration of identity and governance frameworks beyond the cryptographic component.

Technically, the infrastructure combines a core ledger layer for the immutable recording of transactions and digital-asset events with an execution layer for smart contracts, enabling the automation of procedures such as conditional payments, certifications and token management. The architecture is also made of:

- An Application Programming Interface (API) and integration layer, which provides standard APIs and interfaces for banks and fintech applications and ensures secure connectivity and interoperability;
- A compliance layer that provides Anti-Money Laundering (AML) and Know-Your-Customer (KYC) tools that can be integrated at the application layer when required by specific use cases or certain financial applications according to the specific official regulation;
- A security layer combining cryptographic and cybersecurity protections to secure resilience suitable for critical infrastructure.

SwissLedger also incorporates a dedicated module for the tokenization of regulated financial assets, including digital bonds and stable coins, and provides standardized interfaces allowing integration with traditional banking systems and fintech applications.

In this context, SwissLedger aligns with the academic research on tokenization, whose benefits coexist with important governance and financial trade-offs. Tokenization is often argued to improve transparency, reduce transaction costs, and support real-time settlement and fractional ownership, which has been linked to improved market efficiency and broader participation in asset markets [41,42]. However, although tokenized assets can lower frictions and improve market participation, these benefits depend on credible governance structures, careful design of rights and obligations, and transparency in the underlying legal framework [34,43]. However, tokenization also introduces risks related to moral hazard and financing frictions. More specifically, it may increase leverage or liquidity mismatches if tokenized assets are used as a collateral without commensurate risk controls, and it can blur boundaries between traditional intermediation and decentralized finance (DeFi) activities, raising concerns about systemic risk [44,45]. The emerging assurance literature underscores that, despite the on-chain immutability of transactions, significant elements of tokenized financial systems remain off-chain (e.g., oracle feeds, legal personhood of issuers, and compliance processes) and create challenges for auditors and regulators in verifying completeness and integrity of reported information [46,47]. These dimensions suggest that while SwissLedger's tokenization module has the potential to deliver governance and efficiency benefits, at the same time, realizing these gains requires robust institutional

controls (ensured by the public institution's promotion), transparent risk management, and integration with established assurance practices still evolving in the academic and regulatory discourse.

The validator set consists of 33 nodes where 23 are operated by private entities, 8 by public institutions and 2 by academic partners [48]. The blockchain indicators reported in Table 2 are drawn from the SwissLedger public explorer. Moreover, these statistics report the cumulative activity of the blockchain from 2021 (when it was called 3Achain) to November 2025. As of that date, the network issued 25,544,087 blocks with an average block time of five seconds, including 56,310 wallet addresses and processed 1,130,790 transactions.

Table 2. Main indicators of the SwissLedger blockchain.

Indicator	Value
Total Blocks	25,544,087
Average Block Time	5 s
Number of Wallet Addresses	56,310
Total Transactions	1,130,790
Number of Nodes	33
Number of Public Entity Nodes	8
Number of Private Entity Nodes	23
Number of Academic Institutions' Nodes	2

Source: [48].

3.1.1. Next Steps and Governance Evolution

As SwissLedger evolves from a set of municipal and pilot use cases toward broader regional and national deployment, the governance model of the consortium will be progressively formalized to support scale, accountability, and institutional robustness. While the initial configuration relied on coordination among a limited number of actors, the expansion of the network requires clearer codification of decision-making processes, validator admission rules, and conflict-resolution mechanisms.

Despite permissioned consortia are typically exposed to governance risks including validator capture, centralization pressures, and coordination failures, the public management of the SwissLedger infrastructure limits these dangers. Moreover, to mitigate these risks, the framework introduces a structured node admission process. First, the entity that asks to enter the network undergo an audit phase regarding corporation structure and technical capability. Second, validator nodes undertake a formal "validator induction ceremony," whereby entry into the active validator registry requires approval by a majority of existing validators, who must formally sign the acceptance of the new participant. Beyond simple majority voting, admission is conditioned on predefined eligibility criteria, including institutional status, technical capability, regulatory standing, and alignment with the consortium's public-interest objectives. Voting rights are distributed across participant categories (e.g., public institutions, regulated financial entities, and infrastructure providers), with safeguards intended to limit the influence of any single actor or homogeneous group. For critical decisions such as protocol upgrades or changes to validation rules, quorum requirements and qualified majorities are applied.

From a technical perspective, the permissioned PoA architecture also involves explicit trade-offs. While restricting write access to authorized validators enhances throughput and regulatory alignment, it may introduce centralization pressures and require trust in designated entities. Privacy protections depend not only on the permissioned structure but also on identity and access-management layers, as well as on the handling of off-chain data, including compliance processes and document content. Moreover, although PoA configurations typically allow shorter block times and operational finality suitable for

regulated environments, effective settlement robustness depends on governance procedures, validator coordination, and anchoring mechanisms to public blockchains. Taken together, these design choices reflect an attempt to balance performance, compliance, and institutional trust within a shared digital infrastructure.

3.1.2. Applications in Public Administration

A first area in which SwissLedger is being applied concerns the certification and management of public documents. Traditional registries in public administration are—for instance—often characterized by slow and fragmented procedures, with many records still maintained only in paper form or stored in non-interoperable databases. Such fragmentation creates data silos, hampers information sharing across departments and levels of government, and increases the administrative burden on both civil servants and citizens. At the same time, limited transparency and traceability of document flows make it difficult to detect manipulation, corruption, or accidental data loss, potentially undermining public trust in government processes [49]. Centralized architectures also generate a single point of failure, which potentially exposes sensitive records to cyberattacks, unauthorized access, and compliance risks in relation to data-protection regulations [50]. Finally, many existing systems offer little support for automation and are difficult to scale across multiple agencies or jurisdictions.

SwissLedger is designed to address these limitations by providing a permissioned blockchain infrastructure usable as a trusted backbone for document notarization and certification. Public administrations can record cryptographic hashes of documents on the ledger, thereby creating immutable and time-stamped proofs of existence without disclosing the underlying content. Any subsequent modification of a document can be detected by recomputing its hash and comparing it with the on-chain reference, which strengthens integrity guarantees for official records. Because validator nodes are operated by recognized public, private, and academic institutions, the system combines strong security properties and auditability with clear lines of institutional accountability. Beyond notarization, SwissLedger can support the automation and scaling of administrative procedures. Smart contracts can encode rule-based workflows for document validation and approval, triggering automatic updates when predefined conditions are met (for example, in multi-step authorization chains or inter-departmental processes). SwissLedger provides available compliance modules, including KYC/AML functionalities, which developers can choose to integrate at the application layer when building regulated services. This flexible approach allows different use cases to implement appropriate levels of compliance based on their specific regulatory requirements, rather than imposing blanket KYC/AML on all network activities. In this way, SwissLedger does not simply digitize existing routines, but provides a shared, tamper-evident infrastructure on top of which administrations can redesign document-management processes to be more efficient, transparent, and resilient.

As a practical use case, the City of Lugano will adopt a public administration documentation certification service. The very first official documents to be certified will be the statistical reports of the Urban Statistics Service. This implementation is conceived as a first step toward a progressive extension of blockchain-based certification across all municipal departments and the establishment of a unified institutional standard for managing and safeguarding public records.

3.1.3. Applications in the Banking and Finance Sector

The digital transformation of the European financial sector has increasingly highlighted the need for shared, interoperable, and collaboratively governed infrastructures. Advanced economies rely heavily on digital platforms that are largely privately owned,

raising concerns about market concentration, underinvestment in security, and limited inclusiveness [51]. These dynamics have led to viewing certain digital infrastructures as genuine technological "commons," where open access and consortium-based governance become necessary to ensure efficiency and stability. The debate on open banking fits within this context and represents one of the clearest domains in which these issues emerge [52].

In this specific regard, open banking was introduced as a response to the fragmentation of traditional banking infrastructures, historically characterized by limited interoperability and the absence of shared standards for data exchange [53]. International experiences, particularly in the United Kingdom, show that opening data through secure APIs can reduce operational costs, stimulate innovation, and support the entry of new fintech providers [54,55]. Unlike the European Union, which implemented a mandatory regulatory framework through the Payment Services Directive 2 (PSD2), Switzerland has adopted a voluntary, market-driven approach [56] instead of other countries having opted for regulation-led approaches or guided implementation in which "authorities may issue API standards and/or best practices without enforcing strict adherence" [57] as summarized in Table 3. In more detail, in Switzerland, open banking initiatives are coordinated through industry-led frameworks such as the Swiss NextGen API or OpenWealth initiatives, which define common technical and semantic standards for APIs while leaving participation and implementation to financial institutions. SwissLedger's API architecture is designed to operate within this voluntary ecosystem, emphasizing interoperability and modular integration rather than compulsory data access. Specifically, SwissLedger exposes standardized APIs that allow banks, payment service providers, and municipal applications to connect to the shared ledger infrastructure in a controlled manner, consistent with Swiss practices around consent, data governance, and contractual arrangements. Unlike PSD2, where regulated entities are required to provide access to account data and payment initiation services to licensed third parties, SwissLedger's open banking functionality supports collaborative use cases (e.g., municipal payments, tokenized assets, and identity-linked services) without imposing mandatory access obligations on participating institutions. This distinction is relevant for understanding the Lugano case, as SwissLedger's APIs do not replicate PSD2-style regulatory openness but instead enables open banking through voluntary standardization, institutional trust, and bilateral or multilateral agreements aligned with the Swiss financial market structure.

It should be noted that while SwissLedger provides the infrastructure and tools for compliance-ready applications, the actual implementation of KYC/AML requirements remains at the discretion of individual service providers building on the platform. This design choice allows flexibility across different use cases while ensuring that regulated financial services can achieve full compliance when needed. This trajectory is supported by a regulatory environment that explicitly facilitates the use of DLT, providing legal certainty for intermediaries wishing to adopt it.

On the one hand, Switzerland's voluntary and market-driven approach supports private experimentation with DLT and offers legal certainty to intermediaries. However, each institution may build its own proprietary system, creating a fragmented environment with little interoperability. When a private company provides a shared infrastructure, other actors may use it without contributing to its development, generating free-riding incentives and a potential "tragedy of the commons" [27]. On the other hand, fully public and permissionless blockchains such as Bitcoin or Ethereum avoid fragmentation but introduce limitations for institutional use, including limited privacy and transaction fees. These limitations suggest the opportunity to explore the solution-space for intermediate models, where institutional governance and shared infrastructure can balance openness, coordination, and operational requirements.

Table 3. Approaches to open banking and open finance approach (by country/region).

Regulation-Led	Guided Implementation	Voluntary
Middle East and North Africa		
Bahrain, Israel, Jordan, Oman, Saudi Arabia, UAE	-	Egypt, Kuwait, Qatar
Europe and Central Asia		
Albania, Azerbaijan, EU, Georgia, Iceland, Liechtenstein, Monaco, North Macedonia, Norway, Turkey, UK, Ukraine	Kazakhstan, Moldova, Russian Federation	Switzerland
Sub-Saharan Africa		
Nigeria	Angola, Mauritius	Ghana, Kenya, Republic of Namibia, Senegal, South Africa, Uganda, Zambia
Latin America and the Caribbean		
Brazil, Chile, Colombia	Mexico	Argentina
Asia Pacific		
Australia, Indonesia, India, Republic of Korea	Hong Kong, Japan, Malaysia, Philippines, Singapore, Taiwan	China, New Zealand, Sri Lanka, Thailand

Source: [57].

Within this landscape, SwissLedger is presented as an institutional approach to two core challenges including limited privacy and transaction fees (both of which Bitcoin overcomes adopting 'off-chain' or 'layer 2' solutions, namely the Lightning Network, which has also been adopted in Lugano's merchant network):

- Dependence on privately owned banking infrastructure;
- Need for an open financial ecosystem.

The network proposes a shared model of open finance, allowing banks, fintech firms, and regulatory authorities to interact through a common and standardized infrastructure and to overcome current fragmentation. The platform's API-driven architecture enables the creation of interoperable services without requiring each institution to develop its own proprietary system, reducing development costs and enhancing overall system security. This suggests that SwissLedger functions as a common infrastructure, echoing models proposed in the recent international debate on the Finternet [58,59].

In parallel, a shared infrastructure may generate benefits for all actors in the financial system. Users may gain access to more efficient and transparent services, with improved traceability of operations. Banks can reduce technology costs and rely on common tools for security and compliance. Fintech firms operate in a more accessible and interoperable environment for developing new services, while supervisory authorities can rely on integrated mechanisms for auditing and AML monitoring. In this specific regard, ref. [60] "develop a machine learning-based model for classifying blockchain transactions into risky or non-risky ones", which could also be used by supervisory authorities thanks to its clear technical path for the compliance layer. Despite its potential, adopting a DLT-based financial network presents several challenges. Ensuring performance levels consistent with banking standards requires continuous optimisation, including potential scaling solutions such as layer-2 architectures. Consortium governance must also prevent excessive concentration of power and establish clear mechanisms for voting and conflict resolution. Moreover, large-scale adoption depends on strong network effects and a clear regulatory allocation of responsibilities, making ongoing coordination with Swiss financial authorities essential.

Looking ahead, the evolution of SwissLedger follows a trajectory from its pilot phase (completed through the 3Achain experience) to adoption in niche use cases and, ultimately,

integration into Switzerland's core financial sector. To support this evolution, the City of Lugano has promoted the creation of Swiss Digital Key, a collaborative network designed to develop open banking and open finance services within SwissLedger's shared infrastructure [61]. The initiative was formalized through a technical and an academic letter of intent [62]. The network brings together financial and technological actors such as Avaloq, HCLTech Confinale Wealth Solutions, Noku, and Ubq, as well as academic institutions like the USI, the Scuola Universitaria Professionale della Svizzera italiana (SUPSI) and the City of Lugano, facilitating joint work in key areas such as asset tokenization, crypto custody services, trade-finance innovation, decentralized data and identity management, and the development of regulatory and compliance frameworks. In doing so, Swiss Digital Key operationalizes SwissLedger's role as a shared digital infrastructure, strengthening its trajectory toward becoming a national standard for open finance and supporting a more resilient and innovation-oriented economic ecosystem. Future developments include fully optimized national and international extension, potentially linked to European blockchain interoperability initiatives. In this perspective, SwissLedger could become Switzerland's national standard for open finance, providing a shared, resilient, and globally competitive digital financial infrastructure.

3.1.4. Other Use Cases

Beyond applications in public administration and open finance, SwissLedger is gradually being adopted as a shared core infrastructure for a variety of sector-specific solutions, suggesting that an institutional DLT can support heterogeneous business models while maintaining a common governance and security framework. Several private partners have already integrated SwissLedger into their architectures, using it as a trusted layer for notarization, data anchoring and auditability [61].

A first example is provided by Wecan Group (Geneva), a compliance-oriented platform used by banks and wealth managers to manage KYC and Know-Your-Business (KYB) information. Wecan's architecture is organized in four layers:

- A front-end application where financial intermediaries and clients upload and update compliance data;
- "Wecan Chain" which represents the platform's internal infrastructural layer;
- SwissLedger which records hashed references to the underlying information and utilizes Bitcoin blockchain security to ensure data integrity;
- A public blockchain (Ethereum) used as an additional anchoring layer.

This design allows entities to share and verify critical compliance data without centralizing raw personal information, while still obtaining a tamper-evident audit trail. According to project documentation, the system already processed more than one million transactions, indicating a growing operational use in day-to-day compliance processes [63].

A second group of applications concerns the digitalization of corporate document workflows. The consulting firms Palo Alto SA and OWL Solutions SA in Lugano use SwissLedger to notarize business documents for their corporate clients. In these cases, the ledger is employed to timestamp contracts and integrate them into rule-based workflows while reducing the risk of ex-post modifications and simplifying both internal and external audit processes.

A further example of how SwissLedger can support sector-specific innovation is ArtChain, a platform developed by OFFICINEBIT with its headquarters in Chiasso, designed to create a decentralized, secure, and transparent registry of artworks. Its primary objective is to support the creation and management of online reasoned catalogs or *catalogue raisonné* for visual artists, ensuring authorship verification, data integrity, and the long-term preservation of artistic records. By leveraging SwissLedger as its underlying infrastruc-

ture, ArtChain offers artists, collectors, and galleries a trusted environment for certifying and tracking artwork information, simplifying the buying and selling process as well as providing robust protection against fraud. A central element of the platform is also the Digital Passport, a structured record stored on SwissLedger that contains verified metadata about each artwork. These passports include information such as authorship, creation date, materials and techniques, dimensions, country of origin, and associated artistic movements. The blockchain explorer integrated in ArtChain enables any user to consult these passports, verify their authenticity, and inspect the full history of associated transactions, (e.g., such as minting events or validation entries). This provides unprecedented transparency in a sector where provenance and authenticity disputes are frequent and costly [64].

A further use case enabled by SwissLedger is offered by Noku SA (Lugano), which provides a platform that allows users to create and manage digital assets directly on the network through an intuitive interface. Noku provides tools to generate wallets and issue tokens without requiring technical knowledge, making SwissLedger accessible to a broader range of users, including institutions and non-technical operators. Within the platform, users can create SwissLedger-native wallets, which serve as secure accounts for storing and transferring digital assets on the permissioned network. The wallet interface supports full lifecycle management, displaying balances, transaction histories, associated contracts, and asset metadata. This lowers operational barriers and enables organizations to interact with SwissLedger in a user-friendly environment. In this specific regard, a central function is the asset-creation module through which users can deploy new token contracts directly on SwissLedger. Tokens created on the network can represent a wide variety of digital objects, including financial instruments, contractual rights, certificates, access credentials, or sector-specific digital assets. This allows public administrations, companies, and service providers to experiment with tokenization in a secure, permissioned environment aligned with regulatory requirements. Overall, Noku highlights SwissLedger's suitability as a tokenization backbone, enabling the creation of digital assets in a controlled and institutionally governed environment. Its integration illustrates how user-facing platforms can extend SwissLedger's capabilities, making advanced blockchain functions (e.g., asset issuance, contract deployment or wallet administration) accessible to a wider audience [65].

In addition to these applications, starting in 2026 another partner of the network, Var Group Suisse SA (Lugano), will introduce five SwissLedger-based services across different domains. These include:

- APIO, a platform for energy-intelligence analytics;
- Zyphe, which provides KYC and KYB solutions;
- Decripto.org, an API-first AML platform for detecting online and crypto-related fraud;
- KAMA, an all-in-one Software as a Service (SaaS) platform for managing and analyzing the performance of sports clubs;
- TRAENT, which enables data-management solutions for the real-estate sector, including the creation of digital passports for property assets and real estate tokenization.

Finally, SwissLedger also serves as the underlying infrastructure for the tokenization of the LVGA, the municipal digital currency of the City of Lugano, which will be discussed in detail in the following section.

3.2. Municipal Local Payment Token

As an early step in Lugano's broader blockchain strategy, the local municipality introduced the LVGA token, a locally issued digital currency created to encourage residents to spend locally and to gain practical experience with digital payment tools. Launched in 2020 amid the COVID-19 pandemic, LVGA operates as a digital cashback instrument integrated into the MyLugano app [66]. The LVGA maintains a fixed value relative to

the Swiss franc, with a conversion rate of 100 LVGA per 1 CHF, ensuring both monetary stability and simplicity for the public. Users also receive LVGA as a 10% cashback bonus on purchases made at participating businesses and can subsequently spend these tokens within the local network of merchants [67]. Unlike typical loyalty programs, the token is issued and operated directly on SwissLedger, Lugano's public, permissioned blockchain platform. As a result, every LVGA transaction is stored securely on the city's distributed ledger, ensuring full transparency, verifiability, and seamless integration with other blockchain-enabled public services. LVGA can also be used to pay selected municipal fees, such as parking and cultural services. The Swiss Financial Market Supervisory Authority (FINMA) has classified LVGA as a payment token under local regulatory standards, highlighting how institutionally supported complementary currencies can be framed as legitimate instruments within local economic ecosystems [66].

Currently, LVGA counts 47,547 users (+43% in 2024) and 490 participating merchants (+110 in 2024). The average user age is 25 years, with the oldest user being 96 years old and the youngest 14. The total amount of LVGA in circulation is CHF 580,000; this can be considered the total amount of LVGA actively in the wallets of the MyLugano users as of 2024. Finally, LVGA merchants' transaction volume, measured as the amount of payments denominated in LVGA, increased by 97% in 2024 (Table 4).

Table 4. Main Indicators of the LVGA Payment Token.

Indicator	Value
Users	47,547
New Users (2024)	+43%
Youngest User's Age (Years)	14
Oldest User's Age (Years)	96
Average Age	25
LVGA in Circulation (CHF)	580,000
Merchants	490
New Merchants (2024)	110
Increase in LVGA Merchants' transaction volume (2024)	+97%

An additional clarification is required regarding the relationship between on-chain wallet addresses and the number of MyLugano users. The figure of 56,310 wallet addresses refers to blockchain-level accounts interacting with the SwissLedger infrastructure. These addresses should not be interpreted as a direct proxy for unique human users, since on-chain identities are not associated one-to-one with individuals: in fact, a single person or organization may generate multiple addresses for operational or privacy reasons, while institutional actors (e.g., service providers, custodians, exchanges, or public entities) may control large sets of addresses on behalf of many end users. Moreover, SwissLedger addresses are not exclusively linked to the LVGA payment token, but also to other applications and services deployed on the shared infrastructure, including document notarization, open-finance modules, and sector-specific use cases. As a result, the address count captures the broader scale of infrastructural activity on the network rather than the specific diffusion of LVGA among residents. In contrast, the number of 47,547 users as reported in Table 2 refers to registered accounts in the MyLugano application ecosystem, which represents the main interface through which citizens and merchants access LVGA-based payments and reward mechanisms. This measure is therefore closer to a user-level adoption indicator, although it may still include non-active registrants. To better distinguish the level of adoption from the effective usage, "active users" can be defined in behavioral terms, for instance as accounts performing at least one LVGA transaction or reward redemption within a given

time window. In this sense, the monthly active users (MAU) for 2024 corresponds, on average, to 3989.

3.2.1. Civic Engagement

From the perspective of civic engagement, the LVGA project does not simply introduce a new digital means of payment, but turns the MyLugano app into a platform for everyday participation in the city's economic and social life. Through the app, residents can send and receive funds, pay in LVGA at participating merchants, consult the list of affiliated shops, book events, and interact with additional functions such as a multichain wallet and Non-Fungible Tokens (NFTs). In this way, the use of the local currency is embedded in a coherent digital environment that makes the user experience simple and constantly present in daily life [66].

A central role is played by promotional campaigns organized by the municipality to stimulate interaction with the urban space. On several occasions, the city launched initiatives that credit LVGA in exchange for specific actions, such as scanning QR codes placed around town during events, festivals or thematic routes. These activities turn Lugano into an interactive environment: citizens are hence encouraged to explore neighborhoods and public spaces, but also to take part in cultural or commercial events and to experiment with the digital wallet. The LVGA reward represents both an immediate economic incentive and a form of hands-on education in blockchain technologies and digital payments.

The incentive design is structured to generate benefits also on the supply side. For merchants, joining the MyLugano circuit firstly means capturing additional demand generated by the cashback: consumers are encouraged to concentrate their purchases in shops where they can accumulate and reuse LVGA, especially among younger and more digitally oriented residents. Secondly, participation in the circuit provides extra visibility, since affiliated businesses appear on the interactive map in the app and in communication campaigns linked to promotional initiatives. This approach reduces individual marketing costs and allows even small shops to be discovered by new customers [66].

Overall, the combination of a digital local currency, cashback mechanisms, and QR-code-based urban campaigns suggests that the MyLugano ecosystem can function as an infrastructure for civic engagement. In this sense, it is not only a payment channel, but also a tool through which the municipality engages citizens and helps make its digital innovation strategy tangible in everyday practice.

3.2.2. Tourism Promotion and Cultural Participation

The LVGA token is also used for tourism promotion and to broaden access to cultural activities. In collaboration with Lugano Region promoting the territory as the ideal tourism destination, the City developed targeted campaigns that integrate the distribution of LVGA into tourism promotion initiatives. A recent example is the initiative launched during the Rundfunk.fm Festival in Zurich, namely one of the main cultural events of the German-speaking summer. During the festival, a dedicated "Lugano Region" pop-up promoted the key events of Lugano's long summer season and offered participants the opportunity to obtain an exclusive NFT. Visitors who subsequently chose Lugano for their stay could present this NFT, together with proof of accommodation, at the Info Point in Lugano to immediately receive 100 CHF in LVGA credited to the MyLugano app. In total, 10,000 CHF in LVGA were allocated to this campaign and explicitly linked tourism marketing, experimentation with web3 tools, and incentives for local spending.

Comparable logic is applied to residents through specific programs using LVGA to foster inclusion within the local cultural ecosystem. A notable example is the "Buono cultura" (Culture Voucher), introduced in 2024 for all residents turning eighteen in the

current year. Each young adult shall receive 200 CHF in culture credits, issued in tokenized form within the MyLugano app and spendable at a selection of cultural institutions and businesses participating in the LVGA circuit. The measure aims at reducing economic barriers to cultural access for younger cohorts, making them familiarize themselves with the municipal wallet and strengthening their connection with the city's cultural offerings from the outset [68].

Once again, these initiatives suggest that the LVGA token can be used as a flexible policy instrument through which Lugano and regional tourism authorities coordinate incentives across tourism, commerce, and culture. By integrating LVGA-based rewards into campaigns intended at both visitors and young residents, Lugano uses its local digital currency as part of broader initiatives intended to attract tourists, channel spending toward local businesses, and expand access to cultural experiences, thereby aligning blockchain-driven innovation with objectives of territorial development and cultural policy.

3.3. Promoting Digital and Economic Literacy Through Public–Private Partnership: The Plan ₿

In addition to its institutional blockchain infrastructure, Lugano launched a set of complementary initiatives aimed at creating a comprehensive digital ecosystem and promoting digital and economic literacy among residents, businesses, and public institutions. At the center of this strategy is the Plan ₿, a leading initiative supporting Lugano's goal of establishing itself as a European reference for Bitcoin and other decentralized, privacy-oriented technologies [69].

Launched in March 2022 in partnership with the most important stablecoin-issuer, the company Tether, Plan ₿ enables residents and businesses to use Bitcoin, USDt (Tether's dollar-based stablecoin), and LVGA as means of payment for municipal services, including taxes, fines, tuition fees and bills in participating merchants of the LVGA network [70]. The Bitcoin transactions leverage the Lightning Network, also experimenting with its latest innovations (i.e., Ark), but participating merchants can leverage a dedicated payment interface that instantly converts bitcoin into Swiss francs, ensuring price stability. To encourage wider adoption, the municipal administration has distributed payment terminals and provided technical support to merchants. Supported by proportional investment funds, Plan ₿ helped give rise to an effective local Bitcoin-based economy, reinforcing the broader institutional blockchain projects pursued by the municipality.

Recognizing the role of cultural readiness and education in technology adoption, Lugano made substantial investments in training initiatives and outreach activities. The municipality created the Plan ₿ Summer School, which brings together international students and professionals to learn the theory and work on concrete applications, and it set up the Blockchain for Business (B4B) program to deliver targeted training to entrepreneurs, civil servants, and residents on real-world use cases and relevant regulations. Moreover, Lugano organizes the Plan ₿ Forum, held in October on a yearly basis, which rapidly became a major meeting point for the Bitcoin ecosystem, bringing together policymakers, academics, and leading industry figures and attracting more than 5000 participants in its latest edition (2025), with a large number of collateral thematic events during the days before and after the conference itself. Free educational initiatives are also deployed throughout the year, with weekly meetups, open workshops, and networking events. Through these initiatives, Lugano fostered a vibrant local ecosystem that integrates infrastructure development, capacity building, and public dialogue.

3.3.1. Communication Impact of the Plan ₿ Forum

Assessing the impact of the Plan ₿ Forum shows that the event has now become a communication catalyst for the city's blockchain strategy, with positive correlation on the

local economy as well. Media monitoring for October 2024 and October 2025 editions, presented in Figures 1 and 2, highlights a substantial increase in visibility. For instance, the total number of mentions rose sharply between the two editions, increasing from 27.5 to 46.6 thousand (+69.5%), as did the potential reach, which in 2025 exceeded 11 billion potential contacts across digital channels alone. Engagement also increased substantially during the Plan ₿ Week, in line with the peak in mentions and reach. Moreover, the results over time show that mentions sharply increased during the Plan ₿ Week in both years, which supports the interpretation of the Forum as a communication catalyst.

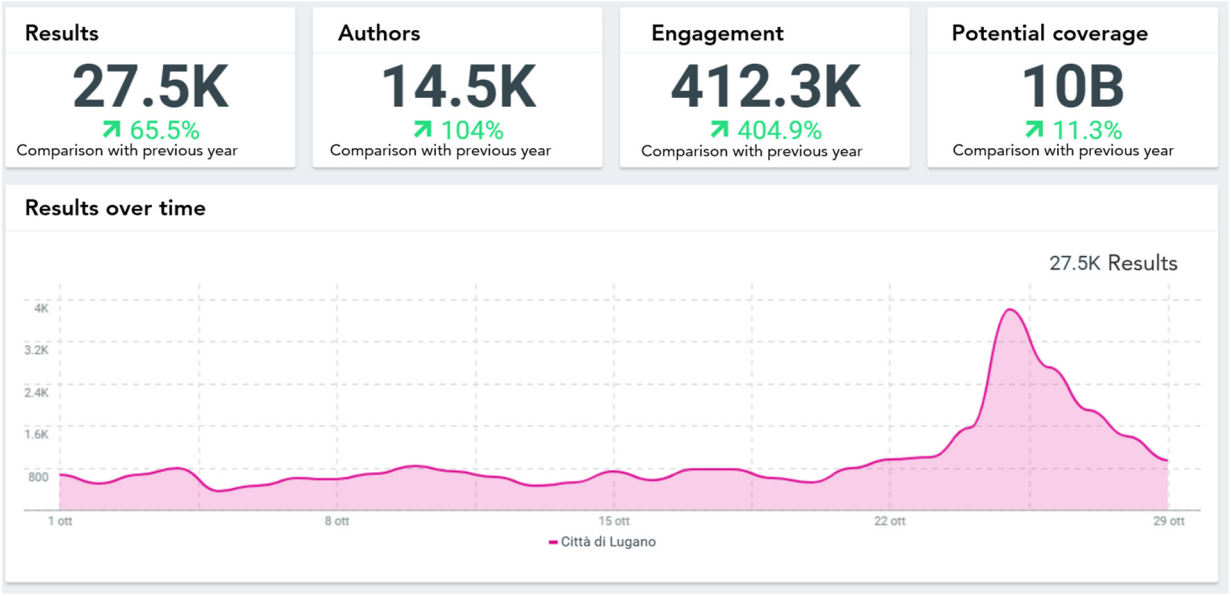

Figure 1. Results for the Plan ₿ Forum in terms of acquired visibility—October 2024 (source: own elaboration based on Talkwalker).

Figure 2. Results for the Plan ₿ Forum in terms of acquired visibility—October 2025 (source: own elaboration based on Talkwalker).

This exposure is spread across a broad geographical landscape: Switzerland remains the primary reference country, but the share of content originating from the United States and other European markets increases significantly. This indicates that the Plan ₿ Forum

is increasingly perceived as an international landmark event within the sector. It also appears that "Lugano" reached between June and August 2024 its peak (100) in terms of worldwide search interest while "Plan B Lugano" its second-highest level of interest in October 2024 (15) and its highest ever (100) in October 2025 precisely during the yearly Plan ₿ Forum [71,72].

The sentiment analysis presented in Figure 3 also shows a particularly pronounced prevalence of positive content (48.9%) and only a residual share of negative evaluations (7%), with a net sentiment of 74.9%. This suggests a positive association between the Plan ₿ Forum and the public perception of the city's digital-finance initiatives. This evidence on the positive mentions of the Plan ₿ Forum confirm the role of communication catalyst of the event also in qualitative terms.

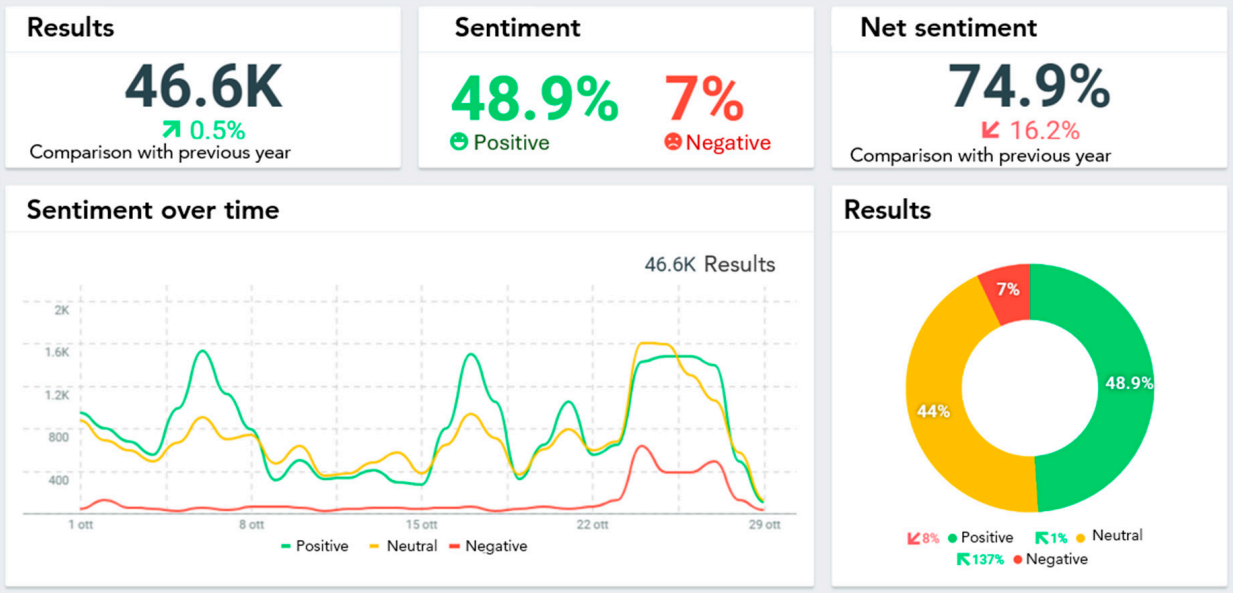

Figure 3. Sentiment analysis of the Plan ₿ Forum—October 2025 (source: own elaboration based on Talkwalker).

3.3.2. Economic Role of the Plan ₿

Alongside the reputational dimension of the Plan ₿ Forum, the overall Plan ₿ initiative is associated with positive indicators for local economic activities, as reported in the City of Lugano's official registers. The presence of thousands of international participants is consistent with increased demand for hospitality services, restaurants, and local commerce during the event window, while the visibility during Plan ₿ Week coincides with a strengthening of Lugano's positioning as a European hub for digital assets and financial innovation. Since 2022, more than 130 companies operating in the Web3 and DLT sectors have established themselves in the city, according to the City of Lugano's official registers of economic activities; this pattern is consistent with a positive association between the broader Plan ₿ strategy and new entrepreneurial activity. In summary, the Plan ₿ functions as an infrastructure for communication and attraction by:

- Reinforcing the public legitimacy of the city's blockchain strategy;
- Drawing human and financial capital from outside the region;
- Showing positive correlations with local economic activity during the event period;
- Integrating the technological dimension with urban development and city promotion.

3.4. Issuance of Digital Municipal Bonds

From 2023 to 2025, the City of Lugano issued five natively digital bond placements totaling CHF 520 million, marking a pioneering achievement among municipal issuers in combining traditional finance with DLT infrastructure [73]. The bonds were fully structured and listed on SDX and, starting with the second issuance, were settled in wCBDC as part of the Swiss National Bank's Helvetia Phase III pilot project.

It is important to note that these digital bonds were issued and settled on SDX, Switzerland's regulated digital asset exchange infrastructure, not on SwissLedger. While SwissLedger serves as the infrastructure for other municipal initiatives like the LVGA token, the digital bonds represent a separate innovation track utilizing SDX's regulated market infrastructure.

The first transaction, in January 2023, involved a bond of the value of CHF 100 million, the first digital bond ever issued by a public entity in Switzerland. In February 2024, Lugano issued a second bond worth CHF 100 million, becoming the first municipal issuer globally to settle a bond in wCBDC. Three further placements followed: a CHF-120-million bond in November 2024 and two CHF-100-million issuances in May and July 2025, consolidating the digital approach as an established practice. The use of wCBDC represented a significant innovation, enabling direct settlement in central bank money, reducing counterparty risk, and increasing settlement efficiency. These issuances tested the entire lifecycle of a digital public security in a live, regulated environment and involved leading Swiss financial institutions such as UBS, Raiffeisen, and Zürcher Kantonalbank.

Internationally, Lugano stands out as the first city worldwide to have issued fully digital municipal bonds on a regulated market infrastructure. Only sovereign or supranational experiences, such as the European Investment Bank or Hong Kong, have demonstrated a comparable level of innovation [74]. The inclusion of Lugano's bonds in the Swiss Bond Index and the confirmation of its Aa3 rating by Moody's have further strengthened the credibility of this initiative [75], which serves as a reference case for digital public finance and may be adaptable for other administrations under comparable conditions [36].

3.4.1. Comparing Digital Bonds with the Traditional Counterpart

The comparison between traditional and digital bonds highlights structural and operational advantages introduced by Lugano's tokenized issuances. Traditional bonds rely on commercial bank money, centralized post-trade infrastructures, and settlement cycles that typically require two business days (T+2). Custody is managed through paper or electronic certificates, and transparency remains limited to post-trade reporting, which restricts real-time monitoring of ownership and transaction flows [76]. In contrast, Lugano's tokenized bonds are processed through SDX, a distributed-ledger-based central securities depository, and are executed with instantaneous Delivery-versus-Payment using wCBDC. Tokenized custody ensures fully digital asset representation, while the on-chain architecture provides complete traceability across the entire lifecycle of the bond. This setup removes counterparty exposure and significantly enhances settlement performance, illustrating how blockchain-enabled instruments can reshape the financial operations of municipal issuers.

3.4.2. Relationship Between Digital Municipal Bonds and Central Bank Digital Currency (CBDC)

The settlement of digital municipal bond issuances on SDX using a wCBDC situates the Lugano case within broader academic and policy discourses on CBDC-enabled securities settlement. Central bank digital currencies, mostly defined as digital forms of central bank money distinct from commercial bank deposits, have been shown to offer potential benefits in terms of settlement efficiency, risk reduction, and integration with distributed ledger

infrastructures (e.g., layered account-based and token-based CBDC design debates) [77]. In the context of tokenized capital markets, using CBDC as settlement medium can address longstanding frictions in delivery-versus-payment mechanisms by reducing the need for reconciliation between different payment and securities systems, and by embedding finality directly within digital ledger protocols [78]. Experimental work, including the Banque de France's CBDC-settled trials, has demonstrated that CBDC can support the end-to-end lifecycle of digital securities without compromising regulatory safeguards [79]. The Swiss National Bank's Project Helvetia pilot extends this logic by making wCBDC available on a production DLT platform to settle tokenized bond transactions, preserving central bank money's safety while harnessing programmable settlement on SDX [80]. Thus, Lugano's issuance provides a useful applied case for discussing how CBDC-based settlement can be implemented in practice in a municipal context, consistent with the literature on the integration between central bank money, digital assets, and market infrastructure.

3.5. Initiative Roadmap and Replicability

A central contribution of the present article is the proposal of a municipal initiative model that is not only descriptive of the specific case examined, but also transferable to other local governments seeking to design, implement, and evaluate similar digital finance and innovation programs. While the previous sections have detailed the empirical context and documented implementation features and observable indicators, this section clarifies how the initiative can be understood as a replicable roadmap rather than as an isolated experience. The initiative can be conceptualized as a structured sequence of interrelated phases that municipalities can adopt according to their institutional capacity and local priorities. Moreover, this applies not only to DLT initiatives but to all types of technological innovation a public entity wants to foster.

The case of Lugano allows the articulation of a mid-range conceptual framework that links core institutional and technological components to intermediate outcomes and, ultimately, to public value creation. In this perspective, the municipal innovation model is based on four mutually reinforcing pillars:

- Shared digital infrastructure and institutional governance;
- Local token-based incentives;
- Capacity building and communication mechanisms;
- Market infrastructure for tokenized public finance instruments.

These pillars operate as coordinated policy levers that generate intermediate outcomes such as interoperability which in turn support broader objectives of inclusion, transparency, resilience, and sustainable urban development. The replicability of the model, therefore, does not lie in the replication of single instruments, but in the transferability of this structured relationship between institutional design, socio-technical adoption, and public value outcomes.

More in detail, the first phase concerns the strategic identification of socio-economic challenges that digital financial tools and fintech-oriented innovation may address. In the case examined, the initiative emerged from the recognition that technological modernization could serve broader objectives such as inclusion, improved service delivery, and local economic development. This diagnostic stage is crucial for replication, as it anchors the technological intervention in clearly defined municipal needs rather than in technology-driven experimentation.

The second phase involves governance and institutional alignment. Replicability depends on the ability of municipalities to establish coordination mechanisms among public authorities, private technology providers, financial institutions, and civil society actors. In conceptual terms, shared infrastructure and governance arrangements constitute the

institutional backbone of the model, enabling interoperability, compliance, and legitimacy. The evidence presented in the article shows that outcomes were not produced solely through the deployment of digital infrastructure, but by the creation of collaborative arrangements that enabled trust, legitimacy, and operational continuity. Municipalities aiming to replicate the model should therefore view governance capacity as a necessary enabling condition rather than as an external contextual factor.

The third phase is represented by the implementation through pilot-driven experimentation. Furthermore, the initiative demonstrates that municipal innovation benefits from incremental deployment, where early-stage pilots generate feedback, reduce uncertainty, and allow for institutional learning. Within the framework, pilot implementation serves as the bridge between technological infrastructure and adoption dynamics, facilitating the diffusion of new digital services. This step is particularly strategic for ensuring that technological outcomes (e.g., improved digital access or service efficiency) translate into socio-economic effects, including participation, inclusion, and economic opportunities. Replication thus requires attention not only to technological adoption, but also to adaptive learning processes within municipal administrations.

The fourth phase focuses on evaluation and outcome measurement. To move beyond rich description, the initiative model emphasizes that municipalities must connect technological outputs with socio-economic indicators. Replicable initiatives therefore require built-in monitoring frameworks that capture technological performance, communications' impact, distributive socio-economic effects, and the extent to which trust and legitimacy are reinforced.

Finally, the model highlights scaling and long-term sustainability as the concluding phase. Replication is not achieved through copying a single intervention, but by adopting a roadmap that municipalities can adjust to their regulatory, demographic, and economic contexts. In Lugano's case, scaling also depends on linking local token incentives and civic engagement tools with broader market infrastructures, such as tokenized securities and digital bond issuances, which enhance transparency and efficiency in public finance. The case demonstrates that sustainability depends on embedding innovation initiatives within municipal planning cycles, securing stakeholder commitment, and ensuring that digital transformation remains linked to inclusive socio-economic objectives.

4. Conclusions

Adopting DLT in the public sector carries implications that go far beyond technical innovation, requiring a profound institutional and cultural shift. Successful implementation demands to rethink administrative processes, decision-making structures, and citizen engagement mechanisms, highlighting that digital transformation ultimately depends on human and organizational readiness. Public institutions, which are traditionally risk-averse and hierarchical, must adapt to a technological paradigm grounded in decentralization, transparency, and collaborative data governance. Clearly, this transition could create a cultural tension between established administrative models and emerging digital practices, making digital literacy and blockchain fundamentals essential skills for public employees. In addition, employees must develop competencies in data governance, cybersecurity, regulatory frameworks for tokenized assets, and interdisciplinary collaboration across finance, IT, legal services, and citizen-facing departments.

Training and education become—once again—strategic investments rather than side projects. To navigate this transformation effectively, administrations shall adopt concrete policies including strong:

- Leadership commitment;
- Pilot projects to test use cases before scaling;

- The creation of internal mentorship roles;
- Continuous feedback loops for ongoing improvement.

Taken together, these elements demonstrate that the adoption of DLT is not merely a technological upgrade but a comprehensive organizational transformation.

4.1. Lessons for Policymakers

This article examined the City of Lugano because it represents a pioneering case of blockchain adoption in local government and showed how a municipal administration can move beyond isolated pilot projects and build an integrated digital ecosystem. Rather than treating DLT as a purely technical experiment, Lugano assembled a coherent architecture in which an institutional, permissioned blockchain (SwissLedger), a local payment token (LVGA), digital literacy initiatives such as the Plan ₿, and natively digital municipal bonds operate as mutually reinforcing components of a broader innovation strategy. Together, these elements illustrate how DLT can be embedded into the everyday functioning of a city (e.g., from document management and financial infrastructure to local commerce, tourism, and cultural participation).

At the infrastructural level, SwissLedger demonstrates that an institutional blockchain can be governed as a digital commons, combining permissioned consensus, public anchoring on open chains, and sector-specific modules for tokenization and compliance. On this foundation, LVGA shows how a municipal digital currency can serve not only as a cashback instrument but also as a flexible policy tool to steer spending towards local businesses, support civic engagement, and coordinate incentives in tourism and culture. The Plan ₿ and, in particular, Plan ₿ Forum highlight the role of education and large-scale events in building cultural readiness and legitimacy around new technologies, while Lugano's digital bond issuances reveal how DLT can be leveraged in public finance to improve settlement efficiency, transparency, and market positioning.

For policymakers, the case of Lugano suggests several practical lessons. First, successful DLT adoption in the public sector requires treating infrastructure, incentives, and communication as interdependent dimensions rather than separate projects. Second, permissioned architectures with clear governance and compliance frameworks can reconcile innovation with regulatory certainty and institutional accountability. Third, complementary investments in digital literacy, stakeholder engagement, and public–private partnerships are essential to translate technical potential into concrete socio-economic outcomes. Local currencies and thematic events, when integrated into a shared digital infrastructure, can become powerful instruments for local development rather than mere marketing tools.

While the policy lessons drawn from Lugano's experience are potentially relevant for other municipalities, their transferability depends on important boundary conditions. The initiative has been enabled by Switzerland's comparatively supportive legal and regulatory framework for digital assets and DLT-based finance, which provides clarity on tokenization, market infrastructure, and institutional experimentation. At the same time, the degree of municipal autonomy and fiscal capacity available in Lugano is not uniform across jurisdictions: local governments operating in more centralized systems may face tighter constraints in launching payment instruments, partnering with private actors, or innovating in public finance. Contextual factors such as local culture, levels of digital literacy, and citizen trust in public institutions further shape adoption dynamics and may determine whether incentive-based tools generate sustained engagement rather than short-term experimentation.

For these reasons, the Lugano model cannot be transferred mechanically to areas characterized by more restrictive or uncertain regulatory environments. In contexts where legal clarity is absent, the model would need to evolve in both its sequencing and institutional

design. Municipalities operating under tighter constraints may have to prioritize permissioned and compliance-oriented infrastructure before introducing token-based incentive schemes, ensuring that governance arrangements remain aligned with national supervisory authorities and existing financial regulations. Similarly, municipal payment tokens may require alternative structures, such as closed-loop voucher systems or partnerships with licensed intermediaries, rather than fully tokenized instruments directly connected to broader crypto-asset ecosystems. The public finance dimension is also more difficult to replicate in jurisdictions lacking regulated DLT market infrastructures comparable to SDX or without central bank support for wholesale CBDC settlement, implying that innovation may initially remain concentrated on administrative services and local commerce rather than on tokenized securities.

More generally, in less supportive environments, the Lugano model should be understood as a modular framework rather than a fixed package. Municipalities may begin with capacity building, digital literacy, and stakeholder engagement initiatives, while gradually developing the institutional trust and regulatory coordination required for more advanced applications. In this sense, replicability depends not on adopting identical technological instruments, but on adapting the underlying governance logic (e.g., linking infrastructure, incentives, and communication to public value objectives) within the specific legal, institutional, and cultural boundaries of each jurisdiction.

4.2. Research Limitations and Future Research Perspectives

The present article has limitations that call for further research. As a single case study situated in a favorable Swiss regulatory context, the findings may not generalize automatically to jurisdictions with different legal, fiscal, or political conditions. The analysis was focused primarily on institutional design, operational indicators, and media sentiment; it did not assess in depth the long-term distributional effects of these policies, their cost-effectiveness compared to alternative interventions, or potential risks related to exclusion, technological lock-in, or dependence on specific private partners. Future work could address these gaps through comparative studies of multiple cities, quantitative evaluations of economic and social impacts, surveys on citizen perceptions and trust, and longitudinal analyses of the resilience and governance of institutional DLT infrastructures.

Despite these limitations, Lugano's experience still shows how a local government can design and govern a DLT-based ecosystem oriented toward public value creation by coordinating infrastructure, policy instruments, and engagement initiatives. In this sense, the Lugano case suggests that the question for local governments is no longer whether to experiment with blockchain, but how to embed it in a way that creates durable public value and supports a broader agenda of digital and urban transformation.

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Appendix A

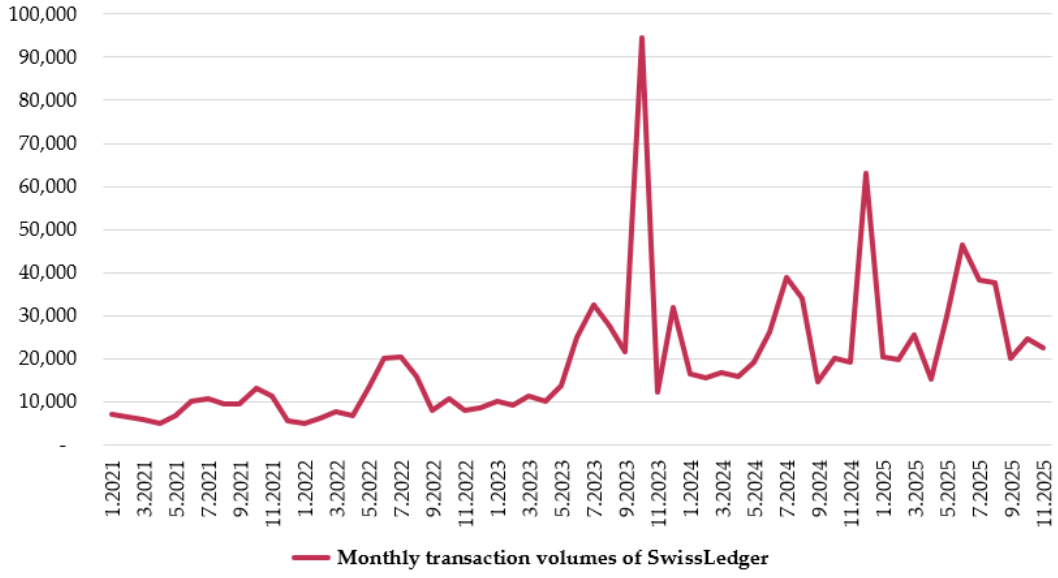

Figure A1. Monthly transaction volumes of SwissLedger.

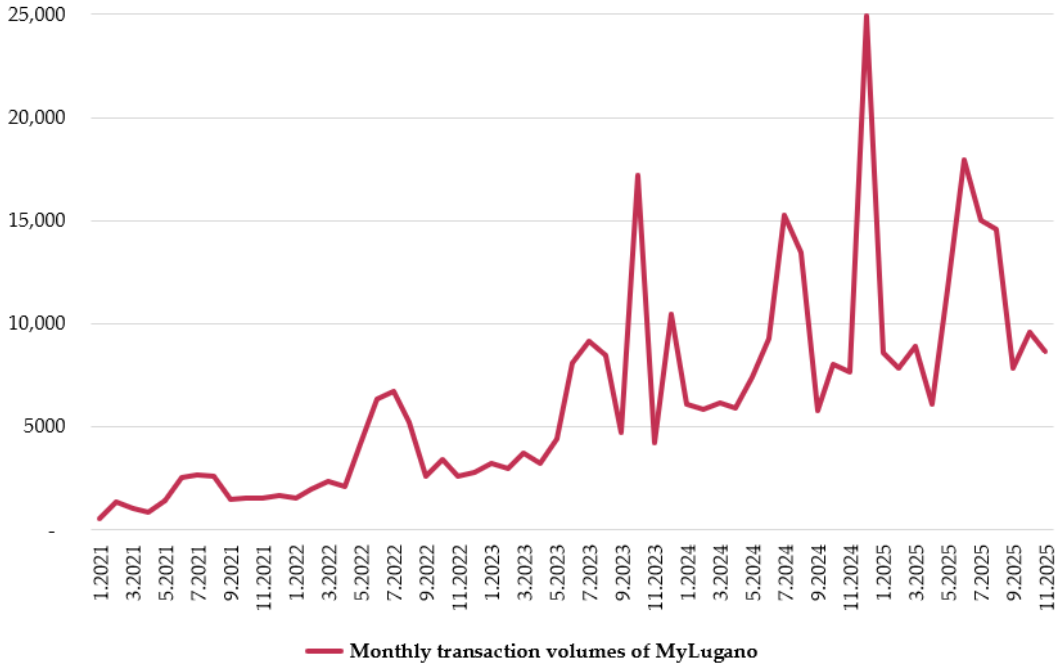

Figure A2. Monthly transaction volumes of MyLugano.

Appendix B

Talkwalker query

Argument: City of Lugano

Query: lugano* OR luganes* OR cittàdilugano OR cityoflugano OR inurls:"lugano.ch" OR luganomycity OR mylugano OR luganocity OR +"#lugano" OR +"#luganomycity" OR +"#cittàdilugano" OR +"#LVGA" OR source_id:"fb:2002944399731817" OR (author-short:luganomycity OR mention:@luganomycity OR media_mention:@luganomycity) OR author_id:"yt:UCRV7asMNWAsuyTvi_YKccKQ"

Theme: Plan B Forum

Query: "Plan B" OR "Plan B Forum" OR "Plan ₿" OR "Plan ₿ Forum" OR "Lugano Plan ₿" OR "PlanB" OR "Plan₿" OR Bitcoin NEAR/5 Lugano

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