

The Evolving Position of the Civic Tech Concept: A Decade of Systematic and Bibliometric Review

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Manuscript received July 7, 2025; accepted August 7, 2025; published November 26, 2025.

Abstract—The development of Information and Communication Technology (ICT) has increased public expectations for higher-quality services across diverse social sectors. This has objectively contributed to reforms in public data utilization and the emergence of more transparent, open policymaking by administrative agencies. In response, a growing number of volunteers with ICT expertise have become actively involved in public service innovation and policy development. A notable example is Code for America, founded in 2009 based on the concept of “Civic Tech” (CT). Although CT-related studies proliferated between 2009 and 2019, there has been no large-scale bibliometric analysis or comprehensive chronological overview of the field. To address this gap, this study crawled the Google Scholar database for CT-related publications from 2009 to 2019, clustered article titles, and analyzed yearly trends based on word similarity. Two main findings emerged. First, CT research consistently shares the long-term objective of advancing smart cities and can be categorized into three disciplinary clusters: informatics, sociology, and political science. Second, the understanding of the CT concept has gradually evolved from fragmentation toward integration, with a broadening of its semantic scope. Over time, the distinct identity of the CT concept is likely to fade, becoming subsumed within the broader discourse of smart cities. Nevertheless, in regions with lower levels of urbanization, the CT framework remains a useful and relevant tool for initiating public service improvements.

Keywords—civic tech, cluster analysis, bibliometric analysis, civic engagement, Information and Communication Technology (ICT)

I. INTRODUCTION

Information and Communication Technology (ICT) has facilitated the transformation and dissemination of information, enabling communities to better understand the fairness and quality of public services [1]. This has driven demand for higher quality and more efficient public services, leading to a growing desire among communities to participate in both decision-making processes and service delivery [2]. When the public sector lacks the resources—both human and financial—to adequately provide services for various social groups, private communities may express their intent to engage in public policy development [3]. Thus, both subjective demands from private actors and objective needs from government institutions have fostered increased participation in policymaking and public service provision. This movement is particularly evident at the local government level, where officials often directly represent community needs.

In response, federal and numerous local governments in the United States have established innovation offices to streamline administrative functions and enhance service delivery. This has encouraged greater involvement from the

private sector in all aspects of policymaking and service provision. Notably, ICT-based participation—such as data collection and analysis—has surged [4], fueled in part by the rapid advancement and diffusion of ICT. Furthermore, many skilled ICT professionals have begun to recognize their potential to contribute meaningfully to the public sector.

One of the most visible outcomes of these changes is the emergence of the concept known as “Civic Technology” (Civic Tech or CT), which merges civic engagement with technological solutions. CT can be defined as a form of governance that leverages collaboration between governments and citizens to solve public issues using ICT-based tools [5]. What distinguishes CT from other types of citizen participation is the prominent involvement of skilled ICT volunteers who improve administrative systems by applying their technical expertise [6]. CT thus represents a new mode of social engagement—driven by both public and private interests—that utilizes digital tools to reform traditional models of citizen involvement and public service provision.

The first organization explicitly aiming to realize the CT concept, Code for America (CFA), was officially founded in 2009. Since then, the concept of Civic Tech has spread from the United States to the rest of the world, with CT organizations growing at an annual rate exceeding 20% [7]. A common naming convention, “Code for + area name”, has emerged among these new organizations. Although no unified definition of CT exists, the term typically refers to volunteer-driven ICT initiatives that efficiently process information and influence the direction of problem-solving [8].

The importance of CT has been acknowledged by private institutions, governments, and international organizations. CT is distinctive in that many of its participants are individuals who were not previously involved in political or civic activities. At the same time, philanthropic foundations—traditionally hesitant to fund public sector projects—have shown growing interest in CT initiatives [9, 10]. CT also plays a vital role in raising public awareness, encouraging civic action, promoting social change, and fostering democratic design models that benefit both citizens and local governments. These models are especially valuable in redefining the relationship between citizens, communities, and the state in an era marked by rapid ICT advancement [9]. Notable examples include “Adopt-a-Hydrant”, a CFA-launched application in Boston that enables residents to locate and clear snow-covered fire hydrants, and “Where Does My Money Go”, a British CT initiative that visualizes tax expenditures using open-source code, now adopted in other countries.

Despite its practical success, CT originated primarily from the innovation efforts of ICT professionals, while its conceptualization, staffing, and organizational dynamics have largely been addressed by social science disciplines. As a result, CT-related research has been fragmented in terms of disciplinary focus and theoretical development [6]. In practice, software engineers and technical staff typically handle coding and development, whereas social scientists and policy professionals engage in broader organizational and conceptual analysis. This disciplinary divide contributes to the impression that CT is inherently interdisciplinary [11]. Indeed, CT often overlaps with related terms such as “GovTech” and “open data”, though the relationships among these concepts are seldom examined systematically. The lack of synthesis across fields has hindered the accumulation and dissemination of practical CT knowledge [11, 12].

CT research has drawn significant interest from both information technology and sociology scholars due to its hybrid nature combining digital tools and civic engagement. Theoretical studies between 2011 and 2015 primarily addressed CT definitions, typologies, and evaluation methods. For example, reference [7] classified CT into two categories: (1) open government, and (2) community-driven civic problem-solving. Later, Stempeck [13] expanded this typology into five categories: (1) responsive and efficient city services, (2) open data portals and open government data, (3) government engagement platforms, (4) community-based organizing services, and (5) geography-based services and open mapping. Modekurty *et al.* [14] traced the evolution of CT-related keywords over time, offering insight into conceptual changes. However, it focused only on internal components of the CT concept, without addressing its broader theoretical positioning. Existing studies, including those cited above, rarely examine CT in relation to its associated concepts—a key step toward resolving conceptual ambiguity.

Therefore, it is essential to objectively position both the CT research field and the CT concept itself by analyzing the body of existing literature. This study identifies trends in CT-related publications by analyzing open-access articles from Google Scholar. Through qualitative and cluster-based approaches, we map the research landscape and clarify how CT is situated among related concepts and disciplines.

II. METHOD AND DATA

The methodological framework used in this study is as follows. Google Scholar was selected as the primary data source to analyze research trends in Civic Tech (CT). This choice was made based on the nature of CT as a relatively new, interdisciplinary, and evolving research field, whose contributors range from academic scholars to practitioners such as engineers, civic activists, and local government staff. As such, relevant publications appear not only in peer-reviewed journals but also across non-academic platforms including blogs, technical reports, and media outlets.

Google Scholar was considered the most suitable database because it indexes a wide variety of sources—both formal and informal—allowing for the inclusion of gray literature critical to understanding the early and practical discourse of CT. Notably, searches using the term “civic tech” on Google

Scholar may yield articles only tangentially related to CT. For example, Ref. [15] is a newspaper article, while Ref. [16] is published in the open-access e-zine Beyond Transparency, which is known for capturing emerging trends within the CT community. These examples demonstrate the importance of including non-traditional sources—such as blogs and newspapers—that are typically not indexed in databases like Scopus or Web of Science. For this reason, those traditional academic databases were excluded from the sampling process.

To ensure comprehensive coverage, two search queries were used: “civic tech” and “Code for America”. The former captures the general conceptual term, while the latter reflects the most prominent organizational embodiment of CT. These keywords were selected based on their widespread use in both academic and practitioner contexts.

Data were collected using a Python-based crawler called “Google Scholar Catcher”, an open-source tool available on GitHub. The initial scraping yielded 1,113 entries. Non-English records were excluded, and metadata that could not be retrieved automatically was completed through manual checking. This process resulted in a final dataset of 711 valid entries.

For each article, the following metadata was extracted: author(s), title, year of publication, and citation count. Given the interdisciplinary nature of CT—spanning informatics, sociology, and political science—and the challenge of accessing consistent full texts or keyword lists, title data was chosen as the primary unit for analysis. The titles were tokenized using Natural Language Processing (NLP) methods in Python, with stop words, punctuation, and non-alphabetic tokens removed. Only nouns and noun phrases appearing at least three times were retained to ensure conceptual relevance and reduce noise.

Two analytical techniques were applied:

1. Bibliometric analysis, focusing on publication year and citation counts, to identify chronological trends and highly cited works;
2. Cluster and word similarity analysis, using Ward’s method for hierarchical clustering and the Jaccard coefficient as the similarity metric, based on cleaned title word frequencies [17].

These methods enabled both macro-level trend visualization and micro-level semantic mapping of CT research over time.

III. RESULTS

A. The Chronological Growth of Civic Tech Research

This study first examined the number of CT-related articles published each year. From 2009 to 2012, only a handful of articles appeared annually. Between 2013 and 2015, the number of publications increased steadily. However, from 2016 onward, a decline in publication volume was observed. This trend suggests that while Civic Tech initially received limited scholarly attention, interest grew rapidly in the mid-2010s before leveling off or declining—possibly due to conceptual saturation or a shift in research priorities.

In terms of academic impact, the average number of citations per article was 9.59. Notably, 316 articles (44.5%)

had not been cited at all. Approximately 30% of the articles had between one and five citations, while 74 articles (10.4%) had received more than 20 citations.

This study also identified the most highly cited articles, using both total citation counts and annual citation averages. For instance, Ref. [18] had been cited 425 times, with an average of 47 citations per year. The most frequently cited articles were predominantly published before 2015 and focused on foundational concepts related to CT, such as “Web 2.0”, “open data”, and “open government”. The top-cited work, Ref. [18], presents a comprehensive discussion of the concept of “government as a platform”, widely considered the theoretical cornerstone of Civic Tech. Similarly, Shelton, Poorthuis, and Zook [19] explored the fundamental logic of “smart cities” and is regarded as a pioneering work that integrated CT with smart city discourse. Further qualitative analysis of a broader dataset is needed to verify and expand upon these inferences.

B. Cluster Analysis of Published Articles

To investigate the thematic interests within CT research, a cluster analysis was conducted using the titles of all 711 valid articles. Words appearing in these titles were coded, and Ward’s method was employed for hierarchical clustering, with the Jaccard coefficient used as the similarity measure. The resulting clusters were visualized on a two-dimensional plane, and the relative proximities among terms were used to interpret the semantic structure of the clusters.

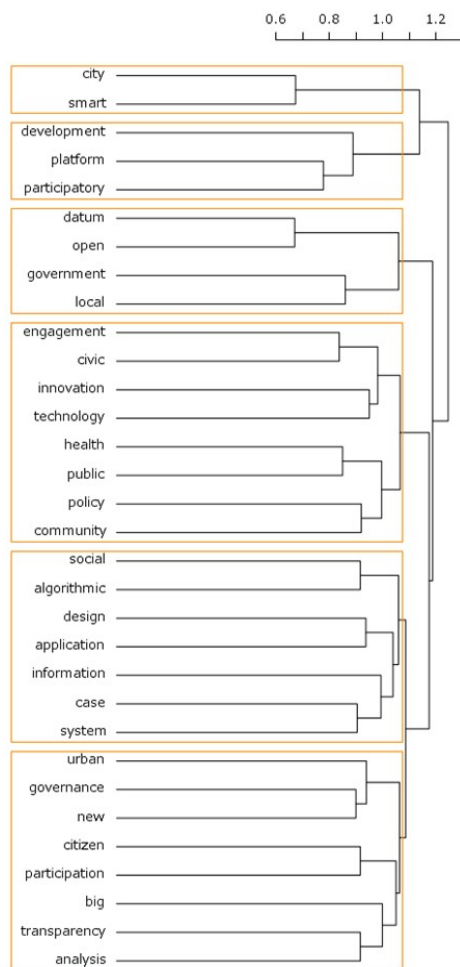


Fig. 1. Cluster analysis of CT research.

Note: The orange box indicates a cluster; the closer the dotted line between two words is to 1.0, the higher their similarity is.

The results of the cluster analysis are presented in Fig. 1, which shows a dendrogram dividing the title words into six clusters, labeled Clusters 1 through 6 from top to bottom. Clusters 1 and 2 form one major category, while Clusters 3 to 6 form another. Within the latter, Cluster 3 stands somewhat apart from Clusters 4 to 6, suggesting an internal subdivision.

Cluster 1 centers on discussions related to smart cities, while Cluster 2 focuses on participatory platforms. Together, they reflect a key research interest in building participatory infrastructures with the long-term aim of developing smart cities. Clusters 4, 5, and 6 represent distinct subfields: citizen participation and innovation, programming systems and applications, and administrative transparency, respectively.

Cluster 3 is characterized by themes related to local governments and open data, indicating another major research direction in CT. This cluster highlights the role of open government data at the local level and encompasses three distinct sub-disciplinary interests. These findings suggest that CT research broadly revolves around two central themes: (1) participatory platform development for smart city implementation, and (2) the promotion of open data practices in local governance, each with diverse interdisciplinary connections.

C. Word Similarity Analysis

To examine how the focus of Civic Tech (CT) research has evolved over time, this study analyzed the most frequently occurring phrases in article titles for each year. Specifically, the three most common title phrases were extracted annually to identify emerging themes and long-term trends.

From 2010 to 2013, the most frequent phrases—such as “rethinking organizational business models”, “social media emergency management camp”, “social design’s implications”, and “community data commons”—tended to be diverse and thematically specific. These early studies reflected a wide range of exploratory approaches and concrete case-based topics.

After 2013, however, the research focus began to converge around broader and more systemic themes, most notably “smart cities” and “open data”. Over time, these terms became increasingly dominant, accompanied by related concepts such as “big data” and “services for smart cities”. This indicates a shift from explorative discussions of specific local ecosystems to studies emphasizing data collection, management, and implementation strategies related to CT.

The analysis suggests that research from 2010 to 2013 was more oriented toward applied, context-specific cases or ecosystem-based initiatives. In contrast, post-2013 research increasingly focused on how data infrastructures support the deployment of CT tools and strategies. Within this framework, smart cities appear to serve as both the goal and operational context for CT development.

From these trends, it can be concluded that CT research has maintained a consistent thematic association with open data and smart cities. Indeed, the term smart cities has become so dominant that it may have begun to overshadow the conceptual identity of Civic Tech itself. This suggests that while CT originated as a distinct paradigm of civic engagement through technology, it is increasingly being absorbed into the broader discourse of smart city development.

IV. ANALYSIS OF THE RESULTS

A. Changes in the Positioning of CT Research and Reasons

Based on the cluster analysis shown in Fig. 1, it can be concluded that the integration of smart cities and participatory platforms represents a major thematic focus within CT research. As the smart city remains an evolving concept—both theoretically and practically—its role as a participatory platform can be regarded as a long-term and ultimate objective of CT research and practice.

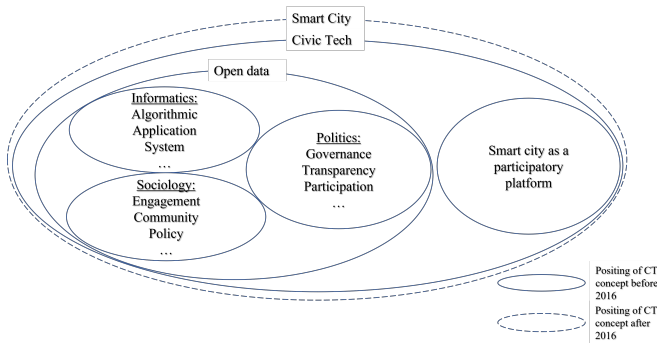


Fig. 2. The positioning of CT research.

Another prominent research focus is the use of open data as a central element in enabling participatory governance and public service innovation. As illustrated in Fig. 2, open data serves as a foundational layer within the broader Civic Tech and Smart City framework, branching into three thematic clusters: (1) algorithmic and application systems, (2) sociotechnical and community policy engagement, and (3) data commons and transparency mechanisms. These clusters demonstrate how CT research leverages open data to support transparent governance, collaborative service design, and participatory urban transformation.

Notably, since 2016, the conceptual positioning of Civic Tech has shown a marked shift toward integration within the broader smart city discourse. While CT was initially recognized as an independent, citizen-centered innovation movement, recent research increasingly treats it as a component of smart city development. This conceptual convergence reflects a transition from localized problem-solving initiatives to systemic, data-driven urban reform strategies, where CT serves as a participatory mechanism embedded in the smart city ecosystem.

However, as noted in Refs. [18, 20], Civic Tech initially emerged as a self-organized initiative by engineers seeking to improve urban services through the application of ICT, primarily from a technical perspective. In its early stages, CT was largely driven by informatics and software engineering concerns, with engineers exploring the potential of ICT to address perceived deficiencies in municipal services.

Over time, however, Civic Tech practitioners—particularly those affiliated with organizations like Code for America (CFA)—began to acknowledge the value of problem identification and agenda-setting by non-technical citizens. This recognition led to a participatory model in which technologists (often working pro bono) collaborated with civically engaged individuals from non-technical backgrounds to co-develop public service solutions [15, 21, 22]. As a result, CT evolved into a multi-community participatory movement, gaining a

sociological dimension and establishing itself as a legitimate actor in public policy discourse.

As the scope and visibility of CT activities expanded, public administrations—many of which were already grappling with budget constraints and workforce shortages—began adopting Civic Tech as a complementary model of public service delivery [19, 23]. A notable example is the City of Chicago’s collaboration with CFA in 2012, which introduced the “Smart Chicago” initiative and its associated policy framework [24]. Such partnerships signal not only increased acceptance of CT practices but also a transformation in traditional administrative structures.

Given that the smart city paradigm explicitly aims to transform urban governance and infrastructure, it is unsurprising that CT practices have become intertwined with various aspects of smart city development. Since 2016, the dominant focus of CT research has shifted toward topics such as data collection, policy development, and urban systems management within the broader smart city discourse.

According to Ref. [25], the incorporation of ICT-driven approaches through CT practices has objectively contributed to the realization of smart city goals. Consequently, it can be argued that Civic Tech is now increasingly perceived as a subset or enabler of smart city initiatives, both in conceptual terms and in practical application—as confirmed by the findings of this study.

B. Changes in the Perception of the Concept of CT Referent and Its Reasons

The findings of this study indicate that the conceptual awareness of Civic Tech (CT) has undergone a significant transformation over time. Prior to 2009, CT was largely unrecognized as a unified concept, and related ideas—such as participatory democracy, peer networks, civic data, and advocacy tech—existed in a fragmented form [14]. Limited by the lack of widespread ICT infrastructure and adoption, these early efforts had minimal societal impact and remained largely theoretical or localized in small-scale initiatives.

From 2009 to 2016, however, the rapid development and diffusion of ICT technologies, coupled with resource shortages in public administration, created a favorable environment for the emergence and popularization of the CT concept. During this period, CT functioned as a broad and integrative term that brought together various pre-2009 ideas, serving as a guiding framework for improving urban public services. Academic interest in CT peaked during this phase, and the term gained traction as a coherent and actionable model for civic engagement through technology.

Since 2016, however, the use of the term “Civic Tech” in academic literature has begun to decline, even as related concepts such as smart cities, open data, and urban innovation have gained momentum [26]. This trend does not necessarily imply a decline in the relevance of CT practices, but rather suggests a conceptual shift—wherein CT is increasingly subsumed under broader, more systemically-oriented paradigms like smart cities. The transformation can be seen as a progression from conceptual fragmentation to integration, accompanied by an expansion in meaning and scope. As a result, while the practices and principles of CT persist, the term itself may gradually fade from academic and policy discourse.

This trend can be explained in part by the conceptual relationship between CT and smart cities. CT initiatives typically focus on targeted improvements to specific public services, aiming to enhance administrative efficiency and civic participation within existing institutional frameworks. In contrast, smart cities represent a systemic restructuring of urban governance, encompassing comprehensive changes in administrative logic, data infrastructure, and service delivery at the citywide level. From this perspective, CT can be viewed as a precursor or transitional concept within the broader smart city discourse—one that is eventually eclipsed by the more expansive and evaluable framework of smart urbanism.

Another factor contributing to the declining visibility of CT is the difficulty in standardizing its evaluation. Given the diverse interpretations of CT and the variability in its application across different social contexts, it is challenging to develop uniform metrics for assessing its outcomes [11, 12]. In contrast, smart city initiatives often emphasize data-driven service models, enabling more consistent inter-city and inter-service comparisons. As such, researchers and practitioners may gravitate toward the smart city framework due to its evaluative clarity and policy applicability.

Despite this shift, it is important to recognize that the CT concept remains highly relevant—particularly in developing countries, where administrative institutions may lack the capacity to deliver effective public services. In such contexts, CT provides a pragmatic entry point for collaboration between civil society, technologists, and government actors, offering scalable solutions without requiring structural overhaul. While CT may serve as a transitional model toward smart cities, the decline in academic focus on CT risks undermining its utility in regions still grappling with fundamental service provision challenges and underdevelopment.

V. CONCLUSION

This study explored the positioning of Civic Tech (CT) research by collecting and analyzing CT-related publications from 2009 to 2019 using data crawled from Google Scholar. Cluster analysis and word similarity analysis were employed to identify thematic patterns and conceptual trends within the field. Two main conclusions can be drawn from this study.

First, Civic Tech research consistently frames smart cities as a long-term objective. As CT practices have expanded, the inclusion of non-technical actors has become increasingly important, thereby imbuing the field with a sociological dimension of citizen participation. Furthermore, the political science perspective in CT research emerges from the fact that CT activities inherently affect the structure of public service delivery. The conceptual overlap between CT and smart cities—particularly in their shared reliance on digital tools and participatory models—positions CT as both a precursor to and a component of smart city development.

Second, the perception of the CT concept has evolved from a fragmented set of ideas into a more integrated and expansive framework. Over time, the conceptual boundaries of CT have broadened, but its distinct identity has begun to fade. In the long run, the functions and values associated with CT are likely to persist, but under the umbrella of the smart

city paradigm. This shift is primarily due to the greater structural comprehensiveness and clarity of evaluation metrics associated with smart cities, which are rooted in the datafication of urban systems. Compared to CT—which is difficult to evaluate uniformly due to its diverse forms and context-dependent practices—smart cities offer a more attractive framework for both researchers and policymakers.

In summary, CT is a multidisciplinary and transitional concept that has played a crucial role in shaping the discourse on public service innovation. While its conceptual prominence may diminish within highly urbanized and technologically advanced contexts, CT remains an essential and irreplaceable framework in regions with lower levels of urbanization. In such areas, CT continues to provide practical, citizen-centered solutions for initiating improvements in public service delivery.

This study is based on data collected from 2009 to 2019, which means that more recent developments in Civic Tech may not be fully reflected. The decision to limit the dataset to this period was due to the need for a consistent and analyzable publication window, as well as data availability at the time of research. However, it is acknowledged that the Civic Tech landscape has continued to evolve—particularly in light of the COVID-19 pandemic and increasing digital transformation efforts by governments. Future research should consider updating the dataset to include publications from 2020 onward in order to capture emerging trends, technologies, and post-pandemic transformations in CT practices and discourse.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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