

Analysis of the Type and Distribution Features of Public Services Based on Civic Tech Concept

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Abstract—Owing to the development of Information Communication Technology (ICT) and the human and financial resources of public institutions, the task of improving public services is increasingly being transferred to the private sector. Civic Tech (CT), a form of public service delivery by ICT professionals in collaboration with citizens, is spreading from the United States to the world and creating many new public services. This study analyzes CT-based public services worldwide by clustering, dimension analysis, and co-occurrence analysis. This study concludes that CT-based public services are generally divided into two forms: direct service delivery to users, which fixes and replaces existing public services, and the creation of generic tools that indirectly support the improvement of public services. Moreover, the fact that the majority of CT-based public services are located in middle-income, medium-population density countries and regions can be a constraint on funding and talent that prevents CT organizations from generating or sustaining the public services created by CT organizations in areas where new and alternative public services are most needed.

Index Terms—Civic tech, ICT, public service, public sector

I. INTRODUCTION

As information communication technology (ICT) has made the transfer of information wider and faster, different communities have relatively improved their understanding of the fairness and quality of their public services [1]. This change led to the growth of the quest for higher quality and more efficient public services, which led to an increasing variety of communities wanting to participate in the decision-making process and the provision of public services [2]. When the public sector cannot meet the needs for public services of various social groups in terms of workforce and finance, private communities must have the intention to create and participate in public policy [3]. Therefore, subjective demands from private communities and objective demands from the government require substantial participation of citizens in policymaking and the provision of public services. This movement is apparent in local governments because they are closely related to the social needs of citizens on the street.

As a result of this change in public service, the central government and numerous local governments in the United States have established innovation offices to streamline their work and enrich the forms of public service delivery. This has also led to the growth of the involvement of the private sector

in all aspects of policymaking and public service provision. In particular, ICT-based participation, such as data collection and analysis, has increased [4]. This is partly because of the rapid development and dissemination of ICT. Moreover, many skilled and trained ICT professionals started to recognize that their potential skills contribute to the public process in a sophisticated way.

One of the most obvious phenomena of it was the birth of a concept called “Civic tech” or “Civic technology,” which is a term for civilian activity and technology. Civic Tech (CT) can be defined as the governance activities that enterprise solutions to the ICT problems between the government and its people [5, 6]. Apart from other citizen participation, the most distinctive feature of CT is the involvement of expert ICT volunteers [7]. They contribute to the progress and improvement of the administrative system by using their ICT-related capabilities. Therefore, it can be considered that CT, as a new form of social activity accepted by both the government and the private sector, is using ICT-based digital tools to change the traditional forms of citizen participation and public service provision.

The first official establishment of CT dates back to 2009 when Code for America was born in the United States. Since then, the word “Civic Tech” has spread from the United States to the rest of the world. The number of civic tech organizations has consistently shown more than 20% annual growth [8]. Accordingly, the phrase “Code for + area name” has become a popular naming convention for newborn civic tech organizations.

Since 2009, CT-based organizations worldwide have released more than 6,000 public service delivery applications, web pages, or data platforms through collaboration between experts and citizens [3, 6]. These public services have improved local public services or replaced public services themselves from different perspectives. However, the CT-based public services noted and studied were concentrated in the United States or other developed countries where they originated. Thus, whether CT has developed in areas with lower levels of economic development and theoretically poorer public services has not been summarized based on a large sample of data. This makes it difficult to answer whether CT is more likely to be generated in regions with greater demand for poorer public services. Further, according to [9], the sustainability and development of CT-based public services vary greatly across regions, presumably because of funding, environmental constraints, and relationships with the government. Hence, it would be useful to analyze the distribution characteristics of CT-based public services and the status of public services in their regions to answer the question of the conditions and constraints of CT-based public services.

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Therefore, this study analyzes the characteristics of public CT-based public services worldwide and discusses, from an objective viewpoint, the main social issues on which CT activities are focused and the characteristics of the regions where CT-based public services are generated.

II. METHOD

In this study, the author collected 6,351 open, accessible public services (including applications, websites, datasets, and platforms.) worldwide by collecting the names, descriptions, and major service areas of the public services. The names and descriptions of the public services collected were analyzed qualitatively through the cluster, multiple dimensions, and co-occurrence network analyses. This was to examine the characteristics of the main social issues and the commonalities, like public services. Finally, the characteristics of the regions where the public services based on the CT concept are mainly born were examined in relation to the population density and GDP per capita of the regions served by these public services.

III. ANALYSIS

First, the authors conducted a cluster analysis of the developer descriptions of the public services, which was used to discuss the direction in which the developers of these published public services were subjectively concerned with social issues or focused primarily on improving society. Specifically, “Ward’s method” was used to calculate the distances for 5,899 public services with developer descriptions out of the total sample of 6,351. The “Jaccard” method was used to arrive at Fig. 1. The first cluster from top to bottom can be seen as a common feature of CT activities, i.e., open data is an important feature, which is also a basic element of the CT concept. The second cluster is an informatics term, which can be considered as part of the public services that do not directly support the solution or improvement of social problems but rather as intermediate systems for the provision of other public services or as part of other public service frameworks. The third cluster has a high frequency of occurrence, and all its words are components of the CT concept. This can be interpreted as “the use of technology by citizens and communities to make use of data to improve government public services” as a common feature of these CT-based public services. The fourth cluster is characterized by using media to promote the rights of citizens and communities, to promote the idea of democracy, or to improve the process of democratic participation. The fifth cluster consists of two words, indicating that cities are the primary service areas for CT-based public services and that these public services have the distinct characteristic of bringing new elements to the city. The sixth cluster contains many words, the core of which can be understood as building a platform for improving public services through citizen activities. This is also an important form of the results produced by CT activities, i.e., not directly improving public services per se. However, building a platform to serve certain groups, thus indirectly serving the community or providing support for other public services. The last cluster also

contains many words. It can be seen more as an innovation through the collaboration between experts and citizens to provide direct solutions to social issues, with more direct service to the community and more emphasis on innovation than cluster 6.

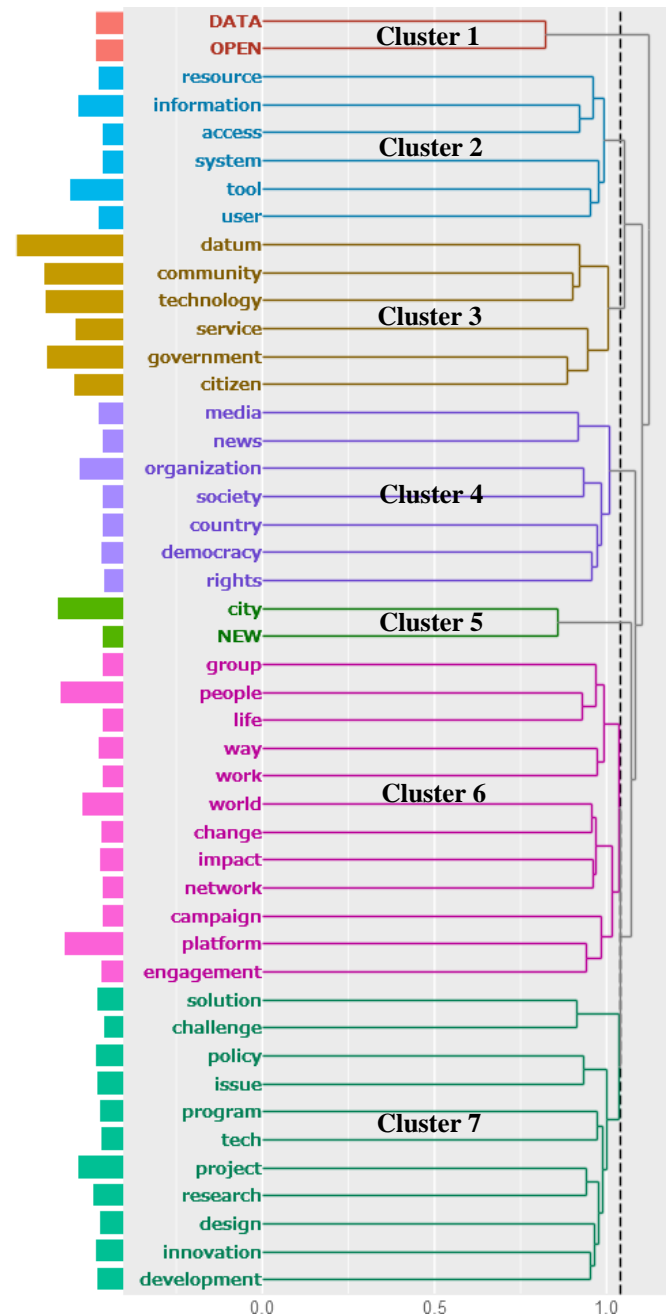


Fig. 1. Clusters of public services based on CT.

Next, the authors analyzed the collected developer descriptions of public services on multiple meta-scales, specifically using Ward’s method and distance measurement using Jaccard’s method, shown in Fig. 2. As seen in Figure 2, a total of five different clusters were classified and presented on two different subscales, which can be interpreted as the coordinate axis’s horizontal and vertical axes. As a result of which the different clusters containing words, in general, the horizontal axis (subdivision 1) can be seen as having a positive direction being practical, favoring direct problem-solving. In contrast, the negative direction is theoretical, favoring indirect theoretical support for problem-solving; the vertical axis (subdivision 2) can be seen as the positive

direction being sociological related. In contrast, the negative direction is informatics related. Looking specifically at the clusters, cluster 1 is in the center of the coordinate system and contains words with high frequency, which are mostly the basic elements of the CT concept, i.e., improving government services and solving social issues through technology and data. Cluster 2 is in the lower left of the middle of the coordinate system and contains words that appear more frequently, mainly in the context of citizens and communities improving services by building platforms and having strong characteristics of improving information delivery using informatics. Cluster 3 is in the upper right corner, where the words emphasize innovation and new ideas, which are closely related to problem-solving solutions. Cluster 4 is in the upper left corner, where the words can be seen as improving the content of democracy through the medium and media of information delivery. Cluster 5 is in the bottom right corner and is a terminal-related informatics word. This section is majorly a direct problem-solving system, that is, programming-related content.

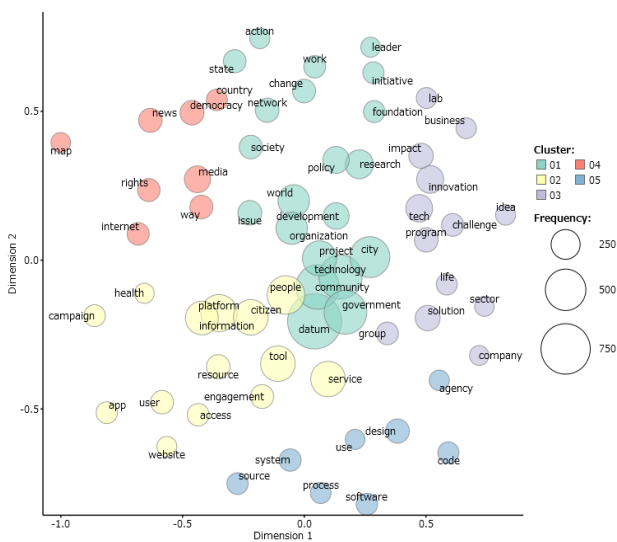


Fig. 2. Dimensions of public services based on CT

Thereafter, the authors conducted a co-occurrence network analysis of the developer descriptions of public services, using the Jaccard method for distance measurement, and the results are summarized in Fig. 3. While clusters 6, 7, and 8 would be entirely end-related for programming development, and it can be understood that many of the descriptions of these public services are informatics terms. Clusters 1-4, which contain several words, are characterized by the high frequency of the words “data,” “community,” and “technology” in both cluster 1 and cluster 2. This can be seen as a feature of CT-based public services wherein the private community is the main developer, and technology and government-owned data are used to improve public services. Simultaneously, considering the high frequency words “citizens” and “platform” in cluster 4, “information” can be interpreted from it, as the main purpose of CT activities is to build a platform for citizens to better access and disseminate information. One of the main purposes of CT activities is to build a platform for citizens to better access and spread information.

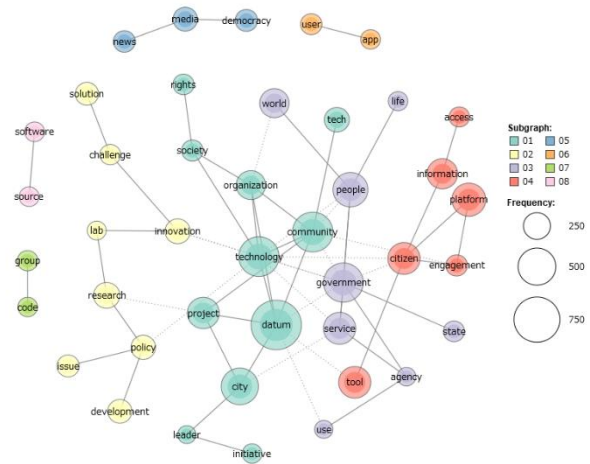


Fig. 3. Co-occurrence network of public services based on CT.

Finally, by analyzing the population density and GDP per capita of the main service areas of the CT-based public services, 5,104 of the total sample of 6,351 were collected with a clear service area and data on population density and GDP per capita. The analysis of these 5,104 samples is summarized in two sectoral charts, Figure 4 and Figure 5. Figure 4 and Figure 5 show that most CT-based public services are in areas with population densities between 100 and 800 and GDP per capita between \$10,000 and \$30,000. These two points suggest that CT-based public services are more likely to be born in upper-middle-income urban areas and are less likely to be found in rural, extremely poor, or extremely wealthy areas.

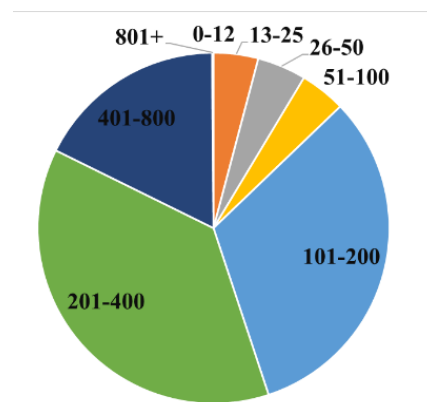


Fig. 4. Percentage for areas' population density of public services based on CT (People/km²).

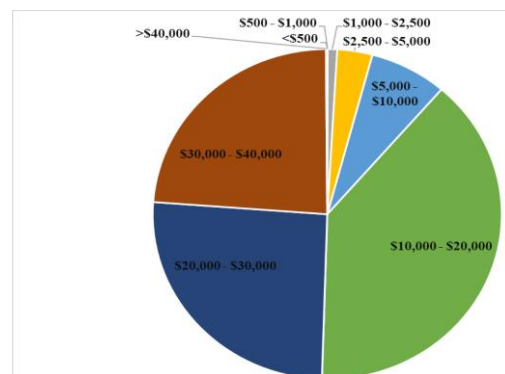


Fig. 5. Percentage for areas' nominal GDP of Public services based on CT

IV. DISCUSSION

A. CT-Based Public Services Have Dual Nature of Solutions and Generic Tools

In the existing case studies of CT-based public services, since most of the problem awareness of CT activities comes from citizens, it is assumed that the production products of CT activities are mostly solutions that directly address a particular social problem [10]. However, the analysis in Figures 1, 2, and 3 shows that although most of the CT-based public services are problem-specific solutions, there is still a significant proportion of public services that serve as generic tools, targeting platform building or the development of a component of a solution, without directly addressing the problem. The sample collected in this study includes, specifically, projects such as “where does my money go,” “5374.jp,” “Stopcovid source code,” and others that are open source in nature. They can be used and modified by anyone based on local data to indirectly improve public services.

In other words, there are two types of public services created by CT activities: end-to-end public services that directly aim at improving social issues and indirect public services that provide support, frameworks, systems, or data for other public services and are not user-oriented. The former is more easily recognized by society because it is used directly by the client population. However, it is also a service with information interaction. Thus it is more expensive to maintain, which poses a challenge to the sustainability of this type of public service. The latter form does not serve users directly but is more of a code-like, architecture-like, innovative service; thus, there is no long-term, ongoing maintenance cost. It can be argued that both forms of public services are necessary to solve social problems and improve existing public services. However, direct user services pose a challenge in securing funding and long-term talent for CT organizations, which are difficult to sustain if they lack payments from the government or private sources. This is in line with the description in [11] that CT organizations cannot sustain their services or even the organization itself without a relationship with the government. For example, the Stopcovid open code created by CT organizations in Japan during the Covid19 epidemic was used to publicize the infection in several regions, including Tokyo.

To summarize, in the field of public service delivery, there are two forms of public services based on CT. The direct-to-customer form of public service delivery involves existing public services’ deficiencies, while the form of providing general-purpose tools is about innovating the form of public service delivery.

B. CT-Based Public Services Do Not Show a Positive Correlation with the Demand for Public Service Improvement

According to [12], the size of population density affects the efficiency of individual people to receive public services, with the total amount of public services being constant. Further, in general, the greater the population density, the lower the satisfaction with public services. Similarly, the higher the GDP per capita of a region, the more resources are usually available to the local administration for public services and the higher the satisfaction with public services

[13]. According to this reasoning, CT-based public services should be mostly found in areas with high population density or low regional GDP per capita. However, Figs. 4 and 5 show that CT activities are more often found in middle-income and medium-population density areas.

This characteristic can have several reasons: A) The majority of CT output is based on ICT technologies, and from this viewpoint, only regions with a certain scale of communication infrastructure and spare capacity can provide services for private CT activities. B) Public services require high maintenance costs, and according to [8, 14], CT-based public services can only be maintained in the long-term if they are funded by the government or have significant private contributions. The lack of government and private funding in low-income areas makes it difficult to sustain CT activities even if they are productive.

C. The Ideal Model of CT-Based Public Service

From the previous analysis, it can be seen that in terms of the distribution of CT-based public services, regions with insufficient levels of economic development should have needed more CT-based public services in terms of demand. However, more and better CT-based public services are found in regions with good economic development levels. In other words, regions with lower levels of development need high-speed and direct solutions to their problems. They need CT-based solutions that directly address social problems, while medium and even developed regions should use CT-developed generic tools to achieve systematic optimization of resources, such as digitalization of data and e-government. This is also because the use of general-purpose tools developed by CT requires a certain amount of budget and time to produce results [13], which is difficult to generate positive feedback and positive evaluation in low-developed regions that need to solve social problems.

Cross-regional activities are a reasonable solution to ensure that these two types of CT-based public services can best serve the areas that need them most. Cross-regional activities here do not necessarily mean the physical movement of talent and resources but also support in the form of remote consultants for programs and technologies. A centralized management organization is needed to achieve the best efficiency in resource deployment. The initial development of Code for America was close to this form of support by sending engineers across the United States. However, later CT organizations in other regions worldwide adopted a more decentralized organization [6, 7]. This phenomenon can be attributed to the influence of regional factors unique to each region. It can also be understood that the Code for America format has many hidden practical problems that need to be studied further.

V. CONCLUSION

This study analyzes CT-based public services worldwide and concludes that CT-based public services are generally divided into two forms: direct delivery of services to users as a fix or replacement for existing public services and the creation of generic tools to indirectly support the improvement of public services. The general-purpose tool form is more likely to be an innovation of the existing public

service delivery model, fundamentally different from the direct-to-consumer form, and more likely to be favored by the government and private organizations. Simultaneously, direct-to-user service delivery is indispensable. However, owing to the nature of most CTs as private non-profit organizations, it is constrained by financial and human resources, which is not fundamentally different from the government's inability to provide some public services because of financial and human resources.

Moreover, the fact that the majority of CT-based public services are located in middle-income, medium-density countries and regions can also be a constraint on funding and talent, preventing CT organizations from generating or sustaining the public services created by CT organizations in areas where new and alternative public services are most needed.

In the long run, the problem of uneven CT-based public services in regions with different levels of economic development will become more serious. In other words, regions with lower levels of economic development will have fewer CT-based public services because of financial and human resource problems. In contrast, in regions with higher levels of development, both existing public and CT-based public services are already sufficient. However, the quantity and quality of public services will be further improved because of sufficient human resources and resources. They will be transformed into the ideal model of CT, the "smart city." From the data in this study, this polarization of CT development is almost inevitable, and further observation and research are needed to avoid this problem.

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