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Civic technology: A chutes and ladders analysis of transformative potential

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Abstract. Smart Cities research has made a significant turn towards a more citizen centered analysis of the advantages and disadvantages of ICT based technology. A key tension exists in the civic technology literature that sets the objective of government efficiency and effectiveness against a more inclusive and potentially transformative objective of citizen coproduction and direct participation in decision making. For the latter outcome to occur, technology must be understood as having the potential to be a non-neutral agent in the formation of a citizen centric imaginary. In this paper, the three major themes of civic technology- e-government, e-engagement, and e-democracy are presented as linearly related in successive stages. Yet, there is a significant risk of breaks in these stages, or even deviations. The discussion identifies the opportunities for transformation of the political system as we know it, and the junctures where the desire to maintain the status quo may eliminate these opportunities.

Keywords: Civic technology, E-Government, E-Engagement, E-Democracy, citizen-centric

1. Introduction

Plato, in *The Republic*, warned against democracy because he believed that citizens were ignorant and uninformed and, as any polity increased in size, this dearth of knowledge would result in a fall into 'mobocracy'. Even later, as his writings progressed through *Politicus* and *The Laws*, he begrudgingly accepted that democracy was perhaps a second-best solution to oligarchy, but only if we build a society under the assumption that there be nothing wiser than the laws [41]. This democratic alternative describes a polity composed of citizens who should not, indeed cannot, question the rule of law, and suggests that there can be no deviation from the law as written [47].

In the 20th century, much of this might have been acceptable, given that the ability to be informed was primarily afforded to an elite group- those with the time, education, and funds to pursue knowledge necessary to participate effectively. Interestingly, most work on active citizenship prior to the last few years used the term 'citizen participation' rather than engagement; the use of this word reflects the assumption that citizens were on a slightly lower playing field than government. Citizen Participation, even at its highest level on Arnstein's ladder [3] still maintains an assumption of a hierarchical government system within which a citizen may interact. In an excellent review of literature on smart city engagement, Simonofski et al. [51] extend citizen participation within an IOT context, bringing the concept closer to actual engagement rather than participation, although they do not take the final step of addressing the disappearance of the traditional governmental structure in physical or cyberspace. With a digital platform, we can see that the opportunities for the individual to fully engage in public decision-making are expanded. As we

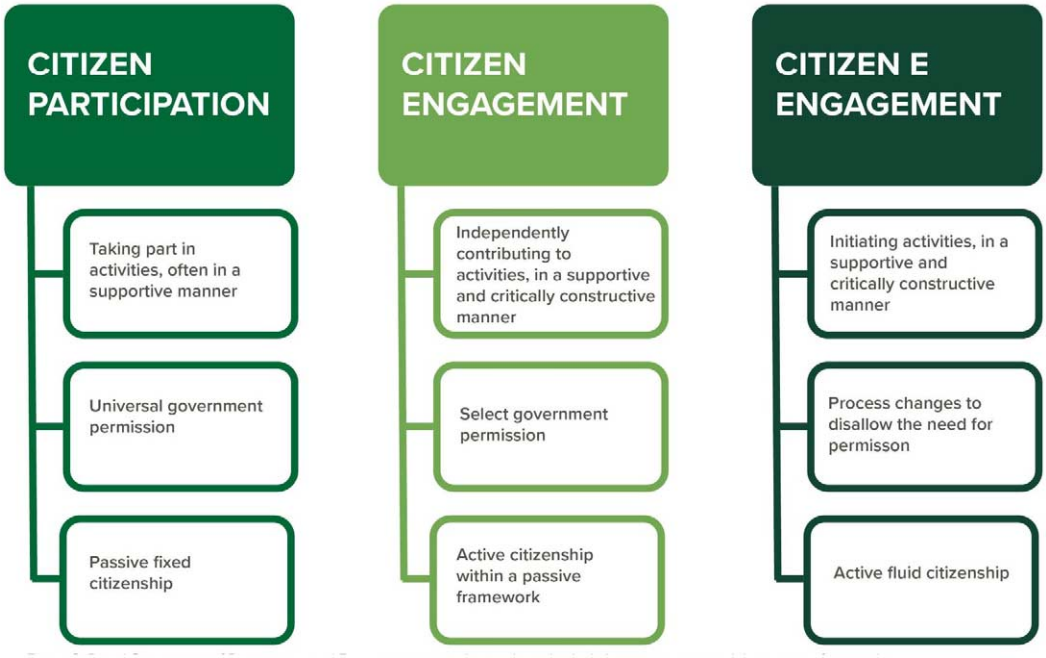

Fig. 1. Broad comparison of participation and engagement.

move from traditional participation to full E engagement, changes in interaction are manifest at the individual level, the government, and the entire political system (see Fig. 1).

Of course, part of the early reason for accepting the limitations of participation over engagement were simply due to the fact that there was nothing in the governance system that allowed for input by the multitude of persons increasingly populating the urban areas. In the 21st century, this has changed. With the ubiquitous IOT, we not only have the ability to gain information and knowledge on a broad scale; we also have the technology to share this information and participate in decision making that circumvents the boundaries of physical engagement. These advances are not only impactful in terms of the efficiency of governance; they have the ability to transform the entire political system in a way that will make true democracy possible, making the worries of Plato obsolete. In the following discussion, the potential pathways to that transformation will be investigated. An argument will be made that, in order to progress towards a technologically enabled true democracy, there are distinct stages of readiness that relate to government and citizens.

2. The classification framework for e-government, e-engagement, and e-democracy

There exist a number of manifestations of civic technology as represented in the literature; we categorize them here as e-Government (or digital government), e-Engagement, and e-Democracy. Although they might informally be used interchangeably, it is useful to distinguish them in terms of objectives and impact, and to establish where meaningful linkages between the three categories occur. Further, they are presented in a framework that suggests a progressive, linear development in order to provide a continuous and stackable foundation for the final outcome-e-Democracy. In any progression, however, there are forks in the road, moments when it is just as possible to stop the progress as it is to continue. And, it may be that certain choices involving civic technology can more us forward faster, or even take us backwards. The reference to the children's game of Chutes and Ladders in the title provides us with the visual to the analysis. In this game, which some might know as Snakes and Ladders, some of the squares are connected by ladders, enabling the player to move further and faster towards the final objective. However, other squares are connected by chutes which will take the player backwards, slowing progress. This is the dispositive which will be used to examine the various risks and opportunities that are created for e-democracy as ICT is applied

in the political system. Throughout this discussion, points will be identified that could take us further forward, or stop/retard the development of civic engagement to its full potential.

If we accept the previous argument that, contrary to Plato's misgivings, it is now possible to entertain a functional democracy, then we need to identify how it can be achieved. I suggest that, with the opportunities afforded by civic technology, we can now use a progressive classification of stages that potentially lead to the creation of social capital as civic engagement [43] and a goal of a "... vigorous civil society [that] strengthens citizens' respect for the state and promotes their positive engagement with it" [13].

Each of the three stages presented here represent levels of citizen engagement in the governing process. E-government is presented as a initial stage where government increases communication to citizens through digital portals, allowing citizens to become better informed regarding government activities, request services, and monitor the activities of their representatives. e-government has the potential to embed public value for institutions, and to increase public involvement through e-comments and other forms of direct access has been [35,49]; others have confirmed the promise of websites to increase citizen engagement. [22] At this initial stage, however, the citizen remains largely a consumer of services and, while there is a potential for increase interest, knowledge, and activity, there is also a possibility of simply remaining in the position of a 'satisfied customer'. The first possibility will allow transition to the second stage of e-Engagement while the second may encourage remaining at a level where efficiency becomes the main objectives of government. The outcome may depend on the government's willingness to turn the digital platform into a two way street.

If the proffered ladder is utilized, there is the possibility of moving to the next stage of e-Engagement. In this stage, the government can expand the social capital of citizen engagement by encouraging connections that are not only with the government, but are with other interested and engaged citizens. E-Engagement occurs when the government makes the transition from a centralized management system, where it is the focus of public service and activities, to a distributed management system, which allows, even encourages, responsible decision making utilizing shared information available through the governance network. E-engagement can facilitate neighbourhood organizations or projects, connect affinity groups interested in municipal issues, and enable knowledge production that can be shared among all, including the government. The chute/ladder decision point can be conceived as a choice between increasing decentralization and an increasingly distributed network. Decentralization can maintain e-engagement in a variety of different spaces, physical or otherwise, but the chute that needs to be avoided is one that results in a disconnect between many of the actors in the entire space. For example, in neighbourhood committee government, decentralization could lead to isolation of neighbourhoods, difficulty in the sharing of information, and an inability to take advantage of synergistic activities, knowledge, and practices. On the other hand, a distributed network allows for a fluidity of centers, meaning that anyone in the network might be a decision maker or source of information, and all actors are advantaged by learned experiences. Moving towards a distributed network through e-Engagement is the ladder to e-Democracy.

In e-Democracy, citizen engagement is most effective when the social capital that has been created is based on information and knowledge regarding not only the context of governing, but the decision-making process afforded by the digital platform. Trust is based on digital democracy, rather than one decision maker – in present day, this decision-making organization would be the government. The risk to a successful e-Democracy is most palpable to those who have their raison d'etre in a permanently centralized and monolithic government structure, as this outcome would fundamentally change the function and role of traditional government.

The relationship of the three stages to efficiency and engagement is heuristically represented in Fig. 2 below, which also identified the ladders to progress, as well as the potential chutes which represent the risks of regression, In the following pages, these stages and the transitions between them will be outlined in more detail.

3. E-government

E-Government, or digital government, can be considered as the first step toward a final outcome of digitally empowered full democracy. At this beginning stage, governments use ICT to facilitate intra-government interaction, and to make service provision more efficient. Increased communication, data sharing, and cross unit analytics allow for decision optimization across units and services. More advanced ICT can assist the government in automatically

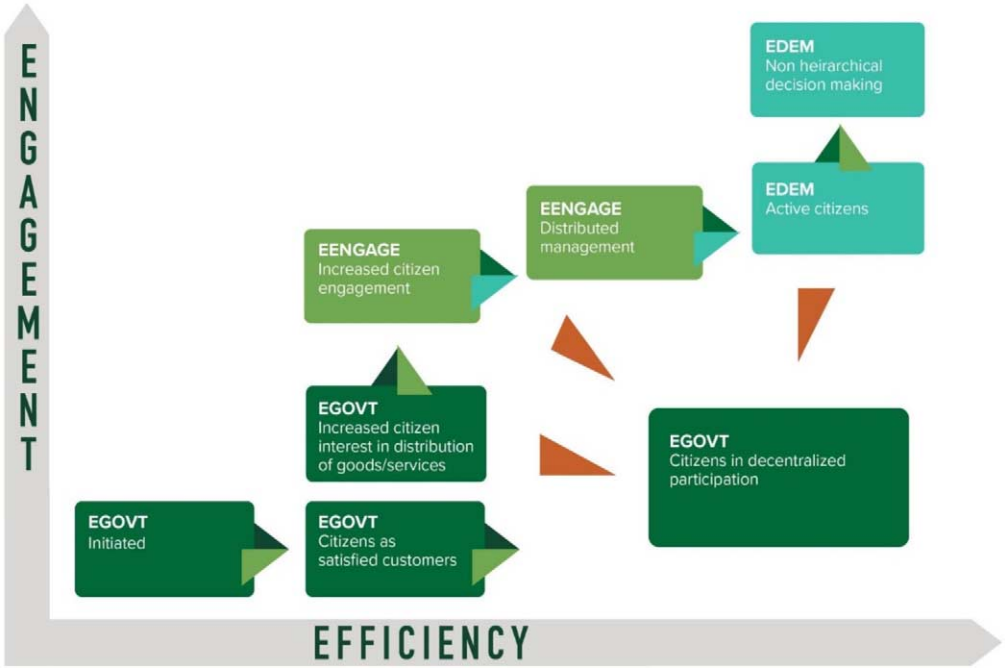

Fig. 2. Heuristic flowchart illustration of chutes and ladders in the process from e government to e democracy on an xy axis.

monitoring relations and networks, so that long term strategic changes can be made in the government structure and process.

Even though this is the most basic stage, there are a number of readiness factors that must be considered for implementation. Since 2004, the United Nations has produced an E-government Development index (originally termed the readiness index) that assesses the implementation of e-government [56]. Countries with the highest rankings on e-government include Denmark, the Republic of Korea, Estonia, Finland, Australia, Sweden, United Kingdom, New Zealand, United States, the Netherlands, Singapore, Iceland, Norway and Japan. Countries at all levels of development demonstrated improved and increased use of e-government from 2016–2020. The national assessment is based on three indices; only one, the online services index actually evaluates the national websites, data portals, and available e-services. The remaining indices assess human capital through literacy and education, and telecommunications infrastructure. The readiness of the government organizations/agencies/institutions and public officials is not evaluated.

Twum-Darko et al. [55] identify 6 infrastructure readiness factors: technological, process, legal, institutional, human, and leadership/strategic thinking. Each one of these factors is a necessary but not sufficient condition for effective e-governance as an outcome, a factor often overlooked when emphasizing only the technological infrastructure. The willingness of public officials to implement technology that might change the traditional power structure is an extremely important factor in effective e-government, as they effectively have veto power over any successful implementation. As e-government is more accepted worldwide, its advantages are especially apparent for small and/or developing countries, resulting in a growing area of research from this perspective. Although not limited to developing countries, we see more of a focus on not only the technology needed for e-government, but also the readiness of the governmental organization and citizens to implement it successfully. In Iran, readiness has been found to have a significant moderating effect on technology, governance, and citizen participation [23]. Glyptis et al. [15] add that the financial position of the country is also an important consideration.

Interestingly, most of the research in this area is being done in countries outside of the highest ranked in the UN assessment, especially in technological readiness. ICT readiness is a foundational requirement [16,23], but it is not only about the ICT infrastructure; compatibility and integration of networks within and across government units is essential [1,20]. This was evidenced during the 2020 COVID-19 pandemic in the United States, when vaccine

registration websites suffered from a lack of integration nationally, local platforms were unable to handle traffic. The same technological crisis occurred in the unemployment registration systems of many states. And, lest the reader believe that this was only occurring due to a lack of overall network capacity, it would be erroneous to assume that ICT levels are consistent throughout any country.

A possible conclusion that can be drawn from these challenges is that even though the literature [10] identifies 3 main forms of government platforms – Government to Citizen, Citizen to Government, and Citizen to Citizen- as smart cities and communities become more ubiquitous, we need to include Government to Government (G2G). This last platform, even though included in the most basic step of civic technology, has the potential to be a 'ladder' to more advanced uses of civic technology. The simplest G2G interaction can be based on an open data policy, often instituted at the national level. The European Data Portal's 2019 report on Open Data Maturity states that 74% of the EU28+ countries have a national open data policy [14]. In the United States, the Open, Public, Electronic, and Necessary (OPEN) Data Act was signed into law in 2019. Globally, the Open Data Barometer reports that of 115 countries surveyed, 79 reported having an open data portal in 2017. However, simply promulgating policy and having an open data portal does not provide any insight on questions regarding the amount, the quality, the type, or the consistency of the data that is shared. The same data shows that 53 of the countries who had participated in the ranking earlier had backslid in their open data impact. For instance, the United States removed open budget data access in 2017 [59]. The United States also illustrates the challenge of translating a national open data policy to the local level, where many of the challenges for citizen participation occur; reports of U.S. cities with open data portals stand at below 100.

The potential to use open data as a ladder to increase engagement and inclusion is currently overshadowed by the tendency for government to use open data to increase economic development more than improve service provision [34]. Buchinger et al. [8] make the important observation that interoperability is not only about the technology; they identify that stakeholders, in this case government, service providers, businesses, and citizens, must have the willingness and the commitment to achieve it. Özdal Oktay et al. [36] provide useful user-centric frameworks that identify legal challenges, community needs, and equity gaps.

E-government takes many forms, and should be considered as a process rather than a state. Siau [50] identified many of the same readiness factors over a decade ago, identifying them instead as contributing to successive developmental stages, with each stage representing a step away from simple digitization that increases efficiency and efficacy to a stage that actually transforms government service. Unsurprisingly we begin with technology; successive, more complex, stages require cultural, legal, and political elements.

New questions that require regulatory and policy supported answers emerge at these latter stages, where open data leads to questions regarding data ownership, data monetization, and privacy issues. Not all of these data questions emerge from citizens. As governments become more transparent, and government to government (G2G) relations are realized to be beneficial for efficiency and effectiveness, open governance among public officials in different government units and the creation of dynamic units depending upon community needs will require the development of clear guidelines for public-public partnerships as well as public-private. This is not to say that a single portal is needed for many government units; actually, it is becoming more apparent that the amount of data collected by governments requires a networked computer capacity to solve public challenges. Copenhagen was the first city to share and monetize data through accessible platforms. In the United States, US Ignite is partnering with Alliance for Telecommunications Industry Solutions to develop a blueprint for smart city open data exchanges. Beyond simply sharing data, solving common problems requires data management across a network. The amount of computing power to be open source is now being estimated as an exaflop (1018 floating-point operations per second), which is only achievable with networked parallel operations. Knotty public dilemmas may be able to be solved with deep learning through these new supercomputers, but cooperative data management across government units will be critical [32]. The democratization of politics can begin here, by moving beyond the open data stage, and allowing for open source platforms, where governments and citizens can collaborate to co-create initiatives that are targeted towards the specific needs of the community [21].

As governments become more willing to engage in the sharing of information through transparent data platforms with other governments and citizens, a foundation for collaboration between governments, and citizen engagement can be established. Recall that e-government must be seen as a process and not and end state. The challenge is for public servants to look upon technology as fundamentally changing the governing process, and not solely a tool to

be wielded in order to make their governing more efficient and effective. As long as that belief remains firmly in place, e-government will progress slowly, perhaps even stagnating. This is our first chute and ladder decision point.

4. E-engagement

As e-government becomes more advanced, e-engagement begins with citizen government interaction. The simplest, most passive, form is the ability of citizens to use an accessible government website for information and to obtain government services. Ideally, we can move quickly through this stage to encourage citizens to provide information to government units to increase the efficiency and effectiveness of service provision. The preferred, more advanced stage, contains an emphasis on electronic community participation in established or emerging policy processes that have specific, identified outcomes [10].

There are two challenges to successfully reaching the advanced stage: 1. The creation and sustainability of an accessible and workable open government platform (mentioned above), and 2. A diverse and widespread participation from the community.

The Open Knowledge Foundation holds that data becomes information, then becomes knowledge, and that 'open knowledge is what data becomes when it is useful, useable, and used'. The Foundation uses the Global Open Data Index to rank 94 places (most are countries) on 15 data subjects. Each data subject is assessed according to 6 measures: 1. Whether it is openly licensed, 2. In open and machine-readable format, 3. Is immediately downloadable, 4. Up to date, 5. Publicly available, and 6. Free. Place scores range from 0 to 100%. The average open data score was 37% with a standard deviation of 20, so we can see that countries/places are at a wide range of readiness for effective implementation of open data and open source platforms. This range of readiness continues within countries- the United States has a country rank of 65%, placing it in the top 15 of the global rank. However, of the 266 places in the US, the average percentage of open platforms is 53%. Algemilli [2] identifies some of the underlying reasons why open data platforms may be difficult to create and to sustain, citing a lack of technical expertise, incompatible data standards, lack of data ownership, and a lack of data processes. In the United States, these organizational deficits are exacerbated by policy incompleteness in this area.

Community participation requires not only the infrastructure to make this happen, but also a willingness on the part of the community to engage electronically. Contrary to a popular assumption, age has not been the most significant determinant of e-engagement; rather, income and education are more significant factors. Cantijoch et al. [9] found that e-engagement in the UK follows the patterns established in offline engagement; as education and income increases, participation also increases, with this behaviour predominantly manifest in males. Trust is based on a perceived sense of efficacy and, as this sense of efficacy increases we can expect that e-engagement will become a pattern of activity for all citizens rather than the actions of specific groups. This trust has a foundation in an interactive and responsive open data platform; consequently, the implementation and sustainability challenges mentioned above cannot be ignored.

Community participation as e-engagement can take place outside of the government arena, manifest in peer to peer networks (P2P), smart neighbourhoods, and microgrid communities. P2P networks are smaller decentralized networks, usually established for file sharing, such as Napster, Gnutella, and Torrent. Although sometimes included in the category, networks such as AirBnB and Uber are not true P2P since they do have a centralized distribution mechanism that allows participants to communicate. Smart neighbourhoods and microgrid communities have been promoted in a variety of settings, although most share common features such as a concern for social well-being, integrative work and living spaces, and, in some cases, an autonomous capability. All of these common concerns result in proximity-based planning.

Essentially, all three of these cooperative platforms represent a move from a technology and data driven effort that is government centered to a place that is more 'people powered'. As a simple extrapolation, we can posit that there are two directions this type of e-engagement can go: 1. Establish independent, possibly informal, networks that put participants in the driver's seat for innovation and implementation that may be a rejection of the idea that government is even necessary for the well-being of citizens, or 2. Establish networks in a parallel relationship with government to encourage and sustain a connected communities pathway that reinforces relationships between cities, either regionally, nationally, or internationally.

The first direction is a fragile outcome in terms of its capacity to provide a connected governing system. Without a solid connection to local and regional government, these networks can fragment services and community relations, increase the equity gap between citizens, and become unsustainable in the long term. Thus, although smart neighbourhoods, microgrid networks, and P2P platforms integrate their members, they do not contribute to the political or social connectivity across cities and communities. For example, in the United States, most of the smart neighbourhoods that are being developed are suburban, where 59% of the residents in 2018 were white [12].

The second direction holds more promise, but requires political will on the part of government [11]. Currently, many of these 'people powered' networks are being pursued for their economic return on investment. Local, state, and national government must realize the political potential of connecting communities within and across a G2G platform. In this way, governing can become more horizontal by allowing feedback of local communities and spatially external communities. To facilitate this potential direction, there must be a smart strategy to enable all citizens to see the value in participation, to engage in an educational process that encourages effective input, and to take responsibility for governing as citizens. As early as 2012, P2P networks were alluded to in a reference to the need to develop spatially enabled populations, suggesting that knotty problems and challenges could be crowd-sourced to a spatially enabled, technologically aware population, capitalizing on informal competences of citizens as opposed to limiting the realm of production of space or spatial knowledge to a limited team of experts." [44] The city of Chicago, in the United States, is beginning this path with the City Tech Collaborative, a non-profit organization designed to increase access and input for resident engagement. While still in early stages, the public commitment to organizing non-profit representatives for citizen input and feedback on policies is a good beginning.

In summary, to truly make e-Engagement a transformational process, we do need an advanced implementation of e-Government, and then the additional lift provided by a critical mass of engaged citizens. Issues of equity and inclusivity are most important at this juncture; if e-engagement is not democratized across all strata of citizens, it will remain a tool of only the elite, thus once again facing the threat of reinforcing existing power relationships between government and citizens. In order for e-engagement to be a ladder for increased citizen participation and governing transformation, there must be a concurrent consideration for equity.

5. E-democracy

An important step from e-engagement to e-democracy is the formal recognition that citizen input into decision making can be more than legitimizing for local government; it can flatten governing hierarchies, allow for equitable input and outcomes, and potentially reduce the equity gaps that exist in all urban environment. Additionally, as citizens become more familiar with the decision-making process, we can expect they will think of government as less of a service provider and more of a facilitator for citizens to work towards their own individual and group potential.

E-democracy is not necessarily more inclusive, however. Minorities may have even less opportunity to participate in online governance. Smith [52] found that 38% of whites were 'online civic communicators' while only 17% of Latinos and 23% of African Americans used an online platform. The impact of race on political participation is further exacerbated by access to technology, typically limited by income level [39,58]. In 2021, 65.6% of the world's population has access to the internet. Distribution of this access varies by world region, with the largest percentage of population with access is in southeast Asia. In the United States 93% of adults have access to the internet but only 77% have high speed broadband access at home. But simple access and use does not necessarily translate into transformative participation. Tsaragousianou [54] identifies three levels of digital democracy in participation – passive, instrumental, and active- yet all of these are based on quantitative levels of participation, not transformative. Each of these levels increases the efficiency and efficacy of service provision, but does not qualitatively change the relationship between a government and its citizens.

Vatikiotis [57] suggests what is needed for a transformative experience – a realization of a true democratic process – is the creation of a public space where civic engagement and common cause can flourish, even while maintaining difference. Public spaces are often created on the margins, however, and can remain in homogenous isolation rather than in a shared space of civic identity.

Early in the 20th Century, Thorstein Veblen coined the term 'technological determinism', a concept that described social and political development as determined by technological advances. While there are many considerations of the degree of determinism, technology can act as an independent change agent if allowed to be the driver of opportunities, or it can be coopted as an instrument to maintain the current order of things. This, in fact, is an underlying theme of this current survey of civic technology.

5.1. E-voting

Just as in e-engagement, there are two paths that development to e-democracy can take. The first emphasizes the objectives of efficiency and efficacy. That is, civic technology is used to enhance traditional forms of participation. The most familiar of these is the act of voting, but we should also include the use of social media and the internet as avenues to enhance our information consumption necessary for responsible voting. This type of e-democracy has been described as based on a liberal interpretation of democracy, one which is most concerned with making participation more efficient within a competitive space where voters are primarily consumers of information to make their decision [30]. Schumpeter [48] argues that "... only a highly formal kind of democracy in which citizens vote in an electoral process for the purpose of selecting competing elites is highly desirable while a conception of democracy that draws on a more ambitious conception of equality is dangerous." This instrumentalist view of democracy is then aligned with an instrumentalist view of technology.

Electronic voting maintains this instrumentalist view, even while making the process potentially more efficient. The National Democratic institute estimates that 31 countries have investigated the use of Electronic Voting Machines (EVMs) in elections; these machines vary in type, ranging from paper based electronic voting systems, to direct recording electronic recording machines, to public networked voting machines. The Institute for Democracy and Electoral Assistance reports in 2021 that of 178 countries surveyed, only 12 utilize internet-based voting systems. Perhaps the most well-known example of internet voting and practical e-democracy is in Estonia, where I-voting has existed since 2005, and 95% of public services can be obtained online.

Usage of EVMs has resulted in mixed results regarding security and cost, but the most important point here is that there has been no consistent evidence that it has increased access or participation. A recent study of voters in Switzerland concluded that any influence e voting had on citizens was limited to specific demographics, some of which maintained the traditional inequities of representation that already existed [40]. In Estonia, online voting, in and of itself, did not immediately result in greater civic engagement [24].

As an alternative, within a technology enhanced environment, the liberal democratic theory manifests as digital democracy, described as "... the use of information and communication technology (ICT) and computer-mediated communication (CMC) in all kinds of media (e.g. the internet, interactive broadcasting and digital telephony) for purposes of enhancing political democracy or the participation of citizens in democratic communication." [16] If we accept this view of democracy, then the most important task is to improve the perceived and real efficacy of representation, especially in the voting process. A number of countries have instituted electronic voting schemes, ranging from voting machines to internet voting, to blockchain.

In modern times, transformative democratic spaces that contain deliberative democracy, liquid democracy, and absolute democracy can only be accomplished effectively through an advanced technology platform. All three of these types of democracy require a space that can accommodate both a huge number of participants and interactions that not only vary in directionality but also in agency. Only deliberative democracy is able to be accommodated within our traditional representative democracies; the outcome rests on majority rule, but is preceded by a requirement of open and mappable discourse. It also opens the door for affective democracy where access to social media and the internet can build movements and campaigns by analyzing responses using methods such as social network analysis, social sentiment analysis, scraping, and text analysis [6]. Yet, it is still only possible within smaller communities and not scalable without sophisticated ICT.

Both absolute and liquid democracy effectively remove the need for a static representative structure, originally established due to the inability to effectively manage direct democracy with large numbers of participants. Liquid democracy is a dynamic mix of direct and delegated participation, potentially removing the need for mediation by a government institution, leading some to suggest that it could be an entirely new, transformative, type of democracy

[37,38]. Liquid democracy works with a blockchain structure which provides a transparent and accountable decision process that self-tallies the votes and the delegation or un-delegation of representatives. Sun et al., [53] define blockchain as "... a distributed, transparent and append-only database technology which incorporates the mechanisms for achieving consensus over data in a large decentralised network of agents who do not trust each other." Recent work on LiquidFeedback Blockchain offers a structure that enables consensus-based decision making rather than the competitive form in a non-trusting environment. Based on swarm optimization models, LiquidFeedback allows for the increase and decrease of trust and influence of nodes (potentially more power to a delegate node), and will result in an eventual consensus [7].

In summary, e-democracy has the potential not only to increase effective and inclusive participation through various technological mechanisms, it is on the cusp of actually transforming the entire democratic process. In the following section, we will examine decentralized governing founded on liquid democracy and blockchain, and provide a theoretical foundation understanding the implications for political and social systems.

6. Decentralized governing – technology as transformation

Following the theme of this survey, the implications of blockchain can take two distinct paths – the technology can be understood as instrumental and only supportive of an existing political and social order, or it can be considered as generative of entirely new and radically different ways of political and social decision making. As should be evident at this point, we hold that technology has the potential to be a non-neutral agent in political and social development, creating new spaces that have implications of blockchain voting outside of access and efficiency. Indeed, Husain et al. [19] refreshingly suggest that "blockchain projects personify 'prefigurative politics' by design, offering a typology of blockchain imaginaries – crypto-libertarians, crypto-commonists, crypto-institutionalists, and crypto-collaborativists." A possibility worth investigating in future research is that, in addition to blockchain schemes being purposefully designed to create an imaginary, there might exist a capacity in blockchain to create an imaginary as a byproduct of individual components in the chain. Rational nodes in blockchains perform actions or strategies that aim to maximize their own utility. Consensus nodes/mechanisms, such as proof-of stake, exist to create and propose new blocks or to validate another. Once a certain number of validations are accumulated, a new block can be created potentially being added to the fixed block. Extending this, is it possible that while maximizing their own utility they are developing a type of swarm mentality that is optimizing the whole? We will investigate this further on in this discussion as we introduce Hardt and Negri's position that in a multitude, individual actors are connected but are not necessarily part of a homogenized group consciousness.

Blockchain governance is based on individual rationality and strategies that are affected by the strategies of others. Algorithmic structure of blockchain makes it difficult to disrupt the chain, since the more interventions occur, the longer and complex the chain, thus the more difficult to disrupt. And even though there is individual competition, there is also an algorithmic structure, the Nakomoto consensus, that uses proof-of-work to reward honesty. Li et al. [27,28] present a blockchain system, Conflux, that has even more potential to prefigure a decentralized, discursive, and agile voting system. In Conflux,

> "... the total orders of the transactions is decided by all participants of the network instead of a confined group. Additionally, Conflux is able to tolerate to half of the network are malicious while the BFT-based approaches can only tolerate up to one third of malicious nodes. Second, the above approaches enforce the total order eagerly as the members of the confined group fully verify and commit the transactions before moving on to the next ones. Conflux, however, allows multiple blocks generating in parallel and finalizes their orders later." (p. 13)

While Li et al. [28] do not make the application specifically to voting, it is suggested that this advancement (with the primary goal of increasing throughput in the chain) has implications for the democratic voting process. Allowing multiple blocks to generate initially encourages minority or alternative opinions in a voting process. The input of all participants in ordering removes the requirement that a particular group (extended here to a political elite) will have the ability to order the agenda and highlight preferred options. Finally, the resilience of the system to malicious transactions make the process more resistant to political manipulation. A quick note to compare this system to the one that currently exists, demonstrates that the flat and complete participation platform described by Plato, thought

to be impossible, can be recreated with technology and challenges our existing democratic processes that sustain a politics of influence that is easy to manipulate and non-transparent.

The Tezos blockchain adds another important attribute to blockchain voting-allowing voters to amend the blockchain or, in the suggested case, the voting process. There are four active periods in the amendment process: 1. The proposal period where voters can propose alternative processes, 2. The exploration period where voters decide on whether a process should be pursued, 3. The promotion period, where voters make a final decision on an alternative process, and 4. The adoption period, switching to the new process. The Tezos blockchain was used in 2020 in Verneuil-sur-Seine, France to decide on a road planning project.

7. Discussion and conclusion

This paper began with a presentation of Plato's version of democracy, suggesting that modernity had resulted in a society that could not support his 'pure' version. Forced to adapt direct democracy to a representative democracy, we gave up on the idea that large populations could be directly and importantly engaged in decision making. Throughout the paper, however, we have pointed to ways in which technology could be used to maintain representative democracy, but could also transform civic engagement (a term that includes but is not limited to, voting) into a direct democracy platform that could meaningfully engage all citizens. There are many facets to civic engagement-citizens as consumers, citizens as consumers, citizens as creators, or citizens as decision makers [5].

Yet, perspectives require foundations, groundings in theoretical arguments that are not inductively formulated around empirical evidence. Bearing this in mind, this section introduces an interpretation of Hardt and Negri [17,18] that can be used to conceptually envision the transformative impacts of technology on democracy.

Hardt and Negri set the stage by describing 'Empire' as a global social order that creates and maintains an apparatus of rule by regulating all human interactions. In a specific application of this assumption to representative democratic systems, biopolitics is a 'strategic relationship' that seeks to coordinate and manage the exercise of power between the system and its constituents [25]. Levine [26] summarizes the evolution of modern voting in the United States as consisting of three stages, all of which manage increased participation by a system of control: 1. the 19th century where voting was primarily symbolic, indicating party loyalty, 2. The Progressive Era, increasing individuation of power, making representation more amenable to manipulation, and 3. Post-Watergate, introducing science and statistics into the vote getting process. Each stage represents an increased distancing from direct, empowered participation to one that is creating the strategic relationship necessary in biopolitics alluded to by Hardt and Negri.

Hardt and Negri [17] offer a philosophical solution that relies on the individual becoming self-aware enough to move from habit to performance, and using performance to create an individual identity through action [6]. Retaining an individual identity, and not being subsumed by the frameworks of organizations, groups, or governments, allows a distinct and non-manipulated decision-making process to exists. This is not anarchy to Hardt and Negri, as it allows for the emergence of a commons, produced by communication, collaboration and consensus. The interest of the common is managed democratically, creating a 'plurality of singularities'.

The consistent and very appropriate criticism of their analysis has been that it lacked a substantive solution to the problem. It is only with the advent of technology such as blockchain that we can see a practical implementation of what Hardt and Negri suggest. One example of this is liquid democracy, a dynamic combination of representative and direct democracy. As a concept, liquid democracy is not new, with origins running back to the late 19th century. However, only recently has technological innovation made it feasible. Simply, this system provides the potential for individuals to create groups, delegate group power to individuals, and to temporarily band together on issues. Most importantly, it allows individuals to change groups, remove power from individuals and transfer it to others, or to themselves. Using this fluid selection model of representation, individuals can transfer their own preferences as they see their internal values mirrored by delegates [33]. This is the plurality of singularities suggested by Hardt and Negri.

Another example of how this can be achieved is provided by Rochet and Belemlih [45] who build on the generative emergence model suggested by Lichenstein [29] to illustrate how bottom-up organizational systems can

encourage dynamic innovation, even while allowing for the emergence of a 'social order'. Collaborative and cooperative platforms can be framed within algorithms that encourage the attainment of both local and global optima, even while avoiding the stagnation of an elite consensus. The work on particle swarm optimization and its application to group decision making will be very helpful in the software development that encourages generative emergence [42].

The transformative question that is suggested here, and indeed throughout this discussion on civic technology and its effect on civic engagement and government overall is this: If it can create the common, then why do we need a government to protect a 'general interest'? The barriers to direct and transactional democracy have been removed by ICT [4]. Political Parties, whose main purpose was to represent the aggregate general interest of a particular group of people, are not necessary. The State moves from organizing and thus controlling decisions for the people, to one that facilitates people organizing and making their own decisions. This last possibility does not require the disappearance, or even the reduction of the state role; technology that is designed to include, improve, and engage citizens will require that the state change its function to one that is more of an enabler, a coordinator, and a platform for collaboration and coproduction [31]. Rodriguez Müeller [46] in a thorough investigation of coproduction within ICT technology, identifies the risks in such a platform as including a widening of the equity gap, an unwillingness to redistribute power dynamically, and a lack of commitment to long term public values.

Some will find this conclusion disturbing, and destabilizing. Indeed, there are many 'chutes' that we have identified throughout that can effectively limit the possibilities of this outcome. And, it is possible that a middle road can be found between the complete qualitative change of governmental function and citizen participation and our existing order of things. Yet, it is probably naïve to believe that technology is truly neutral in its development or utilization, and there will ultimately be a value discussion that needs to be had as to whether we want a system that is simply enhanced and made more effective by technology, or one that is transformed.

Conflict of interest

None to report.

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