Communication

The Use of E-Tools to Engage Citizens in Urban Green Infrastructure Governance: Where Do We Stand and Where Are We Going?

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Abstract: In the unfolding reality of advanced internet-based communication tools, the possibilities and implications for citizens' e-engagement is revealing. The paper introduces different examples of e-tools used in participatory urban green infrastructure governance. E-tools here includes various location-based service apps, and volunteered geographic information stemming from social media activities, as well as public participation geographic information system approaches. Through an analytical framework describing five categories, we discuss the different scopes and possibilities, as well as general barriers and problems to participatory e-tools. We suggest some basic premises for the application of e-tools in urban green infrastructure governance and discussed future development of this field. E-tools can allow interaction between citizens, public authorities, and other stakeholders; however, research on the implications of such location-based governance is needed to make full use of the rapid on-going development of such information and communication technologies, and to avoid possible pitfalls. We suggest that future research into this area of environmental–social–technical solutions should test, discuss, and develop frameworks and standards, for the use of different e-tools in combination with offline approaches.

Keywords: e-tools; e-governance; volunteered geographic information; public participation geographic information system; ICT; location-based services

1. Introduction

Digital tools, or e-tools as we call them here, are increasingly being used in urban green infrastructure (UGI) planning and governance. Examples of this trend include e-tools focused on public participation and co-creation, such as public participatory geographic information system (GIS) launched by cities to create forums to communicate and share information. For example, forums that are focused on urban forests in Philadelphia and San Francisco, USA [1] and also in Melbourne, Australia [2]. Such e-tools show the potential to support place-based knowledge exchange, communication 'anywhere, anytime', empowerment of citizens, and informed planning and governance. When citizens have a greater say about their local environments in planning and policy-making, this can eventually lead to citizen stewardship, which is important both for the quality of urban green infrastructure (UGI) and for human well-being [3–5]. This short communication presents critical understandings of the role of e-tools in UGI governance and what this trend holds in positive and negative aspects. We suggest that several aspects of using e-tools are relevant for participatory UGI governance, whilst we also highlight effects that can be counterproductive.

1.1. Urban Green Infrastructure Governance

It is well documented that urban green infrastructure and the ecosystem services and benefits it provides are of crucial importance to well-functioning cities [4,6–8]. The condition and development of UGI is complex and dependent on many factors, such as social, ecological, economic, and climate-related. The UGI derived ecosystem functions provide multiple services and benefits to human well-being, including clean air and water, food, and space for recreation [9], but also functions that are harmful to human well-being, so called ecosystem disservices, such as pests, litter, and deterioration of grey infrastructure [10].

Ecological dynamics are connected to social-cultural and governance dynamics, as people not only use but also take part in the creation and maintenance of UGI. To support UGI, the need of involving and relying on active citizens has been highlighted. This should help to secure UGI and the associated benefits, such as social cohesion and biodiversity [3,11]. Such thinking is linked to a social-ecological systems approach [3], where the city is understood as a multi-layered system of managed ecosystems, economic activities, human use, and sense-making. Hence, a UGI approach has focus on the urban landscape and on the processes that govern its development.

There is a tendency that the role of municipalities moves from being providers of green services to citizens, to creating value together with citizens [12–14]. The roles of government actors, such as planners, management staff, and decision makers are changing, which is often described as a shift from government to governance, and as moving from leading to enabling [15]. The level of actor's actual influence can however differ substantially, for example, from restricted influence, to communities and individuals creating value from UGI bottom-up without formal involvement [12,16,17]. These varying levels of actors' influence may bring more or less participation into governance, which we elaborate on in the discussion related to the potentials and limitations of e-tools.

At the core of contemporary UGI governance research is a social–ecological approach, which highlights the importance of relations and interactions between citizens and other stakeholders and urban nature to secure, promote, and develop ecological connectivity, biophysical quality, social cohesion, and multifunctionality [7,18]. Hence, drawing strengths from citizen's interaction and supporting citizens in positive activities and initiatives are highlighted as important ingredients in UGI governance [13,19,20]. UGI governance is characterized by unique contextualized situations due to different ecological, physical, political, and social contexts, and there is no simple 'one-size fits all' governance solution. The research concepts of place-based governance [21,22], mosaic governance [23], and biocultural diversity [20] are examples that emphasize the importance of understanding and implementing cultural aspects in UGI governance, because of the presumed linkages between civic value, perception, and use, and the effects of these on UGI quality. The UGI 'reality' of today can be described as mosaic landscapes, both concerning the biophysical and the cultural aspects. Both research and policy have stressed the importance of engaging citizens in their local environment. This can create a sense of ownership and enhance the use of green spaces [3,9].

There is a need to support new types of governance concerned with cross scale collaborations, including active citizens and tailor-made governance approaches [7,23,24]. The emergence of new forms of data may be crucial in understanding human–nature interactions in cities and is therefore of importance to UGI governance [25].

1.2. The Potential of E-Tools in an UGI Governance Perspective

The recent development and adaption of web technologies are changing the way people interact both human–to–human, but also with the surrounding environment. Citizens use information and communication technology (ICT), such as websites and (social media) apps for mobile phones to be 'sensors of their environment' and deliver volunteered geographic information (VGI), as described by Sui & Goodchild (2011). For example, this is also integrated in the Smart City concept [5]. There seems to be a growing need from a policy and planning view, but there are also possibilities for governance, to include community preferences and to engage citizens in the creation and development

of urban natural resources through the use of e-tools [26–30]. E-tools can seemingly facilitate new forms of knowledge sharing and communication [31–33], as they can be used to gather detailed place-based information, citizens and expert knowledge, and facilitate dialogue between varieties of stakeholders [5,34–38].

There are differences in how e-tools are used for information sharing and/or knowledge communication. E-tools can range from supporting crowdsourcing or VGI, where people report observations (for example birdlife) in their local area; to supporting more extended observations that include peoples' perceptions, values, opinions, visions, engagement, etc. [39,40]. Hence, citizens can act as 'sensors' of their environment on different levels of detail [41]. Furthermore, e-tools can operate on different scales, from micro to macro or local to global, and thereby potentially support local to global governance [26,42]. Examples of this scale flexibility include studies focused on social media derived volunteered geographic information which is used to monitor visitation, attractiveness, and environmental justice aspects of UGI from a single green space [43], to city-wide urban green infrastructures [44,45], to global quantification of nature-based tourism and recreation [46].

The potentials of making use of e-tools in governance are also reflected in recent policy agendas and endorsed by important international organizations, including the United Nations, The European Union, as well as in practice, for example, in the Obama Administrations' Open Data Policy. The New Urban Agenda (UN 10 October 2016) addresses e-governance and urge countries to create, promote, and enhance open, user-friendly, and participatory data platforms by using technological tools to transfer and share knowledge among relevant stakeholders, including non-state actors. The UN e-Government 2016 [47] survey also encouraged collaboration via e-tools to enable people to play a more active role in the design and production of public services. The European eGovernment Action Plan 2016–2020 [48] advocates for collaborative and participatory governance and continued commitment to use digital technologies, for open and consistent dialogue between the public and decision-makers.

1.3. Categorisation of E-Tools in UGI Governance

Simply defined, e-governance is technologically mediated communication, coordination, and interaction in governance processes [49]. E-tools are not governance solutions in themselves but are to be perceived as tools to facilitate more or less participatory and collaborative governance. Informational content is the initial stage in any form of e-governance tool. Researchers consider e-governance as evolving through various stages from simply posting information to utilization of websites for citizen participation and collaboration [33,50–53]. Different stages of e-governance can be expressed in a spectrum, where e-tools are roughly categorized due to differences in their functioning as knowledge mediators (Figure 1). If a tool is 'leading' it is one-directional in its communication, whereas if a tool is 'enabling' it allows more collaboration and participation via its communication possibilities. Finally, if an e-tool 'enables', it can empower citizens, groups and entities, and even nature itself (see the 'Terra0' example below), to co-governance and self-governance.
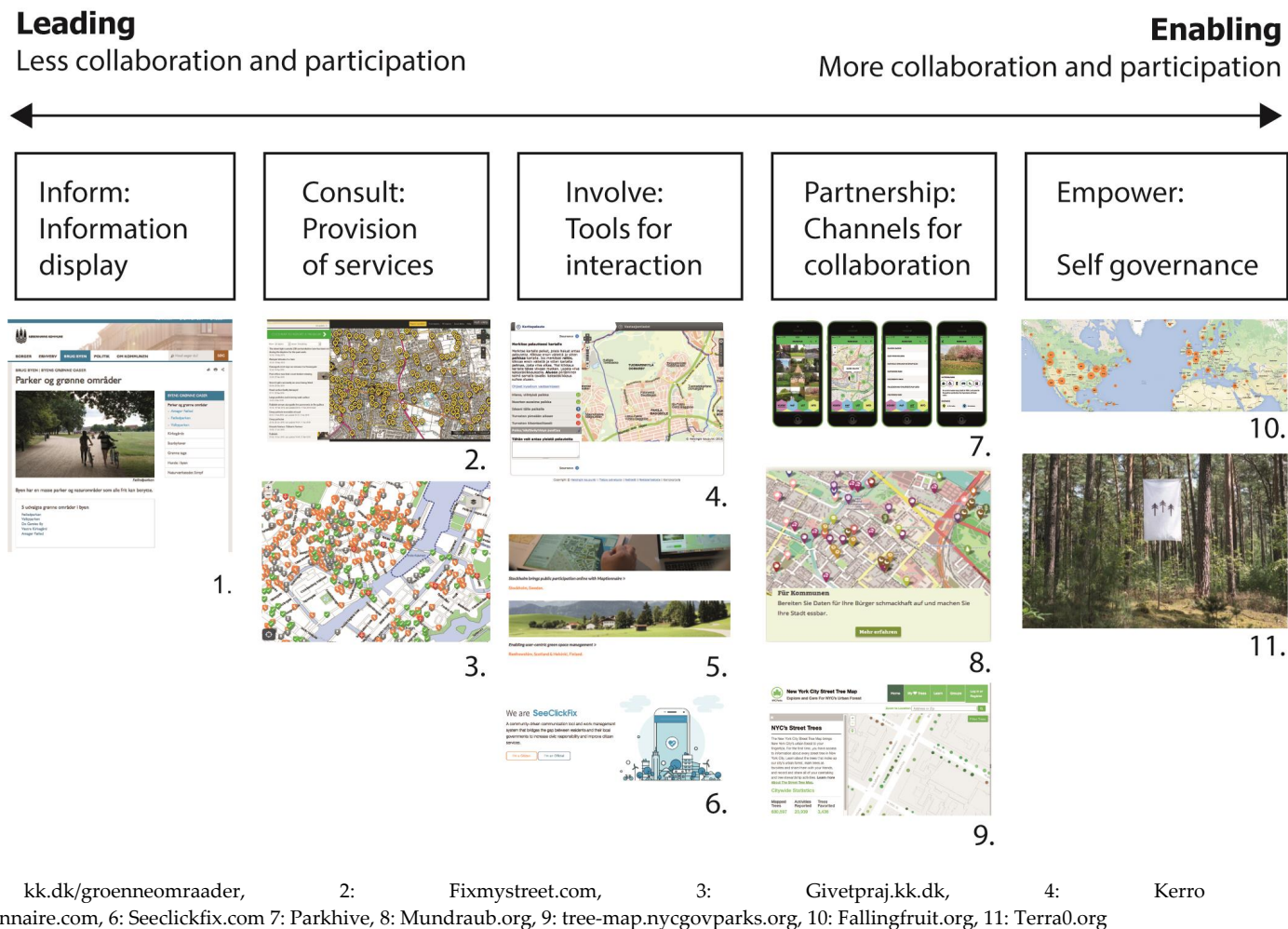
Leading
Less collaboration and participation

Enabling
More collaboration and participation

| Inform: Information display | Consult: Provision of services | Involve: Tools for interaction | Partnership: Channels for collaboration | Empower: Self governance |

1: kk.dk/groenneomraader, 2: Fixmystreet.com, 3: Givetpraj.kk.dk, 4: Kerro kartalla.hel.fi, 5: Maptionnaire.com, 6: Seeclickfix.com 7: Parkhive, 8: Mundraub.org, 9: tree-map.nycgovparks.org, 10: Fallingfruit.org, 11: Terra0.org

Figure 1. Categorization of e-tools from leading to enabling. (The categorization is based on Arnstein's ladder of participation (1969) and supplemented by the categorization in Sandoval-Almazan & Gil-Garcia (2012) and Falco & Kleinhans (2018). Please note that the tools as they are presented in this paper are as they were registered online in January 2018. The examples may change content and even scope over time, since tools are often changed and further developed during use and over time. We therefore cannot guarantee that they will look or work in exactly the same way as presented in Figure 1 in the future.)

Examples in Figure 1 include both publicly and privately developed e-tools. On the left side of the e-governance spectrum, example 1 shows an e-tool for information display and information retrieval. Example 1 is a municipal webpage with information on urban parks. E-tools belonging to the first category 'Inform', are basically used to share information and do not appeal to further communication or interaction online. Moving to the right, in the category 'Consult' (Examples 2 and 3), users share information to gain services such as maintenance. For example, 'fixMyStreet' and 'GivEtPraj' ('*give a hint*') are e-tools where users report problems they observe in public areas, such as lack of inventory or damages on roads, street trees, etc. This information is used by authorities to correct problems that are reported by citizens. Such e-tools are currently used in many European cities. In the 'Involve' category (Examples 4, 5 and 6), e-tools serve to facilitate communication and interaction between citizens, place, and in some cases public actors, such as municipal departments or scientific entities. In the category of 'Partnerships' (Examples 7, 8, 9) shared information is used in collaborative governance approaches, which support and help to shape partnerships and promote activities in UGI. Examples of this category share the communalities of inviting citizens to engage in community groups and to act in collaborative ways. To the far right in the spectrum, the 'Empower' category (Examples 10 and 11) include e-tools that facilitate initiatives that may operate independently from municipal or governmental initiatives. As a perhaps extreme example of an e-tool to empower self-governance, is the 'Terra0' project from 2016, where a piece of forest owns and manages itself via modern technologies. The forest 'Terra0' is capable of self-ownership due to Blockchain technology that creates automated processes and smart contracts, whereby the forest can sell licenses to log wood and in this manner earn money and be able to expand itself through the purchase of more forestland. Another example is FallingFruit.org, where users gather fruits and other food from local resources, based on location indications from other users, without intervention from any authorities.

It is important to emphasize that e-tools can operate within different categories at the same time, for example a tool can be used for both interaction and for self-empowerment. An example of this is bottom-up type are e-tools for urban foraging (harvest of edible plants). Examples of e-tools for foraging show different degrees of interaction, collaboration, and empowerment, depending on the outreach of the organizers and users to, for example, public planners or other relevant public persons or government bodies.

2. Potentials and Limitations to Democratic UGI E-Governance

When looking at e-governance from a Western democracy point of view, it is important to ensure basic democratic values, for instance, legitimacy, data-quality, and trust [27,54]. Even though e-tools are often proclaimed to be easy to use because of the 'anywhere/anytime' participation possibilities, it is important to ensure that e-tools are in fact inclusive and support democratic decision-making. This depends on their participatory set-up, as well as on their moderation [28]. Online avenues for participation can reinforce and sometimes exacerbate the existing social inequalities in offline participation, for example, by marginalizing people from lower socioeconomic groups [55].

In the unfolding context of VGI and citizen science, many questions still remain open among others about data security and data quality, [27,54] and precision of data, such as upload errors. Apart from this, socially related questions, such as longevity of engagement, incentives, and motivations of volunteers and socio-demographic information (ethnic, socio-economic and age aspects), also need in-depth analysis to shed light on how data is produced, used, and disseminated by citizens and other stakeholders [56,57]. There also remains a lack of understanding of how to engage communities and individuals in collaborative processes, including what circumstances may foster engagement. This is linked to, for example, which areas or subjects receive attention and funding and are perceived as valuable while others are not [57,58]. These aspects also relate to power issues, inclusion, monitoring, organizational practices, and cultural influences, which are important issues for further critical studies [57]. Finally, attention should be brought to the fact that data generated from e-tools is often a snapshot of time and place. Therefore, there is a need to understand how information changes

over time. If continuous sharing occurs (as for example in OpenStreetMap or social media sharing), the information and dataset as a whole is dynamic and ever changing [57], providing opportunities for dynamic analyses of changes over time in amount and type of data shared, such as changes in visitors shared posts and images over a year [59,60]. These matters highlight important issues for research communities, to make full use of the capacity of e-tools in UGI governance.

3. Integrating E-Tools in UGI Governance

UGI components, as well as citizens that use them are diverse, so ways of engaging must be diverse too [61]. Both citizens and planners might need training to be able to generate accurate data and be able to handle processes and implement results into UGI governance [11,62]. A way forward might be to mix data from different sources [63], and nurse cross-disciplinary approaches. Such approaches might help to ensure that e-tools accommodate different situations and users, and also helping to discover possibilities of e-tools to support sustainable transition [64,65]. We argue for the importance of data analysis to shed light on the applicability of the data and for future research to provide frameworks for e-governance, which alongside ensuring democratic standards and scientific requirements, will also ensure place-specific ecological considerations, thereby ensuring the best possible basis for e-tools to succeed as efficient tools in participatory UGI governance.

It is important that data derived from e-tools are treated carefully and democratically. If civic generated input is not properly integrated in participatory processes for which they were intended for, it can lead to negative scenarios for participation [28,66]. The use of e-tools to generate civic place-based knowledge should complement traditional ways of data collection, knowledge generation, and participation [67], and not stand as sole solutions to participatory practices [36]. E-governance approaches should be combined with offline meetings and activities to ensure representativeness, and to support social interaction between stakeholders, as well as to enforce links to UGI [28]. At the same time, e-governance should be combined with other digital approaches in data-mashups and mixed data [67,68]. In UGI governance, it is important that landscape and biological needs are central parts of the process, as are social needs and values [36]. However, this depends on resource allocation and supportive political and research frameworks. At the same time, it relies on the research community to engage and on scientists to be connective actors across places, scales, and sectors [7].

4. Conclusions and Future Research

UGI is a key to social and ecological sustainability. The future of UGI is dependent on human behavior and how humans prioritize it. There is a need for shared efforts from a variety of stakeholders to preserve and develop urban natural resources. Seemingly, e-tools can act as facilitators for communication, sharing, and gathering of information and knowledge generation, with relevance for UGI governance. At the same time, key governance issues such as security, legitimacy, and democratic rules are challenged by the openness and insecurity, which comes with novel and not yet fully developed or tested e-governance approaches. Today's urban realities are diverse, multicultural, and complex. Data derives from different places and is generated by different users in different and unique (governance) situations.

E-governance is an on-going process that requires consistent and persistent effort from a variety of stakeholders, as the possibilities of using e-tools are constantly developing.

UGI governance is complex and changing with the dynamics of multicultural urban realities. It is important to continuously test and discuss how to better process, interpret, and use data from e-tools. Therefore, we recommend mixing multiple data sources, as well as combining online and offline approaches.

E-governance is not to be perceived as replacing more traditional governance approaches, but rather as expanding the overall toolbox for participatory/mosaic governance. E-tools can facilitate communication about place-based aspects, such as biological and social qualities, experiences and values, but also critical aspects, such as dividing opinions on perceived beneficial or harmful wellbeing

effects of UGI ecosystem functions. E-governance should seek to harness the potentials of both modern technologies and important social and place related aspects, to ensure informed decisions. Research should suggest frameworks to include key issues of nature development and conservation and ensure standards for inclusive participation. Researchers should act as mediators between UGI, citizens, and (local) government, and strive to create opportunities for developing visions of what sustainable UGI futures would look like with aid from e-tools.

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