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Abstract	<p>The way that we describe and understand cities is radically transforming—just like the tools we use for designing and implementing them. The change is often seen only as a technological aspect, for example, in the concept of smart cities. Smart cities are believed to provide societies with a higher quality of life thanks to modern technologies. However, there is also a human factor that is needed to make these changes go smoothly: acceptance. For many, change and innovation cause fear and disrupt everyday habits. Public participation is crucial both for understanding citizens' needs and for adopting new programs. The ability</p>	

to try, engage, or entertain with new technologies will move innovation from the abstract level to the level of understanding. A smart city can be a living laboratory that tests new technologies and services where citizens and urban communities are active actors in the process. Innovation can be used by the city to improve its services, mutual communication, and engage citizens in its activities and projects, co-creating urban space and city strategy through new participatory tools. Trends in European cities show that the use of modern digital technologies and interactive tools can be used to involve citizens in urban decision-making processes, e.g., when creating or revitalizing public spaces. Modern participatory technologies that enable citizens to explore, analyze, design, and evaluate spatial information on the basis of shared and open data that bring new challenges and new opportunities to cities, as well as for citizens. Our knowledge of the use of these new technologies, however, is still narrow and limited today. In the following research, the authors intend to explore the potential of digital technologies for community engagement in the decision-making process in smart cities by examining the specific settings upon which social innovation builds. We discuss the potential of digital participation for community development and propose good-practice examples for facilitating the process of adopting and integrating digital technologies within such settings. Rather than conclusions, some final reflections are proposed, based on how digital technologies can play a crucial role in involving new groups of people, empowering citizens and building new relationships at the local level.

Keywords
(separated by '-')

Innovation - Digital tools - Decision making - Smart cities

Digital Technologies for Community Engagement in Decision-Making and Planning Process



Antonella Galassi, Lucia Petříková, and Micaela Scacchi

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 22 nologies for community engagement in the decision-making process in smart cities
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31 1 Introduction

32 The boom in the field of information and communication technologies (ICTs) has
33 fundamentally affected the development of societies and the way they interact. The
34 2030 Agenda for Sustainable Development (United Nations 2015) and the Sustain-
35 able Development Goals (SDGs) (Griggs et al. 2013) support the concept of ICTs
36 as the potential means to advance knowledge societies and ameliorate the digital
37 divide—a gap between people with effective access to digital and information tech-
38 nology and those with poor access (Fleming et al. 2018). Governments, policymakers,
39 and city authorities, as well as citizens, realize the power of ICTs and digital engage-
40 ment as the way to improve communication between various urban stakeholders and
41 public institutions and improve public service-delivery capacities. Digital engage-
42 ment can play a vital role in building more effective, inclusive and accessible institu-
43 tions to support policy-making and service delivery for the SDGs to all people and,
44 at the same time, build public trust and ensure transparency, participation and collab-
45 oration in the planning process. A well-fitted participation process may prevent later
46 dissatisfaction and better meet citizens' expectations. Even if public consultations
47 are not mandatory, the process usually includes some type of public meetings or
48 hearings. However, most of citizens do not attend such meetings for various reasons
49 (inconvenient time, location, unfamiliar subject, technical language, etc.). Addition-
50 ally, public meetings typically held at city halls are not very popular among generation
51 Y¹ (MacKinnon 2008; Sloam 2012). To address these limitations, we explore the use
52 of two digital technologies, *CvikerAr* and *InViTo*, interactive engagement tools that
53 help citizens better understand various urban development projects and enable them
54 to express their opinions through digital platforms. This paper shares lessons from
55 our research² into some of the pioneering innovations in digital engagement that are
56 taking place across Europe and beyond.

¹The publication *Advertising Age—Ad Age* was one of the first to coin the term “Generation Y” also known as “Millennials,” generally refers to the generation of people born between the early 1980s and 1990s to early 2000s as ending birth years (*Advertising Age—Ad Age*, 30 August 1993, p. 16).

²Common research topics among our departments and especially part of the process of doctoral thesis of PhD student Lucia Petříková.

2 Method

In the context of the rapid advancement in technologies relevant to community engagement, this paper attempts to explore the relationship between new ICTs and participation, by examining the role played by specific kinds of digital participatory tools, CvikerAr and InViTo, to engage wider community in the planning process. In this regard, the research into community engagement in decision-making and planning process is in the spotlight when we talk about smart cities, yet little research has been carried out in the area of digital-supported community participation. Addressing this gap, we study best practice on the use of digital technologies in communities to reveal the significance of digital participation for community-led development in smart cities and the role of communities in decision-making processes. We explore the role of interactive tools, as the digital engagement—‘connectedness’ in the technical sense; and as opportunities for their effective use by various communities in cities—‘connectedness’ in the social sense.³ A summary of individual cases will be discussed.

3 Digital Tools for Community Engagement

The era of digitalization brings new forms of civic participation. The success of a community to deal with challenges that contemporary cities face is predicated by its community members feeling a sense of belonging and place attachment. “The highly profiled identification with the living space and deeply articulated place attachments” implies the rebirth of the civic sense and belonging, a desire for identity and participation (Jaššo and Petříková 2016). The new generation Y is more attentive and active, with predominant bottom-up movements of social, political, environmental, community interest. Community participation has moved from traditional approaches (such as town hall meetings, opinion polls, etc.) (Glass 1979) to more active and engaging approaches such as e-participation⁴ (Macintosh 2004), supported using ICTs. To help address very complex urban challenges, public and private sectors have begun developing tools that use technology to make participation more informed, transparent, and relevant to citizens’ daily lives. Modern ICTs enable citizens to create, share content, and participate in planning processes using a wide range of digital tools. Such tools can make easier for people to share their views with large groups of people, support greater education, enhance connections between institutions and citizens or small communities, give input to decision-making, connect like-minded

³People with “Connectedness” find meaning, purpose, and deeper relationships. They often feel personal responsibility to the connections they make, actively participating. A structural connectedness is based on the idea that policy and community engagement are made within a context of a network of actors and institutions.

⁴E-participation is the term referring to ICT-supported participation in processes involved in government and governance.

90 people to work with on a common goal and raise attention or money (Bolívar and
 91 Muñoz 2018). Modern community tools build up techniques that have been already
 92 used to engage communities (such as workshops, meetings, etc.); however, they are
 93 not meant to replace them, but rather to complement them. One of the main aspects
 94 of e-participation is to motivate and engage citizens in the decision-making process,
 95 promoting the following advantages: enabling broad participation; adjusting a range
 96 of tools to citizens' varied technical and communication abilities; providing rele-
 97 vant and up-to-date information to citizens to make more informed decisions and
 98 deliberation; and enabling analyzing data provided by citizens (Vito 2018).

99 3.1 Digital Social Innovation

100 Digital technologies are especially well fitted for civic action: from mobilizing
 101 various communities and sharing resources to spreading capabilities. Some of these
 102 are particularly aimed to deal with social challenges. These are, for example, online
 103 platforms for citizen participation in policymaking or new development projects or
 104 open data to promote better transparency around public spending (Kuriyan et al.
 105 2011). This is what we call digital social innovation (DSI). DSI is defined as:

106 a type of social and collaborative innovation in which innovators, users, and communities
 107 collaborate using digital technologies to co-create knowledge and solutions for a wide range
 108 of social needs and at a scale and speed that was unimaginable before the rise of the Internet.
 109 (Bria et al. 2015)

110 Particularly when the level of public participation increases, the tools become
 111 more interactive to foster ever advancing complex discussions. For example, tools
 112 based on *open knowledge*⁵ refer to online platforms through which diverse groups of
 113 citizens can collectively create, analyze various scopes of issues, or crowdfund social
 114 projects. Popular types of digital social innovation include participatory platforms
 115 that enable citizens to crowd-map local problems (e.g., unsafe areas, broken roads,
 116 polluted zones, etc.), e-petitioning, e-budgeting, e-governance, and the like, while
 117 impacting local communities or the wider society. Another interesting example is the
 118 *open ministry* concept (also known as crowdsourcing legislation) that enables citizens
 119 to co-write and grant citizen-led policy proposals, e.g., this concept is implemented
 120 in Finland (Finnish Citizens Initiative Act 2012). Tools based on *open data*⁶ refer to
 121 innovative ways to open, capture, use, analyze, and interpret data. This approach has
 122 been successfully tried and tested in the city of Vienna, Austria, which has set up
 123 over 160 databases to cover issues from budgeting to planning information (Homeier
 124 et al. 2019). This led to development of more than 109 open database apps for the city
 125 and its citizens. Similarly, the city of Barcelona created an open-data digital tool to

⁵Open knowledge is free to use, reuse, and redistribute without legal, social or technological restrictions.

⁶Open data are freely available to everyone to use and republish, without restrictions from copyright, patents, or other mechanisms of control.

126 keep citizens informed on processes and to receive their input, which has eventually
127 become a global initiative (Peña-López 2017). The city of Bologna established the
128 so-called “Office of Civic Imagination” with a specific purpose to advance greater
129 participation by creation of “engagement laboratories” throughout the city and the use
130 of interactive digital tools (d’Alena et al. 2018). It works as a customizable platform
131 for communication between city planners and various communities. Some of those
132 communities have later created their own tools, e.g., *YouthScore*, where youngsters
133 rate their neighborhoods based on their youth-friendliness. We can assume that these
134 examples present a promising trajectory toward more inclusive participation with a
135 potential to engage various different stakeholders and enable people to build positive
136 attitudes toward the places where they live, work, or study. The main idea is to allow
137 communities to easily influence decisions that may impact them and where decision-
138 making process becomes more reactive to community input. The premise is that, the
139 more people feel empowered to shape their communities, the more they will partic-
140 ipate—and the more they participate, the more inclusive decision-making process
141 will be toward the community voice, with aspiration to motivate more community
142 members to participate.

143 3.2 Good Practice

144 As previous examples showed, there are many ways by which interactive tools, along
145 with traditional approaches, can advance civic participation. Based on the outcome
146 of a collaboration between the Slovak University of Technology and the Slovak
147 Smart City Cluster,⁷ we chose *CvikerAr* tool as an example of a local best practice of
148 innovative technology for improving transparency in planning and decision-making
149 processes by enabling community members to better understand specific situations
150 and encourage more collective decisions ahead of individual interests. *InViTo*, the
151 second tool that we present was generated during the LUMAT⁸ project in which the
152 authors participated based on its positive outcomes in multiple case studies (Coppola
153 et al. 2014). This tool is conceived as a toolbox for a visual analysis, exploration,
154 and communication of spatial and non-spatial data to support policy and decision
155 making. These tools are based on the open-data concept with a focus on the visual-
156 ization of spatial data. A visual interface there is used as a new criterion to display
157 both positive and negative impacts on territories while respecting the complexity of
158 multiple stakeholders’ choices. The interactive form enables users to analyze data
159 themselves. Comparing various scenarios and modifying different features of the
160 subject supports discussion of specific issues related to the community. The tools
161 have shown to be effective, especially when evaluating various planning scenarios.

⁷Slovak Smart City Cluster is an association integrating representatives of business sector, public administration, academic environment, and technology innovators.

⁸LUMAT Project—Interreg Central Europe Programme 2019—Implementation of Sustainable Land Use in Integrated Environmental Management of Functional Urban Areas.



Fig. 1 Illustration of the use of CvikerAr to engage communities in the planning process. *Source* www.cvikerar.com (the illustration elaborated by the authors)

3.2.1 CvikerAr, Poprad, Slovakia

In 2016, the Municipality of Poprad, among other cities in Slovakia, adopted the first smart-development strategy with the aim to provide better services to its citizens and improve the quality of life in the urban environment by introducing smart solutions supported by modern technologies. This has caused the city to be ranked among the European Smart Municipalities.⁹ In addition, the strategy covers topics of smart economy and smart governance. The city runs a pilot initiative in the development of digital technologies for community engagement in the planning process with the mobile app CvikerAr that enables visualizing the real world through 3D modeling in virtual reality. Thanks to its virtual feature, it makes it possible for citizens to view any proposal in its realistic environment before their realization. For example, people can visualize how new building plans or areas will look, how they will affect the urban fabric of the city or choose between different scenarios. This interactive tool, at first, will be tried and tested in a revitalization process for current brownfields (a former area of military barracks) located in the city. So far, the tool has been used in minor projects, e.g., for a proposal for a new pedestrian bridge connecting two residential neighborhoods (see Fig. 1) which allowed various stakeholders and residential communities to engage in the planning process. It enabled citizens to actively participate in decision-making process from the beginning, see different drafts in a “real” picture, analyze, and comment, as well as actively co-design.

3.2.2 InViTo, Torino, Italy

The second example of an interactive tool InViTo is an acronym for *Interactive Visualization Tool*. InViTo has been classified within the category of spatial decision-support system (sDSS) as a Web-based GIS tool (Geographic Information System). It was developed to deal with various spatial issues and disciplines with the aim of sharing the spatial information to visualize urban effects in real time and to improve the territorial decision-making process in general (Pensa and Masala 2014). The main purpose of the tool is to help people build their spatial knowledge by interacting with dynamic maps. Similarly to CvikerAr, it is able to display the relationship between an area and a proposed intervention in real time. Having been designed to encourage

⁹https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en [accessed October 19, 2019].



Fig. 2 Illustration of the use of the interactive map in the InViTo platform during a stakeholders' workshop. *Source* www.urbantoolbox.it (the illustration elaborated by the authors)

192 discussion among different actors, e.g., urban planners, stakeholders, non-experts,
 193 focus groups, and urban communities, it enables the exchange of knowledge in
 194 collaborative and participative activities. At the same time, it allows a full interac-
 195 tion between users and the information. For example, citizens can share a map of
 196 their neighborhood with access to local information and, by clicking on the map,
 197 see further details with the possibility to leave a notice (e.g., comment, complaint,
 198 suggestion, etc.). Moreover, it allows citizens to choose an area and receive statisti-
 199 cal data associated with the chosen locality. Citizens can access, edit, or save their
 200 maps and open them later. It is flexible to use for various applications, purposes,
 201 and scales, with the possibility to actively manage and modify data (variables) and
 202 create dynamic scenarios. Because of this, it can showcase areas of interest and create
 203 immediate outputs. The outcomes can be presented in various forms according to the
 204 user expertise and used together with other community planning instruments, during
 205 collaborative working activities, meetings, and workshops (LUMAT Project 2018)
 206 (Fig. 2).

207 4 Results

208 It is clear that all spatial decisions involve a number of different actors, opin-
 209 ions, and interests, and we consider data communication as fundamental to achieve
 210 common agreement. With the boom in ICTs in the field of territorial development,
 211 the vast amount of complex information is not easily understandable through simple
 212 reasoning anymore. Based on the original study of Tang and Waters (2005) and the
 213 research carried out under the LUMAT project, we elaborated a new table on the
 214 effectiveness of different participation techniques, having evaluated them according
 215 the selected criteria—* poor; ** fair; *** good; **** outstanding (see Table 1).
 216 The table shows comparisons between the traditional and new approaches to citizen
 217 engagement in participatory planning practice.

218 Traditional methods of participation in the planning process (such as question-
 219 naires, surveys, public meetings and public hearings) have shown to be relatively
 220 demanding in terms of time and money necessary for their collection. As we can see
 221 from the table, some traditional techniques prove to be more successful than others,
 222 particularly workshops and contacts in communities. Others, i.e., public hearings
 223 and questionnaires, seem to work less successfully. On the other hand, the field of
 224 new participation techniques has been widely introducing a new range of interactive

Table 1 Evaluation of the effectiveness of selected participation techniques

	Participation technique	Providing information	Receiving information	Interaction with communities	Giving assurance to communities	Broad cross-section of opinions	Communication
Traditional	Public hearings, meetings	***	*	*	**	*	one-way
	Workshops, focus groups	****	****	****	**	***	two-way
	Presentations to clubs and groups	***	**	**	**		one-way
	Contacts with people in community	****	****	****	****		two-way
Up to date	Questionnaires, surveys	*/**	****	*	*	***	one-way
	E-participation (e.g., online opinion surveys, e-budgeting)	***	***	***	***	***	one-way
	Digital participatory tools (e.g., CvikerAr, InVito, sDSS)	****	****	****	****	***	two-way

225 tools for citizen involvement. Among the new techniques, digital participatory tools
226 appear to be most effective in various aspects. The right-hand column shows the
227 level of communication. This level involves two dimensions—one-way communi-
228 cation flow and two-way communication flow. As we can see, the one-way commu-
229 nication in e-participation (without the possibility for interaction) may eventually
230 suffer a communication barrier, in comparison with digital participatory tools that
231 provides the space for immediate feedback. The one-way-oriented approach does
232 not allow such a degree of interaction and feedback on both sides. We assume that
233 modern decision-support tools, such as InViTo and CvikerAr presented in this paper,
234 are emerging as promising tools for solving complex urban issues, collaborative
235 participatory planning and effective spatial analysis in territorial decision-making
236 processes. Based on the outcomes of the research, these tools have proved to be
237 able to make very complex information more comprehensible even to people who
238 are not familiar with the technology by combining interactive maps with pictures
239 and text information in a user-friendly visual interface. They can provide better
240 interaction and mutual feedback, while encompassing a broad space for opinions,
241 exchange of ideas and discussion. The basic knowledge of urban dynamics is essen-
242 tial for addressing specific community-related issues. We believe that the better is
243 the knowledge in the planning process, the higher is the chance of community to
244 make better decisions. Communities may have a better chance to actively influence
245 issues that directly concern them with and come up with new social innovations.

246 5 Discussion

247 Of the many different technologies that support participatory approaches to commu-
248 nity engagement in decision making, modern participatory technologies are gaining
249 increased attention as a means of fostering more inclusive planning process. There are
250 many good-practice examples of the successful application of digital participatory
251 tools in urban communities; some are used to monitor a local quality of environment
252 (quality of air, water contamination, dangerous pollutants); others use smart mapping
253 based on local knowledge and information to reveal ‘critical’ areas where people do
254 not feel safe, or suffer a lack of greenery, and spaces for new cycling routes, etc. There
255 are, however, challenges that digital engagement will need to address in the future.
256 In particular, this includes how to define a better understanding of what we mean by
257 “participation,” more flexible communication at the institutional level (open gover-
258 nance) and how to tackle the digital divide. As an important factor, we recognize the
259 digital education at the level of communities with the emphasis on underrepresented
260 groups, e.g., elderly people, the poor, minorities, etc., as well as the diversity and
261 inclusion in the development and testing of new participatory techniques. We can
262 assume that the demand for more participatory and more inclusive ways in decision
263 making will continue to grow, either from city authorities, urban planners or citizens,
264 and the technology will advance to bring more inclusive, cheaper, and easier ways
265 to provide a greater participation and more transparency.

6 Conclusion

This paper provides an overview to help understand its wide scope of activities and the new emerging techniques. Rather than draw a conclusion, we wish to end with some reflections on the role that technological innovation can have in the decision-making process. Lessons from international case studies show that digital tools are being used to engage communities in more meaningful participation, while they are improving the quality and validity of decision making. Experimentations with implementation at the local level have shown that digital technologies can play a crucial role in engaging new groups of people, empowering citizens and building new relationships between cities and local communities, as well as local governments and citizens. As the meaning of community engagement is particularly relevant at the local level, local governments have begun initiating platforms to enable citizens to contribute with their ideas and local knowledge, evaluate priorities, and influence allocation of public resources. In this sense, the community is to be considered both actor and beneficiary. We assume that the biggest concern when using such tools is to overcome the citizens' lack of familiarity with digital technology. This is particularly important in territories with no or little experience in this field. Also, it is important to emphasize that the traditional participation techniques should not be forgotten, simply because even the modern digital methods are not a cure-all for all community-related issues. The 'smart' techniques should be integrated simultaneously with the traditional ones. Eventually, the digital engagement in the field of citizen participation is a multispectral concept that brings a set of challenges for modern cities that will require yet deeper research in the future.

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Change to italics	— under matter to be changed	↵
Change to capitals	≡ under matter to be changed	≡
Change to small capitals	≡ under matter to be changed	≡
Change to bold type	~ under matter to be changed	~
Change to bold italic	≈ under matter to be changed	≈
Change to lower case	Encircle matter to be changed	≡
Change italic to upright type	(As above)	⊕
Change bold to non-bold type	(As above)	⊖
Insert 'superior' character	/ through character or ∧ where required	Υ or Υ under character e.g. Υ or Υ
Insert 'inferior' character	(As above)	∧ over character e.g. ∧
Insert full stop	(As above)	⊙
Insert comma	(As above)	,
Insert single quotation marks	(As above)	ʹ or ʸ and/or ʹ or ʸ
Insert double quotation marks	(As above)	“ or ” and/or ” or ”
Insert hyphen	(As above)	⊞
Start new paragraph	┌	┌
No new paragraph	┐	┐
Transpose	└┘	└┘
Close up	linking ○ characters	Ⓞ
Insert or substitute space between characters or words	/ through character or ∧ where required	Υ
Reduce space between characters or words		↑