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Digital Participatory Planning Tools: Enhancing Public Participation and Data Privacy Challenge

A Case Study Exploring Digital Participatory Planning Tools' Potential to Enhance Public Participation and the Disruption of the Data Privacy Challenge

Abstract

Participatory planning is one of the latest directions of the urban planning field, beginning in the second half of the twentieth century. Participatory planning back then used old fashion methods such as paper survey. Lately, with the internet and information and communication technologies, urban planners have started using digital participatory planning tools for their potential in the participatory urban planning process and participatory urban planning's overall goals.

However, these potentials are not addressed in a definite way in the literature. Urban planners consider the literature on these tools as limited and urge more in-depth research. At the same time, urban planners have expressed a series of serious data privacy concerns in digital participatory planning tools.

Consequently, this research eventually developed through a case study methodology. In which it explored digital participatory planning tools in three directions. Firstly, the research will emphasize the potential of digital participatory planning tools for enhancing public participation with quantitative evidence from the Tuscany region of Italy. Secondly, the research will explore the effects of data privacy challenges in digital participatory planning tools by surveying international experts using a questionnaire

instrument. Thirdly, the research will suggest a potential solution for the data privacy challenge with evidence from the experiment of the Swiss city of Zug.

The research concludes with recommendations for designing future digital participatory planning tools. The future of digital participatory planning tools could be promising after solving this challenge. They can be upgraded significantly in a way that opens up wide advancement toward effective urban planning.

ACKNOWLEDGEMENT

I would like to thank the Italian republic, the region of Tuscany, the city of Florence and the University of Florence headed by the magnificent rector Prof. Luigi Dei for their kind hospitality during my doctorate studies.

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Research Question

How to overcome data privacy challenge disruption for digital participatory planning tools' potential to enhance public participation?

Research Sub-Questions

Question 1: Could enhancing public participation be one of the potentials of digital participatory planning tools?

Question 2: How do data privacy challenges affect digital participatory planning tools' potential to enhance public participation?

Question 3: Could blockchain technology be a potential solution for data privacy challenges in digital participatory planning tools?

Methodology

A case study methodology was followed, focusing on contemporary events and the solutions presented. The case study depends on both qualitative and quantitative data coming from several types of evidence such as documents, interviews and a questionnaire survey. The quantitative evidence comes from the PartecipaToscana tool in the Tuscany region of Italy. The qualitative evidences come from both the Digital Participatory Planning Tools questionnaire results. While, the uPort experiment in the Swiss city of Zug provides both quantitative and qualitative data.

Results of the Research

The research results stress that digital participatory planning tools have the potential to enhance public participation. The data privacy challenge is disrupting this potential by lowering the participation rate. Blockchain technology is a potential solution to the data privacy challenge in digital participatory planning tools.

Structure of the Dissertation

This dissertation is written according to the American Psychological Association (APA) format which is used for social sciences. The writing process follows the instructions of Dunleavy (2003) on academic authoring and organizing the dissertation.

The first three chapters provide the theoretical framework of the research. They place the research in the literature. Therefore, they build the argument of the research and introduce the research sub-questions. Then comes the methodology chapter, Chapter IV, which demonstrates the structure of the subsequent chapters on data collection and analysis. Both Chapter V and Chapter VI consist of three main sections to serve answering the three sub-questions of the research. The conclusion is based on the data collected analysis and it will provide some recommendations.

The research follows the appropriate academic structure before introducing the argument of the research, because it is not appropriate to introduce the data privacy challenge right away while some researchers are still not aware of digital participatory planning tools' potential in the first place. This is why there are three introductory chapters.

Purpose of the Study

This research has several purposes. Its first purpose is to conduct more research on digital participatory planning tools due to the limited literature that exists. Secondly, the research emphasizes on the potentials of Digital Participatory Planning Tools, the potential to enhance public participation in specific. Thirdly, it examines the data privacy challenge in digital participatory planning tools and suggests a solution for the issue. Furthermore, this research recommends two state-of-the-art digital participatory planning tools as role models for the other tools. Finally, the study ends with recommendations for designing future digital participatory planning tools.

Significance of the Study

The research as a whole, with its case study, is one of a countable number of researches in the field of digital participatory planning tools. Addressing the data privacy challenge in detail in digital participatory planning tools is a completely novel research. The evidences of the research are totally authentic. The Swiss experiment was undertaken recently and its final report came out at the end of 2018. Finally, the recommendations for designing future digital participatory planning tools are practical and ready for execution in reality.

CHAPTER I

DIGITAL PARTICIPATORY PLANNING TOOLS

Participatory urban planning requires methods and tools for implementation. These tools need a way to reach citizens, inform them about the discussed plan, and collect their participation feedback afterward. Tools have varied through history from traditional meetings, paper surveys and newspapers to the use of TV and radio. But after the development of the internet, digital tools have begun to be used by urban planners to serve their participation goals. These tools depend on information and communication technologies (ICTs), which refer to technologies that provide access to information through telecommunications such as the Internet, wireless networks, cell phones, and other communication mediums. This chapter will define and categorize digital participatory planning tools and explore their three main categories.

1.1. The Definition of Digital Participatory Planning Tools

Digital participatory planning tools can build a bridge between residents and urban planners, allowing citizens to communicate and exchange ideas, raise debates, suggest solutions, and participate with their local knowledge. Consequently, digital participatory planning tools allow urban planners to collect local knowledge and participation data to analyze statistically and systematically in the urban planning process.

The term digital participatory planning tool can be broken up into digital tool and participatory planning, following the logic of the book *Digital tools in participatory planning* (Wallin, Horelli, & Saad-Sulonen, 2010). The definition of digital participatory planning tool consists of two parts.

The first part of the definition is technology-based, focusing primarily on what a digital tool is. It is an online platform, or website, or mobile application that uses the internet and depends mostly on information and communication technologies (ICTs). It allows computers and other electronic equipment and systems to collect, store, use, and send data electronically. There are three main processes in these tools: data collection, data mapping, and data analysis.

The second part of the definition is participation-based, focusing on levels of participation. Each tool has a certain level of participation which allows a certain type of communication and has a certain kind of effect on the decision-making process. There are three main levels of participation, though some urban planners believe there are more than three (Table 1). For a more in-depth definition, there is a need to categorize digital participatory planning tools and explore the categories.

1.2 The Categories of Digital Participatory Planning Tool

In order to define the categories of digital participatory planning tool, a categorization of these tools is needed. There is no single categorization of digital participatory planning tools, since the research community lacks consensus on the core concepts of digital activities (Horelli & Wallin, 2010). For this reason, this research had to come up with dimensions to categorize these tools. There are other dimensions to categorize digital participatory planning tools beside the technological features and level of participation. These dimensions are the organization, the implementation, and the management of participatory processes (Afzalan, Sanchez, & Evans-Cowley, 2017).

The categorization Table 1 was also made according to the logic of the book *Digital tools in participatory planning* (Wallin, Horelli, & Saad-Sulonen, 2010) which affirm, technological features allow certain kind of communication, which allow a certain level of participation.

Table 1 was made following two steps; the first was collecting all the dimensions that could categorize digital participatory planning tools, such as communication and decision-making. The second step was matching these dimensions levels to each other's, after going into the details of each dimension. For instance, Table 2 is one of the dimensions details. Each of these dimensions has a column and they are coming from different sources.

Each column categorizes a different aspect of the tools, but each one is based on the previous one, starting with technological features and ending with the level of citizen-government relationship. For instance, the technological features allow certain kind of communication, and so on. But before defining each category of digital participatory planning tools, an explanation of some of the columns in Table 1 is required. It should be noted that this table is not strictly fixed: there could be some exceptions with some tools, which do not follow the exact categorization.

Table 1. Categorization of digital participatory planning tools

	Technological features	**Communication**	**Stage of participation** (Arnstein, 1969)		**Level of e-participation** (United Nations, 2018)	**Decision-making**	**Organization** (Afzalan & Muller, 2018)	**Levels of citizen-government relationship** (Falco & Kleinhans, 2018)	**Tools Categories**
Level of participation	Visualizations, analytics, documents, images, and videos.	One-way communication	Degree of tokenism	Informing	e-Information	Does not affect decision-making	Planner-led	Information-sharing	**Informative tools**
	Comments, opinions, discussions, submitting ideas, surveys, interactional maps, geo-tagged photos, GPS tracking, and sensing.	Two-way communication		Consultation	e-Consultation	Could affect decision-making		Interaction	**Interactive tools**
				Placation				Co-production	
	Voting tools, polls, rating, and reporting		Degree of citizen power	Partnership	e-Decision-making	Affects decision-making	Participant-led	Self-organization	**Self-organized tools**
				Delegated Power					
				Citizen Control					
	Categorization direction →								

Source: Own elaboration

The stage of participation. Citizen participation stages and levels come from the root model, which is the eight-rung ladder of citizens' participation designed by Arnstein (1969). This model is still quite relevant to participation today. The ladder consists of three main stages: nonparticipation, degree of tokenism, and degree of citizen power. These stages reflect the different levels of participation. Digital participatory planning tools skip the first stage and start from the degree of tokenism stage. This stage contains three rungs: informing, consultation, and placation; it allows citizens to hear and be heard, but without any further power to implement their participation on reality. The degree of citizen power stage also contains three rungs: partnership, delegated power, and citizen control. This stage starts with enabling negotiation and engagement and ends with full power in the decision-making process.

e-Participation. This is defined "as the process of engaging citizens through ICTs in policy, decision-making, and service design and delivery so as to make it participatory, inclusive, and deliberative" (UNDESA, 2013). The United Nations (2018) e-government survey measures e-participation through the e-Participation Index (EPI). This index consists of the e-information level of participation, which is the availability of online information; e-consultation, which is online public consultations; and e-decision-making, which is directly involving citizens in decision-making processes.

Organization. The organization category comes from Afzalan and Muller (2018), who identify two types of tool under the organization category: participant-led tools and planner-led tools. Participant-led tools are self-organized online communities; these were designed for various purposes that may be unrelated to urban planning. Planner-led tools are technologies such as websites or applications specifically designed for participatory urban planning purposes.

Levels of citizen-government relationship. These levels are defined by Falco and Kleinhans (2018) in one of the most recent categorizations for digital participatory planning tools and are explained in the table below.

Table 2. Levels of citizen-government relationship

Levels	Sub-Levels
Information-sharing	Informing: One-way communication ('broadcasting') from government to citizens.
	Consulting: One-way communication from citizens to governments.
Interaction	Two-way communication with dialogue and feedback between citizens and government representatives.
Co-production	The public sector and citizens making better use of each other's assets and resources to achieve better outcomes and improved efficiency.
Self-organization	Public matters: Citizens create solutions independently that are to be recognized, facilitated, or adopted by governments and require some government action.
	Private matters: Citizens share information and self-organize for matters of private interest that may develop into public demands requiring some government action.

Source: (Falco & Kleinhans, 2018, p.56)

The output of Table 1 indicated three main lines which produced the three main categories of digital participatory planning tools. Also, Table 1 determined these categories definitions as well. Based on Table 1, there are three main categories of digital participatory planning tool (Figure 1).

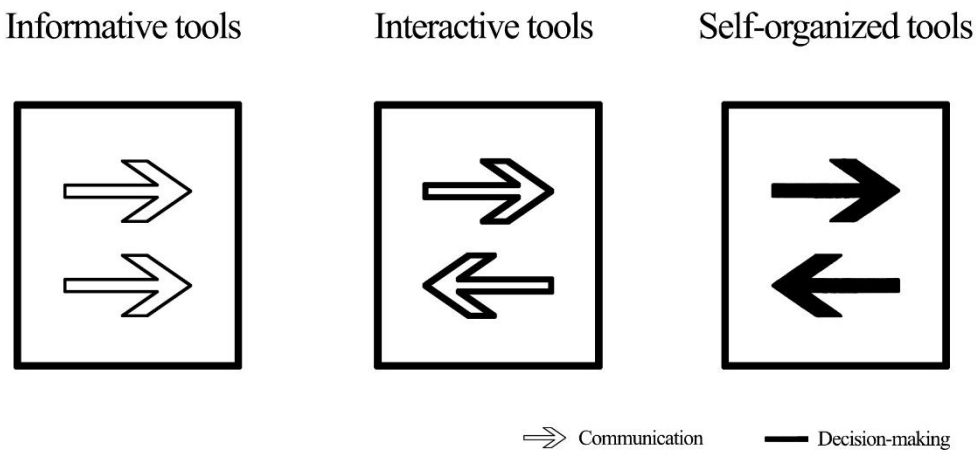

Figure 1. Tool categories
Source: Own design based on Table 1

Informative tools. The main technological features for this category are visualizations, analytics, documents, images, and videos. These technological features allow one-way communication, which means these tools are listed under the degree of tokenism stage of participation (Arnstein, 1969) and under e-information, which is the first level of e-participation. e-Information enables participation by providing citizens with public information and access to information, upon demand or without (United Nations, 2018). Based on the previous categorization and features, the participation of this category of tools does not affect the decision-making process. In term of organization, informative tools are planner-led tools (Afzalan & Muller, 2018). Finally, they are listed under the information-sharing level of citizen-government relationship (Falco & Kleinhans, 2018). MySidewalk is an example of the Informative Tools.

MySidewalk. is a city intelligence tool designed to help local government analysts get data out of silos and into operational, strategic, and policy decisions (Figure 2). Its mission is to empower city leaders and public with the most complete, clear, and real-time understanding of their communities, so they can improve and innovate together. Its features are spatial data collection, interactive maps, visualization, instant storytelling, custom reports, data dashboards, charts & graphs, geospatial analysis, correlations, comparisons, trends and projections.

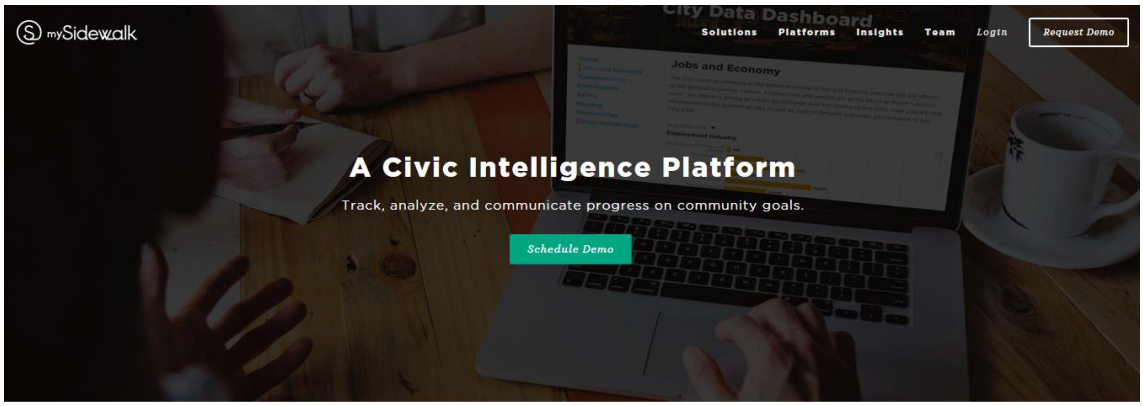

Figure 2. mySidewalk platform interface
Source: www.mysidewalk.com

Interactive tools. The main technological features for this category are comments, opinions, discussions, submitting ideas, surveys, questionnaires, interactional maps, geo-tagged photos, GPS tracking, and sensing. These technological features allow two-way communication, which means that these tools are also listed under the degree of tokenism stage of participation (Arnstein, 1969), and under the second level of e-participation, which is e-consultation. e-Consultation allows citizens to be engaged in contributions to and deliberation on public policies and services (United Nations, 2018). Based on the previous categorization and features, the participation of this category of tools could affect the decision-making process. In terms of organization, interactive tools are also planner-led tools (Afzalan & Muller, 2018). Finally, they have two levels of citizen-government relationship, interaction and co-production (Falco & Kleinhans, 2018). MindMixer is an example of the Interactive Tools.

MindMixer. is a powerful online engagement platform which helps different types of organizations to initiate conversations with people who care about their communities (Figure 3). Its mission is to build better communities by involving people in the things they care about. It helps in starting a conversation that energize community and empower more people to take part in the process of shaping its future. Its features are idea submission, map-based idea submission, survey, instant poll, photo share and challenge.

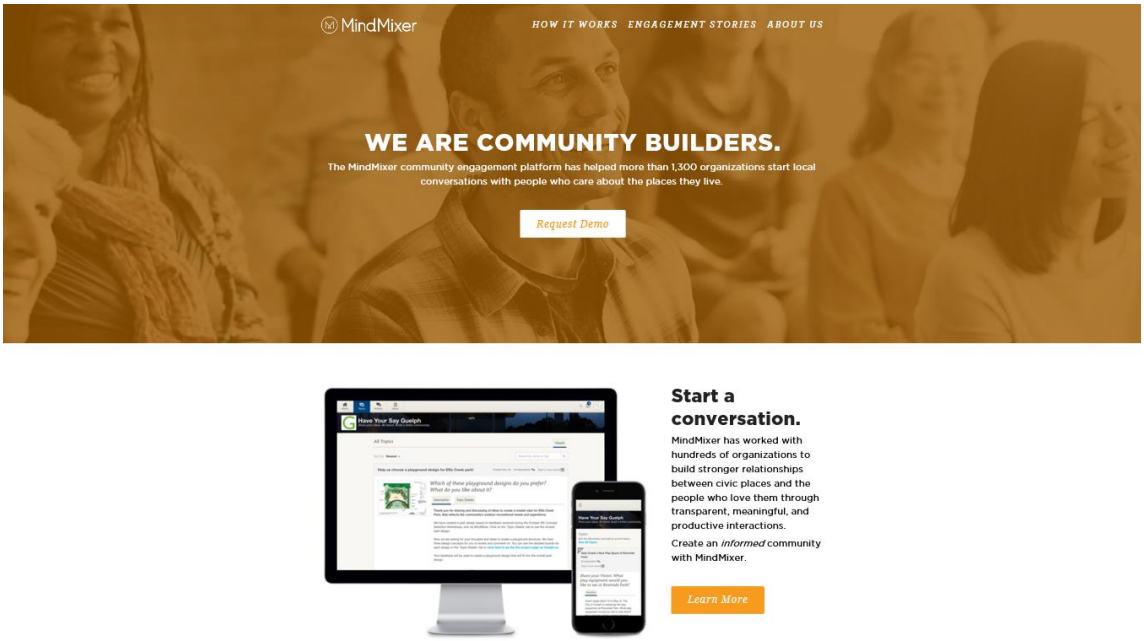

Figure 3. MindMixer platform interface
Source: www.mindmixer.com

Self-organized tools. Along with the same technological features as interactive tools, self-organized tools offer valid and effective voting tools, polls, rating, and reporting features to allow proper self-organization. These technological features allow two-way communication, so these tools are listed under the degree of citizen power stage of participation (Arnstein, 1969) and under the third level of e-participation, which is e-decision-making. e-Decision-making is about empowering citizens through the co-design of policy options and co-production of service

components and delivery modalities (United Nations, E2018). Based on the previous categorization and features, the participation of this category of tools does affect the decision-making process. In term of organization, self-organized tools are participant-led tools (Afzalan & Muller, 2018). Finally, their level of citizen-government relationship is self-organization (Falco & Kleinhans, 2018). Nextdoor is an example of the Self-Organized Tools.

Nextdoor. is a private social network for your neighborhood. When neighbors start talking, good things happen (Figure 4). Its mission is to bring back a sense of community to your neighborhood, by providing a hub for trusted connections and the exchange of helpful information, goods, and services. Its features are chat, forums, maps and photo share.

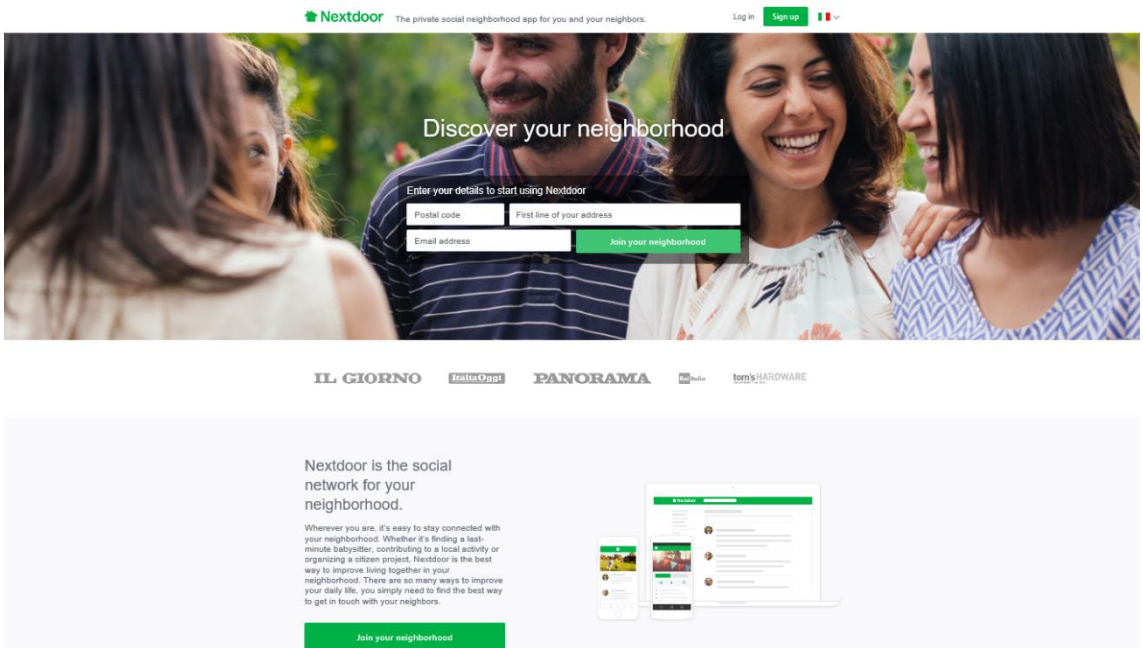

Figure 4. Nextdoor platform interface
Source*:* www.nextdoor.com

To conclude, digital participatory planning tools are internet-based platforms that allow e-participation. There are three main categories of digital participatory planning tools: informative tools, interactive tools, and self-organized tools. Each of these categories of tools allows a certain level of participation according to their technological features. This definition of digital participatory planning tools was needed for understanding what this research is discussing, and for reporting academically the two additional tools that this research will introduce as models. These tools are PartecipaToscana and uPort. They will support the argument of the research with their unique evidences.

CHAPTER II

POTENTIALS OF DIGITAL PARTICIPATORY PLANNING TOOLS

Enhancing public participation is one of digital participatory planning tools' benefits in terms of the overall goals of participatory urban planning. In order to explore this benefit, there is a need to uncover the benefits of digital participatory planning tools in the first place. There are two main categories of these benefits: benefits for the participatory urban planning process and benefits for participatory urban planning's overall goals. Indeed, they overlap, which is why they will be discussed together.

2.1 The Benefits of Digital Participatory Planning Tools

Discussing digital participatory planning tools' benefits is necessary to build the argument of the research and to introduce the potential of digital participatory planning tools for enhancing public participation. For this reason, the chapter starts with the benefits of digital participatory planning tools (Table 3). The table was developed following the logic of theoretical and literal replication of case study findings (Yin, 1994). The locations of the case studies vary around the world, including Australia, Austria, Brazil, Bulgaria, Finland, Italy, Spain, the United Kingdom, and the United States of America. It should be noted that some of the literatures mentioned in the table comprises case studies, while some of the others do not comprise any.

Table 3. The benefits of digital participatory planning tools

Benefits	Literature	Literature overview
Collect local knowledge	Afzalan and Muller (2018);	Theoretical study of online participatory technologies: opportunities and challenges for enriching participatory planning.
	Halttunen, Juustila, and Nuojua (2010);	Article based on the extermination of two tools in Finland: a mobile phone application Tell a Story (TaS), and a web mapping application WebMapMedia.
	Kahila and Kyttä (2009);	Theoretical study of the SoftGIS method as a Bridge-builder in Collaborative Urban Planning. This method is explained in Figure 2.
	Rantanen and Kahila (2009);	SoftGIS is a multidisciplinary approach where different Internet- and GIS-based methods are developed to gather and process local knowledge. The case of Jarvenpaa and the case of the Forum of Espoon keskus in Finland.
	Saad-Sulonen and Horelli (2010);	A Case-Study in Helsinki, Finland to address the value of community informatics to participatory urban planning and design. The case study of the co-design of a shared neighborhood yard.
	Staffans, Rantanen, and Nummi (2010);	Theoretical study of the internet-based OPUS forums. Titled: online environments shake up urban planning developing local internet forum.
	Wallin, Horelli, and Saad-Sulonen (2010)	Theoretical article: Introduction chapter of the book *Digital Tools in Participatory Planning*: ICTs Changing the Research and Practice of Participatory Urban Planning.
Mapping participation data to be used in GIS	Brown (2012);	Public Participation GIS (PPGIS) for Regional and Environmental Planning: Reflections on a Decade of Empirical Research. Based on experience with more than 15 PPGIS studies between 1998 and 2011.
	Brown and Kyttä (2014);	Key issues and research priorities for public participation GIS (PPGIS): A synthesis based on empirical research. Two researchers that have designed and implemented more than 40 empirical studies spanning both environmental and urban applications present their views about the present and future of PPGIS for land use planning and management.
	Kahila and Kyttä (2009)	Theoretical study of the SoftGIS method as a Bridge-builder in Collaborative Urban Planning. This method is explained in Figure 2.
Data-based decision-making	Khan, Ludlow, Loibl, and Soomro (2014);	The case study of the UrbanAPI project presents three planning applications: The Three Dimensional Virtual Reality at the neighborhood scale, Public Motion Explorer at city-wide scale and Urban Growth Simulation at the city-region scale from four countries Austria, Bulgaria, Italy and Spain.
	Staffans et al. (2010);	Theoretical study of the internet-based OPUS forums. Titled: online environments shake up urban planning developing local internet forum.
	Viale Pereira, Cunha, Lampoltshammer, Parycek, and Testa (2017)	The multiple case studies focus on three cities in Brazil. A cross-case analysis of smart city initiatives in Rio de Janeiro, Porto Alegre and Belo Horizonte.

Source: own elaboration

Table continues in the next page

Improve participatory urban planning process	Bugs, Granell, Fonts, Huerta, and Painho (2009);	Local participation for urban planning in Canela, Brazil. Addressing the promising approach of Public Participation GIS (PPGIS).
	Botero & Saad-Sulonen, (2010);	A case of collaboration between designers and city planners. A case study of the design in use and adaptation of the Urban Mediator tool, to be used in a traffic safety planning project in the neighborhood of Malminkartano in Helsinki, Finland.
	Shahin (2019);	Theoretical study of Digital Participatory Planning Tools titled: Digital participatory planning tools helpful side and side effects.
	Staffans et al. (2010);	Theoretical study of the internet-based OPUS forums. Titled: online environments shake up urban planning developing local internet forum.
	Wallin et al. (2010)	Theoretical article: Introduction chapter of the book *Digital Tools in Participatory Planning*: ICTs Changing the Research and Practice of Participatory Urban Planning.
Consensus building	Afzalan and Muller (2018);	Theoretical study of online participatory technologies: opportunities and challenges for enriching participatory planning.
	Horelli and Wallin (2010)	A case study of Ubiquitous Helsinki, Finland on e-planning of services in the context of community development. Based on two web-based platforms Recommendation Machine and Meeting Point.
Reduce marginalization	Brown (2012);	Public Participation GIS (PPGIS) for Regional and Environmental Planning: Reflections on a Decade of Empirical Research. Based on experience with more than 15 PPGIS studies between 1998 and 2011.
	Brown and Kyttä (2014);	Key issues and research priorities for public participation GIS (PPGIS): A synthesis based on empirical research. Two researchers that have designed and implemented more than 40 empirical studies spanning both environmental and urban applications present their views about the present and future of PPGIS for land use planning and management.
	Halttunen et al. (2010);	Article based on the extermination of two tools in Finland: a mobile phone application Tell a Story (TaS), and a web mapping application WebMapMedia.
	Kanervo (2010)	Theoretical study of The Kotikatu system with a comparison of the local websites in Tampere, Vantaa and Helsinki, Finland.
Increase equality	Halttunen, Juustila & Nuojua, (2010);	Article based on the extermination of two tools in Finland: a mobile phone application Tell a Story (TaS), and a web mapping application WebMapMedia.
	Kahila & Kyttä, (2006);	Theoretical study of the SoftGIS method as a Bridge-builder in Collaborative Urban Planning. This method is explained in Figure 2.
	Kanervo,(2010)	Theoretical study of The Kotikatu system with a comparison of the local websites in Tampere, Vantaa and Helsinki, Finland.

Source: own elaboration

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Enhance public participation	Afzalan and Muller (2018);	Theoretical study of online participatory technologies: Opportunities and challenges for enriching participatory planning.
	Brown (2012);	Public Participation GIS (PPGIS) for Regional and Environmental Planning: Reflections on a Decade of Empirical Research. Based on experience with more than 15 PPGIS studies between 1998 and 2011.
	Brown, and Kyttä (2014);	Key issues and research priorities for public participation GIS (PPGIS): A synthesis based on empirical research. Two researchers that have designed and implemented more than 40 empirical studies spanning both environmental and urban applications present their views about the present and future of PPGIS for land use planning and management.
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	Kanervo (2010);	Theoretical study of The Kotikatu system with a comparison of the local websites in Tampere, Vantaa and Helsinki, Finland.
	Macintosh (2004);	A book on *Using information and communication technologies to enhance citizen engagement in the policy process.* It includes numerous examples of current practice from 12 OECD member countries (Australia, Canada, Czech Republic, Finland, Germany, Italy, Mexico, Netherlands, New Zealand, Slovak Republic, Sweden, UK) as well as the European Commission.
	Staffans et al. (2010)	Theoretical study of the internet-based OPUS forums. Titled: online environments shake up urban planning developing local internet forum.

Source: Own elaboration

Collecting local knowledge. The first four benefits can be considered benefits for the participatory urban planning process. Collecting local knowledge is the benefit most agreed on among all benefits (Table 3). Urban planners can be strangers to the project location. For this reason, digital participatory planning tools can help them obtain useful location-based data for the participatory urban planning process. Collecting this local knowledge, information, and data is something to be valued by urban planners and included in their plans (Afzalan & Muller, 2018; Halttunen et al., 2010; Kahila & Kyttä, 2009; Rantanen & Kahila, 2009; Saad-Sulonen & Horelli, 2010; Staffans et al., 2010; Wallin et al., 2010). The instant data collected by digital participatory planning tools can help the urban planners identify local needs so they can plan according to these needs (Fischer, 2000; Rantanen & Kahila, 2009), which can avoid wasting efforts and resources.

Mapping participation data to be used in geographic information systems (GIS). The participation data collected by digital participatory planning tools can be turned into useful maps through the use of artificial intelligence and certain kinds of algorithm.[1] These maps can be added to the GIS software as additional layers (Brown, 2012; Brown & Kyttä, 2014; Kahila & Kyttä, 2009), which will most probably lead to more effective urban planning process, as more data and more input are considered in the planning process. The Urban Happiness project (Kyttä, Broberg, Tzoulas, & Snabb, 2013) explains this through the SoftGIS method, which produces special layers ready to be added to GIS, created by mapping participation data. For instance, after sharing a certain project plan, instant feedback can be collected and mapped to reveal any faults in the project (Figure 5). The map shows the share of positive and negative place markings.

[1] Algorithms are a set of step-based instructions to solve mathematical problems that are used to query and analyze data (United Nations, 2018).

Digital participatory planning tools are the transformation of conventional mapping and GIS tools, according to Kumar, Meshram, and Gowda (2016).

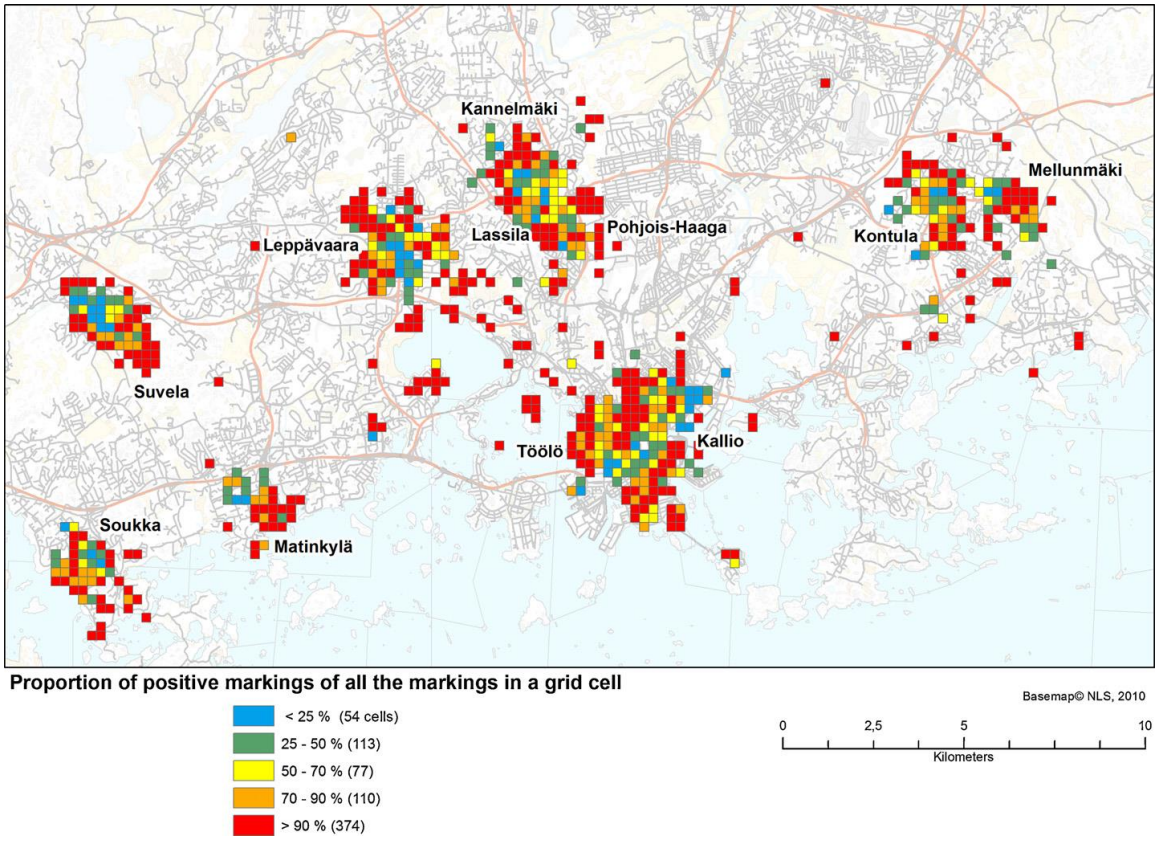

Figure 5. The share of positive and negative place markings
Source: (Kyttä et al, 2013, p.38)

Data-based decision-making. By definition, it is the process of decision driven from actual hard data rather than a decision made based on intuitive or observation alone. It involves collecting and analyzing different types of data including demographic data. The third benefit listed in Table 3 is digital participatory planning tools facilitating an evidence-based decision-making process and allowing urban planners to take evidence-based decisions (Khan, Ludlow et al., 2014; Staffans et al., 2010; Viale Pereira et al., 2017).

Improve participatory urban planning process. Wallin et al. (2010) believe that the development of digital participatory planning tools will change the field of participatory urban

planning in both practice and research. Simultaneously, Staffans et al. (2010) stressed that urban planning institutions can no longer depend only on their own information and data. Ultimately, digital participatory planning tools could improve the participatory urban planning process (Bugs et al., 2009; Botero & Saad-Sulonen, 2010; Shahin, 2019). This improvement is due to the previously discussed three benefits combined and through the same sequence (Table 3). Digital participatory planning tools collect useful additional data for the planning process, and then they allow mapping and analyzing collected data to make data-based decisions.

Consensus building. This is the social process of obtaining a general agreement on an urban plan. It is often used to take advantage of incorporating diverse perspectives of those involved in the process. Consensus building is another benefit of digital participatory planning tools (Afzalan & Muller, 2018; Horelli & Wallin, 2010). This benefit can lead to a reduction in unnecessary conflicts between citizens, stakeholders, and urban planners, and might help build trust in the society. This benefit and the subsequent ones in Table 3 are considered as benefits on the participatory urban planning overall goals.

Reduce marginalization. Marginalization is defined as the process of social exclusion, whereby an individual or a group of people is left out and pushed to the edge of the society. Halttunen et al. (2010) believe that ICT such as digital participatory planning tools could reduce marginalization by allowing the participation of those most isolated. Therefore, digital participatory planning tools have the potential to reduce marginalization (Brown, 2012; Brown & Kyttä, 2014; Kanervo, 2010). When marginalization is reduced, equality hits a higher level by their inverse relationship.

Increase equality. Equality is social status whereby an individual or a group of people has same rights and opportunities as others. Digital participatory planning tools can ensure equality

(Halttunen et al., 2010; Kahila & Kyttä, 2006; Kanervo, 2010) because they can reach a larger number of people. They can reach people who cannot participate in traditional public meetings for reasons of time, place, or other restrictions—for instance, persons with disabilities, older persons, women, indigenous peoples, people living in poverty, or other vulnerable groups and communities. This means ICT reduces inequality by offering everyone the same chances and equal opportunities, which is particularly important for the disadvantaged segments of the society. At the same time, scholars are concerned about the possibility of ICT widening digital divides. Which they could isolate those who do not have online services or do not know how to access or use them (UN E-Government Survey, 2018).

2.2 The Potential to Enhance Public Participation

Enhance public participation. Public participation is the process of social inclusion in the decision-making process. ICT also could attract youths who are fond of technology and technological solutions. Several urban planners claim that the use of digital participatory planning tools could enhance public participation (Afzalan & Muller, 2018; Brown, 2012; Brown & Kyttä, 2014; Halttunen et al., 2010; Kanervo, 2010; Macintosh, 2004; Staffans et al., 2010).

The cruciality of enhancing public participation can be explained through its special relationship with the previous two benefits of digital participatory planning tools. Participation and marginalization are opposites by definition: one denotes inclusion and the other exclusion. As a result, any enhancement of public participation will most likely lead to a reduction of marginalization. Meanwhile, when marginalization is reduced, equality hits a higher level because of their inverse relationship. Consequently, the enhancement of public participation will implicitly reduce both marginalization and inequality.

The argument. Even though, the Table 3 indicates several benefits of digital participatory planning tools, some of the same articles and case studies report negative potentials of digital participatory planning tools. For instance, digital participatory planning tools did not succeed in engaging the whole community in the work by Saad-Sulonen and Horelli (2010). Meanwhile, Babelon, Ståhle, and Balfors (2017) argue that digital participation outcomes remain weak or indeterminate. At the same time, some data privacy concerns were repeatedly expressed which they will be discussed in detail in the next chapter.

Some other researchers have gone even further, not only reporting the negative potential of digital participatory planning tools but being skeptics about the whole potential of digital participatory planning tools. They consider the available literature limited. In addition, they urge conducting more in-depth research to explore the tools' true potential and effectiveness in participatory urban planning (Afzalan & Muller, 2018; Babelon et al., 2017; Falco & Kleinhans, 2018; Panagiotopoulou & Stratigea, 2017; Shahin, 2019).

All of this led to the first sub-question of the research:

- Could enhancing public participation be one of the potentials of digital participatory planning tools?

This motivated the search for additional evidences to strengthen the research argument and further investigate the potential of digital participatory planning tools in enhancing public participation. This search was done firstly by collecting quantitative data from the region of Tuscany in Italy, and secondly, through the collection of qualitative data by surveying international experts using the digital participatory planning tools questionnaire of this research.

Ultimately, digital participatory planning tools could have benefits for the urban planning process and urban planning's overall goals. Although some urban planners believe in the potentials of digital participatory planning tools discussed above, some of these potentials are in need of further research in order to be generalizable. The need for further research stems from the limited literature available on them. Especially since these tools are technology-based and technological research is time sensitive and changes in a short period of time. For this reason, digital participatory planning tools will be researched further to obtain more insights into their various potentials, particularly their potential to enhance public participation. The introduction to the next chapter will explain how this chapter builds its argument.

CHAPTER III

DATA PRIVACY CHALLENGE OF DIGITAL PARTICIPATORY PLANNING TOOLS

Articles on the benefits of digital participatory planning tools (Table 3) have also reported some challenges, such as the challenge of attracting wider public participation (Khan, Ludlow et al., 2014). Others have expressed data privacy concerns in relation to digital participatory planning tools (Afzalan & Muller, 2018; Kahila & Kyttä, 2009; Botero & Saad-Sulonen, 2010; Shahin, 2019). These concerns suggest the need for further exploration of such a challenge and the possible consequences for the potential of digital participatory planning tools to enhance public participation.

This chapter points out the serious data privacy challenge in digital participatory planning tools by discussing urban planners' concerns. It then gives insights into the current situation of the global data, before discussing data privacy effects on the participatory urban planning process and participatory planning's overall goals. The chapter ends with a brief outline of a potential technological solution to this challenge.

3.1 Data Privacy Concerns

Information privacy is defined as: "Privacy is the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others" (Westin, 1970, Section One).

Urban planners have expressed their data privacy concerns specifically in digital participatory planning tools (Afzalan, 2015; Afzalan & Muller, 2018; Blatt, 2012; Foth, 2006; Fredericks & Foth, 2013; Kahila & Kyttä, 2009; Khan, Swar, & Lee, 2014; McNutt, 2014; O'Sullivan, 2006; Botero & Saad-Sulonen, 2010; Shahin, 2019; Shilton, 2012; Zavattaro & Sementelli, 2014) (Figure 6). Broader concerns have been expressed regarding data privacy in

the whole smart city context and its technologies, which includes data related to participation (Angelidou, 2014; Van Zoonen, 2016; Viitanen & Kingston, 2014) (Figure 6). All of the previous data privacy concerns are illustrated in Figure 6. These concerns include the possibility of selling personal data and information; the risk of these data being stolen; and concerns regarding data management, analysis, and storage.

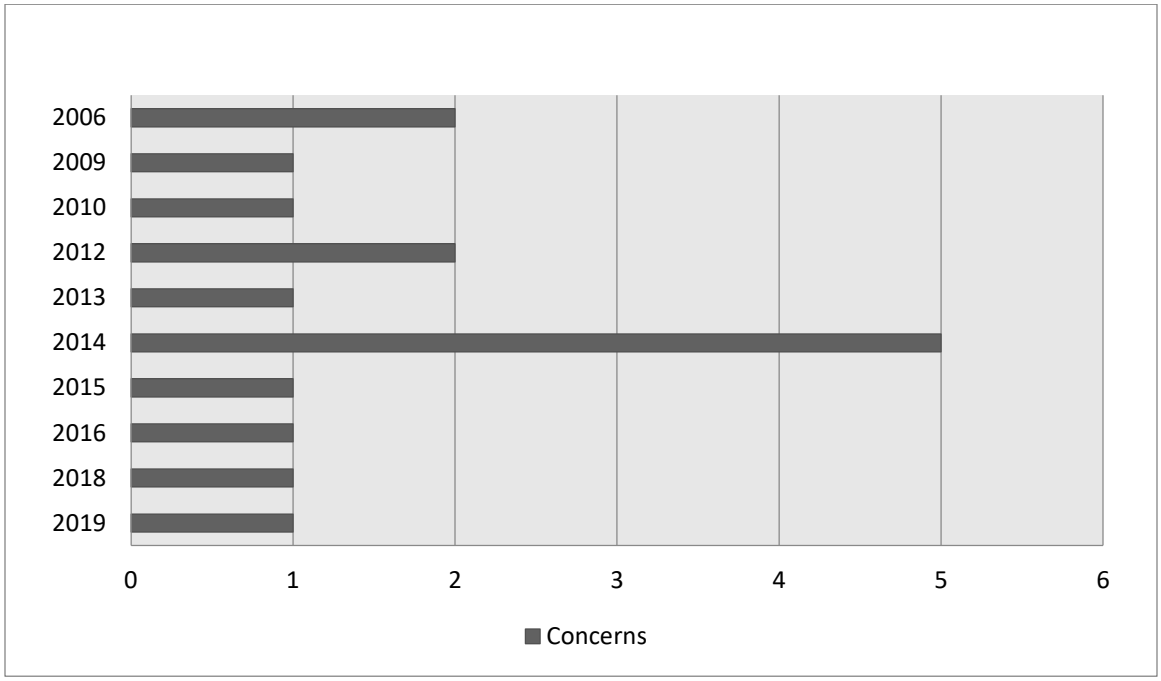

Figure 6. Number of data privacy concerns chronologically
Note: This chart is for illustration purposes
Source: Own elaboration

Data privacy concerns are not a recent thing; urban planners expressed their concerns more than a decade ago. These concerns have stood without a solution since 2006 (Figure 3). The above data privacy concerns are a lot considering the literature regarding digital participatory planning tools, and the concerns show general agreement. It is therefore safe to say that data privacy is one of the main challenges of digital participatory planning tools. There is a need to explore these concerns. Could the real issue be their potential effects and consequences?

The next two sections will give the appropriate insights. The reason behind researching this challenge now will be explained through an overview of the world data situation.

3.2 Global Data Privacy Crises

"Personal data is the new oil of the internet and the new currency of the digital world." (Kuneva, 2009, p.2). Recent data crises can illustrate the current situation of world data in general and data privacy specifically. The first crisis of concern here is the Facebook Cambridge Analytica scandal. *The Guardian* (2018) exposed a series of reports about Cambridge Analytica and how it collected and harvested the data of millions of Facebook users to influence voters in the 2016 presidential campaign in the United States. Later on, it was also discovered that it influenced Brexit voters in the United Kingdom. The second crisis is the WannaCry ransomware cyber-attack of May 2017, which targeted the United Kingdom's National Health Service (NHS). Mike Viscuso, the chief technology officer of the security firm Carbon Black, stated: "The attack against the NHS demonstrates that cyber-attacks can quite literally have life and death consequences" (The Guardian, 2017).

These two recent global data privacy scandals made it unacceptable to keep ignoring urban planners' data privacy concerns in digital participatory planning tools, especially after urban planners' concerns were realized, because the data privacy issue could seriously impact the health, safety, security, and economy of citizens (United Nations, 2018).

3.3 The Effects of Data Privacy Challenges

Personal data privacy is the most urgent issue in the literature in this era, and there is general agreement on it. Personal data refers to any information relating to an identified or identifiable living individual. Sensitive personal data are data related to race, religion, sexual orientation, location, income, health record, contact information, political opinion, and others,

according to General Data Protection Regulation law, which will be discussed later. The following discussion offers insights to understand data privacy effects and consequences.

Safety of the city and society. The safety of the city and the society form part of urban planning's overall goals. Smart city technologies can capture people's real-time demographic data in a way that violates their privacy (Angelidou, 2014; Elmaghraby & Losavio, 2014). Digital participatory planning tools arise from these technologies: they collect critical and sensitive personal data from the participants. Where these data fall into the wrong hands, they can cause serious harm to the participants and the city. Moreover, life and death consequences, as it was discussed earlier in the cyber-attack of the NHS. This places urban planners who run the digital participatory planning tool under massive responsibility.

Data quality. Digital participatory planning tools depend heavily on data coming from participants (Khan, Ludlow et al., 2014). Staffans et al. (2010) consider the quality of the information as one of the most important aspects of digital participatory planning tools (Staffans et al., 2010). At the same time, Kahila and Kyttä (2009) urge additional improvements for digital participatory planning tools to guarantee the quality of the information they produce. But if the participants are skeptical regarding their participation data's privacy, they might participate with fake or inaccurate data to protect themselves, which can lower the data quality obtained by these tools. This will lower the quality of the information these tools produce.

Participation rate. This is one of the overall goals of participatory urban planning. Again, when participants are skeptical regarding their participation data's privacy, they may stop participating to protect themselves, which will lower the participation rate. Since the real challenge for these tools is to attract wider public participation, this is a real issue (Khan, Ludlow et al., 2014).

Consequently, in order to achieve a higher participation rate and higher quality data, participants need to be assured that their data are secure and well-handled so they can contribute and participate more, and with accurate data. Once these tools obtain high quality data, they will produce high quality information, and vice versa. Otherwise, the whole effectiveness of these tools is on the line.

These data privacy effects could be considered hypothetical, since there is not enough data in the literature to support them, perhaps because of the limited literature regarding digital participatory planning tools in the first place. This motivates the second sub-question of the research:

- How do data privacy challenges affect digital participatory planning tools' potential to enhance public participation?

Questions B1 and B2 of the questionnaire for this research will try to find answers to this question through the exploration of data privacy effects on both the participatory urban planning process and the overall goals of participatory urban planning.

3.4. Potential Solution for Data Privacy Challenges

The global data privacy crises mentioned earlier in this chapter pushed towards a recent shake-up event in the data field. This event was the European Union's new data privacy law, General Data Protection Regulation (GDPR),[2] which started to be applied in 2018.

GDPR gives a person the right to know who is processing their data and why, to know who is accessing their data, to object, to correct their data, to delete their data, and to be forgotten. Simply, GDPR law allows a person to take back control over their data. Neisse, Steri,

[2] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April.

and Fovino (2017) believe that blockchain technology could be a solution to enforce the GDPR data privacy law.

Blockchain technology[3]. Blockchain technology is a recent artificial intelligence (AI) application. It consists of blocks of information chained to each other with a unique encrypted key and stored across several locations in a decentralized way. Blockchain technology prevents a single controlling authority from owning and controlling the data and the information; instead, it allows every person to control their own data. Also, it can enhance transparency and save costs (Dunphy & Petitcolas, 2018; Neisse et al., 2017). Blockchain technology has the potential to solve data problems like those related to control over information and access, as well as the security and privacy of data with a high degree of sensitivity (United Nations, 2018).

The question here is:

- Could blockchain technology be a potential solution for data privacy challenges in digital participatory planning tools?

In order to avoid making this research passive by pointing out a challenge without any solution, an exploration for a potential solution was needed. For the purpose of answering this sub-question, the research will report the data from the Swiss city of Zug experiment, the e-voting experiment using a blockchain-based digital participatory planning tool.

In summary, data privacy is quite a serious challenge in digital participatory planning tools. Many urban planners are concerned about this issue. Data privacy could affect both the participatory urban planning process and the overall goals of participatory urban planning. More specifically, it could affect the safety of the city and society, data quality, and participation rate.

[3] For more in-depth explanation on the way blockchain technology works, check Blockchain explained by Reuters Graphics (2018) (see Appendix A).

For this reason, finding a solution to the data privacy challenge in these tools is of great importance. The aim here is to work on finding a solution for data privacy and fix the problem to further develop digital participatory planning tools' features to improve participatory urban planning towards effective urban planning. The future could be promising and open for digital participatory planning tools when the challenges are fixed.

CHAPTER IV

RESEARCH METHODOLOGY AND DATA COLLECTION

This chapter will discuss the methodology followed to examine and find answers to the research question and sub-questions. The methodology chosen is case methodology; it uses several instruments to collect data, such as the online questionnaire instrument. This instrument will be explained first in detail, followed by the units of analysis to which this questionnaire will be sent. The questionnaire was essential for this case study for providing additional evidences to strengthen the argument of the research as much as possible.

4.1. Case Study Methodology

An explanatory case study focuses on contemporary events and there are solutions to be presented. It uses several tools to collect data. It depends on a mix of qualitative and quantitative evidences. It is a holistic case study because it examines the same thing in all the units of analysis. It depends on several types of evidence, such as documents, interviews, and questionnaire surveys. The case study methodology was chosen, firstly, because of the 'how' research question; secondly, the investigator has little control over events; and thirdly, the focus is on a contemporary phenomenon within a real-life context. Moreover, a case study methodology is often used for evaluation and community planning (Yin, 2009).

4.1.1 The questionnaire instrument

The instrument chosen is a web-based self-completion open-ended and closed-ended questionnaire. The reasons behind choosing this methodology derive from its advantages in saving time and providing fast analysis; it is also cheap and accurate, and it can be effective for topics dealing with sensitive issues. In addition, it allows answers to be richer, longer, and more revealing, specifically for open-ended questions (Brace, 2004).

Questionnaire objectives. The questionnaire instrument's main objective is to provide additional legitimacy for the argument of the research, since, as mentioned, some researchers consider that the literature on digital participatory planning tools is limited. For this reason, the questionnaire aims, firstly, to highlight the potential of digital participatory planning tools in enhancing public participation; secondly, to explore data privacy disruption for digital participatory planning tools' potential to enhance public participation; and thirdly, to examine blockchain technology as a potential solution to the data privacy challenge in digital participatory planning tools. Therefore, the research sub-questions were divided into two or more detailed questions (See Appendix B).

Questionnaire design. The questionnaire was designed following the instructions of Dillman, Smyth, and Christian (2014). The questions designed were of a variety of types to obtain accurate information regarding each issue investigated. These types are closed-ended and partially closed-ended, which allow additional open ended answers. The introductory text and the email were designed to reflect legitimacy, trust, and convenience to attract as many responses as possible. The email was designed precisely to avoid the possibility of it being considered as spam and going directly into the junk folder. This is a real problem with the questionnaire instrument. The questionnaire is partly taken from Shahin (2019*).*

A few points should be noted regarding the questionnaire's design and sending. Some platforms of the unit of analysis's list were excluded from the survey, because these platforms are not compatible with the purpose of this questionnaire due to their field of speciality. The questionnaire was forwarded to international experts on digital platforms, which are the units of analysis of this research.

4.1.2 Units of analysis of the case study

The units of analysis for this research are 113 international digital platforms (see Appendix C). These digital platforms are currently active and are used in urban development around the world (Figure 7). They were detected by Falco and Kleinhans (2018). The worldwide spread of these platforms could be considered evidence of the success of digital participatory planning tools. In an interview with Dr Reinout Kleinhans, he answered my question regarding contacting these platforms for a survey, stating "no complicated protocol here", which encouraged me to proceed with the survey methodology. (For full interview, check Appendix D.)

Figure 7. Geographical distribution of digital platforms
Source: (Falco & Kleinhans, 2018, p.59)

Added to the above units of analysis are two more platforms, the Italian PartecipaToscana platform and Swiss uPort platform, which is encouraged by Falco and Kleinhans (2018). The total number is 113+2=115 digital participatory planning tools. The two additional platforms are studied and defined in the next chapter, along with the reasons for adding them to the list of participatory platforms.

4.1.3 Documents and interviews

In addition to the abovementioned instruments, the case study depends on documents and interviews. For example, hundreds of documents and one online interview allow the collection of quantitative data for Tuscany. The questionnaire instrument allows the collection of qualitative data that serve to answer all three sub-questions of the research. The interview instrument allows obtaining the final report for the Swiss experiment. As a result, the evidences of this research are based on the combination of all three methods of data collection: documents, interviews, and the online surveys.

This chapter has explained the case study methodology which this research will use to find insights in response to the research question. The case study's main instrument is the questionnaire. The research has international unit of analysis from across the world. Documents and interviews will be used to study the additional two tools of the unit of analysis. In other words, the chapter has demonstrated the methods this research will use to collect its evidences, which are presented next in Chapter V and discussed in Chapter VI.

CHAPTER V

RESULTS

This chapter will list all data collected and the results of the research questionnaire, hence all evidences which help answer the research question. Evidences vary between quantitative and qualitative. The chapter consists of three main sections, according to the three sub-questions of the research.

5.1 Evidence on the Potential of Digital Participatory Planning Tools to Enhance Public Participation

5.1.1 Quantitative data: PartecipaToscana tool in Tuscany, Italy

The region of Tuscany is located in central Italy. It consists of nine provinces and one metropolitan city which is the regional capital, Florence. The Tuscany Regional Participation Policy (TRPP)[4] is a pioneer initiative in Italy and Europe. The method followed for participation is public debate through different tools such as traditional meetings and use of the internet and digital technologies. PartecipaToscana is the digital tool used for this initiative by the Tuscany region and is a part of OpenToscana (www.open.toscana.it).

PartecipaToscana digital participatory planning tool. This is an innovative interactive tool for Tuscan citizens' participation that allows two-way discussion of Tuscan urban planning projects (Figure 8). This places it under the e-consultation level of e-participation. Based on this level, the participation could affect the decision-making process. As a result, it is an interaction and co-production type of platform (Table 1).

[4] Tuscan regional laws No 69/2007 and No 46/2013.

Figure 8. PartecipaToscana interface
Source: www.open.toscana.it/web/partecipa

Personal information is required for registration, such as first name, last name, city, birth date, sex, and email address. The main technological feature is ideas and news submission through the sharing of documents, photos, videos, comments, and opinions.

Tool mission. PartecipaToscana's mission is to enhance participation, increase equality, build consensus, and improve decision-making.

Tool distinctions. Besides its noble mission, the true distinction of PartecipaToscana derives from its support for both offline participation represented in public meetings and online

participation represented in digital discussions. This tool distinction is invaluable because it allowed the collection of the quantitative evidence below.

The quantitative evidence is based on a comparison between the number of online participants and the number of offline participants for all 130 Tuscan urban planning projects open for participation. Information was available regarding the numbers of online and offline participants for 58 projects (Figure 9). Accordingly, the comparison between the numbers of online and offline participants was therefore made for all 58 projects (Figure 10).

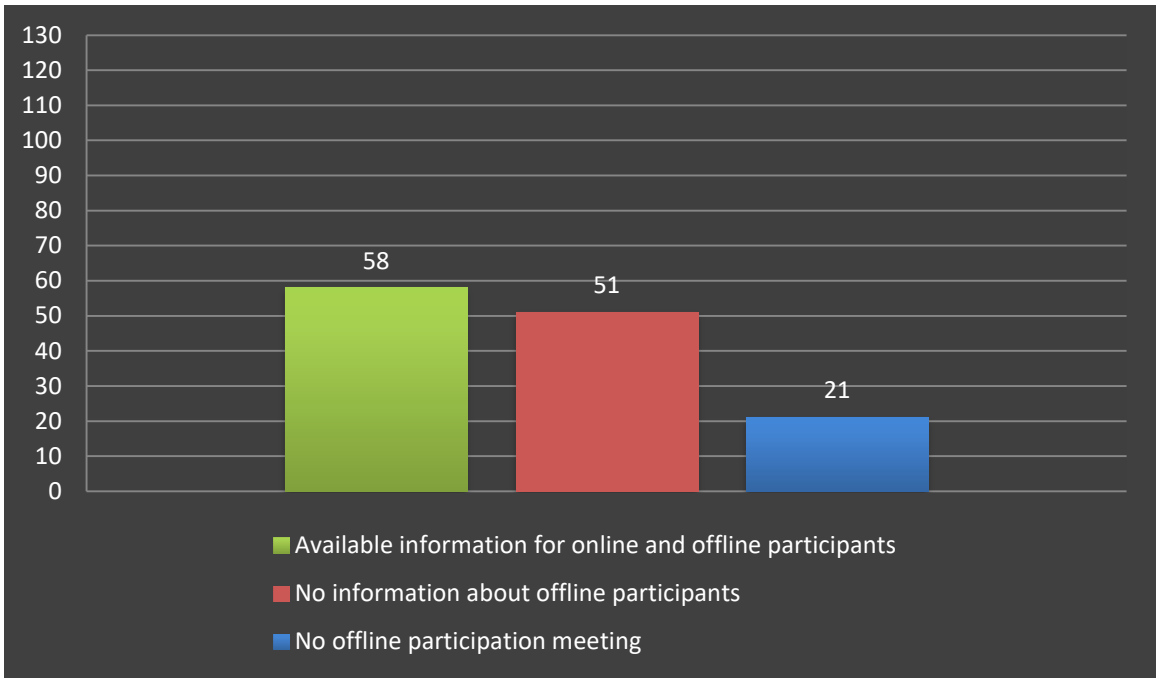

Figure 9. Number of Tuscan participation projects
Source: Own elaboration

I asked about these numbers specifically to the Participation Office of OpenToscana, the one which manage PartecipaToscana tool office of participation. Their answer was that there are no available records for the numbers of online and offline participant. Therefore, the numbers of online and offline participants were collected manually from each project page on the PartecipaToscana website, from several hundred documents. The manual method followed will

be explained through the example of one of the best known participation projects, Aeroporto Parliamone.

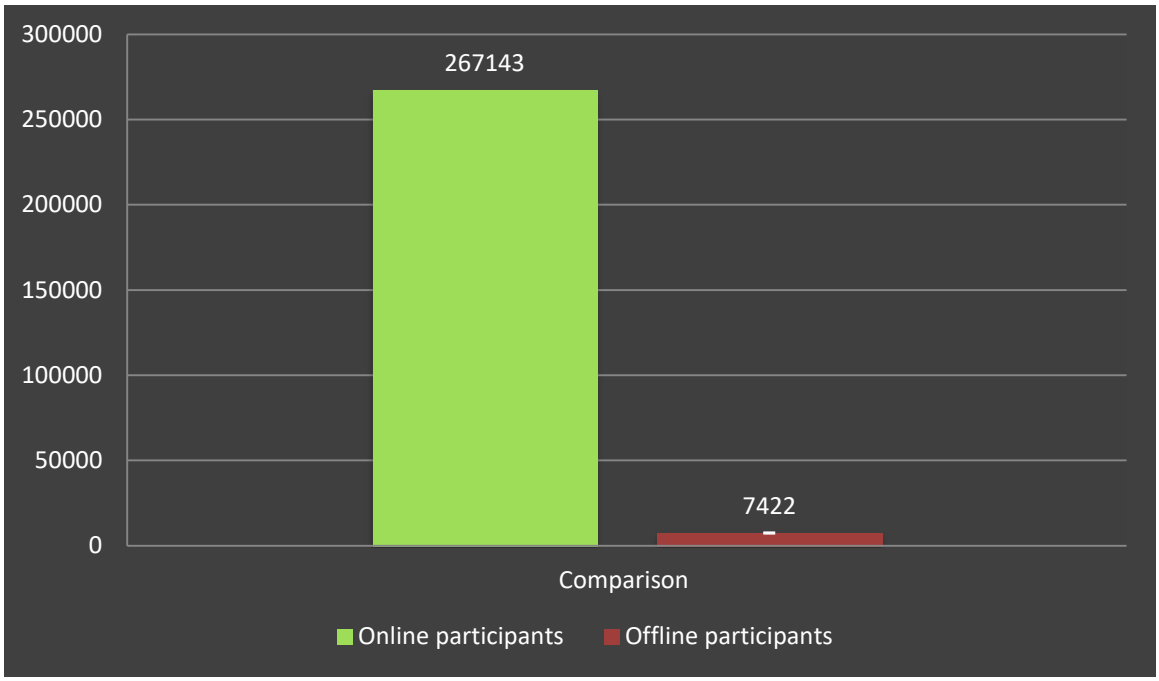

Figure 10. Comparison between the numbers of online and offline participants
Source: Own elaboration

Aeroporto Parliamone. The Florence airport enlargement project is one of the best known participatory urban planning projects on PartecipaToscana (Figure 11). The new runway for Florence's airport project was suggested by the former mayor of Florence, Matteo Renzi, along with the airport company Aeroporto di Firenze (ADF).

This project is controversial and is subject to a lot of criticism from the project's neighboring municipalities, Calenzano, Carmignano, and Poggio a Caiano. The scientific society at the University of Florence also opposes this project for several reasons, mainly ecological ones.

Figure 11. Aeroporto Parliamone page interface
Source: www.open.toscana.it/web/aeroporto-parliamone/home

The number of online participants is stated on the project page interface as being 33,589 (Figure 8). This number is based on the IP device: if a participant opens the page twice, once from a cellphone and once from a laptop, it will be counted as two participants.

The number of offline participants was collected from the materials section of each project page by opening the reports on each meeting. For this participation project, five meetings were conducted and 19 documents were found in the material section. These documents contain the final reports from each meeting and may state the number of offline participants right away, or may require manual calculation. In the case of this project, there were 325 offline participants. Less than ten meetings did not state any offline numbers in their reports, but they had a photo album of the meetings, so offline numbers are based on calculations from the photos.

5.1.2 Qualitative evidence: digital participatory planning tools questionnaire results

The questionnaire was sent to the unit of analysis of this research, the 115 Digital Participatory Planning Tools. This means the questionnaire questions are answered by internatinonal urban planners who are experts in digital participatory planning tools. The questionnaire results will be illustrated in charts and will follow a numerical progression according to the most agreed on answers, in a descending way which shows the answer value (Dunleavy, 2003). Also, they will be reported separately from each other, each questionnaire section will be according in the proper argument discussed in the chapter.

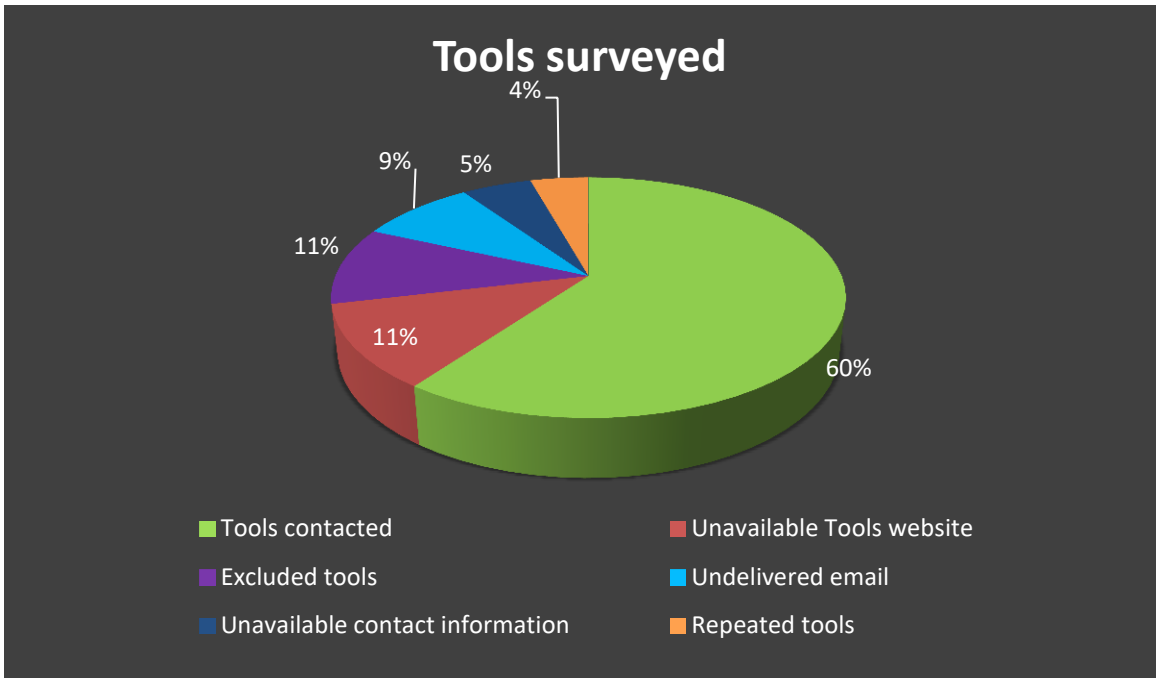

Figure 12. Tools surveyed
Source: Own elaboration

The response rate of 19 per cent was obtained after three communications, including two reminders (Figure 12). This response rate can be considered valuable for two reasons: first, it comes from international experts from different locations around the world. Second, it comes from a very specific tools in respect to their field of speciality urban planning particularly.

The above pie chart categorization was created according to the answers obtained. For example, one tool declared that it was part of another tool: for this reason, the 'repeated tool' category was created. One of the tools answered that it did not think that its tool was suited to this survey: his led to the creation of the 'excluded tools' category (Figure 12). This shows again the value of the response rate.

Qualitative data of Section A of the questionnaire

A. *The benefits of digital participatory planning tools*

A1. Which of the participatory planning benefits do digital participatory planning tools allow?

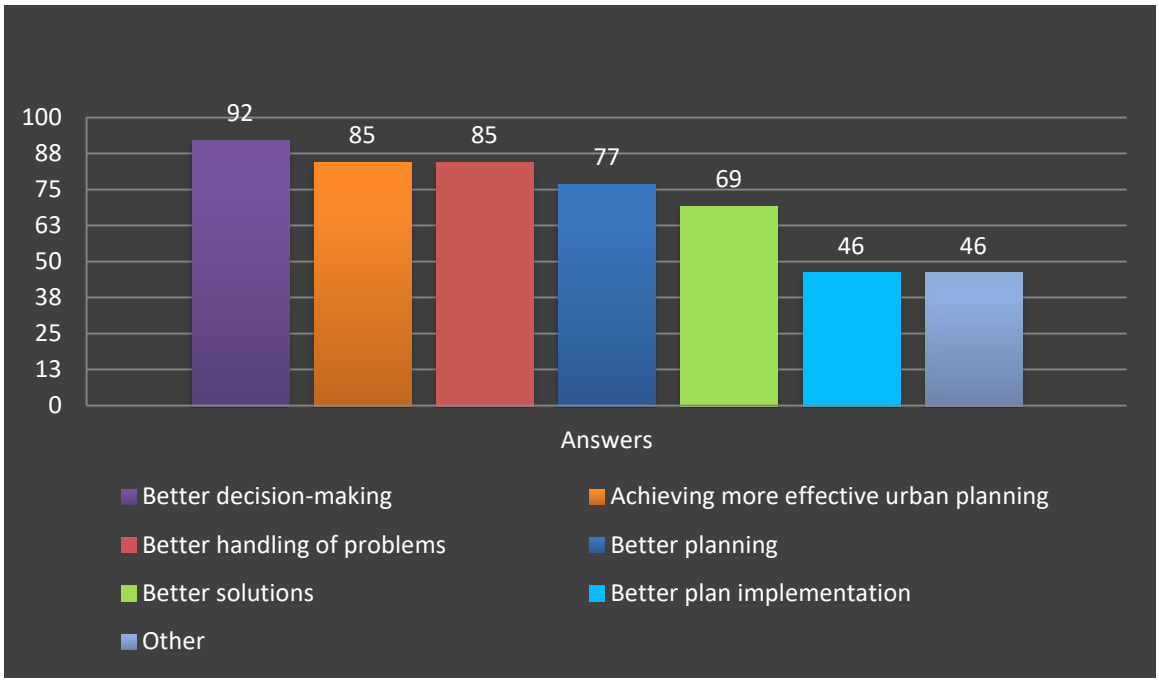

Figure 13. Benefits of participatory urban planning
Source: Own questionnaire results

Table 4. Other benefits of participatory urban planning

"Better ownership, local democracy and increased awareness among civilians as well as government professionals that we are Mutual dependent on each other for increasing our surroundings. Important side-effects: participation-processes increases social cohesion and social capital and possibly prevent loneliness in the longer term."
"Increased empowerment and inclusivity"
"Improved citizen or employee engagement"

"Accelerate rate of implementation"
"Lowering the cost of Engagement while simultaneously increasing the ric. Reachingout to disadvantaged communities, broadening and deepening the engagement. Giving people a sense of ownership of the plans in projects. Adding transparency to the process and building trust"
"Broader reach, Include otherwise silent groups, Higher resident satisfaction in the participatory process, Transparency and good governance. Fostering individual participation."
"Increased public participation"

Source: Own questionnaire results

A2. What are the benefits of your digital participatory planning tools in the urban planning process?

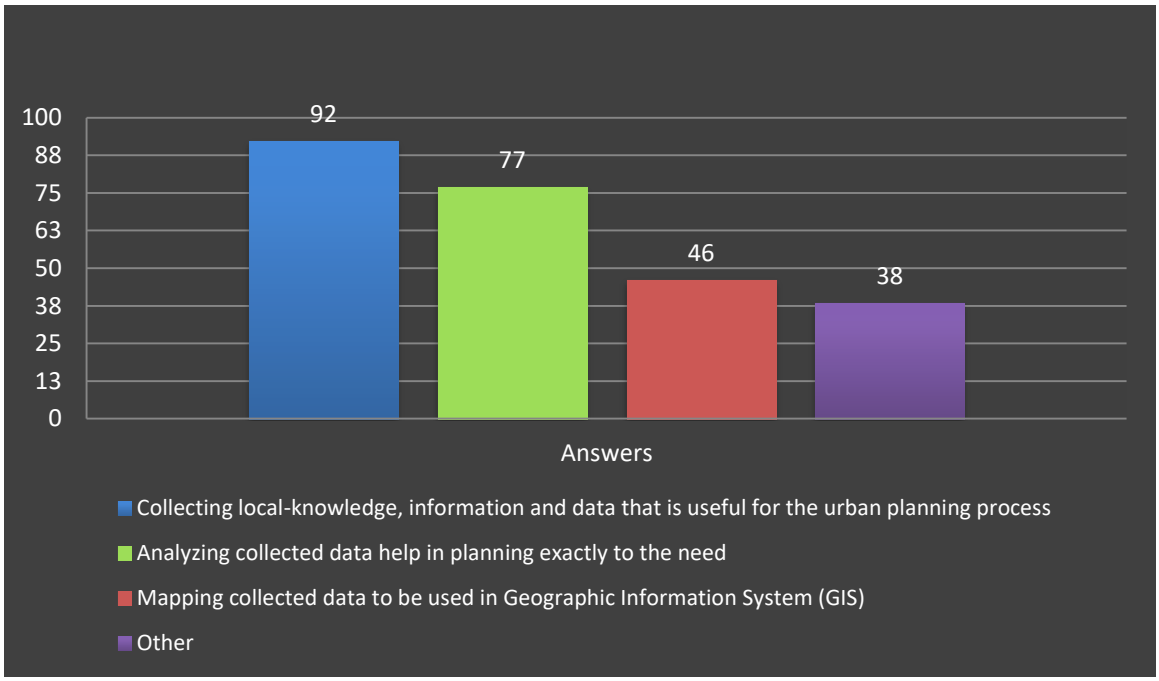

Figure 14. Benefits of the participatory urban planning process
Source: Own questionnaire results

Table 5. Other benefits of the participatory urban planning process

"Simple results visualization for public."
"Providing transparent reasoning for decisions."
"Increased speed and transparency in the process."
"Quicker implementation of projects, Lower data acquisition cost. Lower feedback management cost."
"Increased public participation, more diverse participation, educating the public on planning issues."

Source: Own questionnaire results

A3. What are the benefits of your Digital Participatory Planning Tools on the urban planning overall goals?

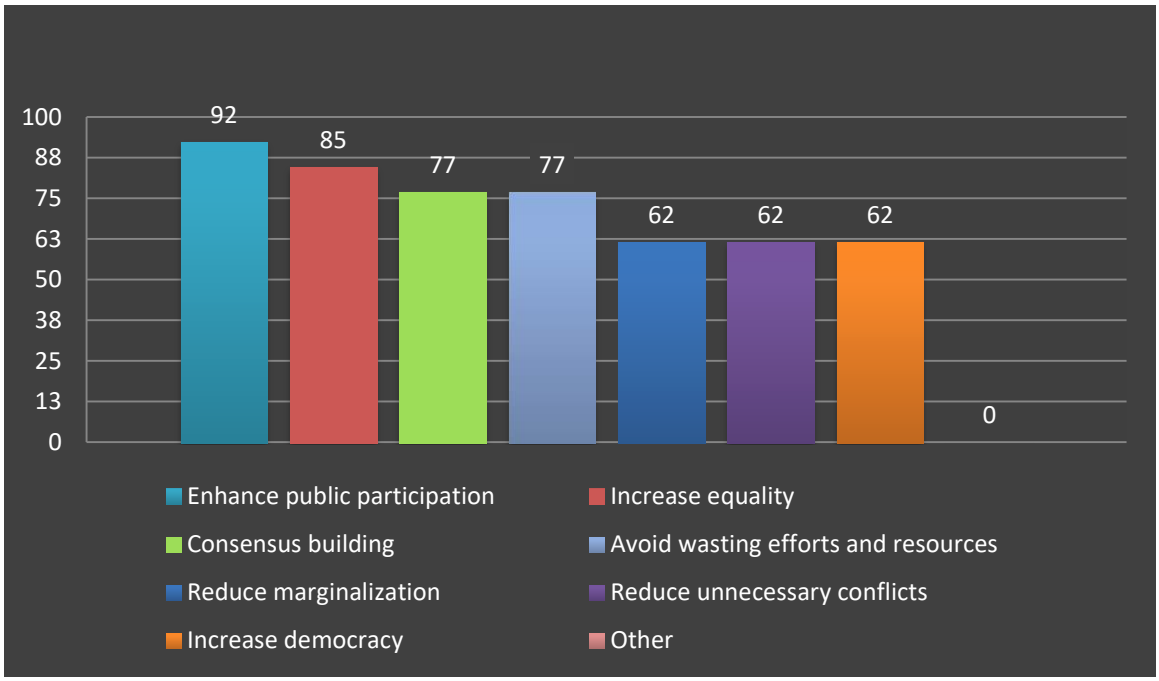

Figure 15. Benefits for urban planning's overall goals
Source: Own questionnaire results

5.2 Questionnaire: Qualitative Evidences on Data Privacy Disruption for the Potential of Digital Participatory Planning Tools to Enhance Public Participation

The evidences in this section depend solely on the qualitative evidence of the questionnaire, specifically, the answers to questions B1 and B2.

B. *Data privacy challenge in digital participatory planning tools*

B1. What are the consequences of data privacy issue in digital participatory planning tools?

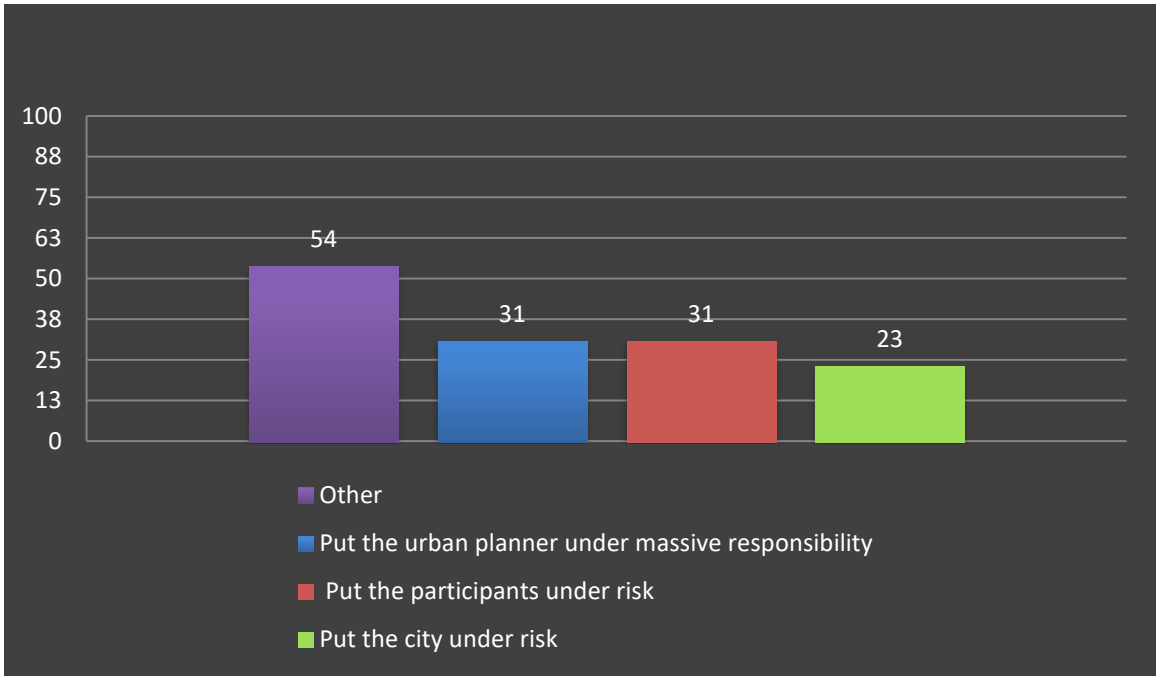

Figure 16. Data privacy consequences
Source: Own questionnaire results

Table 6. Other consequences

"We only collect anonymised data. Personal data is in a separate database which is linked to the comments by an encrypted hash."
"Is bad news for our organization"
"A lot of this depends on the type of data collected. Our work involves community input processes and not so much a collection of personal details that could put them at risk. That being said, data collection should always be accompanied by heightened responsibility."
"We normalize the data so there's not much risk. I don't believe there's risk in much of the data being stolen. I believe there's a risk in people hijacking the tool and corrupting the data with Mis information if it's a project they are not in support of."
"We have not had any issues. There is only public preferences being collected and

clients typically share the results publicly."
"depends on how it is executed and how data ownership is secured"
"My tool does not collect anything that is not publicly available"

Source: Own questionnaire results

B2. What are the possible effects of data privacy issue in digital participatory planning tools?

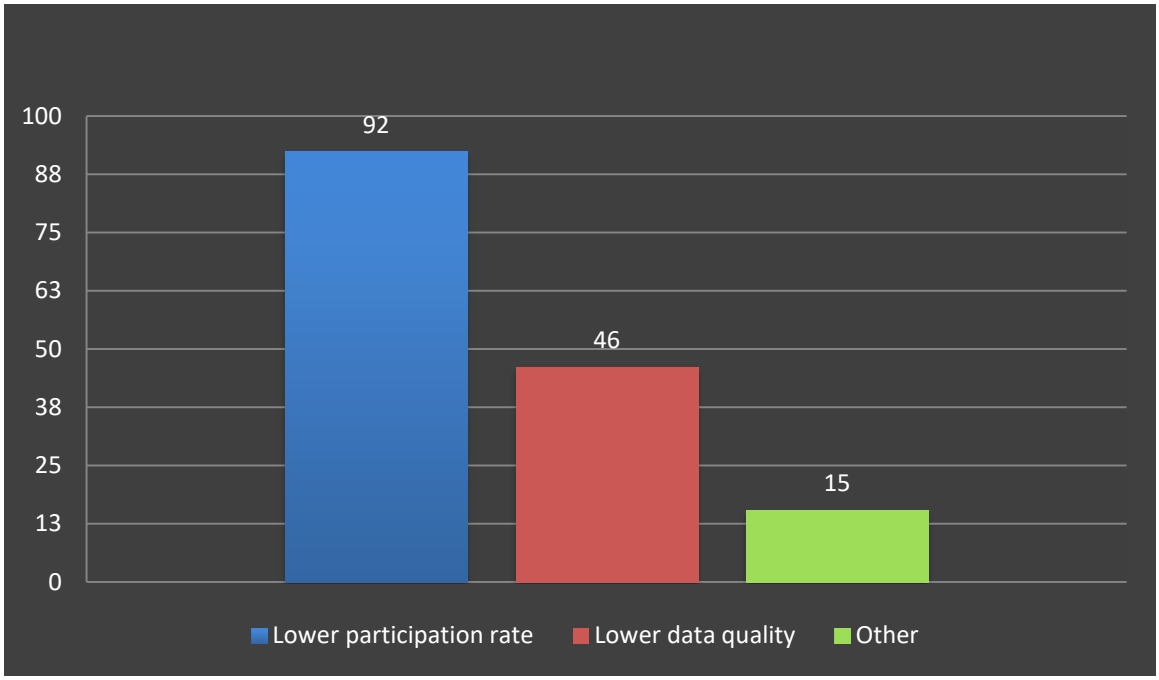

Figure 17. Data privacy: possible effects
Source: Questionnaire results

Table 7. Other effects of data privacy

"People finish part way through the process."
"I think this question should ask whether the perception of data safety is an issue? I believe people trust the tool and trust the process trust that their data is normalized and trust that their personal information is in a separate database from the responses then it'll be fine."

Source: Own questionnaire results

5.3 Evidences of Blockchain Technology as a Potential Solution to the Data Privacy Challenge in Digital Participatory Planning Tools

This section consists of three main parts: the Swiss experiment results and the author own questionnaire results. The questionnaire responses come from international urban planners, who are experts in digital participatory planning tools as mentioned earlier in the methodology Chapter IV.

5.3.1 The uPort tool experiment in the Swiss city of Zug[5]

The city of Zug is located in central Switzerland between the city of Zurich in the north and the city of Lucerne in the south-west. Zug is referred to as crypto-valley because it is a home for startup cryptographic innovations. The city wants to digitalize the voting and needs a reliable solution for this. Generally, voting on urban planning projects is something done regularly in Switzerland.

In June 2018, the city made an e-voting digital participatory planning tool that uses an innovative encryption technology, which anonymizes the votes and allows a tamper-proof tally and secure audit. This technology is called blockchain, and it was created by Luxoft Holding, Inc (NYSE:LXFT), a global IT service provider, partnered with the city of Zug and Lucerne University of Applied Sciences. Before reporting the final results of the experiment, there is a need to explain why this experiment was chosen. Accordingly, this digital participatory planning tool will be explored in detail from its academic definition to its mission (See Appendix. G).

uPort digital participatory planning tool. The uPort mobile application is a secure mobile self-sovereign identity wallet that gives a person complete control over their identity and

[5] This evidence was obtained through an e-mail interview with Janina Römer on 9 November 2018, replying on behalf of Martin Würmli, clerk of the city of Zug (see Appendix E).

personal data (Figure 18). It can be reached by entering the city of Zug official website (www.stadtzugid.zg.ch).

uPort academic definition. uPort is a self-organized tool that allows two-way communication, placing it under the e-decision-making level of e-participation. Based on this level, participation affects the decision-making process. This places it under the self-organization type of platform (see Table 1).

Figure 18. uPort platform interface
Source: www.uport.me

Personal information is required for registration, such as first name, last name, date of birth, ID number, and mobile phone number. uPort's main technological features are storing and sharing information, digital identity, and voting.

Tool mission. The mobile wallet is your connection to the uPort platform, an interoperable identity network for a secure, private, and decentralized web. uPort provides open protocols for decentralized identity and interoperable messaging that enable trusted source attribution for all web communication.

Tool distinctions. In addition to its mission, the other reasons to choose this platform experiment come from its unique features, which are explained in Table 8.

Table 8. uPort digital participatory planning tool features

• There is no literature on using blockchain-based digital participatory planning tools.
• It is a state-of-the-art blockchain-based digital participatory planning tool and was experimented with recently, in the middle of 2018.
• Blockchain technology is based on decentralization, which means no authority can see citizens' personal data (World Economic Forum, 2017).
• Since it is decentralized, the platform is deployed in three different data centers in the cloud: two in Switzerland and one in Ireland. By distributing the data in three different data centers, security and data loss risks are distributed geographically, making the system more robust (Figure 19). Also, the platform can permanently delete voting data within an agreed time in accordance with Swiss law.
• It is an official platform used by government. Its purpose is to drive the adoption of this kind of technology in government. "As a result, we believe this technology cannot be owned by a single company. We will make the e-voting platform open source so people can understand what makes up the technology and how it works, ensuring full transparency. Looking ahead, our alliance will encourage more people to develop blockchain-based applications for Governments worldwide" (Vasily Suvorov, Chief Technology Officer at Luxoft).

Source: The Zug blockchain experiment, stated in two media releases: one by Luxoft and one by the communications department of the city in both English and German Languages (see Appendix F & Appendix G).

The results of the uPort tool experiment in the Swiss city of Zug. The evaluation of the blockchain e-voting experiment in the city of Zug was done after receiving IDs issued from Zug; 72 digital ID holders took part in a consultative vote from 25 June to 1 July 2018. Holding this test vote online was a proof of concept, and regarded as a novel yet practical voting approach that can be used in real life (see Appendix H).

This proof of concept was a success and is a significant milestone demonstrating that blockchain-based e-voting systems work. Nearly all technical expectations of the vote were met.

The e-voting final report emphasizes explanation of the concept of decentralization (Figure 19), showing how the e-voting data are distributed over two data centers, one in Switzerland and the other in Ireland.

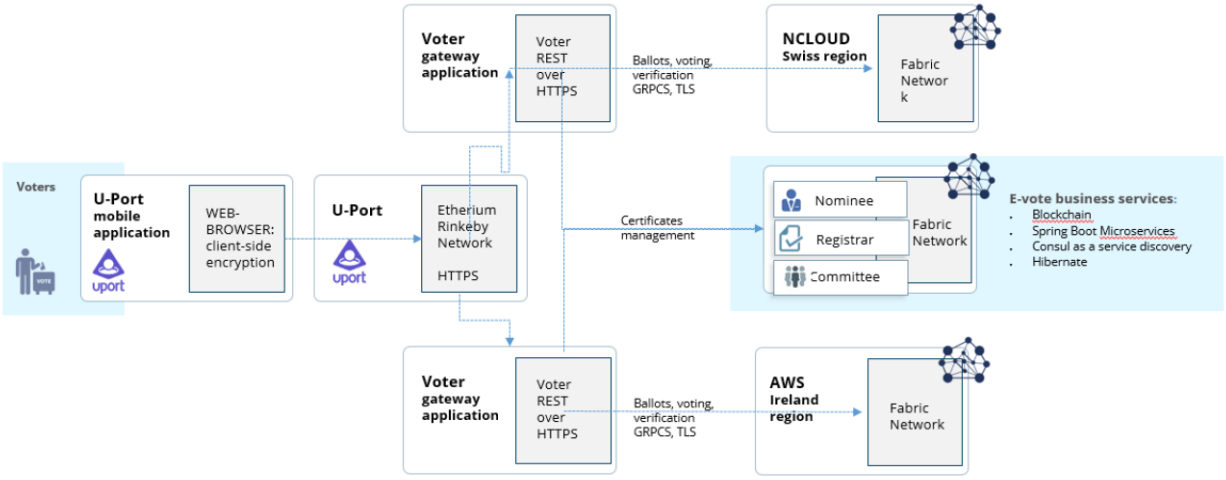

Figure 19. Decentralized e-voting solution
Source: Final report of Zug e-voting platform experiment (see Appendix H)

Benefits of a blockchain-based decentralized e-voting system. The data's authenticity is guaranteed throughout the poll. Firstly, with effective identity management, it is infeasible for hackers to impersonate voters. Secondly, techniques like digital signatures protect the integrity of the data, meaning votes cannot be tampered with in transit. Thirdly, the blockchain technology is immutable: once a vote has been recorded, it cannot be removed or altered. There are also some direct benefits for the participants (Table 9).

Table 9. The benefits of the technological features of blockchain for participants

• As an anonymized process, this solution does not reveal any personal information from voters and keeps their votes private.
• Voters can view and change their own votes at any time during the poll.
• While anonymous, the legitimacy of the participants is still validated by an external identity system, with every user having the power to verify every vote.
• Due to being securely encrypted, all voting data are tamperproof.

Source: Final report of Zug e-voting platform experiment (see Appendix H)

The data are stored across multiple nodes, and even if one or several nodes are hacked, the voting data cannot be destroyed by hackers. As long as there are enough nodes, it is almost impossible for the whole system to be compromised. The way blockchain technology works makes it ideal to handle data. Consequently, this makes blockchain technology a potential solution for the data privacy issue and data security in digital participatory planning tools in defense against cyber-attacks.

Finally, since it was a successful pilot experiment, the city of Zug is planning on adopting this blockchain technology in additional areas. There are various other applications in evaluation or already in operation as pilot projects for the use of the digital ID, including sharing city bicycles and borrowing books from the library.

5.3.2 Qualitative evidence of question B3 of the questionnaire

B3. Can blockchain technology be a solution for data privacy issue in digital participatory planning tools?

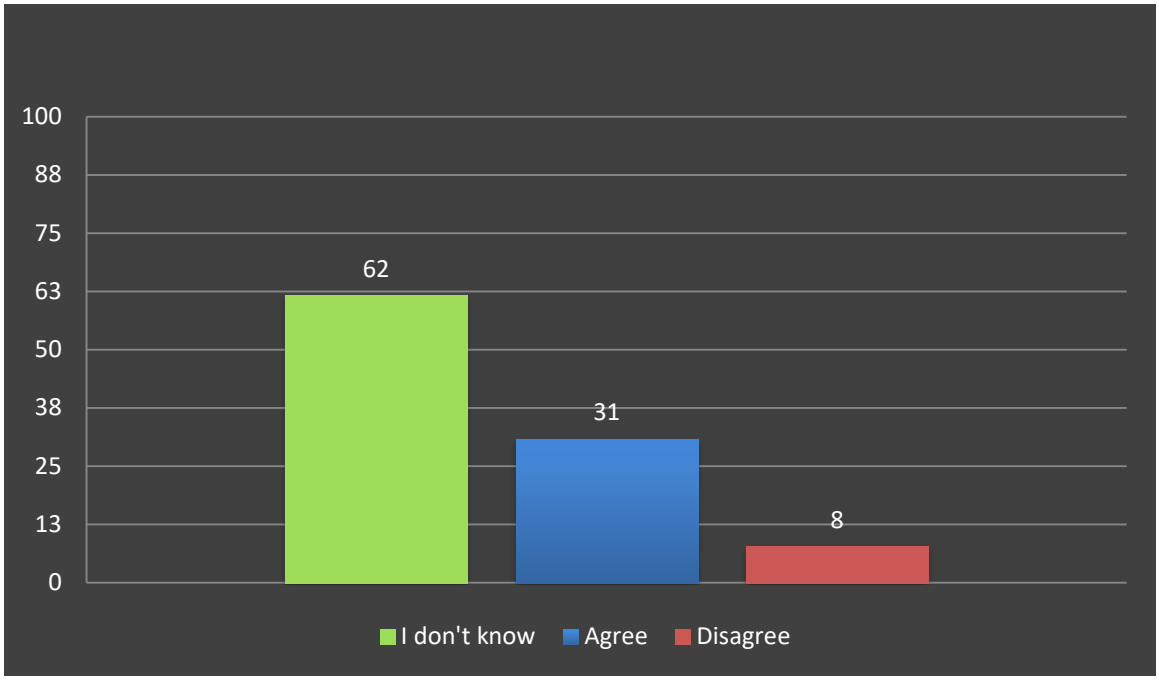

Figure 20. Blockchain technology as a possible solution for data privacy
Source: Questionnaire results

These results show that experts still do not know much about Blockchain technology and its potentials, which could indicate how this technology still in its early phase.

To conclude, this chapter has indicated how the case study methodology was the appropriate choice since it allows multiple types of evidence. The chapter has presented a variety of evidences to support this research in finding answers, including documents, interviews, and questionnaire survey. These data evidences are both qualitative and quantitative. Their location varies across the world. The results are discussed in Chapter VI.

CHAPTER VI

DATA ANALYSIS AND DISCUSSION

The strategy followed in analyzing the case study data is the preliminary sense of 'play with the data', which is a prelude to developing a systematic sense of what is worth analyzing and how it should be analyzed (Yin, 2009). This chapter consists of three sections according to the three main arguments of the research. It provides answers to the sub-questions, which will lead to a final answer to the research question in the next chapter.

The sub-questions of the research are:

Question 1. Could enhancing public participation be one of the potentials of digital participatory planning tools?

Question 2. How do data privacy challenges disrupt digital participatory planning tools' potential to enhance public participation?

Question 3. Could blockchain technology be a potential solution for data privacy challenges in digital participatory planning tools?

6.1 Digital Participatory Planning Tools' Potential to Enhance Public Participation

The research has collected quantitative and qualitative data regarding digital participatory planning tools' potential to enhance public participation. Quantitative data were acquired from the quantitative evidence of the PartecipaToscana tool in Tuscany, Italy. Qualitative data were acquired from the research questionnaire and the Swiss experiment.

The evidence of the PartecipaToscana tool in Tuscany, Italy. The results from the comparison between online and offline participants using the PartecipaToscana tool indicate that only 2.77 percent participated offline: the number of online participants was therefore 36 times

more than the number of offline participants. This percentage supports the argument in Chapter II regarding the digital participatory planning tools potential' to enhance public participation. Once public participation is captured, it is likely that marginalization and inequality will be reduced, since digital participatory planning tools can reach a larger number of people, including those who cannot participate in public meetings due to personal restrictions. In addition to reaching the disadvantaged segments of the society to offer them the same chances and equal opportunities, the system attracts young people, who are fond of technology and technological solutions. Another thing that should be noted from the Tuscany initiative is that digital participation should not completely substitute traditional participation represented by old-fashioned meetings. Because this substitution may widen digital divides, which are still exist in all countries. Digital divides vary from not having a digital device and internet connection, to not knowing how to access or use them (UN E-Government Survey, 2018).

The results of section A of the questionnaire. In order to get a precise answer to digital participatory planning tools' potential to enhance public participation, it was a necessity to address their potentials in general before addressing this specific potential. The author split these potentials into three questions in the questionnaire: digital participatory planning tools' potential for participatory urban planning, for the participatory urban planning process, and for the overall goals of participatory urban planning. Most results agreed on the potentials discussed earlier in Chapter II beside providing additional ones.

Firstly, looking at the potential of digital participatory planning tools for participatory urban planning, 92 percent of international experts believe in better decision-making; 85 percent believe in achieving more effective urban planning and better handling of problems; 77 percent in better planning; 69 percent in better solutions; and 46 percent believe in better plan

implementation, while the same percentage added further potentials in the open-ended questions (Figure 13).

Secondly, in respect of digital participatory planning tools' potential for the participatory urban planning process, 92 percent of international experts believe in collecting local knowledge, information, and data that are useful for the urban planning process; 77 percent believe that analyzing the collected data will help in planning exactly according to need; 46 percent believe that mapping collected data can be used in GIS; and 38 percent provided additional potentials, which will be discussed below (Figure 14).

Thirdly, in terms of digital participatory planning tools' potential for the overall goals of participatory urban planning, 92 percent of the international experts answers believe in the potential to enhance public participation; 85 percent of these answers believe in the potential to increase equality; 77 percent believe the tools will result in consensus building and avoid wasting efforts and resources; while 62 percent believe in the potential to reduce marginalization and unnecessary conflicts and increase democracy (Figure 15). None of the experts gave additional potentials in response to this question because they had already offered additional potentials to the previous (A1 and A2) questions.

Additional potentials in this section of the questionnaire came from the open-ended answers to questions A1 and A2 (Tables 4 and 5). International experts on digital participatory planning tools believe in the potentials of building trust, increasing transparency, and lowering data acquisition cost and time, plus accelerating the implementation process. Also, positive social potentials lie behind increased social cohesion, empowerment, and satisfaction. Specifically, the tools give citizens a sense of ownership and possibly prevent loneliness in the

long term. Above all, several experts stressed here the reduction of marginalization and enhancement of public participation and democracy.

In addition to the above, one of the first results of the uPort tool experiment in Zug was the enhancement of public participation, regardless of people's location.

6.2 Data Privacy Disruption of Digital Participatory Planning Tools' Potential to Enhance Public Participation

The second sub-question of the research was divided into two questions in section B of the questionnaire to help explain how the data privacy challenge could jeopardize digital participatory planning tools' potential to enhance public participation.

Firstly, in respect of the consequences of data privacy in digital participatory planning tools, the results of question B1 in the questionnaire saw "other" as the most popular answer (54%) (Figure 16).This indicates how this question touched a nerve and it was quite provocative for the expert, which could help to comprehend how sensitive they are regarding data privacy challenge in these tools is. Other answers showed that 31 percent believe the challenges put participants at risk and place urban planners under massive responsibility, while 23 percent believed they put the city at risk.

Secondly, the possible effects of the data privacy challenge in digital participatory planning tools saw 92 percent believe the participation rate would be lowered. This answer choice includes the second answer one, because if there is no participation there is no data in the first place whose quality will be lowered. Lowering data quality came second, with 46 percent of responses. 15 percent provided additional effects (Figure 17).

International experts provided additional points for the questions B1 and B2 through the "other" answer choice (Tables 6 and 7). The first point is that the risk depends on the data

collection process, specifically the type of data collected. Experts tried to differentiate two types of data—personal data and participation data—and gave recommendations on handling each type. Personal data should be stored in a separate database from participation data. These two types should be linked by an encrypted hash. Participation data should be normalized. Data normalization means the process of making data less redundant by grouping similar values into one common value. The participants could therefore trust the participatory tool and continue to participate.

6.3 Blockchain Technology as a Potential Solution to the Data Privacy Challenge in Digital Participatory Planning Tools

The e-voting blockchain-based system is considered the next-generation voting solution that makes voting instantaneous, anonymous, secure, transparent, auditable, and immutable. Security is the primary advantage of a decentralized voting system. Consequently, the results of the uPort tool experiment in the Swiss city of Zug clearly support the potentiality of blockchain technology as a solution to the data privacy challenge in digital participatory planning tools.

The answers to question B3 were approximately 61 percent don’t know. While, 31 percent agree and 8 percent disagree (Figure 20). These results confirm that blockchain-based digital participatory planning tools are still a state-of-the-art thing, and experts have not yet discovered their potential.

Finally, the data analysis process was divided into three main parts. The three discussions formed the three arguments which have been discussed in this chapter to help find answers to the research sub-questions. Discussing these three arguments provided insights to answer the research question, which will be discussed in Chapter VII.

CHAPTER VII

CONCLUSION

In order to answer the research question on how to overcome data privacy challenge disruption for digital participatory planning tools' potential in enhancing public participation, this chapter explores this question, summarizing what has been discussed in this research and the results leading to a final answer to the research question.

The research started by exploring the definition of digital participatory planning tools within their three main categories, as informative, interactive, and self-organized tools. In Chapter II, the research explored the potentials of digital participatory planning tools, especially the enhancement of public participation. This led to insight into the gap in the limited literature regarding these tools. As a result, the author searched for additional evidences on digital participatory planning tools' potential to enhance public participation to strengthen the argument of the research and further investigate the potential of digital participatory planning tools to enhance public participation.

Chapter II also yielded insights into the second gap, the data privacy challenge in these tools, discussing in detail in Chapter III how this could have serious consequences. The research suggested a potential solution to this challenge rather than simply pointing out a problem in a negative way just for the sake of criticizing.

Chapter IV introduced the case study methodology for addressing the research question. Three main evidences were presented and discussed. The evidences' location varies from the Italian region of Tuscany to the Swiss city of Zug. In addition, worldwide evidence comes from an international unit of analysis which the research questionnaire surveyed. This exploration ends with the following conclusion.

Digital participatory planning tools have several potentials in participatory urban planning, such as better decision-making. This potential means improving the decision-making process toward a data-based decision-making process, which will lead to more effective urban planning. Meanwhile, their potentials in the participatory urban planning process include collecting useful local knowledge, information, and data for the urban planning process; they allow the analysis of participation data to plan exactly according to need. Last but not least, their potentials in terms of the overall goals of participatory urban planning are enhancing public participation, increasing equality, consensus building, and avoid wasting efforts and resources.

The data privacy challenge is quite a sensitive and serious issue in digital participatory planning tools. The consequences of data privacy challenges vary and are not specifically determined, but the most certain effect of such a challenge is lowering the public participation rate and lower data quality obtained by these tools. There is an urgent need to solve this issue.

Blockchain technology provides several potentials in handling data, such as stability, trust, reassurance, transparency, and security. It is still a state-of-the-art thing in digital participatory planning tools. The future of this technology looks promising, since several private and public institutions are planning on adopting this technology.

How to overcome data privacy challenge disruption to digital participatory planning tools' potential to enhance public participation? In short, digital participatory planning tools have the potential to enhance public participation. Data privacy challenges disrupt this potential by lowering the participation rate. Blockchain technology is a potential solution to the data privacy challenge in digital participatory planning tools. Once the data privacy challenge is fixed, these tools can achieve their true potential in enhancing public participation and reducing marginalization and inequality. Moreover, these tools are a step toward effective urban planning.

Recommendations. This research stresses some recommendations for designing future digital participatory planning tools. Firstly, the design should encourage a higher participation rate for the sake of combating marginalization and inequality. Secondly, the design shouldn't completely substitute offline participation. On the contrary, it should help in organizing and advertising traditional meeting as well. Thirdly, digital participatory planning tools should embrace the highest ethical standards in data privacy and be compatible with European Data Privacy Law and the GDPR. Fourthly, using Blockchain-technology is recommended for its benefits in solving data privacy and security issues. These recommendations are for both urban planners and IT professionals.

Future research. The future is promising and open for digital participatory planning tools. Some experts anticipate that the number of internet connections may grow to nearly a trillion by 2035 (Nye, 2018). This research urges further research to combat the limited literature regarding these tools—in other words, there is a need to expand the literature to know their potentials and value, together with addressing other challenges these tools face, such as the third-level of participation, the e-decision-making level of participation, which still remains a serious challenge (UN E-Government Survey, 2018). This challenge was noticed clearly by the author while researching the data privacy challenge and it will be subject of the future research.

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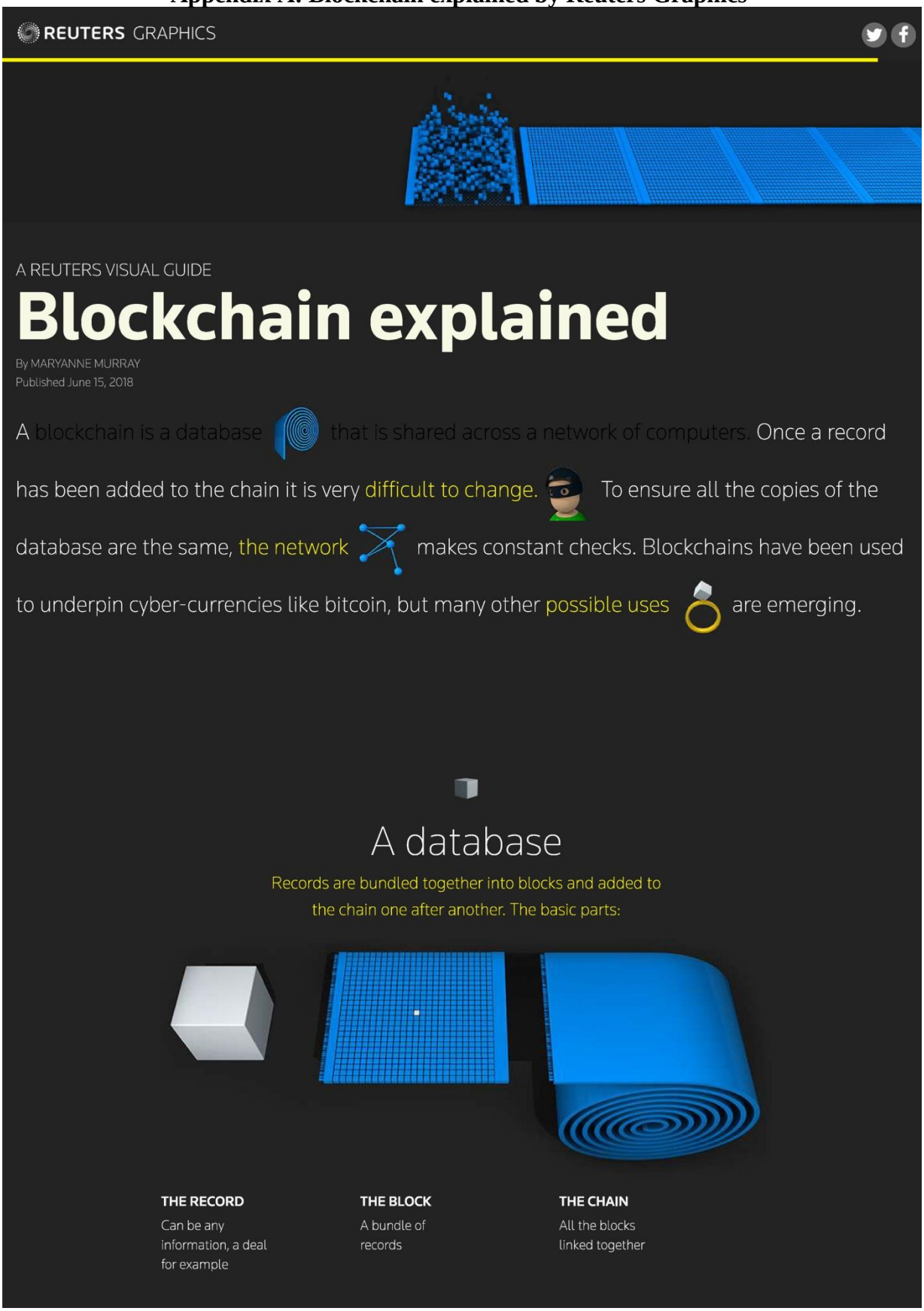
APPENDIX

Appendix A: Blockchain explained by Reuters Graphics



REUTERS GRAPHICS

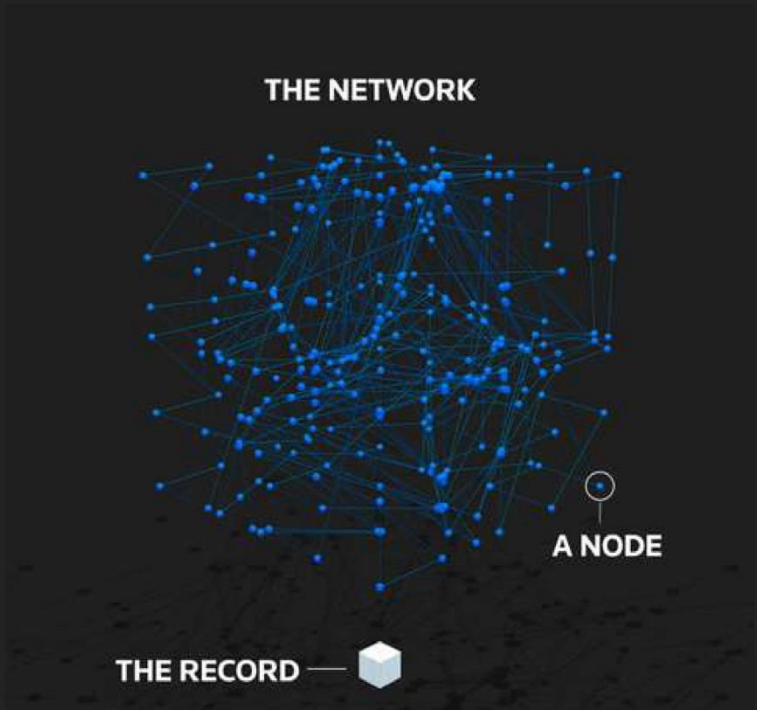
Here's how a deal gets included in a blockchain:

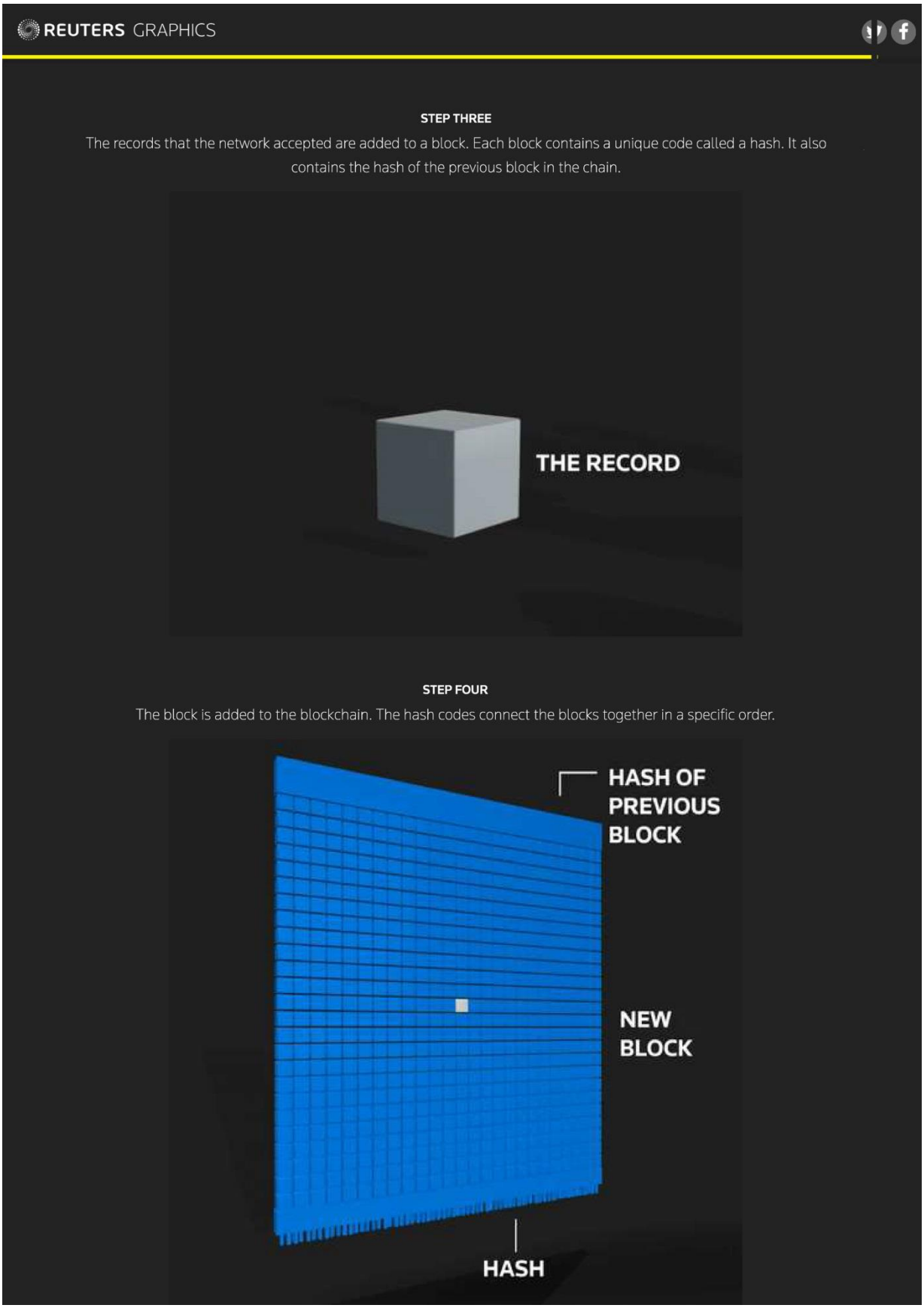
STEP ONE

A trade is recorded. For example, let's say Mr Pink is selling two of his coins to Mr Green for $100. The record lists the details, including a digital signature from each party.

STEP TWO

The record is checked by the network. The computers in the network, called 'nodes', check the details of the trade to make sure it is valid.




REUTERS GRAPHICS
STEP THREE
The records that the network accepted are added to a block. Each block contains a unique code called a hash. It also contains the hash of the previous block in the chain.
THE RECORD
STEP FOUR
The block is added to the blockchain. The hash codes connect the blocks together in a specific order.
HASH OF PREVIOUS BLOCK
NEW BLOCK
HASH

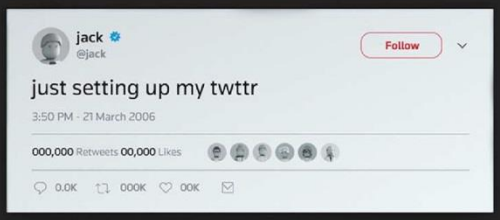
REUTERS GRAPHICS

Difficult to change

Hash codes keep records safe.

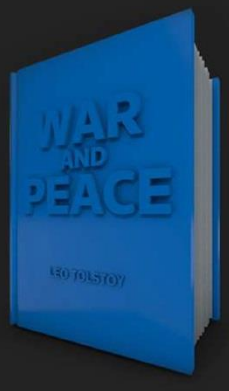
A hash code is created by a math function that takes digital information and generates a string of letters and numbers from it. Let's take a closer look at two important characteristics of hash codes:

First, no matter what the size of the original file, a hash function will always generate a code of the same length. For example, the first tweet from Jack Dorsey was much shorter than "War and Peace" by Leo Tolstoy, but they would yield hashes of the same length.



SAMPLE (32-BYTE) HASH LENGTH OF @JACK'S TWEET:

c6f7257abff7b43959cd728f06c0c74230391640115cc3ea86a7e54be62aecc4

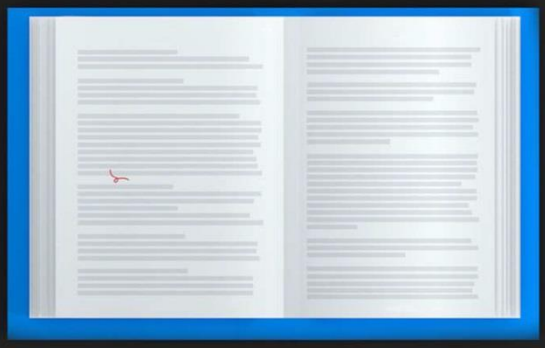


SAMPLE (32-BYTE) HASH LENGTH OF 'WAR & PEACE':

a948904f2f0f479b8f8197694b30184b0d2ed1c1cd2a1ec0fb85d299a192a447

REUTERS GRAPHICS

Second, any change to the original input will generate a new hash. So if someone decided to delete just one comma from Tolstoy's 587,287-word masterpiece, it would show up, because the hash would change.



ORIGINAL HASH:

a948904f2f0f479b8f8197694b30184b0d2ed1c1cd2a1ec0fb85d299a192a447

NEW HASH:

40115cc2aecc43ea86a7e54be6f7257abff7b43959cd728f06c0c7423039166r

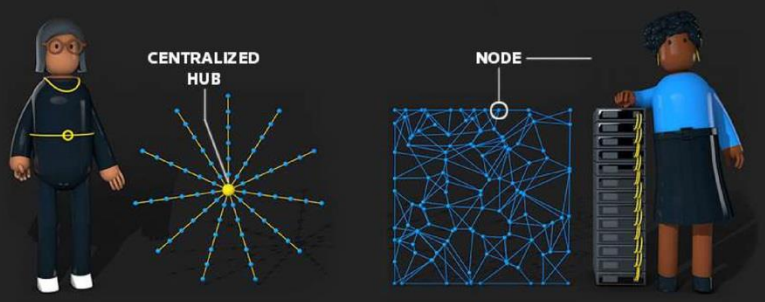
The changed hash breaks the chain.

The next block in the chain still has the old hash, so to restore the chain a hacker would have to recalculate that. And the next, and so on. Recalculating all those hashes would take an enormous amount of computing power.

REUTERS GRAPHICS

The computers in the network

Unlike traditional ledgers, a blockchain database is decentralized and has no "master."



CENTRALIZED NETWORK
Authority is held by a central node.

DECENTRALIZED NETWORK
All the nodes can access the information and compete to be the next to add to the database.

Permission to join

Without centralized control of a network, trust is a problem. One answer is to only let people you know, such as company employees, join in. But blockchains such as the bitcoin network are open to anyone. Members are anonymous. There is no way to know if they are trustworthy.

To resolve this and build trust, these blockchains set tests for the computers that seek to join and add records to the chain. The tests are called consensus models.

Reaching a consensus

The tests require network members to 'prove' themselves. Some examples:

PROOF OF WORK
To add a block to the chain, nodes must demonstrate that they have done 'work' by solving an increasingly difficult computational puzzle. This process, called mining, uses a lot of computing power. In return for their work, members can receive rewards - tokens for instance, or bitcoins.

PROOF OF STAKE
Participants buy tokens which allow them to join the network. The more tokens they have, the more they can mine.

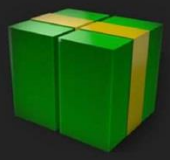
REUTERS GRAPHICS

Possible uses

There is a lot of hype about blockchain, but some promising uses are under development.

CRYPTOCURRENCY

Blockchains are the basis of bitcoin and other cryptocurrencies.



BANKING

Financial institutions have been investing in blockchains to simplify their record-keeping for payments.

SUPPLY CHAIN

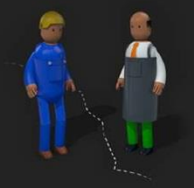
Recording trades on a blockchain offers a way to check the history of a product. For example, jewelry companies hope it can assure customers that diamonds are not from places where they could finance war.

HEALTHCARE

With blockchain, medical history could be securely stored and controlled by patients.

VOTING

Blockchain records could create tamper-proof election returns.



PROPERTY RECORDS

Storing land records on a blockchain could cut down on costly title research and insurance. In politically unstable places, it could help prove ownership.

Correction: An earlier version of this graphic incorrectly described a hash function as an example of encryption. Hashing is a form of cryptographic security that—unlike encryption— cannot be reversed, or decrypted.

For more Reuters coverage of financial technology, please visit our Future of Money page.

GRAPHIC by Maryanne Murray
DEVELOPMENT by Matthew Weber
VISUAL EDITING by Sarah Slobin
EDITED by Sara Ledwith

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Appendix B: Digital Participatory Planning Tools Questionnaire

Welcome to the Study of Exploring Digital Participatory Planning Tools

Greetings,

You are kindly requested to participate in the following questionnaire because of your involvement in digital participatory planning tool. Your experience is helpful for the purpose of enriching the current literature with more explanation regarding the role of Digital Participatory Planning Tools benefits on the urban planning process and an attempt to find a solution for data privacy issue in these tools.

Responding to this questionnaire is completely voluntary. If you come to a question you prefer not to answer, you are welcomed to skip it. The information you provide will remain confidential, anonymous and only be used for academic purposes.

Many thanks for your time and collaboration.

Sincerely,

Anas Shahin PhD.c, Arch

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Please, write your personalized code below:

A. The Benefits of Digital Participatory Planning Tools

A1. Which of the participatory planning benefits does your Digital Participatory Planning Tool allow?

(Please, check all that apply)

- ☐ Better planning
- ☐ Better handling of problems
- ☐ Better solutions
- ☐ Better decision-making
- ☐ Better plan implementation
- ☐ Achieving more effective urban planning
- ☐ *Add another benefit below:*

A2. What are the benefits of your Digital Participatory Planning Tool on the urban planning process?

(Please, check all that apply)

- ☐ Collecting local-knowledge, information and data that is useful for the urban planning process
- ☐ Mapping collected data to be used in Geographic Information System (GIS)
- ☐ Analyzing collected data help in improving the urban planning process
- ☐ *Add another benefit below:*

A.3 What are the benefits of your Digital Participatory Planning Tool on the urban planning overall goals?

(Please, check all that apply)

- ☐ Reduce marginalization
- ☐ Increase equality
- ☐ Consensus building
- ☐ Reduce unnecessary conflicts
- ☐ Enhance public participation
- ☐ Increase democracy
- ☐ Avoid wasting efforts and resources
- ☐ *Add another benefit below:*

B. Data Privacy Challenge in Digital Participatory Planning Tools

B1. What are the consequences of data privacy issue in Digital Participatory Planning Tools?

(For example: If this data got stolen or hacked and fell into the wrong hands)

(Please, check all that apply)

- ☐ Put the urban planner under massive responsibility
- ☐ Put the participants under risk
- ☐ Put the city under risk
- ☐ Other *(please specify)* ……

B2. What are the possible effects of data privacy issue in Digital Participatory Planning Tools?

(For example: When participants get skeptic regarding their data safety, they might stop participating or they might participate with fake or inaccurate data to protect themselves)

(Please, check all that apply)

- ☐ Lower participation rate
- ☐ Lower data quality
- ☐ Other *(please specify)* ……

B3. Can Blockchain technology be a solution for data privacy issue in Digital Participatory Planning Tools?

- ☐ Agree
- ☐ Disagree
- ☐ I don't know

Appendix C: Units of Analysis

Source: Falco and Kleinhans (2018, p. 69-78)

Overview of Digital Participatory Platforms

Table 3. Information sharing: Informing sub-level

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
Civic Insight	http://civicinsight.com/	It helps residents to be informed of issues such as code enforcement, building permits.	USA	Yes	Visualization, Analytics	Yes
OS City	http://www.oscity.eu/	Search, visualize, and combine data to gain insight on spatial planning (EU only).	Netherlands	No	Analytics, visualization, aggregation	N/A (presumably)
Open City Chicago	http://opencityapps.org/	A group that creates apps with open data to improve transparency and understanding of our government.	USA	Yes	Open source, Analytics, Visualization, aggregation	No
Tell Us Toolkit	http://www.tellus-toolkit.com/	A tailored package of map-based software tools for spatial analysis, decision support and stakeholder engagement.	UK	Yes (under Portfolio)	Analytics, visualization Decision support	N/A (presumably)

Table 4. Information sharing: Consulting sub-level

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
All Our Ideas	http://allourideas.org/	All Our Ideas is a research project that seeks to develop a new form of social data collection by combining the best features of quantitative and qualitative methods such as interviews, participant observation, and focus groups.	USA	No	Voting tool, analysis tool, adding ideas. Open source	No
Citizen Space	http://www.citizenspace.com/info	A system for creating online consultations, building surveys, complete with contextual information. Designed in collaboration with government specifically for public sector use.	UK	Yes	Online consultations, and surveys, Statistics and analytics.	Yes
Cycle Tracks	https://play.google.com/store/apps/details?id=org.sfcta.cycletracks&hl=en	CycleTracks uses GPS support to track users' bicycle trip routes. It aims to send data about bicycle trips (purpose, route, date and time) to the San Francisco County Transportation Authority's servers for mobility research and policy purposes.	USA	No	GPS tracking, reporting about user behaviour.	No

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Table 4. Continued

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
Cityzen	http://cityzen.io/	Conduct surveys, analyse and visualise data.	USA	No	Analytics, visualization surveys	N/A
Emotional Maps	http://www.pocitovemapy.cz/index-en.html	Emotional maps allow users to get involved in the process of collecting information related to their emotional links with their environment.	Czech Republic	No	Comments, opinions, maps, exporting data	N/A (presumably)
Epic Collect	http://www.epicollect.net/	EpiCollect.net provides a web and mobile app for the collecting and submitting ideas, comments, geotagged media	UK	No	Open source, Submit ideas, geotagged media, Analytics	No
Fulcrum	http://www.fulcrumapp.com/	Design custom forms and deploy to mobile devices for fast, efficient, and reliable mobile data collection.	USA	Yes	Collecting data, maps, forms,	Yes (18 to 25$/month)
GEOLive	https://geolive.ca/	GeoLive is a flexible and extendable online participatory mapping tool designed to facilitate organizations' ability to capture, manage and communicate their own spatial data	Canada	No	Maps, comments, geotagged photos,	N/A
iSPEX	http://ispex.nl/en/	iSPEX is an innovative way to measure aerosols. This instrument measures properties of small particles in the sky: aerosols. Aerosols can be measured with the iSPEX add-on together with the iPhone app.	Netherlands	No	Reporting	No
LandscapeMap2	http://www.landscapemap2.org/index.html	Collaborative mapping tools for advancing knowledge about places.	USA	Yes	Mapping, comments,	N/A
Local Data	http://localdata.com/about.html	LocalData is a cloud-based mapping platform that helps cities and communities make data-driven decisions by capturing and visualizing street-level information in real time.	USA	No	Open source Mapping Surveying, data collection, crowdsourcing	No
mySidewalk	http://www2.mysidewalk.com/	Ideation platform for community projects	USA	No	Spatial data collection, visualization, questionnaire	Yes
Partecipa!	http://www.partecipa.gov.it/	National Portal for public consultation. Consulting citizens on issues of national relevance such as quality of air, open data, transparency	Italy	No	Forum, Comments,	No
Participa	http://participa.pt/	Public consultations in Portugal. Citizens can contribute to a debate on a specific issue or project.	Portugal	No	Forum, comments	No
Peak Democracy	http://www.peakdemocracy.co/	Online public comment forum for US government.	USA	Yes	Forum, voting tool, analytics	N/A (presumably)
PlaceSpeak	https://www.placespeak.com/about	PlaceSpeak is a location-based consultation platform that solves the problem of how to engage with people online within specific geographical boundaries -- and prove it.	UK	Yes	Map based, survey	Yes (5.000 a year)

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Table 4. Continued

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
Poll Everywhere	https://www.polleverywhere.com/	It enables to conduct polls and moderate.	USA	Yes	Polls, analytics, moderation	Yes
Popularise	https://popularise.com/	Review projects submit, discuss and support new ideas.	USA	Yes (under cities)	Submit ideas, voting tool, discussion forum	No
Street Bump	https://itunes.apple.com/us/app/street-bump/id528964742?mt=8	Crowdsourcing application to improve public streets. Street Bump helps residents improve their neighborhood streets. As they drive, the mobile app collects data about the smoothness of the ride	USA	No	Sensing, GPS	No
Ushahidi	https://www.ushahidi.com/features	Developed to map reports of violence in Kenya after the post-election violence in 2008.	Kenya	No	Open source Data collection analytics	Yes (500$/mo)
We Sense	http://wesense.info/en/	The app is able to generate insights on people's perception of urban environments and what effects these surroundings have on them.	Netherlands	No	Media upload, and surveys	No
WideNoise	http://cs.everyaware.eu/event/widenoise	WideNoise is a project of EveryAware. WideNoise. The mobile app allows data to be collected and helps people understand the level of sound pollution around them.	Italy	No	Data collection	No

Table 5. Interaction level

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
AskTheEU	https://www.asktheeu.org/	AskTheEU.org is an online platform for citizens to send access to documents requests directly to EU institutions.	Spain	No	Send request.	No
Basta Platsen	http://dialog.spacescape.se/sollentuna/	Map-based comments for public engagement and discussion. A way to collect people's ideas and opinions.	Sweden	Yes	Map-based comments	No
长江论坛 (bbs.cjn.cn)	http://bbs.cjn.cn/thread-htm-fid-174.html	Established by local newspaper (public media). Encourage residents to comment, report problems (traffic, bus route, bicycle path, health) and make suggestions on local development.	China	No	Discussion Forum, Photo upload	No
BetterStreet	https://betterstreet.org/	Reporting street potholes and other issues.	Belgium	Yes (search by city)	Mobile app, Geo-located reporting, analytics	No
BougeMaVille	https://www.bougemaville.com/	Reporting issues and receiving feedback once the issue has been solved	France	No	Mobile app, Geo-located reporting, analytics	No

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Table 5. Continued

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
Budget Simulator	http://www.budgetsimulator.com/info	Tool for educating about budget priorities and collecting feedback.	UK	Yes	Sliders to allocate resources, statistics and analytics.	Yes
Buiten Beter	http://www.buitenbeter.nl/	Report to the municipality any issue that needs to be resolved such as broken bus shelter, potholes, full trash bins, and so on.	Netherlands	No	Mobile app, Geo-located reporting, analytics	No
Citizen Budget	http://www.citizenbudget.com/	Citizen Budget online simulator helps solicit residents' feedback on budget consultation.	Canada	Yes (under who's using it)	Comments, survey questions, Analytics	Yes
CitySourced	http://www.citysourced.com/	Quickly identify and report issues effecting communities and quality of life (e.g. potholes, graffiti, broken street lights, public safety).	USA	No	Mobile app, Geo-located reporting, analytics	Yes
Ciudadanos Activos	http://www.ciudadanosactivos.com/	Participación y Control Ciudadano Usando las Nuevas Tecnologías.	Colombia	No	Reporting, Discussion board, Submit idea, Maps,	No
Civic Commons	http://theciviccommons.com/	It serves community leaders, institutions and the growing desire of citizens to be engaged and empowered on key civic decisions. It allows to share ideas and discuss.	USA	Yes	Submit ideas, Discussion board	Yes
Civocracy	https://www.civocracy.org/	Enables effective, constructive discussion and shared decision-making between stakeholders (citizens, businesses, organizations, governments) and encourages active citizen engagement.	Germany	Yes (under top places)	Discussion board, voting tool	Yes
Codigital	http://www.codigital.com/	The most powerful and engaging way for large groups to generate, prioritize and refine ideas. Integrates with Social Networks and Intranets. Demo video.	UK	No	Submit Ideas, Discussion board, Voting tool, Analytics	Yes
Colab	http://www.colab.re/	Mobile app for reporting issues, making suggestions and ideas to local government.	Brazil	No	Mobile app, Geo-located reporting, Voting tool,	No
Deliktum	http://www.deliktum.com	Platform to report problems and crimes on maps.	Ecuador	Yes	Maps, reporting problems and crime, uploading photos.	No
Denuncia BR	http://www.denunciabr.com.br/	Citizens can report and geotag crimes and describe them.	Brazil	No	Geo-located Reporting	No
DialogueApp	http://www.dialogue-app.com/info/	Promotes dialogue to solve policy challenges with citizen input.	UK	Yes	Submit ideas, rate, comment	Yes
Dialoga Brasil	http://www.dialoga.gov.br/	Federal government platform for citizens to contribute with ideas to themes such as health, education, security, culture, and poverty reduction.	Brazil	No	Propose ideas, voting tool,	No

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Table 5. Continued

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
Ethelo Decisions	http://ethelodecisions.com/	Ethelo gathers multiple insights, streamlines collaboration, and identifies highly-supported decisions, all in one intuitive platform.	Canada	Yes	Collect ideas, opinions, analytics	Yes
FixMaVille	http://www.fixmaville.fr/	Reporting issues to councils. As in FixMyStreet	France	No	Mobile app, Geo-located reporting, analytics	No (Yes premium plan)
FixMyStreet	http://fixmystreet.org/	Open source report-mapping software that can be deployed anywhere in the world. Most commonly used for reporting street issues to councils, but flexible enough to fit any project that matches geographical points to email addresses.	UK	Yes	Open source Mobile app, Geo-located reporting, analytics	No
民心网 (For the people)	http://www.mxwz.com/	Established by the government for citizens to complain about and comment on different level of governments and departments' performance.	China	No	Discussion forum, submit ideas, complaints, photo upload, Maps.	No
Fort Worth Forum	http://www.fortwortharchitecture.com/forum/	Forum of the city of Fort Worth where citizens discuss new ideas and issues related to new urban development, use of public funds, transportation and so on.	USA	Yes	Discussion forum.	No
Get it done	https://www.sandiego.gov/get-it-done	Reporting services for abandoned vehicles, potholes, street lights, sidewalks. It has probably replaced Street Report.	USA	No	Mobile app, Geo-located reporting	No
Geo Citizen platform	https://play.google.com/store/apps/details?id=com.geocitizen.report	It allows Citizens and Communities to collaboratively report observations, discuss ideas, and monitor issues around their neighborhoods.	Ecuador	Yes	Mobile app, Geo-located reporting	No
Granicus	http://www.granicus.com/	Granicus Citizen Engagement tools allow for more people to contribute ideas for community improvement and provide feedback on current initiatives.	USA	Yes	Comment, discussion forum, submit ideas	Yes
Hey!Tenerife	http://heytenerife.es/es/index.html	Platform for consultation of citizens on different issues proposed by the government. Citizens can also raise issues and start a new proposal/discussion.	Spain	No	Comments, voting tools, discussion forum	No
InCity	http://www.incityapp.fr/	Reporting street potholes and other issues.	France	No	Mobile app, Geo-located reporting	No
Irekia	http://www.irekia.euskadi.eus/	Citizens as well as government can raise and consult on issues.	Spain	No	Open Source, Submit ideas, voting, comments	No
Jaidemaville	http://jaidemaville.com/	Reporting issues.	France	No	Mobile app, Geo-located reporting	No

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Table 5. Continued

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
Leon Emergente	http://emergenteleon.org	León Emergente is an international research and cooperation project aimed at developing an exhaustive digital, dynamic and collaborative Atlas for the city of León, Nicaragua. The aim is to provide access to the different online maps and to engage citizens in the production of these maps in a simple way.	Nicaragua	Yes	Maps, comments	No
Liquid Feedback	http://liquidfeedback.org/	Governments and parliaments can use LiquidFeedback to poll the opinion of the public, while not being limited to yes/no–questions: Citizens may rephrase the question and provide unforeseen answers.	Germany	No	Open source, Comments, voting	No
Loomio	https://www.loomio.org/marketing	Online tool for collaborative decision-making, built by a team of technologists, activists and social entrepreneurs in New Zealand. Loomio emerged from the need for a scalable way to make inclusive group decisions during the Occupy movement in 2011.	New Zealand	Yes	Open source, Submit ideas, voting, prioritizing,	Yes for premium plans
MapChat	http://mapchat.ca/	MapChat is an open source tool for integrating maps with real-time (as well as asynchronous) discussions between multiple users through chat conversations.	New Zealand	Yes	Open source, Mapping, comments, geotagged media,	No
Mejora tu Ciudad	http://www.mejoratuciudad.org/	Website and mobile application for reporting, interacting, commenting.	Spain	No	Mobile app, Geo-located reporting, comments and ideas, voting	N/A (presumably yes)
Mind Mixer	https://www.mindmixer.com/	It fosters citizens engagement and collaboration. It Allows citizens to submit ideas and vote.	USA	No	Submit ideas, Comments, Voting	Yes
MintScraps	https://www.mintscraps.com/	Online platform that helps restaurants and food service businesses to track and reduce their waste. It connects them with the local waste hauling company to find solutions for recycling, composting and trashing.	USA	No	Analytics, comments, forums.	Yes
mySociety	https://www.mysociety.org/contact/	The tools harness the power of digital technologies to empower citizens, open channels of communication, and help planners make the right decisions. The more famous Fix My Street is part of this effort.	UK	No	Forums, maps, reporting	N/A (presumably yes)
Open311	http://www.open311.org/learn/	Open standard for connecting citizens to government for reporting non-emergency issues.	USA	No	Mobile app, Geo-located reporting	No
OpenDCN	http://www.opendcn.org/index.php/en	The openDCN software environment -- where DCN stands for Deliberative Community Networks – provides on-line dedicated tools to support participation and deliberation. Download	Italy	Yes	Open Source Maps, media upload, comments, Forum.	No

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Table 5. Continued

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
Philly Watchdog	http://www.philadelphiacontroller.org/philly-watchdog	The Nation's first government app allowing citizens to report fraud & waste through smartphone technology.	USA	No	Reporting, media upload	No
PlanYourPlace	http://planyourplace.ca/elgg/	PlanYourPlace is an open source structure of modern web-based solutions to support planning practice that engage community.	Canada	Yes	Open Source Maps, comments, forums	No
PublicStuff	http://www.publicstuff.com/	Communication system for reporting and resolving community concerns.	USA	No	Mobile app, Geo-located reporting, comments, access services	Yes
Sag's Wien	https://www.wien.gv.at/sagswien/	Sending requests to the city of Vienna. At any time, you can report a concern, a danger point or a malfunction via the smartphone to the Vienna City Administration	Austria	No	Mobile app, Geo-located reporting	No
SeeClickFix	http://www.seeclickfix.com/	For reporting and responding to neighbourhood issues.	USA	Yes	Mobile app, Geo-located reporting, Sync, sharing	No
Speak up Austin	http://speakupaustin.org/	The city of Austin's community engagement portal. SpeakUpAustin is making it easier for the public to communicate feedback and receive information.	USA	Yes	Submit ideas, discussion forum, voting tool	No
Textizen	https://www.textizen.com/welcome	Textizen's web platform sends, receives, and analyzes text messages so you can reach the people you serve with the technology already in their pocket, 24/7.	USA	Yes	Text, analytics	N/A (presumably yes)
Tip411	https://tip411site.wordpress.com/	It helps public agencies engage the public through alerts, texts and a mobile app on crime-related information. Tips submitted by citizens can be responded to in real time.	USA	Yes	Submit tips, reporting,	Yes
WeJIT	http://www.mywejit.com/	Collaborative online Forum for decision-making, brainstorming, debating, prioritizing, and more.	USA	No	Submit ideas, voting, comments	No
WhatDoTheyKnow	https://www.whatdotheyknow.com/	You have the **right** to request information from any publicly-funded body, and get answers. WhatDoTheyKnow helps you make a Freedom of Information request. It also publishes all requests online.	UK	No	Send requests to obtain info, comment	No
WriteToThem	https://www.writetothem.com/	Write to your politicians, national or local, for free.	UK	No	Send requests, connect with local politicians	No

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Table 6. Co-production level

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
Bang the Table – Engagement HQ	http://www.bangthetable.com/	Platform for public engagement needs. Digital mapping, ideation, stories, blogs, discussion forums.	Australia	Yes	Opinion maps, surveys, submit Ideas, Forums, Exporting, Analytics	Yes
Block by Block	http://blockbyblock.org/	It is based on Minecraft to engage poor communities in urban design and fund the implementation of public space projects all over the world.	Sweden	Yes	Simulation software and urban design	Yes
Carticipe	https://carticipe.net/	Carticipe is participatory platform designed to foster citizens debate and consultation on city-related matters. The tool combines social networks and interactive maps.	France	Yes	Voting, submit ideas, comments, map-based, Analytics	N/A (Presumably yes)
Citizinvestor	http://www.citizinvestor.com/	Crowdfunding and civic engagement platform for local government projects.	USA	Yes	Crowdfunding, voting, submit ideas. Upload media	Yes
CityLab010	https://www.citylab010.nl/	Platform to develop ideas for Rotterdam to make the city a more attractive place to live, work or study.	Netherlands	Yes	Submit Ideas and Plans to the city of Rotterdam.	No
CityPlanner	https://cityplanneronline.com/site/	Map-based platforms and 3-D models that allows citizens to submit their ideas and projects.	Sweden	Yes	Submit ideas, maps, comments, 3-d models	Yes
Commonplace	http://commonplace.is/	A simple and clear map-based tool for capturing people's views.	UK	Yes	Map-based, Analytics, ideas, comments	N/A (presumably yes)
Community Remarks	http://www.communityremarks.com/	Map-based tool for facilitating dialogue and collecting feedback.	USA	Yes	Maps, Photos, Comments, Exporting, Analytics	Yes
coUrbanize	http://www.courbanize.com/	List project information for development proposals and gather online feedback.	USA	Yes	Comment, voting tool, ideas, maps, Analytics	Yes
Creative Citizens Sticky World	http://info.stickyworld.com/	Stickyworld makes it easy to present, explain and discuss your projects with clients, end users, local communities or citizens	UK	Yes	Maps, comments, ideas, discussion forum	Yes
Crowdbrite	http://www.crowdbrite.net/#_blog	It allows citizens and stakeholders engagement for strategic planning, infrastructure, built environment projects.	USA	Yes	Maps, surveys, comments, ideas, visualization, analytics	Yes
Crowdgauge	http://crowdgauge.org/	Allows users to set priorities, rate and support different options and contribute with ideas about actions and policies.	USA	Yes	Open source Budget allocation, maps, rating, comments	No

continued on following page

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Table 6. Continued

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
Crowdmap	https://crowdmap.com/welcome	Crowdmap allows to aggregate and visualise information and data from cell phones, news and web in general on maps. Add comments and report issues.	Kenya	No	Open source Maps, Comments, Importing, reporting, Analytics	No
Geojson	http://geojson.io/#map=2/20.0/0.0	Geojson is a data format for encoding a variety of geographic data. Mapping application for collaborative mapping exercises. Geographic data can be mapped and exported in different formats.	USA	No	Open Source Maps, Comments, Exporting	No
Ideascale	https://ideascale.com/gov/	The IdeaScale citizen engagement platform will facilitate data gathering from small to large citizen crowds all in one easy-to-create, easy-to-view, easy-to-manage site.	USA	Yes	Submit ideas, comments, voting, Analytics	Yes
Mapping for Change	http://mappingforchange.org.uk/	Participatory and Collaborative mapping services.	UK	Yes	Maps, comments, ideas, analytics,	Yes
Map Server	http://www.mapserver.org/	MapServer is an open source platform for publishing spatial data and interactive mapping applications to the web.	USA	No	Open Source Mapping,	No
Maptionnaire	https://maptionnaire.com/?lang=en#how	Create a map-based questionnaire of your own. Promote discussion by publishing the results in Maptionnaire. Analyze and report.	Finland	Yes	Maps, comments, submit ideas, exporting	Yes
MetroQuest	http://metroquest.com/	It incorporates scenario planning and visualizations for informing the public and collecting feedback. Allows citizens to submit and vote ideas.	USA	Yes	Submit ideas, Voting, maps	Yes
MinStad	http://minstad.goteborg.se/minstad/index.do	This platforms allows citizens to submit ideas in a 3-D model for the city of Goteborg, Sweden.	Sweden	Yes	Submit ideas, comments, maps, 3-D model	No
Neighborland	https://neighborland.com/	It empowers civic leaders to collaborate with residents in an accessible, participatory, and enjoyable way providing real-world design tools and a powerfully simple platform to engage people on the web.	USA	Yes	Submit ideas, comments, maps, discussion forums.	Yes
Shareabouts – Open Plans Project	http://openplans.org/	Shareabouts is a web-based mapping tool for gathering crowdsourced public input in an engaging social process. People can drop a pin on a map to provide ideas, suggestions, and comments.	USA	Yes (under projects)	Open source Map based, comments, submit Ideas,	No
TransformCity	http://www.transformcity.com/	Collaborative mapping. People can share their ideas and wishes for the area.	Netherlands	Yes	Maps, submit ideas, comments.	Yes

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Table 6. Continued

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
Urban Interactive Studio	http://urbaninteractivestudio.com	Reaches, informs, and involves citizens and stakeholders in public projects and decision making allowing them to comment, share pinions.	USA	Yes	Maps, submit ideas, comments, Analytics.	Yes
Voor Je Buurt (Dutch):	https://www.voorjebuurt.nl/	Dutch crowdsourcing version of the New York platform ChangeByUs	Netherlands	Yes	Share projects, crowdfunding	No

Table 7. Self-organization: Public matters sub-level

Platform	Website	Description	Coverage	Case Studies	Main Tech. Features	Pricing
Airesis	https://www.airesis.eu	A platform to organize groups, engage people and hear their opinion. Tools to share documents, discuss ideas, vote and summarize shared solutions. A mass deliberative system. A tool to enhance collective intelligence.	Italy	No	Open Source Discussion, voting tools.	No
BUURbook	https://buurbook.nl/	Forum that encourages community discussion and action at neighbourhood level.	Netherlands	Yes (under Buurten)	Discussion forum, maps, uploads	No
FragNebenan	https://fragnebenan.com/	Networking and improved interaction among neighbours.	Austria	No	Message board, comments, maps	No
Front Porch Forum	http://frontporchforum.com/	Front Porch Forum's mission is to help neighbours connect and build community. We do that by hosting regional networks of online neighbourhood forums.	USA	No	Discussion Forum	No
MataTag	http://www.mata-tag.com/	Citizens can identify places that need graffiti removal and can volunteer to remove them.	Portugal	No	Upload photos, report graffiti, volunteer	No
Mapas Cultura	http://mapas.cultura.gov.br/	Citizens share information about cultural events that take place in their cities. Information sharing among citizens. No government involved.	Brazil	Yes	Open source Post events	No
NextDoor	https://nextdoor.com/	Private social network and forum for neighbourhoods. Demo video.	USA	No	Forum	No
Open Austin	https://github.com/open-austin/project-ideas/issues	Open Austin project ideas. Part of the open Austin initiative for citizens to discuss ideas and project	USA	No	Forum, submit ideas, comments	No
Recovers	https://recovers.org/	App for self-organizing and organizing disaster relief.	USA	Yes	Comments, volunteering, donations	No
Tem Açúcar?	https://play.google.com/store/apps/details?id=com.temacucar&hl=en	Citizens can share goods, opinions and meet.	Brazil	No	Forum, blog	No
中国桐城 (Tongcheng China)	http://bbs.tongcheng.gov.cn/index.php	Established by the municipality government to encourage citizens to share their experiences and comments and complain on local development issues.	China	No	Discussion Forum, Comments, complaints	No

Source: Own Elaboration

Appendix D: Interview with Dr Reinout Kleinhans

Question 1. Do you recommend any references regarding this topic?

Question 2. Could you share with me more data you have collected about these tools?

As for your other two questions: our paper outlines how we started with a first collection of platforms and then snowballed to find other platforms as well. Some of these were suggested by colleagues in the field; others we found through collecting digital newsletters and other information for more than two years. We do not have particular data on these platforms: what we have is compiled in the Appendix table, including links to more data and information on the platforms themselves (such as case study reports).

Question 3. Can you tell me more about the process you followed to contact these tools and the collection of your data? Do you have an email list I can use to contact them?

Question 4. Is there any specific protocol that you used to contact them and make them agree to cooperate with you?

For our follow-up research (see last paragraph of the paper), we are basically contacting representatives from selected platforms by simply emailing them, using the contact data available on the platforms. It helped that we could show this open access paper, so they knew we meant business. The selection of platforms is based on our assessment of the co-production potential and (spatial) ease of access. In other words, there is no complicated protocol here.

Appendix E: Interview with the Communication Office of the Swiss City of Zug

Interview with Janina Römer on 9 November 2018, replying on behalf of Martin Würmli, clerk of the city of Zug.

Question 1. What is your main motivation for applying this digital identity based on decentralization and sovereignty using Blockchain technology?

Concerning your first question, you find attached two media releases: one by Luxoft and one by the communications department of the city.

Question 2. Is there a certain event that pushed you toward adopting this solution?

No, there was not a certain event that pushed us towards adopting this solution.

Question 3. Can you provide me with evidence such as results, academic references or any case studies that were carried out or are even still ongoing which I can use in my dissertation?

Last but not least, I recommend contacting Dr. Alexander Denzler from the University of Lucerne.

Appendix F: The Zug Blockchain Experiment

Luxoft's Blockchain for Government Alliance Set to Drive Blockchain Adoption through Open Source

Zug, SWITZERLAND – June 25, 2018 -- Luxoft Holding, Inc (NYSE:LXFT), a global IT service provider, partnered with the City of Zug and Lucerne University of Applied Sciences in Switzerland to create the first customizable blockchain-based e-voting system to be used by a major economy. To drive the adoption of blockchain-based services in government, Luxoft today announces it is committing to open source this platform and is establishing a Blockchain for Government Alliance to promote blockchain use-cases in public institutions.

"Luxoft is proud to have an opportunity to work together with the city of Zug to explore various blockchain applications," **said Vasily Suvorov, Chief Technology Officer at Luxoft**. "As Europe's leading supporter of blockchain, Zug already accepts cryptocurrency for services, has digitized ID registrations built on the blockchain, and now we have helped them create and try the means to safely and securely move voting online."

Luxoft built the permissioned blockchain based solution e-Vote, including the platform itself, software and algorithms on Hyperledger Fabric. This was then integrated with Zug's Ethereum-based digital ID registration application, enabled by uPort, to allow residents to cast votes on the blockchain. The solution uses an innovative encryption technology that on one hand anonymizes the votes and on the other hand allows tamper-proof tally and secure audit.

With help from the Lucerne University of Applied Sciences and Arts, AWS and n'cloud.swiss, the platform is deployed on three different data centers in the cloud: two in Switzerland and one in Ireland. By distributing the data into three different data centers, security and data loss risks are distributed geographically, making the system more robust. What's more, the platform can permanently delete voting data within an agreed time, in accordance with Swiss law.

"There is a concern with e-voting as it is a fundamental mechanism for direct democracy," **said Suvorov**. "As a result, we believe this technology cannot be owned by a single company. We will make the e-voting platform open source so people can understand what makes up the technology and how it works, ensuring full transparency. Looking ahead, our alliance will encourage more people to develop blockchain-based applications for Governments worldwide."

Luxoft, one of the founding members of the Crypto Valley Association, will partner with organizations working on government-based blockchain service solutions and invite them to jointly create Blockchain for Government Alliance, so all contributing parties can develop the source code of e-Vote further – creating a real-life customizable blockchain solutions organizations can reliably use globally every day.

About Luxoft

Luxoft (NYSE:LXFT) is a global IT service provider of innovative technology solutions that delivers measurable business outcomes to multinational companies. Its offerings encompass strategic consulting, custom software development services, and digital solution engineering. Luxoft enables companies to compete by leveraging its multi-industry expertise in the financial services, automotive, communications, and healthcare & life sciences sectors. Its managed delivery model is underpinned by a

highly-educated workforce, allowing the Company to continuously innovate upwards on the technology stack to meet evolving digital challenges.

Luxoft has more than 12,900 staff across 42 cities in 21 countries within five continents, with its operating headquarters office in Zug, Switzerland. For more information, please visit www.luxoft.com.

Forward-Looking Statements

This news release of Luxoft Holding, Inc ("Luxoft") contains "forward-looking statements" within the meaning of the Private Securities Litigation Reform Act of 1995, Section 27A of the Securities Act of 1933, and Section 21E of the Securities Exchange Act of 1934. These forward-looking statements include information about possible or assumed future results of our business and financial condition, as well as the results of operations, liquidity, plans and objectives. In some cases, you can identify forward-looking statements by terminology such as "believe," "may," "estimate," "continue," "anticipate," "intend," "should," "plan," "expect," "predict," "potential," or the negative of these terms or other similar expressions. These statements are subject to, without limitation, the risk factors discussed under the heading "Risk Factors" in Luxoft's Annual Report on Form 20-F for the year ended March 31, 2017 and other documents filed with or furnished to the Securities and Exchange Commission by Luxoft. Except as required by law, Luxoft undertakes no obligation to publicly update any forward-looking statements for any reason after the date of this news release whether as a result of new information, future events or otherwise.

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Appendix G: The Zug Blockchain Experiment in German Language

Medienmitteilung vom 25. Juni 2018 – frei zur sofortigen Veröffentlichung

Stadt Zug

Blockchain-Konsultativabstimmung erfolgreich gestartet

Am 25. Juni um 10.00 Uhr hat Stadtpräsident Dolfi Müller mit seiner digitalen ID an der ersten blockchainbasierten Konsultativabstimmung in der Stadt Zug teilgenommen und diese damit eröffnet. Die Abstimmung umfasst zwei Ja-/Nein-Fragen und eine Frage mit mehreren Antwortmöglichkeiten. Inhaberinnen und Inhaber einer digitalen ID der Stadt Zug können noch bis am 1. Juli 2018 an der Abstimmung teilnehmen.

Verschiedene andere E-Voting-Systeme werden auch in anderen Schweizer Kantonen getestet. Im Gegensatz zu diesen Systemen erfolgt der Prozess der Abstimmung in der Stadt Zug nicht über einen einzigen zentralen Server, sondern verteilt über eine Blockchain auf vielen Computern. Dies macht das E-Voting-System sicherer und weniger anfällig für unbemerkte Manipulationen. Stadtpräsident Dolfi Müller zeigte sich nach seiner Abstimmung beeindruckt: «Beim dezentralen E-Voting sind die Datensouveränität und die Transparenz für die Abstimmenden am höchsten, weil eine individuelle Nachvollziehbarkeit besteht.»

Mit der blockchainbasierten Testabstimmung will die Stadt Zug zusammen mit den Projektpartnern verschiedene sicherheitsrelevante Aspekte überprüfen. Im Vordergrund stehen der Persönlichkeitsschutz, das Abstimmungsgeheimnis, die Unveränderbarkeit der Abstimmung sowie die Prüf- und Nachvollziehbarkeit der Ergebnisse. Bei der Testabstimmung kommt eine innovative Verschlüsselungstechnologie zum Einsatz, welche einerseits die abgegebenen Stimmen anonymisiert und andererseits eine sichere Prüfung ermöglicht. Es handelt sich um eine Konsultativabstimmung, die dem Stadtrat wertvolle Hinweise aus der Bevölkerung gibt. Sie ist jedoch nicht rechtlich bindend wie eine ordentliche Volksabstimmung.

Das E-Voting-System wurde von der global tätigen, börsenkotierten IT-Unternehmung Luxoft in Zusammenarbeit mit der Stadt Zug und dem Departement Informatik der Hochschule Luzern entwickelt. Die E-Voting-Plattform der in Zug ansässigen Luxoft soll gemäss den Angaben des Unternehmens in Zukunft «Open Source» ausgestaltet werden: Mit dem Offenlegen des Quellcodes will Luxoft blockchainbasierten E-Voting-Lösungen weltweit zum Durchbruch verhelfen. Vasily Suworow, Chief Technology Officer bei Luxoft, sagte dazu: «Es bestehen Bedenken hinsichtlich der elektronischen Stimmabgabe, da Abstimmungen ein grundlegender Mechanismus für die direkte

Demokratie sind. Deshalb glauben wir, dass diese Technologie nicht einem einzigen Unternehmen gehören sollte. Wir werden die E-Voting-Plattform 'Open Source' ausgestalten, damit die Menschen verstehen können, was die Technologie ausmacht und wie sie funktioniert. Wir wollen mehr Menschen ermutigen, blockchainbasierte Anwendungen für Regierungen weltweit zu entwickeln.»

Das Team des Departements Informatik der Hochschule Luzern hat das Forschungsprojekt koordiniert, den Kontakt zwischen der Stadt Zug und Luxoft hergestellt, die E-Voting-Infrastruktur aufgesetzt und schliesslich die von Luxoft kreierte Blockchain-Software – quasi das Herz des E-Voting-Systems – in diese Infrastruktur eingefügt. Dr. Alexander Denzler, Dozent für Blockchain und Big Data am Departement Informatik der Hochschule Luzern, sagte dazu: «Für uns ist dieses Projekt eine tolle Möglichkeit zu testen, was im Bereich E-Voting und Blockchain bereits funktioniert, und wo wir noch an den Schrauben drehen müssen. Bislang gibt es nämlich kaum blockchainbasierte E-Voting-Projekte, an denen wir uns orientieren könnten.»

Die Auswertung der blockchainbasierten Testabstimmung und die Analyse der daraus gewonnenen Erkenntnisse erfolgt in den nächsten zwei Monaten. Über die Resultate werden die Projektpartner nach den Sommerferien informieren.

Die digitale ID der Stadt Zug wurde am 15. November 2017 eingeführt und befindet sich in einer Pilotphase. Neben einer E-Voting-Lösung sind für die Inhaberinnen und Inhaber einer digitalen ID verschiedene andere Anwendungen in der Evaluation, darunter das Ausleihen von Stadtvelos an verschiedenen Orten oder von Büchern in der Bibliothek ohne Bücherausweis. Interessierte haben weiterhin die Möglichkeit, über die Webseite der Stadt Zug und die Installation der «uPort»-App ihre digitale ID zu bekommen und an der Konsultativabstimmung teilzunehmen. Nach dem Abschluss der Registrierung über die Website der Stadt Zug und die «uPort»-App haben die Anwender zwei Wochen Zeit, um bei der Einwohnerkontrolle vorbeizugehen und ihre persönliche ID einmalig beglaubigen zu lassen. Für diese Überprüfung haben sich die Anwenderinnen und Anwender mit ihrem Pass oder ihrer Identitätskarte auszuweisen. Mit einer Beglaubigung bis am 29. Juni besteht auch für Neuregistrierte die Möglichkeit, an der Abstimmung bis am 1. Juli um 23.59 Uhr teilzunehmen.

Zug, 25. Juni 2018

Für Auskünfte:
Dolfi Müller, Stadtpräsident, 041 728 21 01
Martin Würmli, Stadtschreiber, 041 728 21 03

Appendix H: Final Report of Zug e-Voting Platform Experiment

Evaluation of the blockchain vote in the city of Zug

After receiving IDs issued from the city of Zug, 72 digital ID holders took part in a consultative vote from 25 June to 1 July 2018. By holding this test vote online, the blockchain-based proof of concept, eVote, was regarded as a novel yet practical voting approach that can be used in real life. This report presents the various benefits of using a decentralized voting solution, the underlying architecture of the system and feedback from citizens who participated in the vote.

Centralized or decentralized? That is the question

A decentralized voting system underpinned by blockchain has many advantages over traditional, centralized, paper-based systems.

Before going further, it is essential to understand the distinction between centralized and decentralized voting systems. The defining characteristic of a decentralized system is that there is no single entity taking control. A decentralized system also implies it is distributed, meaning that any information processed – whether via computing or data storage – is shared across multiple nodes. By this definition, traditional paper-based voting is considered to be centralized. It is also important to recognize that most other so-called eVoting mechanisms, whether through voting machines or online, are also centralized. Although they are distributed in a sense, the decisions are still made centrally.

A decentralized voting system brings the benefits of online voting with added benefits enabled by blockchain. For instance, there is no geographical restriction: votes can be cast anywhere through the internet, which can certainly boost turnout. Beyond that, we outline its major advantages below:

Security
The primary advantage of a decentralized voting system is security. The data's authenticity is guaranteed throughout the poll.

Firstly, with effective identity management, it is infeasible for hackers to impersonate voters. Secondly, techniques like digital signatures protect the integrity of the data, meaning votes cannot be tampered with in transit. Thirdly, the blockchain is immutable – once a vote has been recorded, it cannot be removed or altered.

As the data is stored across multiple nodes, even if one or several nodes are hacked, the voting data cannot be destroyed by hackers. As long as there are enough nodes, it is almost impossible for the whole system to be compromised.

Stability
As mentioned above, data can be distributed across a decentralized system. Tasks can also be redistributed from overloaded nodes to idle nodes, balancing the system. Because of this, not even a single-node fault can cause a system outage, resulting in a better user experience since voters can always get a timely response.

Trust
In a decentralized voting system, a set of entities validate the votes, and every entity must agree how a vote has been cast before recording it. A validator may not only be the organizer of the poll, a government for example, but it could also be various accredited institutions: these can range from the UN, to particular political parties, and even to local councils. Such a process ensures that even a corrupt government cannot forge the votes. In other words, the decentralized system protects against internal falsification.

Reassurance
When using paper ballots, voters have limited information about their vote. They are often untraceable once placed into the box or sent by mail — voters do not truly know whether their vote has been counted. However, in a decentralized voting system, once all votes are validated and recorded, voters can opt in to receive a notification that confirms their vote has been documented.

Transparency
A centralized system is usually closed-source to prevent the leak of security breaches making it a black box for the end users. In contrast, a decentralized voting application can be open-sourced to allow any person or institution to audit its functions, which increases transparency. In addition, open-source software encourages peer reviews, meaning more developers can contribute to continually improve the system, which further improves its security.

The verifiable electronic voting system

eVote is the next-generation voting solution that, due to its blockchain nature, makes voting instantaneous, anonymous, secure, transparent, auditable and immutable.

eVote allows local and federal authorities to:

- Set up and inform participants about a new poll, processing the results within minutes
- Save time and money on operational costs
- Engage more people via an instant and secure way to vote, regardless of the voter's location
- Significantly improve trust in voting systems since blockchain is fundamentally immutable

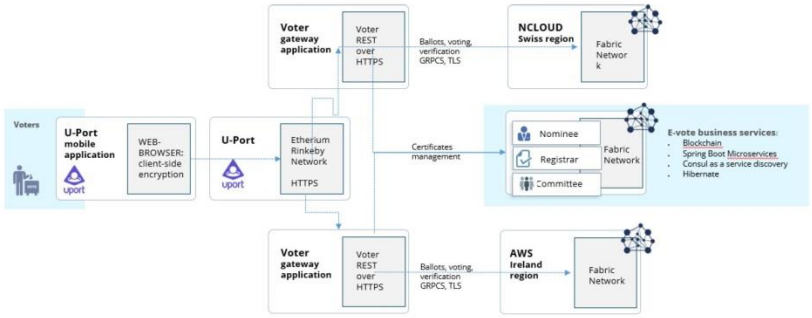
eVote enhances the voting process with the following features:

- As an anonymized process, this solution does not reveal any personal information from voters and keeps their votes private
- Voters can view and change their own votes at any time during the poll
- While anonymous, the legitimacy of the participants is still validated by an external identity system, with every user having the power to verify every vote
- Due to being securely encrypted, all voting data is tamperproof

eVote brings together the following technology:

- Homomorphic encryption – a cryptosystem that allows users to calculate encrypted data as if it were unencrypted, without seeing or disclosing this data. E.g. users can add encoded numbers together without decoding them. eVote uses Paillier for homomorphic encryption.
- Digital signature – a mathematical proof that confirms the signer has submitted data to the system and cannot deny having submitted it. The signature guarantees the data was not altered in transit through the blockchain system.
- Client-side encryption – the voters' private keys are isolated directly on their own PCs, where they are used for private data encryption.
- Zero-knowledge proofs – are a method where one party can prove to another party that a given statement is true, without conveying any information apart from the fact that the statement is indeed true.

How does the eVote solution work? Easily.



Voting Process Definitions:

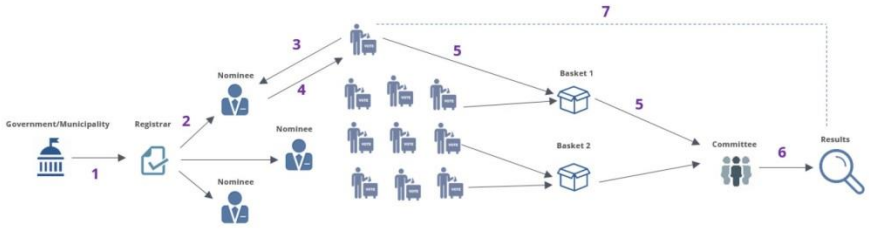
Roles:

- **Registrar** is an authority who initiates and manages a voting poll
- **Nominee** is an authority who verifies and confirms the voters' eligibility to vote (by recognizing voters by their digital ID) and provides voters their ballots
- **Voter** is a person who holds a digital ID and votes
- **Voting Committee** is an authority who counts, verifies and submits the voting results

Terms:

- **Poll** is a group of questions included during a particular round of voting
- **Ballot** is a unique collection of answers for each voter, e.g. for an individual poll
- **Baskets** are decentralized and immutable data storage containers where voters submit their ballots.

What does the voting process look like?



Pre-vote
Before voting begins, every voter obtains a confirmed U-Port digital ID from the authorities.

Step 1
The government or municipality initiates a new round of voting, sending all necessary information about what will be voted on to the appointed registrar.

Step 2
The registrar creates a new poll (with a list of questions and choices, when that vote opens and closes, etc.) on the blockchain and assigns the voting executors, nominees and committee.

Step 3
A voter can then log in to a dedicated voting portal[1] to generate a unique set of keys: one private, and one public[2]. The private key is kept in the user's private wallet, whereas the public key is sent to a nominee alongside a request for a new ballot.

By having a public key, a voter can prove their identity on the blockchain and that their answers are associated with their identity without actually disclosing their answers or identity. And by having a private key, a voter can sign their ballot and prove it belongs to their ID.

Step 4
A nominee authenticates the voter using the U-Port digital ID, issuing them an individual ballot.

Step 5
The voters vote, with their answers encrypted through the committee's public key. This key is included in each poll and based on the Pailler encryption system. The voter signs their ballot using their individual private key and adds it to the blockchain. The votes are then aggregated into decentralized baskets and replicated between network nodes on the blockchain.

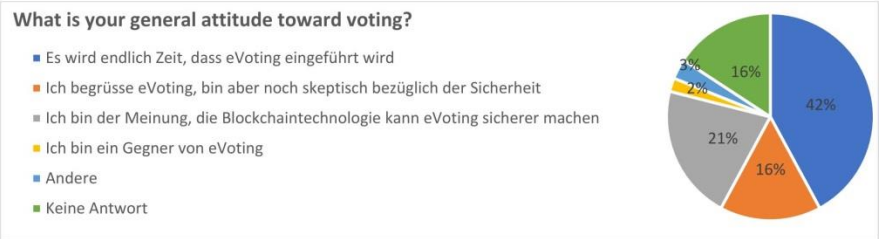
Step 6
Once voting closes, the committee retrieves all anonymized and encrypted ballots from the blockchain, checks their authenticity by verifying all signatures (and a number of cryptographic proofs), then finally calculates the results. After, the committee submits the results to the blockchain along with a generated zero-knowledge proof equivalent to the encrypted sum of votes and decrypted results.

Step 7
Any participant on the blockchain can verify the results by applying a mathematical proof and a committee's public key to a sum of encrypted voting results. A voter can also verify that their own ballot was counted by using their public key. Thus, no one can decrypt individual submissions from other voters, but everyone can rest assured the results were not and cannot be corrupted.

Findings of the online survey by the City of Zug

Subsequently, the City of Zug conducted an online survey of 95 city residents with digital IDs to capture feedback from the community. The findings of the survey are the following: More than three quarters of those surveyed welcome the introduction of eVoting into their voting system and 21% believe blockchain technology can make electronic voting more secure. Only 2% opposed to the introduction of eVoting. Despite a generally high level of approval, some are still sceptical about the security of eVoting. In addition to this, many survey participants believe the Zug population should still have the option to vote by mail in addition to eVoting. More than three quarters of voters already had a digital ID. This means that around 25% of the participants acquired a digital ID for the test vote.

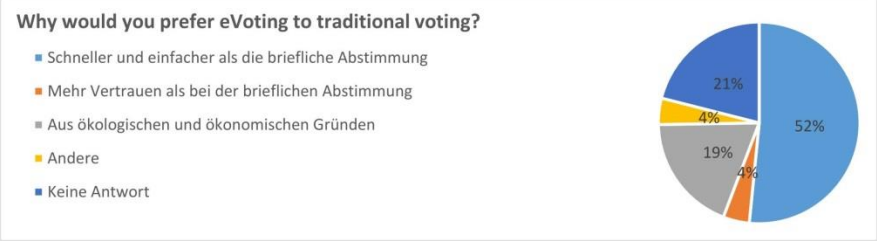
[1] If a voter does not trust any available parties, they can run a private blockchain node by request.
[2] A voter's public key is registered on the blockchain by the nominee during authorization. The nominee anonymizes every voter during this process.



Translation of above:

- "I am glad we are making eVoting an option!"
- "I welcome eVoting, but I am skeptical about its security."
- "In my opinion, blockchain technology can make eVoting more secure."
- "I am against eVoting."
- Other
- No Answer

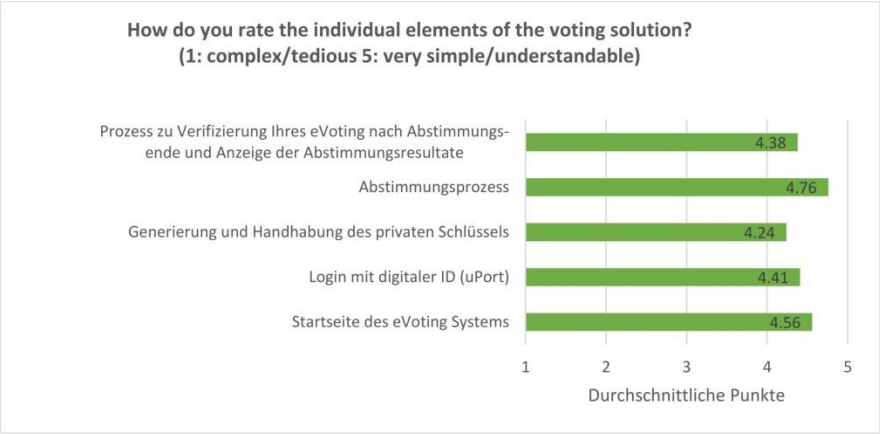
Then, participants explained why they prefer eVoting to traditional voting. 52% said the main reason why eVoting should be introduced was to make voting easier and quicker than filling out a ballot. Ecological and economic arguments were also mentioned.



Translation of above:

- Faster and simpler than voting by mail
- More trustworthy than voting by mail
- Environmental and economic reasons
- Other
- No Answer

Although most participants were very satisfied with how the test vote went, the survey showed that a number of factors can be improved to ensure a smoother voting process. Some voters faced technical problems with their digital ID, which made it impossible for them to vote. The individual elements of the voting solution were rated very positively by the participants. Participants thought the voting process was simple and easy to understand, with the solution's start page remarkably appealing. Nevertheless, the way private keys were handled along with how the steps were explained to the participants could be improved.



Translation of above:

- Process to verify a vote has been cast and how to view the results of the poll
- The overall voting process
- Generation and use of private keys
- Log in with digital IDs
- eVoting system start page

Finally, participants actively used the space for comments at the end of the survey. Many said that the media did not report enough on the voting process, meaning there was a lack of awareness that negatively affected turnout. Some did not know about the blockchain-based vote or only heard last minute. Some reported that they only found out about the voting trial after it had taken place. Unfortunately, for technical reasons, it is not possible to notify digital ID owners via the uPort app that there is an imminent vote. While the uPort app runs other platforms worldwide, the City of Zug did not develop its own app for the test vote due to a lack of funding.

The ability to use digital IDs in the city of Zug was introduced on 15 November 2017, and is still in a pilot phase. In addition to the eVoting solution, there are various other applications in evaluation or already in operation as pilot projects for the use of the digital ID, including sharing city bicycles via an app. Borrowing books from the library will follow next.

Conclusion and Outlook

This proof of concept was a success and is a significant milestone that demonstrates blockchain-based evoting systems work. Nearly all technical expectations of the vote were met. We were able to gather valuable insights to make improvements for future polls. To make the evoting system dependable and secure, tests like these are essential in order to build a working, reliable solution. A link to the code will be made publicly available on various sources, such as the city of Zug website, Hochschule Luzern's Blockchain Lab website and Luxoft.com. All project partners will continue to contribute towards further improving the solution, finding further use cases and sharing new findings with the community.

Zug, 30 November 2018