

PARTICIPATORY MAPPING FOR COMMUNITY ENGAGEMENT AND EMPOWERMENT



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ABSTRACT

Mapping and spatial analysis can be powerful tools for producing knowledge and making decisions. Participatory mapping, which is a "bottom-up" form of map-making, can enable local communities to be directly involved in these processes. Participatory mapping can vary from small community workshops to online mapping applications, but whether a certain technique will be successful at engaging and empowering communities is dependent upon a variety of social, economic, and technological factors. This project explores the potential of different participatory mapping techniques for engaging and empowering local communities, particularly in small-scale asset-based planning efforts. Through a comprehensive literature review, an analysis of a set of case studies, and a survey of participatory mapping participants, I identify advantages and disadvantages of three different participatory mapping approaches. I synthesize this research into a set of best practices for selecting a participatory mapping method and conducting mapping activities, which can provide guidance for those who are hoping to use participatory mapping in their own spatial decision-making processes. While there is no single approach that will always be successful, this project can help planners and community leaders better understand the benefits and drawbacks of certain mapping techniques in order to more effectively engage and empower their communities in spatial decision-making processes.

INTRODUCTION

WHAT IS PARTICIPATORY MAPPING?

"Shaped by principles of **equity**, participatory mapping has become an integral part of **community-based** participatory research enabling scholars to satisfy their research aims and objectives whilst **empowering** participants to build on community strengths to generate a shared awareness and understanding of **community assets**."

BACKGROUND

Participatory mapping, sometimes synonymous with community mapping, is the main focus of this project. In order to provide some background for the research project, I will provide some accepted definitions of terms used throughout this paper. First is the concept of **community mapping**, which is defined as "a participatory map-making process that attempts to gather information about a community's lands and make it visible to outsiders by using the language of cartography."¹ Essentially, community mapping is the umbrella term for all types of participatory mapping processes, which is the creation, visualization, and/or analysis of spatial information created by the focus community.

¹ Jon M. Corbett and Peter C. Keller, "An Analytical Framework to Examine Empowerment Associated with Participatory Geographic Information Systems (PGIS)," *Cartographica* 40 (2005): 195-203.

In order to understand how community mapping affects empowerment and engagement in communities, those terms must also be defined. The term empowerment, however, is a more difficult term to define. One commonly used definition of **empowerment** in the context of community mapping is “a political and social transformation whereby powerless or marginal individuals and groups in society attempt to increase their own power base by struggling against injustice,” and is referred to as both an outcome as well as a process.² **Engagement**, in addition, is difficult to define because of its broad usage and applicability; however, in general, it is the active and intentional inclusion and outreach to communities to involve them in decision-making efforts that affect their community livelihoods. Finally is the term GIS, which will be referenced frequently within the literature review and elsewhere in this project. GIS, or **Geographic Information Systems**, is “a computerized mapping and database system capable of holding and manipulating spatially referenced data.”³ These are all important terms to understand as they are central to the research question and are the essence of this project.

CONTEXT / SIGNIFICANCE

This project is significant to me because it is at the intersection of my two majors at the University of Washington: Geography and Community, Environment, and Planning. It is a combination of community engagement and map-making, which have been two of my main academic foci. I first was introduced to participatory mapping methods through my work as an undergraduate research assistant for a research project within the Department of Urban Design and Planning, which serves as the broader context for my Senior Project. This research is focused on community engagement and asset-based planning for

² Ibid, 92.

³ Steve Carver, Andrew Evans, Richard Kingston, and Ian Turton, “Public participation, GIS, and cyberdemocracy,” *Environment and Planning B: Planning and Design* 28 (2001): 908.

resilience, and is looking at long-term planning for hazard mitigation strategies to prepare for large events and disruptions such as the tsunamis and earthquakes.

The wider research also involved an advanced urban design and planning studio, which aimed to engage the City of Westport's community members and local stakeholders in two community workshops. My role was helping to develop and prepare the participatory mapping technology and data for the workshops, and through this I became familiar with one particular participatory mapping technology. This technology, known as the WeTable, is an interactive mapping technique that utilizes GIS software. With the weTable, data is projected onto a tabletop and participants are able to wield a pen to create their own data layers, which can then be overlaid with other data. The weTable method will be further explored throughout this paper.

Throughout this paper, I reference a series of community workshops that serve as a primary example of participatory mapping in practice. These community workshops took place in Westport,



which is a small coastal town on the coast of Washington state. It has a history in fishing, shellfish, harvesting, seafood production and tourism.⁴ It has a population of 2,110, and sits at the mouth of Grays Harbor. Westport is the focus of this project because it is at high risk of being affected by various hazards, especially tsunamis, due to its geographic location and relatively flat topography. Because of this, it is important to engage the community in participatory mapping in order to understand the town's vulnerable assets and environment

⁴ City of Westport, 2018.

for educating and preparing the community for future potential disruptions. The workshops in Westport provided the first example of participatory mapping technology, and served as a basis for which the rest of this research project was designed.

After engaging with participatory mapping in Westport, I wanted to explore the topic in a variety of contexts in order to understand the ways that participatory mapping can be applied to a variety of asset-based community planning efforts. My goal was to analyze whether the weTable method is the most effective for engaging and empowering local communities, or if there are alternative technologies that were more useful for these goals. If one mapping method in Westport is deemed to be successful, I wanted to find out if and how that methodology can be applied to other communities or improved upon in the future.

RESEARCH QUESTION:

What is the best participatory mapping strategy for engaging and empowering communities?

METHODOLOGY

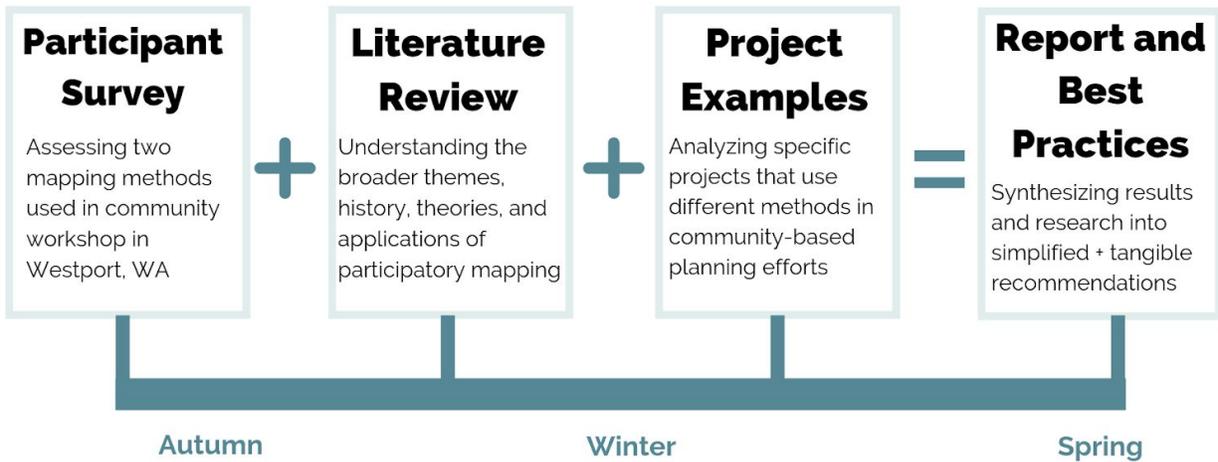


Figure 1: A Visualization of the Year-Long Research Process.

Throughout the course of this project, I considered a variety of different methods for answering my research question. While conducting original research would have produced interesting results, it was not feasible within the time frame, and more importantly, was not necessary for this project. There is a great deal of literature that exists already on participatory mapping approaches. There has been evidence for projects that seem to be successful, as well as evidence for projects that seem to be less effective in their goals. Due to the existing research, the best course of action for my end product was to create a research paper to summarize what has already been done. Despite the fact that a lot of research has been done on my topic, there is still a gap in the literature that this project is addressing. In much of the research that has been done on participatory mapping, each

project is different and there is little direct comparison between the mapping methods themselves. A research paper-based methodology is the most reasonable because it allows for a more direct comparison between the mapping techniques discussed in the literature.

Literature Review

The first venture into my research methodology was the literature review. While this is a required aspect of the senior project, I incorporate it as a part of my methodology because it provides all of the background research that contributes significantly to the final recommendations, and is essential for researching case examples later on. The literature review did not focus on specific mapping methods; rather, it focused on the key ideas that I wanted to explore in my project. The four main subtopics in my literature review were the history of participatory mapping, community engagement, community empowerment, and asset-based planning. These topics are explored further and justified in the literature review section of my project.

Survey

Although researching the current literature is the main aspect of my project, I also wanted to understand participatory mapping from the perspective of the participants of a project that I was directly involved in. This is important because all of the perspectives represented in the other aspects of my methodology are from the experts and researchers, not from the community members themselves. The workshops that took place in Westport were split into two days with different audiences, doing the same activities with different mapping technologies. One group used paper maps, while the other used a higher-tech GIS-based method known as the weTable, and I wanted to be able to directly compare the two methods. The weTable activity took place during the workshop for community leaders

on Friday, November 16, while the paper mapping activity took place during the community-wide workshop on Saturday, November 17.

After the workshop, I distributed a survey to those who participated in either just the Saturday workshop, or both the Friday *and* Saturday workshops (see Appendix 1 for the full set of survey questions). I distributed the online survey via email in early December, and sent a reminder email a few weeks later to gather more responses. In the reminder email, I also sent out a request for short phone interviews to understand more of the nuance in the survey participants ideas, since the questions themselves were somewhat complex. I drafted a guide to follow during the 15-minute interviews so that the responses would be more reliably comparable. However, this request did not return any responses or interest in a phone interview.

Case Examples

One method I considered was to conduct a systematic review, but after considering this method more, it was evident that this method would not be ideal for this project. This method would take much more time than my timeline allowed for, especially with the in-depth literature review taking place simultaneously. From this, I decided to research a select amount of case examples of participatory mapping methods, in order to look in-depth into specific projects in order to truly understand the context of the project. The purpose of exploring these examples is to understand the ways in which participatory mapping methodologies are being applied in different planning projects. The three projects I chose to look at each utilized a different type of participatory mapping technology, and they all aimed to engage the public in the planning process.

LITERATURE REVIEW

THE HISTORY OF COMMUNITY MAPPING

While community mapping has developed greatly over the past few decades due to technological advances, humans have been thinking spatially and representing their environments in some form or another for centuries. Not only have the techniques and map-making methods changed drastically, but so have the authors and owners of the maps themselves, which has played a major role in how cities have been designed and represented. Establishing the history of map-making and how cartographic practices have changed over time is important before having a more focused discussion of participatory mapping. This is because the history of map-making has been traditionally elite and exclusive, has roots in imperialism and has traditionally been used as tools of power and control. Understanding the historical context establishes the need for more democratic map-making processes.

During the eighteenth century, Immanuel Kant said that "objective procedures for representing space, such as maps or charts, are valueless unless they are referred back to the individual and notions of direction, such as left-hand and right-hand, which he/she derives from his/her own body."⁵ Kant recognized the importance of understanding the role that mapmakers play in the visual representation of spaces, through their physical bodies as well as their individual perspectives and understanding of place. However, mapmaking methods before this time (and still today, to a lesser extent) have been biased in whose voices are included. According to Panek, cartography used to be called the "Science of

⁵ Jiří Pánek, "From Mental Maps to Geoparticipation," *The Cartographic Journal* 53 (4), 2016, 1-2.

Princes" due to the fact that it was the elites that had the necessary access to knowledge and tools to create maps.⁶ He explains how maps are often a tool used to control other people's lives; in fact, "in the middle ages, maps were often used as a representation of royal power, as it was royalty who usually commissioned maps, hence their perspective of the area was preferred on the maps."⁷ Maps have historically been used to occupy land, to exploit natural resources, and to take advantage of indigenous peoples who think about space and place very differently. These aspects of the early history of cartography are extremely important to consider because this asymmetric division of power has shaped the way mapmaking, spatial analysis, and consequently, community mapping has developed over time.

Later in the 1960s, Geographic Information Systems (GIS) had not yet been invented but early participatory community mapping methods began to arise for geographical research purposes. During this time, urban researchers Gould and Lynch used mental mapping techniques in their research to understand how people interacted with and understood the built environment.⁸ However, "the participants were merely the subjects of the 'getting the information' process," rather than being the creators and decision-makers themselves.⁹ Typically during this time, the vast majority of participatory map making processes used communities as subjects of study, rather as collaborators.

In the late 1980s, a shift began in the way that planners were involving the public in the spatial decision-making process. During this time, "development professionals began to recognize that the 'top-down development approach' did not lead to sustained improvement in planning execution," and so communities were starting to become more

⁶ Pánek, "From Mental Maps to Geoparticipation," 2.

⁷ *Ibid.*, 2.

⁸ *Ibid.*

⁹ *Ibid.*

involved in the conversation.¹⁰ Soon after, GIS was starting to be developed and widely used. However, in its early stages, GIS “was highly criticized for being a tool of control and technological dominance.”¹¹ Maps have always been used as tools or weapons of power, but with GIS, it has become even easier to manipulate data; GIS has enabled us to easily lie, misrepresent data, “or at least adjust reality if needed.”¹² However, in 1996, the first workshop for Public Participation GIS (PPGIS) took place in Maine. After this time, GIS began to be more widely used and available to the public, meaning that more participatory approaches started to be used in certain contexts. Participatory mapping use first started to be used in “landscape planning and revitalization of public spaces, conflict resolution, land disputes and the exploitation of natural resources, entitlement of First nations to land and access to public services, environmental protection, and land-use and protection of the natural heritage.”¹³ These earlier forms of participatory mapping were limited and mainly focused on gathering objective data from participants, but it was much more progressive and democratic than early cartography.

In the last decade or so, participatory mapping has expanded exponentially and taken on a variety of forms, especially due to the fact that “subjective, emotional, and engaged data and applications appeared on the GIS market” in the last few years.¹⁴ These alternative applications are not even often created by GIS experts, but rather by the public, by individuals known as “neogeographers, neocartographers, DIY scientists, active citizens and geohackers.”¹⁵ These contributions by non-professionals is extremely important to the history of participatory mapping because they have contributed to the humanization of

¹⁰ Bijay Kumar Singh, “Flood Hazard Mapping with Participatory GIS: The Case of Gorakpur,” *Environment and Urbanization* 5 (1), 2014, 162.

¹¹ Pánek, “From Mental Maps to Geoparticipation,” 2.

¹² *Ibid.*, 3.

¹³ *Ibid.*, 4.

¹⁴ *Ibid.*

¹⁵ *Ibid.*

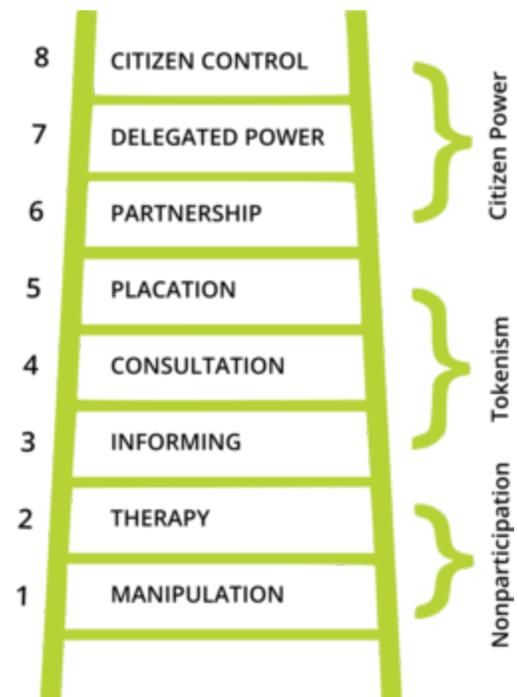
geospatial information and technologies, and have helped to legitimize more subjective forms of data.

MAPPING AND COMMUNITY ENGAGEMENT

From Subjects to Decision-Makers

As discussed within the historical context of community mapping, the participants of earlier mapping projects were often the subjects of research rather than the leaders of the project. However, relatively recently, researchers have recognized the impacts of shallow engagement on the communities of focus, shifting towards practices that enable communities to become the leaders and decision-makers in participatory mapping rather than just mere research subjects.

In the world of map-making, “the role of citizens has changed from being objects of geographical research to becoming the creators of the agenda and decision-makers within their community.”¹⁶ This is much different from when Gould and Lynch started to use mental mapping in their research methods, when “the participants were merely the subjects of the ‘getting the information’ process.”¹⁷ Over time, methods have changed and become more concerned with



ethics, and communities have been able to climb up the “ladder of participation.” Before, “maps were always used as tools of power, but there is a visible shift in the (map) power structures which favors citizens and their active participation.”¹⁸ As power structures shift,

¹⁶ Ibid, 5.

¹⁷ Ibid.

¹⁸ Ibid.

there are more opportunities for communities to be within the rungs of citizen control, rather than within the rungs of tokenism or non-participation.¹⁹

This shift towards more meaningful participation in recent years is important to recognize because it is at the heart of participatory mapping. Participatory mapping has been shaped by principles of equity, and has "become an integral part of community-based participatory research enabling scholars to satisfy their research aims and objectives whilst empowering participants to build on community strengths to generate a shared awareness and understanding of community assets."²⁰ This is because "participatory maps provide a valuable visible representation of what a community perceives as its place and the significant features within it."²¹ Not only are the outputs of a mapping project are extremely important for decision-making, but also the actual process of mapping itself is important as well. In fact, "the process of mapping is as important as the result of the mapping activity."²² It can contribute to "building community cohesion," as well as raise awareness to spatial or non-spatial issues that directly affect the communities involved, which ultimately can contribute to the empowerment of local communities.²³

Who is Excluded?

The issue of community engagement with regards to participatory mapping is not only how people are engaged, but who is engaged in the process. One of the main aims of participatory mapping is to democratize the spatial decision-making process, and to get as many voices heard as possible. Participatory mapping "shares a commitment to research practices that incorporate diverse and potentially oppositional priorities, and include the

¹⁹ Ibid.

²⁰ Mei Lan Fang, Ryan Woolrych, Judith Sixsmith, Sarah Canham, Lupin Battersby, and Andrew Sixsmith, "Place-making with older persons: Establishing sense-of-place through participatory community mapping workshops," *Social Science & Medicine* 168, 224.

²¹ Juri Lienert, "Participatory Mapping for Decision Making," SSWM, 2018.

²² Pánek, "From Mental Maps to Geoparticipation," 5.

²³ Juri Lienert, "Participatory Mapping for Decision Making."

knowledge and perspectives of multiple social groups."²⁴ These practices should be actively engaging social groups that are traditionally socially, political, or economically marginalized in their communities or societies. For example, women, men, and children will likely identify different spatial issues in their communities. Because of this, "there need to be effective ways of protecting the interests of the minority... a high degree of trust and transparency needs to be established and maintained within the public realm to give web-based public participatory processes legitimacy and accountability."²⁵ People from different social status and backgrounds may have differing perspectives on what the spatial issues are and how to address them, so incorporating more than one perspective is essential for an equitable mapping process.

The reason why having more people engaged in the process is important is because traditionally, the subject communities have traditionally not been the decision-makers themselves. In fact, "there are [still] a number of PGIS projects based on maps created and controlled by geo-specialists ... these projects are based on maps that support the arguments of their creators and not the arguments of communities involved in the PGIS projects."²⁶ The outcomes of participatory mapping projects will reflect the priorities of the community if and only if the communities themselves are leading the process. While the expertise of geo-specialists may be needed, depending on the mapping project and the technological skill set of the community itself, the map-making and decision-making processes should be led by those directly affected by local spatial issues. Further, "when facilitated by outsiders such as non-governmental organizations (NGOs), [participatory mapping] is rightfully viewed with skepticism by the target communities, some of which

²⁴ Sarah Elwood, "Negotiating Knowledge Production: The Everyday Inclusions, Exclusions, and Contradictions of Participatory GIS Research," *The Professional Geographer*, 58 (2), 2010.

²⁵ Steve Carver, Andrew Evans, Richard Kingston, and Ian Turton, "Public participation, GIS, and cyberdemocracy: evaluating online spatial decision support systems," *Environment and Planning B: Planning and Design* 28, 919.

²⁶ Pánek, "From Mental Maps to Geoparticipation," 5.

have likely been exploited in the past, and who regularly complain that there are no follow-ups to the [participatory mapping] projects."²⁷ This is another reason why citizen control, more so than tokenism or non-participation, is essential in participatory mapping processes; if an NGO is facilitating the process, then there needs to be more meaningful collaboration as well as follow-up between the groups after the process.

Despite the fact that a variety of perspectives and backgrounds are necessary for an equitable mapping process, there are some limitations. For example, "one should keep in mind that an issue becomes more complex and the process of mapping becomes more time consuming, the more people are getting involved."²⁸ Depending on the scale of the community, the chosen mapping process, and the dynamics of a group, mapping can become less productive when there are too many voices to be included, especially when a community is attempting to create a visual representation of spatial problems and prioritize local issues. However, the more people that participate, the more insights on those spatial issues will be presented, so it is still important to consider who is participating in a mapping project in order to plan and make decisions effectively.

Participation and Knowledge Production

One reason why participation and diverse engagement is so important in participatory mapping is the concept of knowledge production. Participatory mapping is "a valuable, interactive technique for local knowledge production, moving from data description to map based representation, through discussion and visual output."²⁹ Because participatory mapping is a method for knowledge production, it is important to have a diversity of perspectives in the map-making and decision-making process.

²⁷ Greg Brown and Marketta Kytta, "Key Issues and Research Priorities for Public Participation GIS (PPGIS): A Synthesis Based on Empirical Research," *Applied Geography* 46, 2014, 3.

²⁸ Juri Lienert, "Participatory Mapping for Decision Making."

²⁹ Mei Lan Fang, et. al, "Place-making with older persons," 224.

Firstly, "the inclusion or exclusion of particular kinds of information is also shaped by knowledge priorities of the involved individuals and institutions in a [participatory mapping] project."³⁰ This means that the knowledge of the individuals participating in a project will reflect in the knowledge produced through mapping. This is not a simple issue, however, due to the fact that "the integration of local knowledge and the representation of non-hegemonic epistemologies of space, environment, and territory are complex and potentially contradictory aspects of alternative GIS production and use."³¹ GIS and mapping in general tends to represent the more prominent perspectives, especially when used by individual GIS professionals without any community input. In asset-based decision-making in particular, it is important to consider ways in which local knowledge and non-traditional perspectives of spatial issues can be integrated into a participatory mapping project. For example, many forms of local knowledge are difficult to represent spatially, and written word must be used to inform the visual output. This is important for certain populations, especially for traditional peoples or the illiterate, who tend to communicate orally. Because of this, successful participatory mapping projects must consider the knowledge priorities and communication needs of the community in focus in order to actually engage communities in the decision-making process.

Further, the various types of knowledge in the knowledge production process are not always considered equal, even if the mapping process itself is democratic. In participatory mapping "some forms of knowledge are given priority over others, whether in the GIS itself or in the processes in which it is used."³² Elwood explains this further, saying that "knowledge acquired through lived experience, often termed local knowledge or

³⁰ Sarah Elwood, "Negotiating Knowledge Production," 201.

³¹ Trevor Harris and Daniel Weiner, "Empowerment, Marginalization, and "Community-integrated" GIS," *Cartography and Geographic Information Systems* 25 (2) 67-74, 1998, 73.

³² Sarah Elwood, "Negotiating Knowledge Production," 201.

experiential knowledge, is generally granted less legitimacy and sometimes deemed biased because of its close connection to research participants."³³ Because GIS is considered a science, the types of knowledge that are considered legitimate are usually objective, fact-based spatial data. However, this contrasts with the core purpose of participatory mapping projects: to integrate local layman information with objective data in order to plan and make decisions effectively that reflect the priorities and needs of the community itself. Therefore, this discrepancy between how different types of knowledge are viewed is problematic to the concept of participatory mapping itself, and needs to be undone if the communities themselves are to be not only engaged, but in full ownership of the mapping projects themselves.

MAPPING AND COMMUNITY EMPOWERMENT

Community Empowerment

The potential of participatory mapping to empower communities has been thoroughly explored in the literature. The term "empowerment" "has been applied across a range of politicized issues, and is used in a variety of disciplines from urban planning to sociology and politics."³⁴ However, there is little consensus on what the term actually means in the context of participatory mapping, since "as a result of its ubiquitous application, the term has suffered from semantic inflation and so has come to mean almost nothing."³⁵ Some academics define it as both an outcome and a process, something that should be carefully considered in participatory mapping projects. Rappaport explains that the term is "a multilevel construct applicable to individual citizens as well as to organizations and communities."³⁶

³³ Ibid, 198-199.

³⁴ Jon M. Corbett and Peter C. Keller, "An Analytical Framework to Examine Empowerment Associated with Participatory Geographic Information Systems (PGIS)," *Cartographica*, 40 (4), 2005, 93.

³⁵ Ibid, 94.

³⁶ Ibid, 93.

Many academics recognize the importance of scale in the concept of empowerment, as well as the fact that not all empowerment is the same. While there is likely to be overlap, individual empowerment is not equal to community empowerment. Elwood defines three groups of empowerment: "empowerment related to distributive change, which refers to outcomes such as increased access to goods and services; procedural change, which infers shifts in perceived legitimacy of groups; and capacity building, or an increased ability of citizens or communities to 'take action on their own behalf.'"³⁷ Within this framework, the catalysts of empowerment are also discussed in the literature. These are often defined as "information, process, skills, and tools."³⁸ As we will explore, these catalysts affect whether participatory mapping is empowering or disempowering.

Empowering Effects of Participatory Mapping

As explored in the literature, participatory mapping can have an empowering effect on communities by increased community engagement and participation in decision-making processes and knowledge production. For example, "the application of participatory geographic information systems (PGIS) can be empowering to disadvantaged groups by enabling them to use the language and tools of decision makers and so influence events that affect their lives and local geography."³⁹ Participatory mapping methods, including PGIS, allow communities to be more directly involved in decision-making processes. Participatory mapping "can be a medium of empowerment by allowing groups of people to represent themselves spatially, using their own maps to seek recognition and inclusion in land and natural resources planning and management."⁴⁰ One of the main aspects of participatory mapping that this references is the idea that it incorporates layman information

³⁷ Ibid, 94.

³⁸ Ibid, 95.

³⁹ Ibid, 91.

⁴⁰ Ibid, 92.

and participation into otherwise technical or elite processes. By expressing their concerns and priorities spatially, communities are able to be recognized by those who typically make the decisions.

Panek also explains that this sense of ownership that can be initiated through the map making process can lead to feelings of community belongingness and a sense of ownership, as well as recognition and inclusion, which in turn can be a catalyst for action and momentum for sustainable community development. Participatory mapping, in general, can also allow citizens to "climb up Arnstein's ladder of citizen participation," meaning that the community can be directly involved in decision-making processes and knowledge production.⁴¹ Higher-tech participatory mapping techniques can produce valuable products for planning purposes, because they can combine scientific tools such as GIS with layman information from the local community that would otherwise not be integrated into GIS analysis processes.⁴²

Disempowering Effects of Participatory Mapping

While many recognize the empowering effects of participatory mapping, many experts recognize the limitations of mapping methods for empowering communities. Further, many also recognize that certain practices can actively disempower or marginalize communities, "given the cost and complexity of the technologies, inaccessibility of data, restrictive representations of local geographic information, and low and selective levels of community participation."⁴³ In some methods, the technology is complex and requires a high level of skill to use effectively, and some processes can be very expensive, especially in more disadvantaged communities. Additionally, at the basic level of spatial knowledge and

⁴¹ Pánek, "From Mental Maps to Geoparticipation," 5.

⁴² Bijay Kumar Singh, "Flood Hazard Mapping with Participatory GIS," 171.

⁴³ Jon M. Corbett and Peter C. Keller, "An Analytical Framework to Examine Empowerment, 91.

the way that we understand space, many technologies fail to adequately incorporate more qualitative types of knowledge.⁴⁴

Harris and Weiner identify three ways in which GIS contributes to the social and spatial marginalization of communities. This includes 1) access to data and the "political economy of information; 2) geodemographics and the surveillant nature of GIS; and 3) representation of data, "GIS epistemologies and the multiple realities of landscape."⁴⁵ They further explain that "there is little evidence of genuinely 'community-based GIS, despite such stated intentions."⁴⁶ This is due to the fact that communities are often involved in GIS projects, but that does not necessarily mean that they are in control of those projects. This makes communities continuously dependent on state agencies, NGOs, external organizations and elite technical professionals.⁴⁷ Harris and Weiner suggest to stay cautious in assuming that GIS always fosters "grassroots participation," especially due to the fact that participatory mapping methods are often framed with participation and empowerment in mind, yet they are often used as meaningless "buzzwords" in order to legitimize projects that will have the opposite effect on communities. Because of this, it is imperative that participatory mapping should be used with consideration and prioritization of an understanding of the political and social context of that particular place.⁴⁸

The Problematic Dualism

Much of the literature has focused on the empowering and disempowering effects of participatory mapping on communities, with the consensus being that participatory mapping will inevitably simultaneously marginalize and empower people and communities. The contradictory effects are often referred to in the literature as "the problematic dualism."

⁴⁴ Ibid, 92.

⁴⁵ Ibid, 69.

⁴⁶ Ibid, 72.

⁴⁷ Ibid, 74.

⁴⁸ Trevor Harris and Daniel Weiner, "Empowerment, Marginalization," 75.

Harris and Weiner explain that "a problematic dualism exists whereby GIS production and use is understood to be either empowering or marginalizing."⁴⁹ Elwood recognizes this problematic dualism in her discussion of "the contradictory capacity of GIS technologies to empower and disempower."⁵⁰ The social and environmental effects that participatory mapping has on communities are dependent upon a variety of historical, socioeconomic, political, and technological factors.⁵¹ These effects, then, will also take different forms in different places, meaning that the context of a community affects the ways in which a specific participatory mapping method will be empowering or marginalizing.

Some of the reasons that this problematic dualism exists, according to Elwood, are the "exclusions of institutional gatekeeping in the workplace as well as technological and expertise barriers presented by the GIS."⁵² As stated earlier, GIS and mapping requires certain technological and spatial skills to utilize, which can be marginalizing for communities without these skills. Elwood states that because of this problematic dualism, it is imperative to be committed to "fostering bottom-up GIS applications that incorporate diverse forms of local knowledge and participation."⁵³ Similarly, Harris and Weiner explain how true democratic participatory mapping processes are possible only by "overcoming issues associated with differential access to hardware, software, and data."⁵⁴ There is a contradiction between using GIS and mapping for bottom-up community development as the technology itself is "useful for uncovering 'local resources' but are expensive and demand outside expertise."⁵⁵ This means that in order to empower communities through

⁴⁹ Ibid, 68.

⁵⁰ Elwood, "Negotiating Knowledge Production," 198.

⁵¹ Trevor Harris and Daniel Weiner, "Empowerment, Marginalization," 68.

⁵² Elwood, "Negotiating Knowledge Production," 197.

⁵³ Ibid, 198.

⁵⁴ Trevor Harris and Daniel Weiner, "Empowerment, Marginalization," 69.

⁵⁵ Ibid.

participatory mapping, there need to be innovative and collaborative partnerships between those with skills in GIS and the grassroots community organizations.

ASSET-BASED PLANNING

When thinking about how best to engage and empower communities in the participatory mapping process, a concept relevant to community-based planning is asset-based planning. This is known in the literature as “an alternative model of community development [that emphasizes] the importance of building on community assets rather than focusing on needs and problems.”⁵⁶ Assets in this case are the “gifts, skills, and capacities of individuals, associations, and institutions within a community.”⁵⁷ Therefore, asset-based planning approaches include identifying these resources, and deciding how to best use them in a community to achieve goals. This is different from a needs-based approach to planning because it focuses on the positive rather than the negative. Asset-based planning is a way to shift attention “away from the negative and failing, towards what is successful and working.”⁵⁸ Needs-based approaches limit ability for collective action, and does not focus on the vision of the goals of community residents.⁵⁹

Participatory mapping, in many cases, takes on an asset-based approach to planning because it can be a more effective way to mobilize a community around decision-making processes. Asset-based planning “is initiated by mapping the key strengths or available resources in the community. Individuals, organizations, and institutions have resources that

⁵⁶ Gary Paul Green, and Ann Goetting, *Mobilizing Communities: Asset Building as a Community Development Strategy* (Philadelphia: Temple University Press, 2010).

⁵⁷ Green and Goetting, *Mobilizing Communities*.

⁵⁸ Blackman, Deborah Ann, Fiona Buick, and Janine O’Flynn, “From Engaging to Enabling: Could an Asset-Based Approach Transform Indigenous Affairs?,” *Environment and Planning C: Government and Policy* 34, no. 8, 2016, 1634.

⁵⁹ Green and Goetting, *Mobilizing Communities*, 5.

can be used to enhance the quality of life for residents."⁶⁰ There are three categories of assets or types of capital. This includes the built, natural, and social capital. These categories are not exclusive, but can help us to understand the types of assets that one may map in a participatory mapping activity.⁶¹

This is relevant to this project because it is evident in the literature that asset-based approaches tend to be more productive for engaging and empowering communities. Asset-based approaches will establish "a more facilitative, partnering approach, rather than the more traditional interventionist one."⁶² It is important to note that traditional planning methods are led by planning professionals who will identify community needs and strategize to address those needs, often without input from the community. However, an asset-based approach would place the focus on the community strengths, thereby placing decision-making power in the hands of the community itself. They continue to say that "a sense of community can be created through unleashing positive ideas focused upon success."⁶³ Asset-based approaches focus "on empowerment of communities and values collective ownership of community visions."⁶⁴ When used in participatory mapping, asset-based approaches to planning can more effectively involve the communities themselves in identifying their strengths, and enable them to collectively make the decisions that directly affect them.

⁶⁰ Ibid, 6.

⁶¹ Robert C. Freitag, Daniel B Abramson, Manish Chalana, and Maximilian Dixon, "Whole Community Resilience: An Asset-Based Approach to Enhancing Adaptive Capacity Before a Disruption," *Journal of the American Planning Association* 80, no. 4, 2014, 326.

⁶² Blackman, Buick, and O'Flynn, "From Engaging to Enabling," 1635.

⁶³ Ibid, 1634.

⁶⁴ Ibid, 1635.

FINDINGS

In choosing my case example projects to focus on, the aim was to select three different types of mapping in order to have a broader understanding of the ways that participatory mapping can be utilized. One method was a lower-tech method that utilized paper maps, while the other two methods utilized GIS technology. While each project was focused on a different goal, they were all intended to engage a community in the planning process.

MAPPING METHOD EXAMPLES

Example 1: Paper Mapping

The first project example is the use of paper mapping for establishing sense of place. This project combined experiential walks with paper mapping activities in order to understand the sense of place of an older population in an affordable housing community in Western Canada. Participants were asked to experience a place, take note of their surroundings, and discuss what is important to them as a community. Then, through a series of workshops, they used this experience to create maps that represented how they perceived their community assets. The main strength of this method was the ability to incorporate other senses, and include more subjective ways of understanding space. It aimed to identify the community's values and existing resources, which allowed participants to direct the mapping process and retain co-ownership of the maps.⁶⁵

⁶⁵ Mei Lan Fang, et. al, "Place-making with older persons: Establishing sense-of-place through participatory community mapping workshops," *Social Science & Medicine* 168, 2016, 223-229.

Example 2: Online Participatory GIS

The second example project looked at was the use of online Participatory GIS (PGIS) and Web 2.0 technology for participatory urban planning. This project was a prototype developed for use by planners in Canela, Brazil. The goal of this project was to create a more accessible, interactive method, and to promote two-flow ways of information between the planners and community members. For this mapping method, an online mapping website was created to be distributed to the community. Planners were able to upload their own spatial data, based on a series of categories for planning, and community members were able to view the data, comment on it, and create their own features within certain layers. The purpose of this project was to find solutions through participation, and find a balance between interactivity, usability and visualization. This method aimed to connect official and informal information, and was more effective for consensus building.⁶⁶

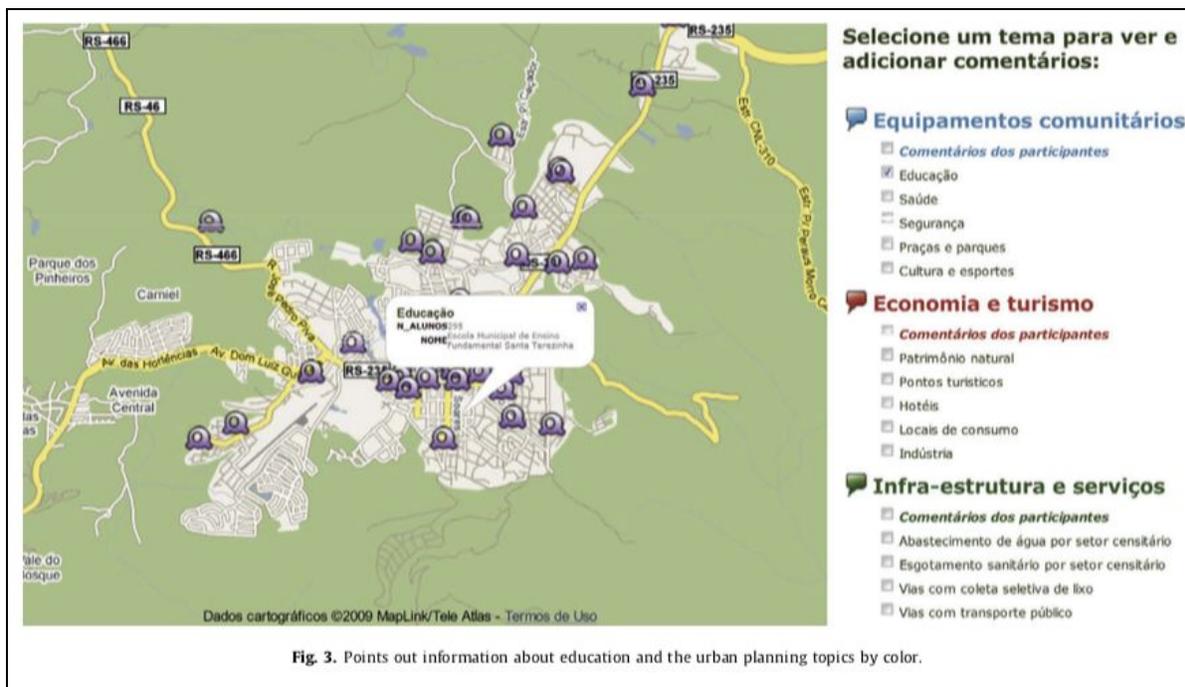


Fig. 3. Points out information about education and the urban planning topics by color.

Fig. 2: An example of what the PGIS interface would look like with selectable layers to edit or comment on.

⁶⁶ Geisa Bugs, et. al, "An assessment of Public Participation GIS and Web 2.0 technologies in urban planning practice in Canela, Brazil," *Cities* 27, 2010, 172-181.

Example 3: The weTable Method

The third participatory mapping method looked at was the weTable method. This mapping method is the same type used in the Westport workshops, which This PGIS approach aimed to engage stakeholders in building resilience to sea level rise in Coastal Virginia. This approach was more process-driven, because of the interactivity of the method. The goal of this project specifically was to promote social learning and to obtain socio-spatial data through the map-making process. In the end, most participants of this project found it to be between moderately and extremely useful for facilitating community-wide discussion.



Fig. 3: An example of what the weTable configuration would look like.

SURVEY RESULTS

After the survey was distributed via email to participants of the Westport community workshops, I received eight responses over the course of two weeks. I reached out for additional phone interviews, but none of the participants expressed any interest. Therefore, the responses I got out of this survey are very limited and should not be considered representative of the entire group. Despite this, the more qualitative open-ended response

questions produced some interesting responses that may provide some insight into the dynamics of the mapping exercises. An analysis of these survey results should not hold very significant weight in the overall results of this project and recommendations, but rather should provide insight into how one particular mapping method operates in a planning project, and what people think about the usefulness of the technology.



Fig. 3: Photos from the Westport community planning workshop utilizing the weTable technology.

Survey results for multiple-choice/quantitative questions:

	<i>Extremely difficult</i>	<i>Somewhat difficult</i>	<i>Somewhat easy</i>	<i>Extremely easy</i>
1. How easy was it to understand the hazard data shown on the WeTable maps?	0	0	5	4
2. How easy was it to create new data using WeTable?	0	0	8	1
	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Agree</i>	<i>Strongly agree</i>
3. The people in my group took part equally in the WeTable mapping activities.	0	1	5	2
4. In my group, the person (or people) who held the WeTable pen had the most control over what the group talked about.	2	4	1	0
5. I felt comfortable using WeTable for the mapping activities.	0	0	5	3
	<i>Never</i>	<i>Rarely</i>	<i>Sometimes</i>	<i>Often</i>
6. Before the workshop, how often did you use GIS technology?	3	0	5	1
7. After the workshop, how often do you think you will use GIS technology?	0	2	6	1

Fig. 4: Chart of responses for multiple-choice survey questions.

Ease of Use/Accessibility

The first of three main themes in the survey results was ease of use, or the accessibility in terms of who can use the technology/if there are any barriers in usability. As shown in Figure 4, people generally felt that the data was easy to understand, and that it was somewhat easy to create new data using the weTable. Participatory mapping

technology should be as easy to use as possible, and make data easy to understand for the typical layman. The weTable was somewhat successful in communicating knowledge and gathering data in a group setting, according to these survey results. One participant wrote that "[t]he ability to add new data points was very helpful," and another stated that it was "graphical and interactive."

On the other hand, there were some technical difficulties that made the technology more difficult to use. One participant said that "[t]he data didn't always line up and had to be manually adjusted," which made it a less useful technology. Another participant wrote that "The equipment is good, but specifically the tables were put together, which caused a gap. The tables were shaky. So, not a knock on the wetable equipment itself." This might suggest that having high-quality equipment and set-up is very important in having a successful mapping workshop that is easy for community members to use.

Group Dynamics

In terms of group dynamics, the weTable was generally successful in promoting even and dynamic group conversations. There was a somewhat weak agreement that the discussion and participation in the mapping activity was completely even across group members. Most participants disagreed that those who felt most comfortable with the weTable technology dominated the conversation, but there may have been instances where that was true. These results might suggest that the weTable, in general, promoted community engagement. As one participant wrote, "[t]he activity promoted great engagement and interaction within the group. This resulted in great ideas and creativity. Participants enjoyed the activity. Everyone felt comfortable contributing." Evidence of group interaction and creativity suggests that the mapping activity promoted a collective sense of community empowerment.

Technical Skills

As far as technical skills, my aim in the final two survey questions was to gauge whether or not people became acquainted with GIS technology enough to use it more outside of the workshop setting. As shown in Figure x, questions 6 and 7, there was a higher response for anticipated GIS use after the workshop compared to current GIS use before the workshop. This indicates that the mapping process was also a learning opportunity that taught community members the power of GIS and mapping technology, which is a primary goal of higher-tech participatory mapping methods.

DISCUSSION AND IMPLICATIONS

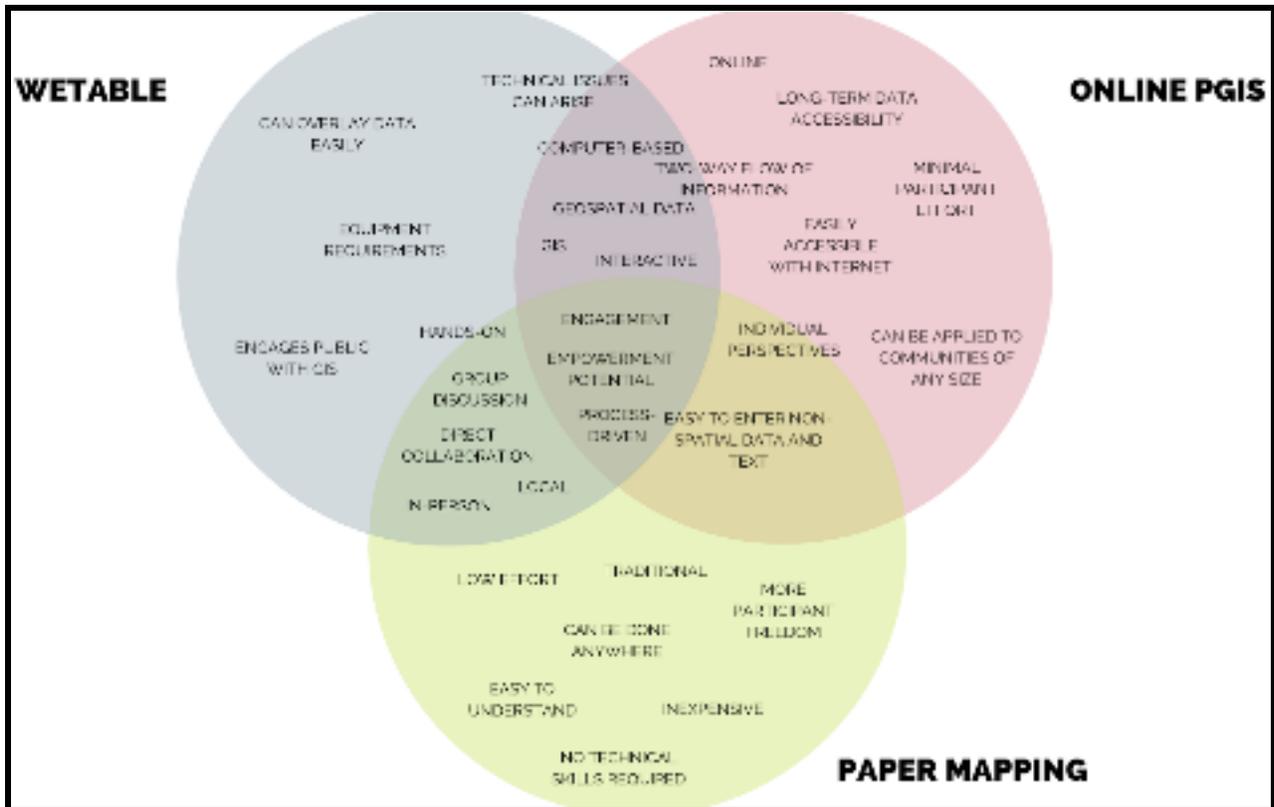


Fig. 5: Venn Diagram visualization of the similarities and differences between the three mapping methods.

DISCUSSION

After conducting the literature review and researching three different mapping methods, it is clear that there is no simple answer to my research question. There is no one single best participatory mapping method for engaging and empowering communities in collaborative planning efforts; however, there are methods that have their own strengths

and weaknesses that make some methods more effective than others within different social, environmental, and economic contexts.

For example, paper mapping methods will be more appropriate for certain types of projects, but less effective for others. For the purpose of engaging an older population in place-making activities, this method was effective because it was appropriate for the context of the community. This group did not have many technical skills in GIS, and the project was more focused on creative representations of space. The focus was on understanding the communities assets (not necessarily just spatial data), meaning that maps supplemented with text was the most appropriate method for the goals of this project.

Paper mapping methods tend to prove more useful for communities where GIS skills and technology are more limited, or in communities that have limited financial resources. They are typically more versatile than higher-tech methods because paper and pens are some of the most accessible tools. When communities are familiar with the tools and technologies used, they are more likely to feel empowering and gain ownership over the outputs of a project and maps or data produced.

Online PGIS methods, on the other hand, will be more effective in projects that are more wide-scale and less focused on a specific subset of a community. Because online PGIS sites can theoretically be accessed any place, any time (so long as an individual can gain access to a computer and internet) there is wider potential for engagement across a larger geographic area. Online PGIS methods allow for engagement from those who may not be able to attend a workshop in-person due to personal temporal or geographic constraints, which can make participatory mapping more accessible. However, there are limitations to online PGIS methods; if the purpose of the project is to enhance social

resilience through community discussion and connection, perhaps an in-person technique would be more appropriate. Additionally, there is the requirement of having access to a computer and an internet connection, making this method less appropriate for less developed communities with limited access to technology.

The weTable method has its own set of advantages and disadvantages that affect its effectiveness at engaging and empowering communities. The weTable is effective at projects that aim to create socio-spatial data and engage the community in map-making and spatial decision-making processes. As shown in the survey response, as well as the results from the weTable mapping project example, this method can be effective at engaging communities in discussion and can promote social learning. Unlike other PGIS methods, it is not necessary for every individual to have skills in GIS to participate in the mapping process. The method can also be fairly inexpensive, due to the limited technological requirements. However, there is still a need to have some GIS and technological support within the project group, making this a less accessible method when compared to paper mapping or other lower-tech methods.

BEST PRACTICES

As discussed in the literature, there are different aspects of participatory mapping that should be focused on when promoting equity and empowerment in engagement. Beyond the mapping activity itself, there are four main themes around which I developed a set of best practices for conducting participatory mapping projects. This includes information, which is the data used, created, or analyzed; the process, which is the way that the project is planned and facilitated; tools, which includes software and hardware, as well as financial cost; and skills, which refers to the community's ability to utilize the technology

itself. While there are many different ways to conduct a participatory mapping project that would encourage empowerment in one way or another, I have synthesized the major common themes that have arisen out of my literature review and methodology into a set of best practices around the four major themes. This set of best practices is intended to be used by any group or individual hoping to conduct a participatory mapping project. Because each project will differ depending on the context of the community and the technology chosen, developing very specific best practices or recommendations that would be appropriate for every situation would be impossible. Therefore, this set of best practices serves as general guidance for both the planning and execution phases of a project, and is focused on larger ideas that can apply to every type of participatory mapping project.

GENERAL BEST PRACTICES FOR EMPOWERING AND ENGAGING COMMUNITIES THROUGH PARTICIPATORY MAPPING PROJECTS

Information

1. Include strategies for incorporating a diversity of information types and formats, not just Euclidean point-based data.
2. Promote community access and ownership over information and data produced.
3. Incorporation of local knowledge, rather than exclusive focus on Western definitions of knowledge and meaning.

Process

1. Invite and encourage (rather than coerce or demand) participation.
2. Deliberately include marginalized groups in a community, both in outreach/recruitment of participants and in the process itself.
3. Promote consensus-based decision-making over top-down approaches.
4. Promote a collective identity and vision and discussion of local issues.
5. Integrate innovative partnerships between GIS users and grassroots community organizations.
6. Ensure continuity between project leaders and community.
7. Assume that local knowledge is valuable and expert.

Tools

1. Consider the social, political, and economic context of technologies to choose an appropriate method.
2. Consider cost and complexity of the technology.
3. Ensure the tools have the ability to record diverse ways of understanding space.
4. Allow for an integration of GIS and multimedia (photography, text, art, etc).

Skills

1. Provide opportunity and resources for marginalized groups to learn new skills.
2. Only use tools that the community will know how to use, rather than focusing on expert-driven processes.
3. Provide software literacy and technical skills in GIS, database management, GPS, photography, or other skills if necessary.

CONCLUSION / NEXT STEPS

This set of best practices provides initial guidance for those planning a participatory mapping project. However, this is not a comprehensive list of every consideration that one should take in planning a project. Each project will be different, the focus community will have their own needs and requirements that project leaders will need to identify and plan for. Nevertheless, these best practices can provide a starting point for incorporating participatory mapping in the planning process.

As discovered through this research, there is no one best participatory mapping strategy for every type of project. Participatory mapping has the potential to engage communities, empower individuals and groups, cultivate a sense of ownership, strengthen social resilience, and incorporate more perspectives in the spatial decision-making process. However, there is no one best participatory mapping method for accomplishing all of this. Not all participatory mapping methods are equally effective, so it is important to consider the specific needs of a community and the goals of the project in order to ensure that a project will lead to meaningful engagement and be truly empowering.

As technology advances and map-making processes are changing, there is greater potential for innovative and engaging participatory mapping methods than ever before. Further research should be done on new emerging technologies and their potential for engaging and empowering communities. The weTable, for example, is a relatively recent technology, but there may be more useful technologies currently being developed that need to be better understood. There are a number of ways to engage a community in map-making exercises, with little understanding of their implications. With this research serving as a foundation of how participatory mapping can engage and empower

communities, further research should be done on specific methodologies in order to provide guidance on how best to implement various strategies.

APPENDIX

APPENDIX 1: SURVEY QUESTIONS

Question:	Response options:	Fri. only	Sat. only	Both days
1.How easy was it to understand the data shown in the WeTable?	extremely easy, somewhat easy, somewhat difficult, extremely difficult	X		
2.How easy was it to understand the data shown in the maps?	extremely easy, somewhat easy, somewhat difficult, extremely difficult		X	
3.How easy was it to map assets using the WeTable?	extremely easy, somewhat easy, somewhat difficult, extremely difficult	X		
5.How easy was it to map assets on the maps?	extremely easy, somewhat easy, somewhat difficult, extremely difficult		X	
6.Before the workshop, how often did you use GIS technology?	frequently, occasionally, rarely, never	X		
7.After the workshop, how often do you anticipate you will be using GIS technology?	frequently, occasionally, rarely, never	X		
8.Did you encounter any difficulties with using the WeTable? Please describe them.	Open ended	X		
9.What did you particularly like about using the WeTable? What did you particularly dislike?	Open ended	X		
10.What did you particularly like about the mapping exercise? What did you particularly dislike?	Open ended		X	
10.If you also participated in the	Open ended	X		

workshop community event on Saturday, November 17, which asset mapping method did you prefer: the WeTable or drawing on paper maps? Why?				
11.The people in my group participated equally in the discussion.	Strongly agree, agree, disagree, strongly disagree			X
12.In my group, one person tended to do most of the mapping.	Strongly agree, agree, disagree, strongly disagree			X
13.In my group, the person who held the pen the most tended to express the most opinions.	Strongly agree, agree, disagree, strongly disagree			X
14. I felt comfortable contributing to the mapping process.	strongly agree, agree, disagree, strongly disagree			X

REFERENCES

- Blackman, Deborah Ann, Fiona Buick, and Janine O'Flynn. 2016. "From Engaging to Enabling: Could an Asset-Based Approach Transform Indigenous Affairs?" *Environment and Planning C: Government and Policy* 34, no. 8 : 1632–51.
- Blake, Denise, Auge, Amelie A., Sherren, Kate. 2017. "Participatory mapping to elicit cultural coastal values for Marine Spatial Planning in a remote archipelago." *Ocean and Coastal Management* 148: 195-203.
- Boll-Bosse, Amber J. and Katherine B. Hankins. 2017. "These Maps Talk for Us:" Participatory Action Mapping as Civic Engagement Practice." *The Professional Geographer* 70 (2): 319-326.
- Brown, Greg, Jennifer Strickland-Munro, Halina Kobryn, Susan A. Moore. 2017. "Mixed methods participatory GIS: An evaluation of the validity of qualitative and quantitative mapping methods." *Applied Geography* 79: 153-166.
- Brown, Greg, and Kytta, Marketta. "Key Issues and Research Priorities for Public Participation GIS (PPGIS): A Synthesis Based on Empirical Research." *Applied Geography* 46 (2014): 122.
- Bugs, Geisa, Carlos Granell, Oscar Fonts, Joaquín Huerta, Marco Painho. 2010. "An assessment of Public Participation GIS and Web 2.0 technologies in urban planning practice in Canela, Brazil." *Cities* 27: 172-181.
- Carver, Steve, Andrew Evans, Richard Kingston, and Ian Turton. 2001. "Public participation, GIS, and cyberdemocracy: evaluating online spatial decision support systems." *Environment and Planning B: Planning and Design* 28: 907-921.
- Corbett, Jon M. and Keller, Peter C. 2005. "An Analytical Framework to Examine Empowerment Associated with Participatory Geographic Information Systems (PGIS)." *Cartographica* 40 (4): 195-203.
- Elwood, Sarah. 2010. "Negotiating Knowledge Production: The Everyday Inclusions, Exclusions, and Contradictions of Participatory GIS Research" *The Professional Geographer*, 58 (2), 197-208.
- Fang, Mei Lan, Ryan Woolrych, Judith Sixsmith, Sarah Canham, Lupin Battersby, and Andrew

- Sixsmith. 2016. "Place-making with older persons: Establishing sense-of-place through participatory community mapping workshops." *Social Science & Medicine* 168: 223-229.
- Freitag, Robert C., Daniel B Abramson, Manish Chalana, and Maximilian Dixon. "Whole Community Resilience: An Asset-Based Approach to Enhancing Adaptive Capacity Before a Disruption." *Journal of the American Planning Association* 80, no. 4 (2014): 324-35.
- Green, Gary Paul, and Ann Goetting, eds. *Mobilizing Communities: Asset Building as a Community Development Strategy*. Philadelphia: Temple University Press, 2010.
- Harris, Trevor and Daniel Weiner. 1998. "Empowerment, Marginalization, and "Community-integrated" GIS." *Cartography and Geographic Information Systems* 25 (2) 67-74.
- Lienert, Juri. "Participatory Mapping for Decision Making." SSWM. April 27, 2018.
- Liu, Wie, Sumit Dugar, Ian McCallum, Guarav Thapa, Linda See, Prakash Khadka, Nama Budhathoki, Sarah Brown, Reinhard Mechler, Steffen Fritz and Puja Shakya. 2018. "Integrated Participatory and Collaborative Risk Mapping for Enhancing Disaster Resilience." *International Journal of Geo-Information* 7 (2): 68-91.
- Pánek, Jiří. 2018. "Emotional Maps: Participatory Crowdsourcing of Citizens' Perceptions of Their Urban Environment." *Cartographic Perspectives* 91.
- Pánek, Jiří. 2016. "From Mental Maps to Geoparticipation." *The Cartographic Journal* 53 (4): 300-307.
- Pánek, Jiří. 2015. "How participatory mapping can drive community empowerment - a case study of Koffiekraal, South Africa." *South African Geographical Journal* 97 (1): 18-30.
- Shumann, Ronald L. III. 2018. "Ground truthing spatial disaster recovery metrics with participatory mapping in post-Katrina Mississippi." *Applied Geography* 99: 63-76.
- Singh, Bijay Kumar. 2014. "Flood Hazard Mapping with Participatory GIS: The Case of Gorakpur." *Environment and Urbanization* 5 (1): 161-173.
- Tanaka, Takahiro, Daniel Benjamin Abramson, Yoshito Yamazaki. 2009. "Using GIS in community design charrettes: Lessons from a Japan-U.S. collaboration in earthquake recovery and mitigation planning for Kobe." *Habitat International* 33: 310-318.