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Field Testing Volunteer Geographic Information Collection – The Viability of Community Mapping

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Abstract

The ubiquity of Internet service and the GPS chip, fused into a device that people cannot leave home without (their phone), has facilitated the rise of "Volunteered Geographic Information" (VGI). VGI has a promising premise; locals go where outsiders can't and are theoretically able to provide highly accurate and useful spatial information. This paper explores one aspect of VGI with the findings from a study of an effort to train volunteers to map "Points of Interest" (POIs) in two Minnesota counties. The findings illustrate that volunteers in rural tourism hubs find the idea of collecting and representing their community's POIs on interactive digital maps relatively easy and useful for community development and tourism. However, the volunteers' apparent enthusiasm does not correlate with the amount of data they collected and mapped.

Introduction

The ubiquity of Internet service and the Global Positioning System (GPS) chip, fused into a device that people cannot leave home without (their phone), has facilitated the rise of "Volunteered Geographic Information (VGI) by motivating and making it easy for people to volunteer geographic information. The availability of user-generated geographic data and the advent of Web 2.0 (interactive online tools) has undeniably improved access to create geographic information. Tremendous amounts of place-based data, images, and other geographically relevant information are now readily available, greatly enhancing the overall body of environmental knowledge. Individuals are in many cases in the best position to provide geographic information that requires local experience, and the intimate understanding and current information about local conditions (Flanigan, 2008).

The author of this paper, and colleagues in Extension, have been training volunteers, and local business and community leaders, for the past three years to assess and edit the geospatial information of their business or organization on Google Maps, Navteq and other location-based services. Through this experience, we encountered several communities in which a majority of the businesses were incorrectly located on many of the major location-based service providers. In these cases, the appropriate response would require that nearly all businesses in the community would need to make edits to their location in these virtual geospatial directories.

Hence the community mapping project was conceived as a possible solution where we could recruit and train local volunteers to assess the community as a whole, make alterations where they need to be made on the respective location-based service, and thus benefit the community as a whole. This project was carried out as a partnership between University of Minnesota Extension (Extension) and Navteq Inc. with two separate groups of volunteers in Douglas and Crow Wing Counties in Minnesota. The study had two main purposes, one primarily for Extension and the other primarily for Navteq. The main purpose of this study for Extension was to assess the effectiveness of training local volunteers to collect spatial data on community points of interest, while for Navteq it was to assess the viability of using trained volunteers to supplement data reported form its own team of professional data collectors.

The logic model of this project is based upon the hypothesis that representation of a community's points of interest on popular location based services creates public value. Public value is created when a service benefits society as a whole (Kalambokidis, 2004). This logic model begins with the premise that people are extensively using location based services to find goods and services. For instance, Google Maps mobile (the most popular location-based service), is accessed by 100 million unique visitors every month (Finocchiaro, 2010). If a business is not discovered through a location-based search, it is likely that this business will miss out on customers. Increased customers

increase business and community vitality while also leading to greater profits and more tax based revenue for government and public entities, resulting in greater public value.

The Emerging Literature on User-Generated Spatial Content

The number of terminologies that academics refer to for user-generated spatial content, reflects the newness of this field of study. Starting in 1996 a group of Geographic Information System (GIS) professionals agreed on the term "Public Participatory GIS" (PPGIS) to define the particular problems of bringing a wider public into the effective use of GIS (Harris, 1996). Howe (2006) refined the concept in relation to web-based services emphasizing online collaboration and sharing technologies (Web 2.0) as "crowd-sourcing," while Goodchild (2007) uses "Volunteered Geographic Information (VGI)" to describe organized collective efforts to generate geographic information. The term "neogeography" (Szott 2006) describes basically self-driven geographic information generation activities on Web 2.0 platforms. Bruns (2008) refers to the terms "Produsage" to describe the dual nature of producing and using the information produced in the participatory Web 2.0 environment. "DigiPlace" is another necessary term that describes the understanding of a location based on, and filtered through, information about a place that is available on the Internet (Zook M.A. 2007). In the emergent Internet culture, activities like crowd-sourcing and produsage seem to derive much of their attractiveness from a sense of participation, connection, and self promotion (Howe, 2006;Goodchild, 2007), from developing reputation and a sense of "good will" (Anthony, 2005), and from empowerment, and use of local knowledge (Tulloch, 2008).

The apparent success of non-spatially oriented, crowd-sourced projects, such as Linux and Wikipedia, has piqued the interest of companies to experiment with spatially oriented, crowd sourcing efforts, or VGI, to enhance their own lines of business (Tapscott 2008). New technologies and Internet services, described as "Web 2.0" (O'Reilly, T. 2005), have made it easy to geo-reference many different types of information and share this information with others on spatially oriented Internet based platforms and social networking sites in recent years.

Companies like Google, Yelp, and Facebook are focusing on location-based services that make it as easy as possible for users to share information about where they are, where they are going, what they like, and what they don't like. These companies, and others, are competing along similar lines where the keys to success lie in making location-based information reliable, accessible, and useful.

In the case of VGI, private citizens, with few formal qualifications, have become involved in the process of creating geographic information, a function that had been reserved for centuries by official agencies (Goodchild, 2007). And even though the results produced by these volunteers may not be up to par with trained professionals, they represent a dramatic innovation that is having a collective impact on the field of GIS) and its relationship to the public (Goodchild, 2007). For instance, companies that provide geographic information for automobile navigation systems are constantly looking for more efficient ways to allow input from their customers on the ever changing layout of the road network.

VGI involves crowd-sourcing but it is different from non spatially oriented endeavors, such as Wikipedia, in the sense the information is location-specific and its accuracy may have more critical consequences in the physical world. For instance, inaccurate volunteered information on Google Maps about a business may result in misleading information and/or people getting lost, with negative consequences for the business (Zook ,2006).

Problems with User-Generated Spatial Content

Recent studies have shown that 35% of Internet users are participating in produsage (Lenhart 2006). Decreased costs of information dissemination have led to increased produsage, which is raising questions about the accuracy and usefulness of the data, and about authenticating the credibility of the sources (Flanigan, 2008). Callister (2000) argues that standard conventions of determining credibility breakdown in crowd-sourced endeavors because the high number of sources and low barriers to access produce a volume of information that belies gate keeping. Also, volunteers may not know nor care about the quality of their contributions (Mummidi 2008). On the other hand, Fischer (2000) argues that local knowledge or expertise often eclipses credentialed experts, while Gouveia (2004) expresses that local knowledge is a big advantage for collaborative VGI systems.

Many approaches tackle credibility and quality of user-generated spatial data by qualifying contributors and contributions. There are several methods which present a classification of users based on their purposes (Coleman, 2009), their geographic locations (Goodchild, 2009), their trust relations with other users (Bishr, 2007), or registered online personas as per the case in the Wikipedia community (Anthony, 2005). The aim is to distinguish between high-value and low-value, inaccurate and even fraudulent contributions.

In order to increase the reliability of geospatial data obtained from volunteers, many localized projects and field tests put emphasis on training volunteers. The variety of topics in available literature range from: Identifying vernal pools (Tulloch, 2008), monitoring invasive species (Newman, 2010), tabulating community features and assets (Hall, 2010), counting migratory birds (Kolok, 2011) among many others. In the field test of vernal pools (temporary pools of water where amphibians breed), an educational process was established through which volunteers were trained and formally certified creating a higher level of reliability. Trained biologists review each submission for quality, but after several years of work only 3,000, out of 13,000, sites have been surveyed. Newman (2010), in field tests to indentify invasive species by trained volunteers, mentions that field skills, such as species identification and GPS use, remain difficult for volunteers. Meng (2010) finds that some participants often just give up in the middle of the participation process because of great learning barriers and complicated interfaces, and many projects end up having only a few number of participants.

Additionally, limited funding, limited opportunities for training, the rigor asked of volunteers, and the difficulty of reaching remote sites have been mentioned as contributors to the slowed progress of these volunteered geographic information collection projects. Although the general public has the opportunity to contribute and exert its influence on these projects, it seems that many people are reluctant to become engaged. These findings illustrate that putting up barriers to participation, through required training and limiting the number of participants, has consequences in reducing the amount of data gathered and perhaps marginalizing the benefits of potentially increasing quality and accuracy.

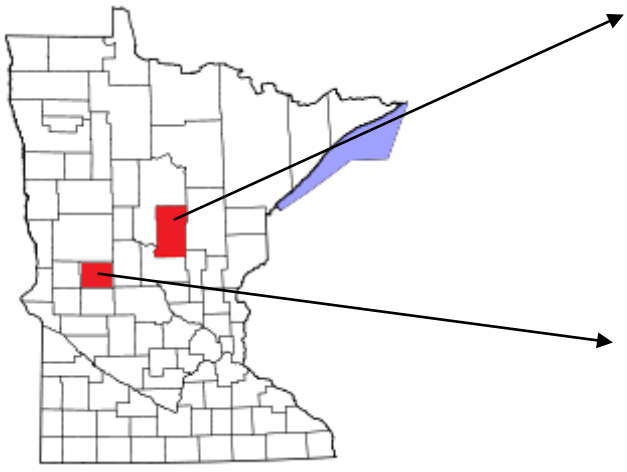
In order to mitigate errors from volunteered data, cartographic information providers (such as Google, Navteq, and TeleAtlas) use automated process to map data spatially. The quality of this data is typically assessed using match rates between the postal address and the spatial location. While match rates vary greatly among different studies, most have found that match rates are much lower in rural areas compared with urban areas (Zandbergen, 2009). In rural areas, the use of rural routes and PO Boxes is common, and these are not suitable for reliable geocoding. In most studies that report specific results for rural areas, PO Boxes account for the majority of addresses that were not geocodable. Different types of addresses also result in different match rates. For

example, higher match rates are typically commercial addresses (Zandbergen, 2008). Multi-unit properties, such as apartment complexes, mobile home parks, shopping plazas and college campuses, may consist of a single parcel but contain many street addresses. Unless a conscious effort has been made to capture these multiple addresses for each parcel, such locations cannot be geocoded using parcel data alone. In addition the diversity of freely available data is significantly less in rural areas than compared with metropolitan areas because there are less volunteers active in the process of collecting and reporting spatial data (Ziestra, 2010).

Minnesota Community Mapping Case Study

This project addressed the deficiency in match rates and the diversity of the available data in rural areas by focusing on augmenting the volunteer pool involved in the process of collecting and reporting spatial data in rural areas. The project was also unique in that it aimed to increase the public value of privately owned businesses in order to improve community vitality. The partnership between Extension and Navteq Inc. was formed because of shared goals and interests. Extension had already been training business owners and obtained for residential addresses relative to managers to assess and fix POIs on Navteq and Google Maps and was interested in a community-based approach to expand POI collection to include public POIs, such as Frisbee golf courses, public beaches, and tennis courts. Navteq was interested in assessing how viable it would be to use trained volunteers to supplement data reported from its own team of professional data collectors. Navteq funded the study and would assess data quality through its proprietary spatial mapping tools to match the data collected. while Extension would recruit and train volunteers to spatially map data.

The private-public partnership between Extension and Navteq influenced which pilot communities were chosen. Extension's priority was to select communities where it had existing social capital. Navteq wanted to maximize its marginal benefit by addressing the needs of customers who wanted access to a larger repository of tourism-related POIs. Douglas and Crow Wing counties were thus selected because of their relatively large populations compared with other rural Minnesota counties, are widely regarded as tourism hubs, and have existing relationships with Extension.



Crow Wing County

Population: 62,500

Major Towns

Brainerd – pop.(2010): 13,500

Baxter – pop. (2010): 7,600

Douglas County

Population (2010): 36,000

Major Towns

Alexandria – pop.(2010): 11,000

Recruitment

Recruitment efforts focused on enlisting volunteers from a wide base of civic-minded organizations, such as 4-H clubs, natural resource preservation groups, chambers of commerce, and Rotary clubs. We were encouraged by the enthusiasm shown at our presentations on the importance of community mapping, yet our goal to recruit 20 volunteers in each county only managed to recruit half that amount. Participants were also heavily encouraged to recruit from family and friends. The goal was to form local teams in each county that would continually assess and improve the community's digital map presence. We ended up recruiting 10 people in Douglas County and 12 people in Crow Wing County by the start of the training sessions.

Training

Volunteers, in each county, underwent 10 hours of training divided into three face-to-face classes held once a week in May and June of 2010. All training was held in a computer lab. Each participant was given the use of a PC with Internet access to get hands-on practice. The training objectives were to:

a. Introduce participants to the key concepts related to location-based services and demonstrate:
    - What information is contained therein,
    - What information is missing, and
    - The sources for existing data.

b. Facilitate discussion to help determine what is important in the community and what category of POIs should participants focus their efforts on collecting.

c. Train volunteers how to gather accurate geographic data.

d. Provide instruction on adding and editing data on Navteq and Google Maps.

e. Form teams to continuously collect and edit data after training has commenced.

The first session focused on illustrating the prevalence of the usage of location-based services and its benefits to community vitality in order to emphasize the importance of the work that the volunteers were training to undertake. Participants also evaluated the accuracy and completeness of Navteq and Google Maps by performing searches on well-known and not so well-known POIs. As predicted, many POIs were not found or were placed at the wrong location, which emphasized the need for volunteer input to raise the accuracy and completeness of entries on these and other location-based services.

The second session focused on data collection and reporting. Training was provided on how to determine geographic coordinates (latitude and longitude) using Google Maps, the EveryTrail application on iPhone and Android phones, and Garmin eTrex GPS units. These tools were selected based on their prevalence, ease of use, and cost. For smartphone users, the EveryTrail app was a low-cost tool to determine geographic coordinates. Many of the participants already had a GPS unit to which they were provided instruction on how to pull geographic coordinate data from it. We provided basic eTrex GPS units to those participants who did not possess a GPS. Training was also provided on best practices in reporting missing POIs and correcting existing POIs.

The process to collect, and report data POIs that was emphasized is as follows:

1. Define a category of POIs to assess and collect further data on. Participants selected categories based on their interests. One chose "free and fun

things to do," another chose antique shops, others chose local business establishments. We were relying on local expertise in order to catalog these POIs and not existing databases.

2. Define a geographic boundary; (what are the geographic limits of local expertise?)

3. Make a list of all the POIs in this category.

4. Do searches on Google Maps and Navteq for POIs and document errors and missing information.

5. Enter data for POIs that are known on Google Maps and Navteq. The process here was to scan the satellite maps to find POIs that the participant knew of and correct the mistakes or input anew. This process took about 10 minutes per POI per service. Navteq provided a special portal for data entry, similar to its public portal,, that gave priority access for participants in this project. Participants were provided IDs to keep track of data entered.

6. If the POI's location could not be determined from satellite imagery, the participants were encouraged to go physically (if possible) to the POI and collect coordinates using one of the devices described above. Participants were also encouraged to hunt for POIs in their category that they were not aware of by asking other local experts. The location data was used to then accurately place the POI on Google Maps or Navteq. This process took much longer, depending on how far participants had to travel to gather data. Participants were not reimbursed for mileage and were encouraged to fit this activity into their existing routines.

Extension also provided an added incentive to collect data by organizing a contest. The contest was that whoever collected the most POIs and added them to the Navteq database would win $1,000 worth of Extension programming for their community. Participants were further encouraged to recruit and form their own teams to help them achieve the highest POI collection counts. Participants were provided access to the training materials online, which consisted of "how to" videos on instructional activity from the training, to which they could refer themselves and others to watch. The contest was to run through Aug. 21, 2010, to allow ample time to recruit helpers and collect POI data.

The third session was held two weeks after the second session to allow for ample time to collect and enter POIs. The purpose was to check on progress the participants had made in collecting POIs and to share problems and concerns they had for this activity. Participants were also given time to enter data they had collected. After this session, email and phone were used to keep tabs on progress participants were making. In-progress checkups showed that few participants were collecting and reporting data. Others reported a lack of time or other priorities that hindered their progress.

Evaluation Findings

A short end of program survey, via the Internet, showed that few participants had collected data (see Table 1 below). Participation in the survey was also low, as only 10 people out of a total of 22 participants took the survey. Repeated Phone and email attempts were made to encourage participants to take the survey using the Dillman method. Only 2 people from the Douglas County group took the survey, compared with eight from the Crow Wing County group. Additional individual interviews were done with all participants.

Of those that did take the survey, their activity focused on documenting and mapping "eating and drinking establishments" (70%), "trail heads" (50%), "retail establishments" (40%), and "public buildings" (40%) (see Table 2 below). First-person interviews revealed that only two

participants had collected data on more than five POIs, while the others all collected at the lower end of less than five POIs.

After three months of work this reflects quite low participation in the work of data collecting and mapping. We did check in with the participants, those that we could contact, several times to check progress and offer encouragement. Several questions arise then: Were the activities too difficult? Were the necessary skills not taught to the participants during the training sessions? Did participants feel it was not worth the effort and time to do the work, or were there conflicting priorities?

We asked several questions in the Internet survey to test these assumptions. First we asked participants what aspects of the project they found difficult and which aspects were easy (on a scale of 1 to 6 with 1 being “no brainer” and 6 being "rocket science" (see Table 3 below). The task participants found most difficult was “Finding time to map POIs,” which had a mean of 4.3. Other mapping activities were relatively easy to accomplish. Comparing the level of difficulty between using Navteq and Google Maps showed comparable results.

As shown in Table 4, participants agreed that mapping POIs improves “community vitality” (mean of 1.7), “drives traffic to local businesses” (mean 1.9), “increases a community’s visibility to outsiders” (mean 1.7), and “found mapping POIs a useful activity”(mean 1.89). In summation, volunteers considered these mapping tasks to be important to support the economic vitality of local businesses and their communities and would recommend referring other interested communities to Extension. Even so, participants had more of a mixed response for continuing the work on their own and recruiting others.

Additionally, 70% were satisfied or very satisfied with the training sessions, and 50% felt they could use the ideas or skills learned in these sessions to a great extent and 30% to a moderate extent. Secondly, 90% of participants indicated they would have liked to have collected more POIs. Then when asked, “what prevented them from adding more POIs,” 89% of respondents reported being “busy with work” and the “time of year,” 44.4% cited “family commitments,” and 22.2% cited “other volunteer work.”.

Individual interviews yielded further insightful information about the community mapping experience. The leading data collector helped businesses in her community asses and fix their map presence. She said these people were her friends and neighbors, and she would not have done it otherwise. Other participants felt frustrated that more volunteers from local business organizations were not involved, while personal recruitment efforts by participants were not fruitful. Several participants expressed a change in the way they viewed interacting with digital maps. Before participating in the workshops, the participants reported being passive consumers of map data, but as a result now see digital maps as editable. This is encouraging preliminary evidence of an attitude change which may lead to future action.

Suggestions to improve the project included allowing participants to email collected data, since data entry was seen as a time consuming and undesirable task. Other suggestions were to hire an intern to map the POIs or training employees at the local chambers of commerce. Another participant liked the initial classroom structure and suggested it would help to keep people on task if there were more in-person sessions. Lastly, participants did express the desire to continue mapping POIs in the fall and winter and asked that the Navteq data entry portal remain open. Having priority access to enter data in Navteq’s portal demonstrated to the participants that this project was important.

Table 1 – POI collection activity in Crow Wing and Douglas Counties. Number of people responding ; N = 10.

"Please select the number of points of interest you mapped for each question below."	Less than 5	6 to 10	11 to 20	21 to 30
Added new on Navteq Maps	6	2	0	1
Edited or fixed on Navteq Maps	9	0	1	0
Added new on Google Maps	7	3	0	0
Edited or fixed on Google Maps	7	1	2	0

Table 2 – POI data collection type; N = 10

"What point of interest categories did you document and map? (Select all that apply)."	Response Count
Eating and drinking establishments (e.g. coffee shops, bars)	7
Trail heads	5
Retail establishments	4
Public buildings (e.g. city hall)	4
Places within public parks (e.g. horse shoe pits, tennis courts)	3
Other types of business (e.g. factories, insurance agents)	2
Historical places	1
Parking lots and garages	1

Table 3 – Level of difficulty in various involved in community mapping

"Please rate the level of difficulty in each of the following "(1 = no brainer to 6 = rocket science);" POIs = Points of Interest	Mean	St Dev	Response Count
Finding time to map POIs	4.3	0.87	9
Finding coordinates of POIs	2.2	1.39	9
Finding address, phone, and website information of POIs	2.6	1.60	8
Searching for POIs in Navteq Maps	2.2	1.04	8
Fixing errors with POIs in Navteq Maps	2.7	1.28	8
Adding new POIs in Navteq Maps	3.0	1.20	8
Searching for POIs in Google Maps	2.4	1.06	8
Fixing errors with POIs Google Maps	2.9	1.68	7
Adding new POIs in Google Maps	2.4	1.19	8

Table 4 – Usefulness of community mapping

"Please rate to the extent you agree or disagree with the following statements: 1 = Strongly Agree to 6 = Strongly Disagree."	Mean	St Dev	Response Count
Mapping POIs improves community vitality	1.7	0.67	10
Mapping POIs drives traffic to local businesses	1.9	0.88	10
Mapping POIs increases a community's visibility to outsiders	1.7	0.67	10
I found mapping POIs a useful activity	1.9	0.60	9
I will continue mapping POIs on my own	2.4	1.17	10
I will recruit and train others to map POIs	2.8	1.48	10
I will refer others to University of Minnesota Extension to learn how to map POIs	1.8	0.67	9

Discussion

This project provided many valuable lessons even though not enough POI data was collected to merit a thorough assessment of whether volunteer community mappers were accurate in their data mapping. These lessons would be well put to use for future VGI projects. The following recommendations are derived from the lessons learned in conducting this project.

1. Season may matter? The time of year or season impacted recruitment levels. Both Douglas and Crow Wing Counties are tourism destinations in the summer and one of the primary reasons for people to live there are to enjoy the beautiful summers, as the winters can be quite harsh. We decided against beginning this project in the winter because we thought people would be unwilling to go outdoors in the cold winter nights and hence decided to do this project in the spring and summer so people could get outdoors and collect data on POIs. What we found is that people find summer a difficult time to volunteer as they pack in their leisure time in the few precious months of the season. The volunteers who did participate repeatedly cited this issue when approached about not gathering enough POIs.

The outcomes of this experiment led to the question of why there was so little physical activity in collecting and mapping POIs even though participants found the activity quite useful, beneficial to their community, and relatively easy. he survey and individual interviews indicate the answer lies in the time of year that the activity was held. Could doing this in the fall or winter make any difference in actual work done? Will people be less busy and will they be willing to leave their homes during the cold winter days and early nights and find points of interest to map?

2. Make it easy to report problems and enter new POIs. We learned that the Navteq Map Reporter interface is more time consuming and difficult than Google Maps. Participants complained about the poor search functionality in Navteq in that they could not accurately determine which POIs were or were not already in the database. In Google Maps they could try a few searches and determine whether the POI they were concerned about was already in the database. This assurance gave participants confidence that their efforts would be influential and would result in a modification to the database. Participants also cited Google's automated emails as assurance that their POI report had been received and was being looked into. Others expressed a desire for making it simple to report new POIs by just being able to send an email with the required information and letting someone else do the data entry.

3. Wider community participation may decrease hesitation on the part of some to map local POIs. Some participants were resistant to map certain POIs that they had a self-interest in or thought that increased visitation of would create a annoyance. For instance, one participant was resistant to mapping local Frisbee golf courses as he thought that people who played this game were a traffic nuisance. This participant was mapping "free and fun things" to do with his wife (who was also a participant).

4. Think outside the box to group POIs. Asset mapping is a community development practice of analyzing the strengths of a community and determining how those can be used for positive change. During the second training session participants were asked to think about the important points of interest in their community from several different perspectives, including travelers, families, and local residents. We then asked the participants to search MapQuest and Google Maps for those important POIs. In both groups the result of this activity was a recognition that many of the important POIs were not listed. Especially interesting was a discussion on the difficulty in finding "free and fun" things to do using digital maps. This is interesting because it signals another possible use for digital maps as a travel destination decision tool. Traditionally POIs have been grouped by industry, but these initial

comments suggest interest in grouping POIs by need. For instance, one group discussed the value that having an "essential services" category would be. This type of category might include utilities, health care, schools, public safety, and business locations necessary for daily life. An additional category for "free and fun" POIs was also discussed, staying on the same theme of organization by interest.

5. Schedule as much activity, in terms of POI data collection and reporting, during the training sessions as possible. Participants reported that mapping outside of the training sessions was a low-priority item on their to-do lists. One recommendation might be to schedule the activity over a longer period of time and have monthly meetings where people can share what they found and mapped.

6. Assess how prevalent volunteering is within a community before beginning any projects. The communities involved had little infrastructure for volunteer activities, as people participated at the individual level and not at the team or organizational level. Perhaps conducting this activity in a community where there was more infrastructure for volunteer participation would lead to greater participation overall? Perhaps if the community had experience working on similar projects participation would be higher? Perhaps the "team" environment would create a sense of responsibility within team members thus leading to more POIs being documented?

Conclusion

The three-month community mapping project yielded many valuable lessons to apply to future projects but did not yield enough POI data to merit an analysis of its spatial accuracy. The need to conduct the project stemmed from a lack of POI data on commercial location-based services and the fewer number of self driven volunteers actively collecting POI data in rural areas as compared to urban areas. A question of great importance then is how much individual incentive is needed for community members to take action to improve the digital presence of their community? In this case, our primary point of advocacy to participants was that mapping points of interest will bring spillover benefits to their community as a whole. Upon further reflection, our case for this lacked specific research to explain correlation between digital presence, individual business metrics, and community metrics as a whole. Additional research needs to be conducted to further explain how the digital presence of a community, especially on digital maps, impacts traveler decision making as well as other pertinent community and economic development metrics.

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