

*Destination Unknown: Design Dimensions of Open Source
Travel Mapping Tools*

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Capstone Project Report

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Introduction

This 596B report includes components from the 596A capstone prospectus, as well as a summary of project results and next steps for future research and development. Our research presents findings that show most users find it challenging to use existing geospatial tools in a meaningful way to complete recreational travel planning tasks based on evidence collected from a survey we designed. The most prevalent challenges for users included the lack of integrated GIS and media capture capabilities as well as difficulties creating structured personal data. We chose to present our findings at the FOSS4G annual international conference in Bucharest, Romania to convey our conclusions and illustrate opportunities for future web application development efforts that can address design needs and functionality in this context.

Background

Destination travel is a popular way to experience the world for millions of people. Our research question focused on generating data to quantitatively and qualitatively understand how the design of interactive web maps can help people plan great travel experiences. Little previous research has been conducted to establish what this type of user might actually need in a map-centric application that emphasizes the role of space and place. Most current approaches fail to assess or incorporate the spatial dimension beyond a simple visualization. In addition, most existing trip planning systems are proprietary in nature or host data on a proprietary system, which often monetize user data to generate ads and influence a user's decision making. Furthermore, the development of proprietary systems are less flexible in accommodating user feedback on a large scale; however, free and open source solutions benefit from a wide community of developers, tailored application initiatives, and more frequent software roll-outs. Our work aimed to understand the specific design elements and usability criteria that might encourage adoption of web-based spatial tools to aid in better decision making.

We designed a survey hosted on the Qualtrics survey platform tool that captured information about when and how people used maps of any kind of in three distinct phases, or stages, of recreational travel: before, during, and after. Our data showed that while web maps are used during each of these stages, integrated tools that allow for both visualization and organization of personally generated data remains opaque, distant, or challenging to most of the users we surveyed.

Finally, our survey data highlighted the great potential for increased utility of web-GIS tools by designing and developing to specific feedback we gathered. Using documented FOSS4G guidelines and application development efforts, many of the challenges we identified can be used to tailor existing or create new web GIS applications that meet a fundamental user need to answer the question of where. The findings presented in our research can be incorporated into design and development planning that targets an existing and accessible user base in need of tools that help them overcome challenges related to efficiency in curating their own data.

Goals and Objectives

Recreational travel tools currently fail to identify that the primary needs of this user are often spatial in nature and can be addressed by integrating structured spatial data creation with existing text and geo-tagging features found in many social media apps. Acknowledging that features which emphasize location and time affect decision-making broadens a user's ability to plan travel, make informed decisions while travelling, and reflect on past experiences. Anecdotally, many can probably present examples of colleagues, family, and friends facing spatially-focused types of challenges while interacting with web-based mapping systems. In some cases, these challenges and educational burdens are so great that it's often easier to avoid using web-based maps at all and use traditional tools like hardcopy maps, calendars, and spreadsheets. While these approaches often meet basic user requirements, there are drawbacks related to the utility and storage of data that can be addressed by integrating these functions into a FOSS4G web mapping application.

Our goals in undertaking this research were to obtain data that would answer the following questions:

- How can interactive maps help people plan great travel experiences?
- What might users be missing out on by not using a web map while planning for travel?
- What does this type of user need from such a tool during travel?
- What memories or experiences can maps help users better recall in the future?

Analysis of the data we collected showed that recreational travelers want and need more interaction with web mapping tools to support their efforts and would very likely use more GIS features if they were integrated and presented in the right context.

Methodology

We defined recreational or destination travel as any type of travel not associated with business that could include sightseeing, education, or cultural exposure. We specifically avoided logistics planning for business or professional travel, like airfare or hotel booking. To design the survey that served as the primary data collection tool for our research, we conducted informal canvassing of travelers about their recreational travel planning activities and the tools they currently use. We also referenced past observations of users interacting with web-based tools and websites to develop an understanding of common tasks recreational travellers undertake at different stages of travel. This emphasis on understanding distinct scenarios and preferences at certain stages of travel served as a key component to our methodology and underpins our efforts to drive greater user interaction as part of a scenario-based design approach, which has been shown to drive greater user adoption across a variety of applications and industries. [Rosson & Carroll, 2002; Reeder & Turner, 2011] Finally, we designed the survey and questions with these behaviors in mind to inform our understanding of how people currently use maps and

what tasks they would like to perform so that we could contrast existing and desired functionality.

The 25-question survey included multiple elements intended to capture demographic information about recreational travelers and how often respondents currently used maps of any type in support of recreational travel activities. Our survey presented Likert-style usability questions that measured whether certain functionalities presented would be useful and if it was easy or convenient for them to accomplish those tasks using current map tool(s) they were familiar with. [Likert, 1932] We then presented questions that helped evaluate types of map-centric tasks users carry out in three distinct phases: planning before a trip, during travel, and after returning home. Our goal was to identify if there were certain types of behaviors, preferences, or tasks associated with each of these phases that we could highlight from a design perspective. Where respondents could select more than one response, we calculated percent out of the total responses available (260 total).

We then asked users to rank commonly used functions that included sharing with friends, writing or journaling, modifying or editing their itinerary to indicate places they were or were not able to visit, and noting simply where they were on a map. For these questions where we asked respondents to rank the importance of behaviors at each stage, we multiplied the rank by the number of responses and divided by the total to generate an average score between 1 and 5, with 1 being the most preferred choice.

Finally, we analyzed responses to a short video that showed a series of wireframe mock-ups we designed to help gather feedback about tasks and functionality [Haklay & Zafiri, 2008]. The video showed various static user interface instances and highlighted how tools would work in a live environment while conducting typical tasks during recreational travel. The 2-minute video walkthrough highlighted features like uploading photos, adding friends that can view or edit an itinerary, point creation and modification, and a structured data entry form which captures relevant information. We presented flexible options for displaying different views of user-generated data in a calendar format, spreadsheet, and map to emphasize time, space, or both. Users were asked to rate the layout of the wireframes, provide feedback on whether the functionality presented was useful and given the opportunity to share additional comments using open-ended questions.

Last, we collected qualitative data using a digital open card sorting exercise to better understand how users perceive themes based on a pre-generated list of commonly used words related to recreational travel. Respondents organized the terms into categories as they saw fit and there was no requirement to use all the items.

Based on the survey data we collected, over 68 percent said they would recommend a web mapping tool with features like the one represented in this walkthrough to friends, family or colleagues. The remaining respondents indicated their desire for an interactive web prototype to evaluate additional functionality, which demonstrates that there is a potential user base with needs not currently met by existing tools.

Survey Summary Outline

Survey Section		Evaluation	Sample
A	User demographics	Education, profession, age	See appendix
B	User Preference and Task Assessment	Before (Planning) During (Conducting updates while traveling) After (Reflection/memories)	-Rank the following items from most (1) to least (5) important prior to travel; -It is easy/convenient for me to share a map or visual representation of my recreational travel plans with family and/or friends on the web.
C	Video Walkthrough	Usability assessment of wireframes Open ended text feedback	-I think this mock-up website presents a balanced layout across elements including the map and other key features (e.g. the map is large enough, customization tools are easy to see, view toggles are intuitive).
D	Card Sorting	Word association and grouping	See appendix

Figure 1. Survey tool outline. The full survey can be found in Appendix A.

We also compared responses to behaviors we presented at varying points of recreational travel to evaluate the importance of each objective at different stages.

- Using online maps to see what the area of travel looks like (spatial awareness)
- Using hardcopy guide books or maps to prepare or review locations they visited (using maps to gather context of space and place)
- Identify lodging and what's nearby (identifying anchor point for spatial awareness)
- Generating or reviewing places to visit (using spatial awareness to generate recreational travel objectives)
- No use of maps at all

We evaluated 52 total responses to our survey. We received 59, but discarded seven that were less than 65 percent complete and contained invalid or incomplete responses (e.g. 'test'). We evaluated survey completions and found that for those that completed at or near 65 percent, most of these users answered all of the Likert-style questions associated with map-based behaviors and preferences, but failed to answer free-text questions or those immediately

following the wire-frame mockup video. Eight of the 52 responses we analyzed were 65 percent complete; their responses were included in our analysis where they provided an answer. The number of recipients evaluated for each question is noted in the results and graphics below.

Project Timeline

We started a literature review in the spring of 2018 to identify existing research that would contribute to the development of our research question and refine our survey questions to answer any gaps. In the fall/winter, we developed wireframe mockups and draft survey questions, which we then shared with a small test group to elicit informal feedback regarding clarity. Our survey collection tool was open for a total of eight weeks from May to July of 2019. After the survey data was cleaned, we analyzed responses and developed key findings over the next two months where we presented this information to the FOSS4G conference in Bucharest, Romania. In total, excluding breaks in the project, this effort took place over the course of 12 months.

Results

Our survey responses showed that respondents use maps to aid in recreational travel at all stages, but too often, this requires multiple web-based applications including calendars, maps, spreadsheets, and social media tools in order to structure information or synthesize information across tools to make informed decisions. This is seen as a substantial burden to users and discourages routine incorporation of these tools. Most typical GIS systems offer tools that are difficult to learn or are costed, even on lightweight web versions; only the most dedicated planners take the time to organize their itineraries into a 'structured spreadsheet' to share or upload to existing web GIS tools.

Highlighted qualitative user feedback: "I would recommend to all as I have not yet found an application to organize and plan travel itineraries in such a comprehensive fashion."

Overarching conclusions

By far, the most prevalent use of maps occurs in the travel planning stage, likely to gain spatial awareness of the destination they will visit. A roughly even amount said that they used maps either during travel or after. When comparing timeframes in which people used maps in multiple stages, this number dropped significantly: about 44 percent said they used maps before and during travel while only 21 percent of total respondents indicated they used maps during all three stages including after returning home from travel.

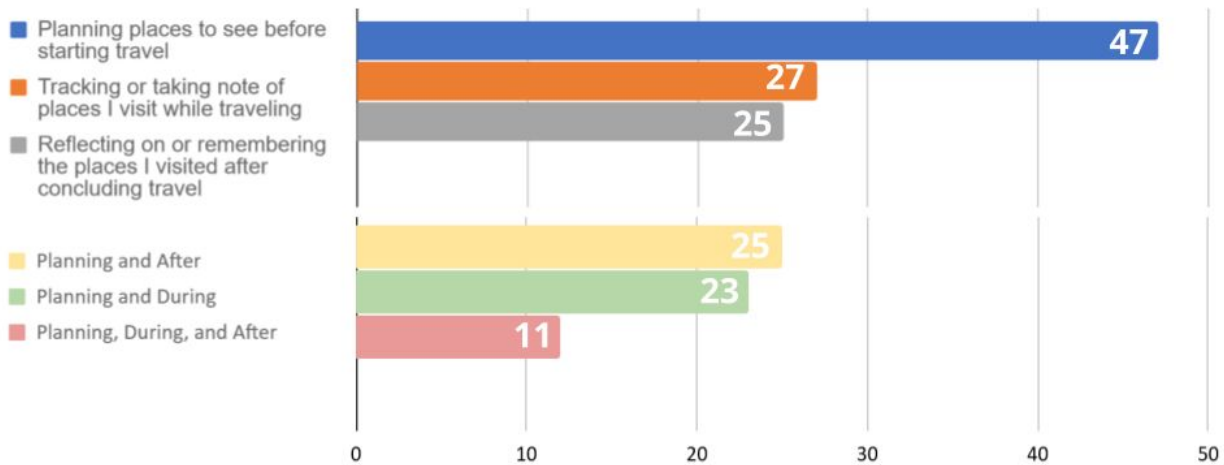


Figure 2. Responses to “Aside from logistics planning (e.g. airfare, lodging), when do you currently use maps to support recreational travel? Please check all that apply.”

While spatial awareness was identified as a priority before and during travel, our data shows potential growth areas for software tools that help people use maps to reflect on and recall past travel. We found that the obstacles facing users at this stage would benefit from further investigation using an interactive prototype or with additional survey questions. Despite the low percentage of respondents that said they use maps after travel, we found that most used maps more often than they were necessarily aware to gain spatial awareness, including reflection on past locations they visited; identifying or remembering their lodging; and identifying or reviewing places they noted were of interest to them. The only time in which some users responded that they didn’t use maps at all was after travel, which accounted for less than 15 percent of responses, while the remaining approximately 75 percent said they did use maps to support decision making at this stage. This may be due to the fact that current mapping tools lack this functionality or that existing software is difficult to use.

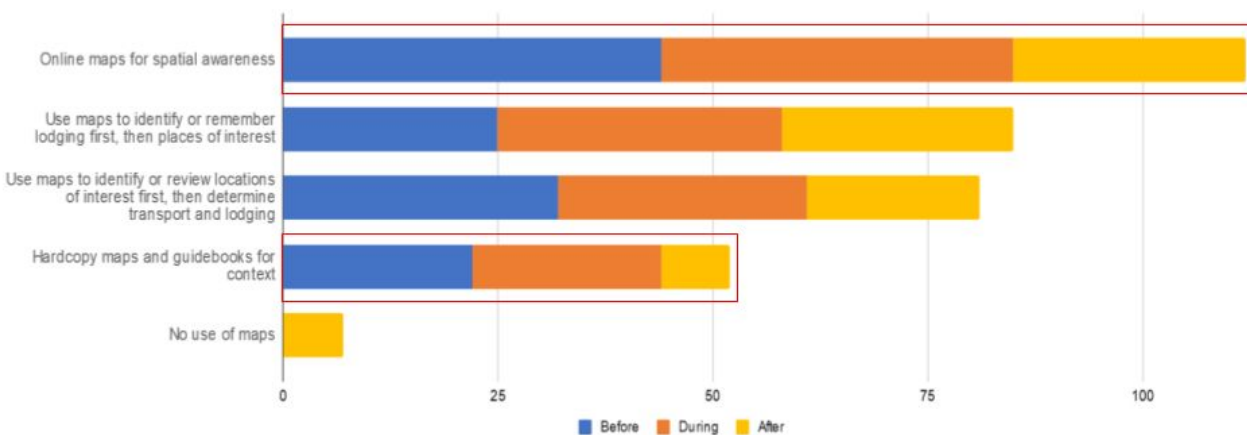


Figure 3. Comparing use of maps before, during, and after travel reveals consistent use of online maps at all stages; respondents also indicated use of maps to reflect on past locations visited.

The ability to store and share travel plans and activities was highlighted as a key element in our survey responses and in the free text write-ins we reviewed. Our data shows there are opportunities for design and development efforts that could better engage users or enhance their ability to share data with others. The ability to share a map that depicted their travel plans was most important in the pre-travel phase as people researched and attempted to gain information about destinations, likely as friends or family coordinate on the development of travel plans, according to an analysis of text-based qualitative feedback we collected. During travel and after, respondents rated this capability roughly the same, however there were between 17 and 22 percent that said they were on the fence about whether this was a priority. This question regarding the utility of sharing warrants further research about user preferences at these stages given the range of responses we received that were undecided.

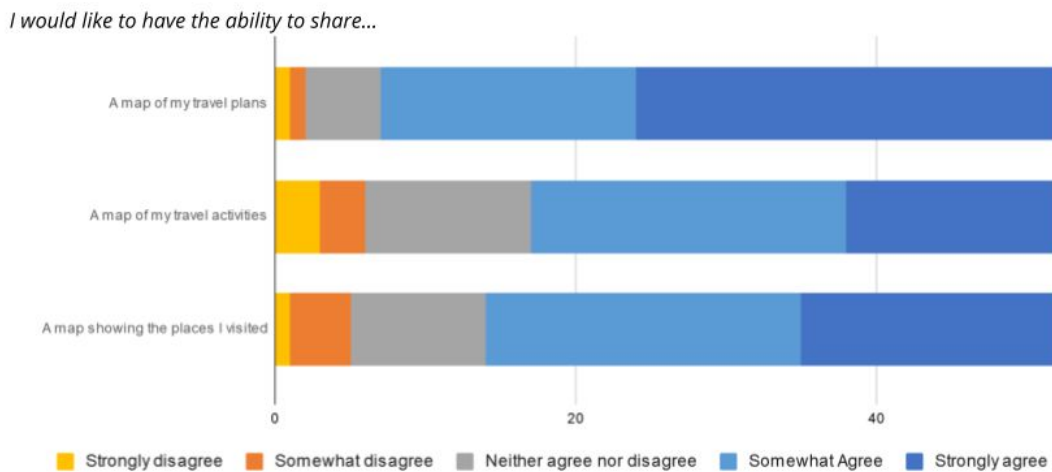


Figure 4. Survey responses reveal that most users agreed with the statement that they would like to have the ability to show - in order- travel plans (before), locations visited (after), and travel activities (during).

We further explored responses related to sharing recreational travel data in another way by comparing how many respondents indicated that sharing was a desired capability and whether users agreed it was easy to do so using a current mapping system of their preference. Our data shows that while most users during the planning phase- nearly 86 percent- wanted this ability, 31 percent said that it was challenging to do so. Similarly for during travel, about 31 percent of respondents said it was difficult to share maps that display updates, changes to, or status of itineraries while travelling compared to 67 percent who wanted the capability. A substantial number, about a quarter of those we surveyed, said they were on the fence about how easy of a task this was at both stages, which demonstrates a disparity between desired function and capabilities offered by web-GIS systems.

Our data highlights specific development focus areas to address differences between the tasks we identified as important compared with the perceived utility of existing, proprietary web mapping tools.

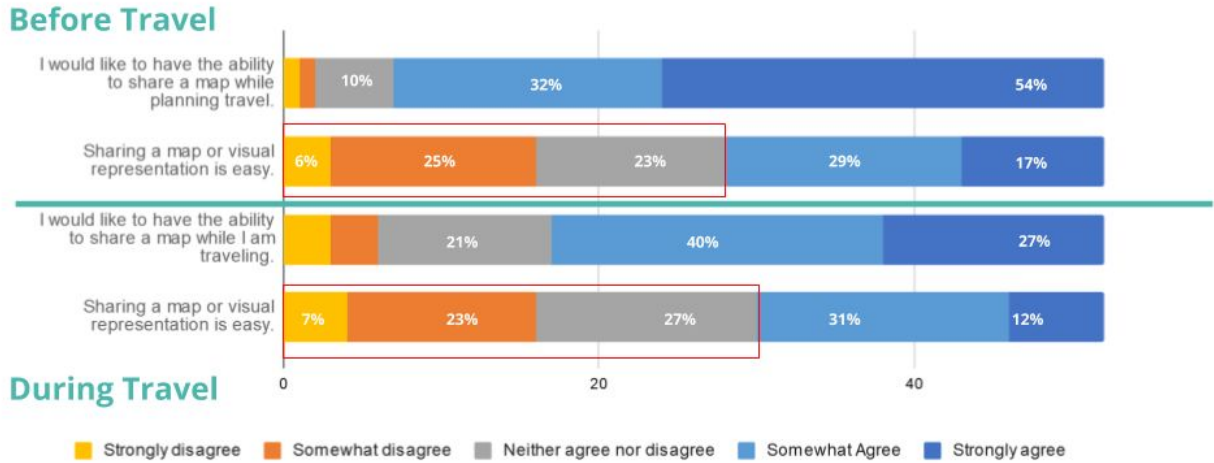


Figure 5. Comparison of before and during travel preferences shows contrast between desirability of sharing in a web map, which reflected high levels of agreement, while ease of use revealed lower agreement numbers and an increase in those who were on the fence.

Finally, more than 82 percent of users agreed that the functionality and the layout presented in the video walkthrough was in line with their current needs, which presents opportunities for FOSS4G web development to refine key elements of design. For those that somewhat disagreed regarding whether they would use a tool as presented in the survey, text-based responses showed that respondents felt they were unable to fully respond to this question without an interactive prototype to assess the utility of the functions presented in the video. We have highlighted this and other recommendations as next steps detailed later in this report.

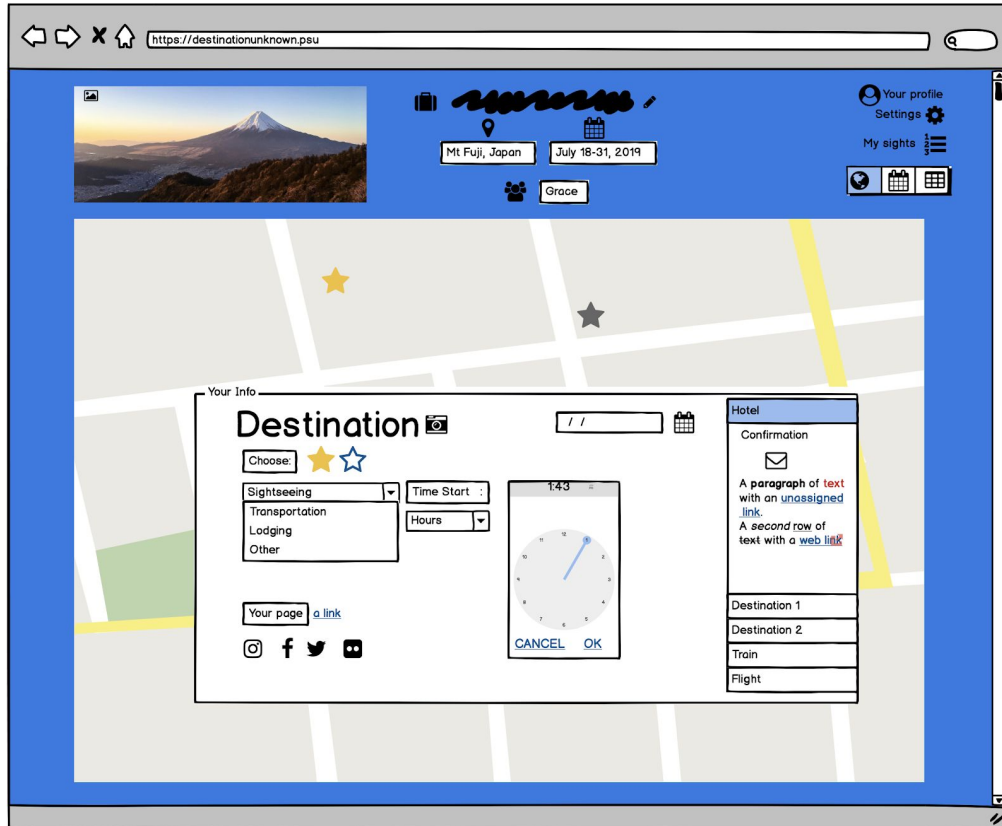


Figure 6. Sample mock-up of the graphic user interface presented during a short wireframe mock-up video walkthrough of functionality.

In-depth survey analysis

The following presents additional background and further analysis of each question presented in our survey tool. We break out user demographics in more detail and discuss conclusions based on responses to each of the three planning stages we presented.

Demographics

Of the 52 total respondents we included in our final analysis, 76% were between the ages of 25 and 35; however, almost 90% of respondents were between 25-45 years old and accounted for the majority of our survey respondents. We also analyzed responses from users that indicated they were age 60 or above.

The majority, at over 80 percent, held some form of post-secondary school education which included an associate's, master's, or doctorate level degree similar to a PhD. Most respondents indicated they worked for a state, local, or federal government entity (38%) followed by responses indicating they working in a science tech engineering arts or mathematics field, followed by academia.

User preferences in three phases

Because we segmented our survey tool to capture travel behaviors in three distinct phases, we present an in-depth review of the responses collected. Using web-GIS tools and maps take different priorities at each of these stages for those that we surveyed; furthermore, we found that maps are used to answer different questions at different stages. In some cases, we found that maps are used to answer multiple questions at once to help people gain awareness of the location they visit, plan lodging as a key anchor point, organize transportation, and identify places of interest. The responses we gathered show trends amongst the users we surveyed, as well as revealed the breadth of travel preferences and approaches.

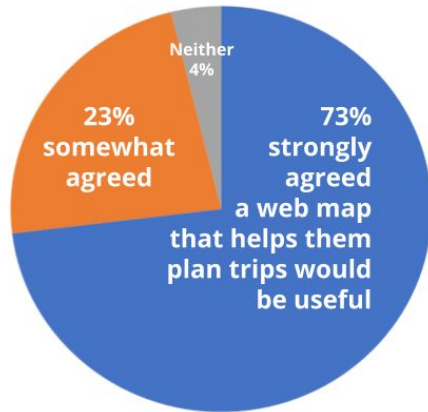
□ Planning Stage (Before Travel)

Maps are a key part of gathering spatial awareness prior to travel as users seek to understand where points of importance or interest are located. When asked how often they used maps of any type prior to travel, nearly all respondents agreed that they used maps (on any type of medium, digital or hardcopy) prior to travel. Seventy-five percent indicated they used maps at this stage with the highest frequency based on the number of responses noting their use of maps was always or most of the time.

Most users said they used some type of online spatial or mapping tool (e.g. Google or Apple maps) to facilitate decision making at this stage. Because users could select all choices that applied, the next highest selected option was using maps to identify places of importance first, then working backwards to identify lodging or transportation as opposed to finding or identifying a place to stay first. Alternatively, some users said they do the opposite and use maps to find accommodation first, then see what's nearby based on proximity.

Nearly all respondents, about 96 percent, agreed a mapping application that helps them plan trips would be useful. Of those, nearly three quarters were in strong agreement. There were no negative responses to this question, which further demonstrated that maps play a critical role at this stage.

Seventy-seven percent agreed that a feature to share a map of travel plans with friends, family, or traveling partners would be useful, while less than half agreed that this was easy to do using current tools. In contrast, about 31 percent disagreed about the ease of sharing and 23 percent were undecided, showing that while utility is needed, not all users are comfortable utilizing this feature in software they're currently using.



77% would like **the ability to share** a map of travel plans with others

Only **46%** said **this was easy**
31% said it was difficult
23% were on the fence

Figure 7. A majority of users responded in agreement to the question “I would like to have the ability to share a map of travel plans with others”. In comparison to ease of use, about 46 percent agreed this was easy to do so.

When asked to rank items of importance prior to travel, most users, nearly 50 percent, said that showing places they plan to or would like to visit on map as the number one priority with an average weighted rating of 1.8.

This was followed by organizing an itinerary and knowing where they would spend the most time. The latter of these is a type of analysis and shows that users want the ability to explore their data from a spatio-temporal context prior to travel, probably in order to make more informed decisions about travel plans.

Uploading photos or notes was ranked second to last, likely because people felt they lacked photos or content to upload/associate with items (compared to stages during or after travel).

%	Overall Rank	
1.8	1	Showing places I plan or would like to visit on a map
1.9	2	Organizing my itinerary
3.2	3	Knowing where I will spend the most time
3.4	4	Sharing my travel information with friends or family
3.7	5	Uploading photos or notes

Based on 50 users that responded to this question

Figure 8. Ranking of travel behavior preferences before travel. “Rank the following items from most (1) to least (5) important prior to travel.”

□ During stage (while traveling)

During travel, tools that provide spatial awareness are critical. Nearly all survey respondents, at about 91 percent said they frequently used a map (on any type of medium) while traveling.

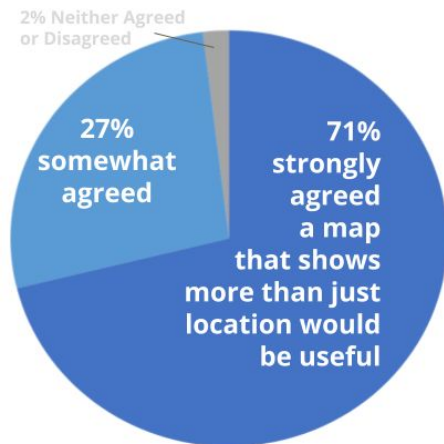
When asked to select what behaviors best described their use of maps at this stage, most respondents indicated that they primarily used them to understand the layout of a city or destination. Just slightly less at 26 percent, respondents noted they used a map to help them understand and gain context about an area [or areas] nearby that they could visit based on proximity to a particular location; this is a 6 percent increase to the same question asked in regards to pre-travel stage. It's likely that users view their lodging as an anchor point to help them locate places of importance based on what's nearby.

Twenty three percent said they identified places to visit first, then used a map to gain insight into how to get there, suggesting that for these respondents, they are not limited by proximity to known areas.

At this stage, web maps could help travelers broaden the area they can explore by adding spatial and temporal components that help people more efficiently plan their days. During travel, users are also more likely to use web mapping tools to help them research and make near-term choices about what they can see or do.

Despite most respondents indicating they used maps to simply show the layout of a destination, more than 71 percent agreed that a mapping system that goes beyond showing their current location would be useful.

We asked users again whether they would like to have the ability to share a map of recreational travel activities with others while traveling; 67 percent agreed that this capability would be useful, while only 43 percent agreed that it was easy to do. In another question, we asked users if they agreed with the statement that they were comfortable using websites and mobile applications to support their recreational travel activities. While 71 percent of users strongly agreed with this question, the responses to how easy sharing a map of their recreational travel plans were similar for both the before and during travel phases. Our data shows that for many, these capabilities are likely lacking, unavailable, or difficult to use.



67% would like **the ability to share** a map showing travel activities with others

43% said **sharing was easy**
30% said it was difficult
27% were on the fence

Figure 9. A majority of users responded in agreement to the question “I would like to have the ability to share a map of travel activities with others” during travel. In comparison to ease of use, about 43 percent agreed this was easy to do so.

At this stage, we found that those we surveyed wanted to be able to note where they are, but also be able to quickly discern and develop a clear picture of where they will go next. When asked to rank items from most to least important at this stage, nearly 60 percent indicated their number one priority was noting where they were on a map, showing a need for spatial awareness to facilitate decision making. This was closely followed by modifying or updating their itinerary.

Uploading photos/notes at this stage was ranked third, while sharing a location and writing or journaling were tied for last place. Close numbers at this stage likely illustrate the variety of travel preferences and priorities during recreational travel or a need for additional exploration of the challenges that might face users at this stage. Further analysis of qualitative write-in responses showed comments that said these activities were hard for them to do with current tools, but might consider prioritizing them higher if it were easier to do so.

Avg.	Overall Rank	
1.8	1	Noting where I am on a map
2.3	2	Modifying my itinerary
2.9	3	Uploading photos
3.6	4	Writing, taking notes, or journaling information about what I did
3.6	5	Sharing my location or places I've visited to sfar with friends or family (same as pre-travel)

Based on 51 users that responded to this question

Figure 10. Ranking of travel behavior preferences before travel. “Rank the following items from most (1) to least (5) important prior to travel.”

□ After stage (travel has concluded)

We found that about 50 percent of those we surveyed said they used maps to reflect on and remember places they visited or remember where they stayed during a prior trip. Based on these responses, web mapping systems can provide much more than just location awareness or itinerary development; rather, web maps have the potential to provide the ability to better reflect on past experiences and recall memories.

However, about 13 percent said they didn’t use maps at all at this stage. This is in stark contrast with the responses we gathered in the pre-travel and during phases, where respondents indicated they used maps at all times. While using maps after travel may not currently be seen as a necessity for many recreational travelers, development of FOSS4G web mapping tools can address an emerging growth area by introducing users to the utility of GIS tools. Since we collected data that placed such a strong emphasis on the ability to share travel plans in the ‘before’ and ‘during’ stages, the ability to store and reference personally curated spatial data could create a cycle using past experience to plan and guide future recreational travel experiences

In fact, 61 percent agreed with the statement that a mapping system that helps them reflect on past travel experiences would be useful and 73 percent said they’d like to have the ability to share a map showing places they visited after concluding travel.

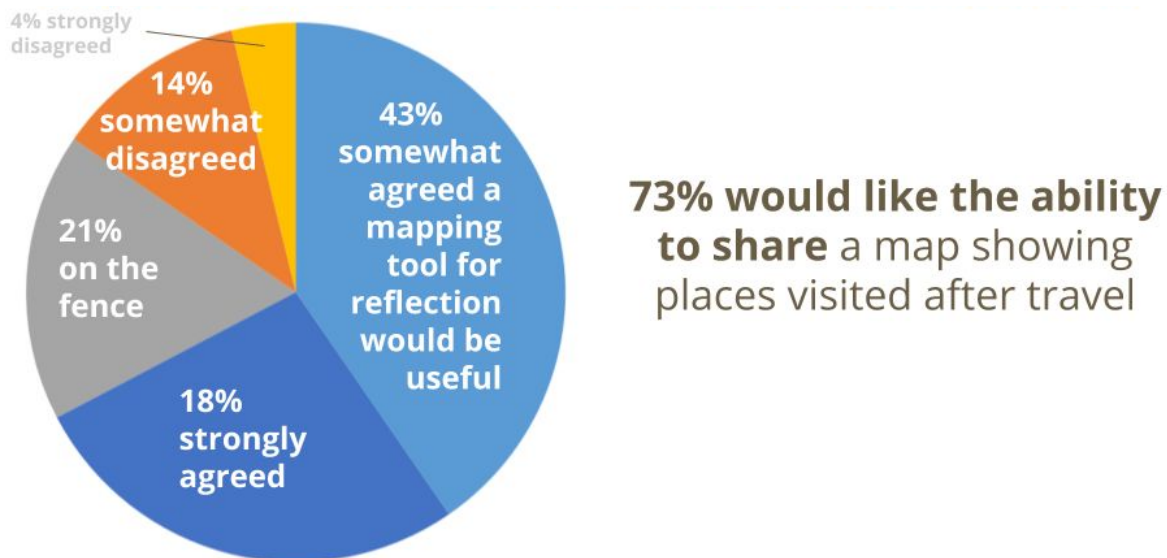


Figure 11. About 60 percent of users agreed that a mapping system that helps them reflect on past travel experience would be useful and 73 percent agreed they would like to have the ability to share a map of past travel experiences.

To do this, data needs to be stored, and easily accessible to users based on a variety of query and sorting parameters including date and location. This functionality can be implemented by

existing FOSS4G database storage solutions and would have a positive impact on users seeking to accomplish these tasks beyond simple location updates.

Finally, we asked respondents to rank items of importance after returning home from travel. Fifty-three percent ranked uploading photos or notes as the most important feature in contrast to the before and during travel phases where this task tended to rank much lower in priority. We found that many users undertake personal data curation and maintenance only after travel concludes, but at this point, the burden of taking time to remember and incorporate into existing web mapping tools likely discourages the use of maps at this stage. Our data findings suggest that this is probably a desired task, but current tools lack an intuitive or easy-to-use capability.

The same is probably also true about writing notes or journaling, which on average was ranked much higher at this stage than other phases of travel.

<i>Avg.</i>	Overall Rank	
2.0	1	Uploading photos or notes
2.4	2	Reviewing where I visited on a map
3.1	3	Writing, taking notes, or journaling information about what I did
3.3	4	Reviewing my itinerary
3.4	5	Reviewing where I spent the most time

Based on 51 users that responded to this question

Figure 12. Ranking of travel behavior preferences after travel. “Rank the following items from most (1) to least (5) important prior to travel.”

Although the ability to evaluate where a person spent the most time is a type of analysis, our data shows that travelers likely want this functionality to further emphasize where they were. Based on qualitative analysis of responses to text-based questions, most common and currently used mapping tools have few options beyond point or pin locations with no summarization or symbology option. While “reviewing where I spent the most time” was ranked last at this stage on average, there was a high degree of variance suggesting its importance to users who are unfamiliar or unsure about how they would interact with such a feature is not yet fully understood.

Limitations

Design elements and preferences for a broad user base can only be realized or captured with additional input from a large, diverse group of respondents. Our sample size of slightly more than 50 respondents, while randomly generated and representative of a variety of backgrounds,

was limited in both its size and scope given that most respondents were likely in the United States. Delivering this survey to a larger or more diverse group in other countries would likely solicit additional feedback to refine design and development efforts, according to a body of research that indicates Likert-style statistical analysis can be susceptible to bias due to attitudinal variations. [Stacey, 2005; Stratton, 2018]

Finally, while this research does not address or evaluate users seeking to book experiences or store logistics like Airbnb, expedia, or any other type of application that displays a map component to help with booking, there are potential opportunities to integrate some of these elements, like viewing a calendar of planned experiences or tracking expenses in an interactive web mapping interface.

Next steps

This research aimed to fill the gap in understanding the behaviors and preferences of recreational travelers when using web-GIS tools. We developed an open, freely available design and evaluation feedback tool for those looking to develop web applications that emphasize the role of space and place. The dataset we collected showing user preferences is also publically available for further trend analysis.

We have identified two areas for further analysis on this topic, which include additional survey results analysis and software development recommendations for an interactive prototype.

Survey data and visualization

Additional research and analysis of the survey results gathered during this effort could reveal trends across a variety of user preferences by evaluating whether demographics, like age or profession, were correlated with certain behaviors at different stages of travel. Our analysis did not explore these complex relationships, but additional research could reveal ways to target or tailor user interface design or identify other challenges based on education level or profession that might increase user adoption.

While we collected responses to an open-ended card sorting exercise and evaluated several responses, we did not quantitatively evaluate this dataset to show how what certain terms we presented were grouped together most often. Card sorting can reveal how users perceive the relationship between certain activities to inform user interface design in the most intuitive way, especially when combined with qualitative analysis [Conrad & Tucker, 2019; McGuire 2001]; in our survey, we provided approximately twenty words commonly associated with travel and asked users to group them together in any way that made the most sense to them. Furthermore, we asked for feedback regarding category types or other words that should be considered. This information, along with the other data collected in the survey tool could drive prototype design for drop-down menus, palettes for adding/modifying data, and what buttons are presented in the hierarchy of the web application.

Finally, several respondents answered questions about their ability to perform certain functions

with answers that indicated they were unsure whether they agreed they were easy to do. Additional questions that explore these themes either on their own or in conjunction with an interactive prototype would provide further insight into design and development efforts.

Development recommendations

After analyzing text-based feedback results, we found that there are five key functional elements that FOSS4G software development tools can address in this context. Each of the items listed here are existing web-GIS capabilities present in a variety of other tools and can be tailored to meet the needs of recreational travelers.

1. **Symbology** Users mentioned symbology to avoid clutter and suggested their desire to visualize data points based on the status of the location (e.g. whether it is a planned visit or noting you visited in the past) or even by the person that suggested/created them using colors and icons.
2. **Dashboard** Users also mentioned that an integrated system with multiple ways to view data would help them plan better. One person noted that they would “recommend [this application] to all as I have not yet found an application to organize and plan travel itineraries in such a comprehensive fashion.”
3. **Reflection** Based on our research, we found that users would like the ability to more easily find, query, and organize past experiences to share memories and places of interest.
4. **Sharing** Throughout our survey, responses indicated a strong emphasis on sharing-whether to show places they’ve visited after travel or used to plan/recommend places during the pre-travel phase. These capabilities can be addressed by current open source stack database storage solutions
5. **Mobile** Finally, users mentioned they would like to be notified when they are nearby points of interest marked by friends or other groups of travelers to aid in the discovery of new places. While the focus of our research did not specifically explore location-based algorithms or automated suggestions of places based on a user’s past preferences, incorporating research efforts in this vein would modernize the way people currently use spatial tools to conduct recreational travel.

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Appendix D

Key development recommendations and selected raw qualitative feedback

- Clutter and visualization are areas where current commercial 'pin-drop' web maps fall short
 - Users mentioned symbology based on type or even who suggested them using color and icons
- Integrated trip planning that balances map and text components (map; text- blog, comments, tips; calendar) in a type of dashboard are most important to users
 - Show points you're visiting later
 - Notify me when points of interest my friends or someone else have marked as interesting?
- Sharing with friends & family should be easy
 - Share itineraries and edit with others or groups
- Users want more based on the design they saw- viewing of calendar format, drop-down menus, interactions
- Mobile integration, accessibility, and views
- Tag photos/integration with other applications?
 - Social tools were mentioned by at least one person- find others near you with similar interests
- Comments about map functionality and additional layers will be addressed with OSM basemap(s) elevation, etc.
- Routing comments addressed with pgrouting
- Data security and privacy
- Many users commented that they'd need to see more detail to fully evaluate the design; a beta mock-up is the next step

Selected qualitative responses

- *I like the functionality it brings to travel planning. Even though **I don't usually share travel photos with friends and family, I find it difficult to ...do that.** It's probably why I don't do it now. Having an application like this would make things much easier.*
- *Its **flexibility**, being able to modify things painlessly, since travel NEVER goes quite according to plan*
- *I like the idea of **integrating an entire trip** (schedules, photos, places visited, notes, etc.) into a single application.*
- *Being able to have the **map and see time/dates** for planning and during trip*
- *I liked being able to **map my itinerary and share it with friends and family.***
- *Ability to **organise thoughts easier** as otherwise it's like pen and paper that gets lost... I'm not really into journaling but with a tool like this **it would be easier for someone that is not very organised** and does not put much thought into how to record things ahead of time.*

- That might help someone **identify when their schedule is too full.**
- Suggestions of sites near routes.
- I would recommend to all as I **have not yet found an application to organize and plan travel itineraries in such a comprehensive fashion.**
- I would recommend to all as I have not yet found an application to organize and plan travel itineraries in such a comprehensive fashion.
- The ability to switch back and forth between **map and calendar views.**
- I like that there is a time slider option this would **make viewing each day** so easy without having to create a new map or have it **all clustered**
- Point creation, undoubtedly -- most commercial/app-based maps are a **cluttered mess** with odd choices for highlighted locations, when I often want things off the beaten path.
- Having the ability to **visualize and map** out your trip while having access to transport options, food stops, and important destinations
- the ability to **organize and visualize a comprehensive custom itinerary**, as well as edit/update in real time and **share with family/friends.**
- The ease of **accessing other views--map vs. spreadsheet--**to see other data associated with the location that I've submitted
- Some sort of visualization options that show different potential itineraries, **based on time, distance, etc.** would be important
- I'm sick of typing the same locations into my Maps app to try to **see where I'm going and what is the most efficient way to get there**
- Also, I love that you can add to that if you go back. Like I would have a NY map that I could **share and add to every time I go back.** This would be so much **easier than spreadsheets or trying to scroll through emails and texts.**