Solution Report

Mobile Ticketing Enhancements for General Population Incident Avoidance

Industry Capstone Team 5

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Background

This focus of this project was to find a way to better notify the general public of extraordinary incidents (three or four times per year) that would greatly impact their travel in the Puget Sound area. There was a secondary focus on how this notification system could be integrated with daily utility through improved mobile ticketing.

To reach our conclusive solution, we completed research on mobile ticketing application best practices, surveyed general populations about their experience with major road incidents, and interviewed experts to learn more about fields we identified to be relevant to our problem space.

Mobile Ticketing Best Practices

In order to better understand all the functionality around mobile ticketing solutions, we downloaded various national and international mobile ticketing app and performed literature research focusing on fare validation, ease of use, marketing and advertising strategies, payment, accessibility, and incident reporting. There are four key takeaways that can be integrated into our solution.

1. Fare validation through an app should be foolproof
2. Mobile ticketing for public transit like bus, light rail, boat should all have standardized checkout experience. Transportation incident reporting should be standardized according to guidelines like TIM.
3. A wide range of payment options should be available to general public ranging from mobile payments to contactless credit cards. A wider range of payment option will not only attract foreign travelers to use public transit with easy payment, but also will benefit local users and prevent people from switching to another mode of transportation when their primary payment is not available.
4. Our marketing plan will be most effective with support from companies and by using a creative campaign. However, case studies in Norway, London, and Seoul revealed that the creativity of the campaign should be balanced with the value of information presented in the campaign so that potential users have the whole picture of what an application or service is all about.

Major Incidents on the Road Survey

Over the course of 3 weeks, we planned and executed a survey on how and why commuters of Puget Sound respond to major incidents on the road. The goals of the survey were to gain insight into the context of incident avoidance, hear concerns from local commuters, and validate early ideas for our solution. We discovered that commuters rely on various platforms to receive

incident information, the need for timely commute recommendations after an incident, and commuters' unwillingness to mode shift.

We distributed our survey through social media with the help of WSDOT, King County Metro, Sound Transit, and others. Additionally, we distributed the survey through various local transportation-related Facebook groups and the Pacific Northwest Transportation Consortium (PacTrans) emailing list. In total, we gathered 95 responses with a diverse age range as shown from Table A1. While our sample demographic was somewhat similar to that of the Puget Sound, we were unable to make a clear comparison due to the unavailability of some demographic data. What is important to note is that we had a clear bias toward white ethnicity (64%) and those with an income of over $150k (33%). Moreover, Figure A1 shows us that most of our participants were public transit riders (44%) and those who drove alone (33%).

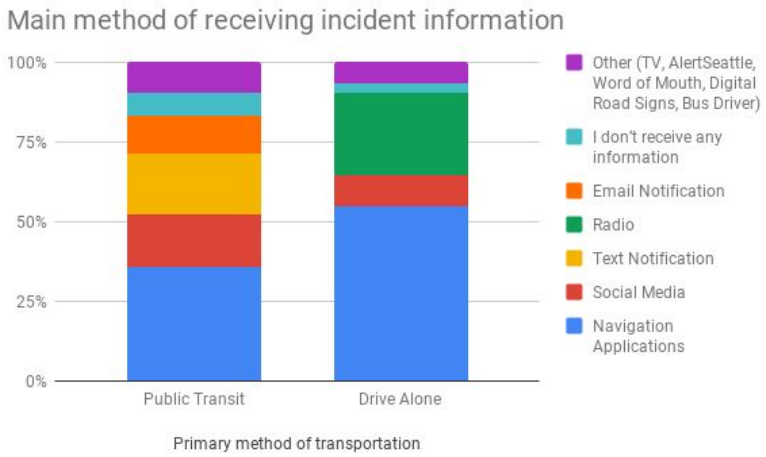

Figure 1: Main method of receiving incident information

Of those that utilize public transit and drive alone, we found out that navigation applications and social media are the two main methods in which incident information is relayed as shown in Figure 1. Additionally, it's important to note that text notifications play a large part in giving timely information to public transit riders as well as radio for those who drive alone. This shows us that while relatively new tools like social media and navigation apps are used by many, it is important to consider older forms of technology as part of our eventual solution.

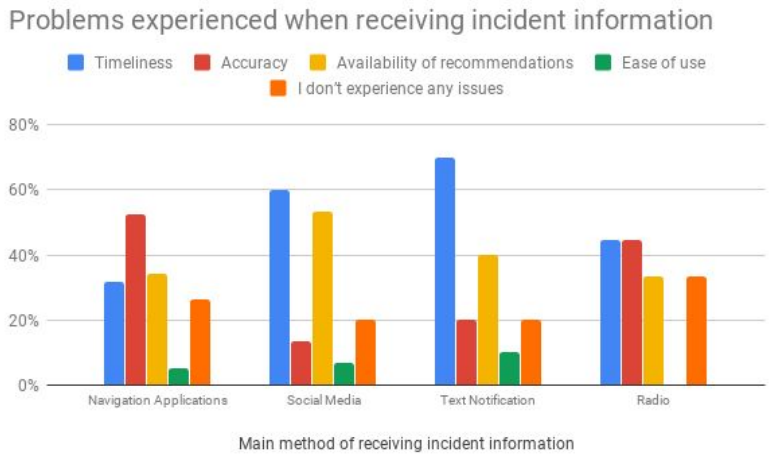

Figure 2: Main method of receiving incident information

Figure 2 shows us that amongst the four top methods of receiving incident information, timelines and availability of recommendations are common pain points experienced by participants. Additionally, a free response question asking about some of the difficulties experienced in a recent incident has raised voices such as “my bus was late/never showed up and I had no idea why and couldn’t do anything about it until it was too late” and “unclear what was going on and what was my best option to get around the incident.” This tells us that commuters care deeply about receiving timely incident information and recommendations.

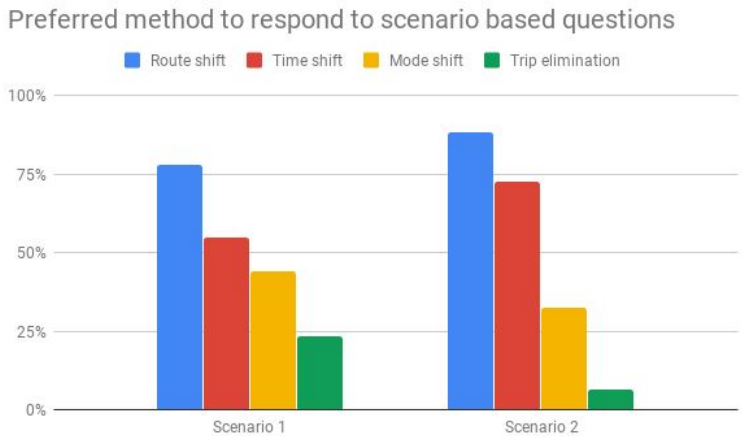

Figure 3: Preferred method to respond to scenario based questions.
Note: This graph indicates the participant’s “very likely” and “likely” response method chosen.

In the survey, we also asked questions that asked about how and why they would respond to an incident on the road going from home to work/school (Figure 4) and work/school to home (Figure 5). Figure 3 shows that out of the four options, the most popular options were to route shift and to time shift. Unsurprisingly, trip elimination was the least popular option with mode shift being the second least likely response method. This unlikeliness to mode shift when there is

an incident is perhaps expected yet it is an opportunity for our team to discover ways to convince commuters, especially single occupancy vehicles, to mode shift.

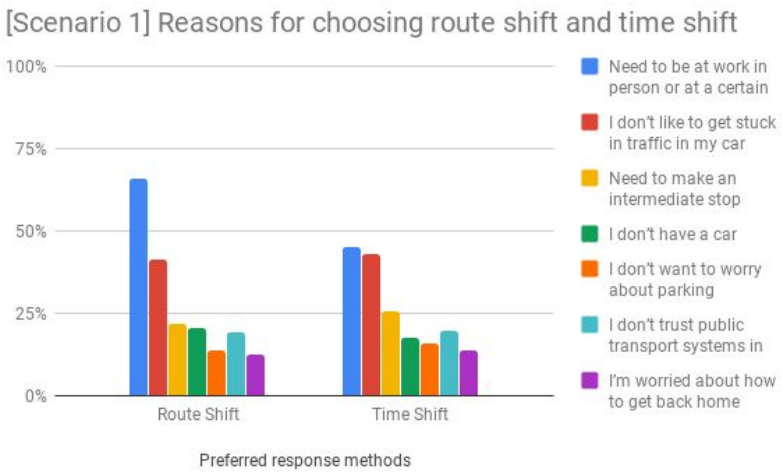

Figure 4: Reasons for choosing route shift and time shift for scenario 1.

Figure 5: Reasons for choosing route shift and time shift for scenario 2.

Figure 4 and figure 5 shows us the reasons why commuters chose route shift and time shift. For those who travel from home to work/school, we see that the biggest reason was because they needed to be at work/school in person or at a certain time. And as an obvious reason for avoiding route and time shift, around half of all participants chose “I don’t like to get stuck in traffic in my car.”

Expert Interviews

Prior to this capstone, our team had little to no experience in the transportation industry in regard to what happens behind the scenes. Because of this, our goals going into expert interviews were to learn as much as we could from different perspectives and to gather relevant information that would be beneficial for the final product. The interview subjects came from diverse fields ranging from marketing and public communications to user experience and technical implementation.

Even though each interview started with its own specific focus, some of the conversations branched out into topics that overlapped with other interviews, leading to some interesting takeaways as our group got back together to discuss the results.

Lack of Internal Communications
One major theme that stuck out over multiple interviews was the apparent lack of regular communication transit entities and outside agencies have with each other. Lisa Van Cise, a public information officer at WSDOT, outlined that even though the agency's Transit Management Center (TMC) has various ways to notify people of what's happening on the road, cross-agency communication and resource sharing is sorely lacking. Adding on to this, Tim McCall at the Seattle Department of Transportation (SDOT) talked about how coordination of incident information with WSDOT and other agencies is limited to major events, and even when that happens, the process is clunky. This lack of coordination not only impacts the agencies, but the third party entities that rely on reliable information to give consumers as Alan Borning mentioned when we spoke to him about OneBusAway.

Multiple Notification Outlets
To this end, the experts recommend utilizing multiple outlets for information distribution. This includes social media, radio, websites, and digital road signs. McCall indicated that social media, electronic reader boards, and the news media are the best ways to reach commuters due to their daily habits and information consumption patterns.

Strategic Partnerships
On the marketing side, we learned that strategic partnerships should be a point of emphasis. Jennifer Dice, Chief of Staff of the Sound Transit Communications Department, touched on a campaign involving Mariners tickets doubling as passes for the Light Rail, thereby reducing the amount of single-occupant vehicles heading to Safeco Field, and increasing the amount of public transit users. Dave Resnick, Digital Sales and Marketing Manager at Hubbard Broadcasting, suggested displaying advertisements in general in areas of high traffic, both in the real world and digitally. The key, he says, is to not interrupt people from doing what they're doing on a day-to-day basis, and to focus efforts on points of interaction and places people have to go (grocery stores, gas stations, etc.).

These findings have led us to the realization our solution should reach commuters before they get in their cars. If forced to make a change in commute at a moment's notice, drivers must be well informed of the options available to them and trust that the recommendation made to them in a certain situation is the right thing to do.

Current Solutions

Transit focused applications designed for the Puget Sound area all pieces of the puzzle that eventually coalesce into a holistic solution for travelers. Each of the available applications has a unique combination of incident notification, trip planning, re-routing, mobile ticketing, and transit schedule functionalities. However, to be successful and efficient in trip planning, one must know where each of these puzzle pieces fit into the larger picture of Puget Sound transit.

The Transit GO application is the only method of mobile ticketing throughout the region but it lacks most other capabilities. The trip planning within the app is through King County Trip Planner but is not real-time and the integration is not mobile or user-friendly. OneBusAway is a standby of the community around Seattle and provides real-time transit information and mobile ticketing. However, the app lacks trip planning except in the Android app and has no incident notification or rerouting. Google Maps is a major player in the transportation industry with the ability to plan trips and provide real-time rerouting. It makes use of Waze for some of its incident notification but is not integrated with mobile ticketing options in the area. The Puget Sound Trip Planner includes the transit schedule, but the application has not been updated in many years and is not usable on some devices. Finally, the WSDOT app has the capability to show incidents using road cameras operated by the TMC, however there are no routing or ticketing options available in the app.

Each of these applications provides some of the aspects we are looking for in a solution, but none have it all. With our solution, we aim to remedy some of these issues.

	Incident Notification	Trip Planning	Rerouting Recommendation	Mobile Ticketing	Transit Schedule
Transit GO		✓		✓	
OneBusAway				✓	✓
Google Maps		✓	✓		✓
Puget Sound Trip Planner		✓			✓
WSDOT Application	✓	✓			

Table 1: Comparison of functionalities among current Apps.

Challenges

There are various challenges we faced during this project as well as challenges we see with current solutions available for transit avoidance which need to be improved.

One problem we faced as a team was learning about the VCC late in the solution design phase of our project. This meant we were working on a solution without an understanding of potentially similar work being completed. This challenge forced us to reevaluate our Spring Quarter work plan and find new solutions for our problem space.

As far as mobile ticketing is concerned, there are many issues. According to Justin Deno of Bytemark, less than 3% of trips throughout the various transit agencies are by way of mobile ticketing. This is mainly due to the lack of options for tickets which do not include an option for monthly passes. The current iteration of the Transit GO app has also played a big part in stagnating the growth of mobile ticketing in this region. However, all of these mobile ticketing issues may be remedied by the next iteration of the ORCA card coming in 2021. ORCA will be NFC enabled and will handle many issues of convenience, universality, and efficiency that we see in today's mobile ticketing solutions.

Moving Forward

This new information on the VCC occupied much of the problem space we hoped our solution would fit into and set us back significantly. We realized our research data was no longer as effective nor targeted for moving forward into next quarter's work since our originally proposed solution functions in a very much similar way as the VCC does.

Ultimately, these new resources have enabled us to come up with an even more specific and effective solution. What we initially viewed as setbacks and challenges propelled our solution forward and motivated us to innovate further from what we had originally planned.

Original Solution

Before acknowledging the development of the VCC and the incoming next-generation ORCA, we proposed a solution that aimed to solve issues of interagency communication. As this was a problem stressed by nearly all of our interviewees who worked with or at transit agencies, we planned to create a platform which stands as a single source of timely information for incidents in the Puget Sound area.

Forum for Interagency Communication

We imagined it as a platform where transit agencies share and gather live incident reports. This platform could take the form of a forum or proprietary communications application for all local transit agencies. In case of incidents within the Puget Sound area, the platform could be used as a communication medium for the first agency who got notified to share the real-time incident

information with other agencies. Then agencies may work together to build the messaging around the incident as well as share recommendations and updates to commuters.

Data Repository for External Communication
In addition to the platform, we also included a data repository in our solution. Tim McCall mentioned that the current solution from Google Map was ineffective due to the lack of communication between APIs from different systems, so we aimed to have our repository serve as a communication medium between transit agencies and outside groups. It would be able to gather all incident information from the platform and translate it into machine-readable data in an API to be used by all authorized apps. This would enable real-time incident information to be shared with the external public transit entities such as Google Maps and OneBusAway. For instance, once the OneBusAway fetches the real-time incident information, it can point out the problem in its system, i.e. mark a route as "snow route" and compute a new trip, possibly pointing the user to a new bus number with different bus routes involved.

Non-software Approaches
From our expert interviews with those at transit agencies, we found that social media, news media and electronic reader boards are currently the most effective ways to reach commuters. This suggests that there should be a non-software part of our solution and that we should not rely on a single outlet. To effectively maximize the usages of all outlets, we planned to use dynamically updated road signs, social media, radio lines, TV, and others to deliver incident information to our commuters.

Proposed Solution #1: Public communications platform

One of the potential focus areas for our Spring Quarter is to create a public communications platform based on the VCC data. To make this happen, we need to have access to more data about the VCC and what information will be input and output from the platform. In our interview with Alan Borning, he suggested that we create a platform that has two distinct sides, one tailored for the agencies and one tailored for the consumer. The agency side has been handled by the VCC as we saw in the dashboard.

To create the consumer side, we would need to restructure our goals for the quarter to better suit our eventual solution. First, we would meet with the VCC team to better understand their current product and future goals. Once we understand the VCC, we can use sample outputs to build how our platform displays data. To understand consumers, we would need to carry out a more specific survey targeting how users interact with notification systems.

Proposed Solution #2: Motivations for Mode Shift

Our other option for next quarter is to research how we might motivate single-occupant vehicle drivers in Seattle to shift to public transportation or other modes when an incident occurs. The goal of reducing single occupant vehicles on the roadway is to reduce traffic and the potential for gridlock across the Puget Sound area during a major incident. This solution seems to be more difficult than creating a public communication platform because it is focused on changing

human behavior. Because this solution is focused on human behavior, we would need to complete another in-depth survey on motivations behind how people choose their method of transport and interview experts in psychology and transit to understand motivations and transit behaviors.

Based on our research and interviews from this quarter, we see information timeliness and accuracy as important factors in building trust and ultimately convincing people to mode shift. We also understand that users must feel as though they are making a choice, not being prescribed a solution, so our solution should be considerate of their options and allow the user to choose what best suits their needs.

Spring Plan

Research and study ongoing and future projects
We will be learning about projects from both private and government agencies related to traffic data and traffic notifications. These include WSDOT's VCC and similar projects in King County Metro and Sound Transit.

Conduct a tailored survey to better understand users
The tailored survey will build upon to better understand our users behavior, motivation, and psychology behind their behavior. Through the insights we gain from the survey, we will develop a game plan to motivate mode shift for single occupancy vehicles.

Conduct expert interviews related to mode-shifting
We will conduct more interviews with experts, but this time our questions will be more focused on the psychology behind mode-shifting and what we can do to change the behavior of commuters through marketing and various other methods.

Appendix A - Survey Results

Gender	Survey Demographic	Puget Sound Demographic	Household income	Survey Demographic	Washington State Demographic**
Male	47%	50%	Below $25k	6%	18%
Female	53%	50%	$25k - 34k	3%	9%
Age	**Survey Demographic**	**Puget Sound Demographic**		5%	13%
Below 18	1%	22%	$55k - 74k	13%	18%
18 - 24	19%		$75k - 99k	11%	13%
25 - 34	28%		$100k - $149k	15%	16%
35 - 44	16%	64%	$150k or above	33%	12%
45 - 54	18%		Prefer not to answer	15%	N/A*
55 - 64	17%		**Ethnicity**	**Survey Demographic**	**Puget Sound Demographic**
Over 65	1%	15%	White	63%	69%
Employment status	**Survey Demographic**	**Puget Sound Demographic**	Black or African-American	1%	6%
Employed, full-time	71%	64%	American Indian or Alaskan Native	0%	1%
Employed, part-time	7%	N/A*	Hispanic	1%	10%
Student	19%	N/A*	Asian	23%	13%
Retired	1%	N/A*	Native Hawaiian or other Pacific Islander	0%	1%
Unemployed	0%	3%	Two or more races	5%	11%
Prefer not to answer	2%	N/A*	Prefer not to answer	5%	N/A*
Flexible / Unflexible hours	**Survey Demographic**	**Puget Sound Demographic**			
Flexible	62%	N/A*			
Unflexible	38%	N/A*			
Source: Puget Sound Regional Council, Office of Financial Management, Statistical Atlas.					
N/A = Data not available.					
****Puget Sound household income bracket data not available.***					

Table A1: Survey Population Demographic. Data for Puget Sound Demographics from the Puget Sound Regional Council (2017), Ethnicity from Washington Office of Financial Management (2017), and Household income from Statistical Atlas (2017).

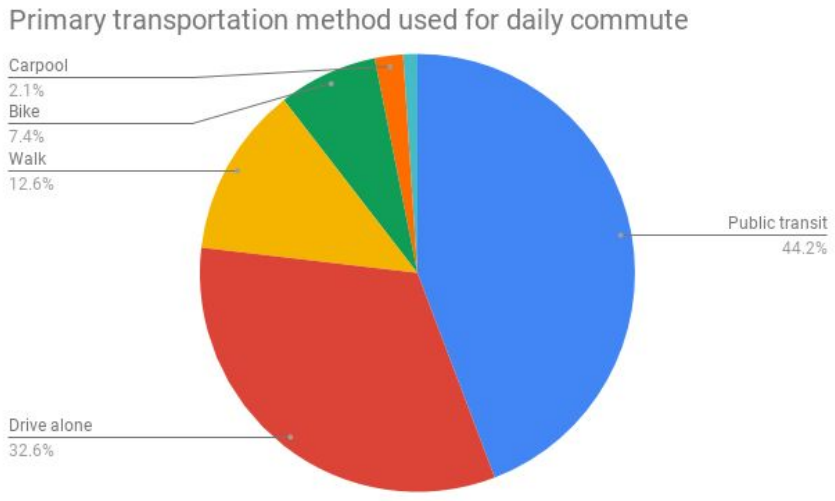

Figure A1: Primary transportation method used for daily commute

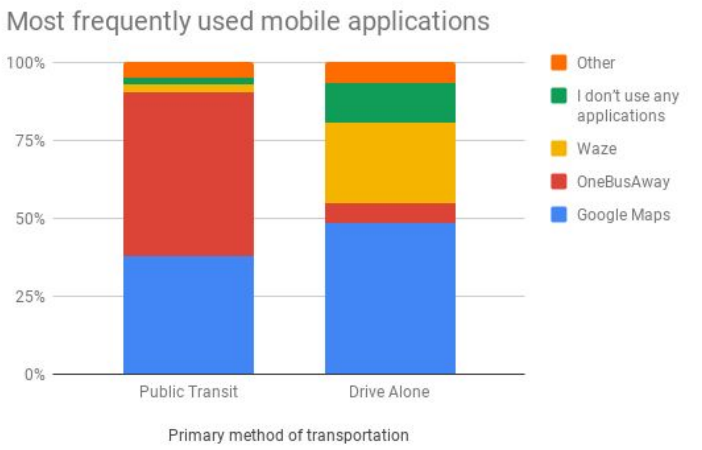

Figure A2: Most frequently used mobile applications

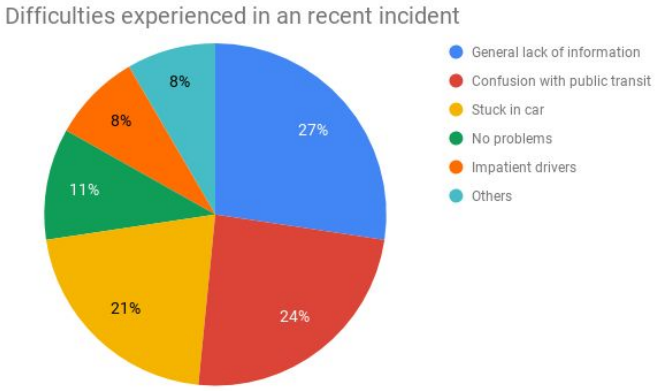

Figure A3: Difficulties experienced in an recent incident.

Appendix B - Expert Interview Synthesis

Brief Introduction of Interviews

Interviewee: Dave Resnick
Role: Digital Sales and Marketing Manager at Hubbard Broadcasting
Interviewer: Chris
Date of interview: 2/20/2019

Interviewee: Justin Deno
Role: Western Region Director at Bytemark
Interviewer: Steven & Anny & Catherine
Date of interview: 2/21/19

Interviewee: Don Champion
Role: Former CBS News Reporter
Interviewer: Pari & Yuki
Date of interview: 2/21/19

Interviewee: Lauren Celenza
Role: Google Maps Lead Designer
Interviewer: Pari & Yuki
Date of interview: 2/26/19

Interviewee: Jennifer Dice
Role: Chief of Staff for the SoundTransit Communications Department
Interviewer: Chris
Date of interview: 2/28/2019

Interviewee: Alan Borning
Role: Former Professor at CSE, on the OneBusAway Board of Directors
Interviewer: Pari & Anny
Date of interview: 2/28/19

Interviewee: Mark Freitag
Role: KCM Transit Control Center
Interviewer: Catherine
Date of interview: 2/28/19

Interviewee: Lisa Van Cise
Role: WSDOT Transit Management Center
Interviewer: Pari and Yuki
Date of interview: 2/28/19

Interviewee: Tim McCall
Role: Traffic Operations Center Supervisor at SDOT
Interviewer: Steven
Date of interview: 3/1/2019

Main Takeaways by Topics

With various expert interviews conducted, we identified several key points that are important to focus on while developing our solution as follows.

Marketing

- Jennifer Dice and Dave Resnick suggested finding marketing **partnerships** that are beneficial to both a public agency and a private outlet.
- Dave and Jennifer indicated that **geographical distinctions** in advertisements are essential for making marketing feel **personalized** and catered to individual consumers.
- Dave talked about the **Sales Funnel**, which is divided into three stages: the **Brand Awareness** Stage, the **Influencing** Stage, and the **Conversion** Stage. He says that people focus too much on the Conversion Stage, and don't spend nearly enough time on building a brand.
- Public marketing plans have to be **risk-averse** to avoid widespread criticism among taxpayers. Public reaction and political reaction must be taken into account when creating a new campaign, and ads cannot look too highly produced as they could be seen as a waste of money.

Public Communications

- Tim McCall and Lauren Celenza pointed out that **Google Maps** is not currently using SDOT incidents and relies on **WAZE**, a community based GPS Navigation App, to get live traffic reports and incident alerts. The reason behind is they do not use the same system as SDOT and WSDOT since they input their incidents manually.
- Tim McCall and Lisa Cise talked that we should not reply on a single outlet and suggested that **Social Media**, **Electronic reader boards** and **News Media** are the best ways to reach commuters. That leads to a potential solution other than software, which is to use dynamically updated road signs, social media, radio lines, TV,... to deliver incident info to our commuters.

Transit Agencies

- Most interviewees stressed the **coordination among agencies and with industries**. Tim McCall said the coordination with WSDOT and other agencies limited to major events. It could be utilized in other events for better efficiency.

User Experience

- Lauren Celenza told us that a public transit App is more than just a tool, and demands considerations in making it easier to use and **more accessible.** However, as pointed

out by Lauren, accessibility is a deep and complicated problem spanning from **disability accommodations** to **safety issues**, and then to **economic considerations**. A case in point could be "I don't feel safe on this route" or "This route is costing me more money because it's not motorbike accessible and I have to reroute myself".

- Lauren Celenza shared that **Contextual information** is important for transit riders. Rather than general info meant for all transit riders, users would more likely to see information about specific bus routes and its delays.
- Lauren Celenza said that **push notifications** should be sent sparingly and at times when they're actually needed, specifically, **during rides, just before, or just after**.
- Lauren Celenza discussed that the **participatory framework** is helpful as Google Maps found it is important to create timely information with **User-contributed** information. For instance, it prompts its user with specific questions, i.e. "Does this train have AC?", "Is it crowded?", "Is my train broken down?". A limitation is that it requires ops teams to review to maintain a flow of factual information.

Mobile Ticketing

- Justin Deno told us that possible integration with the **ORCA** system will potentially increase usability from **3%** to **40 %** as it was in Ohio state.
- Justin Deno recommended us to look into the **Hacon** solution where push notification, rerouting backend, the direct update of transit change by agency end and mobile ticketing features exist. It leads to see the benefits of using a localized App over Google Maps.

Technical Implementation

- Alan Borning recommended us to build our solution on an **Open Source framework** that allows for **contributions**. And a possible platform that is commonly used is GitHub.
- Alan Borning mentioned updates from agencies should be formatted to be **machine readable**. So the data could be automatically fetched from data repositories and feed into Apps.
- Justin Deno said **WSDOT API cannot identify Mode shift during incidents**. In other words, the incident information is not dynamically inputted into the Transit GO App. A possible solution is to let agency's end provide more accurate and timely incident information, and allow the App to update accordingly.
- Justin Deno suggested that each type of incident should establish its own **specialized framework solution**. It is also suggested by Alan. Take the case of the recent snowstorm for example, each bus route should be updated to have a property indicating whether it is a snow route.
- Tim McCall pointed us to the **AlertSeattle**, an **official emergency notification system** that is already used by Seattle. to communicate with city residents during emergencies. That is to say, SDOT already has a notification system to communicate

traffic incidents with its residents and it could be possibly tied to our potential solution, using AlertSeattle as an information source and communication medium for commuters.