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UNDERSTANDING USE OF SOCIAL MEDIA FOR DISSEMINATION OF

TRANSPORTATION INFORMATION

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ABSTRACT

This research explores how agencies use social media and how helpful these technologies are from both the agency and social media-using public perspectives. The impetus for this is the increased use of social media among transportation agencies to reach publics using these technologies. Surveys administered to both transportation agencies and the general public, as well as information collected directly from social media accounts, are used to statistically analyze (negative binomial, logit, ordered logit) how agencies utilize social media.

Social media content analysis indicates that the content posted by agencies and the mode of the agency (e.g. transit or highway) are particularly important to the popularity of agency Twitter and Facebook accounts. Analysis of the agency survey found greater participation and engagement in social media activities leads to more successful outreach. These activities include events such as monitoring social media for service-impacting events, developing a formal system for collecting content, and establishing a formal social media strategy. Analysis of the general public survey found that those more engaged with technology and less engaged with traditional media have more specific preferences and critiques of agency use of social media.

Comparing the results of the surveys, agencies and the general public have a mismatch both in how they perceive success in social media outreach and how information is best communicated. Agencies evaluated their success with social media better than the public did. The agencies also generally thought social media was a better platform for sharing more types of information than the public did.

From comparing the results between the two sets of surveys and the content analyses, it is clear that evaluation and guidance tools for social media use for dissemination of transportation information could be helpful to improve the consistency of information shared, a critical weakness identified by the public, because social media are viewed as an increasingly authoritative and legitimate transportation information source.

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Chapter 1

Introduction

Social media are emerging as significant platforms of communication not only between individuals, but also between organizations and individuals. It is very common to encounter corporations, non-profit groups, and government agencies using social media and incorporating these platforms into their marketing and outreach. In some cases, what these entities do on social media may also be incorporated into their product or service.

The goals of social media for transportation agencies are to inform, motivate, and engage their publics (Kaufman, 2012). Traffic and transit information are products to be consumed by the public via web, mobile phone, or even in-vehicle technologies. Information may also motivate the use or purchase of goods and services (e.g., use transit as an alternative to driving or to pay tolls for access to express lanes or obtain advice on a possibly less congested alternate route). Furthermore, a key aspect for transportation agencies is that social media enable direct engagement without the need for an organized, town-hall style meeting.

Beyond the realm of transportation, more and more people look to the web and social media for any type of information. Currently this is about 74 percent of Americans (Brenner, 2014). Social media, in particular, are well suited for the dissemination of timely information. For example, platforms like Twitter are optimized for short, fast bullets of information that are particularly well suited for mobile technologies. Many social media platforms, including Facebook, also enable engagement via user comments.

More than half of all social media use occurs on a tablet or mobile device (Brenner, 2014). Attempts to obtain travel or transit information with these devices is going to occur. But it is also a well-publicized fact that mobile phone use, particularly texting and use of text-based smart phone functions, are extremely dangerous if done while driving (Wilson and Stimpson, 2010). While many agencies have

always stressed "know before you go" in the launching of their 511 Traveler Information Systems, it is not currently possible to prevent drivers from seeking out information when it is not safe to do so.

Traffic and transit information enables travelers to make educated decisions about where, when, and how they should travel. If a *driver* knows, prior to leaving work, a major crash has closed down the freeway the *they* normally travel to return home, the *they* are able to safely make decisions about their commute that afternoon. *They* may decide to use a different route, leave work at a different time, or decide to run some errands to delay their encounter with the area currently affected by the closure.

Fundamentally, social media sites are those driven primarily by user-participation and user-generated content (Waters et al., 2009). But social media truly encompasses all internet-based technologies that enable individuals to mutually obtain or collect data. In the communication and receiving of transportation information, those characteristics are represented by two entities: the public and the transportation agency.

The social media platform offers the structure by which this mutual information interaction occurs, such as Facebook or Twitter. In the nonprofit sector, social media have developed as a means to interact with volunteers and donors as well as educate the public about their organization (Waters et al., 2009; Briones et al., 2011). Furthermore, social media are not just about communicating with the public, but also a means of communicating with allies, such as local news media or related agencies. The ability to gather or give information quickly to the media can facilitate prompt interventions in addition to the right kind of attention (Briones et al., 2011). Transportation agencies have the same opportunities to gather and give information via social media as other groups.

In transportation, social media offers two major opportunities to agencies. The first opportunity is an open dialogue with the publics they serve. The second opportunity is the dissemination of timely traffic and event-related information. More emphasis has been placed on the development of relationships between agencies and publics in the literature on this subject, both related to transportation and general business. But these opportunities are related. For example, if an agency develops a strong, trustworthy

social media presence they may be more effective in broadcasting timely traffic information (Kaufman, 2012).

The virtual ubiquity of the Internet and growing popularity of social media (Brunner, 2013) means public relations practitioners regularly have the opportunity to communicate with thousands of individuals and many publics that, combined, have multiple interests in an organization at the same time (Kent & Taylor, 1998; Briones et al., 2011). The platforms of communication offered by the Internet are more customizable than traditional media for both producers and consumers. For example, a *member* of the public can choose to specifically follow news of organizations that interest *them* on Twitter rather than having to sift through an entire newspaper for a handful of articles that may be of interest.

There are two sides to the social media relationship, the account-holder side and the public side. The account-holder generates and disseminates information via social media; in the context of transportation information dissemination they are the transportation agencies. The public side consumes the information disseminated via social media by reading it and sharing it. Understanding the behavior of both sides is important in considering not only how useful social media is currently for disseminating traffic information but also how useful it can be.

Gathering information from both the public and agencies regarding the use of social media in transportation enables a clearer understanding of what is useful and desirable. The goal of collecting this information is to understand the characteristics of social media sought after by agencies and the public, and to understand how these characteristics and social media complement a greater program of information dissemination and public engagement by transportation agencies.

This analysis examines the use of social media by transportation agencies and the perception of their use of social media by members of the general public with the aim to better understand how agencies are using these media and what the public wishes to obtain from these media. The specific goals and hypotheses of each the agency and the public analyses are detailed in the following sections.

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Agency Side

Transportation agencies develop and disseminate traffic information for the benefit of their system users. Traditional dissemination media include radio, television, print materials, as well as traditional websites. Given the increasing popularity of social media, there is an opportunity to disseminate information relevant to their publics and develop strategies that can be implemented as well as modified over long periods of time. The degree to which this opportunity is important to agencies is examined by this research in terms of the time dedicated to social media outreach, how or if agencies feel social media affects traditional media outreach, and public perception of agency activities.

In 2010, the American Association of State Highway and Transportation Officials (AASHTO) began surveying state agencies, plus the District of Columbia, about their use of social media. The initial survey yielded only 32 respondents (31 states and the District of Columbia), of which 26 used social media (AASHTO, 2010). The most recent published results, the 2014 survey, 47 entities responded (46 states and the District of Columbia) and only one of these agencies indicated they do not use social media (AASHTO, 2014). In each of the AASHTO surveys, the two social media platforms with the highest usage were Twitter and Facebook (AASHTO, 2014). This experience is similar to that found in nonprofit organizations, such as the Red Cross and its component chapters (Briones et al., 2011).

Despite the lack of a social media guidebook, agency forays into social media were sometimes very successful. Washington State (WSDOT), for example, developed a Facebook page as a way to connect to a younger audience on a small scale but by late 2009, as a result of its popularity, it developed into a hub for the agency to disseminate information on projects that may impact travel in the state and, for better or worse, to directly communicate with their publics. On May 23, 2013 their social media use was tested when the I-5 Skagit River Bridge collapsed. Despite the off-hour of the event (6:55 pm), it took just over thirty minutes for the Northwest Washington Incident Management Team, and then WSDOT, to take to Twitter to communicate what happened and how travelers could cope with the disaster (Deyerin, 2013).

As indicated by the growing numbers of social media users in AASHTO's annual social media survey (AASHTO, 2014), more transportation agencies have taken to social media as a platform for disseminating information. But agencies are not developing a social media presence in the same ways or with the same goals as each other, and they are not finding equal levels of success with their social media outreach. Though some characteristics of the challenges and responses agencies encounter are consistent (AASHTO, 2014).

Research indicates organization-public relationships are best facilitated through a dialogic process where both parties communicate with each other directly as equals. This means that the results of this process may not necessarily be predictable (Theunissen & Wan Noordin, 2011). Such a process demands an organization actively engage the public during communication (Brunning et al., 2008). Active engagement is where information is disseminated in a manner where the public is not only able, but also feels invited and welcome to respond back and engage in some type of dialogue. Social media, indeed, offers a platform by which the public may actively engage with an organization. Although the research has also identified that a lack of dedicated time and staff may interfere with the successful execution of active engagement within a social media program (Briones et al., 2011). Social media activities may exist without active engagement, but the capability of active engagement is what sets social media apart from more generic websites.

Analysis has been performed on the social media presences (e.g. Facebook and Twitter) of non-profit organizations (Bortree & Seltzer, 2009; Briones et al., 2011; Waters et al., 2009), which help describe a framework that can be adapted in the analysis of transportation agencies. This is particularly important because social media is more flexible and offers more features than more traditional mediums may. The following questions form the foundation of what is sought from each agency participating in this research:

- What is the rationale behind the establishment of your agency's social media accounts?
- Do you have a formal strategy or plan for your social media outreach?
- How do you decide what information to share via social media? What information do you share?

- Generally speaking, is your organization satisfied with your social media use?

- Do you foresee social media taking over traditional media as the primary method of dissemination in your agency?

- Do you monitor your social media feeds for potential developing transportation issues? (This could include traffic, weather, police, special events, and other non-traffic incidents)

- What tools do you have for evaluating your social media outreach? What tools do you need?

Fundamentally, a complete concept of how agencies are currently using social media is sought because in the coming years it will be important as an evaluation tool to look back at how use of these media have changed over time.

Public Side

The traveling public, in general, is interested in information that will help them get between points as safely and easily as possible. Interest in this type of information is understood and is evidenced by the continued operation of privately operated radio stations that broadcast nothing but traffic information in urban areas or traffic information in frequent intervals (e.g. every 5 or 10 minutes) as well as advertisement-supported websites. Examples of each source are: AM730 (http://www.am730.ca/) in Vancouver, British Columbia, which broadcasts traffic, ferry, and border crossing information 24 hours per day, and Total Traffic LA (http://totaltrafficla.com/) which has a geographic information system (GIS) that uses colors to illustrate speeds on different roads and symbols to indicate traffic incidents and construction.

Given the existing outlets of traffic information, it is not entirely understood if social media has a niche. Or if it does have a niche, what specific practices or means of presenting information are more effective than others at engaging the public. As social media plans and strategies are developed by agencies it is important to understand which members of the public use social media, whether individuals prefer social media to traditional media, how trustworthy individuals find information shared via social

media, and what characteristics of social media make them preferable to existing mediums of dissemination.

A 2012 report published by Pew Internet and American Life Project found that 67-percent of Americans polled regularly use at least one form of social media (Brenner, 2013). Because of the high rate of social media usage, this research is interested in how social media users interact with transportation agencies via social media. It is likely that many people who use social media do not use it to obtain transportation information. Two broad questions addressed to the public emerge.

The first question: are social media an effective means to communicate transportation information to the public already engaged in social media? Effective, in this case, would mean that a majority of social media users are aware of and able to obtain travel information in their area and prefer or at least like social media as much as traditional media. Despite the ubiquity of the Internet and growing popularity of social media, some users may simply prefer traditional forms of media to obtain travel information. There are numerous reasons why an individual may prefer more traditional outlets ranging from comfort with the technology to the individual's access to social media near and during the time of travel.

The second question is whether or not the public believes information disseminated via social media is credible, transparent, intended for their benefit, and applicable to their community. Each of these characteristics is found to be fundamental to a successful public relations outreach according to prior research into social media use by the nonprofit sector (Brunning et. al., 2008). Understanding how individuals perceive the information shared on social media could direct agencies to focus on characteristics that are critical to the public already engaged with social media. A related issue that has been identified with other intelligent transportation systems (ITS) technologies is reliability (Rama & Kulmala, 2000). For example, if a variable message sign (VMS) broadcasts a false alarm or if it fails to warn of a serious traffic event ahead, how does this impact the effectiveness of this technology?

Chapter 2

Literature Review

Numerous disciplines contribute to the development of the research hypotheses and methodology. These include public relations theory, computer science, the relationship between technology and society, and transportation engineering. By considering theories from many disciplines, the most appropriate methodology is developed given that the subject matter, transportation, is inherently rooted in civil engineering.

Public Relations Theory

The desired outcome of public relations activity should be enhanced organization-public relationships. Ideally, a "state that exists between an organization and its key publics that provides economic, social, political, and/or cultural benefits to all parties involved, and is characterized by mutual positive regard" (Brunning et al., 2008). Overall, the research performed by Brunning et al. (2008) finds that organizations and the public both benefit from open dialogue. Furthermore, those who feel positively about their interactions with an organization are more likely to support it when it may need to make an unpopular decision. Brunning et al.'s research, for example, considered the effect of the relationship between a municipality and the pubic when they sought a tax levy. The municipality felt that passing the tax levy was easier and it appeared as though the general public better understood the need for the levy since utilizing social media with active engagement.

Studies have sought to identify the dimensions of organization-public relationships. Generally, these dimensions include reciprocity, trust, credibility, mutual legitimacy, openness/transparency, mutual satisfaction, mutual understanding, commitment, community relationship, reputation, and relationship termination cost (Brunning et. al., 2008). These dimensions were obtained through content analysis of previous research. Of these dimensions, four were found to be most significant: trust, commitment, community relationship, and reputation (Brunning et al., 2008). It seems reasonable that these characteristics would apply to relationships forged on social media.

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The two-way symmetrical model of public relations practice has been proposed as an ideal means for fostering positive relationships between organizations and stakeholders, placing a premium on understanding stakeholders and then working to ultimately reach mutually beneficial outcomes (Callison & Seltzer, 2010). This two-way symmetrical model is based on the principles put forth by Brunning et al.'s suggestion of a dialogic loop where the public influences an organization that influences the public in a continuous feedback loop. It could be that an important characteristic of social media is the appearance of being managed by an individual who is able to listen and respond.

In an examination of the public relations team at Southwest Airlines by Callison and Seltzer (2010) and their interaction with journalists over the span of four years three fundamental functions emerged. The first is that the public relations team should provide useful, organized, and relevant information to journalists. The second is that they should have a dialogic loop so that public relations personnel are able to respond to the needs of journalists and vice versa. Finally, the public relations team should be able to facilitate communications between journalists with the appropriate internal personnel. These fundamental public relations functions for journalists carry over to what publics utilizing social media seek from the organization they engage with.

Other points of praise in the analysis of Southwest Airlines public relations team included their quick response to inquiries. Consideration is given to the thought that their speed of response and information dissemination may trump other, even potentially negative, characteristics of their public relations team (Callison & Seltzer, 2010). This emphasizes the importance of efficiently disseminating information quickly and accurately for an organization-public relationship to be successful. Social media allow for instant interaction, again underlining the potential power of these technologies. Giering (2012) found that public outreach strategies were more successful if done more often.

Alongside the development of the internet is an increasing call from the public for openness and transparency from the organizations they interact with, especially government (Waters, et. al., 2009). This is defining the development and level of success organizations are finding in their forays into online communications.

What was found by Waters and Williams (2011) in their analysis of governmental usage of Twitter indicates a more evolved approach to how Twitter works with the different theories and models of public relations theory. In their research they examined the prevalence of four different models of public relations: press agentry, public information, two-way asymmetrical, and two-way symmetrical. While public information was the most widely used model, it is the model of merely presenting balanced facts (e.g. notification of crashes or construction). All four models saw use on government agency operated Twitter accounts.

Each of the four models is executable on social media. Indeed, an agency could use multiple models concurrently. Matters that do not require a one-to-one relationship may still be addressed while other matters that may require direct contact are also still feasible on the same media, like Twitter. Waters and Williams get to the core of this, "perhaps, the reality of the situation is that the string of modest results stems from scholars looking to push a symmetrical agenda on a discipline that is only partially symmetrical."

Internet, Social Media, and Public Relations

As the internet is developing into the mainstream technology of communication, research is attempting to understand the critical elements of communication strategies that involve the internet. As in more traditional media, relationships form the foundation in communication online, including social networking tools (Waters, et. al., 2009). As social networking sites become more ingrained in daily life, they will soon see a more diverse audience in terms of age, culture, and socio-economic status (Waters, et. al., 2009). This growth in audience should enable social media to be better at communicating important information.

Research by the Pew Internet and American Life Project has found that a majority of Americans, 67-percent, are actively using social media (Brenner, 2013). Broken down by gender, 62-percent of men and 71-percent of women are social media users. Racially, 65-percent of whites, 68-percent of African-

Americans, and 72-percent of Hispanics are using social media. By age, the only group of adult individuals with less than a 50-percent participation rate is those over age 65.

Social media use is also consistent across income levels. In fact, the highest rates of participation were found to be among those making $30,000 per year or less (72-percent), where all other income groups have participation rates at 65- or 66- percent. Social media participation was found to be highest in urban areas, 70-percent of adults, but even in rural areas participation was found to be 61-percent (Brenner, 2013). A majority of American adults from all backgrounds are engaging with this technology. Furthermore, given the popularity of social media by demographic groups more likely to commute via public transit, social media may be a natural choice for disseminating transit information. Especially since transit users may safely interact with social media while traveling.

Even though numerous organizations believe simply having, for example, a Facebook page is sufficient, merely setting up basic social media profiles and then neglecting them has been found ineffective (Bortree & Seltzer, 2009). Creating an account and then neglecting it generates minimal exposure for an organization and may even discourage potential supporters who are seeking to interact with an organization, noting that it could not be bothered to maintain or even delete an unused or disused social media tool (Waters, et. al., 2009).

Setting up then abandoning or eliminating a social media presence is a missed opportunity to connect with the public (Bortee & Seltzer, 2009). A social media presence may be abandoned for numerous reasons, ranging from it not meeting the expectations set by the organization to the person who was in charge of the page leaving the organization. An issue referred to in the study of Red Cross chapters by Briones (2011). Disinterest is contagious, the Briones research finds and contends that it is often better to avoid creating social media accounts and profiles until resources are available to offer some support to the medium. Or, if the social media tool fails for the organization, it should be deactivated or deleted.

When establishing social media outlets, organizations should pay attention to the desire of the public for increased transparency. Effort must be given to helping the public establish the connection between an organization's social media outlet and the host organization (Waters, et. al., 2009). This is

important for establishing the credibility of the media. It can be accomplished in several ways, including a detailed description of the organization, links connecting to the organization's Web site, logos and visual cues, and the individuals who are responsible for maintaining the social networking outlet (Waters, et. al., 2009). If a social media outlet is very successful, the host organization really should want to identify and be identified closely with it. It should also be possible for a consumer of the social media tool to contact those operating it.

It is fundamental to create an environment in which communication can freely take place to establish meaningful interaction with stakeholders; merely setting up a social media presence and failing to use it is not actually developing a relationship (Callison & Seltzer, 2010; Waters et al., 2009). This environment is increasing facilitated by social media presences that feature details and information clearly indicating it is an official outlet and it is one that will respond to questions and feedback offered by those beyond the organization. It is not uncommon to try to interact with an organization via Twitter or Facebook and be met with silence. A problem with this is that, compared to traditional letter writing or email, if an organization is engaged via social media both sides of the dialog are often visible to the public and others can see that the organization ignored the attempt at engagement.

Analysis of social media use by nonprofit organizations found that education and healthcare organizations use social media most effectively, using more interactive elements both supplied by the social media tool and developed internally and are more skilled at communicating their organizational successes with stakeholders (Waters et al., 2009). Indeed, the Red Cross reported in 2011 that its social media presence better enabled faster service for the community, generation of more media coverage, and receiving positive and negative feedback from stakeholders to improve the organization (Briones, 2011).

Facebook and Twitter have emerged as the most popular sites for transportation organizations. They have been found as the most used mediums by organizations in general (Briones et al., 2011). Research has found that there are five specific characteristics for facilitating dialogue in online spaces. They are outlined by Callison and Seltzer (2010) and Briones et al. (2011) as:

- Providing a feedback loop to facilitate dialogue

- Provide useful information to publics, including the media

- Frequent updates and generating new content to engage publics and encourage return visits

- Providing an easy to use interface for visitors (i.e., making information accessible)

- Facilitating conversation and engagement among visitors to keep them on the site

Each of these characteristics is closely related to responsiveness, accessibility, and professionalism in the evaluation of public relations effectiveness (Callison & Seltzer, 2010). Additional research by others describes means for evaluating different social media and web presences for these characteristics. The social media medium most examined in the literature is Facebook.

One aspect of both Facebook and Twitter that is interesting is how it is possible to plug in secondary mediums of social media. For example, it is very easy to post YouTube videos, Foursquare location check-ins, and Twitter messages on Facebook. Lamm et al. (2009) evaluated the Facebook presence of 275 nonprofit organizations, seeking out the following characteristics across three broad categories:

- Disclosure

    o Description of the organization

    o History of the organization

    o Mission statement

    o URL of the organization's primary website

    o Logo

    o Listing of administration and management

- Information dissemination

    o Links or postings of relevant news stories

    o Photographs

    o Video files

    o Audio files

- o Posted items

- o Discussion wall

- o Press releases

- o Campaign summaries

- o Number of friends or likes

- Involvement

  - o Email to organization

  - o Phone number

  - o Message board usage (this feature is no longer on Facebook)

  - o Calendar of events

  - o Volunteer opportunities

  - o Donation information

  - o Store/way to purchase goods/services

Lamm et al. (2009) hypothesized that the more of these components that were present, the more effective the use of Facebook is by these organizations. Transportation agencies share common characteristics with nonprofit organizations so similar analysis seems reasonable. The analysis of transportation agency Facebook presence considered many of the characteristics. Despite effectively being nonprofit organizations, transportation agencies typically do not solicit donations, sell products, and seek volunteers, though they still have products, in this case travel information, which are of interest to the public.

An additional characteristic to be measured is the agency's interaction with other users on their Facebook pages. For the general public, Facebook may be a very easy way to ask a question or make a comment about something. Kelleher (2009) found that larger organizations have a more difficult time responding to environmental cues. When the members of the public are asking questions on a Facebook wall, not only is it a let down to the individual asking the question if the agency fails to respond, everyone else visiting the page sees that failure to connect as well.

Facebook has also been around for some time and many organizations have had the opportunity to try the medium, though not all have decided it is an area of interest. Some Facebook accounts may not currently be active, having been abandoned by the affiliated organization. Given that the public may find those accounts as easily as those that are active and that they are part of the transportation social media milieu, it is possible for them to be in the study sample for the current research.

The other major social media tool analyzed is Twitter. The forced simplicity of Twitter has made it popular among organizations. With only 140 characters to use per message, points are made one at a time and the media is easy to scan through (Briones et al., 2011). Twitter is intended for short bursts of information rather than a "digital scrapbook" as Facebook tends to be. Therefore, analysis of Twitter presences differs from Facebook.

Waters and Williams (2011) examined how government agencies use Twitter by examining how often they used one of four different models of public communication: press agentry, public information, two-way asymmetrical, and two way symmetrical. In the first two models, communication is broadcast one way. In the latter two models, feedback enters the process. Waters and Williams (2011) briefly describe each of these techniques. Press agentry is intended to draw attention and attract interest to convince the audience of something using any means necessary. A common example of this in transportation could include the sometimes dramatic displays attempting to prove the dangers of drunk or distracted driving. Public information is oriented around releasing accurate material and messages. For example, an agency tweeting that a stalled vehicle is obstructing a lane of traffic.

Two-way asymmetrical communication is where an organization asks questions of its audience to develop information to send back to them. Waters and Williams use the example of an opinion poll. Finally, two-way symmetrical communication is about a balanced dialogue between an organization and the public. On Twitter, this is best epitomized with the @message, enabling content to be specifically directed toward another user. Waters and Williams are also quick to point out that multiple models may be used in the same 140-character message. It is possibly easier and less ambiguous to directly communicate with individual accounts via Twitter than Facebook.

With Twitter, the power of a message is important. The number of followers an organization has and the number of times information from that account is retweeted are valid ways to consider the effectiveness or power of a Twitter feed. Some organizations tweet information not useful to others. In order to evaluate a Twitter feed data will be collected for an entire week, merging basic statistics and information on the models of public communication as identified by Waters and Williams (2011).

Despite recognizing the value of the internet to help improve an organization's competitiveness and image, in general, organizational management at non-profits remains skeptical about its ability to advance their organization (Waters et al., 2009). Similar hesitancy was encountered in the development of social media presence for the Transportation Research Board. Because of the limited experience with social media by administration there at the time, it simply did not make sense that social media had business and branding applications.

Another issue identified with the development of organizational social media sites is a lack of time to learn the capabilities of the medium (Briones et al., 2011). These capabilities include responding to members of the public engaging the organization, sharing multimedia content, and customizing the layout of a social media page to help individuals identify the social media presence with the organization. As a result, managing the social media component of an outreach strategy is often delegated to an intern who is often expected simply to know how social media works because of their age (Waters et al., 2009; Briones et al., 2011).

The problems with delegating this type of task to a new and temporary employee is that they may not fully understand the institutional values of the organization or all of the functions of an organization nor is it a guarantee that they are transferring their knowledge of the capabilities of, for example, Facebook to other employees or the next intern. Furthermore, they may understand how to use the medium, but not as an outreach tool for an organization. Between a lack of time and a lack of understanding of how tools work, it was found that many nonprofit organizations did not post multimedia on their Facebook pages, despite the power of these media to describe the stories and successes taking place within a non-profit organization (Waters et al., 2009).

Research looking into the effect of social media on the different types of power associated with public relations practitioners found that social media has a very positive effect on perceived structural and expert power (Diga & Kelleher, 2009). Structural power refers to someone's formal position within an organization, indicated by characteristics like title and compensation. Expert power being that based on contacts and relationships individuals develop within their environment that makes others turn to them (Diga & Kelleher, 2009). Effectively, social media users are skilled with networking and developing connections with other entities online.

Furthermore, regular use and interaction over social media may improve an individual's perceived influence and power. Klout (http://klout.com) is a website that attempts to capture this effect, ranking users reach on multiple forms of social media on a scale from 1 to 100. A higher score indicates a greater reach, more power. On Klout, those with a higher score (typically 50 or higher) are granted opportunities specific to the areas where Klout has determined they are an expert.

Overall, technology alone neither creates nor destroys relationships. Rather, technology usage can influence the relationships between an organization and a public (Kent & Taylor, 1998). A transportation agency has a relationship with people regardless of whether they use social media by simple virtue that everyone utilizes the transportation network and is affected by their work, but social media may help shape and develop that relationship in a way advantageous to the agency.

Large Organizations and Relationship Development

Social media have been found to not only be a useful outlet for the public to connect with an organization, but also a way for individuals and organizations to demonstrate and capitalize on expert and prestige power (Diga & Kelleher, 2009). Prestige power is a form of status as indicated by networks of powerful friends. Organizations with more prestige power have greater ability to develop social capital. Organizations and individuals reporting more frequent use of social media increase perceived prestige power (Diga & Kelleher, 2009). Organizations with social capital and prestige power are the organizations viewed as authorities and resources in their areas of expertise.

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Measuring mutual benefit should be the centerpiece of public relations evaluation. Mutual benefit is the result of appropriately applying social capital and prestige power in ways of use to the general public. Quantifying mutually beneficial outcomes helps practitioners illustrate the competitive advantages associated with a public relations outreach (Brunning et al., 2008). With social media platforms, it is possible to get some idea of mutual benefit by measuring the level of interaction between the posts to the platform and use by the public. For example, on Twitter the number of replies, retweets, and favorite statuses can be considered or the percentage of posts coded as "two-way symmetrical" communication may be recorded.

Yet, it has also been found that large organizations tend to be more bureaucratic and less able to quickly respond to cues from the environment (Kelleher, 2009). Social media are an always-on type of media and this is a substantial challenge for a large organization that may have a multi-person communications staff with a lot of specific structure. Research by Brunning et al. (2008) finds that when both parties to an organizational-public relationship influence each other, an equal partnership can develop. But if responses and information are delayed by bureaucracy, it may negatively impact the development of the relationship with the public. Information is best when delivered promptly. These are characteristics that affect the helpfulness of social media platforms for consumers.

The initial social media platform was blogging. Unlike with a website, a blog is interaction mimicking one-to-one communication and may effectively humanize a large organization (Kelleher, 2009). Kelleher (2009) also found that blogs were more effective than control conditions in lowering perceptions of the severity of an organizational crisis. Blogs are capable of posts longer than tweets and typically present longer text articles more clearly than Facebook.

Contingency interactivity is a process involving users, media, and messages in which communication roles need to be interchangeable for full interactivity to occur. Therefore, messages in an interactive process of communication are contingent on previous messages (Kelleher, 2009). Participatory media, such as Facebook and Twitter, allow for greater contingency interactivity, thus better

accommodating conversations between individuals in organizations and publics. This could be important in situations where the public may have questions or require additional information.

Ultimately, Kelleher (2009) found that those participants who had the greatest exposure to blogs by an organization were more likely to perceive the organization as communicating with a conversational voice. Those reporting the organization as communicating with a higher level of this conversational voice were more likely to report higher levels of trust, satisfaction, and control mutuality in their relationship with the organization (Kelleher, 2009).

Social Media and Transportation

The bulk of literature relating to the use of social media in transportation is related to its application in public transportation. Most of it also takes the form of reports rather than peer reviewed articles (e.g. Bregman, 2012; Giering, 2011; Kaufman, 2012). This is evidence of the developing role of social media within transportation. The reports indicate many agencies and organizations are struggling to strike a balance of content types to appeal to users. As transportation agencies are getting better at figuring out how to best use social media, the number of individuals following transportation organizations and agencies on social media platforms is increasing. Kaufman (2012) effectively sums up the goals of social media in transportation in three words: inform, motivate, and engage.

The use of social media by transportation agencies developed out of the use of increasingly complex websites to disseminate information, often as a component of their 511 Traveler Information programs. How social media differs from these websites is that it allows for two-way communication (Giering, 2011). Social media can help characterize an agency by projecting a "human" face, enabling direct communication, in real time and unfiltered by the media (Giering, 2011). This may be a terrifying concept for an agency that carefully plans its marketing and public outreach, but transparency facilitates appeal to the public and, if an agency monitors social media, can teach them where their strengths and weaknesses lie (Giering, 2011; Bregman, 2012). The principles of humility, transparency, and authenticity are paramount to agency success on social media (Bregman, 2012).

For most transit agencies, the overarching goals of public involvement are to provide information to the public and obtain feedback on analysis, recommendations, or decisions (Giering, 2011). Social media is one form of soliciting public involvement. The three most common goals of social media use in public transit agencies found by Bregman are communicating with current riders, improving customer satisfaction, and improving the image of the agency (2012). The goals of public involvement and the goals of social media are synchronous with each other.

Analysis of social media use by transportation agencies in or directly related to New York City by Kaufman (2012) discovered several issues with social media use in that region. The first observation is that each transportation organization shared different amounts of different content (Kaufman, 2012). Likewise, many transportation organizations are using social media almost solely as a marketing tool, rather than supplying service information, even though for some of the agencies subscriptions to other sources of communication indicate that there is a great demand for service information (Kaufman, 2012). The research suggests that agencies should focus on what the public really wants from social media: information. Particularly for public agencies, users are already using the service and in using the service likely already have sufficient exposure to features through direct communication (Kaufman, 2012).

Kaufman analyzed social media content whereas Bregman surveyed transit agencies. Bregman compiled a list of challenges that different agencies had faced in the development of their social media programs. Challenges existed at every stage in the development of the social media program. Responding agencies for Bregman's survey indicated that a lack of staff availability was the greatest impediment to adopting social media, which parallels the findings from studies of the non-profit sector (e.g. Briones, 2011). Then, when a social media presence is developed, deciding and managing who has access to post on the agency's behalf. As described earlier, some nonprofit organizations are delegating out the tasks of social media to interns and volunteers (Briones, 2011). Bregman continues to explain how managing responses to online criticism is a challenge, agencies both worry about the number of complaints via social media increasing and responses from disgruntled employees.

Beyond the challenges of delegating and managing the human resources of an agency social media plan are those associated specifically with the technology. Social media is not very accessible to people with certain disabilities (Bregman, 2012). For example, someone with a visual impairment cannot check Twitter easily to determine if there are service interruptions. Bregman (2012) also shares the warning from some information technology and security experts that social media use could increase exposure to cyber threats. Similarly, at some point it is likely that social media will be subject to the same record keeping and disclosure rules and policies that govern written and email communication. Indeed some organizations are already warning users that their interactions are part of the public record and are stored. Especially for large organizations, the storage demands could be immense and ultimately too cumbersome for the perceived benefit of using these technologies (Bregman, 2012). The final note of consideration is that social media is a moving target: changing and evolving constantly.

The challenges transit providers face when engaging the public are great. These challenges have both internal and external origins. Within the agency there may be insufficient resources. However, when the public perceives a void in communication, activity on Twitter suggests, the public attempts to fill the void. It may not do so in a polite manner as is found in, for example, Washington, DC and the @unsuckDCmetro Twitter account, which offers commuters an unfiltered medium on which to share their feelings about the agency in addition to information about service interruptions, delays, and other problems. Merely avoiding social media does not mean your organization is not being discussed or lacks a presence, but avoidance does mean you have no control over that presence. It is also important to note that while these are real challenges, they are not insurmountable (Brown, 2010).

Briones (2011) indicated organizations underused platform specific tools, so it is not surprising that transportation agencies are underutilizing Twitter, particularly related to hashtags and dynamic content (Kaufman, 2012). This is despite Bregman's (2012) finding that Twitter is the most popular social media medium among transit agencies, with over 68-percent of agencies using it.

Using photos and video help illustrate concepts like construction and policies that may affect service. This type of information is also easily shared between users of social media (Kaufman, 2012).

Another way in which Twitter, in particular, is underutilized is for listening to users. Particularly in public transportation, people will turn to Twitter or other social media platforms when something goes wrong (Kaufman, 2012). This is evidenced by the popularity, as gauged by followers and retweets, of Twitter feeds like @unsuckDCmetro, which focuses on the daily problems encountered by users of Metro Rail in the Washington, DC area. An example follows.

Figure 1: A transit user complaining about service retweeted by @unsuckDCmetro

Similarly, sometimes major transportation-related events occur and social media enables fast dissemination of inaccurate information. On May 23, 2013, the bridge carrying Interstate-5 over the Skagit River in Washington State collapsed. Tweeting began immediately, but it was not until 30 minutes later that verified information via the @wsdot_traffic Twitter account began to come out, and two hours until the @wsdot Twitter feed began sharing information. In those first two hours, many inaccurate Tweets were broadcast and retweeted. Participation in social media by @wsdot and by media following along with the official Twitter account eventually managed to correct the social media record. Even if agencies wait to share information, eyewitnesses are now able to make themselves and their Twitter accounts front and center in the information dissemination process.

As indicated in the more general research on the subject, direct interaction between an agency and members of the public is a way to develop a meaningful relationship. Polling followers on matters related to the organization is a good way to not only engage followers, but also understand what may be important to them (Kaufman, 2012). Kaufman's research finds private transportation providers, such as airlines, provide better customer service via social media than their publicly funded counterparts. The theory behind this is that private providers have to compete for customer loyalty, whereas public agencies are often the only option for their mode or route (Kaufman, 2012). Simply acknowledging a service issue

and apologizing with a simple "sorry" does come across as accountability, or at least remorse, for a problem (Kaufman, 2012).

Social media may also effectively draw understanding from the public. An example described by Giering (2011) looked at how the Los Angeles County Metropolitan Transportation Authority (LACMTA) updated its Facebook page as plans for a major a capital project developed. Notably, this effort has increased interest in LACMTA activities by younger members of the affected community. Sharing information routinely with the public is a form of accountability that is appealing to users (Giering, 2011).

One interesting recommendation by Kaufman (2012) is that Twitter feeds be broken down by route or road rather than agency. This has been done by the West Virginia Department of Transportation who, not only subdivided the state into several Twitter feeds by region, but also allows users to subscribe to Twitter feeds dedicated to each of the different interstate highways in the state. For example, users who only use Interstate-79 in West Virginia can now follow @WVinterstate79 and only get information pertaining to I-79.

Over the two month span that Kaufman analyzed social media use by transportation agencies in New York City, the number of followers grew, indicating an increasing demand to obtain information via social media (2012). Kaufman (2012) ultimately proposes two templates for an effective balance of information shared via Twitter, one for rush hour and one for periods outside of rush hour.

- Rush Hour: 65% service information, 30% engagement, 5% marketing
- Off-Peak: 40% service information, 30% engagement, 30% marketing

Advice from other documents is more general. Giering (2011) has several critical observations that seem indicative of successful public outreach. If there is more public involvement, an agency is more likely to judge the outcomes of the involvement as successful. Attempts at reaching out to the public should be thoughtful; ensuring that even a trivia question tweeted is something of value to the user. It is important to dedicate resources to public involvement. These do not necessarily need to be financial. Human resources available for interaction can be critical. The public can sense the value an agency places

on public involvement and communication and they will respond accordingly. Giering's work finds that to the public, openness and transparency are among the most important characteristics of a public outreach program. Similarly, understanding and partnering with communities can benefit public involvement efforts and improve perceptions of an agency.

The chief weakness in social media outreach, as described by Kaufman (2012) and Giering (2011) is evaluation. Many agencies do many things to try to involve the public with varying levels of success, yet this information, if it is even gathered, does not translate into changes in strategy. Or if one strategy does not appear to be successful, it may not be clear what the next strategy should be. With the information gathered by this research some initial guidance on evaluation may be possible.

Summary

The existing literature underlines the mutual benefits to organizations, in this case agencies, and the public of social media use (e.g. Brunning et al, 2008; Callison and Seltzer, 2010; Briones, 2011; Waters and Williams, 2011). The focus of the existing literature is largely in the practice of public relations in the private sphere, with few resources dedicated specifically to usage by transportation agencies. These findings indicate a need for further knowledge in this realm.

Because transportation agencies are typically government run, thus operated with tax dollars, they share many characteristics with non-profit organizations so studies done of organizations like the Red Cross (Briones, 2011) are meaningful. Findings relating to the high turnover of social media account maintainers and establishing and then abandoning accounts are of particular concern in the evaluation of agency social media (Briones, 2011)

Prior studies also give insight into the most meaningful data to collect and the most effective means of structuring this data. For example, Waters and Williams analysis of government Tweets coded each into one four types of interactions, the same technique is employed in the social media content analysis of this analysis. Likewise, Lamm et al. (2009) evaluated Facebook accounts for 275 non-profit organizations and documented the data points of interest. It was then possible to use those points to

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collect data from a pre-test sample to see how they perform with transportation agencies and it strongly informed the data collection in the social media content analysis portion of this research.

The literature that does exist pertaining to transportation use of social media indicates that a chief weakness is evaluation. It is unclear if this is in general or compared to other entities using social media. This recurring theme did lead to more careful observation of two-way interactions between agencies and individuals and to pay careful attention for comments relating to evaluation activities in the survey.

Reviewing the literature indicated a specific need to explore the use of social media in transportation further because of the niche transportation agencies hold. They are not corporations nor are they non-profit organizations, yet they are stewards of something of great importance to the public: their means of traveling between the places they need to be.

Chapter 3

Data Collection

Social Media Content Analysis

There are two primary sources of data in this analysis: surveys and social media accounts. In Analysis of Facebook and Twitter content and interaction will yield insights into how the public uses transportation-related social media; the information they find useful, interesting, or have questions about. Doing this involves developing a list of important characteristics and then counting their frequencies. This enables quantitative analysis on largely qualitative data. Following, the details of this procedure are described in more detail.

There is no published listing of every social media account operated by every single transportation agency. However, AASHTO maintains a list of state-level transportation organizations' social media presence[1], which includes Facebook and Twitter. Each of these accounts has a list of accounts they follow, which is then used to diversify the sample by including non-state level accounts in a form of snowball sampling. This enabled a list of agency accounts of all levels to be compiled. A random sample of the greater list, selected using a random number generator (Haahr & Haahr), of these Twitter and Facebook accounts was generated and used to collect data used in the database. Because of the number of accounts, number of agencies, and lack of centralization of information on social media usage by transportation agencies it was not possible to gather data on all accounts or compile a truly random sample.

Previous analysis of Facebook presence in nonprofit organizations sought out over 20 metrics (Briones, 2011). After pre-testing data collection with 15 different agency Facebook pages, only those characteristics that routinely varied are collected from the agency Facebook pages. There are two sets of characteristics collected from each Facebook account: account level information and post information.

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[1] AASHTO's list of state agency social media outlets:
http://communications.transportation.org/Pages/statesocialmedia.aspx

The details collected from Facebook at the account level were collected and compiled in a Microsoft Access database:

- Agency username

- Agency state or province

- The feed type

    o Route-specific

    o A single jurisdiction (e.g. a city or a county)

    o Regional/multiple counties

    o State

- Whether the account represents a highway or public transit

- The target population (in thousands) based on the boundaries of the account agency from the 2012 American Community Survey (U.S. Census Bureau, 2012)

- Number of account likes on the first day of the study week

- Age of the Facebook account page (in months) at the time of data collection

- Dummy variables to indicate whether the following characteristics are present:

    o Description of the agency

    o Mission of the agency

    o Agency phone number

    o Agency email address

- Date of data collection

- Posts per week

In addition to the information gathered on each agency Facebook account, a number of data points are gathered on each item posted to Facebook during the data collection week. These points are collected and compiled in a Microsoft Access database for later analyses:

- Agency account (so this data may be linked with the agency data)

- Content of the post

- Date of the post

- Day of the week of the post

- Type of content

    o Emergency information, meaning anything pertinent to system users immediately

        ▪ Congestion or volume related

        ▪ Crash or vehicle related

        ▪ Road work or construction

        ▪ Other

    o Engagement with the public

    o Entertainment, news stories, or trivia

    o Routine information that is important to system users but not immediately

    o General information (content with no specific audience, that is not entertainment, and does not apply directly to any transportation route or incident)

    o Weather and situations relating to natural phenomena

- Tone of the content

    o Press agentry

    o Public information

    o Two-way symmetrical

    o Two-way asymmetrical

- Number of likes

- Number of comments

- Number of shares

The other major social media tool analyzed is Twitter. The forced simplicity of Twitter has made it popular among organizations. With only 140 characters to use per message, points are made one at a

time and the media is easy to scan through (Briones et al., 2011). Twitter is intended for short bursts of information rather than a digital scrapbook as Facebook tends to be. Therefore, analysis of Twitter presences differs from Facebook though the data collection process is similar. Information is both gathered at the agency and individual post level. At the agency level, the following data are collected and compiled in a Microsoft Access database:

- Agency account name

- Agency state or province

- The feed type

    o Road-specific

    o Local/single county

    o Regional/multiple counties

    o State

- Whether the account represents a highway or public transit

- The target population (in thousands)

- Number of accounts followed by the agency

- Number of accounts following the agency

- Date of data collection

- Posts per week

In addition to the information gathered on each agency Twitter account, a number of data points are gathered on each item posted to the Twitter account during the data collection week. These points collected and compiled in a Microsoft Access database for analyses are:

- Agency account name (to enable linking this data with the account-level data)

- Content of the post

- Date of the post

- Day of the week of the post

- Type of content

  - Emergency information, meaning anything pertinent to system users immediately

    - Congestion or volume related

    - Crash or vehicle related

    - Road work or construction

    - Other

  - Engagement with the public

  - Entertainment, news stories, or trivia

  - Routine information that is important to system users but not immediately

  - General information (content with no specific audience, that is not entertainment, and does not apply directly to any transportation route or incident)

  - Weather and situations relating to natural phenomena

- Tone of the content

  - Press agentry

  - Public information

  - Two-way symmetrical

  - Two-way asymmetrical

- If the content was retweeted by a Twitter application

- Number of replies

- Number of retweets

- Number of favorites

Transportation Agency Social Media Survey

The first components of social media strategy this research explores are the outward characteristics. The outward characteristics are those that the public sees on platforms like Facebook and Twitter and is the content the public is able to interact with. Analysis has been performed on the social

media presences (e.g. Facebook and Twitter) of non-profit organizations (Bortree & Seltzer, 2009; Briones et al., 2011; Waters et al., 2009), which describe a framework that could be adapted for the analysis of transportation agencies. This is particularly important because social media is more flexible and offers more features than more traditional mediums may.

It is fundamentally important to recognize that usefulness of social networking site profiles is based on the information that is being distributed (Waters et al., 2009). Transportation agencies engaging in social media activity were surveyed about their activities. Survey data has been employed by similar research in the past and appears to be the most reliable means of acquiring this type of information (Kaufman, 2012). As described in the literature, how a social media program is executed does not always match the intentions of those behind it (Bortree & Seltzer, 2009). Depending on responses and willingness to participate, some respondents may be interviewed.

A survey tool given to social media staff at transportation agencies was developed and disseminated to agencies. Survey dissemination to agencies was done in several different ways. Initially, two social media groups targeted toward the social media users at agencies were utilized: Transportation Social Media, a private Facebook group, and the LinkedIn group for AASHTO's TransComm committee, at the invitation of its chair, Lloyd Brown. The second strategy was to identify individuals in my own network who I could reach out to and ask to share the survey in their own organizations. The final strategy was to cold call or email agencies directly. While this strategy was the most time consuming, it yielded the greatest volume of completed surveys as well as enabled a more diverse sample.

Every agency selected for inclusion in the online survey was sent an email or given a phone call to ask if they would participate in the survey. Because multiple individuals at an agency may be responsible for social media or because email addresses sometimes go to generic accounts used by numerous individuals, it is not possible to establish the fraction of respondents versus those the recruitment efforts actually reached. Furthermore, some of the emails sent to agencies failed to send.

In order to assure the quality of the surveys, agency and public survey tools were vetted by the panel of experts listed below. Each member of the panel has experience with transportation, technology

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policy, survey methodology, or social media use in a business or public organization. Several members of the panel have expertise in more than one of those areas.

- Jasmine Davis: Client Engagement Manager at Community Elf

- H.B. Elkins: Public Information Official at the Kentucky Transportation Cabinet

- Errin Jewell: Marketing, Business Proposals, and Grant Coordinator at Terradon Corporation

- Lisa Marflak: Electronic Dissemination Officer at the Transportation Research Board

- Sarah Soliman: Research Associate at RAND Corporation

- Michael Tantillo: Transportation Engineer at Vanasse Hangen Brustlin

Prior to administering the surveys, they were submitted to the Institutional Review Board at the Pennsylvania State University. Because these surveys do not require respondents to divulge deeply personal information nor do they pose any tangible risk to participants, the study was granted exempt status. This is communicated, along with contact information for the Office of Research Protections at the Pennsylvania State University, on the first page of both agency and public surveys.

The survey is divided into several sections, each intended to capture a different aspect of the social media "story" associated with an agency. During the data collection process, the survey was available online. Refer to Appendix I for the complete survey. The first page of the agency survey asks if the agency the participant is representing uses social media. How this question is answered affects the remaining questions in the survey for that respondent. A representative from an agency using social media will answer a different set of questions than a representative from an agency that does not use social media. First, the questions presented when the participant indicates their agency uses social media are reviewed.

The first section lists six types of information commonly shared by transportation agencies on social media: routine information, emergency information, marketing/general information, entertainment, customer engagement, and links to multimedia content (Kaufman, 2012) and asks the respondent to indicate whether that type of information is better suited to social media, traditional media, or both

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equally. In the section header it is described that social media refers to communications platforms that facilitate two-way communication whereas traditional media refers to means of communication that are only one-way. Websites where information is posted for the public to consume but the public cannot directly respond to are considered traditional media for this purpose. The following table illustrates the presentation of this section.

Table 1: Section 1 of the Agency Survey

	Social Media	Traditional Media	Both Equally
Routine information (e.g. planned service/traffic interruptions, construction)			
Emergency information (e.g. crashes, unplanned service interruptions)			
Marketing and general information (e.g. a ribbon cutting event, reminding the public to visit your website)			
Entertainment (e.g. trivia questions, "this day in...")			
Customer engagement (e.g. general questions: "what's the best part of your commute?")			
Links to multimedia content (e.g. a link to a video)			

The second section asks agencies about their social media strategies. This section seeks to understand how an agency specifically uses social media to share and receive different types of information. To accomplish this in a manner yielding results easily analyzed statistically each question

has either checkboxes or radio buttons. Acknowledging that some agencies may wish to elaborate on these questions, each one is accompanied by a text box where more articulate answers may be provided if the respondent wishes to elaborate.

Does your agency have a formal social media strategy or plan? Individuals typically use social media for pleasure whereas organizations are attempting to accomplish specific objectives with a social media presence. This yes or no question indicates whether time has been spent developing a plan for accomplishing a goal or if the social media outreach is done more in a personal or ad-hoc manner.

Does your agency have a system for gathering the information to disseminate via social media? This yes or no question gives insight as to how an agency determines what to include on social media. Some organizations have developed a list of the types of information they would like to disseminate and share it within the organization so everyone has the opportunity to contribute information to be shared via social media and in other organizations the decision on what to share is made fairly autonomously by an individual. This question offers insight into how integrated a social media program is within an organization.

Does your agency respond to questions asked via social media? This is a yes or no question. As described in the literature review, the defining characteristic of social media is the ability to engage in two-way communication. Responding to questions over social media indicates whether or not an agency is utilizing the characteristic that really separates social media from other, more traditional communication media.

Does your agency monitor social media for events that may impact traffic/service? This is a yes or no question included because it has been noted at times that individuals are reporting transportation incidents on social media prior to them officially being reported by a transportation agency on any form of media. Given these circumstances, it seems as if social media could be powerful in learning about incidents sooner.

What traffic/service information do you disseminate? An initial review of Twitter and Facebook presences by transportation agencies shows many use the medium to report on incidents.

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However, common sense indicates that unless every single traffic incident is reported on as soon as the event begins and when it immediately ends, there is opportunity for information to be considered incomplete and not as useful as it could possibly be. It is difficult to know how comprehensive reporting is. The first step to understanding how useful reporting of events is, this question asks agencies to indicate what components of an incident it shares:

- Beginning of event impacting traffic/service

- Updates on event information (e.g. predict time for a road to reopen)

- When the event clears and traffic/service returns to normal

- I don't know

Likewise, reporting this type of information may be more important for route specific, local, and regional agencies than statewide agencies. In a geographically large state, like California, what is occurring in San Diego in terms of traffic is likely not very important to someone trying to commute to work several hundred miles away in Sacramento. Yet if an account is dedicated only to a specific route, each and every incident or event on that route may be very important.

Do you foresee social media impacting your traditional media efforts? This is a yes or no question. In the literature it is emphasized that social media is not intended to replace traditional media but rather function alongside it. However, that does not mean that social media will not impact traditional media efforts. Even at this point, some agencies may feel that social media has reduced the need for or the effectiveness of traditional media for accomplishing certain goals and tasks.

How successful would you consider your agency's social media efforts? If an agency considers its outreach successful, analyzing its characteristics and comparing them to results from the public survey may be important in establishing the characteristics of the most successful strategies or illustrating areas where the public and agencies may not share the same sentiments. Respondents are asked to choose which of five options best describe the success of their program:

- Very Successful

- Successful

- Neither Successful nor Unsuccessful

- Unsuccessful

- Very Unsuccessful

It is expected that agencies will tend to view their efforts positively, but it is also expected that those engaging with social media will be able to honestly consider the strengths and weaknesses of their social media efforts to date. This is a sensitive question but the literature suggests that sensitive questions should still be asked (Groves, et. al., 2009). It is hoped that the anonymous nature of the survey and the private environment in which respondents may take the survey enable honest responses.

The third and final section for those agencies that are using social media asks about the measurable details of the social media platforms used by the agency.

When did your agency initially begin using any social media? Respondents may select a year from 2008 through 2013, as well as indicate usage prior to 2008. While administration of the survey did carry over into 2014, it seemed unlikely that many agencies would set up their social media presence in that very short period of time. Maturity of social media platforms and experience are anticipated to correlate with greater success with social media.

What social media platforms does your agency actively use? Respondents may select from a number of very popular social media platforms: Facebook, Twitter, YouTube, Blog, LinkedIn, Pinterest, Google Plus+, and/or YouTube. Additionally, respondents could fill in additional platforms because at any given time there are niche and emerging platforms that may not yet be common but still in use by particularly savvy organizations. There may also be social media platforms they still use that are less common now than they once were (e.g. MySpace and Friendster).

Are there any additional social media platforms your agency is considering? If an agency has been successful on another platform of social media or seen another agency successfully implement another platform they may be interested in diversifying. Alternatively, they may have had limited success

with a platform and are interested in trying another. This question may also help identify the direction of social media use by transportation agencies moving forward.

Are there any social media platforms your agency developed but no longer use? Social media platforms are constantly evolving and what is popular is changing. For example, MySpace was the premiere social media site for teenagers and college students in the early 2000s, but when Facebook opened up to everyone, rather than just users at certain colleges and high schools, it decimated the popularity of MySpace. Furthermore, as some experiments simply do not work, it is important to know what has not worked for transportation organizations for this research.

How much time do staff spend on social media efforts in an average week overall? It is difficult to measure the resources that are dedicated to social media. Because the platforms themselves are typically free, the best means of measuring the resource demand was determined to be hours. Because it may be difficult to quantify exact time commitments, ranges are given as follows:

- Fewer than 10 hours

- 11-20 hours

- 21-30 hours

- 31-40 hours

- More than 40 hours

- I don't know

What agency or organization are you affiliated with? This question is asked merely to understand what type of agency it is being examined. Knowing if the organization is public transit, a metropolitan planning organization (MPO), or a state department of transportation (DOT) is important because it indicates the scale by which the organizations exist. An MPO and DOT target publics with a different composition. However, it is made explicitly clear that this question is not required to survey takers. This is the most personal question included in the agency survey.

But not all agencies are using social media. Those who answered "no" to the initial question of whether or not they use social media are asked three questions to ascertain the status of social media at their organization and are then asked about their agency or organizational affiliation.

Has your agency ever used social media? This yes or no question is intended to learn whether or not an agency has ever attempted to use social media as an outreach tool. Social media platforms have existed for a long enough time that it is possible for an agency to have attempted using Facebook or Twitter and decided it was not helpful or otherwise worth continuing to pursue. This yields a follow up question.

What are your agency's reasons for not using social media? This is an open-ended question to try to understand what barriers are, or have been holding, the agency back from social media use. A majority of state level agencies are using social media as are many transit agencies. It is at least as important to understand why an agency does not use social media as it is to understand why they do not. It would also be interesting to see if the reasons are in line with the prior research (e.g., Bregman, 2012).

Does your agency plan to use social media in the future? This yes or no question is intended to understand whether or not this agency intends to begin using social media in the future. Given that more and more agencies are using social media, it seems reasonable that there may be agencies planning a social media strategy but have not yet launched their selected platform(s).

What agency or organization are you affiliated with? This question is asked merely to understand what type of agency is being examined. Knowing if the organization is public transit, a metropolitan planning organization (MPO), or a state department of transportation (DOT) is important because it indicates the scale by which the organizations exist. A MPO and DOT target publics with a different composition. However, it is made explicitly clear that this question is not required to survey takers. This is the most personal question included in the agency survey.

Additionally, at the very end of the survey, participants had the opportunity to supply their name and contact information for participation in a follow up interview if they wished to be contacted if further information were desired.

Finally, those who complete the survey are eligible to enter a drawing for one of two $25 Amazon gift cards. Some agencies may prohibit their staff from entering the drawing and it is expected that those individuals will opt out of the form to submit their contact information into the drawing.

General Public Social Media Survey

Like the agency survey, this survey, targeted to the general public, is divided into three sections for those who use social media and a short section for those who are not social media users. While not all of the questions on the agency survey could be modified to be applicable to members of the public, this was done when possible. This was done to facilitate comparisons between public and agency surveys in the analysis stage of this research.

Participants for the survey were recruited in several ways. Primary recruitment was via networks on Twitter, Facebook, and LinkedIn. This recruitment was not limited to transportation communities, but was targeted toward social media users. Access to multiple email lists through the Mid-Atlantic Universities Transportation Center enabled further reach. These participants are not necessarily social media users. This survey was reviewed by the same team that reviewed the agency survey.

Given the broad efforts to recruit respondents and that some individuals were enthusiastic enough about the research to independently help distribute the survey, it is not possible to ascertain the ratio of responses to those who were reached by the recruitment efforts.

The survey was available online during the data collection period. The complete survey may be found in Appendix II of this document. The first page of the agency survey asks if the participant uses social media. How this question is answered affects the questions that are presented for the participant's response. First, the questions presented when the participant indicates they use social media are reviewed.

The first section is identical to that asked in the agency survey. It lists six types of information commonly shared by transportation agencies on social media: routine information, emergency information, marketing/general information, entertainment, customer engagement, and links to

multimedia content (Kaufman, 2012) and asks the respondent to indicate whether that type of information is better suited to social media, traditional media, or both equally.

The second section asks participants about the social media strategies of transportation organizations and how they interact with these strategies. These questions are important as they will either complement or contrast with the equivalent section in the agency survey.

Do you use social media to obtain information on traffic or transit information? This yes or no question is intended to understand if the participant who uses social media in general uses it for the specific purpose of travel information. It is possible that there are social media users who do not use the technology to obtain traffic or transit information. It is important to understand who this group is.

Which type of media do you prefer to get transit or road condition information from? The participant may choose between social and traditional media. It may seem like by surveying social media users it will be the preferred platform for receiving transportation information, but just because an individual uses social media does not automatically mean it is how they prefer to receive transportation-related information. This question is related to the one before it.

Do you expect transportation agencies to respond to your questions via social media? As described, what makes social media unique is the ability to engage in two-way communication. This question seeks to gain insight as to whether or not this is something desired or expected by individuals. For example, some participants may feel that direct interaction with someone they do not know in person or is affiliated with the government is an infringement of privacy.

Do you think transportation agencies could learn of incidents sooner if they monitored social media? It has been observed anecdotally that people tweet about crashes or incidents as they encounter them, often before a transportation agency has the opportunity to report them or even knows about them. Local news organizations that are following social media then sometimes seem to have information on serious transportation events prior to agencies. This is a yes or no question, but the participant may select "I don't know," their ability to knowledgably answer this question may be correlated with their prior use or non-use of social media to obtain travel information.

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Is the traffic/service information posted on social media by transportation agencies useful?
The agency survey asks what information in an incident is shared via social media. This question asks if it is useful. The respondent can answer yes or no. If there are a substantial number of "no" responses, looking at the agency responses may be very important in recommending better ways of sharing this information. This is a yes or no question, but the participant may select "I don't know," their ability to knowledgably answer this question may be correlated with their prior use or non-use of social media to obtain travel information. Furthermore, a textbox is given with this question to encourage respondents to elaborate on why this information is useful or not useful.

Does the use of social media by transportation agencies change how you use traditional media to get transportation information? As agencies develop their outreach strategies in the future, it is important to understand how users are interacting with social versus traditional media. While social media will likely never replace traditional media, if individuals are changing their habits it is something agencies should be aware of and may be a source of further study. This is a yes or no question, but the participant may select "I don't know," their ability to knowledgably answer this question may be correlated with their prior use or non-use of social media to obtain travel information.

How successful do you think transportation agencies are with using social media? This question evaluates the overall success of all agencies they follow on social media and is intended to be compared to the self-evaluation question on the agency survey where, using the same scale, agencies must evaluate themselves. It is broad, but one weak social media presence by a transportation agency could hurt the credibility of another. Participants are asked to choose which of five options best describe the success of their program:

- Very Successful
- Successful
- Neither Successful nor Unsuccessful
- Unsuccessful

- Very Unsuccessful

Why do you think agencies are successful or unsuccessful at using social media? This open ended question intends to understand how people feel about transportation agency use of social media in their own words. It also enables participants to bring up issues that may not otherwise be addressed in the survey and issues that may be important in developing future research in this field.

How long have you been using social media? Participants may choose from the following options:

- Less than a year
- 1-2 years
- 3-4 years
- 5-6 years
- 7-8 years
- 9-10 years
- More than 10 years

What social media platforms do you use at least once per week? Respondents may choose multiple items from a list of the most common platforms: Facebook, Twitter, YouTube, Blog, LinkedIn, Pinterest, and Google Plus+. They may also indicate they use none or write in additional platforms that were not listed.

Have you thought of using other social media sites? If so, which ones? Like the related question on the agency survey, this is important for identifying platforms that may be developing their popularity.

Are there any social media sites that you used in the past and no longer use now? If so, which ones? As the analog to the previous question, this one intends to identify any trends in platforms that are waning in popularity.

Which agency or agencies do you follow on social media? If the participant does use social media to follow transportation related accounts, they may type those they follow or like in this text box.

The third and final section collects general demographic and technology usage information from respondents. If on the very first question in the survey the respondent indicates they do not use social media, they automatically skip the first two sections and complete the third section. The questions are:

- How comfortable are you with computers, cell phones, and other technology?

    o Not comfortable at all

    o Somewhat uncomfortable

    o Neither comfortable or uncomfortable

    o Somewhat comfortable

    o Very comfortable

- What type of cellular phone is your primary device?

    o Smartphone (internet access enabled)

    o Feature phone (calling, texting, plus some other applications that use the cellular network)

    o Traditional phone (calling and texting only)

    o None

- What types of traditional media do you use at least once per week?

    o Newspapers

    o Local television news

    o National television news (e.g. CNN or NBC Nightly News)

    o Local radio

    o Satellite Radio

    o None

    o Other

- What state/province do you live in?

  - There is a dropdown list of all of the states/territories in the United States and all of the provinces/territories in Canada, in addition to options indicating the respondent does not live in the United States or Canada and decline to answer

- How many miles do you think you travel or drive in an average month?

  - Less than 100

  - 100-499

  - 500-999

  - More than 1000

  - I don't know

- What is your age?

  - 18-24

  - 25-34

  - 35-44

  - 45-54

  - 55-64

  - 65 or older

  - Prefer not to answer

- What is your gender?

  - Male

  - Female

  - Prefer not to answer

- What is your race/ethnicity?

  - American Indian/Alaska Native/First Nations

  - Asian

- Black or African American/Canadian

- Hispanic or Latino

- Native Hawaiian or Pacific Islander

- White (non-Hispanic)

- Other

- Prefer not to answer

- Which category describes your annual income?

  - Less than $10,000

  - $10,000-$19,999

  - $20,000-$29,999

  - $30,000-$39,999

  - $40,000-$49,999

  - $50,000-$59,999

  - $60,000-$69,999

  - $70,000-$79,999

  - $80,000-$89,999

  - $90,000-$99,999

  - $100,000-$150,000

  - $150,000+

  - I don't know

  - Prefer not to answer

- Do you have additional feedback for the research team?

  - A text box is provided for participants to leave any additional feedback

Chapter 4

Methodology

Model Development and Selection

The use of statistical modeling is integral to this research. A general procedure was developed to ensure the uniformity of model development and analysis that was applicable to all types of models considered for this dissertation. The following table shows the order of the procedure. Following the table is more detail on each of the steps in the procedure.

Table 2: Model Development Methodology

Step	Model	Description
1	Constant only	Baseline model for comparison with additional predictors
2	Add single predictors	Test for significance with respect to baseline (1)
3	Pairwise predictors	Test for significance with respect to (1) Test for significance and changes in magnitude, sign and significance with respect to (2)
4	Two-way interactions	Test for changes with respect to (2) and (3)
5	Three or more predictors	Test for improvement and changes with respect to (2), (3), and (4). May involve iteration with step three. Continue until best or most reasonable model attained.

Prior to the implementation of the above methodology, data are collected and dependent variables are selected in line with the research questions and hypotheses. A model appearing to be good but with no theoretical basis is not helpful (Studenmund, 2006). Constant-only models are tested to gather base

statistics (e.g. log-likelihood) on the regression and dependent variable. At this point, different independent variables are tested.

Series of models are run with only one independent variable to establish significance with respect to baseline. This step is followed by testing models with combinations of two variables to test for significance with respect to the previous steps. Based on the results of this step, two-way interactions are investigated. Then, with this set of variables, models with three and then four independent variables are tested.

Models at each level are evaluated and ranked for fit, significance, and theory. This methodology enables insight into the relationships of variables that may have otherwise been neglected based on the theories presented in the literature, though it is duly noted that some literature indicates it is dangerous to seek out relationships prior to applying rigorous theory (Studenmund, 2006). The best models are then selected and documented in the research.

Social Media Content Analysis

Such detailed analysis of Twitter and Facebook accounts of transportation agencies has not been done previously. Prior analysis has typically been limited to public transit agencies. Prior to developing statistical models, establishing the characteristics of the data set is important. Doing so enables an understanding of the different accounts, how they operate, their ability to engage the public, as well as comparison between accounts. Stata 12 has a number of different tools that can be used to describe a data set, its variables, and its individual observations. Characteristics of interest are:

- The breakdown between number of Twitter and number of Facebook accounts

- The average number of posts per week for a Twitter versus a Facebook account

- Summary statistics on the number of followers for a Twitter account and the number of likes for a Facebook account

- The social media accounts with the most engagement: by count of engagement activities, per follower, as a ratio to the target population

- The types of content the social media accounts post, both the tone of the content (e.g. public information, two-way symmetrical, and etc.) and the type of content (e.g. about a recent traffic incident, a warning to drive safely, and etc.)

- The geographical distribution of social media accounts

In analyzing the Facebook data, there are two dependent variables of interest: the count of posts in the given study week and the count of likes. Both are count variables well suited for the negative-binomial model because if over-dispersion is present, the alpha term will account for it, and if it is not present the model functions as a traditional Poisson.

Likewise, information collected from Twitter presences may be analyzed statistically using count models. The dependent variables of interest for the Twitter data are the count of posts in the given study week and the count of the Twitter account followers.

The two types of social media are not analyzed together because they were not typically used in the exact same way or, as found in the public survey, for the same purposes. Individuals indicated a strong preference for Twitter in situations where they need urgent or emergent information and Facebook when they want to learn details about projects or events that are planned and may impact them further in the future. Furthermore, the types of posts differ. Twitter is limited to 140-character posts with the possibility to attach some types of multimedia whereas Facebook posts can be of any length and include almost any type of content or multimedia.

The dependent variables in this component of the overall study are count variables that are not normally distributed. The negative-binomial model is ideal for use in these situations where the dependent variable is a count and there is a possibility of over-dispersion (Hilbe, 2011). The negative binomial is a derivative of the Poisson model that accounts for over-dispersion through the inclusion of an error term, $\exp(\varepsilon_i)$, enabling the variance to differ from the mean, described the following equation (Hilbe, 2011). If over-dispersion is not present in the data, the model functions as a Poisson (Hilbe, 2011).

$$\mu = \exp(\beta X_i + \varepsilon_i) = \exp(\beta X_i) \times \exp(\varepsilon_i)$$

$$Var|y_i| = E|y_i| \times (1 + \alpha \times E|y_i|) = E|y_i| + \alpha \times E|y_i|^2$$

Where: μ_i are the predicted number of events for observation i

β_i are the regression coefficients for the explanatory variables for observation i

X_i are the explanatory variables for observation i

$\exp(\varepsilon_i)$ is the gamma-distributed error term (mean = 1, variance = α)

y_i are the observed number of events for observation i

α is the dispersion parameter

The probability of y_i, $Pr(Y_i = y_i)$ can be estimated by the following equation, which adds a gamma (Γ) function (Hilbe, 2011):

$$Pr(Y_i = y_i) = \frac{\Gamma\left(y_i + \left(\frac{1}{\alpha}\right)\right)}{\Gamma\left(\frac{1}{\alpha}\right) y_i!} \left(\frac{\mu_i}{\mu_i + \left(\frac{1}{\alpha}\right)}\right)^{y_i} \left(\frac{\left(\frac{1}{\alpha}\right)}{\mu_i + \left(\frac{1}{\alpha}\right)}\right)^{\left(\frac{1}{\alpha}\right)}$$

Maximum likelihood estimation is used to determine the parameters of the negative binomial model. This is accomplished by maximizing the logarithm of the likelihood function, as described in the following equation (Hilbe, 2011):

$$L(\mu_i) = \prod_{i=1}^{N} \frac{\Gamma\left(y_i + \left(\frac{1}{\alpha}\right)\right)}{\Gamma\left(\frac{1}{\alpha}\right) y_i!} \left(\frac{\mu_i}{\mu_i + \left(\frac{1}{\alpha}\right)}\right)^{y_i} \left(\frac{\left(\frac{1}{\alpha}\right)}{\mu_i + \left(\frac{1}{\alpha}\right)}\right)^{\left(\frac{1}{\alpha}\right)}$$

Where: $L(\mu_i)$ is the maximum likelihood estimator

N is the number of observations

It is also expected that for each dependent variable, there will be several models that are meaningful. The criteria for determining the best model are improvement from the base condition log-likelihood values, the pseudo R^2 value, significance and signs of the coefficients, and that the results are theoretically sound based on prior research or can otherwise be explained logically.

Stata utilizes McFadden's pseudo R^2 in negative binomial, as well as logistic, regression where the traditional R^2 does not apply. The McFadden value is calculated (Long, 1997):

$$R^2 = 1 - \frac{ln\hat{L}(M_{full})}{ln\hat{L}(M_{intercept})}$$

Where: $\hat{L}$ is the estimated likelihood

M_{full} is the model with all of the predictor variables

$M_{intercept}$ is the baseline model, no predictor variables

The range of the McFadden Pseudo R^2 is from 0 to 1, however a fit between 0.2 and 0.4 is considered to be good. This statistic is helpful for interpreting explained variability and improvement from the null to the fitted model (Long, 1997).

Transportation Agency Social Media Survey

The transportation agency survey received 55 responses. Due to the sampling methodologies it is not possible to derive a specific response rate. While this is a small number, it is large enough to gather descriptive statistics and test some basic statistical models. Given the small number of responses, only up to four independent variables can reasonably be analyzed at once. Descriptive statistics of interest are:

- Whether or not an agency has a formal social media strategy or plan

- Whether or not an agency has a formalized system for gathering information to disseminate via social media

- Whether or not an agency responds to questions asked via social media

- Whether or not an agency monitors social media for events that may impact traffic or service

- Whether or not an agency feels social media will affect its traditional media efforts

- The perceived level of success of the agency social media program

- How much time agency staff dedicate to social media each week

The survey data are not as conducive to modeling as the data collected from the agency Twitter and Facebook pages. The dependent variables of interest in the survey data are how successful an agency considers its social media efforts and how many hours are dedicated to social media use each week by the agency. This should be an ordered, categorical variable, however the responses ended up in a binary format. Only three responses, out of 55, were outside of two categories. Because of this, a traditional logit model is used. The logit model is represented as (Long, 1997):

$$\Pr\left(y_j \neq 0 \middle| x_j\right) = \frac{\exp(x_j\beta)}{1 + \exp(x_j\beta)}$$

Additionally, most of the questions in the agency survey had text boxes where the respondent could elaborate on their response. This enables the use of content analysis, where the text responses are coded and analyzed for recurring terms, phrases, and themes. It will glean insight into three specific areas:

- The circumstances where social media has been most successful for agencies

- Insight into the social media platforms that were previously used by the agency but have been retired

- Insight into the social media platforms that agencies are considering for future use

General Public Social Media Survey

The general public social media survey received 409 responses. Because of how the survey was distributed the number of individuals it was distributed to is unknown and thus the response rate is unknown. However, it is known that Internet surveys do not typically have very high response rates compared to other forms of surveying (Groves et. al., 2009). This number of responses is large enough to gather descriptive statistics, test some statistical models, and perform a content analysis on the responses to the open-ended questions. Descriptive statistics are generated on the following items collected from the survey:

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- Whether or not the respondent uses social media to obtain to travel information

- The participant's preference for obtaining travel information via traditional or social media

- Whether or not the participant expects a response when they attempt to interact with agency social media sites

- Whether or not the participant believes agencies could use social media to learn of incidents sooner

- Whether or not the travel information posted on social media by agencies is useful

- Whether or not the use of social media by transportation agencies changes how the participant obtains travel information

- How successful the participant feels agencies are with their social media outreach

The survey data are not as conducive to modeling as the data collected from the agency Twitter and Facebook pages. There are two dependent variables of interest in the survey data: how successful the respondent believes agency social media outreach to be and does the use of social media by agencies change how you obtain travel information. The first dependent variable is an ordered, categorical variable and is well suited for an ordered logit model. In addition to the categories being ordered, the other primary assumption for an ordered logit model is that the categories are proportional, and this can verified with the Brant test. The ordered logit model is described as (Long, 1997):

$$P(Y_i > j) = g(X\beta) = \frac{\exp(\alpha_j + X_i\beta)}{1 + \exp(\alpha_j + X_i\beta)} \qquad j = 1, 2, \ldots, M - 1$$

Where: M is the number of categories of the dependent variable

The models are assessed based on their pseudo R^2 values (McFadden), difference in log-likelihood from base conditions, significance and signs of the coefficients, and theoretical soundness of the results.

The second dependent variable is categorical but not ordered. Omitting the "I don't know" responses, this variable can be modeled with a standard logit model because it is binary. The logit model is described by (Long, 1997):

$$\Pr(y_j \neq 0 | x_j) = \frac{\exp(x_j \beta)}{1 + \exp(x_j \beta)}$$

Additionally, many of the questions in the survey had text boxes where the respondent could elaborate on their response. This enables the use of content analysis, where the text responses are coded and analyzed for recurring terms, phrases, and themes. It will glean insight into several specific areas:

- Perceived usefulness or lack thereof of social media for transportation information

- How agencies are perceived to be successful or unsuccessful with their social media programs

- Insight into the social media platforms that were previously used by the respondent but they have stopped using

- Insight into the social media platforms that respondents are considering for future use

- Insight into the agencies followed by the respondents

- General feedback to the survey and research

Comparative Analysis

The surveys were designed to have several questions that could be directly compared. The first section in both surveys lists six common types of information shared by transportation agencies and respondents are asked to indicate whether or not social or traditional media are better for disseminating that information. In addition, in both of the surveys, respondents are asked how successful agencies have been using social media. Because it is not possible to use the same dependent variables, this comparison is purely descriptive.

Chapter 5

Findings

Social Media Content Analysis

The total number of social media accounts reviewed in the content analysis was 152. Of this number, 36 were Facebook accounts and 116 were Twitter accounts. Facebook and Twitter data are analyzed separately because the mediums do have some notable differences in terms of the types of content posted to them and different ways people use these mediums.

Data collected for the content analysis portion of the analysis represents 29 states plus the District of Columbia. Some states are represented multiple times as accounts representing specific routes, cities/counties, regions/districts, states, and both highway and transit modes are used. For example, in California each Caltrans district has a Twitter account and many also use Facebook.

Table 3: Geographical Distribution of States included in Content Analysis

State	Number of Accounts	Percent	Cumulative Percent
Alaska	3	1.97	1.97
Alberta (Canada)	1	0.66	2.63
Arizona	2	1.32	3.94
Arkansas	1	0.66	4.60
California	25	16.45	21.05
Colorado	2	1.32	22.36
Connecticut	5	3.29	25.65
Delaware	1	0.66	26.31
District of Columbia	2	1.32	27.63
Florida	20	13.16	40.79
Georgia	8	5.26	46.05

Hawaii	2	1.32	47.36
Idaho	5	3.29	50.65
Illinois	11	7.24	57.89
Indiana	2	1.32	59.21
Iowa	3	1.97	61.18
Kansas	2	1.32	62.50
Maryland	1	0.66	63.15
Massachusetts	1	0.66	63.81
Michigan	5	3.29	67.10
Mississippi	1	0.66	67.76
Missouri	3	1.97	69.73
Nebraska	1	0.66	70.39
Nevada	1	0.66	71.05
New Hampshire	1	0.66	71.71
New Jersey	1	0.66	72.36
New York	1	0.66	73.02
North Carolina	2	1.32	74.34
North Dakota	1	0.66	75.00
Ohio	1	0.66	75.65
Ontario (Canada)	1	0.66	76.31
Oregon	3	1.97	78.29
Pennsylvania	2	1.32	79.60
Tennessee	20	13.16	92.76
Texas	4	2.63	95.39

Utah	1	0.66	96.05
Washington	3	1.97	98.02
West Virginia	1	0.66	98.68
Wisconsin	2	1.32	100.00
Total	**152**		

Levels of engagement with the social media platforms varies widely. The following three tables summarize the findings on levels of engagement in terms of the entire week. The first table summarizes the total values of all types of engagement for the entire week depending on whether or not the account used Twitter or Facebook. The social media account for the Bay Bridge in California had the most activity from the public of all agencies considered in the analysis. During the study week the new Bay Bridge opened, which may explain the spike. The Illinois Department of Transportation was also very successful on Facebook and Twitter as severe weather was having an effect on road conditions throughout the state and it appeared as though many were following the situation on social media. It was also noted that as the sample population increased in size, the standard deviations for both Twitter and Facebook reduced in size.

Table 4: Overall Summary of Engagement Activities

Variable	Observations	Mean Interactions per Week	Standard Deviation	Min	Max
Facebook	389	38.62	98.68	0	1028
Twitter	7994	1.84	6.09	0	313

Overall, with the Facebook and Twitter accounts the following summary statistics regarding likes (Facebook), followers (Twitter), and following (Twitter), each expressed as per week, are found:

	Observations	Mean	Standard Deviation	Min	Max
Likes	36	7619.11	13744.41	210	74046
Followers	116	4106.16	6417.80	7	31256
Following	116	617.53	2737.23	0	28542

Overall, the number of weekly posts finds the following summary statistics:

Table 6: Summary Statistics of Weekly Posts

	Observations	Mean	Standard Deviation	Min	Max
Facebook	36	10.83	10.76	0	58
Twitter	116	69.09	155.88	0	1107

It is felt that the preceding two tables support the idea that there are substantial differences between Twitter and Facebook activities, discussed in the introduction and methodology sections, and that it would be difficult to consider both media in the same analysis. First, Facebook activities are analyzed.

Facebook Data Summary

The first set of models run on the data compiled from the content analysis pertains to the agency-level Facebook data. There were two dependent variables of interest: the count of posts in a given study week and the count of likes the agency account has. Given the sample size, models with no more than four variables were considered. First, the variables used in the models are summarized and then an evaluation of the best two, three, and four variable models follows.

The variables collected for the Facebook content models are described in the following table. There are 36 observations for each of the variables. Each variable was selected because it was believed to

have some level of significance based on theory and hypotheses developed after studying the subject in

depth, though not all of these variables proved to be significant or useful in the final models.

Table 7: Summary Statistics on Facebook Variables

Variable	Definition	Mean	Std. Dev.	Min	Max
Regional	Binary variable, 1 if account represents a multi-jurisdiction region and 0 otherwise	0.28	0.45	0	1
Route Specific	Binary variable, 1 if account represents a single route and 0 otherwise	0.06	0.23	0	1
Single Jurisdiction	Binary variable, 1 if account represents a single jurisdiction and 0 otherwise	0.06	0.23	0	1
State	Binary variable, 1 if the account represents an agency at the state level and 0 otherwise	0.61	0.49	0	1
Description	Binary variable, 1 if the account has a description of itself on the page and 0 otherwise	0.67	0.47	0	1
Email	Binary variable, 1 if the account lists a contact email address on the page and 0 otherwise	0.44	0.50	0	1
Phone	Binary variable, 1 if the account lists a contact telephone number on the page and 0 otherwise	0.81	0.40	0	1
Mission	Binary variable, 1 if the account includes an agency mission on the page and 0 otherwise	0.56	0.50	0	1

Posts per Week	Number of posts made each week to Facebook by the agency	10.83	10.76	0	58
Comments	Total number of user comments on the account in the sample week	33.67	62.73	0	247
Shares	Total number of times users shared content from the agency account page during the sample week	157.11	364.64	0	1886
User Likes	Total number times users "liked" content on the agency Facebook page during the sample week	226.56	538.69	0	2897
Crash/Vehicle Incident	Sum of posts in this information category	0.75	1.92	0	10
Congestion Alerts	Sum of posts in this information category	0	0	0	0
Engagement	Sum of posts in this information category	0.92	1.04	0	4
Entertainment	Sum of posts in this information category	2.34	2.37	0	10
General	Sum of posts in this information category	1.40	2.09	0	8
Routine Alerts	Sum of posts in this information category	2.03	2.89	0	10
Immediate Road Work	Sum of posts in this information category	0.56	1.23	0	4
Weather	Sum of posts in this information category	2.66	8.21	0	42
Other Emergent Info	Sum of posts in this information category	0.33	0.97	0	5
Press Agentry	Sum of posts in this communication category	0.19	0.57	0	3

Public Information	Sum of posts in this communication category	7.44	8.72	0	45
Two-Way Asymmetrical	Sum of posts in this communication category	3.08	3.24	0	13
Two-Way Symmetrical	Sum of posts in this communication category	0.08	0.36	0	2
Likes	Number of accounts that had "liked" the agency page on the last day of the study week	7619.11	13744.41	210	74046
Feed Age	The age, in months, of the Facebook account	34.72	14.11	8	68
Sunday	Number of posts on this day	0.75	2.48	0	14
Monday	Number of posts on this day	1.47	1.70	0	7
Tuesday	Number of posts on this day	2.26	2.67	0	14
Wednesday	Number of posts on this day	1.94	2.11	0	8
Thursday	Number of posts on this day	1.92	2.09	0	9
Friday	Number of posts on this day	2.22	2.45	0	10
Saturday	Number of posts on this day	0.42	1.18	0	6
Target Population	The population targeted by the social media effort (e.g. state population, county population) from the 2012 American Community Survey, divided by 1000	7209.16	7749.67	32.84	38,041
Transit	Binary variable, 1 if the account is public transit, 0 otherwise	0.11	0.32	0	1

Both the number of posts per week and the target population are count variables. The distributions of these variables are illustrated in the following graphs. The first illustrates the distribution of the number of posts per week for each account, ordered from fewest to largest number of posts per week. What is clear is that about two-thirds of all accounts made fewer than 10 posts per week, about another third made 10 to 30 posts per week, and one outlier made nearly 60 posts in the study week. Conversely, the mean number of posts made by Twitter accounts is 69.09. Further evidence that direct comparisons are not possible between media.
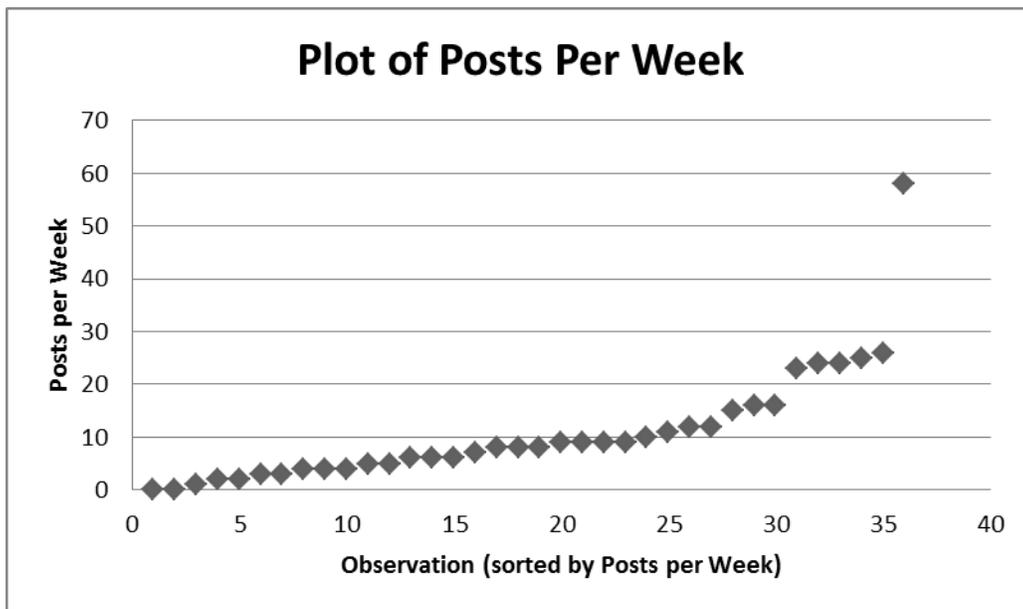
Figure 2: Plot of Posts per Week, Facebook

The second plot illustrates the distribution of target populations, ordered in size by thousands. A little less than half of the accounts target 5 million or fewer people, about a third of accounts target between 5 and 10 million people, and the remainder target even larger populations. This sample of accounts appears to be logarithmic, but that is not necessarily indicative of the entire population of social media accounts belonging to transportation agencies. What is clear is that transportation agencies that have ventured onto social media have large potential audiences but value is also present for agencies representing smaller regions or populations.
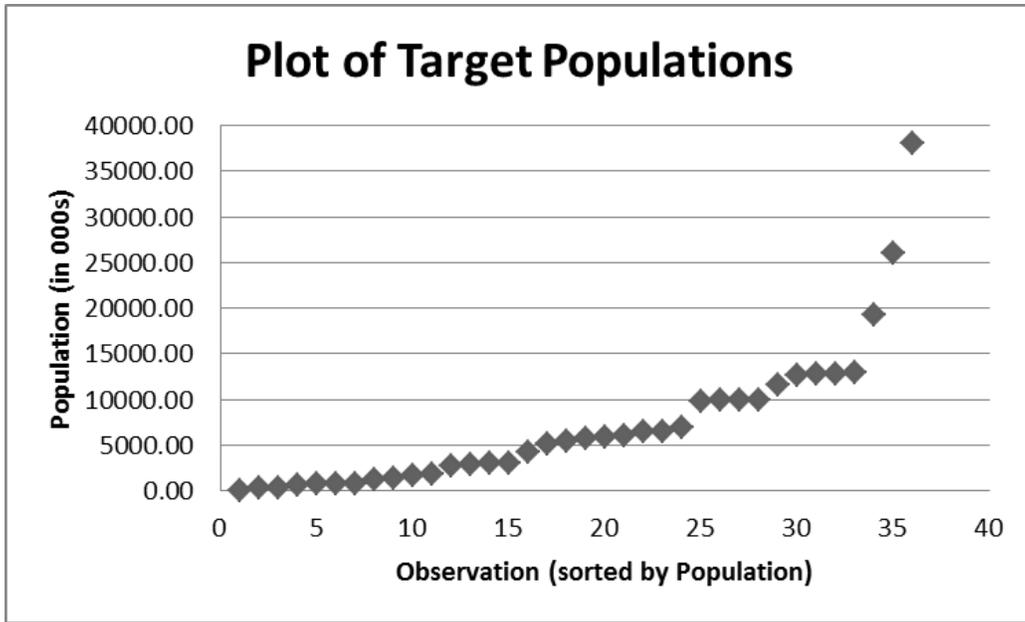
Figure 3: Plot of Target Populations, Facebook

The following table describes the breakdown of accounts by the level of their agency as well as whether or not they are public transit agencies. When analyzing the models, it is important to consider the number of accounts in each category and the related values. It had been desired to obtain more accounts in a broader distribution, but the random nature of the sample did not permit this. It is believed that the distribution of the sample is a representation of Facebook accounts by their level of activity.

Table 8: Types of Accounts, Facebook

Type of Account	Number of Accounts	Transit
Single Route	2	0
Single Jurisdiction	2	0
Regional	10	3
State	22	1
Overall	36	4

Some activities were more popular than others. The following table shows the breakdown of the three measurable activities on Facebook: liking, commenting, and sharing. Liking is the most common

activity, followed by sharing and then commenting. Of the three activities, liking requires the least work from the participant. For a post to receive more than a handful of comments, it must be something that people feel strongly about interacting with. For a post to be shared more than a handful of times it must be considered very useful. The Facebook account with the most sharing was the Illinois Department of Transportation, specifically their posts pertaining to weather and corresponding driving conditions and useful information on driving in such extreme weather.

Table 9: Summary of Facebook Engagement Activities

Variable	Observations	Mean	Std. Dev.	Min	Max
Likes	389	22.02	58.14	0	716
Comments	389	3.12	10.61	0	160
Shares	389	14.61	46.08	0	423

Facebook Posts per Week Models

The first set of Facebook agency models run considers the count of posts in a given study week. Models with two and three variables are considered. Due to the small number of observations, models with four or more variables are not evaluated. At each level of evaluation, over-dispersion was observed, based on the significance of the alpha term, indicating the appropriateness of the negative-binominal specification.

In the design and evaluation of predictive models pertaining to the number of posts per week, several decisions were made. First, use of multiple variables pertaining to posts per day or types of posts (each of which are count variables whose categorical sum is equal to the total number of posts made per week) are omitted. Limiting the use of these variables had a negative effect on fitness of models, but had to be done for the purpose of an accurate and meaningful model. It was felt that excluding them entirely was not necessary as the correlation between the individual variables was not high, it was the cumulative effect.

Additionally, after evaluating them for significance and correlation, only one variable is selected as an indicator of the agency's investment into their Facebook pages. The presence of a written description of the agency is chosen, because it requires more effort to insert than contact information, and it has more utility to the public than an organizational mission statement. The information gathered in the literature, namely the Red Cross (Briones et. al., 2011) and Southwest Airlines (Callison and Seltzer, 2010) studies, as well as the comments given by participants in the general public survey support this selection.

Furthermore, in these models, the number of likes of account postings is chosen over the number of comments and shares. A like is the easiest and least intrusive means of indicating consumption and enjoyment of utility from the activity. The other two measures of public interaction, comments and shares, were not as significant when tested independently. These choices, in conjunction with the first step in the procedure described in Table 2: Model Development Methodology narrowed down the number of variables in consideration to 15.

First, only the dependent variable is tested to understand the base conditions.

Table 10: Base Conditions for Negative Binomial Facebook Posts per Week Models

Variable	Coefficient	Standard Error	z	P-value
Constant	2.383	0.149	16.000	0.000
Log-alpha	-0.348	0.264		
Alpha	0.706	0.186		
Pseudo R^2:	0.000	**N:**	36	
Log-likelihood:	-122.542			

Of the models evaluated with two variables, the following was found to be the most robust based on the improvement of the log-likelihood over the constant only model, pseudo R^2, significance of the variables, and theory.

Variable	Coefficient	Standard Error	z	P-value
Description	0.827	0.272	3.04	0.002
User Likes	0.001	0.000	2.56	0.010
Constant	1.554	0.236	6.58	0.000
Log-alpha	-0.826	0.303		
Alpha	0.438	0.133		
Pseudo R^2:	0.058	**N:**	36	
Log-likelihood:	-115.477			

As predicted, the presence of the description of the agency operating the Facebook page is a significant predictor of the number of posts per week. Compared to those accounts that lack a description on their Facebook page and holding constant for the number of likes on their posts in a week, those that have a description make 129-percent more posts. What this indicates is the expected correlation between having a description as part of an "About" page and overall use and engagement with the medium.

It was also expected that the number of user likes would be positively correlated with use of a Facebook page. User likes are not necessarily directly correlated with the number of posts on an account's page. Rather, user likes are an indicator of quality, useful, and engaging content. While the average number of likes per post in this sample was 22.02, the median was 4 and the mode was 0. This means that some content garners a large number of likes, but most is posted and receives little interaction.

The primary challenge with using likes is that there were 8156 likes across the 389 posts, thus the coefficient is very small. But this is accurate, one or two likes here and there may not have much of an effect on posts, but an accumulation of activity is a sign of the utility of the information and hopefully acts as encouragement for the agency to make additional posts.

The fitness statistics, such as the pseudo R^2 (0.0576) and log-likelihood may not be as impressive as desired, but this is related to the small sample size and selection of so few variables. Compared to

earlier models, run with a smaller sample size, this is still a marked improvement. It is expected that adding a third variable will help with these shortcomings. However, due to the presence of omitted variables that cannot be quantified, explaining more than ten percent of the variance in the dependent variable is unlikely.

Following the two variable models, three variable models were considered. The results were consistent with the findings of the two variable models. In the best model, description and user likes remained significant, as was the geographical variable, which is a composite of the state and regional variables. The results are summarized in the following:

Table 12: Results of Three Variable Posts per Week Models, Facebook

Posts Per Week	Coefficient	Standard Error	z	P-value
Description	0.856	0.246	3.470	0.001
User Likes	0.001	0.000	3.720	0.000
Regional or State	1.198	0.411	2.910	0.004
Constant	0.386	0.455	0.850	0.396
Log-alpha	-1.109	0.334		
Alpha	0.330	0.110		
Pseudo R^2:	0.087	**N:**	36	
Log-likelihood:	-111.948			

This model yielded a great improvement in log-likelihood from the constant only model. It retains the variables from the prior, two-variable model but is modified by the inclusion of the composite geographical variable. Each variable in the equation is significant except for the constant. The insignificant constant term could signal an issue with the inclusion of the composite geographical variable. However, it makes sense theoretically that a Facebook account that has a larger region to cover, in terms of geography or people, may have more information to share via social media than a Facebook account operated to cover a single jurisdiction or single route. It would be interesting to see how this

model performs in a sample with more singe route or single jurisdiction accounts. Furthermore, it speaks to the robustness of the variables for description and user likes of content that their coefficients are virtually unchanged from the two-variable model. This is consistent with the models developed with a smaller sample size.

Pseudo R^2 for this specification is 0.0865, indicating that it describes 8.6-percent of the variation in the posts per week variable. At first glance this may seem like a weak relationship, but it is actually the best result for a model that has carefully excluded irrelevant variables, variables causing some degree of multicollinearity, and variables that have no theoretical bearing on the dependent variable, posts per week.

With the sample size as small as it is, the preferred predictive model is the three-variable model. With a larger sample, larger and more complex models could be developed that could even more effectively glean insight in the ideal number of posts an agency should make each week to retain the attention of their followers based on the level of their agency's Facebook account (e.g. route specific, single jurisdiction, regional, and state). But with so few degrees of freedom parsimony is important.

One takeaway from these two models is that it is important to put the time into setting up the "About" page on the Facebook account. This finding is supported in the literature (e.g. Briones et. al. 2011) and the results of the general public survey, both of which appear to indicate that individuals participate more with pages that have been completed and customized.

Facebook Likes Models

The second set of models pertaining to Facebook data gathered from the content analysis intends to examine the variables that can predict the number of likes that an account may accumulate. Likes were measured on the last day of the study week and they were the total number of likes accumulated by the account. A variable for the age of the social media account was also collected to account for the effect of time on the accumulation of likes, however it was not significant. As with the prior models, because of

the small number of observations, only models of two and three variables are considered for their fit in predicting the number of likes. First, the base conditions are noted in the following table.

Table 13: Base Conditions of the Negative Binomial Facebook Likes Models

Variable	Coefficient	Standard Error	z	p-value
Constant	8.938	0.216	41.44	0.000
Log-alpha	0.515	0.198		
Alpha	1.675	0.331		
Pseudo R^2:	0.000	N:	36	
Log-Likelihood:	-353.842			

The best fitting two-variable model is now considered. The transit variable is a binary variable indicating if the agency account represents a public transit agency. The Road Work or General Posts variable is a composite of those two count variables, counting the number of those types of posts that appeared on the Facebook account in the study week. The other content type variables were not as significant and may be reviewed in Table 7: Summary Statistics on Facebook Variables.

Table 14: Results of Two-Variable Negative Binomial Facebook Likes Model

Variable	Coefficient	Standard Error	z	p-value
Transit	2.280	0.517	4.41	0.000
Road Work or General Posts	0.389	0.082	4.73	0.000
Constant	7.434	0.238	31.17	0.000
Log-alpha	-0.075	0.209		
Alpha	0.928	0.194		
Pseudo R^2:	0.040	N:	36	
Log-Likelihood:	-339.563			

In testing two variable models, it was found that the mode, transit or highway, is strongly significant. The other variables that routinely emerged as significant were those for road work information or general information. Road work or construction related posts were routinely most significant, though there are relatively few of these posts on Facebook, especially compared with Twitter. Given the small number of observations and the significance of the variable for general information posts (e.g. public service or safety announcements), a composite variable was developed by adding the values from each of the respective categories together. By doing this, the pseudo R^2, 0.040, is almost as strong as the three-variable model, where these two categories are separate predictor variables.

As with the models pertaining to the number of posts per week on Facebook, there are omitted variables that cannot be readily measured. For example, likes and preferences are difficult to quantify. Furthermore, when some agencies begin their social media outreach, the individuals behind the outreach may make personal appeals to friends and family to attain a certain goal. So these likes may have not been attained organically but through interpersonal networking that cannot necessarily be quantified in this type of equation because it is not feasible to ask each person who likes a page how they found out about the page and why they decided to click the like button, but we do know there are many reasons why someone would want to be aware of the updates from a transportation agency. This does not mean that the results of the model do not yield meaningful insight, just that the cause or reasons for specific "liking" behavior is extremely difficult to track. What this does suggest is that, especially if the research is being conducted at the individual agency level, more detailed surveying or even focus groups could be meaningful.

The most robust three-variable model is very similar to the two-variable model. It separates the interaction term for General Posts and Road Work back into their original categories. Doing this enables the precise effects of these types of content to be considered independently.

Variable	Coefficient	Standard Error	z	P-value
Transit	2.363	0.497	4.76	0.000
General Posts	0.337	0.080	4.21	0.000
Road Work	0.554	0.135	4.12	0.000
Constant	7.408	0.225	32.89	0.000
Log-alpha	-0.165	0.214		
Alpha	0.848	0.181		
Pseudo R^2:	0.045	**N:**	36	
Log-Likelihood:	-329.366			

For the reasons explained in the prior variables, a smaller pseudo R^2 is not unexpected but it is expected for it to be an improvement over the two-variable model and it is with a value of 0.045, versus 0.040 in the two-variable model.

Transit agencies make up a very small component of the Facebook account sample, but these agencies tend to use social media as a customer service tool. Agencies such as MARTA in Atlanta post service and weather related information that has very immediate effects on the trips of their customers. Given how these organizations tend to utilize social media, especially transit agencies covering areas of higher populations, it seems reasonable they may have more likes. If more of these agencies occupied the sample it would be interesting to see if this relationship were to hold. It is also an overall reminder of the challenges of developing meaningful predictive models with such small datasets. Furthermore, transit users are more able to utilize social media while actively in transit than their highway counterparts, which may also help explain why there is such a correlation between likes and an agency being a transit agency.

The content variables both glean insight on what content is meaningful to the public on this platform. It is expected that "General Posts" will not be a significant predictor for Twitter followers, for

example, because Twitter users are expected to be more focused on information with immediate and interactive qualities.

Twitter Data Summary

The second set of models run concerned the Twitter data at the agency level. There were two dependent variables of interest: the count of posts in the given study week and the count of Twitter account followers. Given the sample size, models with up to four independent variables were considered. First some of the characteristics of the data are described, followed by a summary of the variables, and an evaluation of the best two, three, and four variable models.

Table 16: Summary of Twitter Data Collected

Type of Account	Number of Accounts	Average Target Population	Average Number Following	Average Number of Followers	Average Number of Posts/Study Week
Single Route	29	2,689,437	37.6	1498.9	57.3
Single Jurisdiction	15	1,317,525	233.2	2270.3	15.5
Regional	42	2,592,863	372.5	3492.2	73.2
State	30	7,627,517	1713.4	8403.9	101.5
Overall	116	3,754,158	617.5	4106.2	69.09

As with Facebook, on Twitter some activities were more popular than others. The following table shows the breakdown of the three measurable activities on Twitter: replying, retweeting, and favoriting. By far, retweeting is the most common interaction with Twitter content, with favoriting and replying in distant second and third place, respectively. Similar with Facebook, the easiest activity is the most common. But caution is urged in attempting to directly compare these activities. Content on Twitter and Facebook differ substantially. Twitter content is limited to 140 characters so a lot of content comes in the

form of links that must be clicked to get a fuller idea of the content, as opposed to Facebook where

everything is presented right there.

Variable	Observations	Mean	Standard Deviation	Min	Max
Replies	7994	0.079	0.451	0	17
Retweets	7994	1.738	4.930	0	253
Favorites	7994	0.118	1.256	0	63

The variables used in the following models are defined and described in the following table. Each

variable had 116 observations.

Variable	Definition	Mean	Std. Dev.	Min	Max
Regional	Binary variable, 1 if account represents a multi-jurisdiction region and 0 otherwise	0.36	0.48	0	1
Route Specific	Binary variable, 1 if account represents a single route and 0 otherwise	0.25	0.43	0	1
Single Jurisdiction	Binary variable, 1 if account represents a single jurisdiction and 0 otherwise	0.13	0.34	0	1
State	Binary variable, 1 if the account represents an agency at the state level and 0 otherwise	0.26	0.44	0	1
Posts per Week	Number of posts made each week to Twitter by the agency	69.09	155.88	0	1107
Retweets	Sum of times content posted by the agency was retweeted by Twitter users	113.56	259.64	0	1565

Replies	Sum of times content posted by the agency was replied to by Twitter users	5.19	26.99	0	283
Favorites	Sum of times content posted by the agency was added to a user's favorite list	7.72	27.18	0	210
Content Retweeted by the Account	Number of tweets the agency retweeted during the study week	3.56	8.73	0	53
Crash/Vehicle Incident	Sum of posts in this information category	20.33	49.86	0	344
Congestion Alerts	Sum of posts in this information category	14.66	73.02	0	553
Engagement	Sum of posts in this information category	4.89	20.12	0	205
Entertainment	Sum of posts in this information category	3.65	8.56	0	51
General	Sum of posts in this information category	2.14	4.56	0	35
Routine Alerts	Sum of posts in this information category	6.85	28.21	0	229
Immediate Road Work	Sum of posts in this information category	12.18	45.47	0	396
Weather	Sum of posts in this information category	1.66	7.05	0	53
Other Emergent Info	Sum of posts in this information category	2.53	5.74	0	41
Press Agentry	Sum of posts in this communication category	0.16	0.51	0	3
Public Information	Sum of posts in this communication category	61.00	145.17	0	1105

Two-Way Asymmetrical	Sum of posts in this communication category	4.00	14.15	0	140
Two-Way Symmetrical	Sum of posts in this communication category	3.75	18.94	0	196
Followers	The number of Twitter accounts following the agency at the beginning of the study week	4106.16	6417.80	7	31,256
Following	The number of Twitter accounts the agency is following at the beginning of the study week	617.53	2737.23	0	28,542
Feed Age	The age, in months, of the Twitter account	45.57	15.85	2	74
Sunday	Number of posts on this day	5.46	15.43	0	126
Monday	Number of posts on this day	10.81	22.58	0	154
Tuesday	Number of posts on this day	11.91	22.58	0	210
Wednesday	Number of posts on this day	11.53	27.19	0	201
Thursday	Number of posts on this day	12.09	28.91	0	222
Friday	Number of posts on this day	11.79	27.97	0	193
Saturday	Number of posts on this day	5.34	12.24	0	80
Target Population	The population targeted by the social media effort (e.g. state population, county population) from the 2012 American Community Survey, divided by 1000	3,754.16	5,799.556	14	38,041
Transit	Binary variable, 1 if the account is public transit, 0 otherwise	0.13	0.34	0	1

Twitter Posts per Week Models

The first set of models based on the Twitter data considered the characteristics that could predict or glean insight into the number of posts made by an agency Twitter account each week. Models with two, three, four, and five predictor variables were considered. Both the coefficients and the odds ratios are reported with the results of each model. In each of these negative binomial models the alpha parameter was found to be significantly different from zero, representing some level of over-dispersion in the model. First the base conditions are reported in the following chart.

Table 19: Base Conditions for Negative Binomial Twitter Posts per Week Models

Variable	Coefficient	Standard Error	z	P-value
Constant	4.235	0.148	28.580	<0.001
Log-alpha	0.929	0.117		
Alpha	2.533	0.296		
Pseudo R²:	0.000	**N:**	116	
Log-likelihood:	-568.316			

Now, the results of the two variable model will be considered.

Table 20: Results of Two-Variable Negative Binomial Twitter Posts per Week Model

Variable	Coefficient	Standard Error	z	P-value
Public Information	0.010	0.001	7.230	<0.001
Content Retweeted by the Account	0.038	0.013	2.990	0.003
Constant	2.679	0.141	18.930	<0.001
Log-alpha	0.102	0.137		
Alpha	1.107	0.151		
Pseudo R²:	0.094	**N:**	116	
Log-likelihood:	-514.804			

This model had a pseudo R^2 of 0.0942, which was felt to be strong given the model only included two variables. A challenge with modeling for posts per week is many predictor variables are somewhat collinear with the dependent variable (e.g., frequency of posting different types of content). Yet, types of content posted are key when considering how often an agency posts and how the agency presents itself to the public, and will dictate how useful it is to the public. However, it is acknowledged that some types of information are easier and less time consuming for agencies to disseminate via social media.

Retweeting content of others is easy and not time consuming. Similarly, many public information posts appeared to be generated by automatic processes (e.g., @CTDOT_Statewide, @TN511). With that in mind, it is not surprising that these content choices are positive predictors of higher volumes of weekly posts. Though as models with more variables were considered, variables other than Content Retweeted by the Account fared better, though Public Information proved to be a mainstay through the entire process.

It was also found that most of the variables collected were significant if modeled independently, but then were affected very substantially by other variables; these dramatic shifts naturally suggesting problems with collinearity that great care was given for avoiding at more advanced stages of the statistical modeling. Next, the best model with three variables is considered.

Table 21: Results of Three-Variable Negative Binomial Twitter Posts per Week Model

Variable	Coefficient	Standard Error	z	P-value
Followers	0.000	0.000	2.380	0.017
Public Information	0.007	0.001	5.970	<0.001
Single Jurisdiction	-0.687	0.318	-2.160	0.031
Constant	2.910	0.166	17.480	<0.001
Log-alpha	0.277	0.130		
Alpha	1.319	0.171		
Pseudo R^2:	0.078	**N:**	116	
Log-likelihood:	-540.781			

When considering three variable models, this was the model that emerged that was sound theoretically while retaining some statistical significance. The pseudo R^2 value for this model is actual 0.0776, so it actually explains less of the variance in the posts per week variable than the two-variable model. However, it is felt that the specification is more theoretically sound. In the two-variable model, both variables speak to the volume of certain types of content being published. Both of those information types were among the easier to disseminate via social media and the more plentiful observed in the data collection of the content analysis. Meanwhile, the three-variable specification considers the number of individuals engaged with the account, the volume of public information posts (the most common type of information shared via social media), and one of the agency level dummy variables.

The odds ratio and coefficient are particularly small for the variable for followers. The range of that variable is from 7 to 31,256 so the incremental difference of a single follower, especially as the feed increases in popularity, is indeed small. If the values for the odds ratio and coefficient are drawn out to five or more decimal places the exact effect of an incremental change is clear. The public information variable has a similar situation, ranging from 0 to 1105.

The type of content variables in these models is enabling the consideration of the relationship between the number of posts of a content type and the number of posts overall made by the Twitter account. In the three-variable model, with only one variable representing content type, it is unclear if the types of information themselves affect the number of total posts made by an organization. For example, an agency that utilizes a lot of two-way symmetrical communication may, for some reason, make fewer posts because they are focused mostly on responding to queries rather than disseminating general information on the media. The following four- and five-variable models are focused much more on the roles and effects of content types in predicting the overall number of posts per weeks. It is expected that this design may lead to more collinearity between the dependent and independent variables, but also helps explain what types of content are more prolific on social media platforms.

Table 22: Results of Four-Variable Negative-Binomial Twitter Posts per Week Model

Variable	Coefficient	Standard Error	z	P-value
Public Information	0.007	0.001	5.210	<0.001
Two-Way Symmetrical	0.057	0.020	2.840	0.005
Retweets	0.002	0.001	2.730	0.006
Replies	-0.048	0.017	-2.860	0.004
Constant	2.735	0.136	20.100	<0.001
Log-alpha	0.090	0.137		
Alpha	1.094	0.150		
Pseudo R^2:	0.095	**N:**	116	
Log-likelihood:	-514.259			

The model fit is improved over the two-variable model. The log-likelihood improved as did the pseudo R^2, to 0.0952. There is some collinearity with the inclusion of two of the content tone variables, considering there are four total and one of them, Press Agentry, had very few observations.

This model suggests there is a mixed effect between engagement and posting. We see a positive relationship between users retweeting content and agencies posting more yet a negative relationship between users replying to content and agencies posting more. One thought is that retweeting is a positive at best and neutral at worst means of sharing information posted by an agency and it is very passive, the agency does not need to respond or do anything.

On the contrary, a reply can be anything that user wishes it to be. If the user wishes to say something terrible about the agency, they can. If the user wishes to make a series of complicated comments, they can do that as well. So the reply may have some effect on sharing information on social media, especially if the account is actually staffed by a person who is making an attempt to address incoming questions or comments, whether by responding to them directory, recording them to direct them to the corresponding staff member, or some combination of those or similar activities.

In addition to the four-variable model, a five-variable model was also tested. This model is an evolution of the four-variable model, simply adding the variable counting the number of times an account retweeted content from another Twitter feed. This variable is interesting because it indicates a few things if the count of account retweets is greater than zero. First, it means that the account is following other Twitter accounts. This is important because it means they are using Twitter, at least in some little way, as a *network*. Second, they understand the *social* component of the term *social* media. Though in terms of modeling results, as the variable was described in the two-variable model, it is not time consuming to retweet the content from another account so this is content that one would expect to be positively correlated with the number of posts per week. Because they had been significant in prior specifications and independently, plus they are logical choices theoretically, the variables for followers and following were also evaluated for including in these models, however they did not yield models with the same level of robustness and fitness as the following model, whose results are summarized in the following table.

Table 23: Results of Five-Variable Negative Binomial Twitter Posts per Week Model

Variable	Coefficient	Standard Error	z	P-value
Public Information	0.008	0.001	5.540	<0.001
Two-Way Symmetrical	0.040	0.020	1.990	0.046
Retweets	0.002	0.001	2.380	0.017
Replies	-0.037	0.017	-2.230	0.025
Content Retweeted by the Account	0.029	0.012	2.350	0.019
Constant	2.591	0.141	18.370	<0.001
Log-alpha	0.028	0.139		
Alpha	1.029	0.143		
Pseudo R^2:	0.101	**N:**	116	
Log-likelihood:	-510.772			

With this model, a combination of the two-variable and four-variable specifications, the pseudo R^2 is 0.1043, which is the largest value observed with any specification. The similarity of the coefficient, odds ratio, and significance of the Public Information and Content Retweeted by the Account between this model and the original, two-variable model indicates the importance of these variables in indicating the level of weekly account activity in the sample. This model is also preferred because of the variety of variables included. Public Information and Two-Way Symmetrical are related to the tone of the posts. Replies and Retweets are related to public interaction and response to posts. Content Retweeted by the Account is related to the type of material posted to the account by the agency.

Twitter Followers Models

The other set of models developed related to Twitter use consider the number of followers each of the agency Twitter accounts had during the study week. In each of these negative binomial models the alpha parameter was found to be significantly different from zero, representing some level of over-dispersion in the model. As with the prior set of models, the best models utilizing two, three, and etc. variables are considered, though first the base conditions are indicated for comparison in the following table.

Table 24: Base Conditions for Negative Binomial Twitter Followers Models

Variable	Coefficient	Standard Error	z	P-value
Constant	8.320	0.123	67.530	<0.001
Log-alpha	0.566	0.110		
Alpha	1.761	0.193		
Pseudo R²:	0.000	**N:**	116	
Log-likelihood:	-1065.531			

When two variables were considered, both the strength of models and possible interaction terms were considered. The following results summarize the strongest model that utilized two variables.

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Variable	Coefficient	Standard Error	z	P-value
Retweets	0.002	0.001	3.020	0.003
Route Specific	-1.251	0.264	-4.740	<0.001
Constant	8.168	0.148	55.080	<0.001
Log-alpha	0.462	0.110		
Alpha	1.588	0.175		
Pseudo R^2:	0.015	**N:**	116	
Log-likelihood:	-1076.646			

This model utilizes explanatory variables representing interactions (Retweets) and the agency account level (Route Specific). The relationships are as expected. Retweets, a form of engagement, suggest that an agency is posting material of relevance. Route Specific accounts are expected to have fewer followers than other levels of agency accounts because, in general, they will tend to have smaller or much more specific target populations.

The pseudo R^2 for this mode is 0.0146. As explained previously, there are many factors involved in why individuals follow a given Twitter account and many of them cannot necessarily be gathered or quantified. As discussed in the survey results, many members of the public indicated that marketing is very inconsistent as is the quality of the content, both of which could have an effect on the number of followers but is not measurable. This introduces the idea that there is randomness present that cannot be accounted for with this model and this sample.

What is most important to extrapolate from this sample is a theoretically sound model. Then try and apply it to future data sets to see if, as social media is adopted further and methods may become more standardized, these factors are important in predicting the number of Twitter followers. In future iterations of the models for Twitter Followers, these variables retain their significance. Though in these models, changes in the log-likelihood, compared to the constant only model, are the greatest of any of the model

sets conducted for this research. The two-variable model whose results are presented above had a log likelihood of -1076.646 compared to the base model of -1092.554.

The most robust three-variable model was simply an iteration of the two-variable model where a variable accounting for the length of time the Twitter account has existed is added. This variable is *Feed Age* and measures how long the Twitter account had exist at the time of data collection in months.

Table 26: Results of Three-Variable Negative-Binomial Twitter Followers Model

Variable	Coefficient	Standard Error	z	P-value
Feed Age	0.037	0.007	5.040	<0.001
Retweets	0.002	0.001	2.860	0.004
Route Specific	-0.926	0.250	-3.700	<0.001
Constant	6.371	0.366	17.400	<0.001
Log-alpha	0.205	0.114		
Alpha	1.227	0.140		
Pseudo R^2:	0.026	**N:**	115	
Log-likelihood:	-1031.647			

The inclusion of the exposure variable for Feed Age increases the pseudo R^2 to 0.026, indicating the combination of variables better explains the variance in Followers. We also see a greater improvement to the log-likelihood from the constant than in the two-variable model. The variable representing the Feed Age behaves as anticipated. Older accounts are expected to have more followers because potential followers have had more time to discover the agency's presence. Each of the other variables behave as anticipated, as well.

Another variable that measures exposure to followers, *Target Population*, is added for the four-variable specification. The results of this model are summarized in the following table.

Variable	Coefficient	Standard Error	z	P-value
Feed Age	0.039	0.007	5.860	<0.001
Retweets	0.002	0.001	3.270	0.001
Route Specific	-0.830	0.224	-3.700	<0.001
Target Population	0.0001	0.00002	4.130	<0.001
Constant	5.697	0.347	16.420	<0.001
Log-alpha	0.033	0.116		
Alpha	1.033	0.120		
Pseudo R^2:	0.038	**N:**	115	
Log-likelihood:	-1018.648			

The coefficient for Target Population is extremely small, but significant. If Target Population had been divided by units of 10,000 or 100,000 the coefficient would be larger but overall effect the same. The pseudo R^2 value of 0.038 is not ideal, but it reflects the presence of randomness in the process of accumulating followers. Additional models with a greater number of variables were tested, however their effects on the fit statistics were minimal. The effect on the pseudo R^2 appeared to be limited to the fact that the McFadden R^2 always increases by some amount when variables are added to a model.

Transportation Agency Social Media Survey

Agency Survey Data Description

The total number of agency representatives who completed the Transportation Agency Social Media Survey is 55. The results of the transportation agency survey are described in this section. First the descriptive statistics are discussed, followed by a summary of each of the variables considered in the statistical models, the results of the models, and finally a summary of the qualitative content.

Social media tools can be powerful in disseminating information to the public. However, social media integration into media outreach for many organizations is organic and ad hoc. Given this nature of platform development, respondents were asked if their agency had a formal social media strategy or plan. Currently, specific details of the plan are less important than knowing if an agency has thought about social media in advance of using social media. The breakdown is illustrated in the following chart.
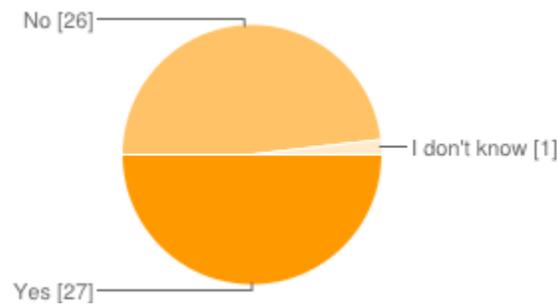

Figure 4: Breakdown of transportation agencies with social media strategies or plans

It is almost an even split in half as to the agencies that do and do not have a formal social media plan. Many that do not have a formal plan indicated that they are working on the development of a specific social media plan or updating their overall communications strategy to include information on social media. Other agencies with social media plans or strategies have indicated they missed the mark and are returning to those plans to make changes. These changes include: increasing the frequency of posting content, increasing live monitoring, and better defining the circumstances in which social media are "the right tool." The respondent who did not know indicated that the web office rather than the communications office handled the day-to-day management of the social media at their agency.

In some organizations, a strategy for compiling information to disseminate via social media is part of a larger media, social or otherwise, plan or strategy. Regardless of whether this is the case or not, if an agency has a pipeline for gathering information to disseminate via social media it is expected that they may more reliably share information, their public will know what they can gather from the agency's social media outlets, and have a more successful overall social media program. The breakdown of the agencies with a plan for content development and/or acquisition is illustrated in the following chart.
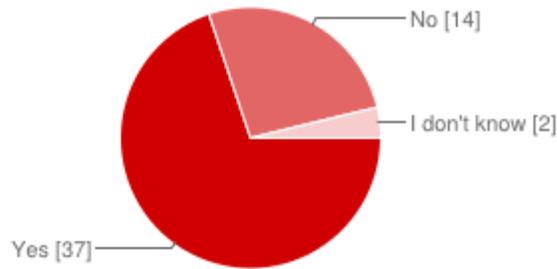
Figure 5: Breakdown of agencies with content development and/or acquisition plans

Nearly three-quarters of agencies, 70-percent, have a strategy for developing or acquiring content for their social media outlets, though these strategies range from being extremely informal and disorganized to rigid, formulaic, and scheduled. Some examples of strategies include:

- Delegating information gathering to the web office

- Routinely contacting district public information officers for local and regional information

- Asking public information officers to contact the communications or web offices when they have information to share

In addition to these strategies, agencies with less formal information gathering plans indicate that they share information from emergent events, utilize the expertise of web-savvy staff who better understand social media, and even have communications staff work directly with district engineers to pull together information to share.

The defining characteristic of social media versus conventional websites is the facilitation of two-way communication. That said, it is key to determine how many agencies take advantage of this feature. The following figure shows the breakdown of agencies that respond to questions asked via social media.

Figure 6: Breakdown of agencies that respond to questions asked via social media

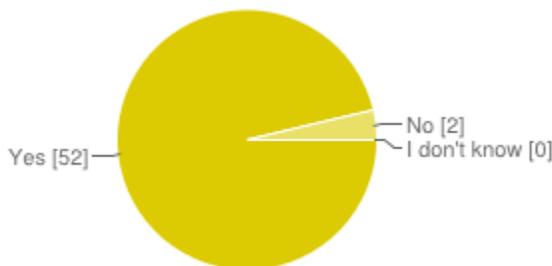The vast majority, 96-percent, of agencies respond to questions asked via social media. The importance of interaction via social media is that questions are often asked via mobile devices. In the content analysis it was found that many smaller transit agencies use social media to offer on-the-spot customer service to those who may need assistance immediately. Other agencies report that few questions are asked via social media. These were largely highway agencies. Another agency indicated that it contracts out this function to an external agency that responds to questions with general information whereas more urgent information is routed back to their Public Affairs Office.

Most social media platforms also enable accounts to select individuals to like or follow, even accounts that represent agencies or organizations rather than individual. The ability to curate a list of vetted sources to follow could enable agencies to obtain information on incidents prior to them receiving notification through internal sources. The following chart illustrates the responding agencies that do and do not utilize social media to obtain information on incidents that may affect their public.
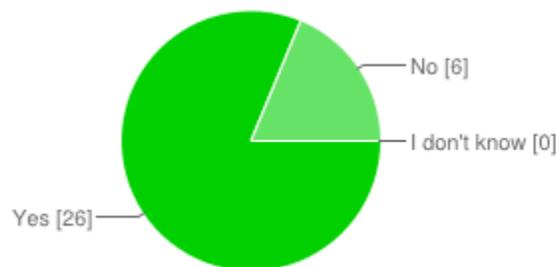
Figure 7: Breakdown of agencies that use social media to monitor events affecting their public

A majority of agencies surveyed, 79-percent, do monitor social media for events that may impact their public. Though it is noted that monitoring social media for events impacting service or traffic may be time consuming and not feasible for many agencies. Some agencies indicate that while they do not ordinarily monitor social media for events, they will have contractors do this as a part of some major projects. Many agencies indicated they choose to avoid this because external sources may vary greatly in reliability and maintaining credibility as an authority is more important than being the absolute first source to share the information.

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Social media platforms offer access to the public unparalleled by previous technologies. It seems reasonable that it may have an effect on their existing, traditional media plan. The following chart illustrates whether or not agencies perceive social media as having any effect on their traditional media plan.
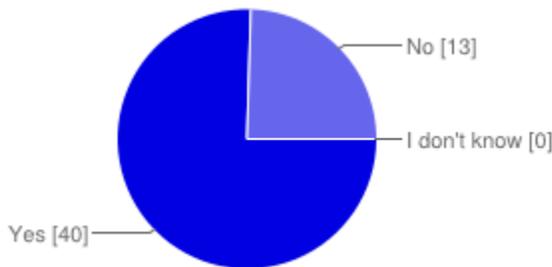
Figure 8: Breakdown of agencies that foresee social media impacting traditional media efforts

The majority of respondents, 75-percent, indicate social media effects their traditional media efforts. Some of the effects on traditional media, as described by responding agencies, include:

- Reducing the number of news releases and relying more on social media for direct contact with the public

- During emergency situations, utilizing social media (especially Twitter) because it has proven to be more effective in terms of timeliness and effectively disseminating the message

- Media closely follows agency social media and is quick to engage prior the agency having the opportunity to publish a formal press release or media advisory

- Using fewer physical resources (e.g. less ink and paper) without compromising on results

- Purchasing less advertising for different online features, disseminating information on job openings, and traveler information

Some agencies still see great power in their traditional media outlets and view social media more as a supplement than a game-changing replacement. Another agency indicated the power of social media to turn the public to the content offered on the agency's traditional web pages. Related is the perceived level of success of an agency's social media efforts. It was expected for agencies to view themselves favorably. The survey results reflect this expectation and are summarized in the following chart.

Successful [26]

Neither Succe [3]
Unsuccessful [0]
Very Unsucess [0]

Very Success [25]
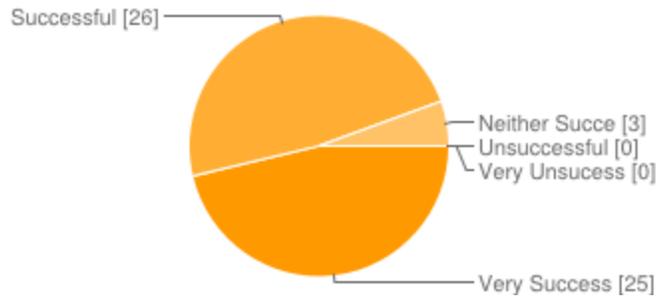
Figure 9: Agency perceived success of social media efforts

No agencies view their efforts as either unsuccessful or very unsuccessful, while only three consider their efforts neither successful nor unsuccessful. Given the number of agencies that indicated a limited or minimal social media presence, it was expected for more agencies to have neutral, if not negative, feelings about the success of their social media programs.

Because, for most agencies, social media is something new for staff to work on rather than a replacement for some other program, there is a question of where these resources might come from and what resources can be applied to social media. Time spent on social media efforts is the measure of effort used because if existing employees merely have it added to their existing workload it may be more difficult to ascertain cost in dollars. The following chart illustrates the amount of time different agencies spend on social media activities each week.

31-40 hours [9]

21-30 hours [10]

More than 40 [7]

I don't know [1]

11-20 hours [10]

Fewer than 1 [17]
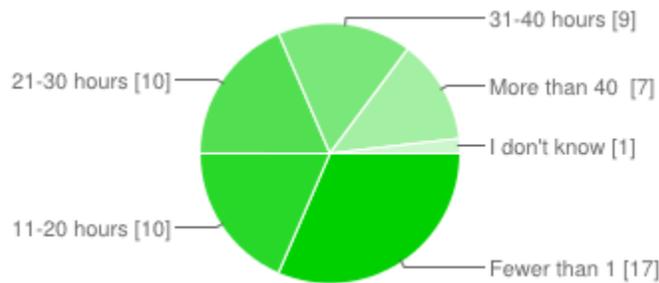
Figure 10: Time commitment to social media efforts by transportation agencies

From this, it is evident that there is no single, perfect fit for agencies when it comes to dedicating time to social media. Of the answers associated with numerical values, the percentage share of each response is fairly balanced. Twenty hours seems to be about the average amount of time spent. However,

smaller agencies (e.g. city departments of transportation) spent less time than larger agencies. Transit agencies dedicated more time to social media than highway agencies.

Reasons for these trends varied. For cities, they may have a smaller population base, less mileage to report on, and/or smaller staffs. For transit agencies, social media is another possible platform to offer personalized customer service-. It was observed in the course of data collection that some transit agencies had individuals dedicated specifically to providing customer service via Twitter (e.g. TransLink, @TransLink, in the Greater Vancouver, BC area).

Other findings from the survey indicate, as expected, that Twitter and Facebook are the most commonly used social media platforms by transportation agencies. YouTube was also found to be fairly popular, with over two-thirds of responding agencies using it in addition to other platforms. Some other platforms have been used sporadically by agencies depending on their specific needs and audiences.

Table 28: Social Media Platform Use by Agencies

Platform	Users	Percentage
Facebook	52	24%
Twitter	53	24%
YouTube	44	20%
Blog	20	9%
LinkedIn	15	7%
Pinterest	9	4%
Google Plus+	1	0%
None	0	0%
Other	25	11%

In addition to these platforms in active use, there are other platforms being considered by agencies. Of these, Vine was the most popular. Vine enables users to create 6-second videos and easily share them via other media. The Texas Department of Transportation has indicated success using this medium to share the message of not drinking and driving to teenagers. This is a case of an agency seeking to use the right tool toward the right audience. Photo platforms (e.g. Flickr, Instagram, and Pinterest) are also under consideration because they enable easy sharing of visual information. A popular application of these media is on "Throwback Thursday" (also known as #tbt) when agencies may wish to share historical information and photographs. Even though blogs are among the oldest types of social media, they were routinely listed as platforms under consideration, namely for their ease of storytelling coupled with the inclusion of multimedia.

Conversely, there are numerous platforms that have fallen out of favor with different agencies for different reasons. Pinterest and FourSquare were the two platforms most commonly listed. Rationale for eliminating these media from their overall strategy was related to insufficient information to support an active presence and a lack of interest by the general public. But the removal of a social media platform from a social media strategy is not always because it was a failure but because it has outlived its purpose. For example, one agency indicated that it had very successfully used a blog during a major construction project but now that the project has concluded the blog had no reason to continue to exist as an abandoned shell. This demonstrates how flexible these media are.

Many agencies participated in the survey, most of which listed the agency they represented (those unable to do so were merely asked to indicate their state of location). Agencies that participated in the survey that listed their affiliation. Agencies representing all levels of jurisdictions (state agencies, metropolitan planning organizations, city departments of transportation, public transportation agencies, and etc.) participated and from all corners of the United States.

Statistical models were developed to consider what variables are related to agency perception of its own success and the number of hours dedicated to social media each week. Agency Success with Social Media was collected on the survey as a categorical variable, however no respondents indicated

they were unsuccessful and only three indicated they were neither successful nor unsuccessful. Because of this, a standard logit model was selected as the best functional form, though interpretation is challenging because the results are comparing two levels of success. With the "Time Spent on Social Media" variable, the responses varied through all five choices and it is felt that the more time dedicated to the outreach the more success it is so an ordered logit approach is indicated.

- "Agency Success with Social Media" is a categorical variable, ranging from 0 to 2

    - 0 = neither successful nor unsuccessful (these observations are omitted from the analysis due to their small number)

    - 1 = successful

    - 2 = very successful

- "Time Spent on Social Media Each Week" is a categorical variable, ranging from 1 to 5. Categories one through four are 10 hour intervals, and category five is for spending more than hours per week on social media efforts.

Numerous independent variables were considered. "Info Type" variables relate to what media is preferred for that type of information: 0 = traditional media, 1 = both equally, 2 = social media. "Shares" variables indicate that the agency shares this type of information routinely on their social media. "Year Agency Began Using Social Media" is categorical and based on the year social media outreach began: 1 = 1-2 years, 2 = 3-4 years, 3 = 5-6 years, 4 = 7-8 years, 5 = 9-10 years, and 6 = More than 10 years. The following table summarizes each of these dependent and independent variables.

Table 29: Quantitative Variables for Analysis from the Agency Social Media Survey

Variable	Yes Responses	Mean	Standard Deviation	Min	Max
Info Type: Routine		1.073	0.567	0	2
Info Type: Emergency		1.463	0.600	0	2
Info Type: Marketing		1.091	0.611	0	2
Info Type: Entertainment		1.939	0.240	1	2
Info Type: Engagement		1.849	0.451	0	2
Info Type: Multimedia		1.755	0.430	1	2
Formal Social Media Strategy	28	0.519	0.500	0	1
System to Collect Social Media Posts	37	0.712	0.453	0	1
Agency Responds to Questions on Social Media	53	0.964	0.187	0	1
Agency Monitors Social Media	42	0.792	0.406	0	1
Shares: Beginning of Event	50	0.980	0.139	0	1
Shares: Updates on Events	45	0.882	0.322	0	1
Shares: End of Event	45	0.882	0.322	0	1
Social Media Impacts Traditional Media	41	0.759	0.428	0	1
Agency Success with Social Media		1.400	0.591	0	2
Year Agency Began Using Social Media		3.827	1.614	1	6
Time Spent on Social Media Each Week		2.593	1.408	1	5

Agency Survey Models: Perceived Success with Social Media Outreach

The other models considered looked at the perceived success by the agency of their social media outreach. Because no agencies felt their performance was either unsuccessful or very unsuccessful and only 3 of the respondents indicated it was neither successful nor unsuccessful, it was adjusted to be used as a binary dependent variable between those who felt their outreach is "successful" and "very successful." Based on the overall data collected, most of the iterations of these models yielded 48 observations. However, none of the models are particularly satisfying. It is felt this is because the dependent variable is merely differentiating between two levels of excellence, rather than a distribution of results.

What is most logical in theory often performs poorly in practice and many of the models that performed well statistically had coefficients with unexpected signs or other hints that there may be omitted variables and that a larger sample or more objective measure of agency success with social media may be necessary for a more accurate study. Others, especially the four-variable model, have such a high pseudo R^2 value it suggests problems with serial correlation.

The factors that indicate the success of an agency may be more complicated than what can be measured in a 10-minute survey and more dynamic than may be described in comparable, quantitative terms. With these cautions in mind, the base conditions followed by the results of the best two, three, and etc. variable models in terms of fitness are presented. The following table summarizes the base conditions.

Table 30: Base Conditions for Logit Agency Survey Agency Success with Social Media Models

Variable	Odds Ratio	Coefficient	Standard Error	z	P-value
Constant	0.926	-0.077	-0.278	-0.280	0.782
Pseudo R²:	0.000	N:	52		
Log-Likelihood:	-36.005				

Now, this table summarizes the results of the best two-variable specification.

Table 31: Results of Two-Variable Logit Agency Survey Agency Success with Social Media Model

Variable	Odds Ratio	Coefficient	Standard Error	z	P-value
Year Agency Began Using Social Media	0.673	-0.396	0.219	-1.810	0.071
Time Spent on Social Media Each Week	1.979	0.683	0.272	2.510	0.012
Constant	0.699	-0.358	1.244	-0.290	0.774
Pseudo R^2:	0.236	**N:**	48		
Log-Likelihood:	-25.414				

It is unexpected for the year the agency began using social media to be negative or to have a negative odds ratio. A smaller value for this variable indicates a more recent foray into social media use by the agency. Values closer to six or seven (2008 and prior to 2008) indicate the longest use of social media. It is possible that with so much experience the initial enthusiasm of trying something new wears off, but it is also expected that with so much experience an agency begins to feel as if they are truly getting a handle on what is required to be successful. Given that this model differentiates the successful from the very successful, "successful" could just be the natural state of affairs once an agency truly establishes their social media presence. Time spent on social media each week is a variable in 10 hour increments and is absolutely expected to be positive and very significant in terms of predicting how successful an agency perceives their social media efforts. This specification has a pseudo R^2 of 0.2361, of which much is driven by the time spent on social media variable.

The next specification is an iteration of the two-variable model adding in the binary variable indicating whether or not the agency has a specific system for developing content and making posts to social media accounts and there are modest improvements. The results are summarized in the following table.

Variable	Odds Ratio	Coefficient	Standard Error	z	P-value
System for Collecting Social Media Posts	0.232	-1.463	0.941	-1.560	0.120
Year Agency Began Using Social Media	0.577	-0.550	0.266	-2.070	0.039
Time Spent on Social Media Each Week	2.112	0.748	0.289	2.590	0.010
Constant	2.927	1.074	1.564	0.690	0.492
Pseudo R^2:	0.253	**N:**	46		
Log-Likelihood:	-23.778				

There is a modest improvement to the explanation of the variance of the dependent variable in the three-variable versus the two-variable model, the pseudo R^2 for the three-variable specification is 0.2532. Though this model has another unexpected coefficient, it is expected that a system for collecting social media posts would be a hallmark of agencies considering themselves very successful, yet we see that "very successful" agencies are only about 77-percent as likely to have a system for collecting social media posts as those who only indicate they are successful, holding constant for their time spent on social media each week and how long they have been using social media.

The best fitting model is found with four variables, it has the same theoretical challenges as the prior two specifications. As it is difficult to effectively model between gradients of excellence, neither outcome is a bad one, it does stress the need for an objective social media evaluation tool to help guide agencies through a self-evaluation process rather than assigning themselves a value based on how they feel. It seems unlikely that every single agency, except for the three who are doing a neutral job, are doing excellent. With this idea in mind, the following table summarizes the results of the final, four-variable specification.

Agency Success	Odds Ratio	Coefficient	Standard Error	z	P-value
System for Collecting Social Media Posts	0.049	-3.021	1.362	-2.220	0.027
Agency Monitors Social Media	0.294	-1.226	1.067	-1.150	0.251
Year Agency Began Using Social Media	0.418	-0.873	0.370	-2.360	0.018
Time Spent on Social Media Each Week	3.725	1.315	0.432	3.040	0.002
Constant	13.293	2.587	1.955	1.320	0.186
Pseudo R^2:	0.413	**N:**	44		
Log-Likelihood:	-17.870				

The model showed the greatest improvement in the pseudo R^2 value, for this model the value is 0.4132. It is expected for the pseudo R^2 to grow at least a small amount by simply adding more variables to the model, but this change was unexpected given the only change from the prior, three-variable specification is the addition of the "Agency Monitors Social Media" variable, which is not significant. However, with four variables, this was the only model that had any changes that were improvements in any way (theoretical, model fitness, or variable fitness). What is absolutely clear is that time spent dedicated to social media does separate the very successful from the successful.

General Public Social Media Survey

<u>Public Survey Data Description</u>

The total number of individuals who completed the General Public Social Media Survey is 409, of whom 386 are active users of social media. The results of the general public survey are described in

this section. First the descriptive statistics are discussed, followed by a summary of each of the variables considered in the statistical models, the results of the models, and finally a summary of the qualitative content.

Of the 386 respondents who use social media, 212 of them, or 52-percent, use social media in some capacity to obtain traffic or transit information.
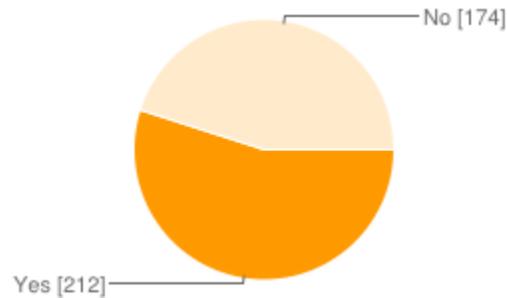
Figure 11: Respondents indicating whether they do or do not use social media for travel information

Following up on the prior question, the next asked which media was preferred for obtaining travel information. Noticeably fewer respondents prefer to get travel information via social media rather than traditional media, only 43-percent (three respondents did not respond to the question). This is a somewhat unexpected dichotomy. It was anticipated that, because use of any type of media is voluntary, those choosing to use social media would prefer it over traditional platforms.
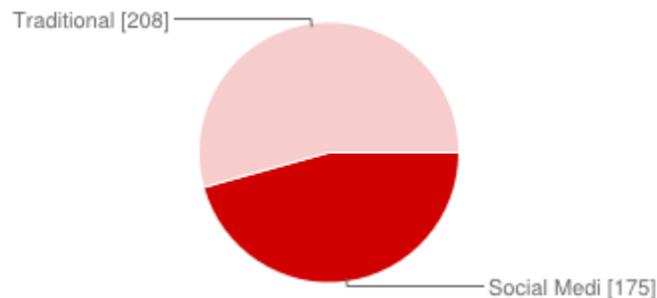
Figure 12: Respondents indicating whether they prefer to obtain travel information via social or traditional media

The following questions sought to glean some understanding in how agencies use or can use social media and how the general public perceive those features and functions. First we asked if individuals expect agencies to respond to their questions using social media platforms. Only 28-percent of respondents definitively felt that they had the expectation of a response. Yet, the ability of two-way

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communication is one of the defining characteristics of social media. Furthermore, 21-percent of respondents did not know. The remaining respondents did not expect a response to questions via social media, suggesting that perhaps the two-way communication aspect is not the most fundamental component to end users when it comes to delivering transportation information via social media.
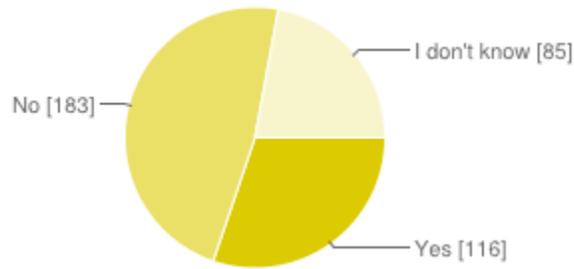
Figure 13: Respondents indicating whether they expect responses to questions from agencies via social media platforms

Next, also related to the two-way communication aspect of social media, it was asked if transportation agencies could learn of incidents sooner if they monitored social media. The overwhelming majority of respondents, 73-percent, agreed that agencies could be better informed of incidents if they monitored social media. Though, as with the previous question, a reasonable number of respondents indicated that they did not know, this may mean that the respondents did not know this was possible with social media or how this may benefit them. The results are summarized in the following chart.
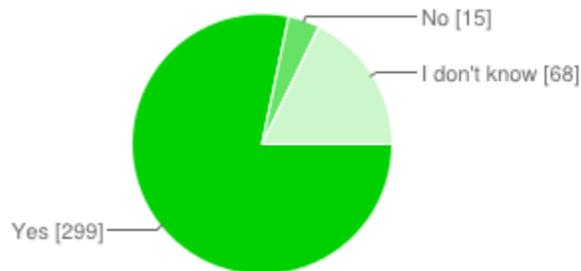
Figure 14: Respondents indicating if they feel agencies could know about incidents sooner if they monitored social media

Only 51-percent of respondents indicated the traffic or service information posted on social media by transportation agencies is useful. Because many individuals who use social media do not necessarily use it for transportation information there was a large number of "I don't know" responses, 37-percent.

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Though because the combined number of yes and no responses exceed the total number of yes responses to the question of whether or not the responded uses social media for transportation information, this suggests that some individuals have used social media for this purpose but no longer do. This is interesting because if the time, money, and energy is going to be dedicated to a social media outreach, agencies do not want to be alienating possible audience members. The following chart summarizes the responses to the question asking if the traffic or service information posted on social media by transportation agencies is useful.
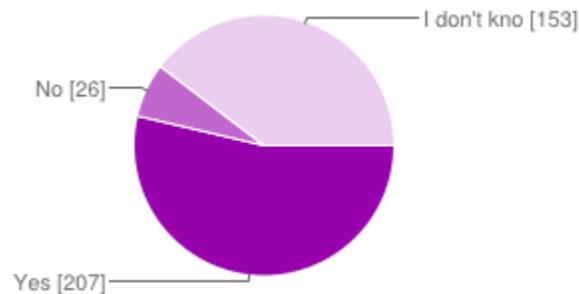

Figure 15: Responses to whether or not the information posted on social media by transportation agencies is useful

Understanding precisely why individuals answer this question the way they do is critical in understanding how information shared on social media is and is not useful, so each respondent was asked to elaborate on their choice. Answers were classified into two categories: useful and not useful. Many responses agreed with each other or overlapped. The following describes the responses given by the survey respondents divided by their categories.

The most common reason respondents gave for agency information posted to social media being useful is that it is timely, accurate and authoritative, and enables users to route around crashes or heavy traffic events. One respondent summarized it very effectively, "better commute plans can be made with better information." Some respondents indicated that very specific issues are often covered at greater depth via social media than on traditional media and that they like how they can access information as they need it on social media, rather than on the schedule the radio or television stations dictate.

Individuals self-identifying as being from rural areas underlined many of these points as exceptionally helpful.

Other ways in which sharing information via social media is useful is that users on some platforms can set up alerts. In some proprietary applications and on Twitter, alerts can be set to send tweets as texts if certain individuals post or certain content is posted. Some respondents indicated that this is very helpful in making travel decisions. Even without setting up alerts, the size and scope of areas covered by social media accounts can be highly customized so the user can often very specifically pick and choose the area(s) they are receiving updates about, as one responded said, social media enables their information to be "localized to my liking."

Some felt that information is posted to social media faster than it is shared via other media outlets. This is possible, especially if it is an event that occurs between peak periods in an area (e.g. a smaller city) that has very limited traffic coverage outside of peak periods. Likewise, it is also able to be updated frequently and in some, very proactive circumstances, agencies can even respond to questions from users about the incident via social media, making it another platform for offering customer service. Some respondents also indicated that it is easier to access information via social media than battling with a complex telephone 511 system.

From a social perspective, respondents indicated that materials posted by official sources, such as agencies, is also commonly shared, reposted, and retweeted among their social network so even if they do not necessarily follow an agency, they often stumble upon the most critical of messages because they will eventually appear in their feeds via their friends who found the information to be useful or important. This indicates another point several respondents brought up: by using social media, agencies are accessing an enormous number of people in a whole new way, bringing them information that can help them with their day-to-day travel needs but also, as one respondent says, "interesting information whether it affects my trip or not." This information also has the ability to reach individuals who do not engage with traditional media, of which there is a noticeable sum.

A respondent who is currently living outside of the United States and Canada and who does not speak the language of the country they are living in had one very unique comment to the usefulness of social media: social media content can easily be translated using a bevy of online tools, yet most traditional media cannot be so easily translated to another language. So social media is better enabling this person to understand and interact with their community.

Survey respondents found social media useful for transportation information for many reasons. The most meaningful for transportation engineering being the ability to avoid and reroute around crashes and congestion that, with enough knowledge and usage of, could have a measurable effect on congestion. However, there were also some criticisms of the current usage of social media to share travel information.

The most common critique of social media for use in sharing travel information is that the usefulness is highly dependent on the agency that is sharing the information. Effectively, some agencies are so terrible at using social media at the moment that it is not a useful tool at all. Almost as common as this critique is that many individuals who use social media had no idea they could get this type of information on social media, this survey is what alerted them to the concept. These individuals would have been interested had they known sooner.

Some of the reasons that social media is not useful as a transportation information sharing platform, however, have nothing to do with the agencies. Some respondents were quick to indicate that they do not necessarily frequent social media sites because few of their friends and colleagues use the sites or that checking these sources for travel information is simply not part of their routine.

For agencies that have not yet mastered the art of effective use of social media, the following issues were brought up by respondents to this survey. Information is often posted too late or after the event is over with. Emergency information is often overlooked, even if information about predicted delays and general construction information is presented well. Sometimes only incomplete information is posted to social media so while a general notice is present, it is not enough to make a decision to change travel plans. Some respondents also felt that incidents and delays were often "sugar coated" or downplayed which leads to questioning to accuracy of the information. While human interest content can

be interesting and make the agency seem more relatable, certain platforms lend better to this type of content than others. One respondent specifically suggested that Facebook be used for routine information and human interest content and then Twitter be used for urgent and time-sensitive information. Sites can be difficult to find or may not clearly appear to be official and authoritative, some respondents fear that information could be hacked or spoofed.

A very important point is that information posted to social media is not intended to be accessed while driving, though respondents to the general public survey seemed concerned with the temptation presented by the presence of such information through social media. Agencies make the point that this information is present for access prior to driving, after driving, during breaks, and to passengers while on the road. However this is not a problem for public transit users. On a final note from the "not useful" category, one respondent had this comment, "Social Media is for ENTERAINMENT, not business."

The next question asked if whether or not the use of social media by transportation agencies changes how the respondent uses traditional media to obtain transportation information. 43-percent of respondents were definitively able to say no. The remaining respondents either said yes or did not know. The following chart describes the results.
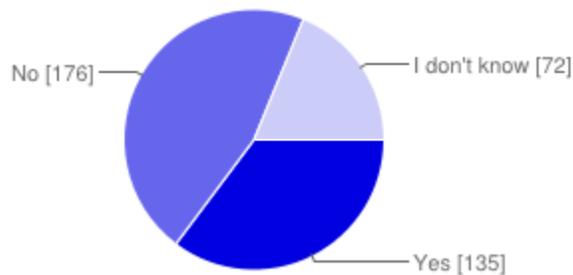
Figure 16: Respondents indicating whether or not agency use of social media changes their use of traditional media for transportation information

So far, the results indicate that the respondents view social media as an emerging legitimate means of disseminating transportation information. The next question asks respondents to rate the success of transportation agencies in terms of their social media use. Almost half of respondents are neutral on the subject, this more or less corresponds to the number of respondents previously unaware that they could

obtain travel information via social media (which is a different indicator of the success of transportation agencies using social media). But the next largest category is "Successful," which accounts for over one quarter of responses. These responses are in stark contrast to the agency survey where all of the responses were neutral or better. The following chart summarizes the responses.
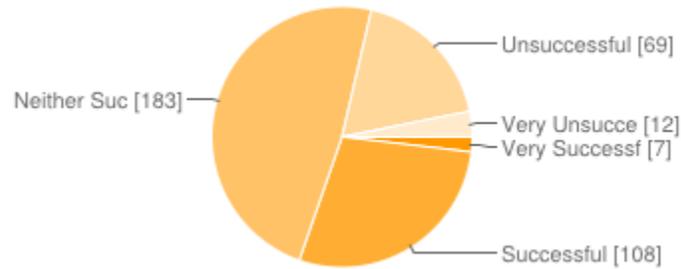
Figure 17: Respondents indicating their perceived success of transportation agency use of social media

After ranking the level of success of the agency, the respondent was asked to elaborate on why they think agencies are successful or unsuccessful at using social media. Answers were categorized into successful, not successful, and neutral categories. Each will be discussed in detail to follow.

Social media was considered most successful in reaching younger audiences, typically under 35-years-old, and those who use smartphones (those phones with complete internet access, e.g. iPhones, etc.). Likewise, social media was felt to be important as a tool by respondents because some people are moving entirely away from utilizing traditional media to obtaining information exclusively though social media. For these individuals use of social media does increase the reach of critical travel information. One respondent also pointed out that information posted to social media outlets could better instruct them on using traditional media to obtain critical information.

Agency use of social media was also commended because of its consistency, authoritativeness, the desire of the public to see more of it, and especially when agencies diligently keep it up to date. Respondents believe social media can get information out faster so it should reliably have these characteristics. To summarize these sentiments in the words of one respondent: "As long as the agencies get their information out to the public as quickly as possible, that's all that matters!"

Others were very focused on the ability to use social media as a customer service platform. Respondents seemed to feel that protracted discussions publicly via social media were unprofessional, but using social media to apologize for a problem and directing a customer to contact them via phone or email seemed genuine and represented good customer service.

Another very common theme throughout the write-in questions is that the quality of content is highly dependent on the agency itself, for a variety of reasons. With that in mind, one of the strengths of social media identified by several respondents was that users can also contribute information. How user contributed information is presented varies, but it is usually possible to locate.

Respondents were also able to testify to the successes of social media to disseminate transportation information. The most common anecdote is of the ability to route around crashes or congestion. However, one respondent described watching a large group of individuals waiting at a bus stop in State College, PA all on their smartphones engaging with the CATA (Centre Area Transit Authority) application, likely referring to the real-time maps that could show them where their desired bus actually was with very little lag. One respondent indicated that they did not know agencies used social media prior to completing the survey, but is now going to actively find out how it could help them plan their travels.

For better or worse, respondents seemed to largely agree that social media for dissemination of transportation information was the "wave of the future." Though respondents did have a substantial number of a critiques for the current way in which social media is being used to disseminate transportation information.

In terms of negative critique, by far the most common comments are that social media efforts are not sufficiently widespread and ubiquitous, nor are they sufficiently advertised. One respondent summarized the situation: "If they were successful, I would be aware of their use of social media." A substantial number of respondents indicated they would be interested in utilizing social media to obtain travel information but that they had no idea where to find this information, who was disseminating this information, or what types of information they should expect to find. In some cases, individuals stated

that they did not know the names of the agencies responsible for the roads in their areas. This suggests agencies may assume a certain level of knowledge or exposure among the public that is not actually present.

The next most common issue respondents brought up is that the information posted to social media is often not kept up to date. Or sometimes some incidents are covered well but others exist without even a whisper. One respondent indicated that they and their coworkers are involved with social media for a living so they are particularly keyed into social media efforts by transportation agencies, yet they are still often surprised by crashes and congestion on the way to and from work. Some respondents described the situation as "hit-or-miss" and "authoritative but they are not reliable."

For some respondents, it is clear that agencies are attempting to try too much with too little support. Several respondents indicated that they have a difficult time figuring out which platforms to use to find information because there are so many and, in many situations, the information posted to each is not complete. So in order to get the complete story, it can require looking in multiple places, which defeats the purpose of the convenience of social media. To this end, some respondents went so far as to suggest that some agencies are not particularly good with traditional media so it would not be expected they would be particularly good with social media either.

Staff issues are also points of criticism of respondents. The age demographic of staff not being oriented toward social media was the most common comment in this vein. The most interesting comment related to staffing, however, was that too few agencies were actively engaging with social media to be able to help each other succeed. Other staffing-related challenges include not having enough staff to respond to user questions and problems, keep content up to date, and even keep the basic framework of the accounts up to date. It is also difficult to know if by not responding to a question or problem they are too short staffed to respond or that they do not know how to respond, though neither is particularly good for public relations.

This leads to the problem that respondents have seemingly found nearly ubiquitous: agencies enthusiastically jump on the social media bandwagon and then fail to keep their presence current. In some

cases maybe lasting as long as a particular intern is present. Many respondents feel that "many [agencies] have not made the investment." This may be due to "archaic policies and stereotypes," but it is viewed as hindering use of the technology, one respondent described agency communications as being "stuck in the 1960's." There is a very real sentiment that government agencies are not only hesitant, but hostile, to change. Some respondents were very clear in suggesting agencies more formally describe to their management the time and money involved in the management of effective social media but pair it with reasonable return on investment (ROI) figures, that this would be an objective means of measuring if social media, or if specific platforms, are currently worthwhile. Another respondent indicated that agencies may feel social media merely adds to user convenience while doing nothing to bring in additional revenue, not thinking long term: that greater user convenience can bring in more users and eventual revenues.

There was also a theme that non-agency sources and applications were doing a better job. Several respondents mentioned the Mifflin County Alerts page on Facebook, which, according to the feedback, was just started by two residents from that county, including one former police officer, who wanted better, more current and accurate information available. Others mentioned applications such as Waze, Inrix Traffic, and Google Maps, each of which offer nothing but real-time traffic information. These applications are very centered on one specific function and the staff demographics likely differ reasonably from a transportation agency. One respondent went so far as to explain: "With services like Waze, they don't have to be successful. The private market will meet demand from users like me."

Criticisms of the types of content do crop up, but are substantially less common than those listed previously. The main issue with content is that the information tends to be general interest, or based on events and projects in a way that is not very time sensitive. Alternatively, agencies will post material to platforms it is not well suited for. For example, one respondent described how Facebook is a better platform for general interest and non-time sensitive information but that on Twitter they only want to see urgent mk3essages, but that is how the developers of those platforms designed it. Twitter is designed for short messages (less than 140 characters) with the occasional link or photograph attached. Facebook is

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designed for longer posts and specifically intended for all sorts of multimedia attachments. This type of media mismatch underlines the issues brought up earlier about staff ill-equipped to manage a social media program or with insufficient guidance as to what sort of information is best on which platform. Similarly, these issues bring about a lack of consistency that can turn users away from using social media for travel information.

Most respondents were also very quick to point out that so much is dependent on the agency presenting the information, that there is so little consistency between agency social media presences that not everyone is doing it incorrectly. For others, traditional media is enough. Then others take a much more balanced approach: "matter of personal preference-can't please everyone with one type, still learning."

Overall, there is a sense that some guidelines for practices could be extremely helpful in helping agencies master more effective use of social media, similar to how the Highway Safety Manual offers robust guidelines pertaining to road safety. Such guidelines should address the different types of information that should be disseminated, the types of platforms best suited for those information types (in general terms because platforms could change over time), general time and staffing guidelines, best practices for providing effective customer service via social media, performance measures, and advice on how to close out a social media account if or when it is deemed to no longer be beneficial to the agency. The timing is still good for this as the technology is still relatively young, as several respondents pointed out.

The remaining survey questions sought to understand more about the respondents on the individual level. Questions are organized into two categories: personal social media use and general demographic questions. First the personal social media use questions are summarized, then the general demographic questions are summarized.

It was expected that the length of time the user has been using social media would be one of the most important indicators of virtually all of the other questions. For example, a more experienced social

media user may be more able to look up travel information on social media if that is a type of information that they are interested in finding. The following table summarizes the results of this question.

Table 34: Length of Time Respondents Have Used Social Media

Duration	Number	Percent
Less than a year	6	1%
1-2 years	14	3%
2-3 years	36	9%
4-5 years	76	19%
5-6 years	61	15%
7-8 years	74	18%
9-10 years	51	12%
More than 10 years	61	15%

It is also important to understand which platforms respondents use on a regular basis. Even though Twitter and Facebook are the most common platforms used for transportation information at the moment, it is important to understand where the people are. Facebook is by far the most popular platform, 89-percent of respondents (362 votes) use Facebook at least once each week. YouTube (65-percent, 264 votes) was the second most popular, followed by Twitter (43-percent. 177 votes). The results are summarized in the following chart.
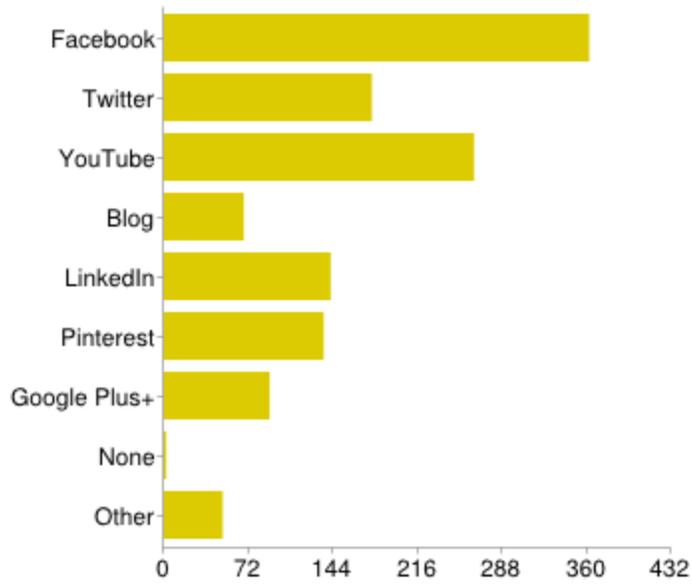
Figure 18: Social Media Types Regularly Used by Respondents

The following question asks if the respondent has ever considered using any other social media sites. If so, which ones. Because there are and have been so many social media platforms, this was a write-in question. Many individuals did not answer or answered that they had not considered any platforms that they did not actively use. The following table summarizes the results of the platforms that were named by respondents.

Table 35: Social media platforms respondents have considered trying in addition those currently used

Votes (per platform)	Platform
11	LinkedIn, Pinterest, Twitter
8	Google+
7	Blog
6	Instagram
4	Tumblr
3	Ello, Facebook, Vine
2	Reddit, Snapchat, Yammer, YouTube
1	Inrix Traffic, Path, Tag, Vimeo, Waze

Some social media sites have already experienced their peak moments of popularity. For example, MySpace and LiveJournal were extremely popular prior to the existence of Facebook and Twitter but have waned in use by the general public in the time since (Curtis, 2013). Given that the presence of trends is very real in social media it was also asked if respondents had used any social media sites in the past that they no longer use anymore. Not every respondent answered this question or listed any sites/platforms when they answered this question, but the following table summarizes the sites/platforms named in the responses to this write-in question.

Table 36: Social media platforms respondents have previously used but have stopped using

Votes (per platform)	Platform
20	MySpace
15	Google+
11	Twitter
7	Facebook
6	Blogs, LinkedIn
5	Pinterest
4	Instagram, LiveJournal, Tumblr
3	Orkut
2	AOL Instant Messanger, Xanga
1	Classmates.com, Diaspora, Find My Friends, FourSquare, Friendster, Fring, Google Latitude, Group Me, MapQuest, Napster, Playlist.com, StumbleUpon, WeRead, Yelp, YouTube

There were numerous responses that indicated that the individual does not follow any transportation agencies, but it was felt by knowing who was being followed it might indicate who is providing useful information and excelling with social media use, in addition to giving an indication of the population responding to the survey. The follow agencies were listed by name:

- Amtran (Altoona, PA)

- Bay Area Rapid Transit

- Caltrain

- Centre Area Transit Authority (State College, PA area)

- Charm City Circulator (Baltimore, MD)

- Chicago Department of Transportation

- Chicago Transit Authority

- Delaware Department of Transportation

- District of Columbia Department of Transportation

- Indiana Department of Transportation

- Kentucky Transportation Cabinet

- Kentucky Transportation Cabinet: District 6

- Kentucky Transportation Cabinet: District 10

- Long Island Railroad

- Maryland State Highway Administration

- Maryland Transit Authority

- Massachusetts Department of Transportation

- Metropolitan Atlanta Rapid Transit Authority

- Metropolitan Transportation Authority (New York)

- Mid Mon Valley Transit Authority (Monongahela, PA area)

- Minnesota Department of Transportation

- New Jersey Department of Transportation

- New York City Department of Transportation

- New York State Department of Transportation

- North Carolina Department of Transportation

- North Carolina Department of Transportation: District 12

- Ohio Department of Transportation

- OKI Regional Council of Governments (Cincinnati Area)

- Pennsylvania Department of Transportation

- Pennsylvania Department of Transportation: District 2

- Pennsylvania Turnpike Authority

- Port Authority of Allegheny County (Pittsburgh, PA area)

- San Francisco Municipal Transportation Agency

- Stockholm Transit

- Translink (Vancouver, BC area)

- Virginia Department of Transportation

- Washington Metro Area Transit Authority

- West Virginia Department of Transportation

After obtaining information on how the respondents used social media, the remaining questions sought to understand more about them as individuals. The next question asked them to rate their comfort with technology on a scale of one to five, with one being not comfortable at all and five being very comfortable. Nearly three-quarters of respondents (74-percent) indicated they were very comfortable. Meanwhile, only five-percent indicated they were any level of uncomfortable or neutral with technology.

Because social media is so commonly accessed via mobile devices, the next question asked what type of mobile or cellular phone the respondent uses on a regular basis. Respondents were given four choices: no phone, a traditional phone (calling and texting only), a feature phone (calling and texting, plus

some features that use the cellular data network), and a smartphone (internet access enabled). Most

respondents have a smartphone (84-percent). Common examples of smartphones include iPhones, the

Samsung Galaxy series phones (which use the Android platform), Blackberries, and the Windows Phone.

It is worth noting that one-percent of respondents indicated that they do not have a cellular phone at all.

To this point, the survey has suggested social media is very common in people's lives, however

only about half of social media users are obtaining travel information this way, indicating demand and use

of traditional media is present. The following question sought to understand the types of traditional media

respondents consumed. Respondents could choose as many media types as they use on a weekly basis

from the following: newspapers, local television news, national television news, local radio, satellite

radio, and other. Respondents could also indicate that they consumed no traditional media each week. The

following chart indicates that traditional media has a strong foothold with individuals, with each form of

media, except for satellite radio and other, reaching over half of survey respondents on a weekly basis.
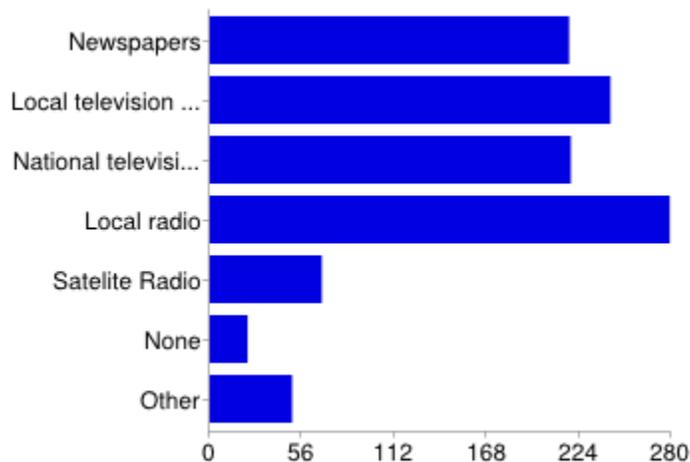
Figure 19: Types of traditional media consumed by respondents on, at least, a weekly basis

In order to understand if there are any geographical trends, it was asked where individuals lived

on a state or provincial level, there was also an option for individuals not wishing to identify or indicate

they did not live in the United States or Canada. Because of the smaller number of respondents in each

state (except for Pennsylvania, where 83-percent of respondents indicated as their home state), states and

provinces were grouped together into regions. Regions were defined as:

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The following table indicates the number of respondents from each region. Adjoining Canadian

provinces are included with the West, Midwest, and Northeast categories as they are culturally similar.

Table 37: Geographical Distribution of Respondents

Region	Number of Respondents	Percentage of Respondents
Midwest (plus Manitoba)	12	2.9
Northeast	350	85.5
South	42	10.2
West (plus British Columbia)	7	1.7
Outside US and Canada	2	0.4

It is also expected that the demand for travel information will be affected by the amount of travel

in a given period. With that in mind, respondents were asked how many miles they travel or drive in a

given month. The question was phrased this way because even if they personally are not driving, they

may wish to engage in what is going on around them. The most popular category was 100 to 499 miles

with 38-percent of respondents, the remaining three numerical categories ranged between 20- and 22-percent of respondents indicating they travel those amounts. The following chart summarizes the results.
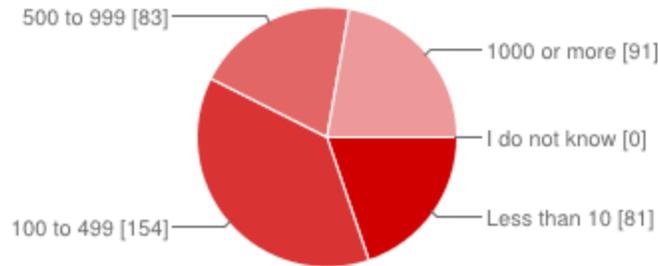
Figure 21: Miles traveled or driven each month indicated by the respondent

Respondents' age is requested, the largest category is 25- 34-years-old, representing 31-percent of the sample. Meanwhile, 65 or older is only 1-percent of the sample. The remaining categories range in size from 13- to 21-percent of the sample. The results are summarized in the following table and the categories are in years of age with one category for individuals who prefer not to indicate their age.
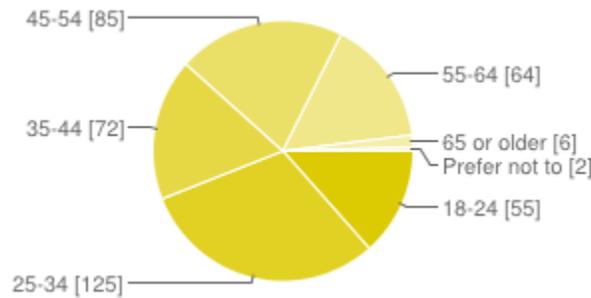
Figure 22: Age categories for public survey respondents

Respondents' gender was requested. 69-percent of respondents are female, 30-percent of respondents are male, and the remaining 1-percent identified as "other," indicating they preferred not to answer, or chose not to answer the question.

Respondents were asked to identify their ethnicity. The majority of respondents (89-percent) indicated they were White (non-Hispanic). The remaining 11 percent identified as: 5 percent Asian, 2 Hispanic or Latino, 1 percent African descent, 1 percent American Indian/Alaska Native/First Nations, less than 1 percent identified as other, indicated multiple ethnicities, or Pacific Islander/Native Hawaiian. Additionally, 3 percent of respondents chose not to answer the question.

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Finally, respondents are asked is to indicate their income by category. From $0 per year to $99,000 per year categories are divided into $10,000 increments. Then, categories are $100,000 to $149,999, $150,000 or more, I do not know, and I prefer not to answer. The largest category, 14-percent of the sample, was $30,000 to $39,000. The smallest numerical category, 2-percent of the sample, was the $150,000 or more range. The following table summarizes the results of this survey question.

Table 38: Summary of income categories from the public survey

Income Category	Percentage of Respondents
Less than $10,000	4
$10,000 to $19,999	5
$20,000 to $29,999	11
$30,000 to $39,999	14
$40,000 to $49,999	8
$50,000 to $59,999	10
$60,000 to $69,999	7
$70,000 to $79,999	4
$80,000 to $89,999	5
$90,000 to $99,999	3
$100,000 to $149,999	10
$150,000 or more	2
I do not know	1
Prefer not to answer	12

A lot of data were collected in the survey. Not all of this data are compatible with statistical modeling. Those data which are quantitative are summarized in the Table 39: Summary of Quantitative Variables in the General Public Survey, which is then followed by the results of the modeling.

There are two dependent variables of interest in the survey data: how successful the respondent believes agency social media outreach to be (Agency Success with Social Media) and does the use of social media by agencies change how you obtain travel information (Changes Use of Traditional Media). Each of the variables is described in detail in the Data Collection chapter of this document.

The variable for "Length of Time Using Social Media" refers to two-year intervals ranging from "Less than a year" to "More than 10 years." Both the "Comfort with Technology" and "Agency Success with Social Media" variables are scales of one to five, with one and two being gradients of negative feelings, three is a neutral choice, and four and five as gradients of positive feelings. The "Info Type" variables indicate the technology preference for sharing different types of information, 0 = traditional media, 1 = both equally, and 2 = social media. The remaining variables are binary variables and the number of positive (1 values) are indicated in the "yes responses" column.

Table 39: Summary of Quantitative Variables in the General Public Survey

Variable	Mean	Standard Deviation	Min	Max
Age (by category)	3.010	1.374	1	7
Agencies Learn of Events Sooner	1.139	0.445	0	2
Agency Success with Social Media	3.087	0.812	1	5
Comfort with Technology	4.660	0.685	1	5
Expect Agency Response	0.745	0.795	0	2
Gender (Female = 1)	0.707	0.526	0	2
Income	6.955	3.960	1	14
Info Type: Emergency	1.249	0.753	0	2

Info Type: Engagement	1.465	0.747	0	2
Info Type: Entertainment	1.514	0.680	0	2
Info Type: Marketing	1.102	0.749	0	2
Info Type: Multimedia	1.615	0.665	0	2
Info Type: Routine	0.894	0.707	0	2
Length of Time Using Social Media	5.383	1.789	1	8
Monthly Miles Traveled	2.450	1.043	1	4
Phone Type	3.703	0.712	1	4
Prefer Social Media for Road Info	0.914	0.996	0	2
Race (White, non-Hispanic = 5)	4.823	0.908	1	7
Respondent Uses Social Media	0.944	0.230	0	1
Respondent Uses Social Media for Travel Info	0.549	0.498	0	1
Social Media use Changes Use of Traditional Media for Travel Info	0.728	0.757	0	2
Traditional Media: Local Radio	0.677	0.468	0	1
Traditional Media: Local TV News	0.599	0.490	0	1
Traditional Media: National TV News	0.532	0.499	0	1
Traditional Media: Newspapers	0.539	0.498	0	1
Traditional Media: None	0.049	0.217	0	1
Traditional Media: Others	0.119	0.323	0	1
Traditional Media: Satellite Radio	0.173	0.378	0	1
Travel Info on Social Media is Useful	1.329	0.596	0	2

There are two dependent variables of interest: Agency Success with Social Media and Social Media use Changes Use of Traditional Media for Travel Info. The first set of models examines Agency Success with Social Media utilizing ordered logit models and the second set uses standard logit to look at social media use changing traditional media use. As with the prior data sets, multiple models were tested with different combinations of variables, seeking a combination of theoretical robustness but also enabling opportunity for the data to indicate relationships where perhaps the literature has not yet.

After reviewing the data collected by the survey administered to the general public, some adjustments were made prior to testing models. First, respondents who do not use social media were omitted, a total of 23 observations. Then "I don't know" and "prefer not to answer" responses for all questions were coded in a way as to omit them from analysis. Finally, the categorical variables were systematically converted into groups of binary variables so they could be tested both categorically and as binary variables. This is important because from a theoretical perspective, some of the binary variables are important independently (e.g. if the respondent uses a smartphone or not).

Public Survey Models: Perceived Agency Success with Social Media

Agency Success with Social Media is a categorical variable, respondents rated agency use of social media on a scale of one through five, with five being very successful. Almost half of respondents indicated their feelings were neutral, but ordered logit models enable slicing categorical variables into each of their pieces and understanding which values and combinations of values for dependent variables yield different outcomes in the dependent variable. With ordered categorical data, the ordered logit model was felt to be the most ideal model structure. Models are tested using the *omodel* add-on within Stata (Wolfe, 1997) to establish the parallel lines assumption and each is found to satisfy this assumption.

Though with ordered logit, the models become more meaningful and usable as more variables are added. Multiple models were tested, including those with each of the demographic variables collected, though at no point were any demographic variables significant. It is hypothesized that this is related to the sample that responded to the survey. Within the responses certain demographic trends appeared that are

not representative of the traveling public at large, particularly in terms of income, racial, and age trends. Future research should be careful to design research to better address these issue. First the base conditions are presented, followed by the results of the best two-variable specification.

Table 40: Base Conditions of Ordered Logit Public Survey Agency Success with Social Media Models

Variable	Coefficient	Standard Error	z	P-value
Cut 1	-3.510	0.306		
Cut 2	-1.318	0.126	**N:**	379
Cut 3	0.819	0.111	**Pseudo R²:**	<0.001
Cut 4	3.837	0.357	**Log-Likelihood:**	-456.154

Table 41: Results of the Two-Variable Ordered Logit Public Survey Agency Success with Social Media Model

Variable	Coefficient	Standard Error	z	P-value
Travel Info on Social Media is Useful	2.134	0.434	4.920	<0.001
Social Media use Changes Use of Traditional Media for Travel Info	0.654	0.275	2.380	0.017
Cut 1	-2.088	0.577		
Cut 2	0.682	0.404	**N:**	197
Cut 3	2.604	0.446	**Pseudo R²:**	0.071
Cut 4	5.737	0.588	**Log-Likelihood:**	-227.502

With this model we find that those who feel the travel information currently on social media is useful and those who state that social media changes how they use traditional media are more likely to feel that agencies are doing a neutral or moderately successful job with social media outreach. Those who answered no to either question are classified into the neutral category, but so are those who answered yes

to only one of the two dependent variables. This suggests the need for additional variables if binary variables are to be used in the analysis.

The next model adds in another binary variable, this one indicates if the respondent consumes no traditional media. This variable was selected because it was felt that those who do not use traditional media will have opinions about how social media is being used. The results of this model are summarized in the following table.

Table 42: Results of the Three-Variable Ordered Logit Public Survey Agency Success with Social Media Model

Variable	Coefficient	Standard Error	z	p-value
Travel Info on Social Media is Useful	2.131	0.437	4.870	<0.001
Social Media use Changes Use of Traditional Media for Travel Info	0.689	0.277	2.490	0.013
Traditional Media: None	-1.065	0.574	-1.860	0.064
Cut 1	-2.166	0.585		
Cut 2	0.621	0.409	N:	195
Cut 3	2.546	0.449	Pseudo R^2:	0.075
Cut 4	5.701	0.592	Log-Likelihood:	-224.119

Compared to the prior model, this is a modest improvement. The variable where the respondent indicates they do not use traditional media has a negative relationship with the respondent's perception of agency success with social media. This is not unexpected as these individuals are expected to use social media more to obtain news and information and therefore be much more specific about what they wish to get out of social media accounts because it is their sole means of obtaining information. So those that indicate they use no traditional media and they answer no to the other two dependent variables, they would be classified as being viewing agency success with social media as moderately unsuccessful. The relationship between the different levels of perceived success and the remaining dependent variables does

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not change. While this model offers more of an explanation than the prior model, there is still opportunity to further explain views on agency success of social media.

The next model adds a binary variable indicating whether or not the respondent uses a smartphone (e.g. an iPhone) with full internet access. This is key because these devices really enable constant use of many forms of social media so individuals with these devices may also have specific preferences and concepts of what they desire out of social media outreach and it may not necessarily be positive.

Table 43: Results of the Four-Variable Ordered Logit Public Survey Agency Success with Social Media Model

Variable	Coefficient	Standard Error	z	p-value
Travel Info on Social Media is Useful	2.063	0.441	4.680	<0.001
Social Media use Changes Use of Traditional Media for Travel Info	0.696	0.279	2.500	0.012
Traditional Media: None	-1.028	0.573	-1.800	0.073
Phone Type: Smartphone	-1.152	0.436	-2.650	0.008
Cut 1	-3.268	0.723		
Cut 2	-0.482	0.587	**N:**	195
Cut 3	1.487	0.605	**Pseudo R^2:**	0.090
Cut 4	4.744	0.683	**Log-Likelihood:**	-220.411

Adding the variable for whether or not the respondent has a smartphone improves the pseudo R^2 value by more than 1.5-percent. While nine-percent is still not ideal, for this type of study there are many unmeasurable, unobservable, and constantly changing variables at play in terms of personal preferences and feeling. Most combinations of responses from the survey will yield a result of "neutral" because that is where nearly half of all responses were in the survey. The results of this model suggest that those relying on social media (or attempting to do entirely without traditional media) and those who are

smartphone users may be ideal candidates for focus groups or surveys on the performance of specific agencies' social media success, as these groups appear to have feelings that trend negatively at statistically significant levels.

Public Survey Models: Agency Use of Social Media Changes Use of Traditional Media

The next set of models examined whether the use of social media by transportation agencies was changing how individuals are using traditional media to obtain travel information. As with the prior models, several models were tested, including models with the entire set of demographic variables, but none of those variables were found to be statistically significant so they were dropped from these final iterations. As was indicated in the literature, perhaps social media really is reaching individuals with less prejudice for demographics as other media have in the past. Because this variable is binary, standard logit is utilized to evaluate the variables. First, the base conditions are presented followed by the results of the best two-variable model. The results are summarized in the following tables.

Table 44: Base Conditions for Logit Public Survey Social Media Use Changes Use of Traditional Media for Travel Information Models

Variable	Odds Ratio	Coefficient	Standard Error	Z	P-value
Constant	0.767	-0.265	0.114	-2.320	0.020
Pseudo R^2:	0.000	**N:**	311		
Log-likelihood:	-212.858				

Table 45: Results of Two-Variable Logit Public Survey Social Media Use Changes Use of Traditional Media for Travel Information Model

Variable	Odds Ratio	Coefficient	Standard Error	Z	P-value
Agency Success with Social Media	1.461	0.379	0.161	2.350	0.019
Expect Agency Response	2.316	0.840	0.272	3.080	0.002
Constant	0.193	-1.645	0.516	-3.190	0.001
Pseudo R^2:	0.053	**N:**	245		
Log-likelihood:	-160.215				

With this model we find that the perception of agency success with social media and expectation of agency engagement with social media are meaningful predictors of whether or not an individual will change their traditional media use due to use of social media. Those who expect an agency to respond to questions via social media are 132-percent more likely to change how they use traditional media because of how social media is used by agencies, holding constant for their perception of agency success. Agency Success with Social Media was an ordered categorical variable, ranging from 1 to 5, with the addition of each increment, holding constant for expecting agency response, respondents are 46-percent more likely to change their traditional media use.

Given the small number of variables and the low pseudo R^2, it was desired to test more complex models. A three-variable model was tested where a binary variable, indicating whether or not the

respondent had a smartphone, was added to the model. The results of this model are summarized in the following table.

Table 46: Results of Three-Variable Public Survey Social Media Use Changes Use of Traditional Media for Travel Information Model

Variable	Odds Ratio	Coefficient	Standard Error	z	p-value
Agency Success with Social Media	1.531	0.426	0.165	2.590	0.010
Expect Agency Response	2.155	0.768	0.276	2.780	0.005
Phone Type: Smartphone	2.243	0.808	0.393	2.060	0.040
Constant	0.087	-2.446	0.659	-3.710	<0.001
Pseudo R^2:	0.067	**N:**	245		
Log-Likelihood:	-157.983				

With this model there is a noted modest improvement to pseudo R^2 and the coefficient for the smartphone variable is significant, while the interpretation of the other variables remains similar to the two-variable model, suggesting the robustness and independence of these two variables. The variable new to this specification strongly indicates that individuals with smartphones are more likely than those without smartphones to change their use of traditional media for travel information based on how agencies use social media. This is expected because smartphones enable convenience access to social media wherever wireless internet and/or cellular data services are available.

After evaluating the list of variables, there were others that had theoretical grounds for inclusion in further models. The results of this, four-variable model are summarized in the following table.

Variable	Odds Ratio	Coefficient	Standard Error	z	P-value
Agency Success with Social Media	1.506	0.410	0.167	2.460	0.014
Expect Agency Response	1.909	0.646	0.283	2.290	0.022
Phone Type: Smartphone	2.461	0.901	0.403	2.240	0.025
Traditional Media: Satellite Radio	2.313	0.839	0.362	2.320	0.020
Constant	0.076	-2.582	0.675	-3.830	<0.001
Pseudo R^2:	0.082	**N:**	245		
Log-Likelihood:	-154.154				

The added variable for satellite radio use was chosen because it was felt it would indicate those more technologically inclined and/or those who spend more time in their cars because many new cars come standard with satellite radio subscriptions for a certain period of time. Because it is a deliberate preference, it was also felt that these individuals may be more selective about their media consumption choices. The coefficients for the variable suggest that those who use satellite radio on a regular basis feel that agency use of social media could change how they use traditional media. The coefficients and effects of the other variables is very similar to previous iterations of the model indicating the robustness of those variables.

Comparative Analysis

In the surveys administered to both agencies and the public, several questions were designed to be directly compared to each other. The purpose of this is to understand how close or far apart the agencies and the public are for each other in how to use social media and in what role traditional media has to play.

In each survey the first questions asked about which media is best for disseminating six types of information. The following table summarizes the responses from both the agencies and the general public.
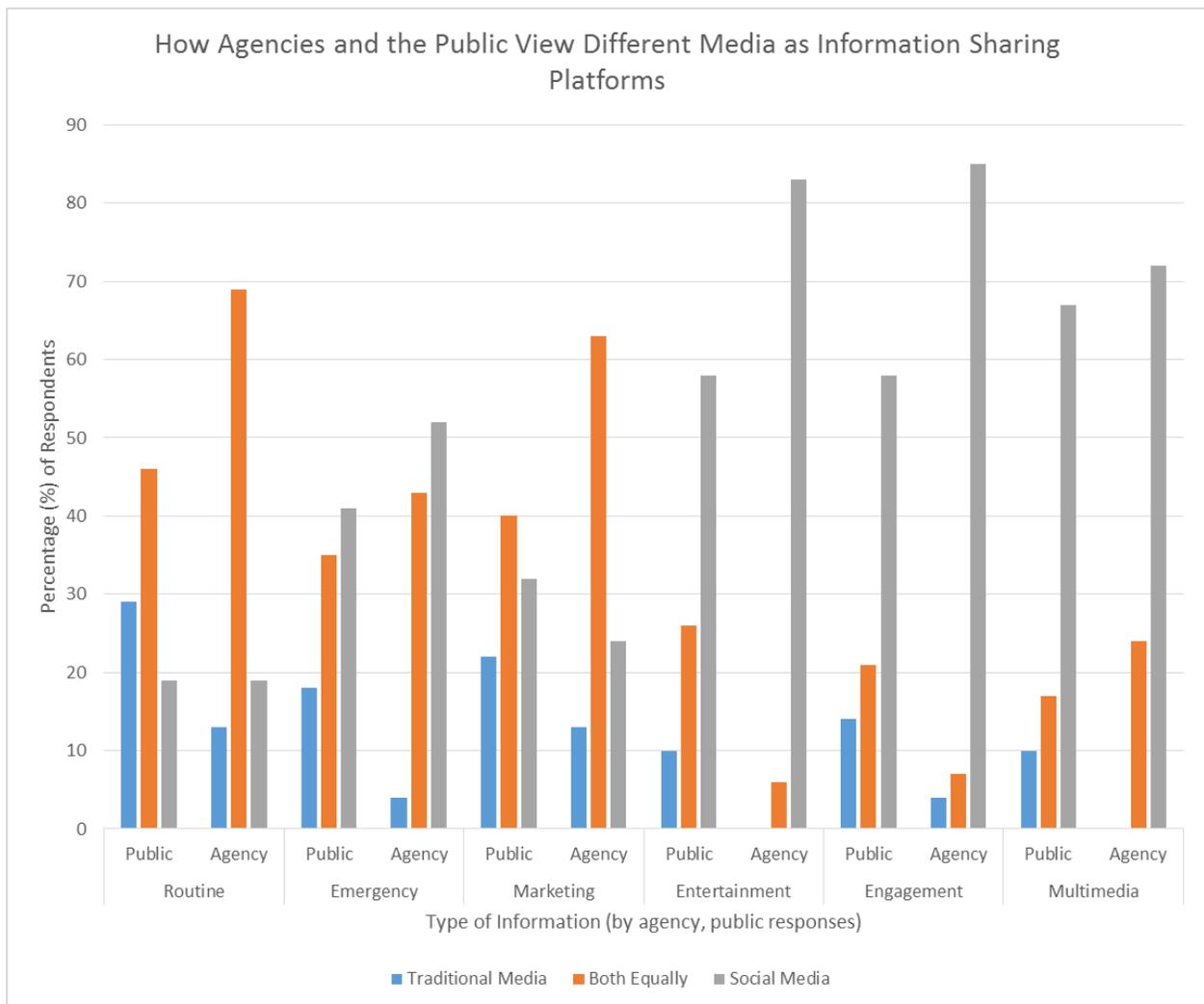

Figure 23: How Agencies and the Public View Different Media as Information Sharing Platforms

In many circumstances, agencies and the public felt the same ways about information dissemination. For example, in the dissemination of routine information (e.g. planned roadwork), both the public and agencies felt both media could handle the task, and the percentage who felt social media could

do the job best were similar in each survey. Similarly, with emergency information, approximately the same percentage of respondents on both surveys felt both traditional and social media could share this information effectively.

Where opinions differ more are the types of softer information, namely entertainment and multimedia, that, while building an identity for the agency with the public, are not necessarily mission critical. Agencies feel very strongly about the use of social media for these types of information and while the public favored social media for these types of information, they were not as focused on social media as much as the agencies. It was also surprising to note that traditional media was not viewed as preferable by any agencies as means to share multimedia content or engage with customers, though few members of the public were expected to indicate a preference for traditional media in these categories.

The other question that was asked of both the agencies and the public was how well agencies are doing with social media. The distribution of responses between the agencies and the public is far less balanced here.
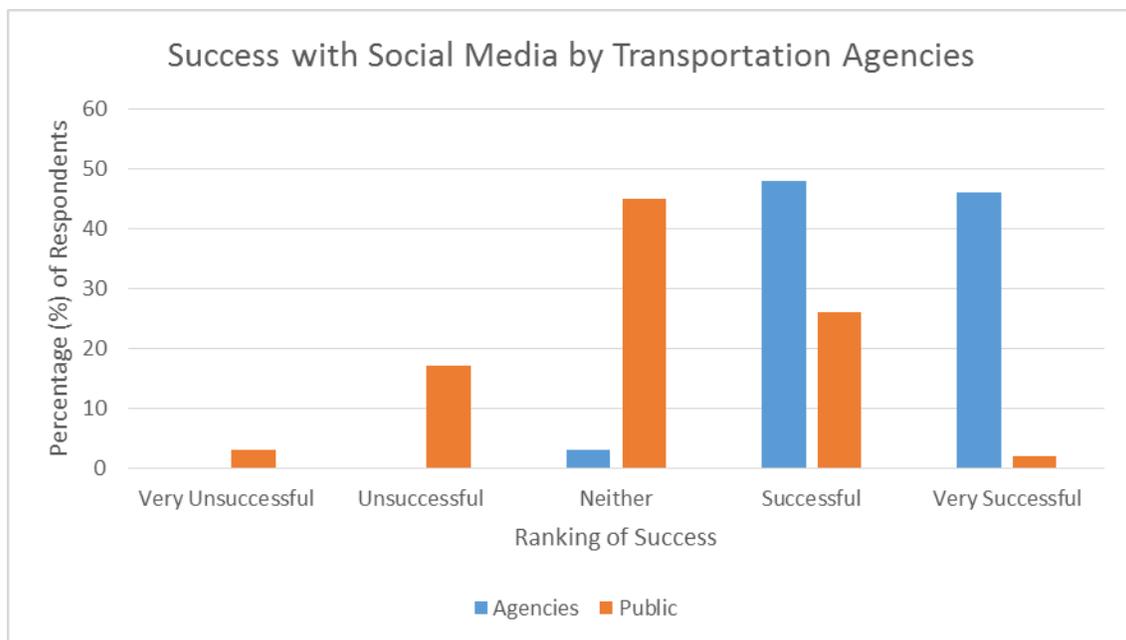
Figure 24: Success of Social Media by Transportation Agencies

No agencies considered their social media outreach to be unsuccessful or very unsuccessful. Conversely, 20-percent of respondents on the general public felt that agency forays into social media were

unsuccessful or very unsuccessful. The public had varied reasons for these rankings. Many took an optimistic stance, indicating that it would get better as agencies hired younger staff and/or developed more experience using social media platforms. Others felt that agencies had not yet made themselves ubiquitous and others felt that outreach still neglected large swaths of territory that are still meaningful to the overall function of the transportation network.

Chapter 6

Conclusions

In the course of collecting data for this research it quickly became clear that social media is a very big concept to approach. What seems like a simple and fun way to pass time during an individual's downtime has a lot of hidden complexity. While it is believed this research is beneficial to the overall knowledge of social media use in disseminating transportation information, it should also stand as a testament to how something so simple on the level of the individual is cause for care and thought when expanded to the agency level, with seemingly infinite means of use. It was also apparent that the public has quickly embraced these technologies based on their response to the survey. People seem to really want agencies to figure out how to effectively use social media and they seem to have a lot of ideas.

One of the most substantial challenges in performing this research is that many characteristics of social media are not easily measured. It is easily to make a note of something that seems unique or interesting, but difficult to find exact replication or even understand what causes certain phenomena. For example, it was noticed that numerous Twitter accounts exist that do nothing but retweet content from certain feeds that fit an algorithm or pattern that could not be fully ascertained. Many of these accounts have very few followers so the power of those retweets for reaching a broader audience is slight, yet because retweets are something that can actually be measured if retweets are used as a source of evaluation, the results may be misleading.

Automation of information dissemination is also common for agencies. There are several programs that agencies may use to share automated information. Furthermore, Twitter has an API that programmers can use to connect more directly with Twitter functionality. In short: it is very easy to share information on Twitter. Some agencies had information post automatically to Facebook and then Facebook would automatically Tweet the same information. If that post exceeded 140 characters, however, it would appear like this Tweet by the Idaho Transportation Department (@IdahoITD):

The lanes of Interstate 84 from the Oregon state line to the Black Canyon Interchange at

Exit 13 will be... http://fb.me/1860GwjAk "" – IdahoITD, 1/14/2014

From this it is not clear what is actually occurring on Interstate-84 without clicking the link. This can

render the Tweet useless to many people who would look to the Twitter feed for quick, accurate

information. Depending on the network connection of the device used to access Twitter, it may not be

possible to click through to another application. Or it may become challenging when someone is

obtaining information via Twitter's website and chooses not to participate in Facebook. Several agencies

were found to have Tweets like this and the critique applies to them as well.

Related, some social media accounts developed their own shorthand to use in social media.

Shorthand can be very important on Twitter when the number of characters is so limited. However,

shorthand can make deciphering a Tweet very difficult for those who do not understand the specific brand

of shorthand. Other accounts use long codes and identifiers that are likely meaningful to those at the

agency but not as much to those outside the agency. For example, the Connecticut Department of

Transportation gives each Tweet its own unique identifier, which takes up important characters that could

be spent on detailing the incident better. For example:

(100413071) Motor Vehicle Accident - NEW HAVEN I95N 0.21 miles before Exit 50

(WOODWARD AVE) at 10/4/2013 11:14:12 PM #cttraffic

In this tweet, 100413071 is the unique identifier, but by also including the date and listing the time to the

second that also acts as a unique identifier. There are many characters in use here that could help describe

the incident, such as indicating if there are any lanes closed or predicting when the crash will be cleared.

Though, in praise of the Connecticut Department of Transportation's Twitter program, they diligently

post when incidents and road work do clear.

In the course of data collection, several different strategies for using social media emerged. Most

of the strategies, whether planned or unplanned, fell into one of three different categories.

1. That one account was used to communicate absolutely everything. This was more common in

   smaller agencies that were accountable to smaller populations or geographical areas, transit

organizations, as well as agencies with limited resources to dedicate to social media or public relations in general. Examples from this research include Miami-Dade Transit and the Honolulu Department of Transportation.

2. Where the geographic jurisdiction is divided up into many small parts, and sometimes even each major road, having a sub-account that tweets location or facility specific information, but control is centralized. These divisions tend to be functional, such as I-40 in Tennessee or Northern West Virginia. Examples of this identified in this research include the West Virginia Department of Transportation and the Tennessee Department of Transportation, each of which have Twitter accounts for regions of the state as well as each of the Interstate highways in their states.

3. A decentralized approach where each district of the state transportation agency has an autonomous social media strategy and then the state headquarters may or may not have their own social media. Examples of this strategy identified in this research include the Kentucky Transportation Cabinet and the Texas Department of Transportation.

It was also found that if a state agency took a decentralized approach and went through the effort of creating all of the lower-level accounts, they were not always used. The Idaho Transportation Department created a 511 Travel Information Twitter account for each county in the state, yet only four of the accounts had ever made at least one Tweet and only two of them appeared to be in use currently. The decentralized approach may pose a challenge in terms of dedicating the resources for updates, but it is the approach the public seemed most receptive to in the write-in portions of the general public survey.

English was the predominant language of communication but Spanish and some Asian languages were used by agencies to broadcast very specific information. For example, the Delaware Department of Transportation Tweeted information in both English and Spanish if it pertained to the operational status of the Department of Motor Vehicle branches.

What was discovered is that agencies, without formal guidance in social media practices, often do what seems prudent based on their feelings, their personal experience, and advice from their peers and superiors. Sometimes their actions make a lot of sense and are very helpful to the specific populations

they are working with. At other points, their actions are confusing and the reasoning unclear. This indicates a need for more guidance on the subject of social media in the sphere of transportation.

For virtually every question asked on each survey or every variable measured in the content analysis another in-depth thesis could be developed. This sentiment is reflected in the detailed and heart-felt responses members of the general public authored in their survey responses. That said, based on the findings of this research, I believe the following are the most pressing areas of future research in this realm.

First, a means to ensure that social media platforms used most often to disseminate urgent information may be safely integrated into the infotainment systems in vehicles as well as the existing ITS infrastructure needs to be developed. There are many ways this could be accomplished and establishing effective techniques would be helpful. Without such universal access, the true benefits to sharing timely transportation information via social media may not be fully realized.

Second, agencies need specific tools to aid in the development and evaluation of social media outreach programs. The results of this research indicate some areas to begin developing these tools in addition to providing evidence they are needed. Not all agencies are equally successful in their forays into social media even though each agency is, more or less, trying to share the same types of information by social media platform (e.g. Twitter is more popular for brief and timely messages). Given the qualitative nature of the use of social media and people's feelings toward social media use, an initial, rudimentary evaluation tool may not even need to be quantitative so much as a guided thought exercise that helps agencies develop institutional goals and strategies with structures in place to receive feedback on their success.

Third, further investigation is needed in what individuals really want from transportation agencies on social media. This is touched on briefly in the public survey where it is found that there are a lot of opinions on use of these media to share transportation information. Despite the flurry of ideas in the responses, some overall themes emerged and were discussed in those results. Further exploration of these findings may improve the usefulness of social media. More focus in this area could better bring together

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the opinions on the success of social media from the perspective of the agency and the perspective of the public. While no agency felt its social media forays were unsuccessful, the general public did not agree. In the public survey, several respondents suggested that agencies have one very centralized page or platform where all information can be obtained, and then offshoots of that central location to address specific needs or problem areas. People seem to want access both to large swaths of raw data and very personalized information. Some of this could be addressed in the creation of an application for either vehicles or mobile phones; this concept has been explored somewhat with applications (e.g. the Pennsylvania Turnpike) already, but also with customized websites.

Fourth, one thing to consider is that the agency social media accounts are relevant to certain geographical areas. It is possible to create geo-fences so that information from approved agency feeds may be transmitted to a vehicle or GPS unit if the driver is in a certain geographical location and opts-in to such a service. Developing this map and approved list of accounts to see if this concept could work could really change how users obtain and employ traffic information.

Fifth, reaching out to agencies not only in different states but different countries around the world to develop a comprehensive database over what is being used in terms of data dissemination, how successful these techniques are, and how to access this information could be meaningful in helping agencies determine best and most common practices, and enable agencies to know whom to reach out to for guidance on different aspects of social media. One thing made very clear in this research is that platforms vary greatly in their success for agencies but they also vary widely in how they are deployed. Not having to reinvent a process already established elsewhere is preferred.

Sixth, some discussion on standardization of certain types of information shared via social media by agencies may be meaningful. Imagine a Twitter feed designated as being a legitimated, authoritative traffic information source that is dedicated exclusively to disseminating information about current events impacting traffic, which could be tagged as affecting a certain geographic area. Then a mobile device, GPS, or vehicle could read this tweet and determine if it is pertinent to the user's current travel. Through existing technology, this is possible. If the data dissemination is standardized on such designated

accounts, it could make it easier to design receiving devices and applications to process this information and make decisions with it. The benefit to considering a platform like Twitter to convey this information is that all agencies have equal access to the platform, it does not require a cost to buy into, is relatively simple to use, is an application many other devices have applications for, and many individuals are already using it (as opposed to a proprietary, agency specific application).

There is also a dichotomy in social media use for transportation information between highway and public transit users that is not fully addressed. After discussing the project at length with the survey testing group, reviewing the results of the surveys, and considering the data collected for the content analysis, it appears that the root of this dichotomy stems from when it is acceptable to be engaged with the content. There are no limitations for transit users like there are for drivers. There is never any fear or hesitation that a transit user is trying to drive down a limited access freeway and send a Tweet simultaneously. While there stands to be a large benefit to the driving public in knowing about incidents prior to beginning a trip, it seems that there are always concerns, well-voiced in the general public survey, that drivers will be seeking information while traveling. That stresses the importance of the first point of further research, vehicle integration, but underlines that social media in transportation offers many opportunities to transit riders that warrant special consideration

The greatest takeaway from this research is the power of technology to transform how we share and gather information. Social media has enabled a great personalization of information, enabling greater access to credible sources of information than ever before. It has also enabled and even mobilized the public to become a part of the information gathering that had for so long been relegated only to the professionals.

But for everything that social media promises, it is clear, based on the results of both the agency and public surveys, that there is still a very valid place for traditional media. For most types of information individuals and agencies both seem to want access to media on both platforms. It is also evident that agencies retain their authority and that protecting that image as an authority is very important,

particularly to end users. Protecting agency image and authority starts with completing the "About" page on Facebook. People will not trust an agency account if they are not aware if the account is affiliated with the agency.

Like with so many technologies, social media continues to evolve and may one day be replaced by a technology that is not yet fully developed. On the stage, the "fourth wall" is the boundary between the performers and the audience. Social media has effectively brought down the fourth wall between agencies and the public. While social media at one point may become outmoded, the removal of this boundary may have a lasting effect.

The effectiveness of social media, in terms of access, is debatable. While the information is largely available, many people indicate that they are unaware that it is out there. Only half of social media users that responded to the survey in this research indicated they used social media to obtain travel information. There is room for improvement. However, it was largely agreed that the information that was presented by agencies on social media was accurate and authoritative. These results suggest that the media is viewed as legitimate, but there is room for improvement in how social media programs are executed, evaluated, and iterated by the agencies who use them.

Until social media are replaced by the next big technology, which, if the Internet is any indication, could take a few decades, it offers numerous opportunities for further development. If this is a meaningful way to communicate transportation information, and it does appear to be based on the findings presented in this work, it is worthy of further research. Given the rate at which conditions change, this research is a snapshot in time. For example, data collection ended in June of 2014 and two months later, the only state-level transportation agency not utilizing social media made their debut (the Alabama Department of Transportation).

The best way to determine the effectiveness of social media at communicating the transportation information most vital for users is to try using it and then offering feedback to the agencies utilizing these tools. Social media platforms typically enable users to sign up for free. Applications (either third-party or agency specific) are typically offered for free for most mobile devices. While not discussed at substantial

depth in this research, mapping applications and agency-specific applications have been developed that utilize all online users as probes to effectively crowd source travel information, which is also a social medium because of the two-way nature of data collection and dissemination.

It is safe to conclude that social media find a comfortable place alongside more traditional media in the ongoing effort to ensure the public are apprised of situations that may affect their travel plans, particularly at the outset of unexpected or major events (e.g. the collapse of the Skagit River Bridge, the opening of the new Oakland Bay Bridge, or simply a disabled vehicle obstructing a lane of traffic on a major commuting route in any city).

Each technology that has come to be indispensable in our vehicles and on our roadways was at one time on the fringes of the field. While social media are in their infancy and agencies are still trying to understand what the best practices look like in their contexts, reception from the agencies and the general public indicate a bright future. Social media, particularly in the transportation context, are something to watch to watch because for many, they will be the media of choice of transportation users.

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Appendix A: Agency Survey

Transportation Agency Social Media Survey

As an employee of a transportation agency or organization who is involved with social media outreach, you are invited to participate in this survey. This survey is intended to better understand the agency uses and preferences regarding dissemination of information via social media. The collected data is a component of a larger research project that is interested in how social media and related technologies may be integrated with the existing systems and technologies to connect with the public and share time-sensitive and emergency transportation information.

The survey should take no more than 15 minutes of your time to complete. When you complete the survey you will have the opportunity to enter a drawing for one of two $25 Amazon gift cards. You will also have the opportunity to volunteer to be interviewed and asked questions about the development of your agency's social media strategy. Neither of these additional opportunities is a requirement. If your organization prohibits receiving gifts while representing it, please do not enter the drawing.

Responses to the survey are confidential and not able to be attributed to any one individual. Participation is strictly voluntary and you may refuse to participate at any time. You may also refuse to answer any questions. There are no known risks to completing these surveys.

This research is being conducted by Janet Fraser, a researcher at the Pennsylvania State University. If you have any questions about the survey or the research please contact Janet Fraser via email at jlf5449@psu.edu. If you have any questions or concerns about your rights as a research participant or the manner in which this research is being conducted, please contact the Pennsylvania State University's Office for Research Protections (ORP) at (814) 865-1775.

The terms "social media" and "traditional media" will be used in this survey. Social media refers to two-way means of communication facilitated by the internet, popular forms of social media include Facebook and Twitter. Traditional media refers to media platforms that are one-way and include television, print media, and websites without interactive features.

If you agree to participate in this research, you may begin the survey by answering the following question.

Does your agency use social media?*

- ○ Yes

- ○ No

[If the respondent indicated their agency does use social media, they answered these questions]

The survey is divided into several sections, each interested in a different component of your agency's social media outreach. Please answer each question to the best of your knowledge.

Section 1: Social or Traditional Media

The questions in this section ask you to select whether social media or traditional media are better at sharing information. Social media refers to communication forms that allow for two-way communication

(e.g. Facebook, Twitter). Traditional media refers to means of communication that are only one-way (e.g. radio, television, websites without interactive features).

Which type of media better shares the following types of information:

	Social Media	Traditional Media	Both Equally
Routine information (e.g. planned service/traffic interruptions, construction)	○	○	○
Emergency information (e.g. crashes, unplanned service interruptions)	○	○	○
Marketing and general information (e.g. a ribbon cutting event, reminding the public to visit your website)	○	○	○
Entertainment (e.g. trivia questions, "this day in...")	○	○	○
Customer engagement (e.g. general questions: "what's the best part of your commute?")	○	○	○
Links to multimedia content (e.g. a link to a video)	○	○	○

Section 2: Social Media Strategies
This section seeks to understand how your agency specifically uses social media to share and receive different types of information. In addition to radio buttons or check boxes, each question has a text field where you may provide additional detail.

Does your agency have a formal social media strategy or plan?

- ○ Yes

- ○ No

- ○ I don't know

[ ]

Does your agency have a system for gathering the information to disseminate via social media?

- ○ Yes
- ○ No
- ○ I don't know

[ ]

Does your agency respond to questions asked via social media?

- ○ Yes
- ○ No
- ○ I don't know

[ ]

Does your agency monitor social media for events that may impact traffic/service?

- ○ Yes
- ○ No
- ○ I don't know

[ ]

What traffic/service information do you disseminate?

- ☐ Beginning of event impacting traffic/service
- ☐ Updates on event information (e.g. predict time for a road to reopen)
- ☐ When the event clears and traffic/service returns to normal
- ☐ I don't know

[ ]

Do you foresee social media impacting your traditional media efforts?

- ○ Yes
- ○ No
- ○ I don't know

How successful would you consider your agency's social media efforts?

- ○ Very Successful
- ○ Successful
- ○ Neither Successful nor Unsuccessful
- ○ Unsuccessful
- ○ Very Unsuccessful

Section 3: About Your Social Media Presence

These questions ask for general information on your agency's social media use and habits.

When did your agency initially begin using any social media?

- ○ 2013
- ○ 2012
- ○ 2011
- ○ 2010
- ○ 2009
- ○ 2008
- ○ Prior to 2008
- ○ My agency does not use social media

What social media platforms does your agency actively use? Select all that apply

- ☐ Facebook
- ☐ Twitter
- ☐ YouTube
- ☐ Blog
- ☐ LinkedIn
- ☐ Pinterest
- ☐ Google Plus+
- ☐ None

- ☐ Other: [_____]

Are there any additional social media platforms your agency is considering?

[_____]

Are there any social media platforms your agency developed but no longer use?

[_____]

How much time do staff spend on social media efforts in an average week overall?

- ○ Fewer than 10 hours
- ○ 11-20 hours
- ○ 21-30 hours
- ○ 31-40 hours
- ○ More than 40 hours
- ○ I don't know

What agency are you affiliated with? If you are not comfortable indicating the agency you are affiliated with, please write in the state or province your agency is located in

[_____]

Submit form

[If the respondent indicated their agency does not use social media, they answered these questions]

Many agencies have decided to pursue social media as additional means to reach out to their public but many agencies have also chosen not to use social media. It is important to understand perspectives from both types of agencies.

Has your agency ever used social media?

- ○ Yes
- ○ No
- ○ I don't know

What are your agency's reasons for not using social media?

[text area]

Does your agency plan on using social media in the future?

- ○ Yes
- ○ No

- ○ I don't know

What agency are you affiliated with?
If you are not comfortable indicating the agency you are affiliated with, please write in the state or province your agency is located in

> [   ]

Confirmation Page

Thank you for your participation, your responses have been recorded.

If you are interested in sharing more about how your agency does or does not use social media, please complete this form:
https://docs.google.com/forms/d/1Uzx_CjktX4zvqcjRUL685HkQMpqZbTzgkSavha1rQzk/

If you would like to be entered to win one of two $25 Amazon gift cards for your participation, please visit this form: https://docs.google.com/forms/d/1Hgs17opR6hLOwx3ko2mX7gkHYFaxW8I9xypHR3elneg/

Appendix B: General Public Survey

General Public Social Media Survey

Did you know that more and more information on travel and road conditions are available on social media like Facebook and Twitter? We are interested in how useful people like you find this kind of information. Understanding how you feel about information shared on social media and how you use social media can help us understand the best ways to deliver important information to you and save you time!

The survey should take no more than 15 minutes of your time to complete. When you complete the survey you will have the opportunity to enter a drawing for one of two $25 Amazon gift cards.

Responses to the survey are confidential and not able to be attributed to any one individual. Participation is strictly voluntary and you may refuse to participate at any time. You may also refuse to answer any questions. There are no known risks to completing these surveys.

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The terms "social media" and "traditional media" will be used in this survey. Social media refers to two-way means of communication facilitated by the internet, popular forms of social media include Facebook and Twitter. Traditional media refers to media platforms that are one-way and include television, print media, and websites without interactive features.

If you agree to participate in this research, you may begin the survey by answering the following question.

Do you use social media?* This question wants to know if you use any social media. Examples of social media include Facebook, Twitter, LinkedIn, Pinterest, YouTube, and Google Plus.

- ○ Yes
- ○ No

Social Media Users

You indicated that you use social media. Please answer the following questions. Thank you for your participation!

Which type of media is best at communicating the following types of information?

	Social Media	Traditional Media	Both Equally
Routine information (e.g. planned service/traffic interruptions, construction)	○	○	○
Emergency information (e.g. crashes, unplanned service interruptions)	○	○	○

	Social Media	Traditional Media	Both Equally
Marketing and general information (e.g. a ribbon cutting event, reminding the public to visit your website)	○	○	○
Entertainment (e.g. trivia questions, "this day in...")	○	○	○
Customer engagement (e.g. general questions: "what's the best part of your commute?")	○	○	○
Links to multimedia content (e.g. a link to a video)	○	○	○

Do you use social media to obtain information on traffic or transit information?

- ○ Yes
- ○ No

Which type of media do you prefer to get transit or road condition information from?

- ○ Social Media
- ○ Traditional Media

Do you expect transportation agencies to respond to your questions via social media?

- ○ Yes
- ○ No
- ○ I don't know

Do you think transportation agencies could learn of incidents sooner if they monitored social media?

- ○ Yes
- ○ No
- ○ I don't know

Is the traffic/service information posted on social media by transportation agencies useful?

- ○ Yes
- ○ No
- ○ I don't know

Why is this information useful or not useful?

[ ]

Does the use of social media by transportation agencies change how you use traditional media to get transportation information?

- ○ Yes
- ○ No
- ○ I don't know

How successful do you think transportation agencies are with using social media?

- ○ Very Successful
- ○ Successful
- ○ Neither Successful nor Unsuccessful
- ○ Unsuccessful
- ○ Very Unsuccessful

Why do you think agencies are successful or unsuccessful at using social media?

[ ]

How long have you been using social media? [▼]

What social media platforms do you use at least once per week?

- ☐ Facebook
- ☐ Twitter
- ☐ YouTube
- ☐ Blog
- ☐ LinkedIn
- ☐ Pinterest
- ☐ Google Plus+

- ☐ None
- ☐ Other: [____]

Have you thought of using other social media sites? If so, which ones?

[____]

Are there any social media sites that you used in the past and no longer use now? If so, which ones?

[____]

Which agency or agencies do you follow on social media?

[____]

About You

These questions help us understand you so we know how to better deliver important information.

How comfortable are you with computers, cell phones, and other technology?

- ○ Not comfortable at all
- ○ Somewhat uncomfortable
- ○ Neither comfortable or uncomfortable
- ○ Somewhat comfortable
- ○ Very comfortable

What type of cellular phone is your primary device?

- ○ Smartphone (internet access enabled)
- ○ Feature phone (calling, texting, plus some other applications that use the cellular network)
- ○ Traditional phone (calling and texting only)
- ○ None

What types of traditional media do you use at least once per week?

- ☐ Newspapers
- ☐ Local television news
- ☐ National television news (e.g. CNN or NBC Nightly News)
- ☐ Local radio
- ☐ Satellite Radio
- ☐ None

- ☐ Other: [   ]

What state/province do you live in? [▾]

How many miles do you think you travel or drive in an average month? [▾]

What is your age? [▾]

What is your gender? [▾]

What is your race/ethnicity?

- ☐ American Indian/Alaska Native/First Nations

- ☐ Asian

- ☐ Black or African American/Canadian

- ☐ Hispanic or Latino

- ☐ Native Hawaiian or Pacific Islander

- ☐ White (non-Hispanic)

- ☐ Other

- ☐ Prefer not to answer

Which category describes your annual income? [▾]

Do you have additional feedback for the research team?

[   ]

Submit Form

Confirmation Page

Thank you for your participation, your responses have been recorded.

If you would like to be entered to win one of two $25 Amazon gift cards for your participation, please visit this form:
https://docs.google.com/forms/d/1Hgs17opR6hLOwx3ko2mX7gkHYFaxW8I9xypHR3elneg/viewform

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EDUCATION

Ph.D. in Civil Engineering. College of Engineering, Pennsylvania State University, University Park, PA. Concentration: Transportation. Dissertation: Understanding Use of Social Media for Dissemination of Transportation Information. May 2015.

M.S. in Technology Management. College of Information Technology and Engineering, Marshall University, Huntington, WV. Focus: Intelligent Transportation Systems. Capstone: Using traffic count data as a method of more equitably allocating emergency resources in geographic information systems. December 2010.

B.A. in Economics and Political Science, minor History. Chatham University, Pittsburgh, PA. Tutorial: Expanding emergency medical services on rural, yet highly traveled I-15 in California. June 2008.

PRESENTATIONS

Fraser, Janet, "Communicating and Collaborating: Using Wiki." Presented at *the 91st Annual Meeting of the Transportation Research Board* in Washington, DC on January 22, 2012.

Fraser, Janet, "Economic Deprivation and Road Safety: Is There a Connection?" Presented at the *Transportation Engineering and Safety Conference* in State College, PA on December 7, 2011.

Fraser, Janet, "Twitter, Facebook, and LinkedIn in Your Organization." Presented at *Keeping up with Communication Technology: An Online Workshop on the Practical Use of Social Media* on September 21, 2011.

Fraser, Janet, "Getting Networked: Using Digg, Facebook, LinkedIn, and Twitter." Presented at the *90th Annual Meeting of the Transportation Research Board* in Washington, DC on January 23, 2011.

ADDITIONAL RESEARCH EXPERIENCE

Second Strategic Highway Research Program (SHRP2) Naturalistic Driving Study. Ensured compliance with and managed documentation for the Institutional Review Board (this study had several hundred human subjects over 3.5 years). Performed intake assessments on study subjects, which included visual acuity, dexterity, physical strength, and memory tests. Analyzed data collected from participants in the study and authored progress reports for research sponsors at scheduled points throughout study. Managed end-of-study tasks for the human subject component including: documentation of study information, compiling and centralizing information collected during the study, scheduling participants for de-installation of the study equipment from their vehicles and exit surveys, and collaborating with the principle investigator and the vehicle team on final deliverables

AWARDS AND FELLOWSHIPS

Pennsylvania State University College of Engineering Fellowship, 2010-2011
Carmen E. Turner Graduate Award, 2010
Christine Mirzayan Science and Technology Policy Graduate Fellow, Fall 2009